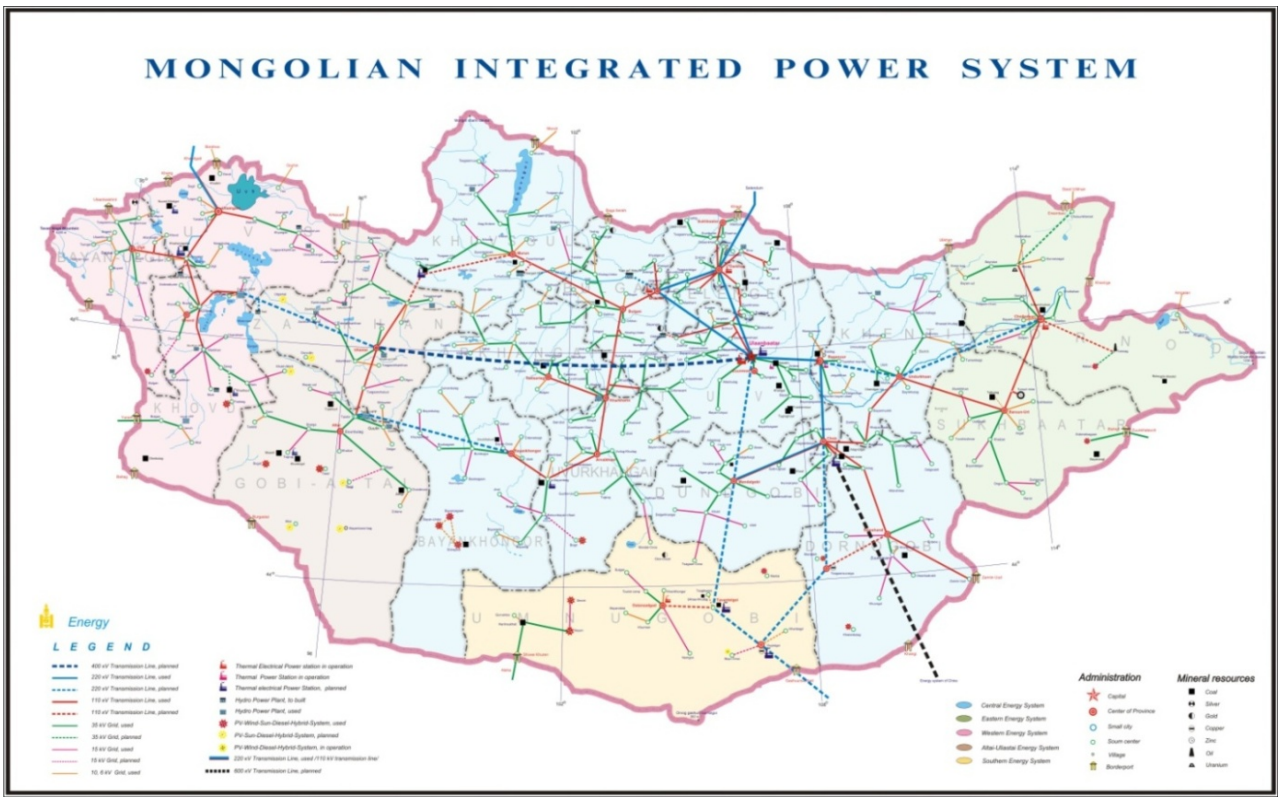
SUSTAINABLE ENERGY FOR ALL

UNDP Mongolia

Rapid Assessment and Gap Analysis

MONGOLIA



2012

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OBJECTIVE

The purpose of Rapid Assessment and Gap Analysis is to provide:

1. A brief overview of the national energy situation within the context of economic and social development and poverty eradication;
2. A detailed review of state of progress in terms of the UN Secretary General's Sustainable Energy for All (SE4All) goals;
3. An estimate of the main challenges and opportunities with respect to the three goals of SE4All and requirements for major investments, policy reforms and enabling environments, and
4. A sound basis and background for development of an Action Plan as part of the SE4All activities.

This report has been prepared with support from UNDP Mongolia and Ministry of Energy of Mongolia.

EXECUTIVE SUMMARY

Mongolia is a Central Asian country located between the Russian Federation and China and with only 2.8 million inhabitants in the massive 1.5 million sq.km land. Since 1990, Mongolia has been implementing a series of economic reforms, aiming at the stabilization of economic performance and restructuring its economy into a market based system. Mongolia has undergone a period of profound economic changes over the last decade based on its huge mineral wealth. The country has seen a sustained period of significant economic growth reaching up to 17.6% in 2011 and it is still progressing at an even faster pace than previously witnessed. Economic growth that is envisaged for Mongolia requires a high degree of macroeconomic management. Concerns over the quality of Mongolia's infrastructure and its capacity to sustain the momentum of very high growth rates, also need to be taken into considerations. These are concerns that can be managed with the right policy measures.

Energy Situation

Mongolia is served by a power system that consists of five detached segments, the Central Energy System (CES), the Western Energy System (WES), the Altai-Uliastai Energy System (AUES), and the Eastern Energy System (EES), Dalanzadgad independent system and comprising eight thermal power plants with heat extraction and several distribution systems.

The Program on Integrated Power Energy System (IPES) of Mongolia is adopted in 2007 by the State Great Hural, the Parliament of Mongolia. Upon a successful implementation of the program, the amount of added generating capacity is expected to reach 5500MW. Total of 385MW of new renewable facilities are expected to be constructed during the period 2012-2022 under scope of the Renewable energy program and The Program on IPES of Mongolia.

Preliminary results predict that the demand would grow at an average rate of 2.9% per year due to the mining sector development, intensive industrialization and construction works that would be carried out in Ulaanbaatar, Darkhan and Erdenet cities, in South Gobi and in the provinces and consistent connection of remote aimags and soums to the centralized power grid. As a result, between 2016-2020 the peak load would reach 1300MW in the CES and power consumption would increase by 9.4-11% on average.

Mongolia has long and harsh winter; hence, the heating is a very important issue. Urban areas are supplied by the CHPs, aimag centers-provinces and soum centers are provided by heat mostly from many small scale heat only boilers. Ger (off center) areas of cities and herder families in the rural areas use coal and biomass burning conventional stoves for cooking and heating.

The most recent available data on energy consumption in Mongolia's regional heat and electricity systems show that Mongolia consumes about 6.9 million tons of coal or 27% of total coal production used domestically (25.16 mln.tons). Most of the coal consumed in Mongolia is the brown coal (65.8 % of total coal production in 2010). Hydro electricity takes up a very small portion.

Nowadays the residential and commercial sectors are the largest energy consuming sectors in Mongolia. As of 2005, the residential and commercial sector use accounted for 43.11% of total final energy demand, the transportation sector for 32.67%, and the industrial sector for 19.72%. Coal is the only fossil fuel produced in Mongolia.

Among the energy sources, coal is the most important fuel in Mongolia followed by the petroleum products. Mongolia imports oil products and electricity from Russia and China.

SE4ALL GOALS AND CURRENT SITUATION

SE4ALL initiative was launched by the secretary general of the UN, Ban Ki-moon in an attempt to stabilize the global climate change issues. Furthermore, the developed countries face the challenge of transforming the existing infrastructure and developing countries to adopt more cleaner and efficient technologies from the start. The initiative includes the following global goals:

- To ensure the global access to the modern energy system
- To double the global rate of improvement in energy efficiency
- To double the global rate of renewable energy in the global energy mix

In May, 2012 UNIDO's Director-General and SE4ALL initiative's Co-Chair Kandeh Yumkella visited Mongolia and invited Mongolia to join the SE4All initiative. The Ministry of Energy initiated the rapid gap assessment of Mongolia for the SE4ALL initiative.

Public utilities, such as companies that generate, transmit and distribute electricity and heat, are a significant part of the infrastructure and major contributors to the national economy. The Government of Mongolia recognized that in order to have successful restructuring, it is necessary to create cost efficient enterprises.

Therefore, the Government programs include concrete short-term and long-term strategies for the development of the energy sector. These policies include plans to set up a fully integrated energy system by 2040 by establishing a transmission line between the Central, Western, Eastern, Altai-Uliastai energy systems, Dalanzadgad CHP and energy systems in Gobi region. The sector development and policy documents planned to establish thermal power plants and as well as to fully meet the increasing energy demand of the country and to have a capacity to export electricity to neighboring countries by producing energy from hydropower plants at Eg, Orkhon, Selenge river, solar and wind power plants to be built in Gobi and central region.

The Government of Mongolia approved in 2002 the "Mongolia Sustainable Energy Sector Development Strategy Plan", and it reflects goals reinforced in the Poverty Reduction Growth Facility (PRGF) program, which is endorsed by international and donor community. The main objective of the Energy Sector Strategy of Mongolia is to create a financially sustainable energy sector that will provide cost-effective energy access, thereby enabling poverty reduction and greater private sector and civil society participation.

In order to create necessary conditions for private sector to enter the power market in Mongolia, the Energy Regulatory Commission is aiming and working to develop the new power market structure. Moreover, Mongolian Parliament approved the Law on Concession in 2010 that opens the opportunities to implement new projects in the energy sector

Energy accessibility

Currently, all 21 aimags and 314 soums are supplied by centralized energy source and of which 10 soums are connected foreign electricity supply. 17 soums are supplied by renewable sources and other hybrid systems. 2 soums are supplied by diesel generator. Urban areas are well connected to the electricity network (99.2% of the urban households) while households in rural areas have limited access to the electricity network (52.8% of the rural households).

As a result of the Project "100000 Sun Light" and "National program on renewable energy", from 170,000 herders families 89% (around 151,300) have access to the electricity by independent solar PV panel and wind energy system.

In Mongolia heating is very important. In the urban areas heat is supplied by the combined heat and power plants mostly. However, in the rural areas and ger districts of the cities, heat supply is mainly based on the coal burning small scale stoves. It covers very large area and not connected to the central heating system.

Energy efficiency

The Government of Mongolia has included energy efficiency strategic goals in its Millennium Development Goals, targeting "incorporating sustainable development principles into and implement national policy and programs, and clean up air pollution of settlements, especially in Ulaanbaatar City". However, there are no formally adopted energy efficiency priorities and policies by the Mongolian government.

In July 2010 with the financial support of ADB the development of a new Draft Energy Conservation Law has been initiated as well as the development of a Medium and Long term Energy Efficiency Action Plan for Mongolia.

The current Building Law, Housing Law, and Urban Planning Law of Mongolia provides the necessary legal basis for the updating of the Mongolian building code energy efficiency provisions systems and in 2010 in the framework of GEF/UNDP Building Energy Efficiency Project new standards for the thermal performances were developed, adopted and number of ISO and EN standards were translated and adopted.

Investments in power infrastructure did not meet the demand, which has significantly lowered the reliability of electricity supply and has increased overloading of aging distribution network. The overall energy system is characterized by low operational efficiency and poorly maintained and obsolete equipment. However, number of actions has been taken in order to promote the supply side and demand side energy efficiency measures with the support of international organisations. This includes, Energy Efficient Housing Project**,** Ulaanbaatar Clean Air project**,** Energy Efficiency in New Construction in the Residential and Commercial Buildings Sector in Mongolia project and the promotion of ESCO companies.

Integration of renewable energy

Renewable energy is one priority of the Mongolian energy sector, as set out by the Government in policy documents such as the Government Action Plan, Millennium Development Goals and Mongolia's Strategy for Sustainable Development of the Energy Sector. The use of renewable energy is vital for improving and securing a sustainable energy supply, particularly for rural electrification and heat supply. It attaches great importance to the research and exploitation of new energy sources.

In June 2005, the Mongolian Parliament approved the **National Renewable Energy Program** which sets ambitious goals for broad-based renewable energy development: increasing the share of renewable energy technologies (hydro, wind, geothermal, biomass and solar power systems) in total energy supply from 0.5% in 2005 to 3-5% by 2010 and to 20-25% by 2020.

The **Renewable Energy Law** of Mongolia came into force on 11 January 2007 and regulates the generation and supply of energy from renewable energy sources.

With an assistance of the international organizations, such as GIZ, WB, CDM program, and private investment, Mongolian renewable energy sector has been developing and many new projects are being planned and studied. Furthermore, the government of Mongolia is supporting the deployment of renewable energy projects by endorsing a PPAs and developing PPP. Currently, the feed in tariff for the wind energy is set at 9.5c/kWh and solar energy is set 15 c/kWh for the projects planned to be build in the near future.

Gaps and Barriers for achieving the SE4ALL initiatives

Gaps

In the urban areas of Mongolia, electricity supply reaches 99.2% of the households while it is only 52.3% in the rural areas while the heating supply is limited even in the urban areas. It is due to the nature of herder families lifestyles which is nomadic. Enabling the access for the modern energy system to the herder families is challenging as herder families move throughout the year depending on the weather.

- It is also necessary to develop more bio-fuel plants to negate the pollutions emitted from the transport sector.
- The government of Mongolia realizes that demand side management should play significant role in meeting the energy demand i.e. electricity and heating. Technical and non technical energy loss in the energy system is significant.
- Currently there is no legal document is in place in Mongolia as of today for the energy efficiency and energy conservation policies. However, there have been several attempts to introduce the law on energy conservation. Current, government now believes that this law should pass the parliamentary discussion in the spring meeting of 2013.
- In Mongolia there are 17 soums supplied by the hybrid power plants. However, the success rate is not so good and affected the reputation of renewable energy negatively.
- Private companies are interested in investing in the renewable energy in Mongolia only if they are provided with the suitable conditions such as power purchasing agreements as the capital of building such systems are high and the energy sector in Mongolia is heavily regulated.

Barriers

Unfortunately, current situation in Mongolia limits the development of energy sector and meet the targets set by the UN's initiative SE4ALL. These barriers that are becoming the limiting factors can be categorized by its nature into the followings:

- Skilled workers in research and development and in implementation and operation of new technology and the modern energy system – *Human resource barriers*
- Reliable information availability - *Information barriers*
- Renewable energy promotion policies and incentive regulations – *Policy barriers*
- Issues related to the nature Mongolia and current developments in the mining sector – *Economic barriers*
- Aging stock of equipments and integration of intermittent electricity source into the inflexible electricity system – *Technical barrier*

1 Introduction

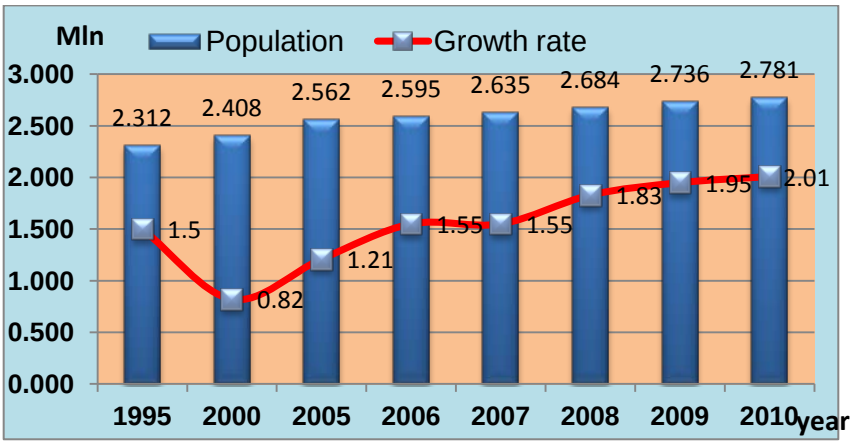
1.1 Country Overview

1.1.1 Economy Overview

Mongolia is a Central Asian country. Mongolia is located between the Siberian part of the Russian Republic and China. The country has a total territory of 1,565,600 km2. The country is known for its steps and the Gobi desert, but it also includes numerous mountainous areas, rivers and lakes. The average altitude is 1,580 meters above the sea level.

The population of Mongolia is about 2.81 million. The population density is 1.78 persons per km^2. Approximately, 1,300,000 people live in Ulaanbaatar, the capital city of Mongolia. About 40% of the population lives in the countryside, primarily subsisting as nomadic livestock herders, while the rest lives in the cities or small settlements spread throughout the country. Mongolia is divided into 21 aimags (provinces), and further into 329 soums (municipal unit).

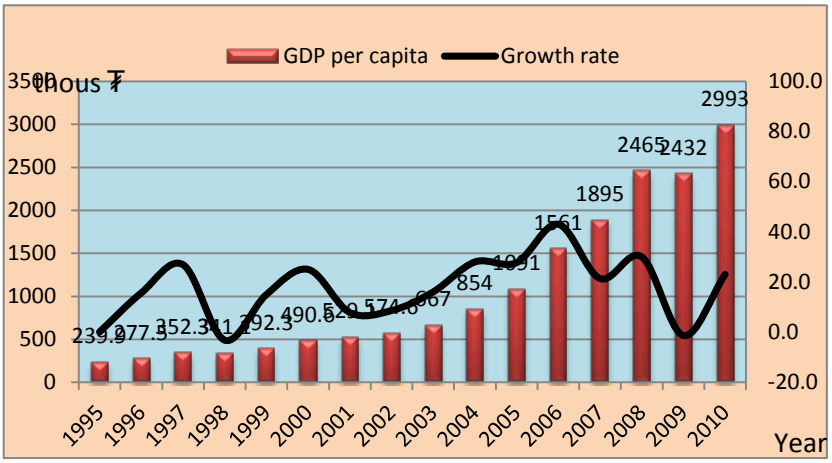
Figure 1. Population and Growth Trend in Mongolia



Mongolia is one of those former communist countries that, after the fall of the Soviet Union, had to make its way towards a market economy and towards participating in the global economy.

Over the past decade, Mongolia has undergone a period of profound economic change. Based on its huge mineral wealth, the country has seen a sustained period of significant economic growth that was only briefly contained as a result of the global economic downturn of 2008. At present, Mongolia is once again experiencing a period of dramatic economic growth but at an even more advanced level than previously witnessed.

Figure 2. GDP per capita and growth rate

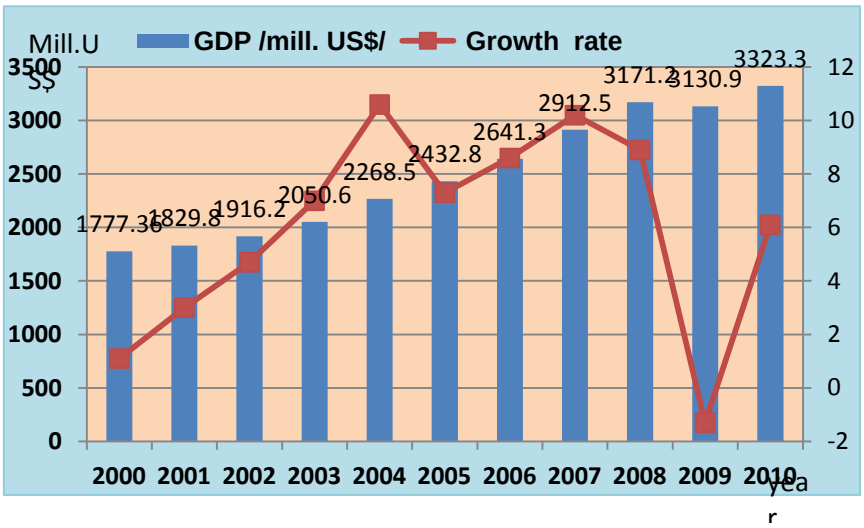


This formidable task has been met with commitment to change and the results have been impressive. Annual growth rate of real (2005 prices) GDP increased from 2.4 to 4.0 percent during the last half of the 1990s, despite the effects of the 1997-1998 Asian financial crises. Also of oil price increase and world economical crises in 2007-

2009 the inflation rate became 22 percent, GDP became 2432 million tugrug by the end of year 2008.

In 2010, GDP was 8255.1 bln.tugrug at current prices and 4154.0 bln.tugrug at constant prices of 2005, representing increases of 1664.4 bln.tog or 25.3 percent at current prices and of 240.3 bln.tog or 6.1 percent at constant prices compared to the previous year.

Figure 3. GDP Growth Trend in Mongolia, at 2005 prices, million US$



Real GDP growth during the first half of 2011 is reported at over 14%, compared to Government of Mongolia's projection of 19.4% for 2011 as a whole. In 2010, Mongolia presently occupied 46-th place in the global ranking of economic growth but for 2011. Earlier in 2011, based on outcomes, the Government increased the 2010 real GDP growth figure from 6.1 to 6.4% and its projections for 2011 and 2012 are 19.4% and 19.9% respectively.

Recently, large copper and coal resources have been discovered. This discovery resulted in large inflow of foreign investments into two mines, the Oyu Tolgoi and Tavan Tolgoi mining complexes. Currently, these two mines are the world's largest coal and copper mines. Especially the coal mines turn out to be of interest to China for input into its coal energy supply.

While the discovery of these resources is leading to a rapid increase in foreign direct investment and associated expected rise in welfare, it should be noted that the current heavily underdeveloped state of the Mongolian economy and infrastructure may well form a hard to take obstacle to realize these welfare gains. Mongolia lacks the necessary transport infrastructure. Also, the existence of the mines will attract a lot of economic activity subsequently leading to a massive increase in energy demand.

The rapid rise in foreign direct investment (some US$ 2.1 billion for the first half of 2011) directed mainly at the development of the Oyu Tolgoi mining complex and the government's US$ 2.3 billion capital budget for investments in major infrastructure and human development projects (social welfare, health and education), are two firm indicators of future economic prospects. Taken together, these investment funds represent over two thirds of Mongolia's 2010 GDP figure. Added to these factors, a positive outlook for commodity prices, rising export revenues driven by continuing strong demand from China and increasing commodity production, have all underpinned the dramatic economic growth rates.

However, significant economic challenges remain for Mongolia. The first is the country's heavy reliance on overseas trade as a component of GDP (export revenues alone is about 35% of total GDP). The second is the country's heavy reliance on commodity exports (whose international

prices are notoriously unstable) and on a single source for those exports, namely China. At present, the global economy appears to be holding its breath waiting for the outcome of the financial crisis that has taken hold in the Eurozone economies. The outcome of this event, coupled with a weakly performing US economy heavily burdened with its own debt worries, is likely to have some, as yet unmeasured effect on the global economy, Asian economies, China's economy and therefore, Mongolia's economy.

Added to these concerns, there is some question as to the capacity of Mongolia to absorb high economic growth rates for a prolonged period and in a sustainable manner. Economic success such as that envisaged for Mongolia requires a high degree of macroeconomic management. Concerns over the quality of Mongolia's infrastructure base and its capacity to sustain the momentum of very high growth rates, also need to be taken into consideration. These are concerns, but can be managed.

Mongolia has implemented a series of economic reforms since 1990, aiming at stabilization of the economic performance and restructuring the economy into a market based system. Measures taken include:

a. implementation of tough monetary, fiscal and exchange rate policies

b. successful privatization of virtually all livestock herds and small scale enterprises

c. steady Government commitment to reforms

These measures have been aided by timely international donor supports, especially during the early crisis years and political instability. The transition of the economy to a market based regime is showing a positive result, but the progress is still slow. The pasturing livestock husbandry, one of the major sectors of Mongolian economy, still plays an important role in the economy. Recently, 20.5% of GDP is produced by agriculture of which 80% accounts for livestock husbandry.

1.2 Energy Situation

1.2.1 Overview on Energy profile

Mongolia is served by a power system that consists of 5 detached segments, the Central Energy System (CES), the Western Energy System (WES), the Altai-Uliastai Energy System (AUES), and the Eastern Energy System (EES), Dalanzadgad independent system and comprising seven thermal power plants with heat extraction and eight distribution systems. The CES supplies power and heat to the capital city of Ulaanbaatar and to thirteen nearby provinces (Aimags), including the industrial towns of Darkhan and Erdenet, and that represents 70 % of all of Mongolia's electricity supply. The CES is based on five coal fired generating plant and it is connected to the Russian Electricity System. The other three grids are quite small.

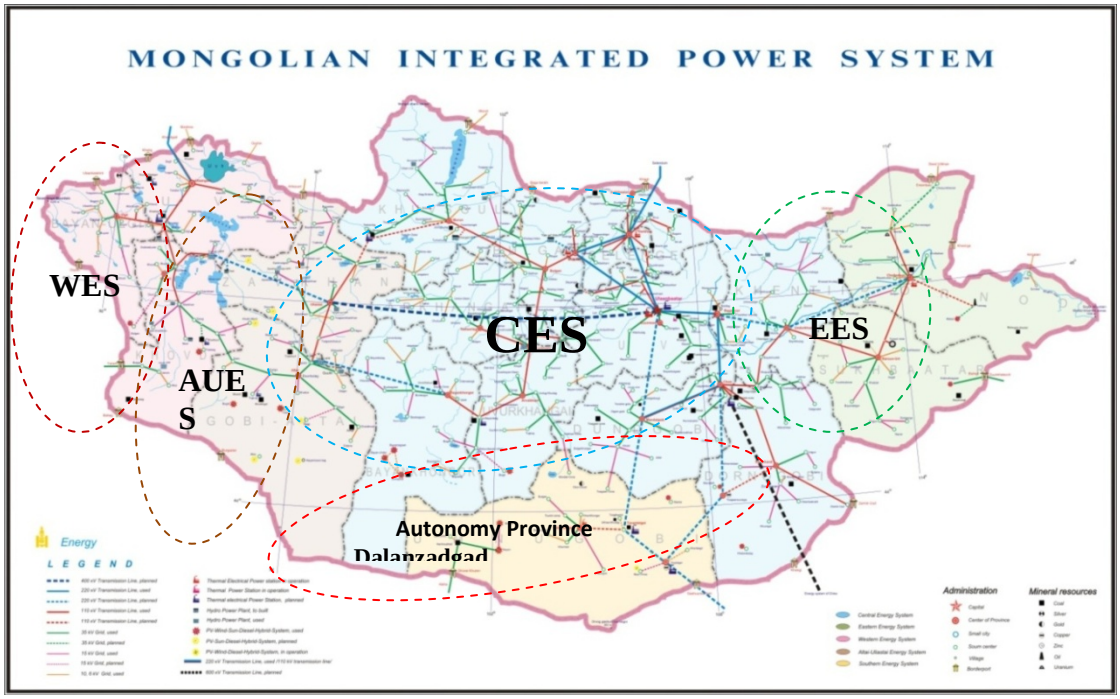
The WES operated on imports of electricity from Russia and in 2008 was put into operation Durgun hydropower plant with capacity 12 MW. But after the Durgun hydro power plant WES is still imports electricity from Russia. When residents have supplied by sustainable electricity, the consumption is rapidly growing.

The EES is centered in Choibalsan town and in EES operates Choibalsan Thermal power plant with capacity 36 MW and supplies electricity to EES and heat to Choibalsan city. In EES is very big demand in electricity, because there are planned new oil explorations and uranium explorations.

AUES is located in Gobi-Altai. Gobi-Altai, Zavkhan provinces are served by AUES, each province have own diesel power plant. In 2010 there was out into operation Taishir hydropower plant with capacity 11 MW. Now the Taishir hydropower plant supplies 10 soums in Gobi-Altai and 19 soums in Zavkhan, but due to the water level the operation of Taishir HPP is not reliable. Government cut diesel fuel subsidizing to Zavkhan, so they have limited electricity.

Dalanzadgad thermal power plant with capacity 6 MW supplies power and heat to Dalanzadgad-central city of Southgobi province. Last year they extracted capacity of the power plant by 3 MW but there is still not finished commissioning process. Now Dalanzadgad is connected to the Tavantolgoi substation by 110 kV overhead line. In Tavantolgoi operates Ukhaa-Khudag thermal power plant with capacity 18 MW, which was commissioned in 2011. There is now establishing new South Gobi Energy System which will be connected to the CES.

Figure 4. The Map of Mongolia



The CES with the poor peaking capability of the essentially base-load plants is unable to properly follow the daily system demand and the problem is aggravated by coal supply and spare part problems. Outages reduce the actual power delivery by about 10-14 %. In spite of recent improvements, the CES uses still 15.62% of the gross generation for its own use during the winter and this amount is high. A serious aspect of the system is its age.

Table 1. Existing Combined Heat and Power Plants (CHPs) in CES and other Power plants

Power & Heating Plant	Installed Capacity (MW_e)	Available Capacity (MW_e)	Boiler Capacity (MW_{th})	District Heating (MW_{th})	Industrial Steam (MW_{th})	Year of Commissioning
Ulaanbaatar CHP-2 (CES)	24	21.5	80	43	58	1961 - 1969
Ulaanbaatar CHP-3 (CES)	148.0	136	1’448	562	105	1968 - 1982

Ulaanbaatar CHP-4 (CES)	580	580	2’450	1040	29	1983 – 1991
Darkhan CHP (CES)	48.0	48	477	210	49	1966, 1986
Erdenet CHP (CES)	36.0	28.8	318	140	24	1987 – 1989
Choibalsan CHP (EES)	36.0	36	397	130	22	1969, 1979
Dalanzadgad PP	6.0+3	5.4	38	8	-	2000
Durgun HPP	12.0	12	--	-	-	2008-2010
Taishir HPP	11.0	11	-	-	-	2010-2011
Diesel PP	80<	80<	-	-	-	
Ukhaa-Khudag PP	18	11		-	-	2011

The population is super-sparse with large distances between load centers and power stations – this creates technical and financial difficulties for Mongolia’s power system.

The CES is controlled by the Russian grid (frequency / load following) – maximum import is limited to 100MW but the night peak during winter is 180MW. It is intended to develop a hydro plant of 300MW capacity on the river that feeds the Baikal lake in Russia to reduce dependency on Russia and for load following; the current situation where water in Mongolia supplies Russian hydro plants but Mongolia then has to pay for power imports.

Table 2. Electricity Generation in CES

	1980	1990	2000	2005	2010
Capacity (MW)	983.03	956.0	937.59	911.03	944.1
Peak Load (Mw)	590	477	526	576	730
Gross Generation (Gwh)	3348	2628	2946	3418.9	4575.7

There is a need to demonstrate the role that renewables can play in Mongolia’s energy landscape in coming years – some believe that new demand can be fully met with renewable energy; a key consideration is the practical difficulty of controlling the system frequency with a large number of distributed loads of approximately 15MW.

Mining developments in the South Gobi area will see major demand growth in the South and will require the creation of a fifth electricity transmission grid.

There are currently six 600MW coal-fired power plants proposed by the private sector. There is a need to identify the best location for new coal-fired power plant.

Mining companies could purchase electricity from the Government instead of building their own power stations; this would provide the Government with revenue.

There is a need to improve energy efficiency of distribution, network losses are unacceptably high and the Government is effectively subsidizing these losses.

The need to provide adequate power and heat (including hot water supply) to rural areas or aimag centers is driven by the need to ensure that people continue to live on the land and do not migrate to the larger cities, the solution may not be economic from a purely power/heat perspective, but may be sensible from a social impact perspective.

In the case of heat, the least cost development of resources typically progresses from stand-alone heating systems, such as building boilers, to District Heating systems supplied by Heat Only Boilers (HOBs) or Combined Heat and Power Plants.

The privatization of rural heating systems in aimag (province) centers has not been successful with low tariff and lack of capital investment.

Ulaanbaatar is a long, narrow city and the UB district heating system cannot be extended further; it appears that peri-urban coal-fired boilers will be required to provide localized district heating service – ideally the solution needs relatively clean coal technology.

Mongolia's Gross Domestic Product (GDP) in 2011 is taken to be MNT 12,093 billion. The per capita consumption in 2011, based on residential and commercial load, was 4,800kWh per annum.

Preliminary calculations predict that if the consumption would increase by this rate the peak load of CES in 2016-2020 would reach 1300 MW approaching the recent installed capacity of 944.1MW. The Mongolian Government adopted a couple of national development programs which shall provide electricity development directions and plan to meet increasing electricity demand and sector development and security. In the first stage of CHP-5 project, 450MW CHPs feasibility study was executed by ADB grants.

The Program on integrated power energy system of Mongolia is adopted in 2007 by the State Great Hural, the Parliamentary of Mongolia. Purpose of this Program is to form the Integrated Power System of Mongolia (IPSM) that enhances reliability of power supply in order to secure economic development of Mongolia, improves efficiency and loss reduction, uses and maintains export of energy resources effectively in harmonization with socio-economic development of the country.

Upon on successful implementation of the program, the amount of added generating capacity is expected to reach 5500 MW except renewable sources of energy and private sector financed and operated power plants. Total of 385 MW new renewable facilities are expected to be constructed during the period 2012 ~ 2022 under scope of the Renewable energy program and The Program on integrated power energy system of Mongolia. Meanwhile total generator retirement is expected to 270.3 MW (22 units).

The intensive industrialization and construction works in Ulaanbaatar, Darkhan and Erdenet cities, as well as consistent connection of remote aimags and soums to the centralized Power grid recent years result to increase in power consumption by 9.4-11% in average.

The Master Plan developed in 2002 indicates that demand is scheduled to increase at an annual average growth rate of 2.9 percent between 2005 and 2020. This growth rate assumes that there will be improved efficiencies in the operating power and heat systems as well as energy savings resulting from conservation and energy efficiencies on the demand side. Energy Sector Master plan updating is going to finish by the next year.

According to the World Bank estimation, peak demand of Mongolia electricity systems going from 570 MW in 2005 to 1,099 MW in 2014, and energy supply from 2,849 GWh to 6,288 GWh. Such

levels of rapid growth in such a short period are unprecedented in Mongolia's electricity sector and bring with it new opportunities and challenges.

The establishment of a new Energy Law in 2001 introduced reforms to improve the commercial performance of the energy sector. A principal element in the reform package was the unbundling of the CES along functional lines and locations of population centers, resulting in the establishment of 19 state-owned joint-stock companies and the independent regulatory body of energy sector.

Losses in the electricity transmission and distribution systems are high. The condition of the heat supply line system is not optimal. Transmission losses in the system due to leakage, radiation and other causes in Ulaanbaatar amounted to 15% of peak capacity, while losses in industrial heat delivery are considerably higher.

1.2.2 Major Energy Indicators

Table 3: Total Primary Energy and Economic Indicator in Mongolia

	1990	1995	2000	2005	2010	Growth rate p.a. (%)			
						'90-'95	'95-'00	'00-'05	'05-'10
Total Primary Energy Supply (1,000 TOE)	3,746	2,317	2,564	2,800	3,545	-9.2%	2.0%	1.8%	4.8%
Energy per capita (TOE)	1.74	1.03	1.06	1.09	1.27	-9.9%	0.6%	0.5%	3.1%
Population (thousand)	2,153	2,243	2,408	2,562	2,781	0.8%	1.4%	1.3%	1.6%
GDP (billion tog, at 2005 constant price)	2,107	1,826	2,100	2,780	4,154	-2.8%	2.8%	5.8%	8.4%
Energy/GDP Intensity (TOE/million Tog)	1.78	1.27	1.22	1.01	0.85	-6.5%	-0.8%	-3.8%	-3.3%
Import Dependency (%)	22.3%	16.2%	19.4 %	21.4%	25.6 %	-6.2%	3.7%	1.9%	3.7%

1.2.3 Total primary Energy supply

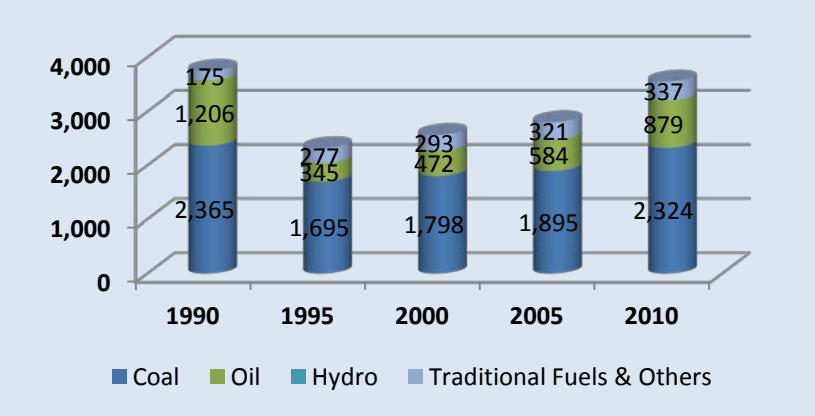
The most recent available data on energy consumption in Mongolia's regional heat and electricity systems shows that they consume about 6.9 million tons of coal or 27 percent of total coal production used domestically (25.16 million tons of coal was produced in 2010). 5.53 million tons of coal was used by the thermal power plants. In addition to the regional coal-based energy systems, there are isolated diesel-power generators that account make up the remaining two percent of electricity production.

The CES has an installed power generating capacity of about 944.1 MW in five power plants with 24 generating units. They produce about 4.3 GWh annually. Approximately, 92% (79.1% of the total demand) comes from coal-fired generators in the regional energy systems and 4.8% from diesel combustion generators, mainly in isolated areas. Also 0.3% comes from the solar and wind systems, 2.9% from the hydro power plants. The imported electricity accounts for the 14% of the total electricity demand.

The industrial sector is the largest consumer of electricity, accounting for about 62 percent of the total. The consumption of electricity in the industrial sector is highly concentrated among 16 mining companies. The largest single consumer is the Erdenet Copper Mine, which accounts for 40% of the energy sales to the mining sector.

The residential sector is the second largest consumer at 24%, followed by transport (4%), agriculture (1%) and others (9%).

Figure 5. Primary Energy supply by the source



1.2.4 Energy Demand Growth

Electricity consumption in Mongolia has been evenly increasing since 90s. Accordingly, the power generation capacity in Mongolia has also increased, from 3,411 mln.kWh in 2005 to 4.3128 mln.kWh in 2010, in order to meet the increased demand for electricity.

The most important implication of industrialization is a significant increase in energy consumption. Total consumption of the primary energy has increased from 2,564 million tones of oil equivalent (TOE) in 2000 to 3,545 million TOE in 2010.

Table 4. Energy production and Net import in Mongolia, (Unit: 1,000 TOE, %)

	1990	1995	2000	2005	2010	Growth rate p.a. (%)			
						'90-'95	'95-'00	'00-'05	'05-'10
Indigenous Production	2,709	1,980	2,019	3,592	11,591	-6.1%	0.4%	12.2%	26.4%
Import	836.0	375.5	497.1	597.8	908.8	-14.8%	5.8%	3.8%	8.7%
Export	-171	-1	-3	-1,405	-9,028	-61.8%	18.4%	236.4%	45.1%
Total Domestic Energy Supply	3374	2355.5	2513.1	2785.8	3471.8	-9.2%	2.0%	1.8%	4.8%

Table 5. Structure of Primary Energy Supply by Source in Mongolia, (Unit : 1,000 TOE, %)

	1990	1995	2000	2005	2010	Growth rate p.a. (%)			
						'90-'95	'95-'00	'00-'05	'05-'10
Coal	2,365	1,695	1,798	1,895	2,324	-6.5%	1.2%	1.0%	4.2%
Oil	1,206	345	472	584	879	-22.1%	6.5%	4.3%	8.5%

Hydro	0.00	0.00	0.25	0.28	4.73	0.0%	0.0%	2.1%	76.0%
Traditional Fuels & Others	175	277	293	321	337	9.6%	1.1%	1.8%	1.0%
Total	3,746	2,317	2,564	2,800	3,545	-9.2%	2.0%	1.8%	4.8%
	100.0%	100.0%	100.0%	100.0%	100.0%	-	-	-	-

Per capita energy consumption has decreased from 1.74 TOE in 1990, 1.03 TOE in 1995, 1,058 TOE in 2000, 1.09 TOE in 2005 and has increased to 1.27 TOE in 2010. Since 2000, energy demand increased faster than the economic growth.

1.2.5 Energy Demand by Sector

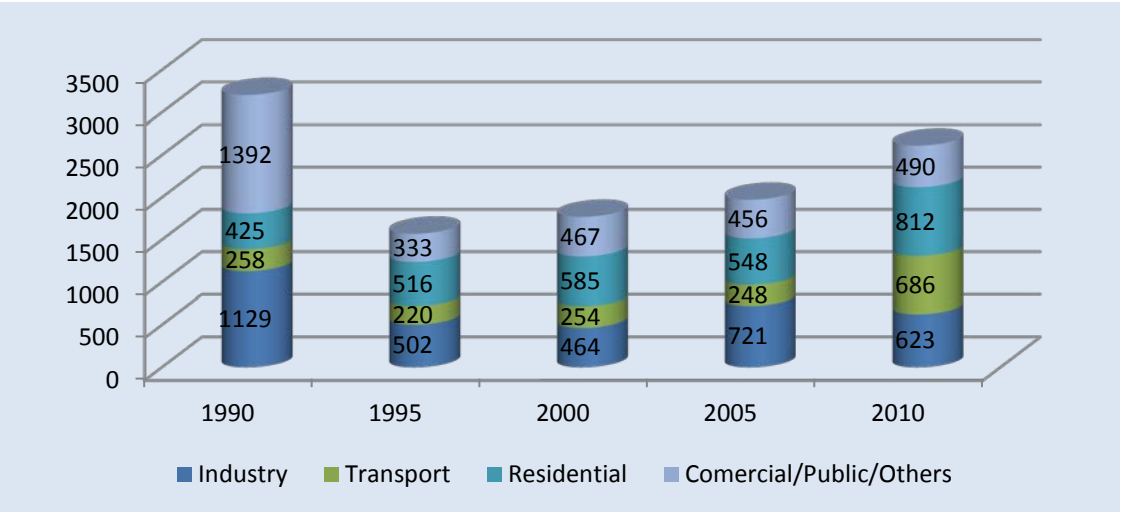
Final energy consumption decreased to 2,611 million TOE in 2010, less than from 3,204 million TOE in 1990. The biggest decrease took place in the 1990's, when economical falling occupied.

Nowadays the residential and commercial use is the largest energy consumption sector in Mongolia. As of 2005, the residential and commercial use accounted for 43,11 percent of total final energy demand, the transportation sector for 32,67 percent, and the industrial sector for 19,72 percent. As shown in following Figure, energy demand in Mongolia has grown since 1995.

Table 6. Final Energy Demand by Sector in Mongolia, (Unit : 1,000 TOE, %)

	1990	**1995**	**2000**	**2005**	**2010**	**Growth rate p.a. (%)**			
						'90-'95	**'95-'00**	**'00-'05**	**'05-'10**
Industry	1129	502	464	721	623	-15.0%	-1.6%	9.2%	-2.9%
Transport	258	220	254	248	686	-3.2%	3.0%	-0.5%	22.6%
Residential	425	516	585	548	812	4.0%	2.5%	-1.3%	8.2%
Comercial/Public/ Others	1392	333	467	456	490	-24.9%	7.0%	-0.5%	1.4%
Total	3204	1571	1770	1973	2611	-13.3%	2.4%	2.2%	5.8%
	100.0%	100.0%	100.0%	100.0%	100.0%	-	-	-	-

Figure 6. Energy Demand by Sector (unit 1000 TOE)



Industrial energy demand has rapidly increased in the past 5 years, from 464 thous. TOE in 2000 to 623 thous.TOE in 2010, due mainly to the expansion of energy intensive industries. The transportation sector has shown the most rapidly increasing energy demand in response to substantial growth in the number of vehicles, while the residential and commercial sector has shown a relatively lower pace of growth in energy demand, compared with the other sector.

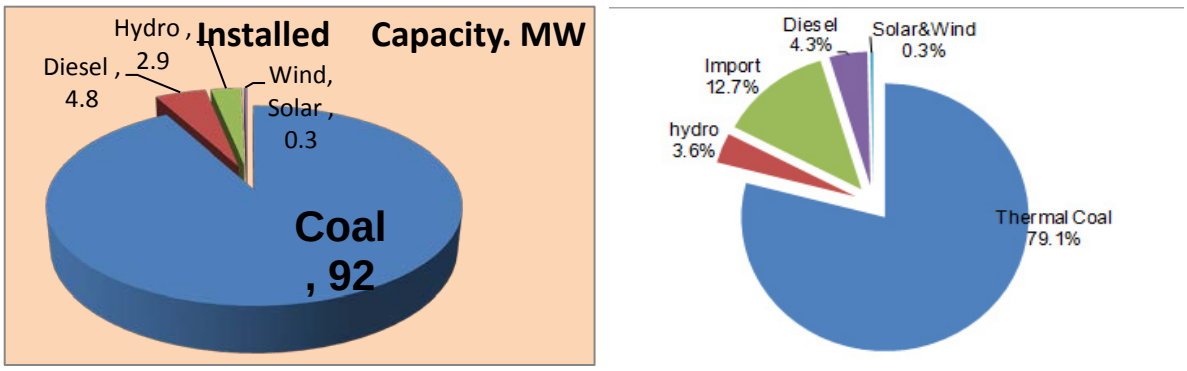
1.2.6 Energy Supply by Source

Coal retains the highest share of total primary energy supply in Mongolia.

Table 7. Structure of Primary Energy Supply by Source in Mongolia, (Unit : 1,000 TOE, %)

	1990	1995	2000	2005	2010	Growth rate p.a. (%)			
						'90-'95	'95-'00	'00-'05	'05-'10
Coal	2,365	1,695	1,798	1,895	2,324	-6.5%	1.2%	1.0%	4.2%
Oil	1,206	345	472	584	879	-22.1%	6.5%	4.3%	8.5%
Hydro	0.00	0.00	0.25	0.28	4.73	0.0%	0.0%	2.1%	76.0%
Traditional Fuels & Others	175	277	293	321	337	9.6%	1.1%	1.8%	1.0%
Total	3,746	2,317	2,564	2,800	3,545	-9.2%	2.0%	1.8%	4.8%
	100.0%	100.0%	100.0%	100.0%	100.0%	-	-	-	-

Figure 7. Electricity generation by source



1.2.7 Structural Change in Energy Mix in Mongolia

1.2.7.1 Demand increases by Source

Mongolia also experienced a significant structural change in energy demand by source over the last five years. This occurred as a result of changing political orientation from centrally planned economy into one that is market-based and private sector driven. This formidable task has been met with commitment to change and the results have been impressive. Coal still accounts for the largest share in Mongolia's total primary energy demand.

1.2.7.2 *Energy* Mix Changes

Among the energy sources, coal is the most important fuel in Mongolia. Next is petroleum. Most of the coal consumed in Mongolia is the brown coal (65.8 % of total coal production in 2010). Hydro electricity takes up a very small portion.

Table 8. Final Energy Demand by Source in Mongolia, (Unit : 1,000 TOE, %)

	1990	1995	2000	2005	2010	Growth rate p.a. (%)			
						’90-’95	’95-’00	’00-‘05	’05-’10
Coal	826	201	217	148	326	-24.59%	1.52%	-7.43%	17.18%
Oil	1,092	273	443	570	876	-24.21%	10.18%	5.16%	8.96%
Electricity	228	161	154	216	290	-6.65%	-0.94%	6.97%	6.14%
Heat	884	658	663	718	782	-5.74%	0.16%	1.62%	1.72%
Traditional Fuels & Others	174	277	293	321	337	9.72%	1.10%	1.85%	0.99%
Total	3,204	1,571	1,770	1,973	2,611	-13.3%	2.4%	2.2%	5.8%
	100.0%	100.0%	100.0%	100.0%	100.0%	-	-	-	-

1.2.8 Coal

Coal supplies about 92 percent of Mongolia's total energy requirements. All of this coal is produced domestically; both lignite and bituminous coal is used for energy production accounting for 99.3% and 0.65% respectively.

In order to rationalize the coal sector, small domestic coal mines were privatized in 1993-2000, mines that affect to the regional power production were reassigned to the local administrative bodies, and the major coal producers for the Central power system were re-organized as the joint stock companies with 70-90% Governmental share.

Since 2000, private coal mining companies started to produce and export high grade metallurgical coal to China. Export has been increasing, reaching and reached 74% of total coal production in 2010. In 2010 year, totally 18,479 тhous.t coal is exported.

Mongolia needs to utilize its abundant coal reserves and hence, clean coal appears to be an imperative in Mongolia’s energy future. However, it is unclear what this means in practice whether the carbon capture and storage (CCS) or coal gasification. Mongolia has estimated total coal resources of approximately 162 billion tons found within 15 coal basins. About one third of resources are in the Gobi region in the south, one third in the eastern region and the balance in the rest of the country, of which the Central Region accounts for about half. Bituminous coal is found in South Gobi and Western basins. Most of the resources in the central, north and western regions are sub-bituminous or lignite.

Even though coal resources are abundant, the infrastructure needed for large scale coal production in Mongolia still needs to be further developed. Pre-requisites of large scale coal fired power and heat generation include that (i) there is a sufficient size in the deposits and scale of operation to support continuous and long-term fuel supply, (ii) the parameters of coal such as calorific value, moisture and ash, among others, are suitable for the planned technology, and (iii) the transport distance is not too long so that the transport logistics work well for the plant, for example, via railway.

Coal deposits in and around the CES area produce mostly lignite with calorific value of around 3,000 kcal/kg. The largest mines currently supplying the CES CHP plants are Baganuur, SharynGol and Shivee-Ovoo.

Baganuur, Sharyn Gol and Shivee Ovoo mines are with annual capacities of 3.5 million, 450 thousand and 1.8 million tons, respectively. Average value of radium equivalent for natural radioactive isotopes in slag of Shivee-Ovoi coal exceeds the permissible limit for the purpose of utilization of ash as building material for public and plant buildings, has resulted to mix ash with other low radioactive materials before using it for construction.

Coal from deposits in north and central regions of Mongolia are mostly rather low in sulphur contents but with high moisture content. Moisture in coal results in efficiency losses in energy conversion. The efficiency of a coal fired power generation drops by about 4 percent points and 9 percent points when coal moisture content increases from 10% to 40% and 60% respectively. High moisture content also results in higher capital cost of the plant as the physical size of the boiler and flue gas channels need to be dimensioned bigger to accommodate the water vapour as a result of the high-moisture coal combustion. Coal drying technologies could be applied in the future to address this issue.

High ash content also has an impact to the efficiency. Key deposits with high ash content coal (over 20%) in Mongolia include Maanit, Nuurst Khotgor, Saikhan Ovoo, Tal Bulag, Tevshiin Gobi, Khar Tarbagatai, Tsakhiurt,Shariin Gol and Alag Tolgoi. High ash content causes additional capital and operational costs for transporting rock matter, in coal handling and ash disposal. Coal washing to improve coal properties prior combustion is rather standard in Europe, North America, Japan and Australia, but it is increasingly demanded also in China and India. There exists no provision currently for coal preparation at mining sites in Mongolia and there is inadequate quality control in the supply system. Coal quality varies substantially, and occasions of substandard coal feed to the CHP plants have caused emergency situations at the power stations. The Mongolian government has addressed this issue in the Copenhagen Accord of the Conference of Parties (COP 15) to the United Nations Framework Convention on Climate Change under the nationally appropriate mitigation actions of developing country parties. The option of coal washing at the biggest coal mines in Mongolia, such as Baganuur and Shivee-Ovoi, is also included in the Mongolian Environmental Action Plan. The increasing production of metallurgical coal may give coal washing technologies new impetus in Mongolia.

Generally, fluidized bed combustion boilers are less sensitive to coal calorific value variation, ash and sulphur content than pulverized coal combustion. At present approximately all boilers in Mongolia use pulverized coal combustion method, but CFB technology has been used in Ukhaa-Hudag PP and proposed for CHP5 plant.

Given the size of the country and long distances between mines and main urban centres and export points, rail transportation of coal is most feasible. Transportation by railway is more economical than road transportation at annual loads of 2-4 million tons.

Other coal based fuels include possibilities to produce liquid fuels from coal or oil shale, gaseous fuel directly from coal mines (CBM) or by converting coal to gas.

Coal-to-Gas technologies can be utilized for (i) the provision of city gas through a piped network to consumers and (ii) for cleaner electricity production by Integrated Gasification Combined Cycle (IGCC) plant.

Coal consumption in the residential sector of Ulaanbaatar is 800,000 t per annum.

Figure 8. Coal Use and Domestic consumption

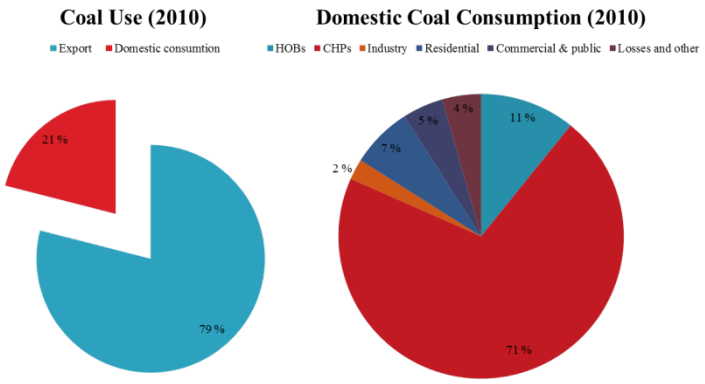
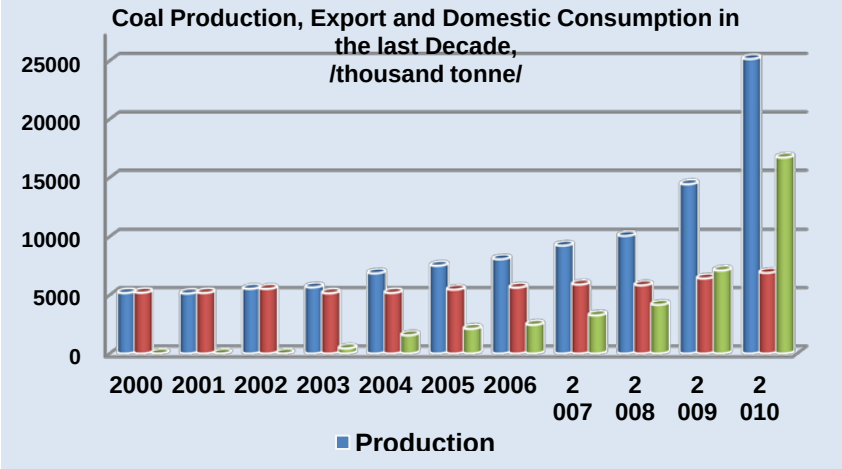


Figure 9. Coal production, consumption and export



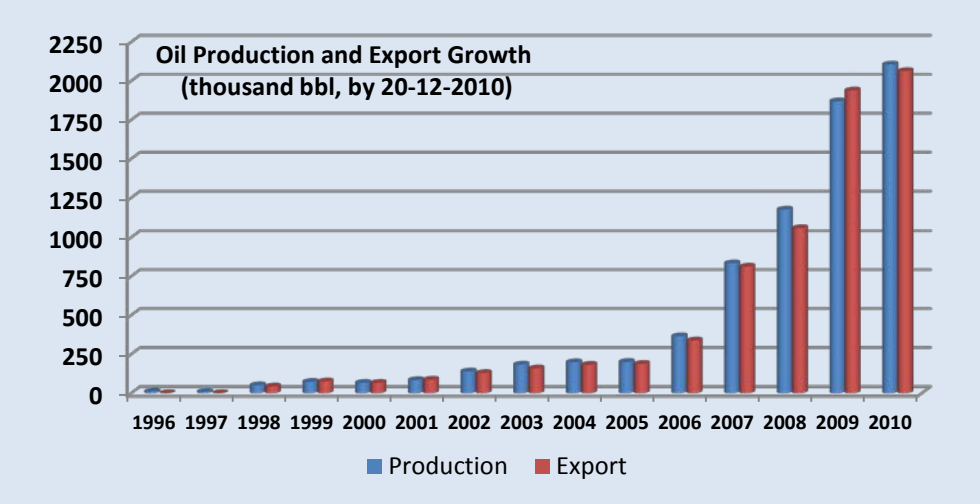
1.2.9 Oil

Although oil products play a minor role in country's energy consumption, some remote and isolated from the central power line settlements still use diesel for electricity generation. However, this consumption accounts for about 1.5% of total imported diesel. Imported oil products are mainly consumed by transport sector of the country.

In 1991, the Petroleum Law of Mongolia was ratified by the Parliament and the Regulation for implementing the Petroleum Law was adopted by the Government of Mongolia. The Law established a legal foundation for new development of petroleum exploration in Mongolia.

The Government policy in the petroleum sector is aimed at developing exploration of the petroleum potential of Mongolia, increasing production and fully supplying oil products from a domestic oil refining industry based on domestic resources to the country's needs through mutually beneficial cooperation with potential international oil companies. The Petroleum Products Law was ratified by the Mongolian Parliament on July 1, 2005. This Law provides the legal environment for State regulation on petroleum products supply and refining operations, safety and issues of petroleum companies' reserves in order to ensure stable supply of petroleum products.

Figure 10. Oil production and export



In 2002, the Government of Mongolia approved the Resolution "Guidelines for Petroleum Sector". In order to increase sources of petroleum product supply, it is important to establish refineries and supply domestic demand with refined petroleum products using imported and domestic crude oil.

1.2.9.1 Oil Products Supply and Demand

As mentioned earlier, Mongolia imports all of its oil product demand. In 2010, Mongolia imported over 878,197 metric tons of petroleum products including gasoline, diesel fuel and lubricants.

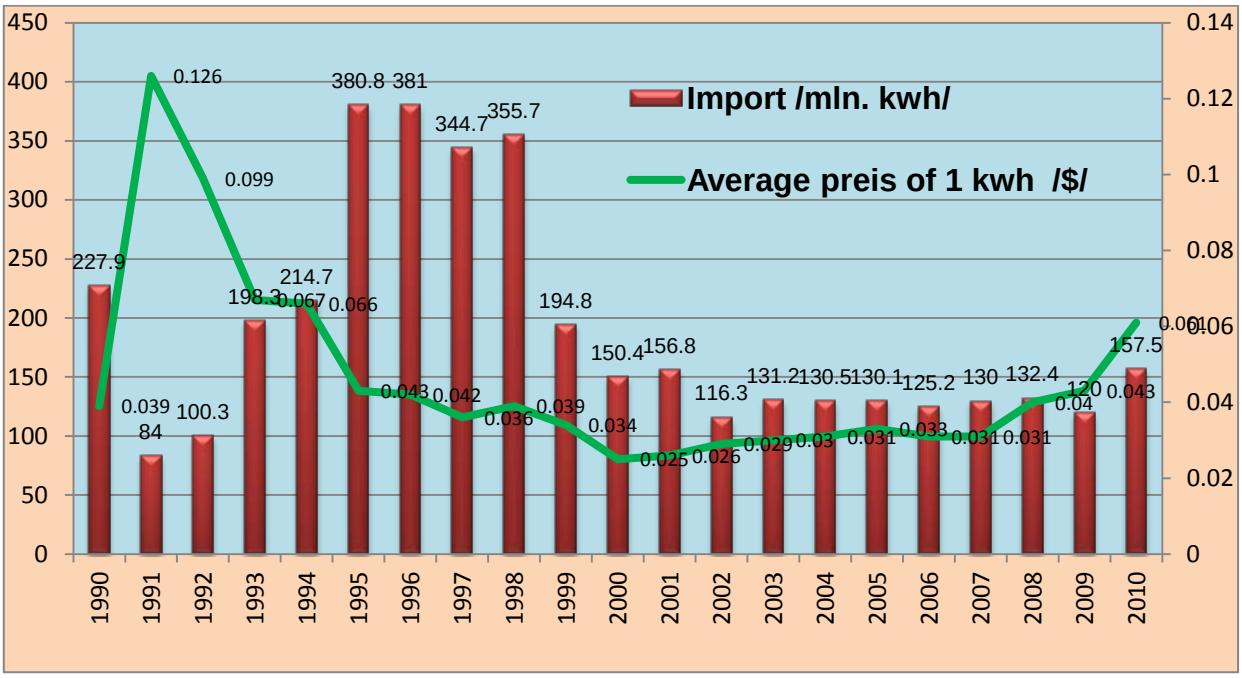
1.2.10 Overseas Energy Dependency

Mongolia imports oil products and electricity from Russia and China. Coal is the only fossil fuel produced in Mongolia.

Table 9. Energy Import Dependence of Mongolia (%)

Year	Energy Import Dependency	Energy Import / total Imports	Russian Dependency	
			Petroleum Products	Electricity
1990	25.21	30.98	100	8.38
1995	17.57	34.21	100	19.95
2000	18.89	26.09	100	9.66
2005	27.52	17.64	95	6.86
2010	25.6	7.78	95	4.2

Figure 11. Electricity Import and Dependency



1.3 Institutional and policy frameworks

The Energy Law was enacted by the Parliament of Mongolia and went into force on April 15, 2001. The law based on economic principles, commercial (market) relationships and on rights and obligations for both the industry and the consumers.

Public utilities, such as companies that generate, transmit and distribute electricity and heat, are a significant part of the infrastructure and major contributors to the national economy. The utilities are traditionally large, capital-intensive entities, and historically have not been subject to competition. Due to their critical role in the economy they are considered strategic. They have been exceptionally vulnerable to political interference in terms of tariff setting and investment decisions. This has frequently led to the imposition of low and controlled prices, subsidized services, and has endangered the financial viability of the energy enterprises and, has subsequently resulted in the introduction of inefficiencies into the economy.

The Government of Mongolia recognized that in order to have successful restructuring, it is necessary to create cost efficient enterprises. With the assistance of the international community, Government is taking steps to assist these new enterprises achieve their needed efficiency levels. Considerable resources are being injected to ensure that plant and equipment are in sound working order, personnel are able to provide the necessary management, and that past financial problems are resolved in a satisfactory manner for all stakeholders, including consumers.

1.3.1 Institutions

Ministry of Energy

According to the new Energy Law the Parliament of Mongolia is in charge of approving the state policy in energy sector. The Ministry of Energy is a line ministry in charge of policy-making for the sector. The policy areas under Ministry of Energy include: development of energy resources; energy use; import and export of energy; construction of power plants, lines and networks; energy conservation; use of renewable energy sources; monitoring the sector; approving rules and regulations for the sector; and, international cooperation.

Ministry of Finance and Economics
The Ministry of Finance and Economics is responsible for socio-economic development policy, strategy, sustainable development strategy, economic security, economic conditions, regulation, investment credit and aid integrated policy, balance of payments, and economic cooperation policies, which are aimed to provide a balanced macro-economy. Since energy sector enterprises are state-owned , investment such as building transmission and distribution lines and networks have been implemented by Ministry of Finance and Economics.

Energy Regulatory Authority (ERA)
According to the Government Resolution #83 of 2001, the Energy Regulatory Authority (ERA) was established, and its code was approved. The ERA is the regulatory body in charge of regulating energy production, transmission, distribution, supply and dispatch according to the Energy Law.

Petroleum Authority
Petroleum Authority of Mongolia, the Implementing Agency of the Government is responsible for the exploration, development and production of oil, as well as of Mongolia's strategic oil reserves. Private foreign companies started oil exploration and extraction since 1998.

Energy Authority
The Energy Authority (EA) was established in 1965, and since then served as the implementing agency responsible for Government's policies for utilization of energy and related resources. The Energy Authority (EA) was reorganized by Government order No. 64 dated on 24th December, 2008 with the following main objectives:

- implementation of projects and programs, funded by foreign loan aid and technical assistance in the fuel and energy sector of Mongolia
- Technical super vision on program and project implementation financed by the state budget
- Planning of short and long term energy prospects
- Carrying out research and evaluation to improve efficiency of energy utilities saving and conservation of energy, decrease energy losses and introduction of new technologies and know-how
- Enhancement of standards and norms of fuel and energy sector
- Chemical regime control, metal logical studies, and monitor and test welding

National Renewable Energy Center
The Renewable Energy Corporation was established as a scientific organization aimed at increasing the use of renewable energy sources and providing research to the government. It now focuses primarily on commercial activities.

The Government of Mongolia passed Resolution #164 on July 9, 2001, which was the first step in corporatizing existing state-owned enterprises in the energy sector. The Government created 18 joint stock companies covering each stage of the energy cycle, including generation, transmission and distribution. According to the resolution, the Ministry of Infrastructure received 41 percent, State Property Committee received 39 percent, and 20 percent of the shares were allocated to the Ministry of Finance and Economics. In addition, the National Dispatching Center (NDC), a company responsible for monitoring and the regulation of dispatch, was created as a limited liabilities company (LLC), and shares of this company were distributed to the Ministry of Infrastructure (51 percent) and the State Property Committee (49 percent).

Currently there is no agency in the country formally mandated to develop and implement the national and sectoral energy efficiency policies and programs and most energy efficiency practices and improvements are voluntarily based in Mongolia. However, the current government believes that the law of energy efficiency would pass the parliamentary discussion in the next spring of

2012. Under the draft of the Energy Efficiency Act, which is to be presented to the Mongolian parliament in 2012, a new office for drawing up and implementing a national energy efficiency strategy is to be set up, which will develop further ordinances and guidelines as well as a central monitoring system.

1.3.2 Private Investment and Enabling Business Environment

The Energy Law provides an establishment of the Energy Regulatory Authority (in 2012 changed to Commission), responsible for regulating power related operations, such as electricity and heat generation, transmission, and distribution activities. The main duties of the Energy Regulatory Authority includes issuance of operational Licenses and monitoring the compliance with the terms and requirements of licenses; review and set up the energy tariffs; keeping an adequate balance between the rights and interests of licensees and consumers; resolving disputes between licensees and consumers; supporting a fair competition in the energy sector.

In 2004-2008 the ERA has been working on following issues, such as energy efficiency, operational model, the Single Buyer Model (SBM), on development of the New Power Market structure, on resolving inter-company arrears and financial sustainability issues.

In order to create necessary conditions for private sector to enter the power market in Mongolia, the ERC is aiming and working to develop the new power market structure.

The new Power Market Structure will differ from the existing operational model totally by introducing power purchasing agreements (PPA) between generating companies and distribution companies and large end-users, which are financial contracts.

Mongolian Parliament approved the Law on Concession in 2010 and this action opens the opportunities to implement new projects in the energy sector such as new power plant by Public-Private-Partnership for private sector.
Following projects are being implemented currently, of which:

- By Concession Agreement:
  - Mogoin Gol/Telmen/ TPP
  - Ulaanbaatar CHP#5
  - Dornod TPP Extention
- By Private Investment :
  - Wind Farms of Salkhit, Choir and Sainshand
  - Chandgana TPP

Hereafter, it is planned to establish methods and mechanisms within the state policy which will implement supports from the government stated on Concession law.

1.3.3 Short-term strategy and goals

In the near future, if new energy sources are not built, a great deal of challenges and difficulties are likely to arise due to growing demand in energy demand in Ulaanbaatar city. Meeting the increasing energy demand of big mining and mineral resource projects that will be implemented in line with the Law on Air Pollution Reduction and "the Program of New Reconstruction and Growth" and the need to urgently solve these issues may result in a serious consequences possibly leading to energy capacity deficiency. Although the issue of developing a new energy sources has been discussed and planned within the sectoral policy systematically, it has been ongoing issue due to the lack of finance and other constraints. Now it is of crucial importance for us to settle this issue of developing new energy sources in a complex way.

Moreover, supporting private sector involvement in the energy sector, creating a favorable legal and tariff condition, developing public-private partnerships are issues that should be settled and can be a gateway to the resolution of above mentioned challenges facing the energy sector in Mongolia. Above issues that should be urgently settled by the Mongolian energy sector in near future incline the need for amending main policy documents of energy sector.

According to numerous studies conducted from government and international organizations on large industrialized and settlement regions and cities (Power consumption prognosis) by 2020 based on the General Plan of Ulaanbaatar city Development; power demand prognosis study of the central energy system of Mongolia and the Gobi mining zone, conducted from Asian Development Bank's consulting company on Ulaanbaatar CHP-5 project's technical study; energy supply required to heat ger district households of Ulaanbaatar city with electric heaters within the framework of Law on Air Pollution Reduction; energy consumption data of industrialized regions by "Worley Parsons" company; technical and economic feasibility study on the Energy Supply to the Mining Consumers of the Gobi Region commissioned from the MMRE in 2010), it can be estimated that between 2015 and 2030, the country's energy consumption rate will reach 1,500 to 3,000MW.

It is necessary to emphasize that the short-term objectives of Mongolia's energy sector are to build new sources of energy to meet the ever-increasing energy demand. In order to meet Mongolia's energy consumption growth for 2015- 2030, it is necessary to build new power stations. The initiatives, active participation and support from international banks, financial institutions, foreign and domestic investors, and business entrepreneurs of the energy sector, are of vital importance for the best implementation of these projects. The fact that our Government's policy and legal environment are favorable in supporting the public-private sector cooperation and investment should create significant incentives for companies investing in Mongolia to further expand their business ventures.

Preconditions of transfer the energy sector to market regulations consist of activities such as making energy tariffs and the legal environment attractive to investors, developing public - private partnership, and establishing and exploiting new energy sources with the participation of the private sector.

However, the Government in accordance with the law needs to improve power lines networks under its purview, and expand and develop it in line with the construction of new energy supply networks. Consequently, with the construction of new power stations, and the creation of a properly balanced supply network system that includes traditional as well as renewable energy sources, the Program on Integrated Energy in Mongolia will be implemented providing opportunities for a reliable and secure energy supply. With the introduction of integrated energy system and new techniques and technologies, Mongolia will have proper conditions to operate its energy supply networks efficiently and economically, contributing to its rapid economic and social development as well as strengthening its economy.

One third of population in Mongolia has nomadic lifestyle herding 50 million livestock. Because of the nomadic style of living, it is difficult to develop appropriate electricity access for them. The Government is encouraging the development of renewable energy, such as small hydro, solar and wind energy.

From the policy view major priorities for the Government is to create necessary institutional framework for private sector participation (PSP), to improve efficiency of energy sector, to facilitate the development of renewable energy, to accelerate commercialization of energy companies. The Government believes that the strong legal, institutional and regulatory framework, which reduces investors' risk and encourages investors' long term commitment (concessions,

independent power producers (IPP), power purchasing agreements (PPA)), is necessary to bring the private sector in building new capacities, in developing power links, introducing energy efficient technologies, and promoting the use of renewable energy sources.

The Government of Mongolia approved in 2002 the “Mongolia Sustainable Energy Sector Development Strategy Plan”, and it reflects goals reinforced in the Poverty Reduction Growth Facility (PRGF) program, which is endorsed by international and donor community. The main objective of the Energy Sector Strategy of Mongolia is to create a financially sustainable energy sector that will provide cost-effective energy access, thereby enabling poverty reduction and greater private sector and civil society participation. Mongolia’s energy sector will be developed within a regional energy context, while at the same time taking advantage of new technologies and sources of energy that might further promote economic efficiency and environmental sustainability.

The Government of Mongolia launched a new program titled “Liquefied Petroleum Gas” which is aimed to promote the use of LPG by households and transport, to introduce necessary safety standards and regulations.

1.3.4 Long-term Policy Objectives and Targets

The State Parliament and the Government of Mongolia approved a "Program on Integrated Energy System of Mongolia", "the National Program on Renewable Energy" and the “100000 Solar Ger” Program in addition to "the Comprehensive Policy on National Development" and Government programs include concrete short-term and long-term strategies for the development of the energy sector.

These policies include plans to set up a fully integrated energy system by 2040 by establishing a transmission line between the Central, Western, Eastern, Altai-Uliastai energy systems, Dalanzadgad CHP and energy systems in Gobi region. The sector development and policy documents planned to establish thermal power plants and as well as to fully meet the increasing energy demand of the country and to have a capacity to export electricity to neighboring countries by producing energy from hydropower plants at Eg, Orkhon, Selenge river, solar and wind power plants to be built in Gobi and central region.

If to assess energy sector according to its developmental phases, the period between 2000 and 2008 was a time of electrification where structural changes into the energy sector was made, state policy on providing electricity were implemented, all aimags and soums in the countryside were connected to electricity and nomads were provided with small scale renewable energy sources.

Period from 2008 to 2011 became a time when equipment and technologies were upgraded and renovated and when preparatory works for supplying sources to regional electricity systems went underway.

The period between 2011 and 2016 can be seen as a beginning of new development era in which large scale energy supply networks and main power lines will be built to establish an Integrated Energy System which will meet the country's ever-growing energy demand. This period is considered to be a technologically progressive stage to bring up the energy sector development to a new stage with modern and environmentally friendly technologies.

2 SE4ALL GOALS AND CURRENT SITUATION

SE4ALL initiative was launched by the secretary general of the UN, Ban Ki-moon in an attempt to stabilize the global climate change issues. Furthermore, the developed countries face the challenge of transforming the existing infrastructure and developing countries to adopt more cleaner and efficient technologies from the start. The initiative includes the following global goals:

- To ensure the global access to the modern energy system
- To double the global rate of improvement in energy efficiency
- To double the global rate of renewable energy in the global energy mix

In May, 2012 UNIDO's Director-General and SE4ALL Co-Chair Kandeh Yumkella visited Mongolia and invited to join Mongolia to the SE4All initiative and the Ministry of Energy initiated the rapid gap assessment of Mongolia for the SE4ALL initiative.

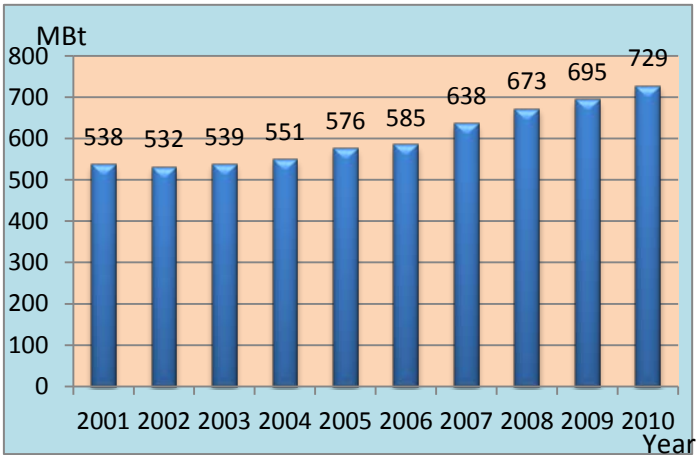
2.1 Energy accessibility

2.1.1 Electricity accessibility

2.1.1.1 Overview of the electricity supply

The largest of the 5 electricity grids, which covers the area where most of the country's population lives, is the Central Energy System or CES. The peak load has been growing continuously in the CES and it reached 729MW in the winter of 2010 (Figure 12**. Peak load and growth rate in CES**) from 538 in the beginning of last decade. This peak load figure includes the Erdenet Copper Mine load and power stations own usage and it accounts for approximately 95% of the total load.

Figure 12. Peak load and growth rate in CES



The other three grids cover the western and eastern part of Mongolia and are very small in comparison with CES. The Western Energy System (WES) covers the aimags of Uvs, Bayan-Ulgii and Khovd in the Altai Region with a total demand of about 23 MW and the Eastern Energy System (EES) serving the two eastern aimags of Dornod and Sukhbaatar with a total demand of about 21 MW and Altai Uliastai Energy System (AUES) serving Gobi-Altai, Zavkhan province with a total demand of about 11 MW.

A serious aspect of the CES is its age. It is apparent to professional circles that major refurbishment must be considered in the short-term and medium term replacement of the generating capacity has to be planned for soon.

Rehabilitation projects on the CHPs TES 3, TES 4 in Ulaanbaatar, the Darkhan CHP and the Choibalsan have been carried out and are partly financed by loans from various donors.

Table below shows the accessibility of energy service to the households in urban and rural areas of Mongolia as of 2008 and 2011. Urban areas are well connected to the electricity network while households in rural areas have limited access to the electricity network. 45.7% of the households have no access to the electricity while 54.3% have an access to electricity. Furthermore, poorer households have slightly less access to the electricity.

Table 10. Accessibility of electricity

Accessibility of electricity				
	Urban		Rural	
	No	Yes	No	Yes
2008[a]	1.2	98.8	59.1	40.9
2011[b]	0.5	99.5	45.7	54.3
Poor households				
2008[a]	3	97	59.1	40.9
2011[b]	0.8	99.2	47.2	52.8

[a] Household Socio-economic survey 2007-2008
[b] Household Socio-economic survey 2011

2.1.1.2 Implementation of the Program on Integrated Energy System of Mongolia

Currently, all 21 aimags and 314 soums are supplied by centralized energy source and of which 10 soums are connected foreign electricity supply. 17 soums are supplied by renewable sources and other hybrid systems. 2 soums are supplied by diesel generator.

The first phase or short-term (from 2007 to 2012) action plan of "the Program on Integrated Energy System of Mongolia" is currently being implemented successfully.

Government of Mongolia is developing private and public partnership in the energy sector and has given number of licenses for the building of power plants by private sector investments at site of demand.

2.1.1.3 *Implementation of "100000 Solar ger" and "the National Program on Renewable Energy"*

Currently, use of renewable energy sources for power generation has become a reality as a result of which about 130,000 nomadic families and 15 soums have access to electricity using a renewable energy sources. 62.5 % (100,000) of all nomadic herder family or 18.2 % of total population (around a half million people) have supplied by independent solar PV system within this project. Additional 30000 families have bought the independent solar PV and wind energy system in the market. Totally, from 170,000 herders families 89% (around 130,000) have access to electricity by independent solar PV and wind energy system. This project made Mongolia as one of the countries with the highest number of wind turbines in the world. Moreover, it made the living standards in the rural area better.

2.1.2 Heat

In the urban areas heat is supplied by the combined heat and power plants mostly. However, in the rural areas and ger districts of the cities, heat source mainly based on the biomass and coal burning small scale stoves (Table 11. **Heating supply**[a]). In the suburban areas of the cities, aimag centres usually regular stoves that burns coal and biomass (animal waste and wood) are used due to the fact that it covers very large area and not connected to the central heating system.

Table 11. Heating supply[a]

	Share of households (%)			
	Ulaanbaatar	Aimag centres	Soum centres	Rural
Central system	34.4	25.1	6	1.5
Regular stove burning coal and biomass	62.9	69.3	89.6	97.3
Other (electric, candle etc.)	2.7	5.6	4.4	1.3

[a] HSES 2011, NSO of Mongolia

2.2 Energy efficiency

2.2.1 Overview of energy efficiency improvements and legal framework

The Government of Mongolia has included energy efficiency strategic goals in its **Millennium Development Goals**, targeting "incorporating sustainable development principles into and implement national policy and programs, and clean up air pollution of settlements, especially in Ulaanbaatar City". An integral part of meeting that target is defined to be "Developing and approving standards and norms for energy efficient building, introducing heating energy assessment system for buildings, support production of construction insulating materials, works on additional insulation of plants, public sites and housing units are important to reduce air pollution gradually."

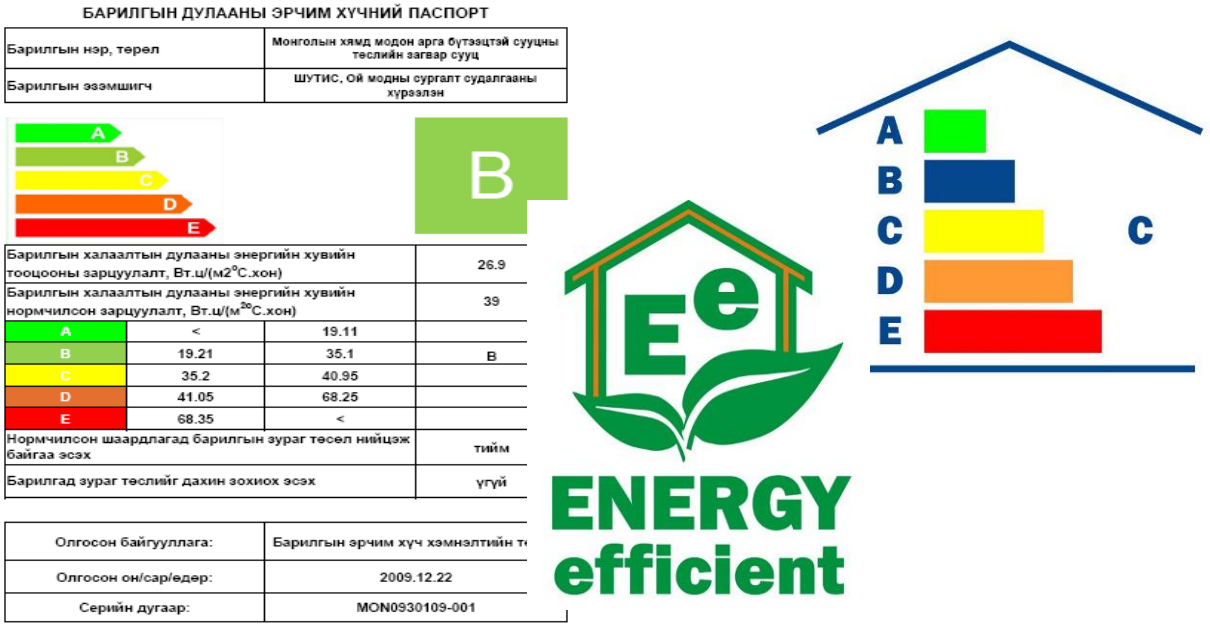
Currently there are no formally adopted energy efficiency priorities and policies by the Mongolian government. Two draft laws on energy efficiency were prepared in 2003, one by the former Ministry of Infrastructure, another one by the USAID consultants. The Ministry's draft was discussed at the cabinet, but was not endorsed for submission to Parliament. No progress was made from 2003 till recently for the development and approval of energy efficiency legislation.

In July 2010 with the financial support of ADB the development of a new Draft Energy Conservation Law has been initiated as well as the development of a Medium and Long term Energy Efficiency Action Plan for Mongolia.

The current Building Law, Housing Law, and Urban Planning Law of Mongolia provides the necessary legal basis for the updating of the Mongolian building code energy efficiency provisions systems.

In 2010 within the framework of GEF/UNDP Building Energy Efficiency Project, BNbD 23-02-2009 "Buildings Thermal Performance"**,** BNbD 41-01-2011 "Heating ventilation and air-conditioning", BNbD 23-101-2010 "Thermal performance design of building"were developed and adopted. Furthermore, 19 ISO and EN standards and norms were translated and adopted in Mongolia in 2010 and 7 in 2011. Another achievement of the project was the introduction of the building label which labels the in terms of it thermal performances (Figure 13**.** and Table 12**. Energy efficiency of buildings**).

Figure 13. Building labels.



БАРИЛГЫН ДУЛААНЫ ЭРЧИМ ХҮЧНИЙ ПАСПОРТ

Барилгын нэр, төрөл	Монголын хямд модон арга бүтээцтэй суурцны төслийн загвар сууц
Барилгын эзэмшигч	ШУТИС, Ой модны сургалт судалгааны хүрээлэн

A B C D E

B

Барилгын халаалтын дулааны энергийн хувийн тооцооны зарцуулалт, Вт.ц/(м2°С.хон)			26.9
Барилгын халаалтын дулааны энергийн хувийн нормчилсон зарцуулалт, Вт.ц/(м2°С.хон)			39
A	<	19.11	
B	19.21	35.1	B
C	35.2	40.95	
D	41.05	68.25	
E	68.35	<	
Нормчилсон шаардлагад барилгын зураг төсөл нийцэж байгаа эсэх			тийм
Барилгад зураг төслийг дахин зохиох эсэх			үгүй

Олгосон байгууллага:	Барилгын эрчим хүч хэмнэлтийн т
Олгосон он/сар/өдөр:	2009.12.22
Серийн дугаар:	MON0930109-001

A B C D E C

Ee ENERGY efficient

Table 12. Energy efficiency of buildings

The Levels	Classification vs. Energy Efficiency	Deviation of design (actual) values of specific thermal energy consumption of for building heating, q_h^{des} from normative, %	Recommended Actions by Authorities
For new and reconstructed buildings			
A	Very good	Less than minus 51	Economic incentives
B	Good	Minus 10 to minus 50	Economic incentives
C	Normal	Plus 5 to minus 9	Increase the efficiency level
For existing buildings			
D	Poor	Plus 6 to plus 75	Preferred refurbishment of the building
E	Very poor	More than 76	Insulate the building in the near future

In the near future new building codes, norms and standards are planned to be developed, covering thermal performance, HVAC systems, insulation materials, lighting systems and hot water systems.

2.2.2 Energy efficiency projects and activities

2.2.2.1 Power and heat generation and distribution

As a result of economic development and construction works in Ulaanbaatar, Darkhan and Erdenet cities as well as continuous connection of remote aimags and soums to the centralized power

supply systems, the power consumption is increasing by 5-8 % on average annually and is expected to continue rising. Investments in power infrastructure did not meet the demand, which has significantly lowered the reliability of electricity supply and has increased overloading of aging distribution network. The overall energy system is characterized by low operational efficiency and poorly maintained and obsolete equipment. There is urgent need of investment in system rehabilitation, improvement of system management, and strengthening of reforms to improve efficiency of electricity generation and distribution and commercial viability. Some projects to improve energy efficiency in the electricity and heat generation and distribution have been already initiated and implemented with the support of various international financing institutions and donors.

Two **Energy Sector Projects**, financed by the **WB** aimed to improve the reliability and financial sustainability of electricity distribution companies in Mongolia, so that consumers are provided high-quality distribution services by commercially-operated distribution utilities.

Table 13. Electricity distribution losses in Ulaanbaatar and aimags, %

	2004	2007
Ulaanbaatar	30.64	23.07
Bayankhongor	46.3	16.6
Gobi-Altai	43.2	9.2
Umnugobi	33.76	12
Dornod	19.46	6.7
Khuvsqul	41.3	21.8
Suhbaatar	18.33	4.8

GIZ has been involved since 1998 in a project **"Promotion of energy efficiency and renewable energy in Mongolia"** which contains a number of actions to support supply side energy efficiency. Core activities included technical and economical analysis of power plants and network systems, measures were introduced to increase power efficiency factors both in heat and power generation and finally support was provided to distribution networks to measure and reduce energy losses. In addition to supply side management, various demand side management project will also be implement by the GIZ between 2010 and 2013. GIZ will provide the grant of 1.7 million euro for the projects while KfW will provide 4.5 million euro grant for the end energy efficiency and 8.5 million euro soft loan for power plant energy efficiency.

The project **Improvement of District Heating Systems in Urban Centres of Mongolia** funded by EuroAid improved the energy efficiency of district heating systems with a capacity of 0.8-2.5 MW and reduced their coal consumption. Main activities in Uliastai municipality included a number of technical and capacity building measures: rehabilitation of the heating plant (boilers, regulation, and distribution system); training and capacity building of local operator to manage and operate the local heating plant.

2.2.2.2 Efficient household stoves

Typically, gers use small stoves for cooking and heating. The stoves are simple in design and tend to produce high levels of air pollution because they rely on short chimneys and are continuously in use.

In 2001-2007 World bank project has been implemented with the support of the Mongolian Government, with the aim to promote the design and dissemination of **stoves with improved fuel**

efficiency, to reduce coal fuel consumption-and corresponding CO_2 emissions and levels of air pollution (indoor and outdoor) in the ger area of Ulaanbaatar.

The **Ulaanbaatar Clean Air project** initiated in 2009 aims to overcome the barriers identified by implementing efficient stove research and development, establishing a testing laboratory and certification system for stoves, develop and launch awareness raising campaign for the benefits of using improved household stoves and propose subsidy mechanism (Voucher system).

2.2.2.3 Straw bale housing and ger insulation

Energy Efficient Housing Project (also named Commercialization of Super-Insulated Buildings in Mongolia) has been implemented during the period 2002 - 2007. to promote the use of straw-bale building (SBB) and other energy efficient technologies for building and ger insulation. Norms and standards for straw-bale housing have been developed in close cooperation with the Ministry of Urban Construction and Development.

As a continuation of these activities "Energy Conservation and emission reduction from poor households" project starting from 2010 will provide high insulation ger to the most vulnerable part of the households in Ulaanbataar ger district.

2.2.2.4 Buildings envelope and district heating systems

Energy Efficiency in New Construction in the Residential and Commercial Buildings Sector in Mongolia (BEEP) is a project, funded by GEF trough UNDP. Local executive partner to the project is MCUD. The implementation will continue till 2013. The project objective is the reduction of green house gas (GHG) emissions from the buildings sector in Mongolia, by improving the energy utilization efficiency in new construction in the residential and commercial buildings sector. With the successful implementation of the envisioned activities, the direct GHG emission savings as a result of the project is expected to be 63,000 tons of CO^2 emissions over a 20 year period.

A pre-feasibility study within ADB Cities Development Initiative for Asia Technical Rehabilitation Program for panel Buildings in Ulaanbaatar was completed in May 2009. The pre-feasibility study has successfully provided the basis for a long-term investment program for the thermo-technical rehabilitation of the 426 pre-cast panel buildings in Ulaanbaatar (Figure 14. **A nine storey pre-cast panel building in Ulaanbaatar**), including introduction of individual metering for households. A CDM baseline study is under development for a selected cluster of panel buildings.

Figure 14. A nine storey pre-cast panel building in Ulaanbaatar

With the assistance of GTZ, 2 family houses with solar heating systems were built in the Khan-Uul district, Ulaanbaatar in 2006. For this project the initial investment for the solar heating system was too high. In 2007, the apartment of 29 households in 6th district, Chingeltei, Ulaanbaatar was insulated as a trial.

USAID financed the project to insulate the building of 79th kindergarden in Bayanzurkh district, Ulaanbaatar and rehabilitate the heating system was implemented in 2012.

2.2.2.5 Industrial sector

Mongolian Chamber of Commerce and Industry is organizing and conducting regular workshops and trainings focused on capacity building to develop and implement energy efficiency projects for their members. They were also involved in a few projects to promote Energy Efficiency/ESCO services in industrial sector.

The NEW 21 Project was implemented in 2001 – 2007 with the financial support Royal Netherlands Embassy in Beijing and the beneficiary was the Mongolian National Chamber of Commerce and Industry. The project organised series of specialized trainings for potential ESCO companies' staff and three demonstration projects were implemented at two private enterprises and in one government building. The project involved modifications to air compressors and improvements to a building.

The project Capacity Building of Mongolian and Inner Mongolian (Chinese) Energy Service Companies (ESCO) was implemented from 2008 to 2009 by Mongolian National Chamber of Commerce and Industry together with Centric Austria International and China Council for the Promotion of International Trade.

2.2.2.6 Energy efficiency financing

Major sources of financing of energy efficiency activities in Mongolia are provided through international co-operations with a number of multilateral institutions such as the WB, ADB, EU and the UNDP, as well as with foreign partners such as USAID, JICA, the German, Norwegian and other Governments. Mongolian government participates with co-financing (including in-kind) in a number of projects.

The **Green Credit Guarantee Fund** was established with financial support of 400000 USD from the Dutch Government to support cleaner production and energy efficiency in the industrial sector of Mongolia. The Mongolian Chamber of Commerce and Industry is discussing possibilities with the Government institutions for additional financial support to be provided for continuing funds operation.

2.3 Integration of renewable energy

Renewable energy is one priority for the Mongolian energy sector, as set out by the Government in policy documents such as the Government Action Plan, Millennium Development Goals and Mongolia's Strategy for Sustainable Development of the Energy Sector. The use of renewable energy is vital for improving and securing a sustainable energy supply, particularly for rural electrification and heat supply. It attaches great importance to the research and exploitation of new energy sources.

In June 2005, the Mongolian Parliament approved the **National Renewable Energy Program** which sets ambitious goals for broad-based renewable energy development: increasing the share of

renewable energy technologies in total energy supply from 0.9% in 2005 to 3-5% by 2010 and to 20-25% by 2020.

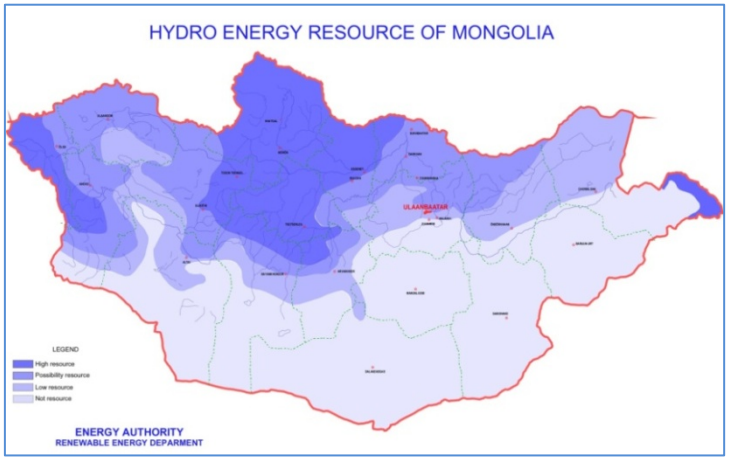
The **Renewable Energy Law** of Mongolia came into force on 11 January 2007 and regulates the generation and supply of energy from renewable energy sources.

2.3.1 Renewable energy potential and utilization

2.3.1.1 Hydropower energy

Another potential source of primary energy in energy mix is hydropower. There is a significant potential in Mongolia for hydropower generation (Figure 15**. Hydro energy resource of Mongolia**). There are around 3,800 small rivers in Mongolia with a total lenght of 65000km with gross theoretical potential of about 6.2GW. At present, more than 1GW of these has been identified. There are 13 hydropower stations in Mongolia in operation and the most of them are small or medium sized plants. Only four plants are connected to local grids while the rest serve isolated grids of nearby soums. Three plants are with installed capacity higher than 1 MW, namely Durgun (12 MW), Taishir (11 MW) and Bogdiin gol (2 MW).

Figure 15. Hydro energy resource of Mongolia



2.3.1.2 Wind Energy

Mongolia has huge potential for wind energy. Mongolia's wind resources occupy around 10% of the total land area with power density of 400-600 W/m^2. The resources could potentially supply over 1,100 GW of installed capacity. All of the Aimags have at least 6,000 MW of wind potential, three Aimags have at least 20,000 MW and nine Aimags more than 50,000 MW of wind power potential. Table 14. **Potential resource of wind energy in Mongolia** shows that Mongolia has potential to generate 2550.1TWh electricity annually from only wind energy sources of which 1975.5TWh is produced from the low wind speed areas. Low wind areas account for the 83% of the total area with the potential for wind energy.

Theoretically, the government's renewable energy target of 20% by year 2020 could be reached by wind power alone. This would require approximately 600 MW in installed wind power capacity producing 1,800 GWh of energy. The intermittent nature of wind power can be smoothened by geographic spread of projects. The wind power capacity of 600 MW would require about 100 MW of fast regulating capacity, such as hydropower or continued import from Russia, to be available.

With the private investment of Newcom, Mongolian company 50MW's wind farm was installed in Salkhit valley of Tuv aimag.

Table 14. Potential resource of wind energy in Mongolia

Category	Wind at 30 m height		Total area coverage		Total capacity MW	Energy to be produced GW.h/year
	Power W/sq.m	speed m/s	Sq.km	%		
3	300-400	6.4-7.1	130.665.	81.3	905.500	1.975.500
4	400-600	7.1-8.1	27.165	16.9	188.300	511.000
5	600-800	8.1-8.9	2.669	1.7	18.500	60.200
6	800-1000	8.9-9.6	142	0.1	1.000	3.400
Total			160.641	100.0	1.113.300	2.550.100

Figure 16. Wind Energy resource of Mongolia

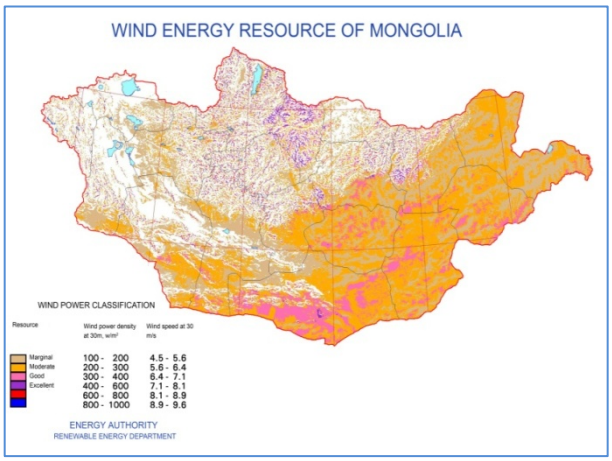


Figure 17. Small Wind Generator Supplying Ger with Power

2.3.1.3 Solar energy

Mongolia has potential resource for solar power and solar heating. Solar irradiation ranges from 4.5kW/m^2 per day in the northern part of the country, with less than 2,600 annual recorded hours, to 5.5-6.0kW/m^2 per day in the Gobi area. Regions with high irradiation account for around 70% of the country, while those with intermediate levels of solar radiation cover 18% of Mongolian territory. A large solar PV project is proposed to be studied in the Gobi area.

Solar heating is under-developed in Mongolia. One reason is that hot domestic water is provided by the district heating company. Therefore, there is no consumer level incentive to install individual roof-top solar heaters. Consequently, solar heating potential should be tapped by the district heat distribution companies and possibly at locations of the nearest heat exchange stations to a block of buildings, i.e. in the secondary networks, where domestic hot water is heated.

Figure 18**. Solar energy resource of Mongolia**

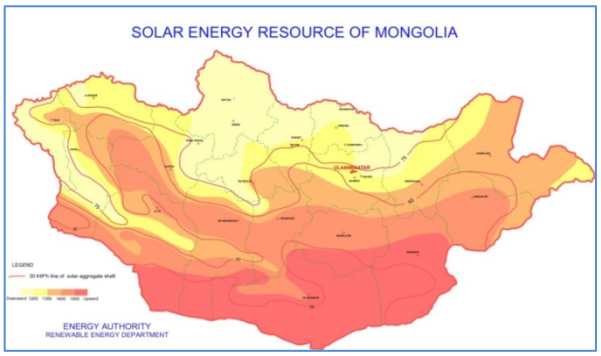


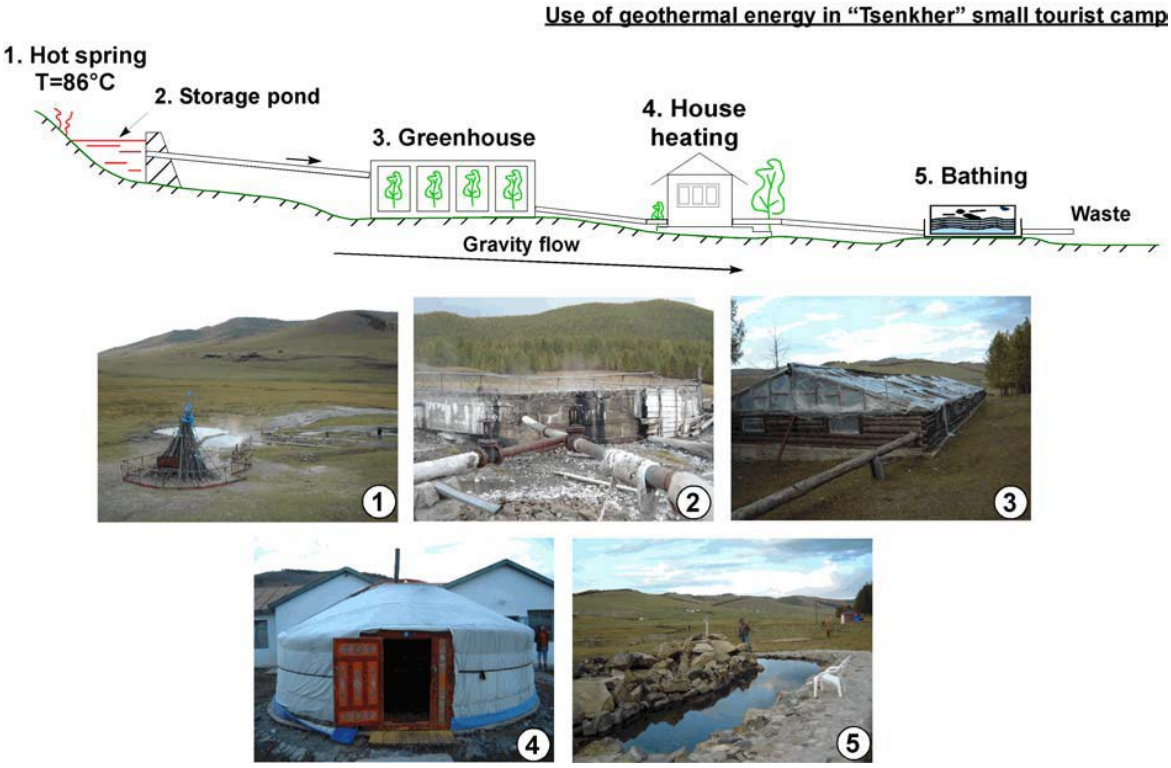
Figure 19**. Photovoltaic Power Generation System in Rural Area**

2.3.1.4 Geothermal energy

There are tens of small hot springs in Mongolia and some of them are used for traditional health resorts and small-scale heating. Geothermal energy, when available, can be combined with heat pump technology to provide district heating.

Today in Mongolia, some hot springs in the Khangai area are used to a small extent for house heating, greenhouse heating and space heating. In the Shargaljuut village of Bayankhongor aimag (Figure 1, hot spring 16) house heating is by using geothermal hot springs (T=92/C, Q=25l/s) since 1960. It is one of the best examples of geothermal energy use for heating in Mongolia.

Figure 20. Use of geothermal energy at a tourist camp



In terms of the suitable region to develop geothermal energy for commercial use, the Khangai-Khentii zone was identified as the favorable and more benefit promising compared to the other regions in Mongolia. The geothermal subsystems of Tsenkher and Taragt are best and benefit

promising on the using for district heating purpose in the towns of Tsetserleg and Arvaikheer. The direct use of geothermal energy is more acceptable in the first cases toward the successful mastering on the geothermal energy utilization in the areas with low temperature hydrothermal resources in Mongolia. The indirect district heating system with a central heat exchanger plant is more attractive on the heat supply of the rural towns in Mongolia. It is more efficient against to the schemes with distributed customer heat exchanger substations.

Table 15. Geothermal energy projects

Zones	Types of structure	Heat flow MWt/m2	Heat kcal/sec	Total heat capacity m3/h	Conditions of hydro-geothermal systems	Depth of geo-thermal
Khangai-Khentii	Open, water and steam mixed pressurized, there are faults and pores fracture	60-70 80-110	14142.0	7321.4	Favorible, more befit promising	500-3000
Khuvsgul	Open and semi open	40-80	1248	59.5	Favorible	1000-3000
Mongol-Altai	Semi-open and closed	30-70	889	39	Probable	1000-3000 (>5000)
Mixed intermediate zones	Closed	30-60	-		Probable	>3500-5000
Orkhon-Selenge	High mineralized, prerssurized between stratums	30-40 70-90	-		Fields to investigate and drill	>2000-5000
Dornod Mongola	Pressurized between stratums, with oil stratums	-	-			
Great lake concaves	Pressurized between stratums	-	-			
Desert Gobi	Improbable		-		-	-

2.3.1.5 Biomass energy

Mongolia has a form of renewable energy resource, biomass originated from livestock (dried cow dung, pellets, horse-dung, hardened dung and urine of sheep and goats) and other types of biomass such as straw, woods, shrubs, biomass waste of urban settlements.

Mongolians have longtime tradition of herding livestock and using the biomass, an accumulated and converted form of energy, such as dried cow dung, hardened dung and urine of sheep and goats as the source of fuel and this tradition continues today. The dried cow dung is cheap fuel that can be collected easily during anytime of the year in all regions of Mongolia. Dried cow dung, and hardened dung and urine of sheep and goats have been the key source of fuel for herders, especially in regions with limited forest reserve or any forest reserve at all [Institute for Renewable energy, Academy of Science].

Mongolia has approximately 40 million livestock. Therefore, Mongolia produces a significant amount of biomass per annum which may enable biogas productions and power plants using biomass. Attempts to build biogas plant were made [Institute for Renewable energy, Academy of Science] and due to scattered locations of the farms (livestock was privatized after collapse of the socialist regime in Mongolia and large farms run by the state were stopped) in Mongolia, it is difficult to make it economical. However, the signs of recovery for the farming industry (dairy and meat production) in Mongolia are being observed in the countryside. Therefore, the biogas plant could become more economical if it is based on the large dairy farm or between several dairy farms which produce significant amount of animal dung per day.

2.3.2 Renewable energy projects

With an assistance of the donor organisations and private sector partnership, several renewable energy projects were undertaken in Mongolia. Table 15. **Renewable energy projects in Mongolia** shows the progress of projects undertaken so far and the source of finance. The installation of first Mongolian wind park project invested by the private sector was started in Salkhit, Tuv aimag. Newcom group of Mongolia is working with the General electric and European Bane of Renovation and Development. Moreover, two of Mongolian hydro power plants (Durgun and Taishir) were qualified for the CDM (Clean development mechanism).

In addition to the project implemented already, Table 16 shows the progress on the proposed large scale hydro, wind and solar power plants projects in Mongolia.

Table 16. Renewable energy projects in Mongolia

Projects		
Name	Description	Financing
Taishir hydro power project	Hydro energy-The government of Mongolia and "Abu Dabu" development fund	CDM Japan
Durgun hydro power project	Hydro energy-The group "Shanghai" of foreign economic and technology cooperation of China	CDM Japan
"100000 solar ger" program	Solar PV system-The government of Mongolia	Government subsidy/WB
Promotion of Renewable Energy Utilization	Wind energy, Solar PV System, Hydro energy-GTZ (German Technical cooperation)	Grant Aid
Development of renewable energy resources	Rehabilitation of Bogdiin Hydro Power Project Rehabilitation of Uliastai Electricity Network project	GTZ, Germany
Wind Park project with 50MW	Wind Energy- group "Newcom" LLC	Private Ownership
Renewable energy and rural electricity access project	Wind Energy, Solar Energy-The WB	Grant Aid
Proposed projects		
Name	Status	Capacity
Erdeneburen hydro power project	Technical and economical feasibility study completed	60MW
Egiin gol hydro power project	Technical and economical feasibility study completed	200MW
Chargait hydro power project	Technical and economical feasibility study completed	24.6MW
Khust aral hydro power project	Pre-Feasibility study completed	15MW
Orkhon hydro power project	Pre-Feasibility study completed	100MW
Taishir wind park project	Pre-Feasibility study on going	10MW
Large scale solar power plant project	Pre-Feasibility study on going	25MW

To support the renewable energy projects the government of Mongolia is providing a feed in tariff of 9.5c/kWh for the wind energy and 15c/kWh for the solar energy. Table below shows the projects

already signed the contract with the government and those projects developing the contract to be signed and the estimated year of completions.

Table 17. Ongoing **r**enewable energy projects in Mongolia

#	Name	Capacity (MW)	Condition	Electricity tariff	Year of Commissioning
1	Salkhit WF	50	Signed a contract	9.5 c/kWh	2012
2	Choir WF	50	Signed a contract	9.5 c/kWh	2015-2017
3	Sainshand WF	50	Under development	-	2015-2017
4	Oyutolgoi WF	102	Signed a contract	9.5 c/kWh	2013-2014
5	Khurmen WF	-	Under development	-	2015-2017
6	Bayanteeg Solar PP	7.8	Under development	-	2015-2017
7	Sainshand Solar PP	50	Under development	-	2018-2020

Since 1998 GTZ has been implementing the project Development of renewable energy resources in Mongolia by promoting the economically efficient use of renewable energy potential in rural areas. The activities were mainly targeting two western aimags Zavkhan and Khuvsgul.

Renewable Energy and Rural Electricity Access project is a GEF/WB five years project, started in 2006. The objectives are to (i) increase access to electricity to the nomadic herder population; (ii) reduce the costs and increase the reliability of electricity service in off-grid soum centers; (iii) remove barriers to the scale-up of renewable energy use; and (iv) reduce emissions of carbon dioxide.

The construction of two hydropower plants Taishir (11 MW) and Durgun (12 MW) are registered as a CDM projects with Japan.

Figure 21. Durgun and Taishir hydropower plants

In the framework of “The 100.000 Solar Gers program” 100,000 gers were provided with solar PV systems using electricity lights, radios, TVs and satellite dishes. In the “National Program for Renewable Energy /2005-2020/” approved by the State Great Khural’s Resolution No 32 June 9, 2005, it was pointed out to perform feasibility studies of hydropower plant construction for electrification of selected 16 soum centers by using hydro energy resource. The pre-feasibility study of the project was implemented by the National Renewable Energy Center in May 2005.

3 GAPS AND BARRIERS FOR ACHIEVING SE4ALL INITIATIVE

The aim of the SE4ALL initiative of the UN is to make the energy accessible for all by 2030, to double the energy efficiency by 2030 and to double the consumption rate of renewable energy in the total energy consumption by 2030. Thus participating countries are required to implement policies and take actions to ensure that households are fully covered by the energy supply and make efforts to improve the efficiency of the energy sector. Finally, countries are required to implement a policy that significantly increase the intake of energy products produced from the renewable sources by 2030.

Gaps:

Accessibility to the energy services

In achieving these goals in Mongolia, Mongolia should increase the electricity accessibility in the rural areas from 47.2% to 100% or close. In urban areas, almost 99% of households are connected to the modern electricity system (Table 10. **Accessibility of electricity**).

On the other hand, it is almost impossible to avail the secure energy services to the household living in the rural areas of Mongolia and keeping the traditional nomadic culture. This issue is being partly resolved by the 100000 sun light program and availability of small scale wind and solar system for herder families. Now, almost 89% of the herder families have such systems in their camp and enjoy having the light bulbs on in the evening and watching TV programs. Only few families have larger systems that support small refrigerators or freezer.

Petroleum products supply

Mongolia has oil reserves located in the southern part of the country. However, currently explored crude oil is exported directly China. In Mongolia, currently there is no oil refinery.

There is one small scale bio-diesel plant in operation in Ulaanbaatar. It has been producing bio-diesel using used vegetable oil from the restaurant and bakeries. However, due to lack of raw material, its production gets interrupted frequently. The main competitor for this distillery is the candle factory in the UB city as they have already contracted with the large bakeries to take their used oil.

Natural gas supply

Mongolia has no natural gas, import of LPG from foreign country is expensive and it cannot compete with the cheap coal reserves. However, the use of LPG is clean and efficient. “Liquefied petroleum gas” programme that was initiated by the Resolution 140 of the Government of Mongolia and it is intending to supply households and public service buildings by LPG. For the supply chain of UB households need 656 408 m^3 LPG.

Central heating supply

In the amaig and soums centre, heating is supplied mostly from the small scale heat only boilers which consumes approximately 80-120 tons of coal per annum and the supply is only limited to the offices and few apartment blocks in the centre. But, in the ger districts, majority of household live and use inefficient stoves using biomass, wood and coal. Therefore, heating systems in the urban

areas need to be improved and new CHPs need to be build and ger districts need to be connected to the centralised heating systems. In the Sukhbaatar aimag centre, attempt to connect the ger districts to the water supply is being made. This would also improve the value of the properties in the ger districts and avail households to more financial independence if they wish use it as collateral.

Currently, 4 briquette factories are producing 40000 tons of briquettes for consumers in ger districts. In order to supply consumers in ger districts, new briquette factory that produces 210000 tons of briquette per year will be installed in 2013. Based on the existing heating systems in the ger districts, the distribution points of the briquette would be set up.

Energy efficiency

The government of Mongolia realizes that demand side management should play significant role in meeting the energy demand i.e. electricity and heating. It realizes that some of the required generating capacity should come from the reduction in demand due to the efficiency improvement. Currently there is no legal document is in place in Mongolia as of today. However, there have been several attempts to introduce the law on energy conservation. Current, government now believes that this law should pass the parliamentary discussion in the spring meeting of 2013.

Furthermore, aging energy infrastructure and equipments are also the main reason of Mongolian low energy efficiency. In transport sector, current stock of vehicles is mostly second hand vehicles purchased in foreign country and imported to Mongolia. Thus, the fuel economy of the transport sector is very poor. In this regard, Mongolia had introduced a duty on the imported vehicles and since January 2012, it was increased dramatically. Unfortunately, the mining sector fueled Mongolian economy created huge demand for vehicles; hence this inflow of second hand vehicle was never slowed.

In general, the monopolistic electricity sector is being liberalized and state owned utility companies were created. Also, spot ancillary service market was initiated within for the participants of the CES. However, the ownership of the power plants still remained state. No private power plants are participating the CES at the moment and the progress of enabling the new entrant enter the market is being extremely slow and bureaucratic. The tender to build CHP 5 was announced in 2011 and the consortium of Newcom group had won the tender to build CHP 5 based on the CHP 3 in the UB city. This location was reconsidered by the government of Mongolia after the parliamentary election.

Technical and non technical energy loss in the energy system is significant. Therefore, CHPs are prioritizing the reduction in the energy the loss and taking an toward this issue. For instance, in 2007, EES carried out a “Loss reduction program” in cooperation with the ERA and achieved upto 9% loss reduction.

Renewable energy

Also, within the framework if the SE4ALL initiative, Mongolia is required to increase the utilization of renewable energy in the everyday life and reduce the consumption of fossil fuels in the face growing economy and harsh climate. This requires us even greater rate of deployment of HPPs, SPPs and shift toward LPG consumptions and more clean fuels for household stoves. Furthermore, in the urban areas it requires people to move from ger districts to apartment blocks or to build more apartment blocks.

The government of Mongolia is promoting and supporting the integration of renewable energy in the power system and it is in line with the targets of the SE4ALL inititative. Unfortunately, due to the import tax on the power system equipments Mogoingol HPP project was delayed [Zavhan province governor's office]. This means that the GoM should relieve the import tax on the power plant equipments, especially for the hydro power plants as well as the SPP and WF equipments.

In Mongolia there are 17 soums supplied by the hybrid power plants. However, the success rate is not so good and affected the reputation of renewable energy negatively. For example, Taishir HPP was installed with the 3 turbines with 3.5MW capacity, but in real the maximum output from turbine reaches only 2.5MW. The reason why, it is not running with its full capacity is due to the incorrect modifications of equipments when it was being built. Also, it is owed to the fact that the special inspection authority received it without testing its full capacity because water reservoir was not full at the time the test run. Currently, there no qualified and experienced engineers available to adjust the equipments, so the HPP would be utilized at its full capacity.

It is a win-win situation if Mongolia integrates as much as renewable energy in to the economy. Unfortunately, the progress that should be rapid and fast in the face worsening global climate and domestic energy demand increase and related pollution issues is not so due to the initial investment cost which is significant and the lack of specialised personals who would work on the planning, implementation and operation of the project. This significantly affects the reputation of the projects and public acceptances as such project should also have strong public support. In reality, the HPP in fact support the local ecosystem by increasing the air humidity which in turn affects the green environment of surrounding area, enable the fishing industry to develop and promote the local businesses. For example, due to the operation of the Taishir HPP, cement plant project is being undertaken and consumption of electricity increased significantly.

Private companies are interested in investing in the renewable energy in Mongolia only if they are provided with the suitable conditions such as power purchasing agreements as the capital of building such systems are high and the energy sector in Mongolia is heavily regulated.

Barriers

Human resource barriers

- Lack of qualified researcher in Mongolia and research institutes
- Current stock labour is not experienced to improve the power system operation and no experience in renewable energy
- Lack of public awareness programs to promote renewable energy developments and energy efficiency

Information barriers

- Lack of cooperations between state agents, research centres and universities.
- No independent academic research institute, that focuses on the energy researches, based in universities
- Researchers and state agencies are reluctant to share any information and studies
- Reliability of the officially published data
- Lack of centralized information systems
- There is a need to demonstrate that the renewable energy can contribute towards

- Mongolia's energy landscape in the coming years. It is believed that the new demand could be fully met by renewable energy; a key consideration is the practical difficulty of controlling the system frequency with a large number of distributed loads.

Policy barriers

- The Government is effectively subsidizing the transmission and distribution network losses and leaves no room for an incentive to reduce the losses.
- The privatization of rural heating systems has not been successful with lack of capital investment.
- Controlled coal price makes the other types of fuels less economical as it is set at extremely low level.
- There is a need to demonstrate that the renewable energy can contribute towards Mongolia's energy landscape in the coming years. It is believed that the new demand could be fully met by renewable energy; a key consideration is the practical difficulty of controlling the system frequency with a large number of distributed loads.

Economic barriers

- Nomadic lifestyle becomes a major barrier in connecting herder families to secure, reliable energy services.
- The population is super-sparse with large distances between load centers and power stations.
- Mining developments in the South Gobi area will see major demand growth in the South and will require the creation of a fifth electricity network system.
- WES uses the electricity imported from Russia and pays very high price.
- The integrated transmission grid concept should be explored in depth (the proposal to integrate the West, Central, East and South Gobi grids)
- Government's attempt to incentivize the private sector investments in the energy sector should be socially optimal as opposed to economically feasible based on the contracts.
- Promotion of optimal generation mix is challenging because Mongolia has only one main indigenous energy source apart from the renewable energy.
- Intensive coal dependent heating systems in the suburban areas of the cities

Technical barriers

- The CES system is controlled by the Russian grid (frequency/load following) and the maximum import is limited to 100MW. But the night peak during the winter is 180MW.
- In the CES system, total installed capacity is 850 and the peak demand at the peak hour reaches 802 MW. It means that the reserve capacity left is only 48MW which is approximately 5% of the total installed capacity. But should be at least 20% as it was in the past. Hence, the security of electricity supply is greatly affected.

- Mining developments are expected in the West – two Aimags in the West have isolated grid systems; these mining developments will likely require the creation of an integrated transmission network supplied by coal-fired power station and a new hydro power station.
- Coal is main source for electricity and heat in Capital city and settlements. To avoid air pollution and environmental impact, there is a need of new coal processing technology and new combustion and cleaning technology for flue gas and wastes.
- There are currently six 600MW coal-fired power plants proposed by the private sector. There is a need to identify the best location for new coal-fired power plant.
- The need to provide adequate power and heat (including hot water supply) to rural areas is driven by the need to ensure that people continue to live on the land and do not migrate to the larger cities, the solution may not be economic from a purely power/heat perspective, but may be sensible from a social impact perspective.
- Integration of intermittent energy source in to the current inflexible electricity system to harvest the available renewable energy as opposed to what the system could take under the given conditions of the electricity system.
- Ulaanbaatar is a long, narrow city and the UB district heating system cannot be extended further; thus peri-urban coal-fired boilers proposed in providing localized district heating services. This requires relatively clean coal technology and requires the transportation of coal to be solved.

Opportunities

- Mining companies could purchase electricity from the Government instead of building their own power stations; this would provide the Government with revenue.
- Coal price rationalization. Linking the domestic coal price with the international market price and supporting the competiveness of electricity generated from the other types of fuel against the electricity generated from the coal.

4 CONCLUSIONS

Providing uninterrupted power and heat to homes, community enterprises and industrial undertakings is the single greatest challenge facing the government today.

The energy sector, and particularly the power sector, faces substantial development challenges. In recognition of the fact that energy has become a binding constraint on the acceleration of GDP growth, the Government has placed the highest priority on allocating resources to this sector. Nevertheless, the investment needs are just too large to be met through the Government's own resources. Accordingly, the key financing strategy is to mobilize as much finance through the PPP (Public Private Partnership) arrangements as possible. The Government is also attracting direct foreign investment and engaging with domestic enterprises for investment in the energy sector. The policy framework for private participation is already in place. Further efforts will be made to strengthen this policy in order to ensure adequate flow of private investment in energy sector.

The development of renewable energy must be part of the way forward if the government is to fulfill its vision of "Electricity for all". It is also an essential element in the drive towards energy security. The government's power generation planning requires renewable energy to play an important role in the overall program for a secure and sustainable energy regime. Implementation of these renewable energy projects needs bilateral and multilateral cooperation, capacity development and technology transfer.

Mongolian Energy Sectors Priorities are:

- Sustain safety and reliability of sector operation,
- Improve energy sector economic capability
- Introduce environmentally friendly equipment and technologies,
- Develop renewable energy
- Facilitate and underpin private sector participation
- Meet efficiency and conservation requirements and growing demand for energy,
- Accelerate Energy sector Innovation

Policies to strengthen the capability of the energy specialists, improve the information flow between the stakeholders, improve the quality of the data and develop the incentive regulations for the renewable energy deployments are vital conditions of successful planning and implementation of future energy sector development projects. These issues need to be resolved through SE4ALL initiative.

5 ACTION PLAN

In order to meet the targets set by the SE4ALL initiatives, Mongolian government should commit to initiating following projects which should form the first stage of the action plan for Mongolia in meeting the SE4ALL targets and they should be implemented (Table 18).

Table 18. The First Stage or Nearest Future (2012-2016)'s Actions

	Projects	Capacity	Purpose	Estimated cost
1	Egiin gol HPP	220MW	To cover the peak load of the CES and imported electricity	
2	CHP in the eastern part of the UB	>300MW	To meet the increased heat demand in UB	
3	Pumped Hydro Electricity storage in the CES	>100MW	To provide flexibility to the CES, peaking capacity and utilize night time electricity generated from the coal PPs	
4	CHPs at TT and OT coking coal mines	>300MW	To supply TT and OT coal mines electricity demand	
5	Rehabilitate and expand capacitities CHPs		Darkhan, Erdenet, UB and Choibalsan	
6	CHP 4 Capacity expansion	100MW	To meet the increasing electricity demand and to strengthen the energy infrastructure	70mln.USD
7	CHP 5			1500mln.USD
8	Energy complex near Choir Nyalga basin		For the power export	
9	PP near Bayanteeg coal mine	15-20MW	To supply Bayantseel coal mine electricity demand	
10	Chargait HPP on the Delgermurun river		To cover the peak load of the CES and imported electricity	
11	PP at Mogoin gol coal mine		To make power supply in Zavhan and Govi-Altai provincial towns sustainable and reliable	
12	FS for geothermal energy in the Khangai-Khentii region		To study the viability of utilizing geothermal energy	
13	FSs on the Erdenburen and Khovd river HPPs		To study the viability of the project	
14	Wind farms		To utilize wind power energy	
15	Oil refinery		To reduce the imported oil dependence	
16	Transmission line	220KV	To connect Egiin gol HPP to the CES	
17	Transmission line	220KV	from UB to OT. To supply OT, Tsagaan suvarga and other mines in Govi	
18	Transmission line		To connect CHP at TT to the CES	
19	Transmission line	110kV	To connect Tashir HPP and Bayankhongor 110kV sub-station	
20	Transmission line	110kV	To connect Chargait HPP and Mogoin gol coal mine PP to Uliastai	
21	Transmission line	110kV	To Altantsogts and Asgat deposits	
22	Transmission line		To connect Dalanzadgand and TT CHPs	
23	Transmission line and Substation		To connect Sainshand industrial park	105mln.USD

In addition to the first stage actions to be taken as part of the IPES of Mongolia, Mongolian government's next four year agenda sets the following action to be taken in order to improve the energy system and sustain the security of supply.

Table 19. The current Government (2012-2016) Actions

	Project	Purpose	Estimated cost
1	Enact The Law on the Energy conservation	To improve the demand side management of the energy system	
2	Improve heat supply in the aimag centres	To improve the living conditions in the aimag centres	
3	Rationalize the coal price	To improve the competitiveness of different types of energy against the coal	
4	Tax incentive for the renewable energy	To create suitable investments conditions for the local and foreign private partners	

In the mid-term (2016 and 2022), following major actions need to taken for the implementation for the IPES based on the successful implementation of the first stage of the plan.

Table 20. The Second Stage or mid-term (2016-2022)'s Actions

	Projects	Capacity	Purpose	Funding
1	Erdeneburen and Khovd river HPPs		To make power supply in WES sustainable and reliable	
2	Capacity extension of Myangat sub-station		To connect Erdeneburen HPP	
3	Transmission line (62km)	220kv	To connect Erdeneburen HPP with the Myangad 110kV sub-station	
4	Orkhon river HPP	100MW		
5	Transmission line	220kV	To connect Orkhon river HPP to the CES	
6	Transmission line (450km)	220kV	From Baganuur to Choibalsan via Undurkhaan	
7	Transmission line (360km)	220kV	To connect Durgun HPP with Uliastai	
8	FSs on Buren & Shuren HPPs on Selenge river		To study the viability of the utilizing hydro power on the Selenge river	
9	Geothermal heat plant	10-15MW	To utilize geothermal energy	
10	Solar PP in Govi	Large	To be connected with the CES	
11	FS on the Nuclear power plant		To study the viability of the utilizing nuclear energy	

The Third Stage or Long Term (2022-2040)'s Actions for the completion of IPES, remaining transmission line to connect the WES and CES need to be build and the generating mix should be reconsidered in the face of growing demand and possible change in technology. Furthermore, capacities of the power plants using renewable energy should be expanded and corresponding feasibility studies need to be conducted prior to it.

Table 21. The Third Stage or Long Term (2022-2040)'s Actions

	Projects	Capacity	Purpose	
1	Transmission line	400kV	To connect UB and Uliastai with	

			WES (to complete the IPES)	
2	Review the generating mix		To build more efficient and low cost power plants	
3	Expand capacities of SPPs and WFs		To increase the usage of RESs	

In addition to the actions needed to be undertaken in order to fully establish the PMIS, capability of energy sector specialists' need to be trained and brought to the level which is required to integrate more renewable energy source in to the power system, utilize its full capacity and operate the sustainable, secure electricity system. In this regard, following actions need to be taken simultaneously.

Table 22. Proposed actions for addressing capacity and research needs

	Projects	Purpose	Estimated cost	Funding source
	Professional trainings for the existing energy sector specialist	Improve the skills of the energy sector specialists to the level which is required to operate renewable energy power plants and fully utilize potentials		
	Study on the optimal generation mix	To define what generating capacity is required to build sustainable and secure power system		
	Definition of value of lost load	To define the social value of the electricity		
	Online database for stakeholders	To protect IP and enable the information to transfer		
	Energy research centre	Independent research centre for the development of energy researches		
	FSs for the biomass energy	To utilize biomass and waste produced by Mongolian animal husbandry industry		

Further actions, to be taken for the improvement of energy sector towards secure and independent energy sector, are shown in the Table below.

Table 23. Proposed consumer level actions

	Projects	Description	Estimated cost
	LPG plants	- Connect 39955 households in the 1 region of the central UB and 109594 households to the central heating system according to the planned development - Supply 47721 households in the 2nd region with the briquette by 2020 (238065 tons) - Households in the public and social welfare buildings of 52060 households in the 3rd region will be supplied by the briquette (66343 tons) - Supply the consumers in the 2nd region with the gas by 2030 (198677 cubic meter per year) and supply all consumers in the 3rd region by the briquette (265 373 tons)	
	Briquette plants		

	Electrification of rural households	Rehabilitation of the existing wind, PV or hybrid system and capacity expansion. Supply remaining 10% of the rural households with the wind, PV or hybrid system	
	Introduction of heating meter	Demand side management	
	Introduction of smart meters	Demand side management	
	Reduce the energy loss of the CHPs	Improve the efficiency of the power system	

Policy actions

- Implement the policy to internalize the energy sector externalities in order to improve the efficiency of the sector and reduce the pollutions from the sector. Thus, the coal price should include the emission tax and make the polluter pay for their pollutions. Current system in Mongolia works in opposite direction and the coal mines pay tax for the pollution.
- Improve and bring the economic capacity of these industrial parks and cities to the level where it is competitive with the Ulaanbaatar city. Furthermore, the Mongolian Integrated Energy System.
- Set up renewable energy fund which would be financed through the emission tax and use this fund to finance the renewable energy projects.
- Resolve the issues related to mining licenses at the water resources and the historical places.

6 RECOMMENDATIONS

Mongolia can implement energy-related activities with UNDP and UNIDO on the promotion of clean and sustainable sources of energy, the facilitation of productive activities in rural areas by providing modern and renewable forms of energy (bioenergy, small hydropower, solar energy, wind energy), and the enhancement of renewable energy in industrial processes. Also another cooperation sector with UNDP and UNIDO can be Energy Efficiency. Reducing Industrial energy intensity will improve competitiveness, economic growth and environmental impact.

Furthermore, the following priorities were identified:

- Establish a platform which protects intellectual properties and enables the information to transfer at the same needs to be built. This platform needs to also be used to improve the quality of the educational system of Mongolia.
- Heating meters to be installed as a demand side management measure in the industrial sector and then in the commercial and residential sector consumers.
- In order to reduce the consumption at the peak hours, more differentiated price scheme to be introduced. This was found be a viable solution in reducing the peak hour load at the load centers [Smart meter trial, Ireland].
- Legislate the energy efficiency act and make it pass the parliamentary discussion in 2013.
- FSs of HPPs, on major rivers of Mongolia, to be conducted and public awareness programs to be prepared.
- Improve the flexibility of the current electricity system and reduce the dependency on the imported energy. In this regard build oil refinery in Darkhan city or Sainshand industrial park. Build HPPs or electricity storage systems.
- Improve the efficiency and reduce the energy loss of CHPs by knowledge and technology transfer.
- Conduct a research on defining the value of lost load in Mongolia, in CES. This would allow the government to define the benefit of building new energy source. In this regard, energy research centre should be set up in cooperation with the economics departments of the universities, power energy schools and participants of energy sector. It should conduct researches focusing on the Mongolian case, development of possible scenarios in the future, feasibility studies and knowledge transfers.
- Increase the transparency of the energy companies and create a suitable condition for them to share their knowledge and experience. In this regards, IP legislation should be improved as such it protects the copyright of the online publication of an original research or study. Also, online database for the research papers and reports to be created in order to reduce the administration work and increase the transparency.
- Implement the policy to internalize the energy sector externalities in order to improve the efficiency of the sector and reduce the pollutions from the sector. Thus, the coal price should include the emission tax and make the polluter pay for their pollutions. Current system in Mongolia works in opposite direction and the coal mines pay tax for the pollution.
- In a small economy, it is not economical to build large energy system. Therefore more cities need to be created in order to increase the economic capacity to afford more energy supply. In this regard, the government of Mongolia is planning to create Sainshand industrial area based on the coal mines in the southern part of Mongolia, Darkhan model city based on the

metallurgical industry in Darkhan city. Improve and bring the economic capacity of these industrial parks and cities to the level where it is competitive with the Ulaanbaatar city. Furthermore, the Mongolian Integrated Energy System.

- In order to meet the target to receive 20-25% of the energy consumption from the renewable energy sources, more HPPs, SPPs or wind solar hybrid systems should be installed and biomass should be utilized and biofuel plants to be built. For all of these, the human resource issue should be solved first.
- Set up renewable energy fund which would be financed through the emission tax and use this fund to finance the renewable energy projects.
- Resolve the issues related to mining licenses at the water resources and the historical places. Because, mining operation at the source of the river significantly reduces the water flow and HPP's dam level lowers to its minimum required level which affects the output of the power plant.

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