MONGOLIA'S PERSPECTIVE ON ONGOING AND FUTURE REGIONAL ENERGY INTERCONNECTIONS

PAPER PREPARED FOR THE NAUTILUS INSTITUTE REGIONAL ENERGY SECURITY PROJECT

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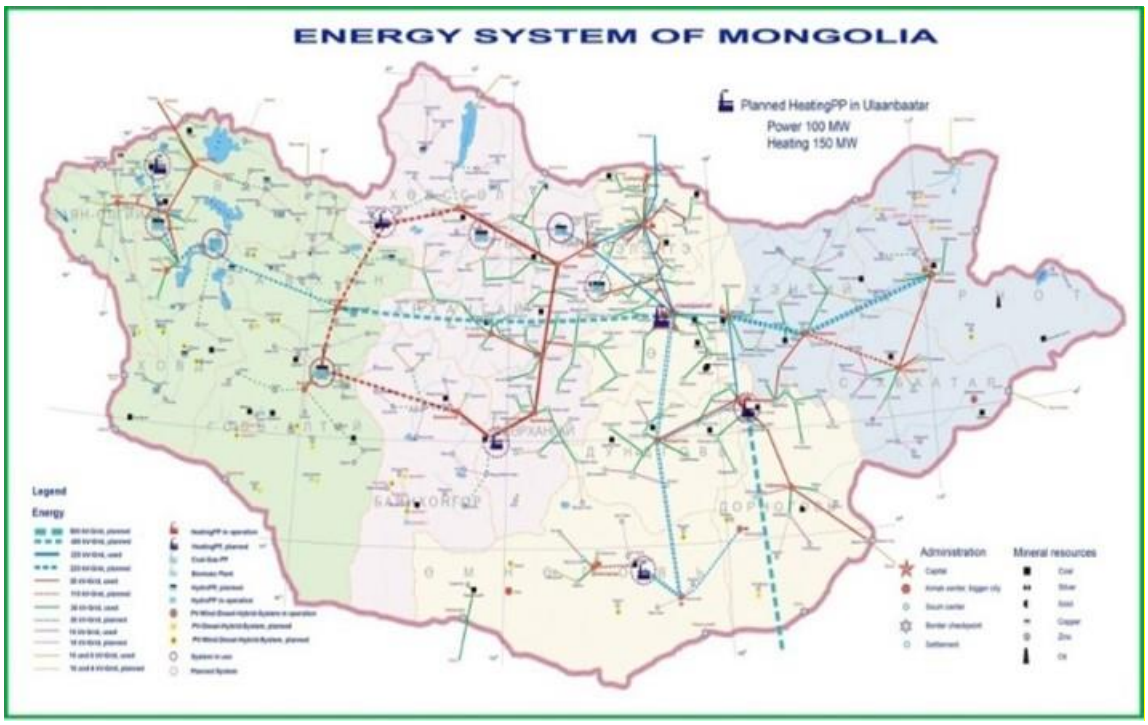
SEPTEMBER 11, 2020



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I. INTRODUCTION

In this Special Report, Tovuudorj summarizes the status of Mongolia's energy resources and electricity and heat production sectors, then describes existing energy policies in Mongolia with a particular emphasis on policies related to international energy infrastructure interconnections between Mongolia and the other nations of Northeast Asia. Mongolia's goals with regard to energy exports are also discussed, along with potential next steps for the country and its neighbors to help establish Mongolia as an energy exporter, including both renewable and fossil energy forms.

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Banner image: Integrated Energy System of Mongolia. Source: Energy Regulatory Authority of Mongolia.

II. NAPSNET SPECIAL REPORT BY TOVUUDORJ PUREVJAV MONGOLIA'S PERSPECTIVE ON ONGOING AND FUTURE REGIONAL ENERGY INTERCONNECTIONS SEPTEMBER 11, 2020

Summary

Although Mongolia has abundant conventional and renewable energy resources, coal still serves as primary energy resource for energy production. Mongolia's energy demand continues to increase by 5–6 percent annually, and electricity consumption per capita also increases to rise.

In order to supply the high energy demand arising in connection with rapid development in the mining and construction industries during recent years, expansions of existing thermal power plants are being completed as a top priority in addition to construction of new coal-fired power stations.

The first and foremost possibility in Mongolia becoming a major "energy-exporter" country is to open an energy trade channel by building high-voltage power-conducting grid to connect it with the countries of the north-eastern Asian region, and particularly with the PRC (China).

To implement a regional energy project that is executed through international participation, benefits for each stakeholder should be fair and planning and management practices transparent, thus it would be more efficient to establish an intermediate organization ensuring equal involvement of all

stakeholders. The more a project primarily serves the interests and reflects the influence of one country, the harder it would be for the project in question to be implemented. It is critical that all the stakeholders should negotiate and unite at the Government level to assure for unified interests and purpose in international grid interconnections.

Contents

1 Mongolia's Energy Resources and Energy Demand

Mongolia has abundant resources of conventional energy (coal and uranium), as well as renewable energy (solar and wind). Coal accounts for over 80 percent of domestic energy production and 37 percent of Mongolia's export revenue, respectively. Overall national energy demand is increasing by 5–6 percent annually, and electric energy consumption per capita has rapidly increased, rising by more than a factor of 2.18 to 2299.4 kWh per person by the end of 2017 from 1053.6 kWh per person in 2000.

1.1 Energy resources and supplies

The primary and fundamental source of energy in Mongolia is coal and the majority of energy production is provided by conventional Combined Heat and Power (CHP) plants. Despite economic complications during recent years, the intensive development of economy and mining industries in our country is increasing energy, and particularly electricity, demand growth nationwide. At various times, Mongolia must purchase electricity from the Russian Federation when there are shortages of domestic generation due to diurnal peak load above what the domestic system can produce. As such, basically, Mongolia is dependent on the energy system of the Russian Federation for servicing its peak loads. Maintain a reliable energy system in the future will thus require the introduction of new, environmentally-friendly, and adaptable/flexible energy sources that can build and ensure the independence of the Mongolian energy sector.

Renewable energy sources such as solar and wind have some disadvantages, such as dependence on natural factors and climate conditions, instability of output, and as incapability of being reliable supply sources due to their intermittency. In highly developed countries, renewable energy is being effectively used by reducing the impact of climate conditions on renewable output, and enhancing the reliability of renewable energy by adding energy storage technologies to renewable energy generation systems.

1.2 Coal reserves, consumption, and exports

Coal is predominantly used in energy production systems in Mongolia, especially in thermal power plants.

Based on 2017 data, Mongolia's coal exports have reached 33.1 million tons per year, with a value of 2,256.7 million USD in 2017, which is higher by 1,284.9 million USD and by 7.6 mil tons compared even to 2016. The average price for a ton of coal increased to 68.4 USD in 2017 from 37.8 USD in 2016. 97.9 percent of Mongolia's coal exports were exported to the PRC.

As of first half of 2018, coal exports reached a total 18.2 million tons, and revenues from those exports were $1.412 million, which is 4.6% less in terms of volume, but in terms of value 10.2% higher compared to the exports during the same period in 2017. Figure 1 shows Mongolia's coal exports in recent years, and projections for 2018 and 2019.

Figure 1: Mongolia's Coal Exports 2015–2019

Table 1: Coal Exporting Companies

№	Company	2014.II	2015.II	2016.II	2017.II	2018.II	Change, % 2018/2017
1	Erdenes Tavan Tolgoi	5,612.2	4,174.4	7,650.1	8,389.9	5,219.9	28.6%
2	Tavan Tolgoi	11.0	435.4	2,184.0	3,608.8	836.9	**4.6%**
3	Mongolyn Alt MAK LLC	4,040.8	3,145.4	5,353.3	4,710.1	4,196.8	**22.9%**
4	Energy Resource LLC	5,184.9	1,123.6	1,705.9	4,440.8	2,092.9	**11.5%**
5	Others	4,650.2	5,593.9	8,804.6	12,250.9	5,924.5	**32.4%**
	TOTAL	**19,499.1**	**14,472.7**	**25,697.9**	**33,400.5**	**18,271.0**	**100%**

As of first half of 2018, a total of 67 companies exported 18.2 million tons of coal. Among the major exporting companies, as shown in Table 1, Erdenes Tavan Tolgoi LLC showed a net change in exports from the first half of 2017 to the first half of 2018 of 28.6%, "Mongolyn Alt Mak" LLC exports rose22.9%, "Energy Resource" LLC increased by 11.5%, "Tavan tolgoi" LC exports rose by 4.6% and the other 63 companies increased their exports by 32.4%.

1.3 Domestic coal consumption

There are main four coal mines that supply domestic Combined-Heat and Power plants and central Heating Plants with coal in at prices regulated by the government. As of the end of 2017, the Baganuur and Shivee-Ovoo mines had together sold 6.1 million tons of coal to domestic energy

producers in the calendar year. Table 2 shows coal sales by mine for domestic power generation for the years 2016 and 2017.

Table 2: Coal Sales by Coal Mine, Thousand tons

Coal Mines	Coal sales by coal mine, Thousand ton		
	2016	**2017**	**Percentage**
Baganuur	3908	4039.2	53.9%
Sharyn Gol	753.7	909.4	12.1%
Shivee-Ovoo	1892	2020.3	27.0%
Aduunchuluun	568.9	526.4	7.0%
TOTAL	7122.6	7495.3	

With respect to the main electricity and heat production plants, CHP (combined heat and power station) #4, and #3 used 3.5 million ton and 1.3 million tons of coal, respectively, in 2017, which was 74.1% of the total coal consumption by heat and power producers by the end of 2017, as shown inTable 3.

Table 3: Coal Consumption for Heat and Power, 2016 and 2017

CHPs	Coal consumption Thousand ton		
	2016	**2017**	**Percentage**
CHP#4	3290.8	3462.4	54%
CHP#3	1285.3	1294.2	20.1%
CHP#2	244.2	244.2	3.8%
Erdenet CHP	284.7	323.8	5.0%
Darkhan CHP	385.6	400.3	6.2%
Baganuur HOB	52.9	56.9	0.9%
Nalaikh HOB	13.9	31.2	0.5%
Amgalan HOB	87.5	125.4	1.9%
Dornod CHP	482.6	500.5	7.8%
TOTAL	6127.5	6438.9	

1.4 Forecast for coal demand in Northeast Asia

The Northeast Asian market is a major market for Mongolian coal. According to the Master Plan Study for Coal Development and Utilization conducted by the Japanese International Cooperation Agency (JICA) in 2013, demand for coal in this region is predicted to increase at an annual rate of 1.9% from 2010 to 2025, with coal demand in 2025 reaching 4,660 million tons, 1.3 times as large as demand in 2010 (see Table 4).

Table 4: Outlook for Coal Demand and Coal Imports in Northeast Asia

							(kT)			(%)
	1980	2000	2010	2020	2025	2030	2035	10/00	25/10	35/25
Demand	775,929	1,734,553	3,534,669	4,360,117	4,660,245	4,973,283	5,213,925	7.4	1.9	1.1
Coking coal	142,271	202,597	532,016	534,684	491,239	444,758	417,346	10.1	-0.5	-1.6
Steam coal	633,658	1,531,956	3,002,653	3,825,433	4,169,006	4,528,525	4,796,580	7.0	2.2	1.4
Lignite	0	0	0	0	0	0	0			
Import	80,232	268,880	535,157	616,110	634,593	652,376	668,691	7.1	1.1	0.5
Coking coal	67,727	82,153	126,137	144,258	147,983	148,823	150,863	4.4	1.1	0.2
Steam coal	12,505	186,727	409,020	471,852	486,610	503,553	517,828	8.2	1.2	0.6
Lignite	0	0	0	0	0	0	0			

Source: JICA study team

In 2025, Northeast Asia will import 635 million tons of coal and India/Southeast Asia will import 414 million tons. Compared with Northeast Asia's increment in annual imports of 99 million tons from 2010 to 2025, however, Indian/Southeast Asia will increase its coal import by 280 million tons over the same period. Looking at import volume increases by coal type up to 2025, coking coal increases by 22 million tons and steam coal increases by 78 million tons in the Northeast Asia market. This can be compared with increases of 39 million tons of coking coal and 240 million tons of steam coal in the Indian/Southeast Asia market.

1.5 Oil resources

Approximately 250 million tons of oil reserves have been indicated in Mongolia. According to the A+B grading reserve classification system adopted in of 1953, the reserves in the oil deposits of Tsagaan Els and Zuunbayan were registered as 3,486,00 tons and as 2,181,500 tons using the A+B grading, based on a 1986 report.

In 2010, the oil reserves of certain areas of the Toson-Uul-19 field, Tamsag basin, Dornod aimag were registered in the integrated depository of Mongolian mineral resources, oil and natural gas as 119.02 mil tons by a proven grading method, together with proven exploitable oil reserves of 13.67 mil tons, proven reserves of oil-saturated gas of 2.589 billion cubic meters and a proven oil-saturated gas exploitable reserve of 296 million cubic meters, as described by a Ministerial order of the Ministry of Mineral Resources and Energy. Apart from these reserves, probable oil reserves estimated within the extent of the other 29 blocks of the same deposit were registered in the integrated depository of mineral resources of oil and natural gas as 74.54 million tons, with probable reserves of oil-saturated gas of 4.692 billion cubic meters, potential oil reserves, estimated within the extent of eight blocks, of 52.78 million Tons, and potential reserves of oil-saturated gas of 2.987 billion cubic meters in those eight blocks.

1.6 Oil utilization, exploitation, and exports

As of today, 21 contractors that have entered into product-sharing agreements and are approved by Government are operating in 25 fields out of 32 identified prospective oil exploration fields within Mongolian territory.

Of the above, "Petrochina Dachin Tamsag" LLC is operating in the Tamsag-XXI and Toson-Uul XIX fields, and "Donshen Petroleum Mongolia" LLC is working in the BKHG-97 field, both for oil utilization and exploitation. Oil exports in 2017 were 7,514.2 thousand Barrels, at a value of 374.1 million USD. This was lower by 501.7 thousand barrels in output compared to 2016, in the value of

the oil exports in 2017 had increased by 36.9 million USD. The average price per barrel of crude oil had increased to 49.8 USD in 2017, while it was 42.1 USD in 2016. Figure 2 shows the trends in Mongolia's oil production and exports over the last decade.

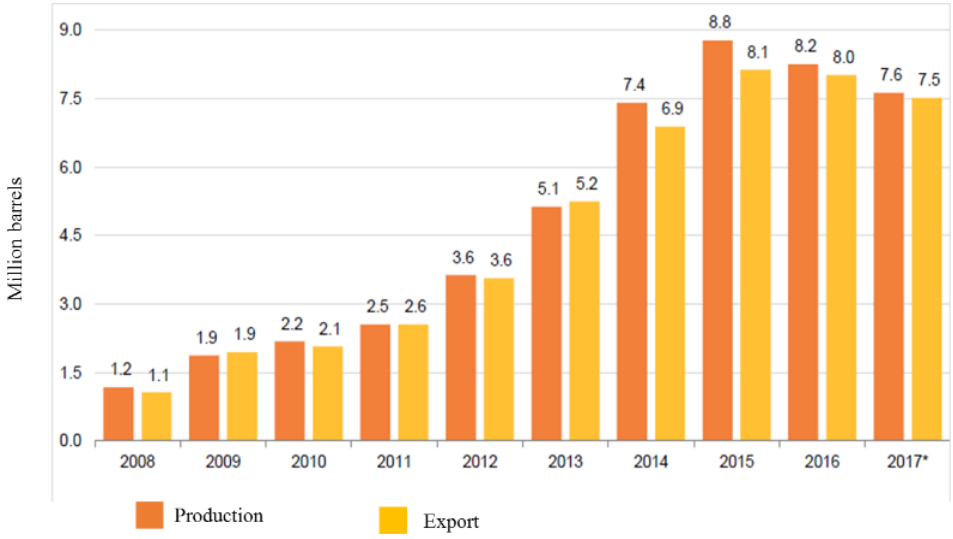

Figure 2: Oil Production and Exports

1.7 Uranium reserves

Mongolia has extensive uranium reserves that could be used for energy production. but there are no specific plans for how to use the reserves in question in the future. In terms of reserves, as of today, uranium in the amount of approximately 126.000 tons is divided into 12 explored and proven deposits in the territory of Mongolia, which places us in 13th position in the world in terms of deposits by country. On average 63.000 tons of uranium are annually mined worldwide and used for nuclear energy and other purposes.

In consideration of the vast concentration of interests of great nations in the uranium field and the strong potential increase in demand of uranium worldwide, the State Ikh Khural enacted documents on "Policy set on radio-active mineral resources and nuclear energy governed by Mongolian state" and "Law on nuclear energy" in 2009.

In the implementation of this set of policies, the Mongolian government has sought to observe policies of maximizing nation's strategic significance, of forming strategic interests with influential countries, and of collaboration with domestic and foreign state-owned and private sector entities with the goal of attracting investors and establishing long-term agreements consistent with Mongolian national security interests.

1.8 Renewable energy reserves

In addition to conventional energy reserves such as coal and uranium, Mongolia has immense reserves of renewable energy. Of these reserves, based on estimates of potential capacity and current utilization levels, solar, wind and hydro-energy reserves are available. Research studies to identify the reserves of these renewable energy forms have been conducted by organizations such as NREL

(National Renewable Energy Laboratory, USA) IRENA (the International Renewable Energy Agency) and the World Bank (WB).

Wind energy

Based on an assessment by USA's, around 10% of Mongolia's area has good-to-excellent wind potential, with power densities of 400–600 W/m^2.

NREL has estimated that the potential installed capacity in Mongolia could be up to 1,100,000 MW (1.1 TW), with the capability to deliver over 2.5 trillion kWh per annum. Figure 3 shows the wind power map of Mongolia prepared by NREL, including the locations of three existing and licensed wind power projects.

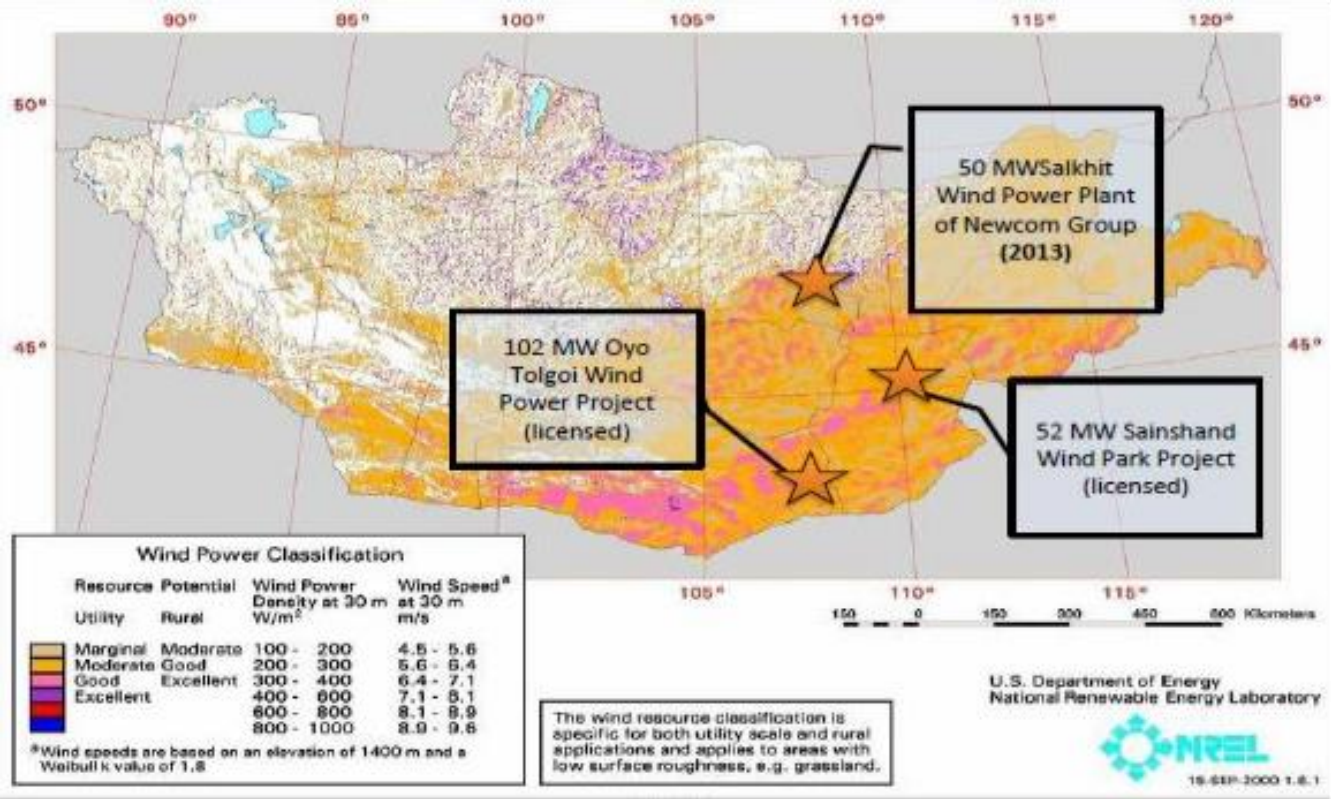

Figure 3: Wind Energy Resources in Mongolia

Solar energy

According to the *Global Solar Atlas*, the long-term average of for PV output in Mongolia can reach a yield of 1899 kWh/kW installed, with a particularly strong solar resource in the middle and southern parts of the country, as shown in Figure 4. According to NREL, the solar energy potential for Mongolia is 1,500 GW (1.5 TW). This installed capacity is estimated to yield up to 4,774,000 GWh per annum.

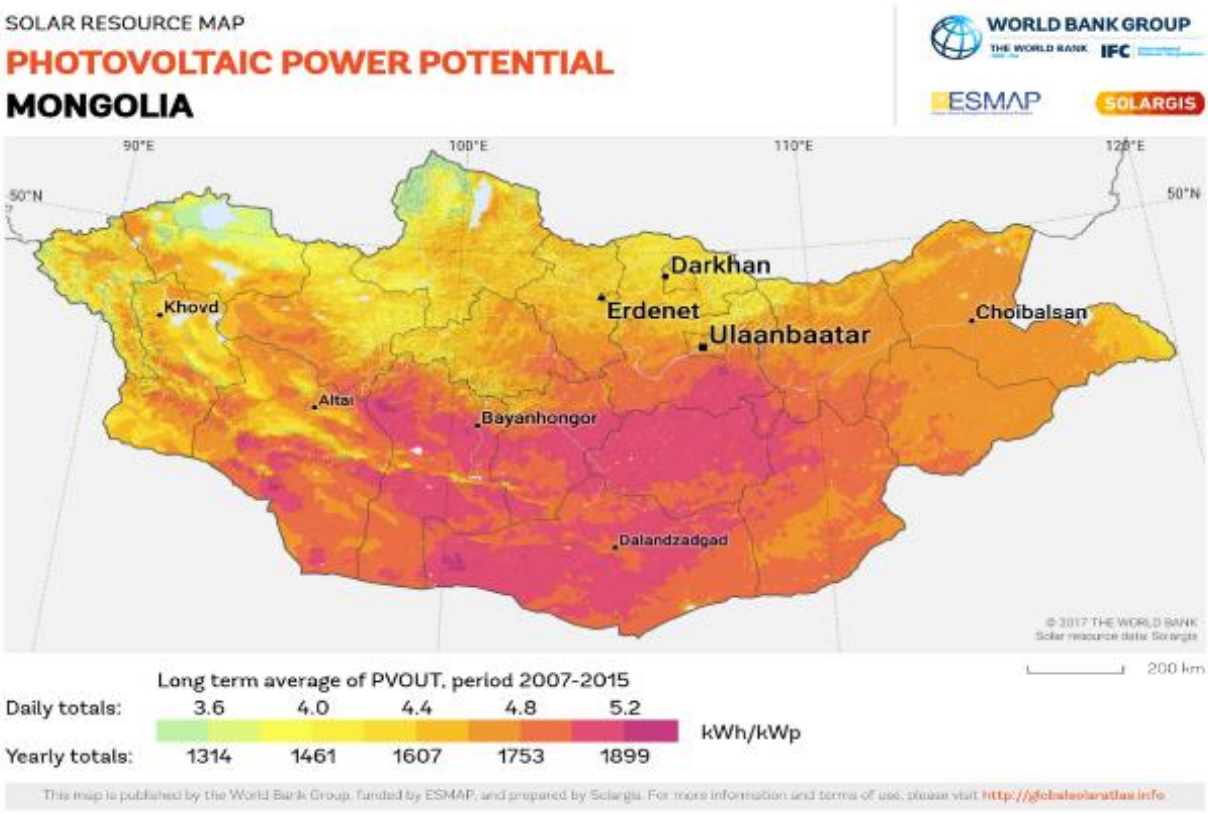

Figure 4: Solar Energy in Mongolia

Hydro energy

According to the institute of Water Policy of Mongolia, a gross theoretical hydropower production capacity of 6.4 GW is available. This capacity can deliver 56.2 million MWh of electricity per year. According to the Ministry of Green Development in its Water Management Report published in 2013, the actual hydropower potential is between 20% to 60% of this estimate, that is, between 1,280 MW and 3,840 MW. Already specific hydropower projects totaling more than 1 GW of this potential have been identified (see Figure 5).

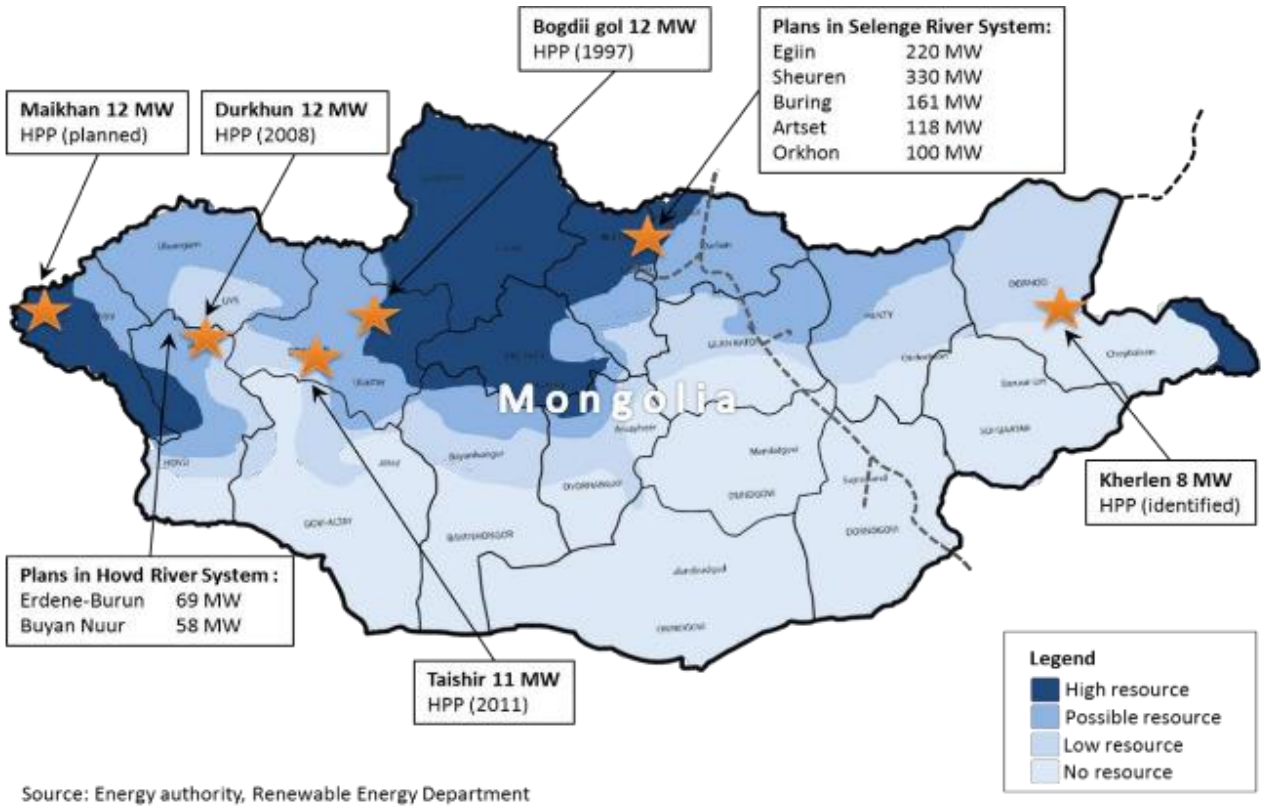

Figure 5: Hydro Energy Resources in Mongolia

1.9 Electricity consumption per capita

In fairly direct correlation with economic growth, electricity consumption per capita in Mongolia has been consistently increasing since about 2000 (see

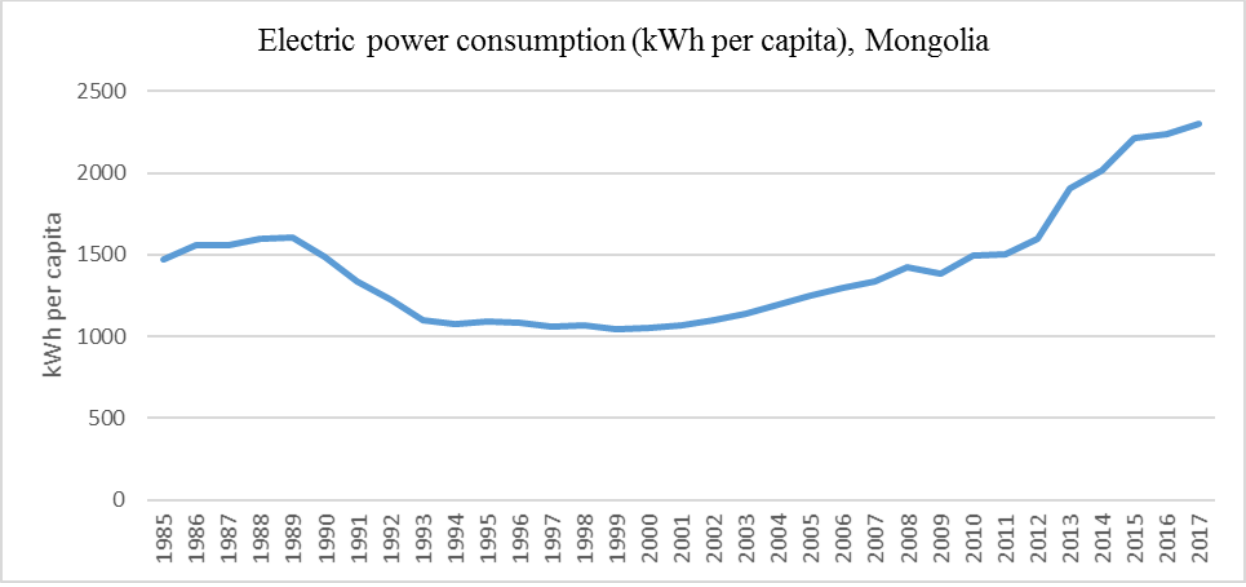

Figure 6). As a result of the particular characteristics of the Mongolian economy and Mongolia's extreme and changeable climate, Mongolian electricity consumption per capita is relatively higher than in other countries of approximately equivalent economic status.

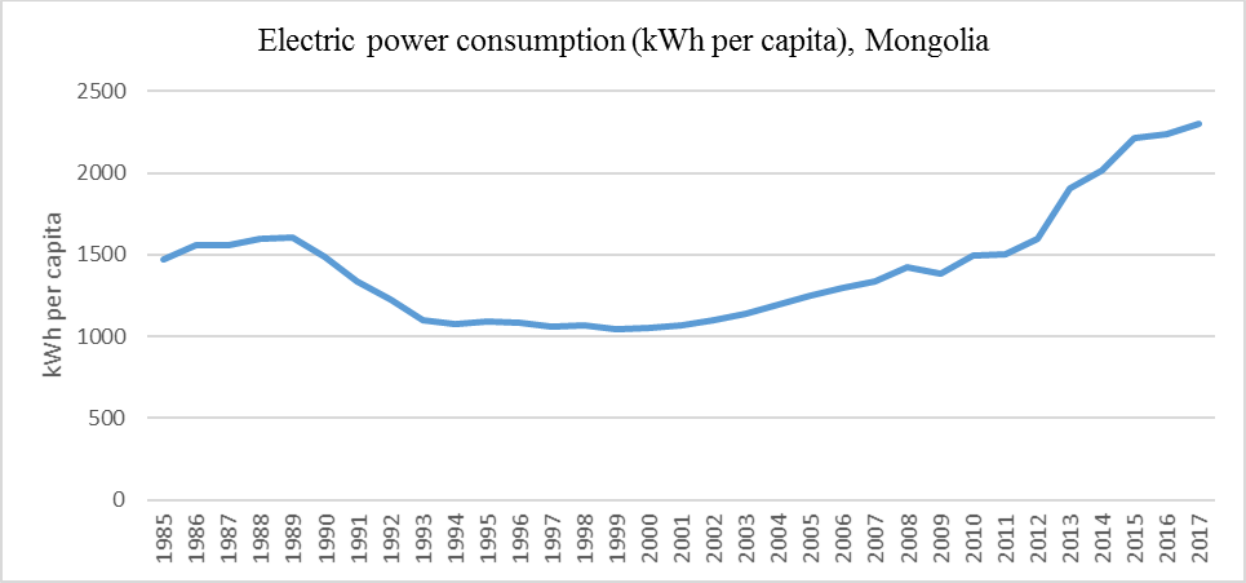

Figure 6: Electric Power Consumption per Capita in Mongolia, 1985–2017

1.10 Electricity Consumption

Due to the large size of Mongolia and the great distances between population centers, The Mongolian power grid is composed of five major regional grids with some interconnections. ***Error! Reference source not found.*** shows the number of electricity consumers by system for 2011 through 2017 for the five major energy systems. The electricity consumption within the Central Region Energy System (CRES) has been constantly increasing during recent years, and its annual average rate of increase has been 4.6%. The consumption of CRES reached at 5,802.9 million kWh in 2017, with a peak load of 1016 MW. Over the last 5 years, consumption of electricity in the CRES has grown an average of 244.5 million kWh per annum.

80–85 percent of CRES consumption has been supplied by domestic power production, with much of the annual growth in energy consumption supplied by imports starting from 2012 due to lack of new sources of electricity on the CRES grid.

Table 5: Number of Electricity Consumers by Region

	Energy system	2011	2012	2013	2014	2015	2016	2017
1	Central	384,722	404,152	429,047	452,169	493,959	523,208	547,348
2	Western	26,141	26,261	30,558	37,917	42,811	42,864	42,898
3	Eastern	20,038	20,190	23,562	23,267	24,373	22,997	27,607
4	Southern	6,339	6,581	9,090	10,221	10,629	11,442	12,284
5	Altai-Uliastai	10,588	13,116	16,620	19,632	20,677	20,571	23,460
TOTAL		447,828	470,300	508,877	543,206	592,449	621,082	653,594

The Mongolian population has historically been loosely scattered throughout the country's wide-open territory, and as a result low-load high voltage lines that extend for many hundred kilometers and multiple dozen sub-stations were built in order to interconnect the centers of the remotely settled aimags and soums (provinces and districts) with integrated energy grid systems. Shunt reactors are permanently used for voltage regulation, which causes increased grid losses. Also, the fact that operation of CHPs uses suppressed reactive loads for voltage regulation adversely affects the reliable operation of the CRES. Table 6 and Table 7 show general statistics of the electricity sector of Mongolia.

Table 6: Structure of Electricity Consumers

№	Energy System	Entities	Households		Others	Total consumers
			Apartment	Ger district		
1	Central	36,240	205,540	250,347	1,832	493,959
2	Western	3,975	3,732	35,104	0	42,811
3	Eastern	1,961	6,023	16,091	298	24,373
4	Southern	1,084	1,303	8,242	0	10,629
5	Altai-Uliastai	1,798	2,526	16,353	0	20,677
TOTAL		45,058	219,124	326,137	2,130	592,449

Table 7 Domestic Electricity Sales, Million kWh

№	Energy Systems	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
1	Central	3545.1	3730.7	3965.1	4010.4	4105.2	4363.7
2	Western	77.9	89.6	104	104.1	103.9	108.7
3	Eastern	102.6	125.3	139.1	147.8	213.4	241.9
4	Altai-Uliastai	25.4	40.3	47.2	47.9	51.9	53.4
5	Dalanzadgad	13.7	7.7				
6	Soutern	0	12.1	29.9	33.3	34	37.8
	Total	**3764.7**	**4005.7**	**4285.3**	**4343.5**	**4508.4**	**4805.5**

2 The Mongolian Electricity System

Driven by growth in mining and construction industries during recent years, Mongolia's overall electric energy consumption has been increasing by an average 5–8 percent per annum, and as a result expansions of existing thermal power plants are being completed as a top priority, along with construction of new coal-fired generating stations, in order to supply this rising demand.

Although CHPs are generally intended to operate as the baseload portion of the system load curve, Mongolia's CHPs operate in almost all parts of load curve, with considerable fluctuation of load corresponding to the characteristics of the Mongolian power system. In particular, CHP-4, the plant that by itself provides over 60 percent of the overall installed capacity of the system, operates with significant changes in output, playing the role of a "load regulator station" in the daily load curve by varying its output by 100–180 MW. CHP-4 also functions as a "frequency regulator" when needed. The capacities of the generators at the 6 CHPs that are specifically intended to operate in synchronization with CRES are relatively constrained, at 3.5 MW to 123 MW per plant. This lack of facilities for synchronization, combined with the need for these baseload-type plants to follow load, has a negative impact on the consistent and reliable operation of the system, and means that any accident or malfunction causes a constraint in power availability and requires a process of compensation between generators to adjust their operations.

2.1 Electricity Supplies

The energy sector of Mongolia operates under a structure that comprises 5 energy systems, namely the Central Region Energy System (CRES), the Western Region Energy System (WRES), the Dornod Region Energy System (DRES), the Altai-Uliastain Energy System (AUES), and the Southern Region Integrated Energy System (SRIES), as well as renewable energy sources and diesel stations for remote soums and settlements. The constituent parts of this system are 6 CHP plants in Ulaanbaatar, Darkhan, Erdenet, and Choibalsan cities, the Salkhit wind electric station, the Darkhan solar power plant, the Durgun-Taishir hydro-power plant, the Altai-Uliastai diesel electric station, the Dalanzadgad and Ukhaa Khudag thermal power plants, and 6 x 220 kV (kilovolt) substations. In addition, electric energy is produced by low-capacity renewable energy sources in located in some soum centers and owned by certain private entities. The transmission and distribution system includes over 1,434 km of 220 kV high-voltage lines, more than 87 sub-stations of 110 kV with 5,655 km of 110 kV lines, over 259 sub-stations of 35 kV with 9,426 km of 35 kV lines, 5,214 sub-stations of 0.4–

20 kV and 24,637 km of electricity distribution lines and associated objects. Figure 7 provides an overview of the Mongolian energy system, including both electricity facilities and other resources.

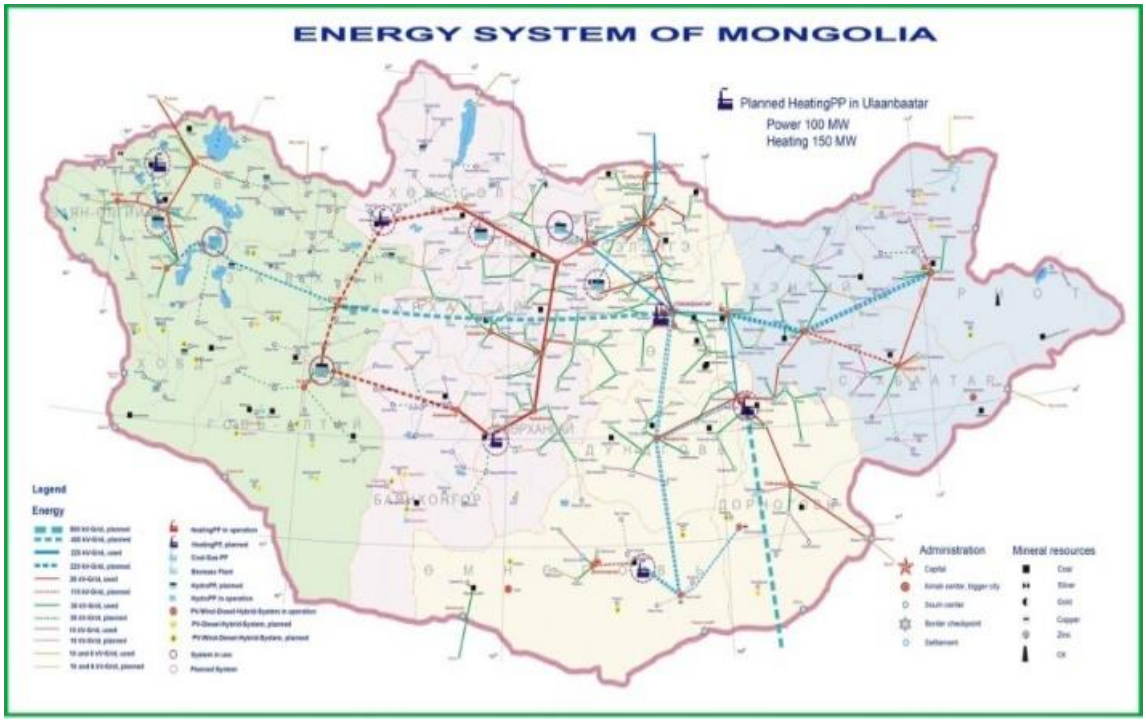

Figure 7: The Mongolian Energy Integrated System

The consumption of electricity in Mongolia is increasing at a rate of 5–7 percent annually, and the electricity output reached 5802.9 mil. kWh in CRES in 2017, a 4.3 percent increase compared to the previous year. Table 8 provides a summary of electricity supply and demand in Mongolia in 2017.

Table 8: Summary of Nationwide Electricity Supply and Demand (2017)

Parameter	**Value**		**Share (%)**	
Installed Capacity	1073 MW			
Peak demand	975 MW			
Total Electricity Supply	7221 GWh			
Electricity Generated	5,802 GWh		80.4% of Total Electricity Supplies	
Imported Electricity	1,419 GWh		19.6% of Total Electricity Supplies	
Thermal Generation	5,556 GWh		95.8% of Electricity Generated	
Imports	1,419 GWh	52 MW	19.6% of GWh	5.3% of MW
Renewable Generation	242.6 GWh		4.1 % (1.5% Hydro, 2.61% Wind and Solar)	

2.2 Energy Systems

Central Region Energy System (CRES)

The CRES supplies the capital city, 13 aimag centers and their nearby soums and settlements, providing 96.0 percent of overall demand in the area through the centralized system. Electricity consumption on the CRES is consistently increasing year to year, and according to 2017 figures, peak loads have reached 1016 MW and annual consumption stood at 5,763.1 million kWh. The CRES is comprised of 6 domestic CHPs with installed capacity of 1030.8 MW that produce a combination of heat and electricity. The CRES has been in synchronous operation with the electricity system of the Russian Federation since 1977. As such, the CRES plays the role of a "frequency regulator" for the electricity system of the Russian Federation. According to 2017 figures, the CRES imported 270.6 million kWh from Russia and exported 34.1 million kWh.

Southern Region Integrated Energy System

In this territory, the Dalanzadgad CHPs with 9 MW installed capacity operate and supply electricity to the Umnu-gobi aimag center and other soum settlements such as Nomgon, Khurmen, Bulgan and Bayandalai, producing 13.47 million kWh per annum. In response to the ever-increasing electricity demand in the area, the average annual growth of Dalanzadgad TPP electricity production is 12.3 percent.

The intensive development of the mining industry in the territory of southern Gobi region has continued with the commissioning of the Oyu Tolgoi copper mining and Tavan Tolgoi mining complexes, both of which are strategically important to Mongolia. Initially, these mining concerns have been supplying their own electricity needs using on-site diesel power stations and by importing power through an interconnection of a 220-kV transmission line with a sub-station in the vicinity of the PRC border.

The Energy Resources company built and commissioned the Ukhaa Khudag thermal power station with a capacity of 18 MW in March, 2011 on its own coal mine site to meet the power demands of coal processing, and has provided an option to supply the demand of some soum settlements of Umnu-Gobi aimag and Dalanzadgad city when required. In addition to this, as of today, the Ukhaa Khudaq station is operating with an interconnection to CRES, and previously had been operating in a synchronous regime with the Dalanzadgad CHP since December 2012.

In 2015, the consumption of electricity in the vicinity of Ukhaa Khudag was 63.1 million kWh, of which 87.7% of overall consumption or 55.33 million kWh energy was supplied and distributed by the Ukhaa Khudag thermal power station. The fraction of the electricity consumption of southern Gobi region provided by privately-financed power generation sources is increasing year to year.

According to Mongolian energy sector policies and development programs, several generation sources are planned for the southern Gobi region apart from the power station being constructed in Tavan Tolgoi.

In the territory of Tsogttsetsii soum, Umnu-Gobi aimag, a Wind Park project with a 50 MW installed capacity was implemented by Clean Energy Asia LLC starting in 2016, and is currently operational through an interconnection to the system as of 2018.

Dornod Region Energy System

In the Dornod region, a thermal power plant with 36 MW capacity, which is the only energy source operational, provides electricity for the system. The renewal of the plant was implemented

with a loan provided by the German Bank for Reconstruction and Development. This system has been operating relatively consistently subsequent to its renewal. The Choibalsan CHP facility supplies Dornod, Sukhbaatar aimag centers, and neighboring soums with energy. Annual consumption on the DRES reached 241.9 million kWh, and the annual consumption growth rate was 5% in 2017, with electricity from the system supplied for oil extraction and other nearby mining entities. Given the rapid development of the mining industry occurring in the territory, it is likely that electric consumption in the region will drastically increase. Projections suggest that electricity consumption will reach 100 MW based on prediction for development of in the region in the next 5 years, and thus the energy sector of this territory seems likely to have power shortage in near future.

With the commissioning of the 230 km long 110 kV Baruun Urt – Undurkhaan transmission line, the conditions for synchronous operation of the DRES with the CRES were enabled, but complications resulting in overloads occur at the Baruun Urt 110/35/10 kV sub-station because of the connection with a tapping shunt reactor due to a voltage regime jam caused by the relative great distance from the 110 kV transmission line source side. Therefore, the line in question has not been energized for operation as of now, as the Choibalsan TPP generators are in danger of being damaged by line generation when the line is off from the Undurkhaan side

Altai-Uliastain Energy System

The AUES is a regional system having only one renewable energy source with specific characteristics, and it purchases electric energy through interconnection with the Central Region Energy System and Western Region Energy System.

In 2017, the electric consumption of AUES has reached 53.4 million kWh, an increase of 1.9 percent from the previous year, and purchased energy from the CRES reached 4.1 million kWh, an increase of 17.8 percent. The production from renewable energy sources and diesel stations decreased by 4.6 percent, while purchased energy from WRES fell to 0.9 million kWh, a decrease of 21.4 percent.

The Taishir Hydro-Electric Station was commissioned in 2011 with an installed total capacity of 11 MW, and it is the largest electricity source in the territory. Electricity supplies in this territory have been stabilized through synchronous operation of this station with the Gobi-Altai diesel-powered station and the operation of the Altai-Uliastain energy system is expanding with the connection of the Uliastai 110 kV transmission line.

The summer and autumn month operations of seasonal micro hydro-electric stations constructed in Bogdyn Gol, Tosontsengel, Khungui, Galuutain Gol, facilitates operation regime of the Taishir Hydro-Electric Stations.

Western Region Energy System

With the connection of Ulaangom 110/35/10 kV sub-station to the Chadan sub-station of Russian Federation in 1996, via a 110 kV transmission line, the Western Region Energy System (WRES) was founded and currently supplies the consumers of western region—Uvs, Khovd and Bayan-Ulgii aimags—plus over 40 soum settlements with electric energy.

Although in the past the WRES had been engaged in activities to supply the consumers with only imported energy, it now has its own source of power, and the operation has become smoother, with the commissioning and acceptance in 2008 of the Durgun hydro-electric station with an installed capacity of 12 MW.

In 2017, the electric consumption of WRES has reached 142.8 million kWh, an increase of 2.8 percent compared to the previous year, and 29.9% of overall consumption was supplied by the Durgun hydro-electric station while 70.1% electrical energy was imported and supplied by imports from the Russian Federation and PRC. Since 2009, when the Durgun hydro-electric station was distributing 11.03 million kWh of electricity, output has grown to 34.4 million kWh, or 3-fold increased production, thanks to the improved reliability and consistency of the operation of the station.

2.3 Current status of the integrated energy system

Grid operation

As shown in Table 9, the high average age of the CHPs and the need to fully utilize existing capacity to meet current peak loads are indications of insufficiency of reserve capacity and show the necessity for new power. Most of the existing CHPs also have very high auxiliary power usage, meaning a significant part of their gross generation goes to meet in-plant electricity requirements, and is not available for distribution to consumers. This is particularly true relative to the wind and hydro power plants listed.

Table 9: Information on Power Stations Currently Operational on the Integrated Energy System

Plant (Name)	**Installed Capacity (MW gross)**	**Dependable Capacity (MW gross)**	**Auxiliary Usage (%)**	**Commissioning Date**
CHP#2	24	22	13.8	1961
CHP#3	186	153	16.9	1968
CHP#4	683	580	12.47	1983
Darkhan CHP	48	44	17.6	1965
Erdenet CHP	28.8	27	19.6	1986
Erdenet factory CHP	53	35		(1976)2017
Choibalsan CHP	36	36	14	1967
Dalanzadgad CHP	9	4	39.7	2000
Ukhaa hudag CHP	18	16	10	2011
"Taishir Guulin HPP" LLC	11	11	1.5–2%	2009
"Durgun HPP" XXK	12	12	1.5–2%	2008
"Clean Energy" LLC	50	50	3%	2013
"Clean Energy Asia" LLC	50	50	3%	2017
"Solar power international" LLC	10	10	3%	2017
"Everyday Farm" LLC	10	10	3%	2017

2.4 Domestic production

The CRES must supply loads that have been substantially increasing each year. As a result, domestic production increased by 1,018.9 million kWh by 2015 relative to the 2011 level, as shown

in Figure 8. Table 10 shows domestic electricity production in Mongolia by type of generator for the years 2012 through 2017.

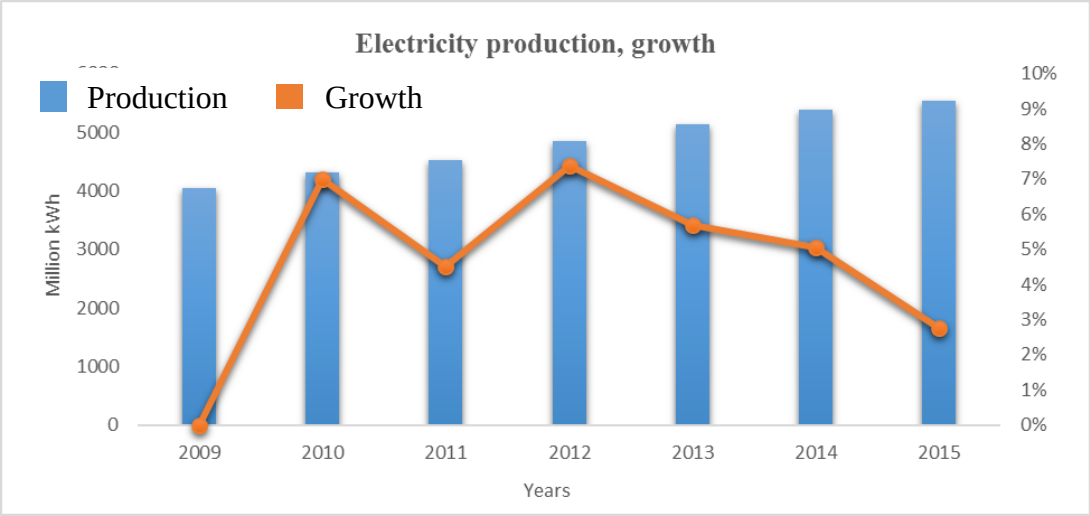

Figure 8: Domestic Electricity Production, and Growth in Production %/yr

Table 10: Domestic Electricity Production by Resource, million kWh

Resource	2012	2013	2014	2015	2016	2017
CHPs	4775.5	5014	5191.3	5415.8	5555.9	5826.9
Diesel	28.7	5.4	8.2	6	3.8	3.7
Solar energy	0	0	0.6	0.5	0.3	19.7
Hydro energy	52.1	59.9	66.3	59.3	84.7	84.5
Wind Energy	0	52.9	125.4	152.5	157.5	154.4
TOTAL PRODUCTION	4856.3	5132.2	5391.8	5634.1	5802.2	6089.2

2.5 Imports and exports

Since 1977, the CRES has been operating in a connected fashion with the Eastern Siberian energy system of the Russian Federation, through a connection of power-conducting double lines at the 220-kV voltage level. For the CRES, which relies on CHPs that produce both heat and electricity, it is of the utmost importance to maintain synchronous operation with the Energy System of the Russian Federation in order to eliminate complications caused by the need to provide power to meet high loads in the morning and evening, to regulate frequency, and to maximize reliable operation. In addition, Mongolia has no alternative but to export electricity to Russia under the interconnection agreement at a very low per kWh price even if Mongolia's CHP units are run at their technical minimum loads during the low-load periods at night. Essentially, the combination of ongoing heat demand and technical limits on the degree to which power generation at the CHPs can be turned down, plus Mongolia's intermittent generation, creates a surplus of power at nights, with the Russian energy system as the only possible customer. With the commissioning of Salkhit Wind Park, the

amount of export energy has often reached 20–60 MW during periods of low load of night. Table 11 show electricity imports and exports by the Central System from 2011 through 2017.

Electricity consumption has been substantially increasing in the southern region as a result of intensive growth and development in the mining industry. The Oyu Tolgoi copper deposit is a leading deposit in globally by volume of reserves, and operations there are currently using electrical energy imported from the People's Republic of China. Based on 2017 statistical data, the amount of electric energy imported from China for the copper producing area, at 1,130.7 million kWh (see Table 12), was equal to 20% of Mongolian domestic production in that year. Table 13 shows Mongolia's energy imports from Russia.

Table 11: Imports and Exports in the Central System

Indicators	2011	2012	2013	2014	2015	2016	2017
Imported electricity (million kWh)	200.6	307.8	325.3	288.0	176.3	201.4	270.6
Exported electricity (million kWh)	21.4	21	23.3	30.3	54.3	33.9	34.1

Table 12: Electricity Imports from China, Million kWh

		Oyu-Tolgoi	Western	Others	TOTAL
2016		1,095.50	5.40	12.80	1,113.80
2017		1,130.70	5.80	14.80	1,151.30
Change	Actual, (kWh)	35.10	0.40	2.00	37.50
	%	3.2%	7.4%	15.3%	3.4%

Table 13: Electricity Imports from Russia, Million kWh

		Central ES	Western	Others	TOTAL
2016		201.4	103.0	0.9	305.3
2017		270.6	99.7	0.9	371.2
Change	Actual, (kWh)	69.2	-3.3	0.0	65.9
	%	34.4%	-3.2%	0.6%	21.6%

2.6 Expansions and renovations

In order to satisfy Mongolia's ever-growing electricity demand, a policy to address the issue by expanding of existing thermal power plant capacity is being carried out by the state.

In the past several years, projects such as the 123 MW expansion of CHP #4, the 50 MW expansion of CHP-3, and the removal and relocation of the Amgalan thermal power plant in the east

part of Ulaanbaatar city have been completed, and a 35 MW expansion of the Darkhan CHP plant is ongoing.

Further, the government has decided to implement projects such as expansion of the electricity and heat distribution grids by increasing installed capacity of "CHP#3" by 250 MW and "renovation of No. 1–4 turbine generators of CHP#4" using credit provided by the Russian Federation.

In addition, the decision has been made implement of thermal power plant and heating network construction projects including the Erdenet Thermal Power Plant (TPP), a CHP plant in Dornod, and heating plants in the centers of 10 aimags: Arkhangai, Bayankhongor, Gobi-Altai, Gobi-Sumber, Dund-Gobi, Zavkhan, Uvurkhangai, Sukhbaatar, Khentii and Tuv. Financing for these projects will be provided by the "Export and Import" bank of the Republic of Korea.

2.7 Unit cost for electricity

The Mongolian electricity sector, it is characterized by its use thermal power plants with combined production of electricity and heating. Over 80 percent of electric energy production is produced by the aforementioned combined thermal power plants. The unit cost for electric energy sold to end users is comprised of 6 groups of costs, including production cost, transmission and distribution costs, costs for transmission and distribution losses, and costs for importing electricity from the Russian Federation.

Based on 2017 statistical data, the actual unit cost of electric energy per kWh was 145.84 MNT, or approximately 0.06 USD, and the average cost of production at thermal power plants and at renewable energy stations was 80.86 MNT/kWh, accounting for 56% percent of overall costs.

Electric energy price and tariff

The selling price and tariff of electricity to consumers is set by the Energy Regulatory Commission depending on consumption volume, consumer classification and number of kilowatt-hours consumed monthly.

The electricity tariff applied to household consumers is currently lower than the electricity unit costs, and this discrepancy is compensated for by the higher electricity tariffs that apply to commercial and industrial consumers and mining consumers, as shown in Table 14.

Table 14: Electricity Tariffs in Mongolia as of 2017

Single rate tariff /VAT excluded/

CONSUMER CATEGORY	MNT/kWh
Industrial	
Mining, processing industry	167.78
Other industries, business entities and organizations	140.38
Residential	
Monthly consumption below 150 kWh	110.28
Monthly consumption above 150 kWh	130.08
Included the renewable energy levy (11.88 MNT/kWh), Entities capacity charge is 9,000 MNT/kWh. /month included	

3 State Energy Policies in Mongolia

The current Mongolia State policy on energy, calls for Mongolia to become an energy exporter in medium- and long-term by developing its energy sector in a regulated market form based on private sector investment and ownership in a way that satisfies reliable, safe, efficient, and environmentally-friendly operation of energy production facilities.

3.1 Legal Environment of the Mongolian Energy Sector

There are three individual independent laws and other policy documents that describe the overarching policies for the energy sector. These are as follows, and are described below:

- Law on Energy, 2001
- Law on Renewable Energy, 2007
- Law on Energy Conservation 2015
- State Policy on Energy 2015

3.2 Law on Energy

The State Ikh Khural of Mongolia approved the "Law on Energy" in 2001. The most important element of this law was to constitute a system in which energy production organizations operate under market principles. The Law focused on creating State-regulatory mechanism independent of energy companies, providing conditions under which the private sector can participate in the energy industries, creating competitive markets for energy, and creating legal environments that supports such competition.

With the approval of law on energy, structural changes in the energy sector were initiated by the Mongolian Government starting in 2001, and several regulations and procedures for structural change in the energy sector and for the participation of private sector investment in energy industries were approved by establishing the Energy Regulatory Commission. 18 new companies operating generation, transmission, and distribution networks as well as the National Dispatching Center

(NDC), were formed by dissolving the former structure that provided electricity and central heat in Mongolia.

3.3 Mongolian Law on Renewable Energy

On 11 January 2007, the Mongolian State Ikh Khural approved the Law on Renewable energy. This law is focused on regulation of relations with respect to energy production and supply using renewable energy sources. According to the Law on Renewable energy, the Energy Regulatory Commission is obligated to oversee the approval and issuance of power purchase agreement drafts that specify the price and tariff of electric energy to be supplied into the grid system, with prices varying depending on the type of renewable energy generation. The Energy Regulatory Commission sets the tariff within scope of the following range:

- 0.08–0.095 USD per kWh electricity produced using wind energy and supplied into the grid system
- 0.045–0.06 USD per kWh electricity produced by hydro energy (with up to 5 MW installed capacity) supplied into the grid system
- 0.15–0. 18 USD per kWh electricity produced by solar energy and supplied into the grid system

In line with the additions and amendments made in June 2015 to the Law on Renewable Energy , the discrepancy between the renewable energy tariffs and tariffs for electricity to be sold to consumers was designed to be compensated for by a "Supporting tariff" as a levy, and the consumers of electricity thus started to pay a somewhat higher amount per kWh consumed in order to support renewable energy projects. Also, with the above amendment, individuals and entities have been provided with the opportunity to connect their distributed renewable energy resources into the distribution grid and operate as grid-interconnected generators, as well as to sell any excess electricity not needed for their own consumption into the distribution grid.

3.4 Law on Energy Conservation

The Law on Energy Conservation was approved by the State Ikh Khural on 26 November 2015. The purpose of this law is to constitute a legal regulatory mechanism required for implementation of energy conservation and efficiency in practice, and to create economic interest among consumers and investors in seeking means of using energy more efficiently and properly. Within the scope of the law, arrangements are provided for the appointment of energy auditors who will conduct energy audits for high-consumption organizations. These registered "Designated Consumers" have energy consumption higher than a threshold amount set by the Government. In addition, the Law provides for the formation of ESCOs (Energy Services Companies), dedicated organizations for providing energy services and implementing projects based on opportunities to save energy that have been identified as a result of energy audits.

As of now, there are over 130 registered "Designated Consumers" that are operational, and projects have been initiated to maintain energy saving and improve efficiency based on audits conducted every 3 year for each of these Designated Consumers.

3.5 Policy Set on Energy by State, 2015–2030

The program "The State Policy on Energy for 2015–2030" was approved by resolution No. 63 dated 19 June 2015 by the Mongolian State Ikh Khural. The main objectives of this set of policies are to emphasize the program of policy, lines of activity and investments in the energy sector governed

by the State, identify the achievable results of policies, and set benchmark performance targets for sectoral development.

As reflected in this policy set, the vision of Mongolian energy sector development is to become an electricity energy exporting country by producing electric energy that is regulated, efficient, and produced based on a competitive market, resulting in economic savings, which uses environmentally-friendly technologies, and which is supported by the private sector, while fully satisfying Mongolian goals for economic growth, sustainable development, and safe and reliable operation of energy facilities. Major energy sector development should thus provide:

- Reliable supply and safety of energy production;
- Effectiveness and efficiency;
- Environmental sustainability and green development.

Based on the potential of and challenges facing the energy sector of Mongolia, the State Policy on Energy sets following strategic objectives:

- In the scope of energy reliability and security: Ensure energy safety and supply reliability;
- Develop mutually beneficial cooperation with regional countries;
- Develop human resources and build human capacity in the energy sector in order to assist in developing capabilities toincrease efficiency and productivity;
- Transform the energy sector into a private entity-based competitive market scheme with an independent regulator;
- Introduce and implement policies to support the implementation of innovative and advanced technologies;
- In the scope of environmental sustainability and green development, reduce negative impacts on the environment, reduce of greenhouse gas emissions, and increase the production of energy by renewable energy sources.

3.6 Medium -term program for implementation of policy set governed by State on energy, 2018–2023

The medium-term program for the implementation of the above policy documents was approved by Mongolian Government in Resolution No. 325 dated 14 October 2018. In this Resolution detailed information on locations, capacities and preliminary budgets for significant measures and projects providing construction of energy storage and energy sources, construction of transmission lines, and other important activities were delineated.

Below is a summary of the major projects and measures, in terms of target capacity, to be implemented in order to engage in commerce of energy with regional countries.

Within the scope of aims for providing safe reserves of primary energy and petroleum supply, goals in the Resolution include:

- To ensure that Baganuur coal mine exploitation reaches a capacity of 8–10 million tons per year, and to increase the reliable operation of the Shivee-Ovoo coal mine, and to provide support in financing technical and technological renovation in these mines;

- To increase the opportunity to supplying coal demand for electricity and heat plants from private-sector mines;
- To identify exploitable reserves of coal-bed methane by conducting detailed studies of coal deposits; and
- To conduct a research study of hydrocarbon-bearing shales for use in energy production.

Within the scope of aims for providing capacity reserves that will fully satisfy domestic electricity and heat demand, goals are:

- To expand the Darkhan thermal power plant capacity by 35 MW;
- To renovate turbine generators №1-4 of thermal power plant-4 of Ulaanbaatar city;
- To expand the Erdenet thermal power plant capacity by 35 MW;
- To expand the Choibalsan thermal power plant capacity by 50 MW;
- To expand the installed capacity of high-pressure section of thermal power plant-3 of Ulaanbaatar city by 75 MW;
- To expand the Amgalan thermal power plant of Ulaanbaatar city, making it a 50 MW combined heating and electricity producing station;
- To carry out an expansion and renovation adding 250 MW to thermal power plant-3 of Ulaanbaatar city;
- To commence expansion work (with 1 addition including a gas generator operating to supply peak power) to augment the capacity of thermal power plant-2 of Ulaanbaatar city by 300 MW;
- To construct a thermal power plant that will domestically supply the energy demand of the Oyu Tolgoi copper mining and processing plant by relying upon the Tavan Tolgoi coal deposit;
- To develop and implement technical and technological solutions that will ensure consistent and reliable operation of integrated system for thermal power plants projects such as the 700 MW Baganuur plant and the 300 MW capacity Booroljuut plant;
- To commence construction of generation sources with capacity not lower than 100 MW for the Altai-Uliastai energy system;
- To commence construction of thermal power plants relying on coal deposits to supply 5 aimags in the Western region;
- To commence construction of the 315 MW capacity Egiin Gol hydro power plant.

Within the scope of aims for creating an integrated energy system by connecting regional energy systems with high capacity power conducting lines:

- Construction of the Ulaanbaatar-Mandal-Gobi 330 kV, 2-circuit, 260 km long overhead power line and 220 kV sub-station;
- Full expansion and renovation of the Choir 220 kV sub-station;
- Commence construction of the Choir-Sainshand-Zamyn Ude 220 kV long overhead power line and sub-station;

- Commence construction and expansion work on the 220 kV, 2-circuit 118 km long overhead power line and associated sub-stations that will interconnect the Baganuur sub-station with the Ulaanbaatar sub-station;
- Commence construction and expansion work on the 220 kV, 2-circuit 518 km long overhead power line and 220 kV sub-station to serve the Baganuur-Undurkhaan-Choibalsan area;
- Conduct a study on construction of a 220 kV, 2-circuit 380 km long overhead power line and sub-station to Uliastai-Durgun-Myangad and commence associated work;
- Conduct a study on construction of a super-voltage long overhead power line and sub-stations for Ulaanbaatar-Uliastai.

The following measures will be taken and implemented within the scope of secondary strategic aims for development of mutually beneficial energy collaboration with regional countries.
Within the scope of aims for expanding energy collaboration through establishment of long-term mutually beneficial energy import and export agreement with neighboring countries:

- Establish collaborations in planning and negotiations on energy sector resource cooperation between the governments of the Russian Federation and Mongolia;
- Establish a collaborative agreement on energy sector activities between the governments of the People's Republic of China and Mongolia;
- Collaborate with neighboring countries towards the development of electricity transmission and gas pipeline transit infrastructure within the scope of an initiative to establish an Economic Corridor between Mongolia, the Russian Federation, and the People's Republic of China;
- Initiate mine expansion and construction of an electric station of 2528 MW capacity with a direct current power conducting line of 660 kV to export power to the PRC, relying upon the Shivee-Ovoo lignite coal deposit, and establish an associated energy export agreement ensuring project commencement; and
- Within the scope of aims for pro-active involvement and collaboration in preparing proposals and initiatives for energy collaboration involving international organizations and regional countries, pursue proactive involvement in international initiatives and regional collaborations such as Central Asian region economic cooperation, Ikh Tumen Initiative, Energy charter treaty, One road one region and establishment of North eastern Asian integrated energy grid.

Within the scope of aims for collaboration with regional countries to implement the Gobitech-Asian integrated energy grid initiative that will export electricity to North eastern Asian countries from high-capacity renewable energy complexes based on the abundant reserve of Mongolian Gobi regional solar and wind sources:

- Conduct baseline studies of Gobitech-Asian integrated energy grid initiatives in collaboration with international bank and other financing organizations and with regional countries; and
- Collaborate with regional countries and international organizations to develop a framework for collaboration and negotiation mechanisms related to the Asian Super Grid-Ulaanbaatar international initiative.

4 Regional Interest in International Energy Commerce in Northeast Asia

An interest in international energy commerce is increasing as the economic growth of Northeastern Asian countries, particularly that of the People's Republic of China, increases energy demand. Projects such as construction of oil and natural gas pipelines between the countries of the region, the Asian Super Grid, Gobitech, and bilateral initiatives between the Russian Federation and the People's Republic of China, including creating high voltage power conducting network for electric energy commerce between countries are being proposed, and, in some cases, implemented. In the case of Mongolia, there is currently trade with the Russian Federations and People's Republic of China in electric energy, as well as coal export to the People's Republic of China. Furthermore, projects have been started in Mongolia to export electric energy by building plants to produce electricity based on coal and renewable energy.

Due to an unequal distribution of resources and sources for electric energy production in the countries of Northeast Asia, some countries are choosing to collaborate with other countries to help in boosting the reliabilities of their electric energy supplies in the long term, and are seeking new sources for power. The consumption for electric energy of countries in the Asian-Pacific region, particularly the eastern Asian countries, namely Japan, the Republic of Korea, the Democratic People's Republic of Korea, the People's Republic of China, Mongolia, and the Russian Federation are growing steadily. In order to meet growth in electricity needs, which depend on population and economic growth and the shortage of electric energy reserves, of, in particular, China, Japan and the Republic of Korea, sources of electricity imports from foreign countries are being explored.

As of today, electric energy exports and imports is undertaken in some regions of Mongolia, with the Russian Federation and the People's Republic of China.

Negotiations for implementation of projects for increasing the capacity of existing power lines and construction of new extra-high-voltage, high-capacity transmission lines are taking place between the Northeast Asian countries.

As interconnections between the grids of the countries of the region require significant investment, require years to complete, and need international implementation, various factors will be required to successfully implement these energy projects. Of those factors, the most crucial is that the policies in the countries to be connected, and government support in the participating countries, are integrated and unified with respect to the goals of building and operating the interconnected systems.

The projects being planned for implementation in the Northeast Asia region include projects for construction of international high voltage electric energy transmission grids, construction of high capacity renewable energy sources, and construction of natural gas pipelines. A listing of current power trading points between the countries is provided in Table 15.

Table 15: Current Power Trading Points

Transmission Line Component	Voltage [kV]	Current type
Gusinoozerskaya GRES (Russia) – Darkhan (Mongolia)	220	AC
Kharanorskay GRES (Russia) – Choibalsan (Mongolia)	110	AC
Chadan (Russia) – Khandagaity – Ulanngom (Mongolia)	110	AC
Blagoveshensk (Russia) – Heihe (China)	220/110	AC
Sivaki (Russia) – Sirius /Aigun (China)	110	AC
Blagoveshensk (Russia) – Sirius /Aigun (China)	2x220	AC
Oyutolgoi (Mongolia) –Hohhot (China)	220	AC
Amurskay (Russia) – Heihe (China)	500	Back-to-back HVDC

4.1 Shivee-Ovee power plant

In November of 2015, the Mongolian and Chinese governments signed a Memorandum of Understanding to execute the FEASIBILITY STUDY for the "Shivee Energy Complex Project of Energy Export" during the Mongolian President's visit to the People's Republic of China.

The Shivee-Ovoo export-oriented project will be successfully implemented under the framework of Mongolia-China energy cooperation and China's One Belt and One Road initiative. The main purpose of the project is to build a large-scale power and DC power transmission between Mongolia and China as the start of the Asian Super Grid Initiative in Northeast Asia.

The Shivee-Ovoo is a complex project that integrates fossil fuel and renewable energy, including transmission lines for energy export. Included in the project are:

- A coal mine with the capacity over 20 million tons/per year
- Power plants with total installed capacity of 5,280 (for export) plus 70 MW (for local and domestic use).
- Transmissions line with the capability to transmit 4,600 MW at ± 660 kV UHV DC.
- Renewable power plants with installed capacity of 15 percent of that of the coal-fired power plants included in the project.

The project plans to construct a power station of 6 blocks, with each block having capacity of 660 MW, plus 2 blocks with capacity of 35 MW each. Annual coal production from the mine is expected to be around 21 million tons, and water consumption for the project is projected to be 13.47 million cubic meters per year.

The project is located in the Shivee Ovoo strategic coal deposit area in Shivee-Gobi, in the Sumber soum of Gobisumber province, Mongolia.

The project location lies 200 km to the southeast of Ulaanbaatar, and 400 km from the Mongolian and Chinese border.

4.2 The Asian Super Grid and Gobitech projects

The Asian Super Grid initiative was proposed first in 2011 by Masayoshi Son, the executive director of Softbank, a Japanese leading and multi-national information technology company. Since that time, pro-active efforts have been underway to start to implement the initiative at the international level. Within the scope of this initiative, the North eastern Asian countries such as Mongolia, the People's Republic of China, the Republic of Korea, and Japan, as well as the Russian Federation, are conducting research studies on how to implement this initiative from their own perspectives.

According to general layout expected in the Asia Super Grid, Mongolia and the Russian Federation will be able to sell electric energy to China, the Republic of Korea, and Japan (which produce electricity domestically and import electric energy) through long overhead power lines and direct current high voltage cables. In addition, the importing countries, could sell excess electric energy to other countries during their low-load periods via the integrated grid.

In initial planning of the Asian Super Grid, it was estimated that energy to be exported to other countries would be produced from renewable energy sources. Power distributed through the Asian Super Grid by would come (in part) from electricity plants built under the "GOBITECH" initiative, tapping the immense renewable energy reserves of solar and wind resources of the Gobi region located in the southern part of Mongolia and the northern part of the People's Republic of China.

According to this plan, Mongolia will take part in this initiative with high obligations to provide power and will be able to greatly benefit from it as a result. As most of the power resources are to be constructed in Mongolian territory, the projects will bring development of the renewable energy industry to Mongolia, with the additional benefit of creating many jobs and a workforce associated with the renewable energy industry. Our Gobi region offers plentiful reserves of renewable energy, in comparison with other countries, and thus it has the relative advantage of offering the large territory (land area) required for implementation of major projects.

As described in the 2013 study "Gobitech in North eastern Asia and Asian Integrated Grid" assembled by the stakeholder countries of the Asian Super Grid Initiative through a research study jointly-conducted by several organizations, a baseline study was completed to assess construction possibilities for the development of the Solar energy resource to provide installed capacity of 50 GW, and development of the wind energy resource to yield an additional 50 GW of installed capacity of, respectively in Gobi region in total. Figure 9 shows the proposed design of the Asian Super Grid/Gobitec project, including the current distribution of power sources in the countries of the region.

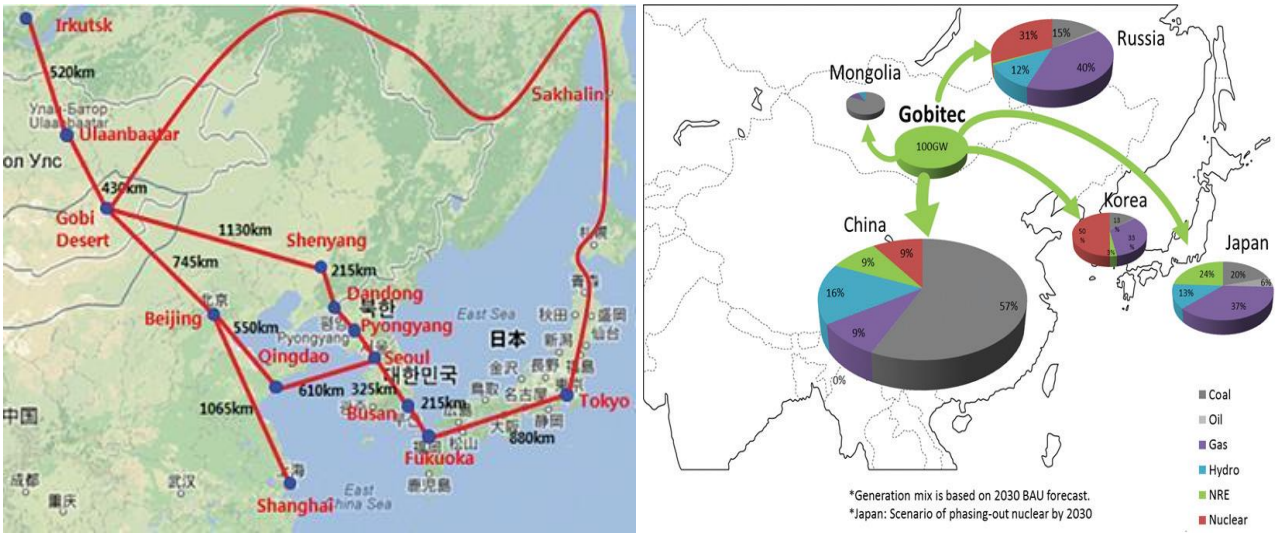

Figure 9: Asian Super Grid & Gobitech Project

In principle, the implementation of regional joint electricity interconnection projects is supported by North-East Asian countries such the Republic of Korea, the People's Republic of China, the Russian Federation, Japan and Mongolia, and project alternatives consistent with each country's own interests have been developed and introduced.

4.3 Other project initiatives for regional electricity interconnection

The support of regional energy collaboration could be a significant means to accomplish the goals of the Paris agreement to minimize emissions of greenhouse gasses by supplying consumers with environmentally-friendly, cheap, and clean energy. In this sense, support has been provided towards financial and technical collaboration on regional electricity interconnections by the United Nations Economic and Social Committee of the Asia Pacific Region (UNESCAP), the International Development and Financing organization (World Bank), the Asian Development Bank (ADB), and the International Renewable Energy Agency (IRENA).

Figure 10 show maps of regional interconnection projects proposed by Russia and the Republic of Korea.

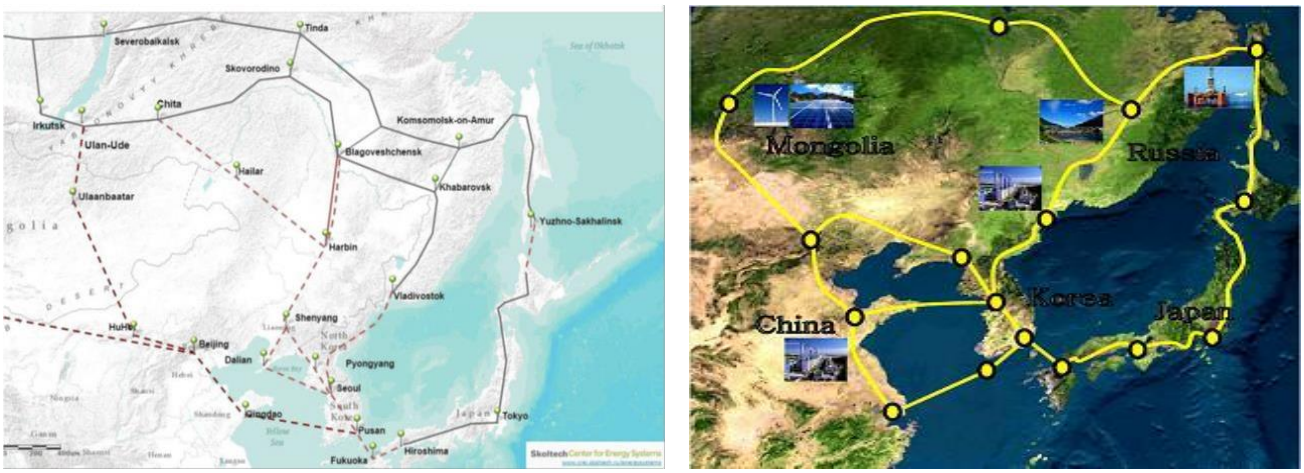

Figure 10: Regional Electricity Interconnection projects by Russia and South Korea

In a recent collaboration example, a detailed study was completed on regional electricity interconnection within the scope of research study "North-East Asian Regional Power Trading Strategy" being implemented with the technical assistance of the Asian Development Bank.

Within the scope of this study, the following high-voltage power conducting line project has been proposed.

Phase I (2026): Gobi RE base to reach 5 GW

- Development of Gobi Re base 500kV substation
- Construct a new 500kV AC transmission system overlaying on the existing 220kV one in Mongolia
- Darkhan (Mongolia) — Buryatia (Russia) 500kV AC
- Kyzylskaya (Russia) — Emnegov (Mongolia) 500kV AC
- Uprating Oyutolgoi — Hohhot (China) 500kV AC
- Weihai (China) – Sinsiheung (ROK) 500kV, LCC HVDC, 3GW
- Vladivostok — DPRK-Donghe (ROK) 500kV, LCC-HVDC, 2GW
- Hadong (SK) — Hino (Japan) 500kV LCC-HVDC, 2GW
- Primorsky (Russia FE) — Kashiwazaki-Kariwa, 500kV, LCC-HVDC, 2GW

Figure 11 shows a map of conceptual global land and sea channels for energy interconnections, including interconnections linking Northeast Asia with South Asia and Australia, Russia, and beyond to North America and Europe.

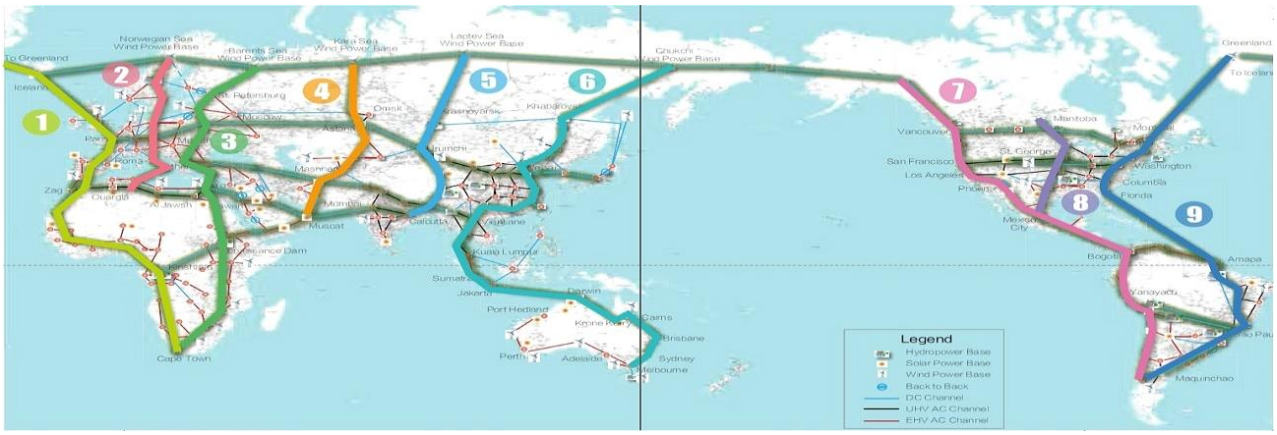

Figure 11: Map of GEI land and sea channels by 2070 (Source: Global Energy Interconnection Backbone Grid Research, GEIDCO 2018, China)

4.4 Oil and natural gas pipeline interconnecting Russian Federations and People's Republic of China

The project for the construction of oil and natural gas pipelines with the purpose of supplying oil and natural gas from the Siberian region and other areas of Russia to supply markets in the People's Republic of China has been under active negotiation in recent years.

As of today, the Russian company "Gazprom" is building the "Siberian Energy" gas pipeline. This pipeline will draw natural gas from the Kovikta gas condensation deposit in Eastern Siberia's Erkhuu region, Chayandin deposit and gas condensation deposit of Yakut and will supply domestic markets for gas in the Russian Far East and nearby areas as well as markets in the People's Republic of China via a Khabarovsk-Vladivostok route.

Within the scope of these negotiation, called the "Eastern" agreements, it was agreed that Russia would supply 38 billion cubic meters of natural gas annually into the eastern region of People's Republic of China for the period of 30 years starting from 2019.

In parallel with this initiative, the "Western" agreement includes plans to supply 30 billion cubic meters of natural gas per year for a period of 30 years into the northwestern region of the People's Republic of China via a pipeline that will be built through the Mongolian Altai region from Yamalo-Nenets autonomous district of the Russian Federations.

In the case of Mongolia, no final decision has currently been made on hosting these facilities, even though the proposals for these oil and natural gas pipelines transiting Mongolia's territory (see Figure 12) were proposed at the government level in meetings of the two neighboring countries.

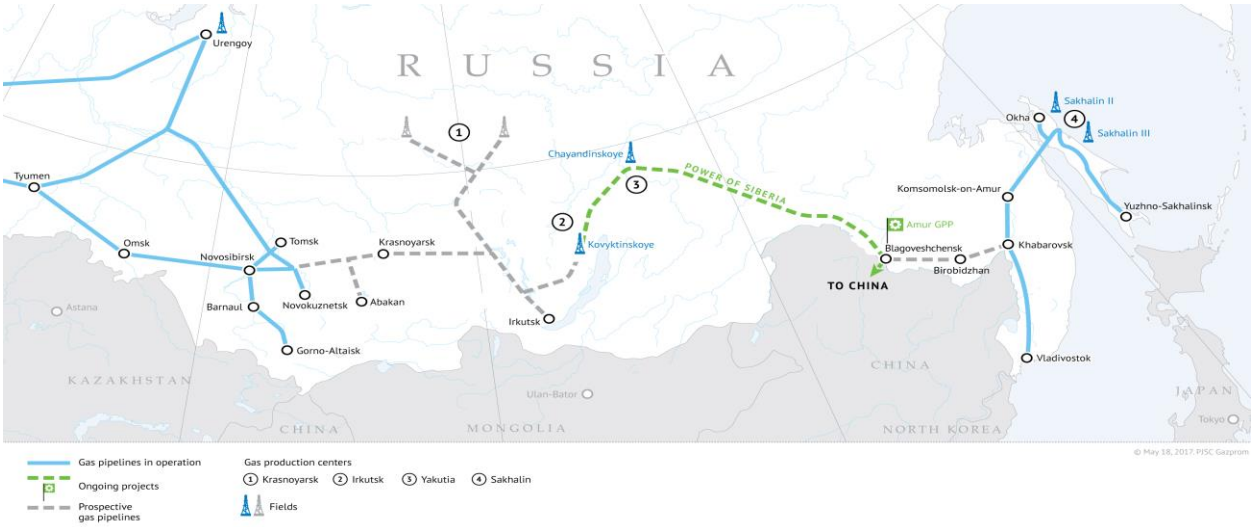

Figure 12: Russia to China gas and oil pipeline project

5 Mongolia's Energy Export Goals

At the Mongolian Government level, a target was set clearly to become an "Energy Exporter" by expressing its support for regional energy collaboration. Mongolia gas many advantages as a source of energy production, including vast reserves of conventional and renewable resources, a large territory with low population densities, politically-friendly relationships with neighboring nations, and a favorable investment environment. In addition, within the scope of aims to reducing greenhouse gas emissions to mitigate global warming and climate change, Mongolia needs to collaborate with neighbors by developing detailed plans that meet the requirements of energy consumers based on advanced of renewable energy and clean energy technologies on one hand, and meeting the requirements of international development bank and financing organizations on the other.

Selling electricity to the Northeastern Asian countries using its own vast reserve of energy would bring positive effects to Mongolia's society and economy. From this point of view, Mongolian government has been conducting corresponding joint research studies together with international organizations by fully supporting energy exporting endeavors at all levels and by developing state policy and directions consistent with an energy export focus. As regional energy sales do not solely depend on Mongolia, it is crucial to collaborate and thoroughly coordinate with other countries in order to achieve successful outcomes.

In terms of the particular economic capacity of stakeholder countries, the People's Republic of China and Japan are ranked 2nd and 3rd internationally in terms their economic capacity and in terms of national influence and international collaboration, China and the Russian Federation are permanent members of the UN Security Council, while Japan and the Republic of Korea are the members of Organization for Economic Development (OECD).

As the different countries have different perspectives and targets, it is necessary to emphasize the goals for countries to take part in power trading and to understand what benefits each of the countries would expect by defining the interests of each country. Doing so is required to in order to develop attractive and realizable plans based on the interests of the countries of the region.

Mongolia has the following advantages as an energy supplier:

- Its solar and wind reserves are vast—this is the most important factor
- Availability of land and territory
- Technically convenient (soil and surrounding environment)
- Peaceful state relationships with other nations, offering security of energy supply for importer countries
- An able workforce and attractive tax environment

The most effective strategy for Mongolia would to emphasize its potential contribution in minimizing greenhouse gas emissions, which is a common target of the participating countries and draws on the advantages above.

Within the scope of this strategy, Mongolia needs to permanently arrange special meetings to start proactive negotiations towards development of electricity and natural gas transit pipeline infrastructure within the scope of initiatives to create economic corridors with neighboring countries such as the Russian Federation and the People's Republic of China. These corridors would allow Russia to export energy resources to China via Mongolian territory, but would also allow Mongolia to export energy resources to third countries such as Japan and the Koreas via Russian and/or Chinese territory.

In terms of developing realizable project in the near term, it is possible to establish electricity an interconnection agreement and initiate a corresponding project by constructing the Shivee-Ovoo power plant with 5280 MW capacity and building a 660 kV Ultra high-voltage direct current overhead power line based on the latest advanced technology in order to compensate for the intermittency of high capacity solar and wind energy stations.

With the establishment of an electric energy integrated system based on renewable energy, the stakeholder countries will be provided with the following advantages.

- They would be able to efficiently and cost-effectively reduce greenhouse gas emissions as part of their obligations bound by Paris agreement.
- They would be able purchase clean energy at a lower tariff than the average tariffs for electricity in their nations.
- Their system consistency will be improved with the integration various types of sources (solar, wind and hydro).
- The stakeholder countries will be able to make their own regulations (providing their own power dispatch)
- Power plant operators in all countries would be able to increase economic efficiency at power station by interconnecting and operating energy sources (hydro power plant and energy storage, for example) with the grid
- Due to the capacity provided by the interconnections, and the capacity available in the interconnected countries, grid operators in each country would be able to reduce the level of capacity additions required to meet reserve margins on their systems.

Depending on the geographical location and different time zones of the stakeholder countries, as well as the different climates in the region, the peak load of electricity consumption occurs at different times and in different seasons. For instance, the peak load on the South Korean and Mongolian grids occur during the winter season, while that of Japan increases during the summer season.

6 Requirements for Regional Energy Projects, and Next Steps for Mongolia

To implement regional energy projects that are executed through international participation, the benefits for each stakeholder should be fairly distributed and transparent. In order to assure such outcomes, it would be more efficient to establish a designated organization ensuring equal involvement of all stakeholders based on principles of fairness and transparency, or to build new coordination functions within currently operational UN and/or other representative organizations. The larger the interests and influence of one country are in a project, the harder it will be for the project in question to be implemented in a way that meets the requirements of all stakeholders. Although each country has its own policy set, strategy, and economic attributes, it is critical that all the stakeholders should negotiate and unite at the government level in order to provide unified interests and purposes.

Measures to be taken by the Mongolian side to prepare for regional energy projects include:

- Establishing joint organizations working towards an Asian Super Grid with the stakeholder countries taking part in the initiative at the governmental level, and intensify collaboration at all levels to provide regular consultation and venues for negotiation;
- Develop a sophisticated and favorable business environment to attract investors into the project. For instance, ensure a healthy bid selection process and to work to make obtaining special licenses clearer and simpler, as well as to maintain and provide the required information for transparent collaboration;
- Jointly develop legal regulations with the importer country by anticipating complications that could occur when trading electricity cross-border (for example, technical regulations, power purchase agreements dedicated to independent electricity producers, and environmental standards);
- Create a unified single tax system taking account of international guarantees and double-taxation issues during negotiation. Resolving tax issues will be required to allow project implementing organizations to estimate their investment risk with respect to financing and to create an Asian Super Grid development fund that will support the projects to be implemented initially;
- Ensure the connection of power sources to be built within the scope of the project with the project transmission lines as a priority, and support and operate the connection of private sector transmission lines with the national and international grids;
- Study the availability of land required for project implementation, develop a process of obtaining land use approval, and set up a process to address and fairly minimize any dispute which may arise with respect to land uses;

- Develop integrated data systems for assessing of renewable energy resources that could provide bankable resource data to project developers;
- Prepare and implement educational systems to develop the human resources required for actual implementation of the Mongolian elements of the Asian Super Grid.

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III. NAUTILUS INVITES YOUR RESPONSE

The Nautilus Asia Peace and Security Network invites your responses to this report. Please send responses to: nautilus@nautilus.org. Responses will be considered for redistribution to the network only if they include the author's name, affiliation, and explicit consent.