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**Synthesis research contributing to introduction
of advanced technologies for energy efficiency
and renewable energy sources
in the countries of Central Asia**

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Brief summary of research. Introduction.

The present research covers the issues of extensive use of renewable energy sources (RES), improvement of energy efficiency (EE) and development of alternative energy sources in the countries of Central Asia (CA).

Section 1 provides brief analysis of general economic situation, overview of energy production and energy policy, national priorities and legislation in the area of energy efficiency and renewable energy sources. The region under review is distinguished by extreme irregular economic and social development, the degree of market institutions establishment, and the level of population income.

Moreover, the issues of high depreciation of generating capacities and infrastructure, energy intensity of industry and public utilities sector, commercial and technical losses are typical for all states of Central Asia. Tajikistan and Kyrgyzstan, in particular, face the problem of non-payments on the part of consumers, which results in significant deficit of financial resources and has an adverse effect on the activity of energy production companies. Disproportions in the structure of placing generating capacities are very topical; they are connected with breaking integrated system formed in the USSR, as well as their deficit. The situation is aggravated by subsidized tariffs, which do not encourage producers and consumers of energy sources to decrease expenditures for electric energy. Even in the Republic of Kazakhstan, where market reforms were characterized by consistency, the tariffs for electric energy were close to the cost of its generation exclusive of amortization deductions necessary for replacement of outdated equipment. Currently, in all reviewed states the degree of the main equipment deterioration applied in the electric power grids constitute 50% and more. At that, a large proportion of grids and equipment are not suitable for further operation. Outdated equipment, imperfect record keeping of actual power consumption complicates attraction of investments and development of competitiveness in the energy sector.

In general, many states are nowadays concerned about high energy intensity of gross domestic product (GDP), which significantly exceeds the level of GDP energy intensity in developed countries. The governments are aware of the importance of national policy-making and its implementation in the area of energy saving and improvement of energy efficiency.

Moreover, as the countries of this region differ significantly in the structure of national economies and energy security, the priorities of policy in the area of energy efficiency improvement and use of renewable energy sources, as well as the approaches to its implementation are different.

It should be noted that currently national energy markets have not been formed to the full extent, state price adjustment for energy resources is evident, as well as regulation of rates for services provided by natural monopolies.

Section 2 provides analysis of investment climate in the countries of Central Asia, as well as possibilities of the private sector to play a role of accelerator for introduction of advanced technologies. Neither of the states was rather successful in attraction of private investments for energy efficiency improvement and development of renewable energy sources regardless of necessary regulatory and legal framework for favorable investment climate. Lack of political and economic stability, poor creditworthiness of population, subsidization of energy tariffs or other reasonable factors neutralize all efforts taken by the national governments.

Besides, it should be noted that Kazakhstan is generally a regional leader in investment climate formation and development of measures for encouraging inflow of private investments directed for improvement of renewable energy sources and energy efficiency.

Section 3 describes the attempts to understand and summarize the best practices of the countries in projects implementation on energy efficiency and renewable energy sources. Power generation using renewable energy sources in the states of Central Asia is without prejudice still less profitable and more capital intensive as compared to power generation using fossil fuels. The cost of alternative energy production is at least 3 times more expensive than the cost of

traditional energy production. Therefore the energy companies are not interested in production of renewable energy. Besides, the current mechanism of production support and use of these energy sources is not developed properly.

Nowadays, almost all large-scale projects and programs in the area of energy efficiency and renewable energy sources were implemented in the states of Central Asia either within the framework of state programs funded by budgetary means, or within the framework of projects on international technical assistance funded by foreign grants. This issue refers particularly to development of alternative and renewable energy sector (besides small hydro power plant).

Market principles are used in implementation of the projects on improvement of energy efficiency in the industrial sector and in projects executed by large extracting and generating companies for improvement of energy efficiency. Besides, improvement of energy efficiency in the industrial and energy sector is closely connected with upgrading of production facilities and infrastructure.

The national reports actually provide solitary examples of implemented projects in the area of renewable energy sources use on the market principles.

Section 4 provides estimated potential for use of the most advanced technologies in each country of Central Asia, taking into account particular conditions and national priorities in development of each state.

In general, the most promising for this region renewable energy sources are given below:

- wind energy;
- small hydro power plants ;
- solar plants for thermal and electric energy generation;
- bioenergy.

Under the current market conditions, the alternative energy is not likely to be widely produced for industrial purposes, as each state of this region either is rich in fossil fuels or has a huge hydropower potential. Application of renewable energy sources is considered either in the context of power supply to hardly accessible and remote sites and settlements, or for the purposes of environmental protection.

Section 5 provides detailed estimate of existing tools and major obstacles for encouraging introduction of advanced technologies in the area of energy efficiency and renewable energy sources in each state of Central Asia.

Generally, the regulatory and legal framework is not developed properly in the states of the region, measures for economic encouragement of energy efficiency and development of renewable energy sources are not pilot tested, and there is lack of qualified specialists, lack of access to the sources of financing.

Section 6 provides conclusions and recommendations in respect of further actions for stimulation of advanced technologies introduction in the states of Central Asia at the national and regional level. This section includes recommendations for improvement of regulatory, legal and institutional environment in the area of projects implementation on energy efficiency and renewable energy sources, on development of regional cooperation in this area.

1. Brief analysis of general economic situation, review of energy sector and priorities in energy policy, the legislation in the area of energy efficiency and renewable energy sources.

1.1. Brief analysis of general economic situation

Kazakhstan. Kazakhstan is believed to be the most developed country in Central Asia: it is characterized by highly developed financial infrastructure, powerful banking system, powerful industrial sector as its most developed sector of economy, market institutions, high level of investments, and large number of joint ventures with western business companies. All those factors cause leading technological development of Kazakhstan among its neighboring countries in the region.

The country is rich in natural energy resources, particularly with coal, oil, gas and uranium.

Currently, the estimated volume of proven reserves of oil in the Republic makes about 6.5 billion tons. Anticipated reserves of oil at common pool in Kazakhstan's sector of the Caspian Sea make more than 17 billion tons. Explored gas reserves of Kazakhstan make about 2.7 billion tons which constitutes 1.5% of the world reserves (12th place in the world as of 2008). Explored uranium reserves of Kazakhstan make 1.69 million tons which constitutes 21% of the world uranium reserves (the 2nd place in the world as of 2005). Kazakhstan is rich in deposits of different metals – lead, zinc, chrome, gold, bismuth, copper, molybdenum, aluminum, iron, manganese, rare-earth elements and useful non-metallic natural resources – coal, phosphorites and some others.

Mining industry is highly developed in Kazakhstan. Coal, oil, natural gas, iron ores, copper ores, lead zinc ores, nickel ores, bauxite and other useful natural resources are actively mined in the region. Kazakhstan is an active actor at the Caspian regional scene of oil extraction.

The leading industry sectors of the country's economy are non-ferrous and iron industry, chemical industry, engineering, garment industry, food manufacturing industry. Also oil processing and construction materials production industries are developed in the country.

At that, the sectoral structure of the economy is characterized by predominance of raw materials and significant dependence on import of consumer goods.

The strategy of market reforms in Kazakhstan provides for forming of socially orientated market economy, based on combination of state, cooperative and private property. Simultaneously, the program of investments implementation into the basic sectors of economy is carried out so that within 8-10 years, the country could both pull through lopsidedly orientated market development (raw material industry and extractive industry) and enter the group of the industrialized countries with developed market infrastructure and competitive economy.

In 2011-2012, economic revival, which started in the first half of 2010, continued. At the end of 2011, economy grew up by 7.5%, as compared to the previous year, having increased by 0.2% against the corresponding index of the last year. GDP per capita amounted to USD 11.2 thousand. Increase of exporters profit and revival in consumers demand supported by improving situation in the labor market were the main factors of economic growth in 2011.

Favorable external conditions stimulated strong growth of export orientated economic sectors as well as the economic sectors focused on the domestic market.

Economic growth is primarily conditioned by favorable conjuncture in the world markets, price growth for energy carriers. Raw-material focused structure still characterizes the national economy of Kazakhstan, despite all efforts and a great number of programs for development and modernization. This state of the matters reflects significant dependence of Kazakhstan on the fluctuation of prices in the world market of energy carriers and food products. Absence of high

level of technological effectiveness and scientific intensity in the industry forms low level of competitiveness of the national economy. This is expressed in the following:

- obvious lopsided dominance of raw-materials sectors in the production structure (production and processing of oil, gas, metals, production and marketing of agricultural products but not the finished goods), which is the sign of unbalanced development of economical system and its weak competitiveness;
- effective and competitive mechanism has yet to be formed in the Republic, which could stimulate the processes of innovation financing, namely, the whole process is based on the principle of “hand-control” as well as on the system of government investments by means of Samruk-Kazyna National Welfare Fund;
- despite all efforts, rather high rate of consumer prices index growth is still observed in the economy;

Great gap between the rich and the poor social classes is observed in the society of the country despite growth of population income.

Kyrgyzstan. Within twenty years of its sovereign development, Kyrgyzstan has overcome rather painful way from the centralized, administrative and state-controlled economy to the economy with particular market-based peculiarities. Currently, approximately 85% of total GDP is produced in the non-public sector of economy (excluding the data of nationalization within the last two years). The share of goods, which prices and tariffs are adjusted by the government, does not exceed 10-15% of GDP volume. The results of reforms were irreversible due to critical amount of implemented changes. However, the Republic is continuously suffering from crises, both economic and political, which are mainly caused by economic problems (extremely low level of living standard, social inequality, poor social security system, and the main thing – low efficiency of the national economy).

In 2011-2013, Kyrgyzstan demonstrated encouraging macroeconomic indices under the conditions of evident economic revival, having overcome the most significant consequences of financial and economic crisis in 2008. According to official statistics, rapid growth rate was observed in all sectors of economy. Increase by 18% in the manufacturing industry was the most evident:

- energy sector growth – by 30%,
- mining industry – by 16.9%,
- textile industry and garment manufacture – by 29.4%,
- production of construction materials – by 31.7%.

On assessing the economic status of the Kyrgyz Republic, it is necessary to emphasize that this country is under the pressure of systemic crisis, which combines the elements of financial, monetary and structural crisis aggravated by poor developed market-based mechanisms applied for management of the economy during the period of market formation.

Development of the national economy is still under the significant impact of external factors, which are hardly dependant on the attempts of entrepreneurs and states. This refers to external financial dependence on foreign investments. If favorable external conjuncture is destroyed, the economy will be in a difficult situation again and will be unable to pay its debts, its abilities to perform social obligations of the state will be minimal, the KGS exchange rate will fall down, etc.

According to the data of sectoral growth, sustainable growth trend in the non-production sector of economy was observed in the Kyrgyz Republic till 2009, which was conditioned by low risk of invested funds loss, due to accelerated turnover, low capital intensity of these sectors and availability of sales market in the bordering countries. The main reasons for the manufacturing industry instability in the majority of its sectors are the following:

- availability of physically and morally outdated equipment at the enterprises, upgrading thereof require investments thereby depriving of a possibility to produce competitive goods even for the domestic market;
- impact of this factor is aggravated by actual lack of protectionist measures for support of the local manufacturers in the domestic market thereby depriving them of the sales market;
- lack of credit resources availability due to high interest rates and their short terms significantly restricts the possibilities for financing technical upgrading of enterprises, application of advanced technologies;
- high level of taxation prevent the enterprises from funds accumulation and use thereof for replacement of fixed assets, as well as working capital financing;
- large scale export of raw materials from the Republic, including agricultural stock, breaking of cooperation between enterprises of the Republic decreased the rate of available production facilities utilization up to 34%;
- infringement of property rights for large business.

Decrease in the production output of consumer goods, their competitive weakness resulted in displacement of local manufacturers from the internal commodity market of the Republic. The sales share of domestic goods in the total volume of commodity turnover in the domestic market in 2010 constituted 25-30%. In 2010, 53 large industrial enterprises did not operate. Among 267 most important types of industrial products, the volume of production output was reduced in respect of 102 (38.6%) types of goods; manufacturing of 50 (18.7%) types of goods was stopped.

Thus, the total state of manufacturing industry is rather fragile; some sectors suffer from profound crisis. Such situation is conditioned by stock depletion in many sectors (the level of fixed assets depreciation reaches 90%), loss of sales market, low workability and competitiveness of goods, export of raw materials, and decrease in the volume of cheap and quality goods.

Tajikistan. Tajikistan is one of the poorest agricultural and industrial countries in the world, despite its rather significant economic potential. According to the estimates of the International Monetary Fund, 63% of its population lives on less than USD 2 (under the parity rate of purchase ability) per a day. The economy of Tajikistan is one of the weakest in Central Asia region. Strong side of this Republic is that it possesses large deposits of uranium ore as well as hydro power potential and competitive carpet manufacture.

The economy of the Republic is characterized by the highest import dependence rate, weakly developed agricultural sector, practical absence of industrial sector of economy, low qualification level of human potential (prevails progressing labor outflow of highly qualified specialists). Agriculture makes 30.8% of GDP, industry – 29.1%, sector of services – 40.1%.

The main export article is aluminum. The second export article is cotton though its quality for some parameters is worse than that of the cotton in Uzbekistan. So Uzbekistan is the main and direct competitor of Tajikistan at the cotton market in the region.

The main agricultural items of the country are cotton, silk, grain, tobacco, vegetables, fruits which are mainly used for satisfaction of domestic needs for foodstuff and therefore agricultural exporting potential of the country is rather low.

Energy sector is one of the most promising sectors of the Republic for it possesses significant potential of water energy resources although it has been realized for less than one third of its capacity. The main part of electrical energy in Tajikistan is produced at hydropower plants. The overall capacity of the hydropower plants makes up to 4070 MW. Power generation makes up to 17.1 billion kW per year.

The government of Tajikistan has worked out large scale plans for reconstruction and modernization of the existing facilities of hydropower sector as well as plans for completion of deactivated hydro power plants and construction of new hydropower plants and cross-border

power transmission lines. The largest power plants included are Nurekskiy hydropower plant – 3,000 MW (reconstruction and modernization till 2016), Sangtudinskiy hydropower plant -2 – capacity of 220 MW (the first power-generating unit placed in service), Rogunskiy hydropower plant – capacity of 3600 MW with its first power-generating unit of 800 MW to be placed into operation in 2015, also they plan the construction of Dashtidzhumskiy hydropower plant with capacity of 4000 MW. It is supposed to enlarge the existing cascades of hydropower plants and engage the resources of such rivers as the Zeravshan, Pyandj and some others. However, implementation of all these projects seems to be rather difficult for the reason of severe lack of investments, weak capacity of Tajikistan to negotiate with potential investors and the problems of shared water consuming with its neighboring countries.

There is developed mining industry in Tajikistan: coal mining, gas mining (with gas deposits in Vahsh and Gissar valleys though their reserves are quite small and are able to satisfy only a part of domestic needs), non-ferrous metal industry (lead, zinc, bismuth, mercury, tungsten, molybdenum, gold), garment industry is closely connected with processing of agricultural raw materials.

Foreign trade turnover has got negative balance during all of the sovereign status of the Republic. The dominating import items are ferrous metals, production of garment industry, cars, agricultural machinery, food, pharmaceutical production, medical equipment.

The main articles of export are: aluminum, lead, zinc, rare-earth metals, vanadium, uranium oxide, production of light industry (cotton and silk fabrics), cotton, and agricultural production (vegetables and fruits).

National economy development following the results of 2012 was provided by growth in the amounts of industrial output, production of agriculture, turnover of retail trade and growth in the amounts of foreign trade turnover. Meanwhile, decrease in the amounts of capital investments by 24.5 % was observed last year.

As the country is exporter of oil, it strongly depends on oil price fluctuations. Thus, in 2010-2011, change of export duties rate on fuels and lubricants in the part of Russia resulted in dramatic growth of inflation rates.

Thus, the economic situation of Tajikistan is rather difficult. Tajikistan, in carrying out the transition program to market economy, tries to find the most suitable ways of recovery from the crisis. Measures are taken for overcoming monopolism in the economy, and joint ventures are established for this purpose (including with foreign partners). The country's strategy is aimed at a multi-format model in economy, a variety of forms of ownership on the basis of denationalization and privatization.

Instability of internal political and economic situation is the main obstacle for economic reforms, resulting in poor penetration of foreign capital and low economic activity of all agents present in the domestic market, including government sector of economy. The Republic has significantly fallen behind its Central Asian neighboring countries in many aspects of market reforms of its economy. The state budget is formed with great deficit; price formation policy has not been coordinated with the purchasing ability of the country's population and domestic marketability of the economy.

Turkmenistan. Turkmenistan is one of the leading countries with large deposits of hydrocarbons; in particular it is on the list of five leading countries with the largest gas deposits. According to the official statistics as of October 01, 2011, proven reserves of natural gas in Turkmenistan account for 25.2 trillion cubic meters and about 20.8 billion tons of oil and gas condensate. Anticipated reserves of oil in Turkmenistan's sector of the Caspian Sea account for about 12 billion tons and those of natural gas account for – 6.5 trillion of cubic meters. Nowadays, about 160 oil and gas deposits, of which 70 are being developed, have been itemized into the State Reserves Register of Turkmenistan.

Besides hydrocarbon resources, more than 160 deposits of other useful raw materials have been explored, including colestine, coal, native sulfur, mineral salts, kaolin, bentonite, ozokerit, mineral paints, and carbonate raw materials.

Turkmenistan takes one of the leading positions in the world for its deposits of hydro-mineral raw materials, in particular for its deposits of inter-crystal and surface brines of Karabogazgol bay as well as for its underground iodine-bromine waters, field waters of oil, gas and sulphur deposits.

The main industrial sectors of Turkmenistan are mining and processing of natural gas and oil, electricity, textile industry and construction. The bulk of government and foreign investment funding comes into these sectors. Processing industries, such as chemical industry, petrochemical industry, engineering, metal working industry, light industry, and food industry have been developed rather quickly in the last years.

Such new industrial sector as metallurgical sector is currently under development in Turkmenistan. Metallurgical plant producing construction building bars, L-steel, U-sections was put into operation near Ashgabat.

The main part of plowed fields is used for growing of cotton and corn. As for the other agricultural items they also grow rice, potatoes, melons and gourds, grapes and vegetables. Turkmenistan is actively developing transporting infrastructure of railway and automobile road communications, pipelines, electric transmission lines. The country is developing merchant navy.

Sectors of trade, services and tourism are also developing rapidly.

The economy of Turkmenistan is developing very fast during the recent years. In 2009, despite the world financial crisis, the country's gross domestic product ratio in comparable prices increased of 6.1%. In 2010, growth in GDP made 9.2%, in 2011-14.7%.

The main factor of economic development in 2011 as well as in the previous years is still the area of construction of infrastructural, industrial and civil objects in the country. The added value increased significantly in the construction sector.

Investments amount into the basic capital in 2011 increased by 23.2% as compared to 2010. Accelerated progress rates of investments into economy provided GDP of Turkmenistan with high percent of investments in 2011.

With a view of high multiplicative effect the main part of internal government investments (61.3%) is directed into production sector (oil and gas and construction sectors of economy). In 2011, growth of production output was observed in many sectors of economy. The highest growth rates of production output were observed in the following sectors: gas production, oil production and processing, production of construction materials, light and food industry, metalwork. In 2011, growth of natural gas production made 40.6%, electricity-12.0%, oil (including gas condensate) – 8.7%, kerosene-8.7%, diesel fuel-3.4%, benzine-3.3% in fuel and energy complex as compared to 2010.

The measures taken by the government in order to increase financing directed to small and middle enterprises, including the private sector, with the help of credits with soft interest rate of 5% encouraged output of separate types of goods produced by such enterprises, especially in the food industry sector.

Turkmenistan has kept stable economic, monetary and financial positions and improved its balance of payment owing to equalization of demand level and prices for hydrocarbons exported from Turkmenistan at the international energy markets, as the most part of the exchange earnings of the country (up to 85%) are actually the earnings from foreign economic activity.

The Central Bank of Turkmenistan has kept stability of the national currency exchange rate (1 manat = 2.85 USD) for a long time. The Central Bank has also increased the volume of crediting resources and supported asset liquidity of the banking system in the country.

Uzbekistan. Competitive advantages of economy in the country are based on the natural factors: mining of gold, gas industry, developed market of cotton, experience of agricultural machines production, as well as on the availability of an aircraft-building plant which is the only one in Central Asia. Uzbekistan possesses large deposits of oil and gas. The current activity on mining of gold is contributing into electricity generation.

However, Uzbekistan greatly depends on import of crops because domestic production thereof satisfies only 25% of demand. Low rate of market reforms in the economy, domination of government regulated economic system, low rate of business and democracy rights development, closed national market and low rate of integration with its neighboring countries cause additional conditions for isolation of the economy in Uzbekistan. The country has got constantly high inflation rate (with its maximum level of 23% in 2004, according to the official statistics), fixed exchange rate of the national currency, and high rate of exchange restrictions. The main sector of agriculture is production of cotton which inherited ecologically harmful system of irrigation of cotton fields which has not been modernized since the time of the former USSR.

In the structure of GDP the value of agriculture is rather significant – 38%, at that, 26% are accounted for the manufacturing industry, 36% - the sector of services. In 2011, GDP increased by 8.2%. The country occupies approximately the third place in the world on export and the sixth place on production of cotton. Rates of development of the other macroeconomic indicators were the following: amounts of production output – 107.0%, consumer goods – 111.4%, products of agriculture – 106.8%, investments into the basic capital – 108.0%, retail turnover – 116.2%, paid services – 114.2%. Foreign trade turnover increased by 121.6% (100.3%), including export – by 121.4% (108.3%), import – by 121.8% (90.1%).

The most important agricultural products of Uzbekistan, besides cotton, are fruits, vegetables and corn (wheat, rice and maize). Uzbekistan exports cotton, gold, natural gas, mineral fertilizer agents, metals, products of textile and food industries, cars.

The main energy resources of the country are natural gas (proven reserves up to 2 trillion cubic meters), coal (up to 1.9 billion tons of brown coal), deposits of uranium ores (total up to 230 thousand tons of uranium) and hydroenergetics.

Uzbekistan has experienced quite insignificant market reforming and is still the most closed sector of the region. But that closed type of national economy probably saved the country's economy from being strongly affected by the world financial crisis. Expansion of inflation is restrained though its rates are still high. As a result of consistent implementation of rather strict monetary policy Uzbekistan succeeded in restraining inflation within the planned estimated indicators – at the level of 7.8% in the annual terms.

The rates of industrial growth made 112.7% including the growth in the sector of consumer goods production – 117.7%, sector of services has increased by 21.3%.

However, the national economy of Uzbekistan is still dependent on market fluctuations of the world economy throughout reduction of prices for exchange goods which are the main items of export from Uzbekistan as well as throughout weakening of demand for export from Uzbekistan, which is caused by decrease of economic growth rates in the countries that are the main trade partners of Uzbekistan and also throughout reduction of money transfers. The economy of Uzbekistan is not integrated with the financial markets of the developed countries. However, it should be noted that the main source of economic wealth, which is demonstrated by the official statistics of the country is still represented by the powerful administrative resource of the centralized management system. Low level of market relationships development as well as planned and centralized system of market institutes and mechanisms causes the absence of real competitiveness in the domestic market, low level of small and middle business development.

During crisis and especially in 2010-2011, the government of Uzbekistan gave more rights to the small and middle business which resulted in some revival of the domestic market. Programs of small and middle business development have been implemented under patronage and financing of the International Monetary Fund. As a result, the part of small business in GDP

reached 50.5% against 48.5% for 9 months of 2010. The volumes of production output in the small business increased by 26.5%, the volume of export of their production increased by 1.6 times.

The principle of centralized planning of economy is still preserved in Uzbekistan.

1.2. Overview of energy sector

All states of Central Asia face the following problems in the energy sector:

- high commercial and technical losses;
- problems of non-payment on the part of consumers, resulting in significant deficit of financial resources, which has an adverse effect on the operation of energy companies;
- subsidized tariffs, which do not encourage producers and consumers of energy sources to reduce expenditures for energy. Even in the Republic of Kazakhstan, where reforms were carried out most consistently, tariffs for electricity are close to its production cost excluding necessary depreciation expenses for replacement of outdated equipment. Currently, the basic facilities deterioration of the electric power networks constitutes approximately 50% and more, meanwhile, in a number of cases a large proportion of networks and equipment is not suitable for further operation. Outdated equipment, imperfect record keeping of actual power consumption complicates attraction of investments and development of competitiveness in the energy sector.
- Disproportions in the structure of placing generating capacities connected with breaking integrated system formed in the USSR.

Kazakhstan. The Republic of Kazakhstan (RK) possesses 57 power plants. Stations capacity in Kazakhstan as of January 01, 2010 constituted 19.1 thousand MW, available capacity – 14.8 thousand MW. Breakages and capacity limitations constituted 14.8 thousand MW. Approximately 41% of generating capacities have already been in operation for more than 30 years, i.e. 40 of 53 thermal stations in Kazakhstan. The share of thermal stations in the total power balance constitutes 88%, hydropower plants – 12%. In the fuel balance, hydroenergy is the second in its proportion energy source, which gives way only to coal.

The structural analysis of stations capacity in Kazakhstan indicates that the unified energy system (UES) of the Republic of Kazakhstan is characterized by:

- predominance of thermal stations, burning coal (75%), gas (23%) and black oil fuel (2%) as a major fuel;
- insufficiency of hydropower plants in the electric facilities balance of the Republic.

Generating capacity deficit of the power plants in the Republic of Kazakhstan, on exceeding winter maximum in 2010, constituted 790 MW. Energy production increased by 3.9 billion kWh or by 4.9%, energy consumption – by 5.9 billion kWh or by 7.5% compared to 2009. Electricity consumption increased by 16.5% within the last 5 years. Meanwhile, growth of power plants capacity constituted 667 MW within these years. Sustainable growth of electricity consumption is expected with average dynamics of 4% per year.

Electricity sector includes the following problems: significant exhaustion of generating equipment fleet life (the remaining fleet life constitutes 18-30% at the thermal station of highest significance for the Republic), heavy exhaustion of power supply network (approximately 65-70%), deficit of maneuvering facilities to cover peak loads due to low share of hydropower plants (approximately 12 %) in the structure of generating capacities, irregular distribution of generating capacities (42% of installed capacity in the unified energy system of Kazakhstan is concentrated in the Pavlodar region). Further development of energy sector in the Republic of Kazakhstan is impossible without upgrading of the current power plants and construction of new ones operating of the solid fuel.

According to the estimates of the Ministry of Industry and New Technologies (MIaNT), which supervises development of energy sector in the Republic, electric capacities of 2,740 MW should be introduced into the energy sector by 2015 for uninterrupted power supply.

The peculiarity of the energy sector in Kazakhstan consists in solid fuel oriented generation of electricity and heat; this trend will remain unchanged for a long time. Concentration of generating capacities near coal deposits with availability of vast territories make extended electric networks very necessary (more than 370 thous. km), which cause significant losses of electricity in transportation. Total losses of electricity constitute approximately 20-40% of its consumption.

Currently, up to 85% of the total electricity generated in Kazakhstan is produced by means of burning organic fuel, primarily, local coal, to a lesser extent - raw hydrocarbons, 68% of generating capacities have been in operation for more than 30 years. Several large projects related to hydropower plants to be implemented in the nearest years will result in certain improvements: Moinakskiy hydropower plant with installed capacity of 300 MW, Kerbulakskiy hydropower plant – 49.5 MW, Bulakskiy hydropower plant – 68.25 MW.

Kyrgyzstan. Kyrgyzstan possesses significant energy resources and is able to satisfy its own need to a large extent. However, currently, potential of the fuel and energy sector (hereinafter referred to as FES) is not adequately realized, the efficiency of many energy companies decreased, this sector is suffering significant financial and economic difficulties. The Republic is dependent on imported coal, natural gas, and petroleum products. The share of import constitutes more than 50% in the structure of fuel and energy balance of the Republic.

Expected reserves of 70 major coal deposits are estimated at the level of more than 2.2 billion tons with available balance reserves of 1317 million tons. According to the forecasts, the reserves of undiscovered resources of oil and gas constitute approximately 289 tons of reference fuel. 15 oil and gas deposits are developed in the south of the country, where the volume of produced commercial oil reserves makes 11.6 million tons and natural gas makes 4.9 billion cubic meters.

Development of water-power potential in Kyrgyzstan is the main objective of the program on energy sector development in the Republic. 20 power plants with total capacity of 3786 MW are operating in the energy sector, while the capacity of hydropower plant is 3070 MW and two heat and power plants with capacity of 716 MW. Average annual production of electricity constitutes 12-15 billion kWh. The basic share of production at hydropower plants is accounted for a cascade of Toktogulskiy hydropower plant with the Toktogulskiy water storage reservoir, the hugest over-year water storage basin, water volume – 19.5 billion cubic meters, which provides Kyrgyzstan and the neighboring countries of Central Asia with electricity and water for irrigation of the most important agricultural crops.

Approximately 5% of GDP, 16% of the industrial output and 10% of the state budget revenue are accounted for the energy sector. It provides access to electricity for almost all population. Water-power potential of 252 large and medium rivers is estimated as follows: capacity - 18.5 million kW, electricity – more than 160 billion kWh. Water-power potential of small rivers and water streams is approximately 5-8 billion kWh per year, thereof only 3% are used.

Electricity system of Kyrgyzstan is an independent organization, which operates in parallel with the energy system of Central Asia and includes:

- 18 power plants with total installed capacity of 3,666 MW, of which the installed capacity of hydraulic power plants is 2,950 MW and the installed capacity of two heat and power plants is 716 MW. The available capacity of energy system is 3,135 MW for the current period, taking into account exhaustion of generating capacities. The average annual generation of electricity is approximately 12 billion kWh;
- 513 electric substations with voltage of 35-500 kW;
- 64993 kilometers of transmission lines with voltage of 0.4-500 kW.

The energy sector is governed by the Ministry of energy and industry of the Kyrgyz Republic. Seven energy companies founded on the basis of open joint-stock companies (OJSC) are currently operating in the Kyrgyz Republic.

The major hydropower plants of the Republic, located on Naryn river, which flows in the valley of the south-west part of the country, form a group of stations on 5 dams (with total capacity of 2,870 MW).

More than 70 thousand kilometers of transmission lines with voltage of 0.4-500 kW are put into operation in the electric energy system of Kyrgyzstan, whereof 546 kilometers are lines with voltage of 500 kW, 1,714 kilometers – lines with voltage of 220 kW and 4,380 kilometers – lines with voltage of 110 kW, as well as approximately 490 of transforming sub-stations with voltage of 35-500 kW, the total capacity is more than 8,000 MVA. However, these facilities are outdated part thereof shall be replaced or upgraded.

Tajikistan. The Republic of Tajikistan possesses significant reserves of fuel and energy resources. The total annual potential resources of hydro power engineering in the Republic constitute approximately 527 billion kWh. Nowadays, Tajikistan uses only 5% of the total estimated water-power resources.

Currently, the installed capacity of hydropower plants enables to generate more than 5 million kWh per day, the average annual generation of electric energy constituted 16 billion 256 million kWh within the last three years.

Tajikistan possesses comparatively poor reserves of fossil fuel thereby resulting in insignificant production thereof. Explored reserves of oil, gas and condensates, which are currently available, constitute less than 1% of the total reserves, amounting to 1,033 tons of reference fuel. According to the data of 2011, the volume of oil and natural gas produced in the Republic constituted 28.6 thousand tons and 18.8 million cubic meters, respectively.

In 1990, more than 2 million tons of petroleum products and 2.1 billion cubic meters of natural gas were imported to the Republic, currently, these indicators decreased by 30 and 70 percent, respectively.

Currently, the reserves of coal are expected at the level of 4.5 billion tons (whereof insignificant share is mined, thus, only 236.7 thousand tons were mined in 2011). The reserves of coal fuel are available almost in all regions of the Republic; however, many deposits are located in the distant mountainous areas, where communication infrastructures are underdeveloped.

In 2011, the total domestic electric energy consumption constituted 16.2 billion kWh. The share of renewable energy sources in the total energy consumption made 0.07% (120.9 million kWh). The electricity deficit constituted 4 million kWh.

The Republic suffers significant difficulties. Existing deficit of electricity and introduction of limits on its consumption (particularly in winter period) are conditioned by scarcity of water and energy resources at Nurek water storage reservoir, low tariffs, availability of losses due to basic facilities exhaustion. This deficit is also connected with insufficient use of other energy carriers, high energy intensity of manufactures industrial goods and above-limit electricity consumption by the population, high cost of fuel supplies intended for heating energy generation, problems on export of excess energy.

Electricity deficit in Tajikistan is conditioned by insufficient domestic financial opportunities of the country, high capital intensity of upgrading and construction of large hydropower plants, exploitation and production of natural gas, coal, oil and generation of alternative energy.

Turkmenistan. Electricity sector of Turkmenistan is not profitable. Extra-market sector regulatory system is operating in the country, within the framework thereof the priority is placed on execution of social functions – till 2007, electricity was provided for the population free of charge, which constituted 2,723.8 million kWh at the end of 2007. Supplies of electricity increased by 45% in 2007 compared to 2000. The sector is operating under the conditions of

state regulated prices. The price for electricity was approved on November 1, 1996 and amounted to 40 manat per 1 kWh and till January 1, 2008 remained unchanged with growth of expenditures and introduction of new facilities.

During the last years, balance profit is gained in the sector due to exchange difference. The major share of electricity is provided for the domestic consumers in Turkmenistan.

Since January 1, 2008, the price for electricity for the consumers of Turkmenistan increased by 10%, and expenditures for free energy use by the population were covered by means of the public budget. Besides, transition to unitary USD exchange rate affected the revenues gained from energy export. All these factors improved the financial status of the energy sector.

All generating capacities are concentrated within the framework of the State Electric Energy Corporation (SEC) Turkmenenergo. Currently, the system of SEC Turkmenenergo of the Ministry of energy and industry of Turkmenistan includes: 10 state-owned power plants with total installed capacity of 4,104.2 MW; 6 manufacturing groups, 1 enterprise of electrical networks: Department of public lightening of Ashhabad city; specialized manufacturing group Turkmenenergoabatkaiysh, state power supply inspectorate, enterprise Energoendzham and administration of public utilities sector.

This corporation is a complex organization, which provides operation and maintenance of energy sector facilities, fulfills centralized power supply to the national economy consumers and heating supply to several cities.

The capacity of energy sector of Turkmenistan is excessive, it completely satisfies the domestic electricity needs and in case of demand Turkmenistan can export energy to other countries. All power plants are operating on the natural gas provided by the nearby gas deposits, black oil fuel and diesel fuel produced by domestic oil refineries are used as a standby fuel.

According to the Resolution of the President of Turkmenistan dated 1993, the population of this country shall be provided with free consumption of electricity, gas and water. In 2006, in accordance with the Decree of the President of Turkmenistan this social benefit was prolonged till 2030.

Uzbekistan. Since 2011, the electricity sector of the Republic of Uzbekistan has been operating within the framework of Uzbekenergo State Joint-Stock Company (SJSC) established as an open joint-stock company with the enterprises of coal industry included in it. Uzbekenergo SJSC is the governing body in the electricity sector and coal industry of the most important structural components of the economy in the country.

Uzbekenergo SJSC establishes operating mode of the unified energy system, carrying out uniform technological policy in the sector, improvement of energy production efficiency, introduction of new technologies and equipment, provision of energy sector advanced development for the purposes of satisfying the country's electricity needs to the full extent.

Energy system of Uzbekistan is the major element in the inseparable chain of electricity production and transmission in the region. Strategic geographical location, availability of extensive networks contributes to successful organization and active participation in the electricity and capacity market.

The installed capacity of power plants in the Republic is more than 12.4 million kWh, including 39 thermal and hydropower plants with capacity of 12.0 million kWh, which belong to Uzbekenergo SJSC. The remaining capacity of 300 MW is managed by government subdivisions and industrial sectors.

The major share of electricity, up to 90%, is produced by 10 thermal power plants of the company with total installed capacity of 10.6 million kW.

Energy system of Uzbekistan satisfies the demands of the economic sectors and the population of the Republic for electricity to the full extent and exports thereof to other counties.

Technical losses of electricity in the electricity supply network of Uzbekenergo SJSC constitute approximately 13%, including technical losses thereof at the enterprises generating

electricity for main power transmission lines and the enterprises of territorial electrical networks. Meanwhile, there is no term “commercial losses” in the regulatory documents.

Gas fuel makes 92%, with equal shares of black oil fuel and coal, in the structure of primary resources, used for generation of electric and thermal energy. 3.6 million tons of coal is produced at the enterprises of coal industry, as well as 222 million cubic meters of gas is produced by means of underground gasification.

Currently, the share of renewable energy sources in the fuel and energy balance of the country does not exceed one percent. Meanwhile, the potential of renewable energy sources of Uzbekistan constitute approximately 51 billion tons of oil equivalent, technical potential – more than 179 00.0 million tons of oil equivalent.

According to the laws of the Republic of Uzbekistan, the enterprises producing electricity are obliged to provide safety in the process of electricity production and supply main power transmission lines with the electric energy, quality indices of which comply with the state standards.

The activity on electricity generation at the stationary electric power plants connected to the unified energy system shall be licensed in the country.

Thermal stations, heat and power plants, as well as power plants applying renewable energy sources connected to the unified energy system may be in public or private ownership. The exception are hydropower plants, which are connected to the unified energy system and in accordance with the laws on hydropower plants are in public ownership.

1.3. Overview of energy policy, national priorities in the area of energy efficiency and renewable energy sources

All states of Central Asia are provided with energy resources. Kazakhstan, Uzbekistan and Turkmenistan possess significant hydrocarbon reserves, and Tajikistan and Kyrgyzstan possess a great water-power potential.

In this regard, importance is attached to energy saving from the point of view of generation capacities compensation deficit and/or releasing of additional amounts of energy resources for export, and renewable energy sources development is considered first of all as a measure of preventing climate change and environmental protection, and also in the context of providing all distant, hard-to-reach areas with power supply.

In Kazakhstan and Tajikistan, the fundamental documents in the area of improvement of energy efficiency are national laws on energy saving, in Uzbekistan – the law on well-minded and reasonable use of energy.

In Tajikistan, a complex legislation base for improvement of renewable and small scale energy generation was elaborated in accordance with national priorities of development, which includes also norms, standards, and methodological documentation.

In Kyrgyzstan energy saving policy is regulated by the Laws of Kyrgyz Republic “On energy sector”, “On electric energy sector”, “On energy saving” and “On energy efficiency of buildings”.

In Turkmenistan, the legal and regulatory base has not been formed yet, but great attention is paid to the issues of development of wind and solar energy generation.

Alongside with it, the legal and regulatory base has rather declarative character in the country. In the majority of countries laws on energy saving do not contain any mechanisms of direct effect and are weakly connected with the other legislation acts regulating different energy generation and environmental issues, etc. Norms of energy legislation are often not coordinated, have gaps, and open issues. Moreover, practically in all countries mentioned above, international experience is studied actively and the work on its adaptation to the national conditions is being carried out. In particular, we may emphasize the tendency of harmonization of the legislation in the area of energy efficiency with the legislation of the European Union.

On the whole, currently, there is no complex and consistent approach to carrying out the policy in the area of energy efficiency improvement in reviewed states: the system of energy efficiency target values is not properly developed, there is no mechanism of monitoring and estimation, there is improperly adjusted system of statistical data collection, there is no mechanism of middle-term objectives correction as well as the mechanisms of achievement thereof, the system of by-laws has been underdeveloped. The mechanisms of investments into economic stimulation of energy efficiency have not been worked out yet.

The following may be considered as the main obstacles for implementation of energy saving measures: imperfect tariffs policy and practice of cross subsidizing, underdevelopment of energy service market and energy saving technologies, uncertainty on budget support of energy saving for prospective future, high investment risks, low qualified management at the local levels, insufficient culture of energy resources rational use, insufficiently developed market relations, lack of effective economic stimuli for investing into fixed production assets and implementation of energy saving projects; imperfect state administration and monitoring in the area of energy saving, especially at regional and local levels.

The common peculiarity of reviewed states is the necessity of equipment upgrading in the energy, public utilities sector, and practically in all sectors of industry.

In the area of energy saving, **Kazakhstan** set the objective to reduce GDP energy intensity at least by 10% by 2015 and by 25% by 2020, respectively. Till present, Kazakhstan has not had any complex national policy in the area of energy saving, though some of its elements are being developed rather successfully. It is supposed that by 2024 the ratio of RES (renewable energy sources) is to make 5% in the general energy balance of the country.

In 2009, the Law of the Republic of Kazakhstan “On renewable energy sources support” and the Law of the Republic of Kazakhstan “On introduction of amendments and additions to some legislative acts of the Republic of Kazakhstan on the issues of renewable energy sources support” were adopted.

A set of measures is provided for renewable energy sources support, including: reservation and priority in providing with land areas for construction of renewable energy sources facilities; obligations of the power transmitting organizations regarding power purchase produced by means of applying renewable energy sources; exemption of the renewable energy sources from payment for power transportation through the transmission lines; support in the process of connecting facilities, which apply renewable energy sources, to power supply networks of the transmission organization; providing individuals and legal entities, carrying out design, construction and exploitation of the facilities, which apply renewable energy sources, with investment preferences in accordance with the legislation of Republic of Kazakhstan on investments. In particular, the reviewed law provides for investment preferences to RES projects, priority in applying net energy in the market and also when it is transmitted through the power supply networks as well as support by means of the certificates system monitored by the government.

In execution of the Law of the Republic of Kazakhstan “On renewable energy sources support” a set of by-laws and plan of facilities location, which apply renewable energy sources, was adopted. Besides the Law on RES support it is possible to name a whole pack of documents adopted by the Government and meant for RES support.

All those documents, allow to state that there is increasing interest on the part of the investors, including foreign ones (first of all China and Germany) to the RES projects in Kazakhstan, due to adopting provisions of the Republican regulatory base. After adopting the Law, a number of domestic and foreign investors expressed their willingness to take part in implementation of the projects in the area of RES.

It should be noted that implementation of some separate projects in the field of wind, hydro, and solar power has started recently in the country.

It should be emphasized as well that at the present stage Kazakhstan has the most developed regulatory and legal framework in the area of energy efficiency and RES.

Kyrgyzstan and Tajikistan are currently solving the issues on achieving financial and economic rehabilitation of the sector by 2014-2015, as well as putting into operation new generation and transmitting capacities, increasing the share of renewable energy in the structure of production, improving energy efficiency by means of energy saving, improving reliability of power supply to the consumers and carrying out socially acceptable tariffs policy.

The major objectives of energy saving policy are: rational energy use in its production and consumption through active introduction of energy saving and advanced technologies, as well as renewable energy sources.

In Kyrgyzstan, the share of domestic household significantly increased, while the share of industrial and agrarian sector decreased in the structure of fuel and energy resources consumption by sectors within the last 20 years. Currently, the population consumes approximately 60.5% of the total power supplied to the domestic market; budgetary sphere – 10.5%; industry, agriculture and commercial consumers – 29%. Significant changes are observed in the structure of fuel and energy balance: coal consumption decreased significantly, and therefore heating, hot water supply, and food preparation is carried out by means of applying electric energy. In 1990, the population consumed 1 billion kWh, meanwhile, in 2010 – 3.64 billion kWh, with significant seasonal fluctuations: energy consumption in winter is 3.5 times more than in summer.

Major objectives of the policy carried out in Kyrgyzstan:

1. Achievement of financial and economic recovery of the sector;
2. Provision of sustainable development of energy sector, technological re-equipment;
3. Putting into operation new generating and transmitting capacities;
4. Increase in the share of renewable energy in the structure of production;
5. Improvement of energy efficiency by means of energy saving;
6. Increase of reliable energy supply to the consumers.

Implementation of energy saving events and measures on improvement of energy efficiency will be fulfilled in the nearest future in the following direction:

- Preparation of draft regulatory and legal documents to fulfill the requirements of the Law “On energy saving” and taking measures improvement of energy efficiency;
- Reconstruction of existing energy and energy intensive enterprises, upgrading of energy sector, insulation and construction of buildings, where energy resources are consumed more effectively;
 - Use of domestic energy resources;
 - Restructuring of industry, which produces construction materials, start-up of energy saving and heat insulating materials production;
 - Development, manufacturing and installation of equipment and systems for record keeping and monitoring of hot water, steam, natural gas and electricity consumption.

In Tajikistan, state energy policy provides for measures meant for:

- Electricity tariff raising;
- Improvement of investment attractiveness for investment energy projects and increase of the funds inflow to the state budget;
- Building of intensive dialog with potential power importers;
- Continuing of negotiations on mutually profitable monitoring of water resources with the neighboring countries;
- Improving of efficiency of administration and transparency in the energy sector by means of further restructuring of Barki Tochik Open Joint-Stock Holding Company;

- Placing of the generating facilities and main power transmission lines, including the ones with capacity of more than 110 kW into a separate structure;
- Establishing three distributing companies with a possibility of attracting private investments;
- Working out of incentives for increasing energy production with the use of renewable energy sources, including those on exploration and mining of natural gas, mining and transportation of coal for population, reconstruction of thermal stations.

Conception of the fuel and energy complex development in the Republic of Tajikistan for the period of 2003-2015 provides for stopping of extraction and production decline of energy resources not lower than the rate of 2000-2001 by means of reconstruction of the existing energy resources production facilities, use of advanced technologies and fixing of market prices for energy products, which would guarantee self-financing of the sectors of the fuel and energy complex and regulatory level of their profitability. At the second stage (2007-2011), development of the fuel and energy complex must be provided by means of putting into operation new energy sector facilities, carrying out of geological exploration works and infrastructure development of new deposits of oil and gas, as well as technological improvement of coal extraction and processing, development of alternative energy sector (solar and wind plants, etc). At the third stage (2011-2015), improvement of the fuel and energy complex must be provided on the basis of export of energy resources (electricity and coal) of Republic of Tajikistan in the markets of Eurasian countries and far-abroad countries.

The Program of “Effective use of renewable energy sources of the Republic of Tajikistan with the purpose of stable development till 2020” provides for increase in the share of alternative energy sources to the total volume of energy consumption: in 2015 – 32,850 kWh, in 2020 – 104,000 kWh (annual production – 898.56 million kWh) or 5.54% of the total energy production in the country.

In Turkmenistan, the policy in the area of energy efficiency increase as a separate direction of the national policy does not exist at all. There is no regulatory, legal and institutional framework. Moreover, some measures are taken for optimization of the fuel and energy balance, optimization of generating capacities and development of renewable energy sources in the framework of energy policy implementation.

Turkmenistan is solving the issues of energy efficiency increase in the framework of the general plans on modernization of economy and energy sector, as well as development of renewable energy sources. There are a lot of hard-to-reach regions in the country, where the centralized delivery of power transmission lines is rather obstructed. RES use and development of appropriate technologies are meant to solve that problem, for example at the far distant pastures, oil and gas fields, on the island of the Caspian Sea.

In Uzbekistan, energy saving and using of RES is getting the most important direction in the national energy policy of the country for it allows reducing the need in large investments into the energy sector. In contrast with the recent orientation on a large scale increase of energy resource production the main priority at present time is improvement of efficiency of applied energy resources on the existing equipment.

In this regard, the priority directions in the energy sector development are as follows:

- technical re-equipping, reconstruction and upgrading of energy equipment, all of them meant for keeping and saving of the installed capacity of the power plants and improvement of their technical and economic characteristics;
- introduction of modern high efficiency technologies and equipment providing rational use of fuel and energy resources and reduction of ecological environmental impact.

Main aims and goals of the country in the area of energy efficiency:

- decrease of final energy expenditure for satisfying of corresponding volume of needs;

- increase of efficiency in energy resources use and improvement of the system of “extraction-transformation-distribution-use” at each of its stages;
- replacement of expensive and limited (according to their deposits amount) sources of energy with cheaper and renewable energy sources;
- implementation of potentially productive technologies which increase energy efficiency in using energy resources while complying with environmental requirements.

The major objectives of the government control system in implementation of energy saving at the current stage are as follows:

- working out of appropriate legislative, regulatory and methodological framework stimulating implementation of energy saving measures;
- providing conditions for legislative and economic interest;
- determining the level of efficiency in consumption of energy resources by the production enterprises and revealing of energy saving potential.

2. Analysis of investment climate and market conditions for implementation of the projects in the area of energy efficiency and renewable energy sources in Central Asia.

Kazakhstan. New market relations were established in the power generation sector of the Republic of Kazakhstan. Power generation sector has been restructured to the full extent: approximately 100% of generating plants of the national level were privatized or transferred to the private companies. The national electric power network was created as well as open competitive electricity market.

Rather high level of investments directed to the fixed assets remains in the Republic, which is surely considered as competitive advantage. Meanwhile, a significant share of these investments is attributed to the public financing.

Generally, in 2011, fixed investments growth constituted 2.4% compared to the corresponding level of the previous year. Although investment demand recovery is very slow, meanwhile, sustainable fixed investments growth is observed every year. Upward trend of reduction in the volume of credits provided by the banks and borrowed fund of organizations was observed in the structure of investment financing sources. Simultaneous reduction of credits provided by the banks and increase of the capital outflow reflects the necessity of introducing fundamental changes into investment climate.

Necessary legal framework was established in Kazakhstan for the purposes of carrying out investment activity. The laws provide for full protection of investors rights and stability of concluded contracts, as well as strictly regulated activity of government bodies in respect of investors (free floating of capital, repatriation of capital, free use of profit, the right for land ownership, including foreign companies). There are determined measures for the state support of investments directed to the priority sector of economy in Kazakhstan. Thus, the investors are provided with the following types of investment preferences in implementation of the projects in the non-resource sector of economy in Kazakhstan:

- 1) *exemption from customs fees imposed on equipment and accessories necessary for implementation of investment project;*
- 2) *state grants in kind (land plots, buildings, constructions, cars and equipment may be provided as state land grants);*
- 3) *investment tax preferences.*

According to the Tax Code of the Republic of Kazakhstan valid since January 1, 2009, the procedure of **tax investment preferences** applied by the investors is simplified, namely, previously existing procedure of investment preferences receipt was eliminated, under this procedure such preferences shall be provided immediately upon conclusion of a contract with an authorized body (Committee on Investments). Investment tax preferences consist in referring the value of preference objects to deductions, as well as subsequent expenses for reconstruction and upgrading. Meanwhile, the term of losses carrying forward is prolonged from 3 to 10 years, thereby contributing to benefits from advantages of investment tax preferences. Moreover, corporate income tax rate is to be decreased: since 2009 – up to 20%, since 2010 – up to 17.5%, since 2011 – up to 15% (in 2008 – by 30%).

The rate of value added tax was reduced by 12%.

It is necessary to emphasize such measure of investment support on the part of the government as projects co-financing by means of state financial institutions of development (National Innovation Fund, Corporation for the Insurance of Investments and Export Credits, Development Bank of Kazakhstan, Investment Fund of Kazakhstan, KAZNEX Corporation for Export Development and Promotion).

Such instruments of economic encouragement as industrial and special economic zones, as well as technology parks were newly developed.

Currently, there are six special economic zones in Kazakhstan, such as Aktau Seaport providing transportation and logistics services, Astana-New City - construction and production of construction materials, Information Technology Park in the suburb of Almaty, Ontustik, in the South-Kazakhstan region – development of textile industry, National Petrochemical Industrial Park in Atyrau region and Buranai - development of tourism cluster 200 kilometer from Astana.

The Center for Public-Private Partnership was established not so long ago under the support of the World Bank within the framework of the Ministry of economy and budgetary planning.

There are three major factors, affecting investment attractiveness of Kazakhstan:

- Business climate of the country supported by favorable investment laws, attractive measures of investment support, as well as economic and political stability;
- Availability of rich natural and mineral resources;
- Beneficial geographical location of Kazakhstan and membership in the Customs Union with Russia and Belarus.

Thus, under the current laws, private investments can be directed to power generating sector, however, low tariff rates for electricity do not attract investors. Besides, existing level of tariffs was unpredictable due to absence of long term government strategy.

The program on staged rise in prices till 2015 by the groups of energy sources was approved in the Republic for attraction of investments in the power generating sector. These are so called “cap” tariff rates.

Funds are not invested into the energy saving despite relatively favorable investment climate.

Currently, clean energy technologies forming the basis for RES application are not able to compete with large deposits of cheap coal available in the country.

Renewable sources (except for large hydropower plants) are not used to the full extent due to absence of supporting laws, strategies and stimulating mechanisms. Under such conditions, RES application (except for large HPPs) with availability of electricity market without appropriate legislative support on the part of the government is very difficult due to high electric energy production cost.

The cost of electricity generated by means of RES application is higher than the one produced by means of traditional methods. In respect of Kazakhstan, this difference constitutes KZT 3-5 per 1 kWh depending on the region. The cost of electricity generated by means of RES application taking into account investments repayment is likely to make KZT 8-12/kWh. Currently, the busbar cost of electricity produced by the energy organizations constitutes KZT 2-4.5/kWh. Under such conditions, RES investment is not profitable and obvious investment activity for promotion of RES construction is not observed yet. Therefore, the Ministry of industry and advanced technologies of the Republic of Kazakhstan introduced new concept of the draft law of the Republic of Kazakhstan “On introduction of amendments and additions in some legislative acts of the Republic of Kazakhstan on the issues of supporting renewable energy sources application”, which is based on introduction of fixed tariff rates in the Committee on the issues of ecology and natural resources management of Majlis of the KR parliament on February 15, 2012. Concept, which forms the basis of fixed tariff rates consists in providing investment attractiveness of the projects on RES application for private investors.

Kyrgyzstan. Lack of financial, economic and political stability contributes to negative background and discourages investors regardless of the existing legislation. Low solvency of the population, high risks of non-payments and low tariffs for electricity do not stimulate investments inflow to the energy sector, efficiency and renewable energy sources. Measures of economic stimulation for attraction of investments, envisaged by the Law of the Kyrgyz Republic “On renewable energy sources”, will not change the situation.

Therefore, the Law of the Kyrgyz Republic “On introduction of amendments and additions into the Law of the Kyrgyz Republic “On renewable energy sources” was adopted on August 3, 2012. The major objective of this law is to improve economic mechanisms for

stimulation of renewable energy sources use, including small HPPs, for the purposes of investments attraction.

According to the law, extra charges shall be established to a tariff rate for electricity generated from RESs and small HPPs for the pay-off period of the projects on RES application. This extra charge will be calculated by means of multiplying maximum current tariff rate by electricity and corresponding ratio, approved for each RES:

- for the hydro power plants the coefficient is equal to 2.1;
- for the solar power plants the coefficient is equal to 6.0;
- for the biomass power plants the coefficient is equal to 2.75;
- for the wind power plants the coefficient is equal to 2.5;
- for the terrestrial power plants the coefficient is equal to 3.35.

The amount of extra charges was defined with regard to special RES tariffs in some other countries.

Moreover, the maximum pay-off period for the projects on RES use is suggested to be not more than 8 years. In other words, grace period is determined in order to impose special tariffs for renewable generation plants, during this period these plants shall be paid off.

Besides, according to this law, the energy distribution companies shall be obliged to purchase all auxiliary power generated by means of RESs and small HPPs and not consumed by the plant owners as well as power not sold to other consumers on the contractual basis. In other words the largest energy distribution company, which dominates in the energy market, in the administrative and territorial area, where renewable generation plant or small HPP are located, shall be determined as a purchaser of energy produced by renewable generation plants and small HPPs. These regulations correspond to international practice and create conditions for sales of energy produced at the renewable generation plants.

Such mechanism combines transparency and clarity for potential investor as extra charge ratios are set forth and the purchaser for sales of energy produced at the renewable generation plants is determined. These regulations create opportunities for improvement of RES competitiveness on the background of conventional energy sources application.

Besides, the Regulations on the procedure of construction, acceptance and technological connection of small HPPs to electrical power networks as well as the procedure of putting into operation completed small HPPs were approved by Resolution of the Government of the Kyrgyz Republic № 476 dated July 28, 2009.

The share of imported and manufactured energy saving equipment and materials is not significant in the country, as well as advanced energy saving technologies are poorly introduced. Lack of proper data base, energy saving equipment and technologies market contributes to such situation, as well as insufficient funds possessed by potential producers and consumers, complexity of innovations crediting. Till present, the government has not allocated any funds from the budget for the purposes of development and introduction of energy saving technologies.

In recent year, the government started focusing on introduction of **energy saving technologies at the level of regions and cities**.

Tajikistan. Unfavorable business climate is observed in Tajikistan, which discourages potential investors in displaying business activity. According to the annual index of economic freedom of the World Bank, Tajikistan takes 159th place of 183 possible ones, thereby reflecting difficulties connected with establishment of enterprises, credits obtaining and carrying out international trade. In 2011, three-year program developed by the IMF on improvement of business environment in the domestic market allowed Tajikistan improving its positions by five points in the rating on ease of Doing Business, set up by the World Bank and the International Finance Commission (IFC). Tajikistan was 147th among 183 countries against its 152 place in 2010 in the Doing Business-2011 rating.

Poor developed market mechanisms contributed to dominance of public sector of economy. The economy of the country is significantly dependant on the funds of migrant

workers, the share of money inflows from migrant workers constitute 50% of GDP in the country and exceed annual budget of the country, these funds are completely concentrated in Russia, thereby putting the Republic in direct dependence on migration policy of the Russian Federation.

Social strain in the Republic is rather high due to low incomes of the population.

The situation in the hydro power generating sector of Tajikistan is still difficult due to insufficient volumes of generated energy and disagreements with Uzbekistan with regard to construction of the Rogunsk hydro power plant. It complicates relationships between the countries. Thus, for example, Uzbekistan has reduced gas supplies to Tajikistan due to debts of this country. Last year, Uzbekistan stopped railway transit traffic through its territory, etc.

Instability of domestic political and economic situation is the main obstacle for economic reforms, results in poor penetration of foreign capital and weak economic activity for all agents of the domestic market, including public sector of the economy. The Republic is left behind its Central Asian neighbors in all directions of market reforming. State budget is formed with significant deficit; price formation policy is not coordinated with purchasing capacity of the population and marketability.

In the period till 2015, scenario conditions for economic development in Tajikistan provide for price growth with corresponding increase of energy tariff rates by 4.0 cents per 1 kWh for industrial consumers (against 1.4 cents per 1 kWh in 2006). Under the Resolution of the Government of the Republic of Tajikistan dated March 1, 2012, growth rates of prices for gas in the next years will depend on the situation in the gas market and increase in gas production. Free prices formation in the domestic market will be exposed to impact of demand and supply.

In other words, strengthening financial discipline, reduction of losses and introduction of appropriate tariffs is the only source of income necessary for satisfying all major financial obligations in this sector (expenses for operation and maintenance, debt servicing, satisfying demands for working capital and capital expenses). Draft of tariff setting policy till 2016 is developed in the Republic, the later provides for gradual increase of tariffs up to the level, which covers all expenses.

For development of power generation sector in Tajikistan in 2012-2020, demand for investments constitutes USD 2 billion 700 million. The government of the Republic takes all opportunities for cooperation with the United Nations Development Program (UNDP), international banks and funds, such as World Bank (WB), International Monetary Fund (IMF), Asian Development Bank (ADB), European Bank for Reconstruction and Development (EBRD), Eurasian Development Bank (EDB) and others in order to attract investments in the power generation sector.

The laws and programs approved by the government of the Republic do not provide for authorized institutional bodies responsible for coordination of investment activity in the area of energy efficiency and renewable energy sources.

The program on application of renewable energy sources in 2007-2015 approved by the Government of Tajikistan provides for carrying out works on development, establishment, research and introduction of perspective renewable power generation systems, but there is no here directed financing of projects on energy efficiency and renewable energy sources of the local financial institutions.

Turkmenistan. Turkmenistan is a specific and closed state for all including foreign investments. As for domestic investments, the major share of domestic public investments, 61.3%, is directed to manufacturing sector (oil, gas and construction sectors of economy). Measures taken by the government in order to increase the amounts of financing of small and medium enterprises, including private sector, by means of loans with soft lending rate in the amount of 5% contributed to growth of production output of separate types of goods in these enterprises, particularly in the food processing industry.

With regard to peculiar monitoring of power generation sector in Turkmenistan (the sector is operating under the conditions of state regulated prices; the population is provided with electricity, gas and water free of charge), this country is not attractive for private investors.

Uzbekistan. Favorable investment climate is created in the Republic of Uzbekistan; extended system of legal guarantees and benefits is developed for the foreign investors in the country, as well as the integral system of measures on stimulation of enterprises operating with foreign investments. Investors' credibility is supported by the fact that during the period, when significant decline of economic growth and stagnation of production was observed in many countries of the world, GDP growth rates constituted more than 8 percent in Uzbekistan in the last 3 years. According to the estimates of the world financial institutions, it is one of the most significant indicators in the whole world.

Investors are attracted by strict execution on the part of the government of its obligations on credits and loans. Sustainable economic growth, stable banking system, weighted lending and investment policy is the guarantor of funds safety invested into the economy of the country.

Investments laws of the Republic of Uzbekistan are among the progressive ones in the legislative system of the CIS countries, which comprise general provision of international investment law, in particular, regulations on guarantees of the foreign investors' rights, on providing investors and others with certain preferences.

The policy carried out by the government is implemented in growing foreign investments into the economy of the country. In 2011, capital investments were realized by means of all sources of financing to the amount of more than USD 10.8 billion, having increased by 11.2 percent compared to 2010. The share of investments in GDP constituted 23.9 percent, thereby reflecting significant investment activity in the country.

The share of foreign investments attracted to the real sector of the country constituted approximately USD 2.9 billion, whereof 78.8% are direct foreign investments.

More than 73.5% of all investments are directed for the purposes of industrial construction, and most notably, approximately 45.3% of investments were directed for purchase of advanced high-production equipment.

In 1990, more than 46.3 percent of all investments were the funds of the public budget, meanwhile, in 2010, non-centralized sources provided for 57.9% of all investments, and foreign investments constituted 29.1% of all investments. Moreover, investments into manufacturing sector increased from 58.3 to 73% within this period.

Particular attention is focused on implementation of the projects in the area of advanced technologies, such as organization of synthetic liquid fuel production, construction of new modern gas and chemical complexes manufacturing polyethylene and polypropylene products, liquefied and compressed natural gas, mineral fertilizers and new types of chemical products in accordance with up-to-date energy saving technologies, dynamic development of power generation sector by means of substituting old equipment with modern combined cycle plants.

New enterprises established by means of foreign investments attraction (FIA) and foreign funds invested in the amount of not less than USD 5 million received the right for 10-year prolongation of transition to new tax regimes. In other words, if legislation affecting the issues of calculation and payment of all types of taxes is amended, a legal entity is entitled to pay taxes in accordance with the regulations valid at the moment of registration thereof.

Within the framework of investment projects with the value of more than USD 50 million and with the share of foreign investments not less than 50%, construction of any mechanical, electrical and plumbing complexes beyond production sites will be implemented by means of public funds and other domestic sources of financing.

3 Analysis of projects implementation experience on energy efficiency and renewable energy sources

Objectively, till present renewable energy generation plants in Central Asia have been less profitable and significantly more capital intensive in comparison to the traditional ones. The cost of alternative energy production is three and more times than the cost of traditional energy production. For example, in Kazakhstan the wholesale cost of wind power generation in 2009 constituted KZT 8-9, the cost of solar energy was KZT 22, and the cost of biomass was KZT 6-12 per 1 kWh. Therefore energy companies are not interested in renewable energy generation. Besides, at present the mechanism of production support and using of these kinds of energy is not properly developed.

Currently almost all large-scale projects and programs in the area of energy efficiency and RES in the states of Central Asia have been realized either within the framework of implementation of the government programs on support of the budget funds or at the account of foreign grants within the framework of the projects of international technological assistance. Particularly, it is subject to development of alternative and renewable energy production sector (with the exception of small hydropower plants).

The main part of the national programs, strategies, maps of distribution of the wind and solar energy potential, legislation in the area of energy efficiency and RESs was worked out in the course of implementing the programs on international technological assistance.

For example, the Ministry of Energy and Mineral Resources of the Republic of Kazakhstan in cooperation with the UN Development Program of “Kazakhstan - wind power market development initiative” worked out the project of the National Program on wind power engineering development till 2015 with the prospective till 2024. The National Program on wind power engineering development is directed to involvement of significant wind power resources into the power balance of the country and thereby supporting the plans for reducing energy intensity of the economy and increasing alternative energy sources in the total power balance of the country up to 5% by 2024 as well as stabilization of greenhouse gas emissions at the level of 1990. The objective of the Program consists in applying wind power potential of Kazakhstan for electricity production in the amount of 900 million kWh per a year by 2015 and 5 billion kWh by 2024 with regard to the tasks assigned in the Concept on the transition of Kazakhstan to sustainable development for 2007-2024 and the Strategy of innovative industrial development of the Republic of Kazakhstan for 2003 – 2015 on natural resources and environment saving.

Kazakhstan. Despite measures undertaken at the state level, even in Kazakhstan, a country with the best conditions for establishment of regulatory, legal and institutional framework, renewable and alternative power generation (excluding large HPPs) has not been developed yet. Up to the present time, none of the large projects in this area has been realized, despite a series of attempts of construction, in particular, wind power complexes.

However, Kazakhstan has gained some experience in implementation of small- and middle- scale projects on arm’s length terms. Currently, the total amount of investments into the RES projects in Kazakhstan is more than KZT 107 billion (that equals to RUB 22 billion).

Small HPP is the most actively developing direction of renewable energy sources in Kazakhstan. During the period since 2007 till 2010, 5 small HPPs with the total installed capacity of about 20 MW were put into operation in Almaty region, and a small HPP with its capacity of 1.5 MW was constructed in Dzhambul region. Besides, a series of projects is being at different stages of their implementation.

In the current year, two autonomous power generation wind and solar energy-oriented complexes were put into operation in Akmola region (two wind turbines with capacity of 5 kW each and two solar power plants with capacity of 1.5 kW each). Besides, three wind-solar energy complexes with total capacity of 5.32 kW were constructed in the North Kazakhstan region (for

the standby power supply to the equipment of Kazakhtelecom Joint-Stock Company). And the largest wind-power plant with its capacity of 30 kW was put into operation in Atyrau region by Dolara LLP.

In Kazakhstan, several venture projects on design and serial production of equipment for small wind-power plants are being currently implemented. The conducted testing of experimental models showed that the cost of 1 kW of installed capacity of such plants will be about USD 1.5 thousand, which is twice less than that of European wind power plants of the same capacity.

In 2011, Korday wind farm was put into operation. Izen Su Company, the main investor of Korday Wind Farm Project, invested about KZT 370 million into the construction of the first stage. Owing to this project about 40 job places were created. The staff for servicing power plant consists of nine workers. Specialists expect that power will be supplied to more than 500 households owing to the construction of the new wind farm with capacity of 1500 kW. Korday wind farm is to be an additional power source of Merken HPP-3 with capacity of 1.5 MW, has already been operating since December 2012.

Construction of new modular vertical-axis rotor turbine (VRTB) of Bolotov was completed in Kazakhstan. On the basis of this turbine, the enterprises of Kazakhstan and the Russian Federation design, produce and put into operation the complex energy systems (CES) of the modular vertical-axis rotor turbine of Bolotov with capacity of 2÷5÷10÷20 kW. They are completed with solar transducers and accumulators, intellectual charging devices and protection means under requirements of autonomous facility, thereby providing safe power supply to the consumers.

In compliance with the decisions approved by the President of the country, NAC Kazatomprom JSC opened its affiliate company Ecoenergomash LLP and approved the program of using wind power for the purposes of production of vertical-axis rotor turbines of Bolotov.

Currently, more than 40 CESs with VRTBs are successfully operating on the territory of the Republic of Kazakhstan (for example, CESs with VRTBs with the capacity of 2 kW located in the Gzungarian Gates supply power to the facilities of Transtelecom under extreme wind and weather conditions: temperature - up to -40°C, wind speed – up to 45 m/s, two CESs with VRTBs with the capacity of 5 kW each are operating at Lesnoi Kordon (Forest Cordon) facility located in the suburbs of Astana city, etc.). Large numbers of CESs with VRTBs have been installed and are operating in the Russian Federation. CESs with VRTBs supply power to the light towers of the Northern Sea Route and frontier posts, they are considered to be perspective if installed in the retranslator towers.

Financing of a series of projects has already been in progress. Thus, first wind power plant LLP (affiliate company of Samruk-Green Energy LLP) and Eurasian Development Bank concluded the agreement on opening of crediting line to the amount of KZT14.2 billion for financing project on turnkey construction of the first large in Kazakhstan wind power plant with the capacity of 45 MW at the site of Erementau in Akmola region. Power generation in the volume of more than 172 million kWh per a year without consumption of hydrocarbon fuel will contribute to saving more than 60 thousand tons of coal and increasing stable power supply in the region. Within the framework of forthcoming exhibition of EXPO-2017 it is planned to supply the facilities of the exhibition with power generated by means of the above mentioned wind power plant.

It is necessary to mention implementation of KAZPV project meant for creation and development of silicon solar energy in Kazakhstan.

The main idea of its implementation is the availability of very large deposits of high purity quartz in the interior of the earth in Kazakhstan. France committed development and realization of the project to Commissariat a l'Energie Atomique (CEA) & Alternative Energy Sources, and Kazakhstan committed the project to Kazatomprom.

In April 2011, Memorandum on intentions was signed for carrying out joint research and development programs in the area of new materials for different kinds of renewable energy

sources. Agreement on transfer of CEA technologies was reached in that period, thereby contributing to maximum use of the potential on the part of Kazakhstan for creation of new energy sources. France appointed one of the best world Institutes in the field of renewable energy, the National Institute of Solar Energy (NISE) in France, responsible for transfer of technologies and knowledge. It possesses the most advanced technologies in the area of photo electricity.

They also discussed the issues concerning commencement of metallurgical silicon clearance production. The metallurgical silicon is produced in Kazakhstan by MC KazSilicon LLP till solar-grade silicon in Ust-Kamenogorsk and by sun battery panel production plant in Astana.

Currently, there are two enterprises, such as: Quartz LLP engaged in extraction and processing of gangue quartz at Sarykul deposit (Ushtobe, Almaty region), and KazSilicon LLP engaged in production of metallurgical silicon.

Metallurgical silicon used in production of solar batteries and for that reason also called solar-grade silicon is able to lay foundation to creation of quite a new industry in Central Asia region. Metallurgical plant KazSilicon was put into operation in 2006. It is the first plant in Central Asia producing metallurgical silicon. In 2007, the team of that plant was the first in CIS to master the technology of producing 99.96% high quality refined silicon with minimal content of iron (0.05%) and to prove the possibility of industrial production of silicon with content of Si-99.96%, which is a potential semi-product for producing of solar-grade silicon. KazSilicon developed quite a unique technology of producing solar-grade silicon, which in future might allow escaping the process of producing poly crystal silicon and, thus, significantly reducing the cost of solar batteries production.

KazSilicon will be the supplier of silicon, main component in solar batteries production, which is produced by this company in the volume of 5,000 tons per a year. CEIS will provide technical consulting on the project.

This Kazakh – French common project allows establishing joint scientific and research laboratory on development of technologies connected with renewable and alternative energy.

In Kazakhstan, the entire production line from the raw material to the final product is being currently built up. Solar batteries production capacities completion is expected in December 2012, whereas power ascension is to be in the 1st quarter of 2013.

In June 2012, the scientists of the Semiconductor Structure Technologies Laboratory of the Scientific and Research Institute of Experimental and Theoretical Physics (SRI ETP) under the Kazakh National University named after Al-Farabi offered quite a **new solar battery**. They worked out an improved solar battery, which produces capacity seven times as much as the already existing analogues. So **a new solar cell produces the capacity of about 15 W**, whereas the others, including foreign analogues are able to produce not more than 2.2 W. Such results were obtained owing to significant reduction of electrical resistance of the photo element. While developing the technology, the scientists used the factory plate and changed its current-conducting scheme.

It should be noted that there is quite a small number of companies in the world that are ready to offer any alternative to the existing poly crystal silicon. The scientists of the Institute of Mining named after D.A. Kunaev started their own production of solar energy holographic concentrators allowing producing solar batteries, which are much cheaper than any known analogues.

This project is very important from the point of view on saving and developing of scientific and industrial potential of Kazakhstan. Photo electric batteries intended for production in Kazakhstan are to be cheaper than the batteries in the world market and may cause good basement for development of the national solar energy sector in the market conditions.

Some private companies and local authorities, akimats, are also interested in RES development and introduction, for example, Otar solar power plant.

KazEcoWatt LLP was the investor on the project on construction of Otar solar power plant with its capacity of 504 kW. The cost of the 1st construction stage of Otar solar power plant has made about KZT 200 million. About 20 job places were created in the process of construction and in operation the maintenance staff will consist of 5 workers. The capacity of the 1st stage of Otar solar power plant is currently enough for satisfying electric energy needs of more than 200 households. The total installed capacity of Otar solar power plant will make 7 MW.

Project implementation on Otar solar power plant construction was possible also owing to active support of akimat in Dzhambyl region. The latter provided Otar solar power plant with land area of more than 14 hectare for construction and exploitation, tariff rate for electricity has been agreed and support was provided in concluding electric energy purchase-and-sale agreement.

The cost of electricity produced by Otar solar power plant will make KZT 23.4 with value added tax per 1kWh, whereas in Europe the cost of solar energy is more than KZT 60 per 1 kWh.

In Kyrgyzstan, almost all projects implemented in the area of energy efficiency and renewable energy sources were financed by foreign donors within the framework of the programs on international technical assistance. However, there are no successful examples of projects implementation in the area of renewable energy sources. Moreover, investment in energy efficiency could be commercially attractive in a number of cases, however, lack of access to financing and general instability create obstacles for private investments. The Government of Switzerland granted USD 23.6 million, the World Bank and the International Development Association provided the loan in the amount of USD 4.2 million for implementation of measures on energy efficiency in the Kyrgyz Republic till 1998.

Moreover, about USD 73 million were provided for rehabilitation of power supply and municipal heating system for the period till 2002 (Northern Development Fund, Asian Bank for Reconstruction and Development, Government of Denmark, World Bank and International Development Association). The Government of Japan granted USD 1.5 million and the World Bank provided the loan in the amount of USD 0.65 for purchase of gas meters for Kyrgyzgas OJSC.

The Kyrgyz Republic is engaged in the following programs of energy efficiency: TACIS, USAID. Within the framework of these programs the Kyrgyz Republic cooperates with Denmark, Sweden, Germany, Great Britain, France, Norway, Finland and the USA.

The Kyrgyz Republic is a member of the CIS Electrical Energy Council and the Interstate Council of Central Asia on Fuel and Energy Sector.

In 1995-1995, the pilot project on residential energy efficiency was implemented in the Kyrgyz Republic. This project was financed by the EU Commission and implemented by the German company Friedman and Johnson. The area for demonstration of energy and water efficiency was organized in Bishkek in 2000 within the framework of the UN project "Energy Saving - XXI". Several pilot projects aimed at reduction of heat energy and hot water consumption were successfully implemented within the period of 2000-2002. On the basis of these projects, the Government of the Kyrgyz Republic intends to develop encouraging strategy for the investments, directed to reconstruction of buildings, and measures in the area of energy efficiency. Driving force of this measure is improvement of energy efficiency in the construction sector, decreasing dependence on imported fuel and reduced impact of power generation sector on the environment.

The project "Rehabilitation of power supply and central heating systems" with the cost of the first stage amounting to USD 20 million, financed by the International Development Association, the Asian Bank for Reconstruction and Development, the Danish International Development Agency (DANIDA) and the Government of Switzerland has been implemented in the Republic since 1997. Within the framework of this project, re-equipment of residential heat

supply stations and main thermal power system in Bishkek city was implemented under the auspices of TACIS, the governments of Denmark and other countries. Moreover, upgrading of boiler houses in the schools, educational institutions, hospitals and child-care centers of the Kyrgyz Republic was implemented with the support of the Asian Bank for Reconstruction and Development.

UNDP possesses a special program in the area of promoting small-scale power generation and energy saving technologies. GEF/UNDP is implementing the project "Improvement of municipal energy efficiency, heat and hot water supply" aimed at supporting improved efficiency of heat and hot water supply, as well as consumption of all types of energy in the buildings. Moreover, the project "Development of small HPPs" is implemented within the UNDP framework.

In 2008, German Society for Technical Cooperation (GTZ) commenced the research of Kyrgyzstan potential in the area of energy saving and renewable energy sources for the purposes of rendering technical assistance in future. Currently, any government body is unlikely to possess complete information about donors' activity in the area of improvement of energy saving technologies and renewable energy sources.

Moreover, donors' activity was independent, there were no coordination implemented on the part of authorized government body in this area as little attention was paid to this direction by the government.

It is necessary to emphasize that, currently, Kyrgyzstan possesses its own innovation technologies based on application of the solar, wind, biomass, and small water flows energy. Thus, production of solar thermal batteries for water heating and cooking by the population of rural areas was implemented within the framework of Kun project. There is a scientific research on wind turbines. Such aggregates are able to work twice slower with the wind speed and produce ordinary capacity for wind turbines.

Environmental movement BIOM is public association established in 1993. The objective of this association is to create a network of scientific researches in the area of renewable energy sources, which are to be profitable in the conditions of Kyrgyzstan. Separate scientific and research institutes on entering into agreements with energy companies carry out researches for such companies. Thus, the Kyrgyz Scientific and Technical Center, carries out examination of power generating equipment and assessment of technical condition of power transmission lines.

Such institute was engaged in development of small- and large-scale HPPs during 40 years. Small HPPs developed by this instituted were at a time constructed in Cuba and Mongolia. Moreover, this institute is ready to develop a complex of recommendations on reduction of commercial and technical losses in the energy system of the whole Republic based on the researches carried out on the example of village and district.

Currently, small HPPs with capacity from 3.5 kW to 30 kW can be produced on OREMI plant.

Currently, the following units are developed, experimentally adopted and are ready for industrial operation in the result of joint work of scientific and research institutes and industrial organizations carried out in Kyrgyzstan:

a) **Double-wheel wind-driven power plant DWPP-0.25** for power supply to not energy intensive agricultural consumers and individual residential houses. This plant is developed particularly for the climate conditions of mountainous areas of Kyrgyzstan, where concentration of wind potential is obvious due to mountainous uneven territory and is meant for autonomous work. Technical solutions are protected by several patents. Work was carried out in joint cooperation with OREMI JSC and the Institute of Automation of the National Academy of Sciences.

b) **Independent power source unit IPSU-0.5**, which provides autonomous backup power supply to the consumers during emergency outages or in case of necessity of autonomous power supply to household appliances.

c) Heat-pump systems for heat supply to different industrial and agricultural facilities, as well as residential houses and premises with thermal rating of 3, 12 and 15 kW. Such work was carried out for the first time and the results thereof are considered as the most perspective for application in the conditions of the Republic of Kyrgyzstan. Preproduction models of HPS with capacity of 2 and 5 kW were produced with Agrohладremmash JSC and passed industrial tests at this enterprise. HPS-12 was developed in cooperation with Zhanar JSC. The advantage of HPS over other energy sources is its high efficiency. Thus, the efficiency of electric energy applied in HPS is 3-5 times higher as compared to electrical heaters. HPS is considered as one of the most effective and potentially productive directions for application of low-potential and secondary energy sources for residential houses and premises.

d) Biomass plant producing inflammable gas – methane. A number of research, development and experimental works were carried out in this direction, which allowed creating 2 types of biogas plants. The first one – biogas plants for rural areas, the second one – of industrial type. These types of plants passed operational tests and the program on their demonstration was commenced in such region of the Republic as Osh region, Talas, Batken, Issyk-Kul and Chui region. Such plants are used to produce inflammable gas – methane out of farm animals' by-products and for household purposes to prepare food, to boil water, to heat premises, etc.

Generally, about 70 biogas plants are constructed in the territory of the Kyrgyz Republic, such plants are mainly located in Chui and Issyk-Kul regions. About 25 biogas plants located in Chui and Issyk-Kul regions were constructed during the last 4 years within the framework of different projects TB with assistance of individuals. 12 biogas plants were constructed within the framework of JICA projects (Japan International Cooperation Agency). The major enterprises which introduce biogas plants are the following: Fluid Public Fund produced 24 biogas units with reactor volume from 10 to 200 cubic meters, which allows producing from 20 to 360 cubic meters of gas (methane) per day, as well as Zhaz JSC and the Renewable Energy Source Center.

e) Solar photoelectric transducers plant for producing electric energy is currently one of the potentially productive and rapidly developing directions. Kyrgyzstan possesses a unique opportunity for rapid development of this direction and entrance to the international market due to availability of two large plants producing and processing silicon (Kristal JSC and KCMC (Kyrgyz chemical and metallurgical complex) JSC), which is the basis for manufacturing solar photoelectric transducers (PET). However, these systems are no able to compete with traditional energy systems. One of the major factors restraining large-scale use is high cost of polysilicon and monosilicon production.

Unfortunately, due to lack of fund with the population and at many enterprises, as well as desire to purchase solar power plants, production was shut down at such enterprises as Electroterm JSC, Zhyrgal JSC and ENVOD JSC. These enterprises mastered and were able to produce sufficient quantity of solar power plants, however, there was no demand for their products and the later had to execute retail orders. Kristal JSC and Kyrgyz chemical and metallurgical complex JSC (KCMC, Orlovka town) due to inability to resolve financial and economic problems did not manage to start production of solar power plants. Santehma JSC stopped producing solar power plants ten years ago. Zhanar JSC, which assembled solar power plants from constituent parts supplied from Russia, did not find the sales market, which resulted in accumulation of products in the warehouse of this enterprise.

Use of small rivers energy. Medium-scale grant project “Development of small HPPs” has been implemented in Kyrgyzstan in cooperation with UNDP. The major objective of the project is to create conditions to attract investors to small-scale power generating sector, elaborate and develop regulatory and legal framework in the area of renewable energy sources and small HPPs.

The small-and medium-scale power generation program in the Kyrgyz Republic till 2012 was approved by Decree of the President of the Kyrgyz Republic №365 dated October 14, 2008 for taking particular measures on attraction of investments to development of small- and

medium-scale power generation sector, the responsibility for implementation of this program was imposed on the administration of the project on development of small-and medium-scale power generation sector in the Kyrgyz Republic. In 2009, the draft of the national small-scale power generation program was developed within the framework of the UNDP project.

In Tajikistan, the Government supports development of small scale energy sector. In 1994-2000, the following small power plants were built: Teharv, 360 kW, Histervars, 630 kW, Hazara 1 and Hazara 2, 250 kW, Kyzyl-Mazar, 70 kW, Anderbag, 300 kW. At the end of the 90s, 12 small hydropower plants with total capacity of 540 kW were constructed on Pamir.

The construction of small hydropower plants is financed by the Government and donors. The Asian Development Bank financed the construction program of small hydropower plants in Tajikistan. Since the beginning of 2007, two power plants were put into operation in Rasht Valley: Dushohazamin power plant in Nurobod district and Kalandak station in Rasht district.

Currently, construction of other two more power plants is in progress.

The Islamic Development Bank (IDB) financed construction of 8 small plants in rural districts of Tajikistan. The credit of USD 9.3 million provided by the Islamic Development Bank was used for construction of 5 small hydropower plants in rural districts of Tajikistan:

- Marzich hydropower plant with the capacity of 2 750 kW (Aini district in Sughde);
- Sangikor hydropower plant with the capacity of 667 kW in Rasht district (north-eastern part of Tajikistan);
- Fathobod hydropower plant with the capacity of 600 kW in Tanjikabad district (north-east of Tajikistan);
- Pitavkul hydropower plant with the capacity of 850 kW in Dzhirgatal (north-east of Tajikistan);
- Shahboloi hydropower plant with the capacity of 100 kW in Nurobad (east of Tajikistan).

UN Development Program and Agro Action organization from Germany also financed construction of several small hydropower plants in Tajikistan.

The Government of Tajikistan represented by Barki Todzhik Company granted USD 2.4 million for construction of 3 smaller hydropower plants:

- Horma hydropower plant with the capacity of 360 kW Baldzhuvon (Hatlon);
- Todzh hydropower plant with the capacity of 500 kW in Shakhrinav (Central Tajikistan);
- Shirkent hydropower plant with the capacity of 700 kW in Tursunzoda city (Central Tajikistan).

A series of bilateral donors (Switzerland, Germany and Japan) supported construction of mini hydropower plants (mini-HPPs) in Tajikistan.

Ministry of Energy & Industry informed that since the beginning of 2009 43 new small hydropower plants were put into operation with capacity from 4 to 400 kW. Total number of small hydropower plants reached the amount of 190 and their total capacity is 14 MW. 96 of the hydropower plants mentioned above operate all year round, and 94 power plants operate only in autumn and winter periods of the year.

Turkmenistan presently together with the UN Development Program and Global Ecology Fund realizes the project of “Energy efficiency improvement in accommodation buildings of Turkmenistan” (2010-2015). Such a project has been realized in Turkmenistan for the first time. The project’s budget makes 46 million USD the most part of which is invested by the financial means of the national partners such as Turkmengas State Concern, hyakimlik of Ashgabad and the Ministry of Construction of Turkmenistan. The following organizations also take part in the activity on the project realization: NeftegazStroy State Concern, the Ministry of Energy and Industry, Ministry of Communal Service and Polytechnic Institute of Turkmenistan.

The project includes two main directions – taking into account of the principles of energy efficiency in the projecting (construction & service) process of accommodation buildings and rational energy consumption in accommodation buildings.

In the State Energy Institute with support of Ministry of Energy and Industry of Turkmenistan Educational Production Center is being formed currently. There they will conduct practical and laboratory work, research in the field of effective energy provision with using of non-traditional and renewable energy sources. The following measures have been planned – energy saving technologies development with the use of solar energy, wind energy, water energy and biofuel as well as of local sorts of fuel in complex with equipment of traditional energy sector (diesel power stations, gas turbine and other devices).

Turkmenistan's specialists believe solar and wind energy as the most promising alternative energy sources.

As it is known 80% of the territory of Turkmenistan are represented by deserts and mountains and about 10% of the population have got their settlement there. Desert zone's population is mainly provided with electricity from diesel generators with fuel for them being delivered by auto transport from the oasis zone. For a series of reasons this means of fuel transportation is not comfortable and always depends of weather conditions. However, in this case the mentioned solar energy may be of a great use there because any desert is rich in sun energy.

Natural climate conditions of Turkmenistan are very favorable for intense use of renewable energy. The sunshine duration in Turkmenistan makes 2768-3081 hours per a year and in other words the sunshine duration is almost all – season in this country. At the same time in sub Caspian zone the wind speed is enough high for stable work of wind power stations all year round. A great power potential is available in Turkmenistan which is better be used in desert and mountainous areas as well as in oasis zone including for hot water supply, provision of household electric devices, autonomous charge of radio phones of the road Police and security departments, outdoor and different signs lighting.

They have already built wasteless fully autonomous sheep-breeding helio-complexes for keeping of a thousand heads flock of sheep as well as for life activity of sheepmen's brigade. Complex wind-solar autonomous devices are able to provide with electricity during all year as well as provide with hot and drinking water allowing to keep a thousand heads flock of sheep. The main value of so complexes is that they can be constructed at any place in the desert.

In **Uzbekistan** in 1995 they adopted the **“Program of small-scale hydro power sector development”** determining stages of construction of small hydro power stations: 14 fast recoup stations of the sort (they will recoup with 10 years) and 127 prospective stations (recoup within more than 10 years). In 2004-2010 in the frame of realization of the Program they put into operation 4 small and middle scale hydro power plants with total capacity of 102,5 MW.

The Republic has implemented several projects financed by international organizations and financial institutions.

First practical steps in this direction were done by the Agency on technology transfer (ATT) in 2000. ATTs designed and produced first photo electrical systems based on amorphous silicon of 3 types which were located in a sheepmen's household of Nurabadskiy district of Samarkand region. Naraban's experience was used for realization of **the UNDP project of “Pure energy for rural districts of Karakalpakstan”** in 2003. The objective of the project was to demonstrate practical usage of photo electrical modules for autonomous electricity provision of by place farms of Karakalpakstan having deficit of electricity. Assemblage, installation and put into operation of 25 photo electrical stations of two kinds was carried out (1st type for daily living needs and 2nd type for water lifting from its underground sources). **With assistance of the project at Public Corporation of “Foton” they mastered production of photo electrical systems in the set of photo electrical panels, controller and lead battery.**

The project of Tacis EUZ9803 “Technological assistance in restructuring of heat supply system in Uzbekistan” (2002-2004).

In the frame of the project they carried out evaluation and review of potential on renewable energy sources on the results of demonstrational projects and conducted research works in the general frame of national policy and projects of the Republic of Uzbekistan.

UNDP Project of “Transfer of technology for local production of solar water heating panels” (2003-2004).

The project was realized by UNDP in cooperation with Hokimiyat of Tashkent city with financial support of the Government of Denmark and Scandinavian Trust Fund. Its aim is to assist production of solar panels in Uzbekistan by means of assisting local producers in their access to corresponding European technologies. In the framework of the project two local enterprises were granted European technology and equipment on production of solar water heating systems for provision with hot water supply and heating. Here they worked out the construction of solar panel adapted to local conditions and produced with using of local materials. They also started producing solar panels of new type. In general, about 300 m² (75 items) of solar panels were set at the sun testing field at the Boiler Station of “Vodnik”.

In 2005 in the frame of **the project financed by UNESCO, physical – Technical Institute of Academy of Science of Uzbekistan together with Institute of Nuclear Physics** developed, produced and activated autonomous complex photo electrical system of electricity supply and water cleaning at the by place tourism object of “Aiezkala-Tour” (Karakalpakstan). The capacity of the photoelectrical system of electricity supply and water cleaning is 300 W.

In 2006-2008 with support of UNDP they implemented the project of **Mechanism of Clean Development in Agriculture - №00049811 “Assistance to bio gas technologies development in Uzbekistan”**. The main purpose of the project is setting and controlling of pilot plant’s (Device) activity on using of bio gas energy on the base of the Farm of “MilkAgro” located in Tashkent region. Owing to construction of bio gas plant they reached partial substitution of natural gas energy with biogas energy for heating of farm greenhouses and other economy structures of the farm. Moreover, biogas plant (Device) allows to produce ecologically clean highly effective organic fertilizer which stimulates growth of agricultural cultures.

4. Analysis of demands and assessment of potential in application of the most advanced technologies in the countries of Central Asia

The Republic of Kazakhstan possesses high energy potential of renewable energy sources. For example, in applying 1-1.5% of incoming solar energy in the territory of the Republic, it is possible to produce (1.0-1.5)·10¹³ kWh per a year, which is equivalent to 1.2-1.8 billion tons of reference fuel without causing damage to the environment. Unfortunately, till present the share of solar, wind, thermal waters and biomass energy is insignificant and constitute 0.02% in the general energy consumption of Kazakhstan.

In the Republic of Kazakhstan, application of renewable energy sources has recently become a priority direction in development of energy saving, which consists in reducing energy intensity of the economy in the Republic. RES development in the country is conditioned by availability of significant potential of these sources, which makes this sector potentially productive and investment-attractive direction for development of energy sector in the Republic. Besides ecological advantages of RES application, there are significant economic benefits. RES application for power generation and supply to the existing energy networks is likely to be economically sound in the districts of Kazakhstan experiencing power shortages. Moreover, it is renewable energy, which will become a key factor for development of separate regions of the country.

The following types of renewable energy sources are the most potentially productive in the territory of Kazakhstan:

- wind energy;
- small hydropower stations;
- solar plants producing heat and electric energy .

In Kazakhstan, alternative energy forms can not be extensively used in Kazakhstan, as the Republic possesses reserves of natural fuel sufficient for many years to come. **It is the main obstacle for RES development.** Meanwhile, independent alternative systems can exist in separate regions of Kazakhstan.

According to the strategic plan for development of the Republic of Kazakhstan till 2020, the share of alternative energy sources in the total volume of energy consumption shall constitute 1.5% by 2015, and more than 3% - by 2020.

According to the State Program of Accelerated Industrial and Innovative Development of the Republic of Kazakhstan for 2010-2014, by 2015, it is planned to:

- put into operation **wind turbines** with installed capacity of 125 MW generating 400 million kWh of electric energy;
- put into operation **new small HPPs** with total installed capacity of more than 100 MW, which are expected to generate 300 million kWh of electricity;
- put into operation solar plants with total capacity of 91 MW.

Akimats in the regions and limited liability partnerships bear responsibility for implementation of the projects on RES implementation. Domestic and borrowed funds provided by the investors will be attracted for construction of power plants.

Moreover, the government will provide subsidies for wind-driven power plants installed by the farmers. Particularly, financial assistance will be rendered to the individuals, whose households are not connected to the energy system: 50% of the plant cost with capacity of up to 5 kW will be subsidized by means of the public funds. According to general estimates, there are 1,200 farm enterprises and distant pastures in the country, which are not connected to the energy networks.

Wind-power engineering. Almaty region (Zhungarian Gates, Shelek Corridor), Akmola (Ereimentau), Zhambyl (Kordai) and other regions are promising areas for wind-power engineering. The results of researches carried out within the framework of UNDP project on wind energy reflect that in several regions of Kazakhstan with total area of 50 thousand km² the

average annual wind speed is about 6 m/s. Therefore, these regions are very attractive for wind-power engineering development. Wind power resources of the Zhungarian Gates (17 thous. Kwh per 1 m²) are the most significant. Within the framework of program on wind-power engineering development till 2030, the sites were selected for construction of the following wind-power plants: Zhungarian wind power plant – 40MW; Shelek wind power plant – 140 MW; Saryozek wind power plant – 140 MW; Alakol wind power plant – 140 MW; Karoy wind power plant – 20 MW; Shengeldy wind power plant – 20 MW; Kurdai wind power plant – 20 MW. They will be able to generate about 1.8÷2 billion kWh of electricity per a year.

It should be emphasized that the experience of Kazakhstan in composing the wind map, the only one in the former Soviet Union territory, attracts interest of potential investors. The wind map is one of the most significant results of the joint project implemented by the Government of the Republic of Kazakhstan and the United Nations Development Program (UNDP) on wind energy.

Capacities of industrial scale will be introduced besides local low-capacity wind turbines. Particularly, project feasibility study for construction of wind power plants with capacity of 50 MW (with further extension up to 300 MW) in Shelek wind corridor of Almaty region is developed within the framework of agreement with the China Guangdong Nuclear Power Group. Several more wind power plants projects are more or less developed. According to the data submitted by the Global Environment Fund, the total capacity of wind power plants in Kazakhstan is likely to achieve 250 MW by 2015, and they will produce 750-900 million kWh per a year (0.6% of the annual electricity generation in the Republic of Kazakhstan). By 2030, these indices are likely to achieve 2000 MW and 5 billion kWh per a year, respectively (2.7% of the annual electric energy generation in the Republic of Kazakhstan).

In the Republic of Kazakhstan, the potential of applied complex energy systems with low capacity is estimated at the level of 5 million kW and creates fundamental basis for development of domestic power-plant engineering, using products of internal metallurgical industry, smoothes the problem of cost intensive network complex establishment.

The following directions of wind energy development are the most promising for the Republic of Kazakhstan:

- autonomous wind power complexes with low capacity of 2, 5, 10, 20, 100 kW for power supply to remote facilities;
- power generating complexes with medium capacity of 200÷800 kW for power supply to distributed loads in the territories with low density of population;
- power generating complexes with high capacity of 1600÷5000 kW for application in synchronized energy systems.

Solar energy. The potentially possible amount of solar energy generation is estimated at the level of 2.5 billion kWh per a year. Despite the fact that Kazakhstan is located in the northern hemisphere, the potential of solar radiation in the territory of the Republic is rather significant (it constitutes 1.3-1.8 thousand kWh/m² per a year, while the quantity of solar hours is 2.2÷3 thousand per a year). Solar energy can be extensively used on two thirds of the territory of the Republic of Kazakhstan (to the south from 50⁰ north latitude). Meanwhile, the solar energy can be applied for generation of electricity and heat, this fact conditions the possibility of point introduction of solar power plants, including the districts with distant location from central electricity and heat supply system.

In 2010, NAC Kazatomprom JSC, MC Kaz Silicon LLP and the French company CEIS entered into agreement on development of solar energy technologies and establishment of fully integrated industrial line for production of panels generating electric energy on the basis of solar photoelectric transducers in the Republic of Kazakhstan. Designed capacity of the enterprise producing such panels will constitute 60 MW with further increase up to 100 MW. Completion of construction and putting into operation is expected in 2013.

Moreover, NAC Kazatomprom LLP and the French company CEIS will keep cooperating in the scientific and research area and establish joint scientific and research laboratory for development of technologies related to renewable and alternative power generation.

Enterprises producing solar-grade silicon and photoelectric cells in Ust-Kamenogorsk and the enterprise producing photoelectric transducing modules in Astana are to be launched in the current year.

Hydro-power engineering. Kazakhstan is the third among the CIS countries after Russia and Tajikistan in the reserves of hydropower resources. The major hydropower resources are concentrated in eastern and south-eastern regions of the Republic. Technological potential of small HPPs constitute about 8 billion kWh. According to the results of analyses, at least 480 projects of small HPPs construction with total initial capacity of 1,868 MW (8,510 GW of annual average capacity) can be potentially implemented in the Republic.

The following rivers are the most promising for construction of large hydropower plants in the region: Ili, Charyn, Chilik, Karatal, Koksu, Tentek, Horgos, Talgar, Large and Small Almatinka, Usek, Aksu, Lepsy, Yrgaily.

According the State Program of Accelerated Industrial and Innovative Development of the Republic of Kazakhstan for 2010-2014, new small hydropower plants with total installed capacity of more than 100 MW, with expected amount of generated energy of 300 million kWh, are to be put into operation by 2015.

Biofuel energy. Kazakhstan has sufficient potential for satisfying domestic demand for energy and improving the quality of agricultural soils by means of processing farm animals' by-products in biogas plants for producing methane and high efficient liquid fertilizers. Kazakhstan is a large-scale producer of crops, which footstalks are used as biomass, more than 3 million tons thereof are produced every year. There is an actual possibility for construction of biomass processing plants, for decentralized production of heat and electricity thereof. 35 billion kWh of electricity and 44 million gigacalorie of heat energy can be produced by means of agricultural wastes processing.

Large-scale introduction of biogas technologies in agriculture contributed to resolving the issue of environmental protection and reduction of total methane emission to the atmosphere with simultaneous prevention of soil and underground waters pollution and had a significant and effective impact on poverty reduction among rural population.

Currently, the activity on biomass application carried out in the Republic is likely to be ecologically oriented. Wastes liquidation for improvement of ecological, sanitary and epidemiological conditions is more important compared to energy effect.

Kazakhstan is planning to implement joint projects with Korea and Germany in the nearest future.

Korean consortium of companies - Korea Electric Power Corporation и Samsung C&T Corporation- is planning to implement the largest in the CIS countries joint project in the area of power generation with the Ministry of industry and new technologies of Kazakhstan (MINT). According to preliminary estimations, investments in the amount of from USD 2.5 to 2.8 billion will be necessary for implementation of this project.

German corporate group Vestas is considering the possibility to invest about EUR 200 million for construction of wind power plants in Kazakhstan. Currently, it had developed business-plan for construction of wind power plants in the suburbs of Astana, in Ereimentau and Shelek corridor. Capacity of wind power plant is 500 MW.

KEGOC and Sqamruk-Energo can become potential partners of Kazakhstan. However, it is necessary to find a reliable purchaser for the electricity produced by wind power plants, for this purpose Vestas will have to carry out HR campaign and make the price for this energy very attractive.

Kyrgyz Republic. Currently, practical use of wind power plants potential is not significant and constitutes less than 1% in the energy balance of the country. The above

mentioned situation is connected with different facts and the major one is weak mechanism of economic stimulation in RES application. The Ministry of energy and industry is planning to increase the share of renewable energy sources up to 4% by 2025.

It is necessary to use wind power plants due to peculiarities of the natural landscape. Almost 90 % of the territory is covered by mountains. More than 60% of the population lives in rural districts of piedmont and mountain areas, where traditional fuel supply is very complicated. Under such conditions, application of local autonomous RES systems, which do not require connection to the existing energy system, is very profitable. Application of wind power plants and micro-HPPs for power supply to such consumers will be less cost-intensive. RES is the only one available opportunity to resolve energetic, social and economic problems of the population. Thus, application of solar heating systems will contribute to funds saving for purchase of traditional fuel and improving living conditions by means of hot water supply necessary for household needs. Application of biogas plants will allow the inhabitants of villages to produce inflammable gas and high efficient fertilizers improving yielding capacity of crops and population quality of life. Moreover, application of biomass plants, wind energy or micro-HPPs will contribute to creation of new jobs.

Solar energy. The indicators of sunshine duration are defines according to the data of 15 stations of the Kyrgyz Republic, the indicators of solar radiation – on the basis of the data submitted by 4 stations. Thus, the intensity of solar radiation can not be measured by means of tools in the major territory of Kyrgyzstan; meanwhile, the results can be achieved through calculations by means of indirect methods. Change of the solar radiation intensity is observed due to orientation of the territory of Kyrgyzstan in the latitudinal direction.

Meanwhile, mountainous relief, which covers 94% of the territory, and altitude, which varies form 800 to 4000 meters above the sea level, condition significant differences in intensity of solar energy received by the territory.

Technological annual potential of *solar heating systems* is likely to reach 1.7 million MJ under such conditions. Economic potential of such solar heating systems application is estimates at the level of 26 MJ per a year due to low quality of life and technological literacy of the population, as well as availability of such traditional energy sources as wood, coal and animal dung. Application of solar thermal collectors is the perspective method of reducing social strain, as huge potential of solar energy combined with rather low indices of investments and operational costs can cover 50% of demands for heat energy in the Republic in future. Introduction of different *solar power plants* (solar boilers, solar cookers, solar distillers, solar drying devices, etc.) is one of the potentially productive directions of RES development in Kyrgyzstan. That is why transformation of solar radiation into low potential heat for hot water supply can be efficient in insignificant territory of the Republic.

Wind energy. Wind energy potential is not equal in different regions of the Kyrgyz Republic. Average annual wind flow energy varies from 170 to 1300 kWh/m². Comparison of small facilities demand for electric energy with the data of wind cadaster indicates that the wind power potential is sufficient and can be successfully used to satisfy the need of such facilities in energy.

Gross annual *winter power potential* of Kyrgyzstan constitutes 2 billion kWh. Analysis of wind power peculiarities indicated that more than 50% of all winds in Kyrgyzstan are light breezes and windless conditions, 30-40% - gentle breezes (2-5m/s) and the rest part – moderate and fresh winds (6-10 m/s). Energy potential is not high on the significant part of plains and piedmont areas, where the majority of moderate consumers live. There are no consumers in the areas, where winds with high energy potential and the wind speed of 8-12 m/s dominate. Therefore, development of small-scale wind power engineering (wind power plants with capacity of 1-10 kW) is considered to be potentially productive and is primarily intended for power supply to separate not energy intensive autonomous consumers living in piedmont and mountainous areas.

Hydropower resources for small HPPs. Currently, technological water-power potential constitute 73 billion kWh. Economic strength of small-scale hydropower engineering of Kyrgyzstan exceeds the potential of all other renewable energy sources.

The following nine rivers possess highly concentrated reserves of hydropower resources: Naryn, Sary-Djaz, Kekemerren, Chatkal, Tar, Chu, Kara-Daria and Chon-Naryn, with average specific capacity ranging from 2,227 to 5,322 kW/km. About 90% of potential energy possessed by small water streams is concentrated in the upper and medium parts of river beds, where scattered consumption locations are concentrated. Construction of small HPPs, particularly in mountainous regions will provide sustainable development for small- and medium scale business in agriculture, industry, tourism, improvement of social and living conditions of the population engaged in the sphere of distant-pasture cattle tending, organization of seasonal agricultural products processing, production of construction materials.

Geothermal resources. Research of currently known geothermal sources reflects low-temperature character of thermal resources, i.e. not more than 60 °C. There are at least 20 well known geothermal sources, which energy can be primarily used for heating and hot water supply primarily to recreation zones of the Issyk-Kul region.

Technological capabilities of geothermal energy potential in explored sources constitute 170 GJ per year, or 27%. The potential of 22 GJ per year is economically sound. Low-potential sources of geothermal energy can be used for hot water supply and heating. For example, thermal source in Ak-Suu gorge can be use for heating of Kara-Kol town, as it is situated at a short distance – 10 km. The source has a stable temperature of 55°C all year round with water flow of 83 m³/h. Such thermal sources as Ysyk-Ata and Jergalan are very promising for application.

Biomass energy. Local biomass sources include biomass of agricultural cattle breeding and straw, their potential is estimated at the level of 9.732 thousand TJ per year. However, the share of their application is not significant and is usually restricted to heating of dwelling premises with dry animal dung (kysiak – pressed dung used as fuel).

Forest biomass is characterized by restricted potential, as only 4.32% of the territory of Kyrgyzstan is covered with forests. Forest biomass is not appropriate for power generation purposes due to seasonal reasons, geographic dispersion; the major share of biomass is located in poorly populated areas with undeveloped transportation infrastructure.

Calculated energy potential of agricultural and forest biomass, which is technically available for application, constitute more than 12.0 thousand TJ per a year.

Analysis of expert estimation reflected that the priority of RES technologies for Kyrgyzstan can be the following:

1. Biogas technologies: for agricultural regions development thereof is conditioned on the one part by availability of animal stock significant amount, and on the other part – actual lack of possibility to use traditional fuel (coal, gas).

2. Technologies and solar power plants: simple in operation and not cost-intensive, actually available for rural population: solar cookers, water boilers, solar drying devices, photoelectric transducers.

3. Small and micro-HPPs. Rural population see interdependence between implementation of projects on small HPPs and the government policy, which is able to raise funds necessary for construction of such plants and has specialists, who have enough experience for design and construction of small HPPs.

4. Technologies with passive use of solar energy for buildings heating are constantly in demand in the whole territory of the Republic. Insignificant interest to such technologies on the part of rural population is explained by their cost-intensity and complexity.

Wind and geothermal energy plants are least popular. According to the local experts, they are not competitive in the areas with rather high potential of their application. The results of capabilities evaluation indicate that RES potential is almost not used and integrated efforts of all

interested in this area parties is considered to be rather promising, thereby offering significant opportunities for resolving of important tasks very necessary for Kyrgyzstan.

Currently, heat supply by means of solar radiation and electric power supply on the basis of small water flows energy are the most technologically prepared for large-scale application in the Republic.

Republic of Tajikistan. Generally, the Republic suffers significant difficulties and deficit in the area of power engineering. Existing deficit of electricity and imposed restrictions on its consumption (particularly in winter period) are conditioned by poor water and energy resources of Nurek water storage reservoir, low tariff rates and availability of losses due to outdated basic facilities. This deficit is also connected with insufficient use of other energy carriers, high energy intensity of manufactured products and excess consumption of electricity by the population, high cost of fuel supply intended for heat energy generation, existing problems on export of excess energy.

Current shortage of electric energy in Tajikistan is also conditioned by restricted domestic financial capabilities of the country, high capital intensity of upgrading and construction of large HPPs, development and production of natural gas, coal, oil, generation of alternative energy, construction of transmission lines, as well as for the purposes of power export.

Tajikistan possesses a huge potential of renewable energy sources, which can frequently replace traditional sources. Such sources, besides water energy of small rivers, comprise solar energy. Solar energy can be effectively applied in the whole territory of Tajikistan. The country could satisfy the demands for energy by 10-20% by means of solar radiation.

Wind-driven power plants could successively compete with other sources of energy. RES can be applied in Tajikistan for power generation, water pumping, grain milling, etc. Agricultural wastes can be successively used for power supply in the valleys, particularly, in private farms, where agricultural production is well developed. The technology of solar, wind, small rivers and agricultural wastes energy application is very promising. According to the expert's estimates, the share of RES in the total power generation over the country is currently characterized as insignificant and constitutes less than 0.1%.

All experts associate the necessity of RES application primarily with of energy supply to the remote regions, energy safety, and afterwards with the problems of environmental protection and global climate change.

Solar energy. Solar energy application is very promising for Tajikistan. The total duration of sunshine constitute approximately 2,500-3,000 hours per a year. Minimum sunshine is characteristic of the high-mountain station Dehavz (2,097 hours) in the upper stream of the Zaravsgan River at the elevation of 2,500 m and the "Fedchenko Glacier" station at the elevation of 4,169 m (2,217 hours). The maximum duration of sunshine (more than 3,000 hours) is observed in the south of the Republic (weather station Pianj – 3,029 hours) and the Eastern Pamir (weather station Karakul – 3,166 hours). The estimates reflect that 60-80% of the population demand can be satisfied by means of solar energy during 10 months per a year. In conversion into reference fuel this volume will constitute about 400 thousand tons of reference fuel (t.r.f.), which is equivalent to 460 million cubic meters of gas and 528 thousand tons of black oil fuel.

Wind energy. The strongest winds are observed in the high-mountainous regions on the open areas (the Fedchenko Glacier, the Anzob Pass, etc.), and in the regions, where orographic factors contribute to increase of baric gradient (Hudjand, Faizabad, Shuroabad, Ishkashim, Murgab). In such regions, the average annual wind speed reaches 5–6 m/sec. On the open plains and in the vast valleys, the wind speed is a little slower and constitutes 3–4 m/sec, on the foothills – up to 3 m/sec, the wind speed of the closed depressions and the southern lowlands does not exceed 1–2 m/sec. The Faizabad mountain region, the Fergana valley, the Murgab depression and such mountain passes as Haburobad, Shahrstan and Anzob are expectedly the

most suitable territories for wind energy application. Under existing large scale application of hydro energy, use of wind energy can be profitable only in particular regions and in the facilities used as autonomous or additional energy sources with high capacity (1-50 kW).

Biogas. Only 0.5% of the total volume of biomass is used by people as food. Application of wood, dung and plant tops as bio fuel is of primary importance in the households. Approximately 50% of population in the world is provided with energy produced from these sources and the capacity of 300 GW. Technology of biogas production by means of anaerobic fermentation of farm animal wastes is the most appropriate and potentially productive among well-known methods applied in Tajikistan. Application of biogas plants is appropriate in the cattle and poultry farms, where demand for electric energy is combined with need in waste treatment. Biogas generators with low capacity have already put into operation in Tajikistan. Production of such generators is technically possible and reasonable under local conditions due to availability of necessary production base, engineering developments and experienced personnel.

Currently, there are 35 complexes and farms with animals exceeding 400 heads in the Republic. The technology of methane recuperation out of farm animal wastes shall be introduced for production of energy satisfying internal requirements of the households. This technology is potentially very productive in the rural areas with no access to natural gas.

Hydropower resources for small HPPs. Developed hydrological network of Tajikistan, which includes large and small rivers, provides reliable basis for application of hydropower resources, particularly in the mountainous regions of the Republic. Small HPPs (or micro- and mini-HPPs) with capacity of 1÷10,000 kW can be constructed based on the local resources. Potential of small-scale hydropower generation in Tajikistan constitute more than 18 billion kWh per a year.

Construction of more than 20 small HPPs is possible in Kalai-Humboskiy, Vanchskiy and Rushanskiy districts (the West Pamir). Central Tajikistan possesses favorable conditions for development of small-scale energy generation, construction of 100 micro- and mini-HPPs is possible here. Moreover, technical and economic estimates for construction of 14 potential small HPPs indicate that average annual energy output can constitute 348 million kWh. Application of small rivers energy can satisfy demands for energy in separate regions by 50-70% and more.

The following types of renewable energy sources are the most potentially productive Tajikistan: **small hydro power plants, solar power plants for generation of heat and electricity, wind-power engineering and biogas plants.**

Within the framework of the program “Efficient application of renewable energy sources in the Republic of Tajikistan for the purposes of sustainable development till 2020”, the share of applied alternative energy sources to the total volume of energy consumption will constitute: by 2015 – 32,850 kWh; by 2020 -104,000 kWh (annual output – 898.56 million kWh) or 5.54% of total energy output in the country.

Current economy of Tajikistan is characterized by high energy intensity, 2-3 times exceeding the share of energy intensity in the economy of developed countries. Besides territorial factor, the reasons for such situation is the structure of industrial production, which has been forming for a long period of time, increasing technological weakness of energy intensive industrial and public utility sectors, as well as undervalued energy resources preventing from stimulation of energy saving.

Energy policy, including the issues of policy implementation, in the area of energy efficiency improvement and renewable energy sources is carried out by the Ministry of energy and industry of the Republic of Tajikistan. The ministry’s activities in the area of supervision over fuel and energy complex improvement, as well as energy efficiency, energy saving and RES development comprise such authorized institutions and organizations as Open Joint-Stock Holding Company “Barki Tochik”, State Unitary Enterprise “Oil, gas and coal”, State Unitary Enterprise “Tajiktransgas” and institution “Gosenergonadzor” (“State Energy Supervision”).

Currently, the Republic of Turkmenistan possesses nearly completely developed regulatory and legal base in the area of energy saving and improvement of energy efficiency, the stage of practical implementation of targeted course has started. The above mentioned program on efficient application of hydro energy resources and energy efficiency for 2012-2016, which defines direction on implementation of program measures aimed at improvement of energy efficiency including specific features of separate industrial sectors.

Tajikistan is successful in developing cooperation in the area of energy generation with the countries of the Commonwealth of Independent States, the Eaurasian Economic Community, the European Union, the international Energy Agency, the countries of Central and South Asia, other international organizations and states.

In 2007, within the framework of Complex program on large-scale application of alternative energy, the Government of Tajikistan assigned the Academy of Sciences to establish **special center and engineering bureau for carrying out research and development with regard to technology solutions for generation of alternative energy**. Generally, this program is divided into several time-phased components:

Phase 1: Terms of implementation: 2007-2009; the amount of the state financing constitutes USD 87,000. Scientific researches in the area of drawing up a cadaster of alternative energy sources; analysis of energy efficiency taking into account geoclimatic conditions, development of new technique, materials and technologies for energy generation. Creation of data bank for alternative sources of energy is envisaged as well as international cooperation in the area of alternative energy.

Phase 2: Terms of implementation: 2010-2012; the amount of the state financing constitutes USD 290,000. Extension of scientific researches; manufacturing of pilot prototypes of highly efficient plants for energy generation; development of industrial base for production thereof; focus of human and technical capacity building.

Phase 3: Terms of implementation 2013-2015; the amount of the state financing constitutes USD 1,450,000. Extension of scientific researches; industrial production of highly efficient plants for alternative energy generation. The program is financed by 25.4% from the state budget. The remaining financing can be received from attracted foreign partners and private sector. The program is supervised by the Academy of Sciences. The main coordinator of the program is the Physical - Technical Institute named after S.U. Umarov under the Academy of Sciences of Tajikistan.

The Decree “On additional measures for economic application of energy and energy efficiency” was signed by the president on April 27, 2009. Under this Decree all heads of central and local authorities, organizations, institutions and enterprises, irrespective of the form of ownership are obliged to provide transfer to application of energy saving lamps till the end of 2009. Pursuant to this Decree, embargo imposed on import of incandescent lamps to the territory of the country has come into force in Tajikistan since October 1, 2009. This measure was taken for the soonest transfer of the country to effective energy consumption. The main objective is energy saving, deficit whereof Tajikistan incurs every year in winter period. According to the specialists’ estimates, transfer to energy saving lamps will save up 3.5 billion kWh per a year.

The Government of the Republic of Tajikistan was obliged to:

- develop and approve schedule of measures on construction and putting into operation large, medium and small power plants and reconstruction of existing hydropower plants, as well as combined heat and power plants for achievement of energy independence in the end of 2013;
- establish a competent commission composed of experienced specialists out of corresponding ministries and departments, as well as the representatives of executive authorities at the level of regions, cities and districts for the purpose of measures implementation for energy saving;
- develop and approve the program on effective use of energy resources for 2009-2015 for reducing losses of electricity, gas and water;

- take necessary measures on large-scale application of alternative and renewable energy sources.

Current energy consumption in the Republic of Tajikistan is characterized by complex structure. In the Republic, the share of manufacturing industry in the total consumption of fuel and energy resources constitute approximately 49.2% (without in-house load of a power plants and losses), 9% are accounted for construction and transport, 11% - agriculture and pumping irrigation and 26.1% - for public utility sector and the sector of services, 10.5% - other consumers. Meanwhile, the territorial structure of electricity consumption is not regular. The major objectives of energy saving policy carried out in the Republic are the following: effective use of energy with its production and consumption by means of dynamic introduction of energy saving and innovation technologies, as well as renewable energy sources. The population shall be actively involved in energy saving.

Meanwhile, the priorities in development of energy saving and efficiency are the following:

a) in industry:

- carrying out structural reconstruction of enterprises, renovation of major production facilities, introduction of advanced technologies and equipment, optimization of operating equipment production cycle intended for output of equally energy intensive high-tech and competitive products;

- determining potential of energy saving on all types thereof, revision of specific power requirements, rules and procedures of energy resources consumption per 1 unit of output products and provision of control over their observance, composing and periodic updating of energy performance certificates of enterprises;

- standard-setting for energy consumption and maximum energy losses, development of domestic energy base primarily by means of RES introduction, application of secondary energy resources and alternative types of fuel, use of efficient system of heat supply, lighting, ventilation, hot water supply;

- obligatory certification of energy consumption devices and equipment, organization of up-to-date staff metrology, equipping enterprises with devices of technical record-keeping and control at all stages of energy consumption, automated control over energy consumption regimes;

- stimulation of special-purpose business development in the area of energy efficiency, formation of economic agents implementing optimum scientific engineering, technological and production solutions, aimed at energy intensity reduction.

b) in agriculture:

- reducing energy intensity in the system of pumping irrigation through rehabilitation of existing water supply systems, construction of small, medium and small systems, water-intake stand-pipes private and crew-served on the basis of high-efficient power-generating equipment;

- application of multi-tariff system of energy accounting;

- observance of all current construction standards and requirements on building and communication lines insulation, ventilation and lightening design, temperature control in buildings, heating and boiling water systems;

- application of energy-saving and photodiode lamps, control electric drives;

- in-house generation of different types of energy by applying wind turbines, solar batteries, solar heating systems and hot water supply, production of bio gas and bio fuel.

c) in the public utilities sector and budget sphere:

- to approve the procedure of introduction of economic energy saving mechanism for state-financed organizations and standard form of energy service agreement, procedure of its conclusion and restrictions imposed on purchase of electric and heat energy for the institutions financed from the Republican and local budget;

- development of regulatory and legal framework for energy saving in the public sector

improving its investment attractiveness and interest of executors, as well as possibility of forwarding saved public funds for the purposes of further energy saving;

- carrying out energy audit, composing energy performance certificates of state-financed organizations, determining rates of energy consumption and potential of energy saving, establishment of energy saving management system in this sector without increasing staff size;

- upgrading and reconstruction of heating and hot water supply system, transfer to autonomous sources of thermal energy, putting into operation energy efficient equipment, transfer to less cost-intensive types of fuel and materials;

- installation of technically and commercially efficient metering devices, introduction of automation control systems of energy resources consumption, providing maintenance and carrying out metrological research of accounting systems, energy consumption supervision and management;

- promotion of achievements in the area of energy efficiency, carrying out information and analytical activity.

d) in the transport sector:

- improving efficiency of transportation system operation by means of upgrading motor vehicles fleet with reducing the rates of motor fuel consumption, improving the system of rate setting for energy resources and improving the system of motor vehicles fleet and transportation control;

- introduction of advanced high technologies and up-to-date equipment, optimization of technological process parameters by means of rational use of fuel and energy resources;

- improving the quality of contents and service of railway and automobile roads, route optimization for cargo and passenger transportations

- replacing of existing outdated power equipment for new energy saving one.

Republic of Turkmenistan. Energy strategy of Turkmenistan in the XXI century consisted in priority construction of large facilities applying organic fuel. Turkmenistan is the country producing energy carriers. Within the framework of the National Program on social and economic development of Turkmenistan for the period till 2030 power generation will significantly increase due to growth of domestic consumption and export. In 2030, power generation in Turkmenistan is expected to increase and reach 35.5 kWh.

In increasing export of its energy carriers to the world markets, Turkmenistan set a course for extensive introduction of advanced, energy saving and environmentally friendly technologies, having determined alternative energy as one of the priority directions in the development of the national fuel and energy complex.

In May 2007, the President of Turkmenistan instructed ministries and departments to study the best practices on application of ecologically friendly energy saving technologies based on use of renewable energy sources – sun and wind, which are inexhaustible resources in Turkmenistan. The Decree of President on establishment of the Sun scientific and research institute under the newly organized Academy of Sciences of Turkmenistan was a very significant step for intensification of scientific and technical investigations in this area, as well as increase in the efficiency of their results.

RES energy potential in Turkmenistan is estimated at the level of 100 tons of reference fuel per a year. **The sun and the wind** are the most promising RES.

Solar energy. About 300 shiny days are observed during the year, average annual intensity of solar radiation constitute about 700-800 W/m², which is equal to energy supply on the Earth surface with capacity of 2000 kWh/m² per a year. Annual average energy potential of solar energy is estimated at the level of 110 billion tons of reference fuel. Distribution of solar energy potential over the territory of Turkmenistan is considered regular due to its latitudinal location. However, in developing solar heat supply systems it is necessary to take into account temperature regime of the region, where the renewable energy generation facilities are located.

High temperature losses decrease efficiency of solar heat supply system due to low environmental temperatures in winter period, particularly in Dashkhovuz region (up to 20-28° C below zero).

Wind energy. Approximately 40% of the territory in the country is favorable for wind energy application. The wind regime is the most favorable in western and north-western regions of the country, where the dominant wind speed is more than 4 m/s. In the northern near-shore area of the Caspian Sea, the specific capacity of air flow is comparatively high and constitutes approximately 110-135 W/m². High level of wind energy potential is the characteristic of Balkans-Kopetdag Corridor, which is more than 150 W/m². The specific wind capacity of 100W/m² dominates in the central regions and up to the northern border. Generally, wind energy potential can be estimated at the level of approximately 5.5 billion tons of reference fuel. Wind energy generation with its up-to-date technical equipment is rather well developed sector of power generation.

Hydropower resources of the country are represented by such trans-border rivers as Amudaria, Murgab, Tedjen, Ertek and 20 small rivers flowing from northern slopes of the Kopetdag. The largest river is Amudaria, which provides 95% of water supply in the country. It flows on the plain territories of Turkmenistan at a distance of 1,000 km and construction of special-purpose dams there is reasonable. Construction of other hydropower plants on other rivers (Murgab, Tedjen, Atrek) is economically unreasonable due to their low water level. Construction of small hydro turbines with capacity of 0.5-2.0 kW for power supply to individual consumers is reasonable on small swift-slowning mountain rivers.

Geothermal energy. In Turkmenistan, the perspectives of thermal waters application are generally considered in three directions: for therapeutic purposes, as a source of chemical raw materials and in heat energy generation. The perspectives of profitable use of the subsurface heat are defined by the character of temperatures distribution at the depth of 3,000 m, which reflects peculiar geothermal regime in separate regions of Turkmenistan. There are regions corresponding to peculiar geotectonic elements, which are selected by the type of geothermal regime: Karakumskiy (ep-Hercynian platform), Kopetdagskiy (orogenic geosyncline) and Western-Turkmen (intermountain geosynclinal basin). Within the limits of these regions, the temperatures at the depth of 3,000 m are varying from 80 to 110°C.

In Turkmenistan, which is located among the deserts the climate is extremely continental. Shortage of fresh drinking water is very obvious in the Central Karakum due to insufficient amount of atmospheric precipitations and lack of surface waters. It causes significant problems for development of agriculture and stock breeding, for creating necessary conditions for people living in remote villages and settlements, as well as for infrastructure in general. According to the scientists, Turkmenistan possesses huge reserves of water resources (about 80 cubic meters), however, at a great depth. Water necessary for living and development of infrastructure of remote settlements shall be lifted through artesian wells. Meanwhile, diesel generators are widely used; they are operating on the organic fuel, which pollute environment and require additional expenses for their maintenance and transportation of fuel.

In view of the aforesaid, the problem of renewable energy sources application, primarily solar power plants for water supply, is very topical. Introduction of solar energy generation will generally contribute to sustainable economic development, small-scale business and creation of new jobs in the regions of Turkmenistan and assist in implementation of the National Program on development of desert territories of the Central Karakum, the National Plan on environmental protection.

The Sun Institute possesses several successfully implemented projects in this topical direction, including the projects on development and approbation of pilot plants. Taking into account solar and wind energy potential, as well as peculiarities of power, heat and water potential of the natural zones of the country, 80% whereof are covered with deserts and mountains, the research and engineering activity of the scientists in the institute are primarily focused *on satisfying the needs of population living and working at the distance from the*

industrial central regions. The activities are carried out in the sector of power supply, water pumping from pits and wells, heating, cooling, drying, cultivation of microalgae biomass, domestic and industrial wastes recovery for production of bio fuel and organic fertilizers, autonomous non-waste livestock management and cropping, creation of comfortable conditions for living. Among the achievements of scientists and specialists of the institute are non-waste autonomous wind and solar complexes with full life support system, universal solar drying device, solar distiller and solar heating module, unit for cultivation of microalgae in the solar photobioreactors, solar furnace for high-temperature researches, various designs of solar greenhouses, biogas production plant. Wind turbine for power supply to school operating on Gyzylysu Island in the Caspian Sea shows significant results. Practical value of such projects is obvious.

As mentioned above, although Turkmenistan produces enough electricity, part of its territory is occupied by the areas, where installation of power transmission lines is difficult. Local power generation by means of RESs is free from outage risks and does not require expenditures for cost-intensive equipment and its supply. In the areas where population has no access to electric power networks, renewable energy sources can provide faster power supply and with lower costs. Plants suggested by the scientists of Turkmenistan assist in resolving this issue, for example, on the remote pastures, oil and gas fields, on the islands and seacoast of the Caspian Sea providing local population with new jobs. Besides ecological cleanliness, energy saving technologies possess one more significant advantage – long time operation provided by almost inexhaustible reserves. Their complex application will be connected with desert zone development around the Turkmen Lake, implementation of the grand project on creation of the national tourist zone Avaza on the Caspian Sea coast.

The evidence of intensified mutually beneficial international cooperation in this direction with leading scientific centers of the world is implementation of joint projects with the scientists of Germany – acknowledged leader in the area of RES practical application. Among the first steps is **the project within the framework of Tempus program aimed at professional advancement and training of specialists** on the basis of the world known pioneer of solar equipment – Freiberg Mining Academy.

The specialists of the Ministry of energy and industry in cooperation with such consulting companies as Goetzpartners and Concentrix Solar (Germany) considered **the possibility and justified reasonability of construction of photoelectric solar power plants, as well as pilot construction project has been developed for construction of such power plant in the suburbs of the capital of Turkmenistan.** The analysis of the wind speed and energy efficiency carried out in cooperation with the specialists of Windtest on the basis of three weather stations (Kuli, Mayak (Light tower), Turkmenbashi and Balkanabad) indicated that the average wind speed in the region of Balkanabad at the elevation of 50 and 80 meters constitute 6.8m/s and 7.3 m/s, which corresponds to minimum speed **appropriate for application of wind turbines.**

The grant provided by the Islamic Development Bank was directed by the Sun Institute for **implementation of the project on research of silicon production capabilities from the sand of the Karakum Desert for the solar photoelectric transducers.**

New ways of cooperation in the area of clean technologies and practical implementation of advanced technological solutions in the area of RES were defined in the course of the forum held by Turkmenistan and Korea in November 2009 in the Academy of Sciences of Turkmenistan with participation of the scientists of the Korea Environmental Industry and Technology Institute.

Republic of Uzbekistan. The Republic of Uzbekistan is among few countries, which satisfies its domestic demands for energy resources to the full extent. Currently, significant reserves of traditional energy sources provide energy independence of the country. Uzbekistan possesses significant potential of renewable energy, three times exceeding the current national production volumes of all types of organic fuel. Climate and environmental conditions of

Uzbekistan provide significant opportunities for RES application. According to the estimates, gross RES potential constitute approximately 51 billion tons of reference fuel, technical potential - 179 million tons of reference fuel. Currently, only 0.6 million tons of reference fuel (0.3%) of technical potential has been developed by means of hydro energy application in the natural and artificial water reservoirs.

Gross potential of the *solar energy* is estimated at the level of 99.9% of the total RES potential, technical potential – 98.9%. Areal distribution of the solar energy in the territory of the Republic is not regular: the Republic of Karakalpakstan possesses the most significant potential (19,548 million tons of reference fuel), Andijan region possesses the lowest potential (129 million tons of reference fuel). Moreover, the Republic is rich in workable reserves of silicon, the major raw material for production of photoelectric plants. Development of silicon workable reserves and improvement of high-technology industrial photovoltaic production can become a good stimulus for large-scale development of solar energy generation in Uzbekistan.

Wind flows in the territory of Uzbekistan are seasonal due to its geographic position. According to the estimates the wind energy gross potential constitute 2.2 million tons of oil equivalent, technical potential – 0.4 million tons of oil equivalent. Areal distribution of the gross wind potential is rather irregular: the maximum volume – 924.7 thousand ton of oil equivalent is the characteristic of the territory of Karakalpakstan, the minimum volume – 4.3 thousand tons of oil equivalent are registered in Fergana region. Only few zones of Uzbekistan can be used for construction of up-to-date wind-driven generators. However, it is necessary to carry out detailed investigations of the wind speed at different altitudes in each particular case.

Energy potential of large rivers in the country, as well existing canals and water storage reservoirs, where 32 HPPs are constructed, is estimated at the level of 88.5 billion kWh (9.2 million tons of oil equivalent), including technical potential – 27.4 billion kWh (1.8 million tons of oil equivalent.) Currently, only 30% of the current potential are used.

Generally, the following plants are in demand in Uzbekistan:

- system small TB autonomous micro-HPPs in separate regions;
- wind-driven generators connected to poorly loaded energy system networks supplying power to remote districts;
- solar water heating units for hot water supply to domestic consumers;
- biogas plants for electric and thermal energy generation;
- combined wind and solar plants for low-capacity units in the districts of grassland farming.

Demonstration projects showed that application of wind energy and solar photocells is the most advantageous combination, when wind and solar energies replace each other. Calculations show that electric energy supply to remote rural settlements by means of construction of power transmission lines is 20-30 times more expensive than installation of photovoltaic systems (PVS). There are approximately *4,500 shepherdsman staying points and about 900 remote kishlaks* in the Republic, which cannot be provided with power and drinking water by means of traditional methods. In the current situation, the only alternative variant of improvement social conditions of life is putting into operation wind-driven/solar plants. Moreover, these plants can be used for water lifting and desalination thereof.

In Uzbekistan, application of biogas plants is considered as one of the potential and alternative sources, alongside with solar and small-scale hydroelectric energy, thermal energy and electricity in the rural regions and as efficient method of cattle breeding waste processing.

The significance of biogas sector in Uzbekistan is conditioned by the following circumstances:

- deficit of energy resources in agriculture due to their high value and irregular supplies;
- increase in the share of energy component in the production cost of agricultural products;
- growth of electric intensity of agriculture, expenses for fuel and energy;

- availability of unused raw material resources (dung, excrements, plant bypass) for production of biogas and perspectives of its application;
- negative impact of cattle breeding wastes on environment;
- reduction in the volume of mineral and chemical fertilizers due to their high price.

In Uzbekistan, the UNDP in cooperation with local partners have implemented several projects within the last few years, these projects are aimed at development of the RES technologies, as well as extension of RES application in the Republic of Uzbekistan.

In 2011, the economic investigations center prepared analytical report “Alternative sources of energy: possible application in Uzbekistan”, which contains expert assessment of energy balance of the Republic of Uzbekistan for the period till 2020, generalized rich international experience on introduction of alternative energy sources in brief for appraisal of capabilities of application thereof in Uzbekistan. The report contains general, technical and developed potential of alternative energy sources application in Uzbekistan, as well as measures for stimulation of alternative energy sources promotion. Draft law on application of renewable energy sources has been developed within the framework of this report. This law shall stimulate development of renewable energy with involvement of the public and private sector and increase the potential of the national and foreign investments.

In 2012, the grant in the amount of KGS 28 million was provided by the government for construction of photo power plants in several social facilities located in the remote regions of the Republic for continuous power supply within the framework of the program of the State Environmental Committee devoted to the Year of family. Currently, the works on construction of photo power plants are being completed in the medical center of Usmon Nosir shikrat (i.e. agricultural cooperative) in the Syrdaria region, the medical center of the Pastdagamskiy district, the Samarkand region. The works on construction of photo power plant were commenced in the facilities of the Surhondaria, Navoi and Kashdaria regions.

The Eco-energy scientific and implementation center is actively participating in the international projects on RES application and development.

In Uzbekistan, the UNDP in cooperation with local partners have implemented several projects within the last few years, these projects are aimed at development of the domestic market on renewable energy sources. The component connected with extension of RES application is included in **the UNDP project “Supporting Uzbekistan in the Transition to Low-Carbon National Economy”**.

Measures taken for introduction of new technologies on energy efficiency and energy saving. Currently, the issue of energy saving is becoming more significant in Uzbekistan. Its potential is highly appreciated in all branches of economy and public utilities sector.

“The current management system of energy consumption, as well as obsolete standards, rules and approaches to building construction do not take into account modern requirements to the full extent, stimulate insufficiently increase of energy efficiency and, as a result, contribute to excessive energy consumption and large volumes of greenhouse gas emissions to the atmosphere”, the analysts of the economic investigations center say.

According to the estimates, the implementation of the energy saving program in Uzbekistan will cost USD 34.6 million, including USD 25 million provided by the World Bank as a soft loan for implementation of the program on reduction of energy consumption in industry, and USD9.6 million will be provided by banks and industrial enterprises of Uzbekistan.

Uzbekistan, being the country, which possesses significant reserves of energy resources, has recently demonstrated rapid economic development. It is possible due to sustainable development of **electricity sector** – one of the major sectors of industry.

Enhancement of the energy sector efficiency, which provides power supply to rapidly developing national economy, is one of the most significant factors of improvements introduced in the economic and social spheres of our country. Meanwhile, a very significant legal basis is **the Decree of the President Islam Karimov “On priorities in the industrial development of**

the Republic of Uzbekistan in 2011-2015” dated December 15, 2010. According to this document, the industrial enterprises were to implement investment projects aimed at further development of energy potential of the country, to fulfill upgrading, technical and technological re-equipment of production, introduction of resource saving technologies, reliable and quality supply of electric and heat energy to the consumers.

Currently, the projects on construction of **energy saving combined cycle plants (CCP)** have been launched in Navoiiskaya, Talimarjanskaya and Tashkentskaya TPPs. Introduced CCPs will have high technical and economic indices; annual fuel saving per each TPP is expected in the volume of 360 million cubic meters.

Particular attention is paid to the issues of **upgrading the system of power metering with introduction of automated system of energy commercial accounting.** By 2015, installation of approximately 4.5 million of up-to-date electronic energy accounting devices, which shall provide energy saving is expected in the electrical networks of Uzbekenergo State Joint-Stock Company and with the consumers.

Generally, Uzbekenergo State Joint-Stock Company is to implement 44 investment projects to the amount of USD 5 billion 272.7 million by 2016. Moreover, 12 operating HPPs are planned to be upgraded by means of increasing their capacity by 55.8 MW till 2016, pilot wind turbine with capacity of 750 kW is to be built on the Charvakskiye water storage reservoir.

Recent researches indicate that about **half of the total energy consumption balance in Uzbekistan is accounted for buildings and constructions**, the degree of communications deterioration thereof results in increase of losses, energy consumption in these buildings 2-2.5 times exceeds corresponding indices of other countries. The total losses due to lack of measures taken for improvement of energy saving in the buildings constitute UD 2.115 billion, this fact is reflected in the results of researches conducted within the framework of the project “Green” buildings in Uzbekistan: technologies, standards and stimuli” implemented by the economic investigations center in association with the United Nations Development Program and the Global Environment Facility project “Improvement of energy efficiency in public buildings in Uzbekistan”.

The government is planning to reduce energy consumption in buildings by 25% due to **new energy efficient construction standards and rules.** New energy efficient standards comply with advanced international standards and their extensive application in Uzbekistan will contribute to saving about 200 thousand tons of fuel in oil equivalent per a year, which corresponds to more than 600 thousand tons of coal. This, in turn, will contribute to reducing of CO₂ emissions by more than 870 thousand tons per a year.

Measures on introduction of new energy saving technologies will contribute to large-scale production of energy saving materials thereby providing new jobs.

The line on production of energy saving wall panels, intended for construction of four-room cottages per one week has been put into operation at **Deutsche Kabel AG Tashkent plant in the course of new technologies development for energy saving and alternative energy generation.** The panels are manufactured from non-combustible and self-extinguishing (in case of fire outbreak) material. Energy consumption in such house decreases by approximately 35% and the cost of its construction is by 30% lower compared to the similar buildings made out of bricks. The equipment is being developed for the **premises heating systems operating on the basis of heat pump mechanism.**

However, according to some expects, the aggregate annual expenditures necessary for introduction of the “green” construction principles are less than the expected benefits. Meanwhile, the significance of introduction of the “green” construction principles is not taken into account, as well as perspectives of creation jobs in this sector (15 thousand jobs by 2020 and up to 120 thousand – by 2050). Moreover, additional benefits are very important, they can be achieved by means of development and extension of corresponding materials production, development of associated branches and creation of jobs in these sectors.

“The key problem conditioning persistently low level of energy efficiency and restraining introduction of “green” buildings **is lack of stimuli and efficient mechanisms for introduction and widespread distribution of the “green” construction principles.** Particularly, the current management system of energy consumption, as well as outdated standards, rules and approaches to building construction do not comply to the full extent with up-to-date requirements, insufficiently stimulate improvement of energy efficiency and, consequently, contribute to excessive energy consumption and significant greenhouse gas emissions into the atmosphere”, say the analysts from the economic investigations center.

Recently, the technologies of energy saving and application of renewable energy sources are widely used in Uzbekistan. The investment targeted program is implemented by the government; it envisages development of RES such as wind, solar, hydro energy, introduction of combined solar and thermal power plant

5. Analysis of instruments stimulating introduction of advanced technologies in the area of energy efficiency and renewable energy sources in the countries of Central Asia and detection of major obstacles

Republic of Kazakhstan. Currently, Kazakhstan is among ten energy wasteful countries of the world on energy consumption per 1 unit of GDP. 500 grams of fuel in oil equivalent are necessary for production of USD 1 of GDP; meanwhile, this index constitutes 130 grams in the countries-participants of the Organization for Economic Co-operation and Development. However, Kazakhstan possesses significant potential in the area of energy saving, according to the specialists, it constitutes 30% of the total level of energy consumption.

The Concept of the transition of the Republic of Kazakhstan to sustainable development for 2007-2024 envisages provision of sustainable economic development by means of supporting environmentally efficient power generation, including RES and recycled material application. The RES share is expected to constitute 5% in the total energy balance of the country by 2024.

In July 2009, the head of the state N. Nazarbayev signed the law of the Republic of Kazakhstan “On support rendering in application of renewable energy sources” and the law of the Republic of Kazakhstan “On introduction of amendments and additions into some legislative instruments of the Republic of Kazakhstan on the issues of support rendering in application of renewable energy sources”. Particularly, the law envisages provision of investment preferences for RES projects, priority of “clean” power application in the market and in its transmission through the network, as well as support rendered through the system of certificates being supervised by the government.

In November 2011, the Government of Kazakhstan approved complex plan in the area of energy saving, which will contribute to save up to KZT 200 billion per a year. Complex plan consists of 47 measures, including 25 intersectoral measures, 5 pilot projects, 24 measures for industry, power sector, thermal energy and public utilities sector. All national companies, state authorities, akimats of the regions, the cities of Almaty and Astana and the entities of the public utilities sector will be involved in implementation of the complex plan. Implementation of this plan will provide decrease of the GDP energy intensity by 10%, annual savings will constitute 16 billion kWh of electric energy, 10 kWh of electricity, 11 kcal of thermal energy, 7 million tons of coal and about KZT 200 billion.

Implementation of the complex plan will contribute to formation of a new system, which will improve upgraded industry with efficient production, develop and introduce new technologies of energy efficiency improvement, train new personnel and provide interaction of sciences and real sector of economy, form another attitude and perception of population towards rational use and efficient consumption of energy resources.

In December 2011, the Senate of the parliament of Kazakhstan approved the draft law “On energy saving and improvement of energy efficiency”. The law provides for development of regulatory and legal framework on the issues of energy saving and improvement of energy efficiency, as well as financing of measures from the budgets of all levels. Moreover, these documents regulate the rules of indentifying the competence of government authorities for implementation of upgrading of production, storage, transportation and consumption of energy carriers, carrying out control and supervision for efficient use of energy resources, determining responsibility for compliance with the provisions of law in the area of energy saving and energy efficiency. Moreover, the public energy sector shall be established under the law. Registered entities consuming more than 1.5 thousand tons of reference fuel per a year shall pass energy audit and based on the audit results draw up the plan of measures for energy saving and provide annual decrease in consumption of energy resources.

The Government of Kazakhstan is planning in the nearest future to review the issues on support of renewable energy sources:

- reservation and priority in providing land plots for construction of RES facilities; obligations of power transmission organizations on purchase of electricity generated by means of RES application;
- exemption of renewable energy sources from payment for network power transmission;
- support in connection of facilities applying renewable sources to the networks of power transmission organization.

Currently, increasing interest is observed on the part of domestic and foreign investors (primarily China and Germany), to the RES projects in Kazakhstan due to the key provisions approved within the framework of the Republican regulatory and legal base. However, the quantity of joint projects on RES is not significant in the territory of the country. The main driving force of cooperation in the area of RES at the international level remain separate representatives of business communities of Kazakhstan, Russia, PRC, the Ukraine, the USA, Germany and other countries. They independently advance new ideas and projects in different directions of RES development, i.e. production and equipment supply, consulting services, detailed engineering or inquiries.

Existing obstacles for investments in energy saving

- low level of tariff rates for electricity and central heating preventing from upgrading of station equipment and power supply network facilities, as well as construction of new stations and networks;
- lack of system providing special tax benefits to the entities, which introduce energy saving projects and measures;
- low qualification of the staff in the area of energy saving;
- lack of stimulus for introduction of energy saving measures and attraction of investments for improvement of energy efficiency in the public sector;
- lack of methods stimulating energy saving and financing schemes, which contribute to introduction of energy saving technologies;
- current legislative, regulatory and legal framework in the area of energy saving can not resolve the issues of energy efficiency improvement to the full extent;
- lack of energy service companies, demonstration zones of high energy efficiency;
- lack of energy saving funds;
- budgetary restrictions and withdrawal of enjoyed saving in the budgetary and tariff processes;
- information and motivation support of solutions development and implementation are often neglected;
- lack of personnel responsible for energy efficiency in the sectoral ministries, municipal bodies, institutions and enterprises;
- lack of experience and efficient mechanisms of borrowing attraction for implementation of investment projects;
- unstable character of contractual relations, lack of guarantees for obligations fulfillment on the part of consumers, non-repayment of implemented investments due to investment costs not involved in the tariff rates;
- poor awareness about energy efficiency among authorized people, who take decisions at the municipal level.

Kyrgyz Republic. Currently, energy intensity of the economy in the Republic generally remains at a high level. The experience of developed countries indicates that active government policy carried out for energy saving purposes can reduce energy intensity of the economy by several times.

Energy saving policy in the Republic is governed by the Laws of the Kyrgyz Republic “On energy”, “On electricity generation”, “On energy saving” and “On Buildings energy efficiency”.

The major principles of the government policy on energy saving in the Kyrgyz Republic were concentrated in the law “On energy saving” dated July 7, 1998, the law amended on December 24, 2008 envisages:

- priority of efficient application of fuel and energy resources;
- fulfillment of government supervision over efficient energy resources application;
- mandatory accounting of produced, received or consumed energy resources;
- involvement of energy efficiency indices into state standards for equipment, materials, constructions and transportation means;
- certification of fuel, energy consumption, energy saving and diagnostic equipment, materials, constructions, transportation means and energy resources.

The major disadvantages of this law are the following:

- ambiguous determining of principles of legal control in the area of energy saving;
- information on the facilities subjected to certification, standardization, control, energy expertise, metrological control and supervision is not clearly worded;

Besides:

- the law does not envisage the requirements of the procedures, terms, conditions of certification, standardization, control, energy expertise, metrological control and supervision;
- the facilities, where measures on energy saving should be observed, are not classified;
- there is no point on priority and hierarchy of regulatory and legal acts upon disputes occurrence and in decisions taking;
- there is to chapter on disputes and complaints settlement;
- the legal penalty for violations is not properly worded in the chapter on responsibility of the energy market entities, particular types of legal responsibility for violations are not specified, as well as prosecuting body.

The Law of the Kyrgyz Republic “On the buildings energy efficiency” was approved on July 26, 2011 for the purposes of improving energy efficiency law, this law establishes legal basis in the area of energy efficiency estimates and reduction of energy resources consumption in buildings and construction energy efficiency, moreover, it regulates legal and organizational relations between owners of buildings irrespective of the forms of ownership, between certified specialists and executive government authorities. The law was drafted by the specialists of the State Agency of Architecture and Construction under the principles of the Energy Performance of Buildings Directive (EPBD) with technical assistance of international advisers.

The Program on energy saving of the Kyrgyz Republic till 2015 has been developed and prepared for approval. The main objective of the Program is to contribute to GDP growth in 2015 without increase in consumption of fuel and energy resources by means of improving energy saving potential in production, transfer and consumption of energy resources. Moreover, it is necessary to improve the quality of life of the population, strengthen energy efficiency of the economy and diminish negative impact on the environment.

In the Kyrgyz Republic, energy saving potential is estimated at the level of 35-40% of the total domestic consumption of primary energy resources, or 1-1.14 million tons of oil equivalent as compared to the level of energy consumption in 2008. Among the priority tasks specified in the Program on energy saving in the Kyrgyz Republic for the period 2009-2015 are the following:

- to provide the process of energy saving in the country by 2015, the volume of saved energy – up to 840 tons of oil equivalent by means of quality organizational and managerial support;
- to provide the volume of energy saving of 450 thousand tons of oil equivalent by stimulating development and application of energy and gas efficient technical means, technologies and materials in the process of production and transition of energy and gas;

- to provide the volume of saved energy up to 700 thousand tons of oil equivalent by means structural reconstruction of economy.

Practical measures represented by the action plan with expected results upon implementation, responsible persons and terms of performance specified in it have been developed for achievement of aforementioned objectives and priorities.

Program implementation will be carried out with the government support within the framework of energy saving policy, which is widely used in the industrially developed countries and contributes to opening enough credit lines and attraction of direct investments.

Obstacles for RES introduction in Kyrgyzstan.

These obstacles are the following:

1. Till present, there was no practical requirement for RES application for several reasons, primarily, due to low value of energy produced by traditional methods as compared to the value of energy produced by means of RES application. Currently, the situation has changed significantly and increased need in such energy application can be expected.

2. The major amount of consumers is not ready to use new technologies and technical devices. Consequently, this obstacle should be overcome by means of methodological training, propaganda, explanations and bringing these technologies to a wide range of consumers, i.e. it is necessary to carry out large scale, within the framework of the whole Republic, trainings and explanatory activity.

3. In the initial period, the technologies applying RES require involvement of significant volumes of funds, particularly for arrangement of equipment production, which is unfortunately difficult to fulfill due to unstable economic situation in the Republic. Consequently, one should not say about significant advancement in RES application until the Government of the Kyrgyz Republic has raised sufficient funds and rendered substantial assistance.

4. Unfortunately, the today consumers (the major part of the population) are not morally ready to perception of RES technologies and they are economically illiterate. They are not able to understand that initial significant expenses for installation of devices will be justified in time and bring net profit.

5. Social and economic status of the Republic and the population's quality of life are very significant in large-scale RES application. Unfortunately, the major share of the population is currently solving the issues of surviving. It defines the priorities of need in food, accommodation, work, etc. Under such conditions, the issues of RES application are not top-priority.

6. Civilized and high-efficient promotion of new technologies is surely impossible without personnel highly qualified at the level of operation and experienced engineers. Consequently, such specialists should be trained in vocational schools, colleges and higher educational institutions, by means of postgraduate education and higher doctorate.

7. Unfortunately, there is no current appraisal system, as well as technical standard documentation enabling the industrial enterprises to produce new technical devices for RES application, and engineers to develop projects with involvement thereof (lack of technical conditions, state standards, construction rules and regulations, etc.). Consequently, such services shall be established and such issues shall be settled.

8. Fundamental and accurate investigation of the sales market is necessary, as it is a separate science with its own methods, mechanisms, etc. therefore, it is necessary to arrange operation in this direction.

9. Specialized enterprises on installation and service maintenance of RES systems should be established. All attempts on practical implementation of new technologies will be useless due to lack of such service maintenance.

Taking into account all aforementioned facts, the government takes active measures for support and promotion of renewable energy sources.

The regulation on the procedure of construction, acceptance and technological connection of small HPPs to the electrical networks was approved by Resolution of the Government of the Kyrgyz Republic № 476 dated July 28, 2009.

The program of energy saving of the Kyrgyz Republic envisages state support which is expressed in:

- stimulation of fuel and energy saving by means of carrying out appropriate focused policy;
- establishment of energy saving fund;
- creation of favorable conditions for the producers of energy generation equipment and materials;
- provision of benefits in the manner prescribed by the law in the process of crediting energy saving projects, as well as importing energy efficient equipment, devices and other technical means;
- stimulation of development and introduction of energy saving technologies and RES;
- development of international scientific and technical cooperation in training of specialists on efficient use of energy resources.

Republic of Tajikistan. Energy policy is based on the National strategy of development of the Republic of Tajikistan for the period till 2015 (NSD). It is based on the following principles: energy safety, energy efficiency of the economy, budgetary efficiency of energy sector, ecological safety of energy sector.

The major components of the state energy policy are the following: decrease of dependence on energy resources imported into the country, increase of power generation by means of renewable energy sources; maximum efficient use of natural fuel and energy resources and the potential of energy sector for economic growth and improvement of the population quality of life in the Republic; subsoil use and management of the state subsurface fund; development of domestic energy markets, formation of rational fuel and energy balance; regional energy policy; innovation, scientific and technical policy carried out in the energy sector; social policy in the energy sector and external energy policy.

Strategic guidelines in the long-term state energy policy of Tajikistan are the following:

- **the Law of the Republic of Tajikistan “On energy sector” dated November 29, 2000.**

The objective of this Law is to provide regulatory support to the government policy in the power generation sector of the Republic of Tajikistan of the basis market, institutional and information mechanisms for the purpose of ensuring its reliability and development, as well as protection of the energy consumers’ interests. The law defines the peculiarities of activity in the power generation sector and norms of established standards observance in production, transportation, processing and consumption of energy resources. The Parliament of the Republic approved the Law “On additions introduced into the Law on energy sector” on June 30, 2007 for the purpose of energy saving promotion and support rendered for introduction and application of alternative and renewable energy sources. Amendments were introduced into the law for stimulation of alternative energy sources application and providing for introduction of “green” tariff rate for sales of electricity generated by means of renewable energy sources application.

- **the Law of the Republic of Tajikistan “On energy saving” dated May 10, 2002** envisages public control in the area of energy saving, supervision over efficiency of energy resources, their accounting, economic and financial mechanisms of energy saving.

- **the Law of the Republic of Tajikistan “On allocation of renewable energy sources” dated January 7, 2010** regulates activity in the area of renewable energy sources, determines economic and arrangement measures aimed at stimulating production and application of renewable energy sources.

- **the Law of the Republic of Tajikistan “On investments” dated May 12, 2007** regulates relations connected with investment activity, legal and economic framework for

intensification, stimulation and government support of investments by means of providing reasonable equal legal regime and the security of the investors' rights in the territory of the Republic of Tajikistan.

The Law is aimed at attraction and efficient application of material and financial resources in the economy of the Republic of Tajikistan, as well as up-to-date equipment and advanced technologies, experience in management; provision of favorable conditions for investment activity, as well as conditions for free use, transparency, possession and direction of investment; compliance with the rules of international law and the best practice of investment cooperation.

Resolutions of the Government of the Republic of Tajikistan:

- № 73 “**On long-term program on construction of small HPPs cascade for 2009-2020**” dated February 2, 2009. The main objective of the program implementation is as follows:

- development of hydro power resources of small rivers and establishment of appropriate infrastructure;
- development of feasible study for construction of small HPPs;
- attraction of foreign and domestic investors for construction and reconstruction of small HPPs;

- determination of demand balance and electricity generation in remote hard-to-access settlements of the Republic.

- № 318 “**On approval of measures for implementation of priority projects in the energy sphere for 2003-2015**” dated August 3, 2002;

- № 280 “**On approval of measures on for implementation of priority projects in the energy sector of the Republic of Tajikistan for 2010-2015**” dated May 29, 2010.

This resolution envisages implementation of particular projects: HPPs construction, thermal power plants, rehabilitation and reconstruction of operating HPPs, construction and rehabilitation of power transmission lines of domestic and regional significance with specified volume of investments, as well as the sources of domestic and foreign investments. The total capacity of power plants being constructed and to be constructed ones constitute in the period 2010-2015 constitutes 3,670MW.

The following projects have been implemented within the framework of aforementioned resolutions:

- HPPs rehabilitation of the Vahshskiy and Varzobskiy cascades, the Kairakkumskiy HPP, Dushanbinskiy and Yavanskiy CHPP;

- completion of Sangtudinskiy HPP-1 (with capacity of 670 MW), Pamirskiy HPP-1 (with capacity of 28MW) and the first phase of Sangtudinskiy HPP-2;

- completion and putting into operation of 265 HPPs (with capacity of 21 MW), “Lolazor-Hatlon” and “South-North” power transmission lines (with capacity of 500kW) construction of “Tajikistan-Afghanistan” power transmission line for the purposes of integration of the energy systems in two countries.

The Resolution of the Government of the Republic of Tajikistan № 551 “On approval of the Program on efficient application of hydro power resources and energy saving for 2012-2016” dated November 2, 2011. This Program covers more precisely the major directions of hydro power resources efficient application in the Republic. The program envisages measures for implementation of plans and measures in the area of energy efficiency and energy saving, rational use of electricity and decrease of energy losses; the policy of the government is determined for achievement of energy independence, as well as efficient use of water and energy resources; investment attraction and encouragement for generation of ecologically friendly energy and introduction of energy saving devices and equipment on the basis of regulatory and legal acts, determination of ways for achievement of goals and major tasks.

The Program on application of renewable energy sources for 2007-2015 was approved by **Resolution of the Government of Tajikistan №41 dated February 2, 2007.** The program envisages works implemented in the following directions:

- development, establishment, research and introduction of promising systems for renewable energy sector;
- production of pilot renewable energy plants;
- establishment of manufacturing base for production of blocks and details for plants and renewable energy systems;
- training highly-qualified personnel in the area of renewable energy sector;
- carrying out trainings and consultations for the population of the country on large-scale and rational use of renewable energy plants.
- publication of books, brochures, advertising folders, information leaflets and instructions about renewable energy sources.

Taking into account the aforementioned, one can make a conclusion that the laws of the Republic of Tajikistan acknowledge the importance of energy efficiency and promotion of renewable energy sources application, necessary support is declared for business, scientific and technical activity in this area.

The results of the energy policy analysis indicate that the government has recently approved a lot of laws and programs related to energy efficiency and application of renewable energy sources. It has not significantly affected the development of energy efficiency on the basis of renewable energy sources due to availability of several factors preventing from its development.

The factors preventing from RES application and EE development in Tajikistan can be divided into three categories:

Legal and institutional obstacles:

- Underdeveloped legal and regulatory framework contributing to RES application;
- Underdeveloped legal and regulatory framework contributing to improvement of measures for provision of energy efficiency;
- Inconsistency of political measures with regard to the issues of energy sector and environment, i.e. the laws of environmental protection does not contribute to promotion of ecologically friendly alternatives of energy supply;
- Non-strict distribution of roles and functions of the public executive authorities in promotion of RES and EE issues; poor coordination between major interested parties;
- Insufficient potential for management at all levels (national and local).

Financial obstacles:

- Lack of internal and external investments: the companies of Tajikistan interested in RES development do not have enough funds and restricted access to financing of RES projects. Participation in foreign investments is restricted due to unstable business environment, unfavorable economic conditions, lack of appropriate legal and regulatory framework, as well as inefficient compliance with the requirements of the laws;
- Lack of long-term credits with acceptable conditions: commercial banks do not provide credits due to high risk of long-term investments pay-back; the government can not guarantee (tariff setting system) that all generated energy will be distributed at the fixed prices providing investments pay-back within reasonable terms. Moreover, financial institutions have no sufficient experience in carrying out financial analysis of investments in RES and EE area. Foreign long-term credits are not appropriate due to high risk perception on the part of the foreign commercial banks;
- Calculation of expenditures for investment project implementation should be carried out prior to funds provision (without any guarantees for receipt of funds necessary for project implementation). Lack of projects proving efficiency and profitability increases the cost of preparatory phase for such investment projects;
- Special equipment for RES application and EE provision are expensive and is usually imported, the prices remain high due to low demand;

- Lack of public financing mechanisms necessary for smoothing commercial risks related to RES and EE;
- Low market competitiveness in power generation by means of RES, for this purpose government support is necessary in the form of guarantees for repurchasing price set in compliance with regulatory and legal acts (tariff-setting system).

Obstacles in receipt of information, knowledge and experience:

- Lack of public awareness about technologies and application of RES and EE potential;
- Lack of public awareness about financial, social and ecological benefits from RES application;
- Lack of reliable information, useful for potential investors about possible location of significant and suitable for application RES potential (currently, there are only primary data about deposits with conditions potentially beneficial for RES application);
- Insufficient number of specialists in the area of RES and EE;
- Inconsistence of potential with capabilities of the domestic industry in provision with equipment and services in the area of RES and EE.

The approaches for achievement of goals and major tasks of investment attractiveness and encouragement of advance technologies involvement in the area of energy saving and renewable energy sources are the following:

- Amendments introduced into legislative documents, which envisage particular approaches in the area of stimulation and mechanism for implementation of investment projects on energy efficiency and RES, as well as determining authorized institutions responsible for coordination of investment activity in the area of EE and RES;
- Approval of the targeted State program developed for and contributing to implementation of investment projects in the area of EE and RES will assist financial institutions in acquiring experience of assessment and financing the projects in the area of energy efficiency and renewable energy sources, the later, in turn, will contribute to service rendering to clients and stand out among other market participants;
- Development and upgrading mechanisms and instruments for economic stimulation, which, in the process of production and service rendering, provide energy saving and efficient energy consumption;
- Phased increase of tariff rates for electricity.

Amendments introduced into the Law “On electricity” approved in 2007, according to which electricity generated by means of RES shall be signed off to the natural monopolies (electrical networks) at the price set by the bodies authorized to control the activity thereof, are considered to be a significant step towards consolidation of complete and favorable legal framework for RES application. However, a lot of things should be done in order to provide fulfillment of aforementioned steps. The most perspective method is providing compliance with recently approved Law “On renewable energy sources”, besides execution of appropriate resolutions, thereby creating transparent conditions for construction and operation of RES facilities, as well as simultaneous attraction of necessary financial support for compensation of high price for electricity generated by small HPPs (compared with the current average production cost in the Barki Tochik system).

It is necessary to emphasize that the Law “On renewable energy sources” approved in January 2010 creates general frameworks for RES application in Tajikistan, however, it requires development of several resolutions and by-laws contributing to operation and monitoring of RES plants in Tajikistan. This law envisages a lot of regulatory and legal acts. It is necessary to emphasize that the quantity of regulations can become additional obstacle preventing from further development. The investors are likely to review a great number of documents in order to understand their liabilities if they are interested in project implementation and power generation by means of RES application.

Experience of developed countries indicates that one of the major conditions for economic growth is introduction of energy saving management system, which will contribute to optimization of energy consumption and will increase reliability of energy supply. For this purpose the aforementioned legislative acts envisage carrying out energy overview, analysis of the power and heat supply system, assessment of energy carriers accounting systems and equipment (devices) and their compliance with established requirement, detection of unreasonable losses, assessment of the system of energy consumption rating and application of energy carriers. Such measures also comprise: monitoring of the energy balance at the enterprises, calculation of specific energy consumption for manufactured products, drawing up the enterprise performance certificate, imposing prohibition on use of incandescent lamps with capacity of 100 MW and more in the territory of the country.

Republic of Turkmenistan. Turkmenistan is the only one country in the world, where, for the purposes of social protection of the population, the President approved the Decree dated 1993 on free supply of electricity, gas and water to the population, in 2006, this social benefit was extended till 2030 in compliance with the Decree of the President of Turkmenistan.

Tariff rates for electricity are so small that they do not require attraction of investments into any projects in the area of energy efficiency, there is no motivation for energy saving, although this fact is mentioned at the government level. Consequently, there is no demand for energy saving equipment. Nevertheless, the government is going to develop legislative and institutional framework, along with economic incentives, and carry out informative campaign among the population.

The government can take into account the fact that measures for EE improvement could save up billions of cubic meters of the natural gas, which can be exported. Ecologically friendly energy sector require EE improvement and saving measures, as well as development of renewable energy sources.

Currently, the existing regulatory and legal framework for energy saving in the country has not been properly developed and it is not characterized by direct targeted action, therefore the later should be revised or additional by-laws shall be developed. This is necessary to develop the national program on energy saving, which will determine the major strategic tasks, for example, annual decrease of GDP energy intensity by 3-5%, achievement of target indices for energy efficiency in different sectors of economy.

The law on energy saving aimed at encouragement of energy saving and development of renewable energy sector shall be the legal basis for introduction of efficient measures for energy saving. Tax advantages for investments into RES and exemption from import duties imposed on the equipment for RES can be envisaged in the law for stimulation of RES introduction in the energy balance of the country. It is reasonable to include in the national program on energy efficiency the key indices for RES introduction, for example RES increase by 1-2% in the balance of the country within the period of five years.

Thus, lack of institutional and legislative framework, as well as significant subsidies for electricity and natural gas **are the major obstacle** for any measures for improvement of energy efficiency and introduction of renewable energy sources.

The public fund of energy efficiency, financed by means by means of profit received from export of saved gas as a result of measures on energy saving, can be used for investment of measures on energy efficiency and RES development.

Operative institutional mechanisms are essential condition for implementation of effective measures and strategies in the area of energy efficiency. With this regard, it is necessary to establish national authority in Turkmenistan, which will be responsible for carrying out public policy in the area of energy resources efficient use and energy saving.

For a short-term period its priority tasks can include:

- Establishment and operation of the integrated system for standardizing specific consumption of energy resources in different sectors of economy;

- establishment of monitoring system for energy carriers consumption, improvement of accounting and control system for consumption of energy resources;
- development of measures for energy efficiency and monitoring of implementation thereof;
- provision of renewable energy sources share in the energy balance of the country.

Republic of Uzbekistan. The Government of the Republic of Uzbekistan properly assesses the situation in the area of alternative technologies introduction.

The regulatory framework in the area of foreign investments attraction to the Republic of Uzbekistan comprises:

- Law “On foreign investments”;
- Law “On investment activity”;
- Law “On guarantees and measures for protecting the rights of foreign investors”;
- as well as several regulatory and legal acts approved in the form of decisions of the President of the Republic of Uzbekistan and resolutions of the government.

For the purposes of rational energy consumption the Government of the Republic of Uzbekistan provides legal entities and individuals the following benefits:

- financing the national, sectoral and regional purpose-oriented programs on rational energy consumption by means of the public soft credit;
- financing intersectoral scientific, research, design and engineering operations for production of pilot batches of energy efficient equipment;
- customs duties and taxes imposed on imported equipment, devices and materials, application whereof can significantly improve efficiency of energy consumption.

The Decree of the President “On additional measures stimulating attraction of direct foreign investments” dated April 10, 2012 envisages additional guarantees and preferences for the investors.

Particularly, newly established enterprises with direct foreign investments (DFI) and the foreign investor’s deposit in the amount not less than USD 5 million **have gained the right for 10-year delay for transition to new tax regimes.** In other words, in case of amendments introduced into the laws affecting the issues of calculation and payment of taxes on profit, property, capital improvement and development of social infrastructure, VAT (value added tax), USP (unified social payment), UTP (unified tax payment) and mandatory deductions to the Republican Public Children’s Fund and the Fund for reconstruction, overhaul and equipping of educational and public health institutions, business entity shall be entitled to pay taxes according to the rules current at the moment of the entity registration.

Within the framework of investment projects with the value of more than USD 50 million and the foreign investor’s share not exceeding 50%, **construction of any electrical and pumping networks beyond the production site will be fulfilled at the expense of budgetary funds and other domestic sources of financing.**

The state tender board **was entitled to sell low-liquid facilities from the balance of the government authorities in places at a zero repurchase price without holding a competitive tender for establishment of enterprises with DFI** – by means of entering into direct agreements with the investor with particular investment obligations.

The Decree of the President envisages other benefits and guarantees, which are currently distributed among 20 sectors of economy; the territorial aspect of their application is extended significantly.

Within the framework of the President of the Republic of Uzbekistan executive order № P-3902 dated September 5, 2012 “On creation of the Working group for development of the Program on promotion of alternative energy sources” the working group was assigned to develop the Program on promotion of alternative energy sources for 2013-2017.

The objective of this document is to develop offers related to introduction of amendments into the legislative, regulatory and legal framework, which provide for conditions and additional incentives for business entities implementing projects on application of alternative energy sources and related production processes, as well as development of particular measures:

- for extensive application of alternative energy sources in order to provide sustainable development of sectors and spheres of economy, to improve their efficiency and competitiveness in the middle- and long-term perspective;
- for the most rational and targeted application of non-renewable fuel and energy resources.

The Ministry of Energy of Uzbekistan, the Academy of Sciences and Uzbekenergo State Joint-Stock Company will complete development of the draft law “On alternative energy sources” till the end of June of the current year. The main provisions and articles of the draft law will contribute to profound scientific and experimental researches in the area of alternative energy sources, application of alternative energy sources in practice in conditions of Uzbekistan, as well as domestic production of up-to-date equipment and advanced technologies for this sphere and rational consumption and saving of fuel and energy resources.

Conceptual provisions and directions of development and application of renewable energy sources for electric and thermal energy generation in Uzbekistan for long-term prospective were developed by Uzbekenergo SJSC with involvement of the specialists of the Institute for Energy and Automation under the Academy of Sciences of the Republic of Uzbekistan for the purposes of further advancement of the issues on RES development and application in the Republic.

On March 1, 2013, the President of the Republic of Uzbekistan signed **the Decree “On measures for further development of alternative energy sources”**.

This document is directed for further studies and pilot commercial developments in the area of alternative energy sources at the higher technical and scientific level, for practical application taking into account the best practices, separate decisions on application of alternative energy sources in Uzbekistan, as well as arrangement of domestic production of up-to-date equipment and advanced technologies for this sector.

The Decree approved the suggestion of the Ministry of Economy, the Ministry of Finance, the Academy of Sciences and Uzbekenergo SJSC on establishment of **the International Institute of Solar Energy** in Tashkent with participation of the Asian Development Bank and other international financial institutions on the basis of Research-and-Production Union “Physics-Sun” of the Academy of Sciences. The major objectives and directions of activity are as follows:

- implementation of high-technology solutions in the area of solar energy industrial application;
- development of suggestions for practical use of solar energy potential in different sectors of economy and social sphere on the basis of advanced and economically efficient technologies;
- carrying out applied researches connected with application of the solar energy in different sectors of economy, including the technologies of the special material synthesis and thermal treatment;
- coordination of works on elaborating documentation for particular projects in the area of solar energy.

It is specified in the decree that Uzbekenergo and Suntech Power (PRC) have reached agreements of establishing in Navoi free industrial and economic zone joint venture for production of photovoltaic panels with capacity of 100 MW on the basis of advanced technologies equal-shared financing of project documents and putting into operation the first phase with capacity of 50 MW in October of the current and reaching project capacity by 2015. Meanwhile, particular attention shall be paid to profound analysis of demand and the sales market for the products manufactured at the enterprise.

The Decree also approved the offer of the Ministry of Energy, Ministry of Finance and Uzbekenergo about implementation of the project on construction of the solar photovoltaic plant with capacity of 100 MW in the Samarkand region with attraction of the soft credit provided by the Asian Development Bank and the monetary funds provided by the Fund for Reconstruction and Development of Uzbekistan. Hokimiyat (city council) of the Samarkand region was assigned to perform allocation of land for Uzbekenergo in order to arrange construction site and power plant.

Moreover, the Cabinet of Ministers together the Ministry of Economy, the Ministry of Foreign Economic Relations, Investments and Trade, the Ministry of Finance, the Council of Ministers of the Republic of Karakalpakstan, hokimiyats of regions and cities in Tashkent, as well as other interested ministries, departments and business complexes were assigned to **develop and approve the list of experimental and pilot projects of application of solar and biogas energy**, with involvement of funds provided for these purposes by the ADB and other financial institutions.

The Ministry of Finance and the Ministry of Economy with participation of international experts were assigned to submit proposals at the meeting of the Cabinet of Ministers on **encouragement of producers and consumers of solar and biogas energy, as well as submission tax and customs benefits, taking into accounts the international experience.**

The Ministry of Economy, the Academy of Sciences and Uzbekenergo with interested ministries and departments were assigned to introduce the **draft law “On alternative energy sources”** in the first half-year.

The association “Enterprises of alternative fuel and energy” developed: the project **“Concepts of the Republic of Uzbekistan on development of alternative fuel and energy for 2012-2020” and the State program “Perspectives of sector development on alternative energy sources and fuel for 2013-2020”.**

On February 22, 2012, the association invited a tender for selection of projects on development and application of alternative energy sources in Uzbekistan for rendering assistance in financing thereof within the framework of international and government grants. The list of projects recommended for inclusion into the composite plan of investment project of the Republic of Uzbekistan for 2012-2015:

- Composing a map of wind energy resources of Samarkand region. The value of the project is UZS 150 million. Samarkand State University named after A. Navoi;
- Construction of biogas complex for utilization of the poultry farm brood intended for 30 thousand of laying hens and production of alternative fuel and ecologically clean fertilizers. The value of the project is USD 142.114,00. Smart Biogaz LLC and EKORAVNAQ LLC;
- Construction of biogas complex for utilization of the farm dung intended for 1,000 of cattle heads and production of alternative fuel and ecologically clean fertilizers. The value of the project is USD 629.980,00. Smart Biogaz LLC and EKORAVNAQ LLC;
- Development of pilot sample, field tests and preparation of batch production of controllers with capacity of 10 kW for photovoltaic stations adjusted to the climate conditions of Central Asia. The value of the project is UZS 3 million. Mir-Solar LLC, Tashkent;
- Training complex for mastering physicotchnical basic principles in the area of development and application of renewable alternative energy sources. The value of the project is USD 30.000,00. The Tashkent State Pedagogical Institute named after Nisami;
- Autonomous solar power plant and photodiode lamps for night street lighting. The value of the project is USD 30.000,00. ATETM LLC – The center of communication technology and clean energy, Tashkent;
- Research of quantum-size effects in the foams of silicon and gallium-arsenide with multi-component nanocrystals. The department of nanotechnologies of the Tashkent State Technical University;

- Design and production of autonomous solar power plant for water pumping. The value of the project is UZS 68,623,950. The department of electronics and micro-electronics of the Tashkent State Technical University.

Obstacles in the area of EE and RES and recommendations for overcoming thereof. Deficit of hydrocarbon materials and rise in prices for it conditioned the upward trend in the application of alternative energy sources in the developed and in many developing countries of the world. Developed strategies set an objective to achieve the share of such sources at the level of 18-20% by 2020. **The major obstacle for large-scale application of alternative energy sources is their low economical efficiency compared to traditional ones.** However, many experts reasonably emphasize the trend of rapid elimination of gap between production cost of traditional and alternative sources of energy.

The economy of Uzbekistan is very energy intensive in accordance with the international standards. This is conditioned by application of technologically outdated equipment, significant share of fuel and energy resources in production of goods, in the export of the country, by comparatively low prices for electricity and some types of fuel. **Low energy efficiency and low energy saving in all sectors of economy is primarily connected with low price for energy resources** (prices for natural gas and electricity are one of the lowest in the world).

The tariff system existing in the country and lack of appropriate legislative framework in the area of renewable energy sources **do not contribute RES investment.** Application of renewable energy sources is a competitive traditional energy sources in the remote regions of the Republic with lack of adequate energy infrastructure.

There is significant **deficit of the specialists in the area of engineering development and science**, who are able to resolve organizational and technical, ecological and economic issues related to renewable energy sources (RES) application, including the problems of biogas technologies introduction. The group of factors contributing to formation of more independent energy policy in the countries of Central Asia includes optimistic forecasts for the social and economic situation in the region, primarily in Kazakhstan.

Kyrgyzstan and Tajikistan are considered the poorest countries in the region: according to the latest data, about 50% of the population are below the poverty line in each of these countries. Systemic crisis as a significant negative impact in the Republics, it is characterized by profound decline in all sectors of economy. In these countries, the problem of decline in all sectors of economy is aggravated by insignificant growth of GDP, slow inflation rates, 24.5 and 20.4% respectively. Meanwhile, Tajikistan imports from Kazakhstan more than 90% of all milling wheat and flour and about 40% of oil products.

Controllability of the national economy of Uzbekistan is based on the real sector and, consequently, weak interaction with speculative capital, generally, allowed Uzbekistan to avoid the most negative manifestations of the world financial crisis. However, the crisis occurred in the consumers market, which manifested itself in reduction of the consumer demand solvency. In 2009, the major event occurred in Turkmenistan was denomination of the national currency which was caused by necessity to increase the efficiency of currency circulation in the economy of the country.

Possible instruments stimulating introduction of advanced technologies in the area of energy efficiency and renewable energy sources in the countries of Central Asia:

– *Strengthening environmental legislation.* The emissions of mercury and heavy metals are not controlled on TPPs of Kazakhstan and Uzbekistan, such supervision procedure exists in the developed countries. Carrying out of such control will improve ecological situation, health of people and will make hydrocarbon materials less competitive compared to RES. Necessity in large-scale involvement of renewable energy sources into the energy balance, which is an environmentally clean process, is dictated by decreased technological impact on the environment.

– *Improvement of the social living conditions of the population.* Some settlements located in the desert and mountainous areas are provided with electricity generally by means of

autonomous diesel generators. It requires supply of significant volumes of diesel fuel to the remote regions, the price for this fuel as well as transportation services are constantly increasing, which is very burdensome for many inhabitants.

The only one alternative method for improvement of social living conditions is introduction of solar, wind or biogas plants. Such plants can be used for purposes of lightening, TV, radio for water pumping, heating and cooking.

Due to increase in production cost of primary energy carriers (geological exploration, production and supply) on the one part, and development of RES technologies on the other part, this energy is becoming competitive.

– *Application of “green” certificates system as the instruments for accounting and monitoring of production and consumption of electricity on the basis of RES and efficient mechanism for support of RES application.* Energy producers on the basis of renewable energy sources receive “green” certificates confirming that they have produced and sold particular volume of renewable (“green”) energy.

– *Legislative support of RES application.* These are targeted public programs; grants for RES projects implementation; investment subsidies; particular tariff rates for RES; customs benefits; credit, tax and sales benefits.

6. Conclusions and recommendations on promotion of advanced technologies introduction in the area of energy saving and renewable energy sources in the countries of Central Asia

The issues of provision with energy resources are high priority for any country, the level of its development and potential capabilities indicate the economic strength of the country. Central Asia is among the richest in energy resources regions in the world. All the countries of this region are currently suffering political and economic transformations, which have a significant impact on the situation in the country and international relations both in the region and with other countries.

The analysis of the dynamics of energy resources self-sufficiency in the countries of Central Asia reflected that only Kazakhstan, Turkmenistan and Uzbekistan are energetically independent. The volume of energy resources in Kyrgyzstan and Tajikistan is not sufficient.

The countries of Central Asia possess significant reserves of water and energy resources, which are characterized by irregular distribution on the territory of these states.

The results of analysis carried out for determining the energy resources potential in the countries of Central Asia reflected significant issues, which require collective efforts of all the states of the region:

- integration of water and energy resources, as unified power system had been operating in the region for many years, where hydropower energy of Kyrgyzstan and Tajikistan took the dominant position, while Turkmenistan and Uzbekistan were the major suppliers of gas;
- cooperation in the environment area. Due to the extensive exploitation the ability of environment reproduction was significantly undermined;
- rational and efficient consumption of water in transboundary rivers.

Complex settlement of these issues will define social, economic and ecological well-being of the countries in Central Asia. Moreover, the region possesses significant reserves of renewable energy; introduction thereof into the energy balance is surely to become significant contribution into sustainable economic development, stability of energy market and provision of favorable ecological conditions. In many Republics the trend of RES application is in the stage of the National programs development.

Republic of Kazakhstan. The following RES types are the most promising for the territory of Kazakhstan:

- wind-power engineering;
 - small HPPs;
 - solar plants for generation of heat and electricity;
- Promising directions for development of wind-power engineering are as follows:
- Autonomous wind power complexes with low capacity of 2, 5, 10, 20, 100 kW for power supply to remote facilities;
 - Power generating complexes with medium capacity of 200 – 800 kW for power supply to distributed loads in the territories with low density of population;
 - Power generating complexes with high capacity of 1600÷5000 kW for application in synchronized energy systems.

It is necessary to continue considering the issues on:

- **Creating** favorable conditions for construction and putting into operation the facilities applying renewable energy sources;

- **Provision** with investment preferences for construction and putting into operation the facilities applying renewable energy sources;
- **Creating** favorable conditions for efficient integration of the facilities applying renewable energy sources into the unified power system and the electricity market of the Republic of Kazakhstan.

Meanwhile, new facilities applying renewable energy sources should be connected to the nearest point of electrical networks of the power transmission organization corresponding to the appropriate voltage class. Power transmission company provides free and non-discriminating determination of the nearest point of electrical networks corresponding to the voltage class and connection of the facilities applying renewable energy sources.

In case of restricted network transfer capacity of the power transmission organizations, the priority is given to power transmission carried out by qualified power generating organization.

In case of dispatching control over electrical capacity, the dominance is given to power generating facilities applying renewable energy sources.

Kyrgyz Republic. The Kyrgyz Republic is among the countries possessing huge potential of renewable energy. First of all, it is the solar, water streams wind and biogas energy. According to the experts, RES can satisfy 50% of the county's demand for fuel and energy resources.

RES palpation shall be considered as the most promising in the remote mountainous and rural districts, which have centralized power supply: farms and cattle breeding complexes, mining enterprises, road services, tourism an ecological facilities, pumping stations, the facilities of the forest and hunting farms, etc.; dwelling houses, social amenities, the facilities of culture and sport, sales outlets, health-related institutions, etc.

Analysis of expert estimates showed that the priority of RES technologies for Kyrgyzstan can be presented in the following way:

1. Biogas technologies: the development thereof in the rural region is conditioned primarily by availability of significant cattle quantities, as well as lack of possibility to use traditional (coal, gas) fuel.

2. Solar technologies and plants: they are simple in use and not expensive, affordable for rural people: solar cookers, boilers, solar drying devices, photovoltaic transducers.

3. Small and micro-HPPs. Rural people associate implementation of the projects on construction of small HPPs with the policy carried out by the government, which can raise sufficient funds necessary for construction thereof and has specialists, who are able design and construct small HPPs.

According to the assessments of capabilities, one can say that RES potential is not properly used and integration of attempts of all interested in this area parties is considered to be very promising, thereby providing significant opportunities for resolution of very important and necessary tasks for Kyrgyzstan.

Taking into account the best practices of energy saving and RES application, as well as the trends of rise in prices for energy carriers, it is recommended:

1. To improve the laws of the Kyrgyz Republic in the area of energy saving and RES by means of elaborating particular regulatory and legal base for development thereof.

2. To develop and approve regulatory and legal acts, which provide conditions for institutional changes in respect of energy saving and energy efficiency in the process of energy generation, transmission and consumption.

3. To determine authorized bodies at the state and regional levels, as well as the systems coordinating activities of the departments and self-government authorities on the issues of implementing the policy of energy saving, energy efficiency and RES application.

4. To develop the scheduled plan for implementation of the Program on energy saving and improvement of energy efficiency for 2012-2015 and in the perspective for 2025 and carry out energy audit in the enterprises and organizations of the Republic.

5. To develop sectoral, departmental and territorial programs on energy saving, as well as the programs for enterprises and organizations on complex introduction of energy saving within the boundaries of one country.

6. To develop financial mechanisms stimulating introduction of measures for energy efficiency, energy saving and application of renewable energy sources.

7. To arrange research of potential opportunities for energy saving, renewable energy sources, wind, solar and geothermal waters energy, etc.

8. To re-launch the state program (silicon) on development of solar plants operating on the basis of silicon materials.

Republic of Tajikistan. Tajikistan possesses huge potential of renewable energy sources, which can generally replace traditional energy sources. According to the local experts, the RES share in the total power generation is currently characterized as insignificant and constitutes less than 0.1%.

The following types of renewable energy sources are the most promising for Tajikistan: small HPPs, solar plants for generation of thermal and electricity, wind and biogas plants.

It is possible to efficiently apply the solar energy in the whole territory of Tajikistan. The country can satisfy demands for electricity by 10-20 % by means of solar radiation.

Wind-driven power plants could successfully compete with other energy sources. RES can be applied in Tajikistan for generation of electricity, water pumping and grain milling

In the valley, particularly in the private farms where agriculture is well developed, agricultural wastes can be used for energy generation.

The laws of the Republic of Tajikistan acknowledge the importance of energy efficiency and promotion of renewable energy sources application, necessary support is declared for business, scientific and technical activity in this area.

Republic of Turkmenistan. Turkmenistan is the country, which produces energy carriers. According to the National program on social and economic development of Turkmenistan for the period till 2030 production of electric energy will increase significantly due to growth of domestic consumption and export. In increasing the volumes of exported energy carriers, Turkmenistan set a course for extensive introduction of advanced, resource saving and ecologically friendly technologies, having defined alternative energy as one of the priority directions in development of the national fuel and energy complex. **The specialists of Turkmenistan emphasize sun and wind as the most promising sources of alternative energy.**

Annual RES energy potential, which is estimated at the level of 110 billion tons of reference fuel, will be in demand in Turkmenistan in several years. The calculations reflect that nowadays there are districts **in the desert area of the country, which occupies more than 86% of the territory**, where application of alternative fuel, rather than imported fuel, is more reasonable from economic, ecological and investment positions.

Currently, the regulatory and legal framework of energy saving is not enough developed and is not characterized by direct action, therefore it should be revised or additional by-laws should be developed. It is necessary to develop innovation program on energy saving and RES application, which will set major strategic tasks for achievement of energy efficiency in different sectors of economy.

Lack of appropriate institutional and legislative framework, as well as subsidies for electricity and natural gas are **the major obstacles** for any measures for EE improvement and RES introduction.

The public fund of energy efficiency, financed by means of profit received from export of saved gas as a result of measures on energy saving, can be used for investment of measures on energy efficiency and RES development.

Operative institutional mechanisms are essential condition for implementation of effective measures and strategies in the area of energy efficiency. With this regard, it is necessary to establish national authority in Turkmenistan, which will be responsible for carrying out public policy in the area of energy resources efficient use and energy saving.

For a short-term period its priority tasks can include:

- Establishment and operation of the integrated system for standardizing specific consumption of energy resources in different sectors of economy;
- establishment of monitoring system for energy carriers consumption, improvement of accounting and control system for consumption of energy resources;
- development of measures for energy efficiency and monitoring of implementation thereof;
- provision of renewable energy sources share in the energy balance of the country.

Republic of Uzbekistan. Uzbekistan possesses significant potential of renewable energy, three times exceeding the current national production volumes of all types of organic fuel. Climate and environmental conditions of Uzbekistan provide significant opportunities for RES application. According to the estimates, gross RES potential constitute approximately 51 billion tons of reference fuel, technical potential - 179 million tons of reference fuel. Currently, only 0.6 million tons of reference fuel (0.3%) of technical potential has been developed by means of hydro energy application in the natural and artificial water reservoirs.

The major reasons of low level of renewable energy sources application are the following:

- high specific production cost compare to traditional energy sources;
- availability of cheap traditional energy sources;
- lack of mechanisms for financial resources formation for accelerated investment into alternative energy generation.

Recently, the technologies of energy saving and application of renewable energy sources are widely used in Uzbekistan. The investment targeted program is implemented by the government; it envisages development of RES such as wind, solar, hydro energy, introduction of combined solar and thermal power plant

Currently, the most perspective RES in Uzbekistan are the following:

- systemic small and autonomous micro-HPPs in the remote districts;
- wind turbines connected to poorly loaded networks of the energy system, which supply energy to the remote districts;
- solar water heating units for hot water supply to domestic consumers;
- biogas plants for electric and thermal energy generation;
- combined wind and solar plants for low-capacity units in the districts of grassland farming.

Demonstration projects showed that application of wind energy and solar photocells is the most advantageous combination, when wind and solar energies replace each other.

The economy of Uzbekistan is very energy intensive in accordance with the international standards. This is conditioned by application of technologically outdated equipment, significant share of fuel and energy resources in production of goods, in the export of the country, by comparatively low prices for electricity and some types of fuel. Low energy efficiency and low energy saving in all sectors of economy is primarily connected with low price for energy resources (prices for natural gas and electricity are one of the lowest in the world).

The tariff system existing in the country and lack of appropriate legislative framework in the area of renewable energy sources do not contribute to RES investment. Application of renewable energy sources is a competitive traditional energy sources in the remote regions of the Republic with lack of adequate energy infrastructure.

Recommendations:

- to provide legislative, institutional, financial and information support at the government level for extensive introduction and application of alternative energy sources, to develop necessary standards, norms and rules;
- to define public authority responsible for introduction of alternative energy;
- to approve the state program on stimulation and introduction of alternative energy, energy efficiency and energy saving.

It is necessary to adopt specialized regulatory and legal acts and carry out the following events in order to provide the public support for development of renewable energy:

- regulatory and legal acts in the area of energy saving and energy efficiency;
- the National program (Strategy) for development of the renewable energy sources for the nearest years and a long perspective;
- establishment of the state energy saving fund for development of new ecologically friendly technologies in the energy sector;
- Soft taxes and credits for designers;
- Cheap rates for consumers;
- Creation of the up-to-date technological basis.

The group of factors contributing to formation of more independent energy policy in the countries of Central Asia includes optimistic forecasts for the social and economic situation in the region, primarily in Kazakhstan.

Kyrgyzstan and Tajikistan are considered the poorest countries in the region: according to the latest data, about 50% of the population is below the poverty line in each of these countries. Systemic crisis as a significant negative impact in the Republics, it is characterized by profound decline in all sectors of economy. In these countries, the problem of decline in all sectors of economy is aggravated by insignificant growth of GDP, slow inflation rates, 24.5 and 20.4% respectively. Meanwhile, Tajikistan imports from Kazakhstan more than 90% of all milling wheat and flour and about 40% of oil products.

Controllability of the national economy of Uzbekistan is based on the real sector and, consequently, weak interaction with speculative capital, generally, allowed Uzbekistan to avoid the most negative manifestations of the world financial crisis. However, the crisis occurred in the consumers market, which manifested itself in reduction of the consumer demand solvency. In 2009, the major event occurred in Turkmenistan was denomination of the national currency which was caused by necessity to increase the efficiency of currency circulation in the economy of the country.