PART I MASTER PLAN

CHAPTER 1
INTRODUCTION

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1.1 Background of the Study

In Mongolia some 50% of the total population of about 2.4 million are nomadic families. For the nomadic families Sum centers are key places for supplying their vital goods, and also for receiving public services such as administration, medical care, education, etc.

As of November 1997, the electric power at 117 out of 314 Sum centers in total in Mongolia is being supplied from the national power transmission network. At the remaining 197 Sum centers, the electric power is supplied by the diesel engine generators by Sum center independently. Most of these diesels generating facilities were manufactured during the former Soviet Union era and installed long ago from 1963 to 1990.

During the Social Republic era of the country, Mongolia depended on the Soviet Union for the supply of spare parts necessary for maintenance of the generating equipment and technical guidance. Due to the corruption of the Soviet Union's economy in 1991 and associated transition to a market economy, the following four factors caused troubles to the operation and maintenance of the Sum's generating facilities, i.e. (1) the lack of business operating senses, (2) the interruption of spare parts supply, (3) the lack of technical capability and (4) shortage of management budget. The operation of much equipment has been obliged to be kept stopped after failure, as operators cannot repair them. The affected generation quantity, and aggravated the conditions of daily lives of people in Sum center and caused serious effects to the socio-economic activities of the Sum centers.

Under such situations, the Government of Mongolia decided to supply electric power adequately to the Sum centers by renewable energy which exists in the country as indigenous and abundant solar and wind energy resources. The adoption of the power supply facilities by the renewable energy is expected to contribute to the saving of valuable fossil energy and to reducing outflow of foreign currency reserves.

In 1995 the Government of Mongolia asked the Government of Japan to formulate the master plan on the rural power supply by renewable energy. On the basis of the request from the Government of Mongolia, the Government of Japan dispatched the Project Selection Team to Mongolia in June 1997 and Project Formulation Basic Study Team in December 1997. The Preliminary Study Team was then dispatched to Mongolia and the scope of work was concluded between Government of Mongolia and the Government of Japan in June 1998.

1.2 Objectives of Study

The objectives of the Study are;

(1) Formulation of Master Plan

The least cost alternatives of supplying electric power to 167 Sum centers shall be determined, where the power system interconnection with the grid system is not available by the year 2000, by isolated diesel power generator and various isolated renewable systems such as solar power system, wind power system and suitable hybrid systems. Optimum power supply systems shall be planned and an implementation program shall be made.

(2) Pilot Plant Installation and Tests

Renewable energy pilot power plants (hereinafter referred to as "the Pilot Plant") shall be installed and operated in three Sum centers selected in order to collect technical data and examine the outcome of the systems.

(3) Establishment of management, operation and maintenance organization

Establishment of management bodies in each Sum center shall be made prior to the installation, in order to enable them to maintain and operate the Pilot Plant by themselves for more than 10 years (of the Pilot Plant.)

(4) Technology Transfer

Relevant technology and know how shall be transferred to the Ministry of Infrastructure Development (hereinafter referred to as "MOID") counterpart personnel and Sum people concerned in the course of the Study.

In addition to the above 4 objectives, it would be emphasized that the importance of development of renewable energy in spite of the existing diesel generator is recognized broadly in respect to saving fossil oil resources and environmental protection. Therefore, a fifth objective is added as follows.

(5) Global Environmental Protection

Development of renewable energy and its effective use shall contribute to saving fossil oil resources and global environmental protection.

1.3 Sites to be Studied

1.3.1 Master Plan Study

Targeted Sites of the Master Plan Study include 171 Sum centers in Mongolia where the power system interconnection with the grid system is not available by the year 2000. In the Master Plan Study, the power supply system will be planned to meet the public demand and general demand by the target year in the objective sites. Table I.1.3-1 in the databook shows the list of the sites for the Master Plan Study.

1.3.2 Pilot Plant Installation

Targeted Sites of the Pilot Plant Installation, as the result of discussion with MOID, had been selected with the conditions that the sites are suitable for power generation by utilizing renewable energy resources and the locations are to be selected in mountainous and plain areas. However, the targeted sites of Japan's Grant Aid Cooperation project (Grant Aid projects of Diesel Generators) exclude the targeted sites of the Pilot Plant Installation. Furthermore, two Sum centers were not selected in one Aimag and the distance from Ulaanbaatar is near which enables the collection of observed data.

The selection of the Pilot Plant Installation sites should have the priority to supply power for the Sum center where power supply condition is considerably poor, and the Pilot Plants were considered to be maintained sustainably by the Sum's established organization. Consequently, the following three (3) Sum centers were selected for the sites of Pilot Plant Installation.

(1) Arkhangai Aimag: Tariat Sum center
(2) Uvurkhangai Aimag: Bayan-Undur Sum center
(3) Dundgovi Aimag: Adaatsag Sum center

The ratings of the Pilot Plant are as follows:

(a) Rated voltage: single phase 220 V
(b) Type of system: wind and solar power hybrid generation system
(c) Output by solar cell: 3 kW class
(d) Output by wind power: 1.8 kW class
(e) Frequency: 50 Hz
(f) Battery capacity: 48,000 Ah x 2 (96,000 Ah: for about 2 days supply)

The study results of the Pilot Plant Installation are described in the subsequent Part II.

1.4 General Description of the Study

1.4.1 Procedure of the Study

The Study was carried out by the Study Team for two years from October 1998 to September 2000 with the following procedures and schedules.

(1) Master Plan Study

	Study	Study Period	Description
1	Preparatory in (J)	Oct. 1998	Preparation for the Study
2	First Study in (M)	Oct. 1998 - Dec. 1998	Inception Report presentation, Inventory Survey
3	First Study in (J)	Jan. 1999 - Feb. 1999	Progress Report 1(PR1) preparation
4	Second Study in (M)	Feb. 1999 - Mar. 1999	PR1 presentation, Technology Transfer Seminar 1
5	Third Study in (M)	May 1999 - Jul. 1999	Sample Survey
6	Second Study in (J)	Jul. 1999 - Aug. 1999	Progress Report 2（PR2） preparation
7	Fourth Study in (M)	Oct. 1999	PR2 presentation, Data Collection
8	Third Study in (J)	Nov. 1999	Interim Report（ITR） preparation
9	Fifth Study in (M)	Feb. 2000 - Mar. 2000	ITR presentation, Technology Transfer Seminar 2
10	Fourth Study in (J)	May 2000 - Jun. 2000	Draft Final Report（DFR） preparation
11	Sixth Study in (M)	Jul. 2000 - Aug. 2000	DFR presentation, Technology Transfer Seminar 3

(Note) (J): Japan, (M): Mongolia

For the purpose of fully involving the Mongolian opinion in the Master Plan, an advanced work schedule of the formulation of the Master Plan including economic and financial analysis was taken into consideration in the Study. The Study Team presented the recommended Master Plan in detail and discussed the realization of the project with the counterpart.

(2) Pilot Plant Installation Survey

	Study	Study Period	Description
1	Preparatory in (J)	Oct. 1998	Draft tender documents preparation of pilot plant
2	First Study in (M)	Oct. 1998 - Dec. 1998	Field Reconnaissance, Preparation of local supply
3	Second Study in (M)	Feb. 1999 - Mar. 1999	Preparation of installation work of pilot plant
4	Third Study in (M)	May 1999 - Jul. 1999	Installation work, Technology Transfer, Test
5	Fourth Study in (M)	Oct. 1999	Technology Transfer, Mid-term Review of Test
6	Fifth Study in (M)	Feb. 2000 - Mar. 2000	Final Review of Test

(Note) (J): Japan, (M): Mongolia

The equipment and materials made in Japan were procured under the guideline of JICA.

(3) Consignment of Field Survey Works

Field Works were consigned by the local consultant and contractors as follows.

(a) Assistance work by Local Consultant, first year (Oct. 1998 - Mar. 1999)

- Assistance work of preparation of construction plan for pilot plant installation

- Assistance work of preparation of distribution line installation plan
- Preparation of specifications and drawings for procurement of materials and construction work and cost estimate
- Assistance work of inventory survey
- Assistance work of technology transfer seminar

(b) Assistance work by Local Consultant, second year (May 1999 - Mar. 2000)

- Assistance work of procurement of installation materials for pilot plant installation
- Supervision work of installation of pilot plants and distribution line installation
- Monitoring and data collection of pilot plants
- Assistance work of sample survey
- Assistance work of technology transfer seminar

(c) Assistance work by Local Consultant, third year (May 2000 - Aug. 2000)

- Monitoring and data collection of pilot plants
- Assistance work of technology transfer seminar

(d) Procurement of survey materials, pilot plant installation work and distribution line installation work (May 1999 - Jun. 1999)

Refer to the attached general description of pilot plant installation work and distribution line installation work in Data Book.

(4) Technology Transfer Seminar

Technology Transfer Seminars were held 3 times in total. In addition to these seminars inventory survey seminars were held at each Aimag center and technical guidance of pilot plants was executed at 3 Sum centers for sustainable and smooth management, operation and maintenance.

(a) First Technology Transfer Seminar (Mar. 4, 1999)
(b) Second Technology Transfer Seminar (Mar. 6, 2000)
(c) Third Technology Transfer Seminar (Aug. 7, 2000)

1.4.2 Summary of the Study

(1) Master Plan Study

(a) Solar and wind energy potential is high in the southern, southwestern and eastern areas. At these high potential areas the solar and wind power generation system is positively planned to be installed.

(b) High priority of power supply should be given to the public facilities (hospitals, schools, Sum office) in the Sum centers. For these facilities power supply facilities by renewable energy are planned to be provided by 2005.

(c) Power supply system to the general consumers is planned to be completed by 2010. Diesel generator sets are still used for peak power supply.

(d) All the diesel power generation systems are planned to be replaced with fuel cells power generation systems utilizing hydrogen energy by 2015. Hydrogen, which is the fuel of fuel cells, is produced by a renewable energy generation system. At this time all the diesel generator sets are retired.

(e) A new organization is proposed to establish for the effective operation of the facilities and sustainable economic management of the system.

(f) As a result of economic analysis, Project implementation plan by equity or loan by the foreign assistance in the 2005 is not feasible at all.

(2) Pilot Plant Installation Study

(a) Power supply for the public facilities has been maintained for a year. 24-hour services of the public facilities have been provided to the inhabitants in the Sum centers, and public services have been improved remarkably.

(b) The fuel cost of the existing diesel generator sets is reduced about 10%.

(c) Through the collaboration work for the Study and seminar of the Pilot Plant Installation, the technology of demand side management was transferred, and renovation of consciousness, which includes energy saving and effective use of energy, was diffused.

(d) The collected meteorological and wind observation data are analyzed in detail, and such data are utilized effectively for the formulation of the master plan of the optimum power supply system.

CHAPTER 2
OVERVIEW OF MONGOLIA

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2.1 The Land

Mongolia is located approximately in the central part of Asian continent, and is constituted mainly of Mongols. Landlocked by Russia and China, it measures 1,486 miles (2,392 km) from west to east, and 782 miles (1259 km) from north to south. It occupies an area of 604,000 square miles (1,565,100 km^2), which is 4 times as much as that of Japan. The total length of the borderline reaches 8,161 km, bounded by Russia for 3,485 km and by China for 4,676 km.

The entire country land is situated on the Mongolian Plateau, with an average altitude of 5,200 feet (1,585 m) above sea level. In this highland country, Khokh Nuur basin shows the lowest altitude of 532 m. The western part of the land is in a lower altitude than the eastern part. The highest peaks are in the Mongol Altai Mountains, of which Nayramadln Peak (also called Huyten Peak; 14,350 feet [4,374 m]), at the western tip of the country, is Mongolia's highest point. The northernmost point is Sharyn Davaa at lat. 52°06' N. and the southernmost is Orvog Gashuuny Ovoo at lat. 41°35' N. The easternmost is Numrugin Ovoo at long. 119°57' E. and the westernmost is Tavan Bogd at long. 87°47' E.

Mongolia has 3,811 constantly flowing rivers with a total length of 67,000 km. The rivers are divided into two major flows.

(1) Arctic Ocean Flow: includes Selenge River Mainstream (1,024 km) running into Lake Baikal, and its major tributaries such as Egiin River, Chuluut River, Ider River (323 km), Orkhon River (1,124 km) and Tuul River which is 704 km in length and merges into Orkhon River across Ulaanbaatar city.

(2) Pacific Ocean Flow: Onon River (298 km), Kherlen River (1,090 km), Mingi River, Khalkhyn River (291 km), etc. run into the Amur tributaries and then flow into the Pacific Ocean.

Mongolia has a few hundred lakes. The largest is Lake Uvs (3,350 km^2), and the second largest is Khuvsgul, (2,760 km^2). There are 6 lakes with 500 km^2 in area. The lakes located in the lowerland of the Gobi area are small enough to dry up easily in a year of little rainfall. There are numerous salt lakes in Mongolia, such as Lake Uvs and Lake Khyargas, especially in where Gobi area the most of them are salt lakes.

2.2 Climate

Mongolia is situated at high latitudes and high above the sea level, and far from the ocean. It is surrounded by mountain ranges; Greater Khingan Range and the Himalayas in the east, the Altai Mountains in the west, and Sayan Mountains and Yablonovyi Mountains in the north. Under the geographical conditions, Mongolia is hardly affected by the oceanic climate. It has the typical continental subarctic climate which is extremely dry and temperature varies rapidly.

The national average annual rainfall is as little as 200 - 250 mm. Al-Khangai Aimag shows the highest rainfall of approximately 350 mm, while the Gobi area has the lowest rainfall showing less than 100 mm in about 30 rainy days. Khangai area has 40 to 50 rainy days while the rest of the 300 days and more are sunny days.

In Mongolia, the winter season lasts long with severe coldness. The coldest month is January when the mean temperature for the coldest Ulaangom city in Uvs Aimag is -33°C, and that for the warmest, Dalanzadgad city in Umnugovi Aimag, is -15°C to -16°C. The lowest temperature recorded is -50°C. The hottest month is July. The mean temperature for Saynshand city in Dornogovi Aimag located in the Gobi area is 23°C, and for Altai city in Govi-Altai Aimag is 14°C. The highest temperature recorded is 35.83°C in various areas. Temperature variations of as much as 90°C can occur in a year, and more than 30°C in a single day. This big variation in temperature leads to vegetation patterns particular to the Mongolian Plateau, and enables nomadic stock farming.

Mongolia is roughly divided into 4 areas according to its physical geography: (1) the Gobi area (semi-arid zone), (2) Kher-tar area (steppes zone), (3) Khangai area (forest-steppe zone), and (4) Altai area (alpestrine zone).

(1) The Gobi area (semi-arid zone)

This area covers the southern parts of Mongolia. It has scanty rainfall and a few rivers because of frizzling hot weather during the summer. Unlike the typical image people hve for the name "the Gobi desert", the area is rich with ground water and has grass scattered around. Thus, it is the area where people and stocks can live without difficulty. In this area, which accounts for 20% of the entire land area, 10% of the population reside and more than 10% of the livestock the nation has are raised. There are some deserts and semi-deserts where people and animals can survive, but such areas occupy only 3 % of the entire land area.

(2) Kher-tar area (steppes zone)

This area is flat grassland, located at 600 m - 1,100 m above sea level, sweeping from the central parts to the eastern parts. It has few trees and is covered with dense grass.

(3) Khangai area (forest-steppe zone)

This area sweeps, centering upon the Khangai Mountains and the Khentei Range with rough grasslands. It has an abundance of forests and lakes. Because it rains much and the plants grow higher, it is the most suitable area for nomadic life.

(4) Altai area (alpestrine zone)

Centering upon the Altai Mountains (Gobi Altai, Mongolian Altai) in the west, the mountainous area stretches. The area located at the highest altitude has a series of high mountains with more than 4,000 m, among which the highest peak is Huyten Peak (4,374 m).

2.3 Population, Ethnic Groups and Culture

The population of Mongolia is 2,413,000 (estimate as of the end of 1998). With a population density of 1.5 person per square km, Mongolia has one of the lowest population densities of any country in the world. Mongolian people all can be categorized as Mongols, but they can also be divided into some ethnic groups based on the historical traces as a multiracial nation. Within Mongolia, Khalkha-speaking Mongols constitute almost 70% of the population and exist widely throughout the nation. Other Mongolian groups include Kazaks, Tolgot and Bayad. In the beginning of the 1960s, Chinese accounted for 2% of the population, and Russian 1% (excluding stationed forces), but their population had rapidly decreased by the end of the decade. In the 1990s, the Chinese and Russian population became scant. Though the official language in Mongolia is Mongolian, while the Kazak language is also assigned as the official language in the Bayan-Ulgii Aimag which is located in the western part of the country and where Kazak people predominate.

Table I.2.3-1 describes the number of Sum and population by Aimag in Mongolia, together with those for the survey.

Table I.2.3-1 Population by Aimag (1998)

Aimag	Overview		for the survey		Ratio of population for the survey
	No. of Sum	Population	No. of Sum	Population	
Arkhangai	19	103,700	4	15,639	15%
Bayan-Ulgii	13	96,200	9	41,656	43%
Bayankhongor	20	91,600	17	60,695	66%
Bulgan	16	66,100	1	3,318	5%
Govi-Altai	18	74,900	16	47,784	64%
Dornogovi	14	49,900	8	18,146	36%
Dornod	14	84,300	7	20,806	25%
Dundgovi	16	54,400	8	24,082	44%
Zavkhan	24	105,000	23	77,545	74%
Uvurkhangai	19	116,900	7	25,505	22%
Umnugovi	15	46,200	13	29,817	65%
Sukhbaatar	13	59,700	10	36,738	62%
Selenge	17	107,000	0	0	0%
Tuv	27	113,700	0	0	0%
Uvs	20	100,500	10	40,104	40%
Khovd	17	93,000	13	51,170	55%
Khuvsgul	23	123,600	20	78,183	63%
Khentii	19	77,700	7	18,384	24%
Darhan-Uul	4	94,200	0	0	0%
Ulaanbaatar	9	668,800	0	0	0%
Orhon	2	72,500	0	0	0%
Govisumber	3	13,100	0	0	0%
Total	342	2,413,000	173	589,572	24%

Source: Inventory Survey and Mongolian Statistical Yearbook 1998

The annual rate of natural increase in Mongolia showed 1.0 % in 1997-1998, which dropped by 1.5% in comparison with those of 10 years ago. As for male-female composition, males account for 49.6%, and females 50.4%. People at the age of 0 to 19 occupy 46.6% of the population, while those at the age of 0 to 34 take up 74.0%.

The capital, Ulaanbaatar, has a population of 668,800, 27.7% of the population of the entire country. The total population in three major cities, Ulaanbaatar, Darkhan and Erdenet amounts to 835,500, approximately 35% of the entire population. Thus the urban areas tend to be heavily populated.

As of 1998, Mongolia has 859,300 in work force though it has potentially 1,256,800 in work force. Among the working population, 809,500 people are employed and 49,800 are unemployed (5.8% of unemployment rate). The breakdown of the employed is as follows: 97,900 people (12%) are engaged in industry, 394,100 (49%) in agriculture and stock-farming, 27,500 (3%) in the construction industry, 33,400 (4%) in transportation and commerce, etc. Thus nearly half of the employed make a living by agriculture and stock-farming

In the capital, Ulaanbaatar, people lead a modern urban life as is seen in Japan. In the city, trolley buses run busily and buildings are equipped with central heating systems. Many households have color TV sets and businessmen possess mobile phones. But once on steps into the grassland, nomadism appears. In the world, like the old days, people move from pasture to pasture with livestock. Thus in modern Mongolia, the urban style and the traditional nomadic style co-exist. Even in the urban areas which seem to be irrelevant to the nomadic life, the nomadic culture is still alive underneath the modern life.

Traditionally, Mongolian people have supported their lives by nomadism, which means people move from one place to another while raising a lot of livestock. The nomadic life has cultivated their own culture. It is quite unique and completely different from those of an agricultural society in which people settle down in one place. Being required to move frequently, simplicity has important value. People have sought for the simplest way of food, clothing and shelter. They live in a ger, a mobile dwelling which is easy to assemble and is simply covered with felt. Their meals are basically prepared with meat, dairy products, and flour, adding salt for seasoning. They neither cook any vegetables nor add any spices. As for clothing, they wear very simple and practical clothes which are loose, have long sleeves, and become a substitute for nightwear.

Because of the nomadic life, literature in written form has not been well developed, while the world-distinctive culture of oral literature has been cultivated. The Mongolian language is also unique in terms of its extensive vocabulary about livestock and stock-farming. For example, it has more than 200 kinds of words to describe the color of horse hair. The Mongolian's thought of land ownership is different from that of Japanese. Since they move around, they do not need to fence land off and do not want to own land. They have long lived holding nature in respect, not confronting with it. Among nature, they regard "Heaven" as the most awesome. Such religious faith in Heaven has been strongly retained in people's mind even after the Lamaism (Tibetan Buddhism) became widespread throughout the nation at the end of the 16th century, and also even in the religious oppression during the socialism era. Both the faith in Heaven and Lamaism revived at the same time when democratization started in 1990.

The characteristics of contemporary Mongolian culture are formed on the basis of the nomadic traditional values which still remain in contemporary manners and customs, or in arts such as music, painting, literature, dancing, etc. The examples are also seen in some nomadic sports competitions held in the annual Naadam festival; children's horse-riding competition in which they race for about 30 km across grassland, wrestling on the grassland, and archery shooting at a target set at a long distance, which is the biggest event in the festival. The nomadic life spirit is reflected in the music played by a musical instrument called Morin Khuur (horse-head fiddle) whose head is sculptured in the shape of horse head, and whose bow and string are both made of horse tails. The spirit also can be expressed in songs called Urtin Duu or in the original vocal act called Khoomei which is one throat singing but producing two different sounds simultaneously. The Mongolian tradition of oral literature has been succeeded to the contemporary poems and novels.

2.4 Politics

During a few years after 1990, the Mongolian political scene showed a drastic change from the socialism which dominated the country for 70 years to the parliamentary democracy with market economy. The country also realized that it must shake itself free from the thorough dependency upon the former Soviet Union. These reforms were attained through a legitimate and democratic election without bloody accidents and no arrests for political reasons

It was the 19th Convention of Mongolian People's Revolutionary Party (MPRP) that opened the door to the economic and social revolution which was influenced by the "glasnost and perestroika" (reconstruction) movement of the former Soviet Union. The Mongolian revolution called "Siretiner" (regeneration) aimed to break down the long-lasting economic depression and social stagnant condition. The Party attempted to revitalize its economy by introducing a self-supporting accounting system and its politics by expanding democratization within the party. The revolution, however, did not go ahead as expected, and in 1988, the party itself was forced to propose the political reforms including the constitutional amendments at the 5th General Assembly of MPRP Central Committees. Though the reform proposals were prepared primarily to maintain the party's "leadership", it also helped in accelerating people's interest in the political reform. In December 1989, the Democratic Alliance (DA), mainly consisting of intellectuals and young generation, held a small-size meeting for democratization which had about 300 participants. Since then, the democratization movement gained stronger power day by day and people's demands became more radical. On the other hand, the movement was strongly inclined to nationalism. The nationalism movement aimed at the revival of Mongolian's identity which decayed during the socialism era and elimination of political, economic, and social influence by the former Soviet Union. Thus, the Mongolian democratization movement was developed by two major factors working closely; the democratization of the nation's politics and nationalism which gained momentum by the climate of "independence from the Soviet".

In February 1990, the Democratic Alliance (DA) organized the opposition party, the Democratic Party, for the first time in the Mongolian history. The Party called for introduction of a multi-party system, enforcement of free election, abolishment of bureaucracy and privilege, review of thorough commitment to the former Soviet Union, and others. New political parties were founded one after another. The MPRP and the Mongolian government did not oppress these requests, but responded to them by accepting them roughly or execution in advance. For example, at the People's Congress (Parliament) held in May 1990, the amendment of constitution was approved. The major points of the amendment were to introduce a multi-party system, to organize a presidential government, and to establish the two-chamber system for the Parliament. In July of that year, the first elections were held under the supervision of an election monitoring team abroad and ended in the overwhelming victory of the Government party MPRP. After the elections, MPRP formed a coalition government of national unity involving each opposition party. The establishment of a coalition government secured Mongolia the stable political climate. Then the nation shifted its focus on preparation of laws required for creation of new social and economic system which led to the introduction of market economy at full scale.

In the new constitution amended in 1990, socialism remained as the nation's principle. The parliament with a two-chamber system was produced as a compromise with the former system. The number of parliament members was 480, which was too many in light of the national population of 2,300,000. Afterward, coming through several changes such as the shift to a market economy, independence from the former Soviet Union, and a more close relationship with Western countries, Mongolia came to strongly recognize the necessity to break away with the socialism and establish the national policies rapidly. In February 1992, the nation finally promulgated the new constitution which proclaimed that Mongolia renounced socialism. Changing the nation's name, flag and emblem, Mongolia pledged to reconstruct the nation based on the democracy and the principle of market economy. Since then, under the new constitution it held national elections twice and presidential election once. Thus, the democracy has been well-established and the shift to market economy has been on going.

2.5 Transportation

Due to the wide land area and small population with low density, the transportation network is not well developed in Mongolia. In addition, because it is a landlocked country, it does not have seaports which it can use freely. What is worse, the seaport it can access to is located a few thousand kilometers away. These geographical conditions have hampered the development of a transportation system. In fact, transportation and communication industries were badly affected by the confusion through the economic transition. Their devastating situations deteriorated the nation's economy, and resulted in the least improvement among its industries.

In 1989, the volume of freight transportation (both domestic and abroad) was 8,068.9 million t/km: railway 73.8%, road 26.0%, air 0.1%, and marine 0.1%). After the introduction of the market economy, it had been rapidly decreasing, and in 1998 dropped to 2,946.1 million t/km: railway 95.6%, road 4.2%, and air 0.2%. As seen in the breakdown, the amount of freight transportation by road has plunged sharply, though road transportation used to play the major role among other means. This is because the influx of petroleum, mechanical parts and food rapidly decreased along with the destruction of COMECON trade system, and the rate of truck operation became lower. Moreover, the economic difficulties resulted in less demand for construction materials and capital goods.

As for the number of passenger transportation (both domestic and abroad), it showed a sharp drop to 81.5 million persons in 1998, compared with 242.2 million in 1989. On the per capita per kilometer base, the figure shows a more moderate plunge: in 1989, 2102.9 million persons per kilometer (railway 27.5%, road 45.5%, and air 27.0%), while in 1998, 1,789.7 million persons per kilometer (railway 54.8%, road 19.0%, air 26.2%). As seen in the breakdown, like the freight transportation, the passenger transportation by road decreases rapidly, and the railway plays a more important role. This is because the road transportation tends to be used for short distance conveyance.

The major transportation network in Mongolia is shown below.

(1) Road

The total length of road for vehicles including metallic and dirt road decreased from 4,249.7 km in 1989 to 3,351.3 km in 1998. On the other hand, the total length of metallic road increased from 1,184.6 km in 1989 to 1,531.7 km in 1998. The reason the roads are not well developed though it has wide land area may be explained by the fact that people regarded it useless to develop a road under the long-lasting and severely cold weather in winter and could not recognize the importance.

(2） Railway

The total length of railway is 1,815 km, which has remained the same for the past 10 years. The route running Beijin - Zameen-Uvd (bordered by China) - Choir (used to locate coal mine and military base of the former Soviet Union) - Ulaanbaatar - Darhan (industrial city) - Sukhbaatar (bordered by Russia) - Moscow occupies 1,110 km. This line is connected with Ulaanbaatar - Baganuur (coal mine) line of 84 km, Ulaanbaatar - Nalaykh (coal mine closed in 1993) line of 45 km, Darhan - Erdenet (the largest industrial city centering on copper mine) line of 160 km, and Darhan - Sharyngol (coal mine and gold mine) line of 30 km. Except for those lines, there is Choibalsan (uranium mine completely controlled by the former Soviet Union) - Ereentsav (bordered by Russia) - Russia line of 238 km. Thus, railways were developed as a means of conveying mainly mineral resources to the former Soviet Union. The number of trains possessed has been falling since its peak in 1988 because all the trains are made by the Soviet and it became difficult to repair due to the shortage of mechanical parts. At present, among the entire railway transportation, conveying coals to power plants accounts for approximately 40 %.

(3) Air

Departing from Ulaanbaatar, Mongolia has some international regular flights to several destinations such as Osaka, Moscow, Irkutsk, Ulan-Ude, Alma-Ata, Beijing, Huhhot, and Seoul. In addition, international flights departing from local airports connect Bob Dozier - Urumchi, Ulgii - Alma-Ata. As for domestic flight service, regular flights leave Ulaanbaatar for center of each Aimag except Tuv and Selenge Aimag which are near Ulaanbaatar. Because the prices of fuel and parts were raised in accordance with the shift to settlement system by foreign currencies, the number of both passengers and flights has been dropping.

2.6 Central Administrative Body

Article 3 of the existing constitution which was adopted on January 13, 1992 stipulates that the national governing system consists of Great Hural (Parliament), President, Government and the Judiciary.

The Great Hural (Parliament) is the highest organ of state power, and the only legislative body. The parliament has a single chamber with 76 members having a 4-year term in office. Those who have Mongolian nationality and are over 25 years old are eligible for the candidacy. A regular session of the Parliament is convenes once every half a year and lasts more than 75 days. The Parliament appoints and dismisses the prime minister and ministers of state, decides the basic policies for domestic and foreign affairs, designs governmental action plans, approves the budget draft and execution report, declares war and disarmament, and other duties. The Great Hural also can establish a standing committee needed for the activities.

The president is the head of state and represents the symbol of the unity of the people. The president has a 4-year term in office and is elected among those who are over 45 years old and have resided in Mongolia for more than 5 years so far. For the presidential election, political parties which have seats in Great Hural put up candidates by itself or jointly with other parties. Among the candidates, the president is nominated through a direct election. Any president can be re-elected only once. One of the significant responsibilities for presidency is to exercise the power of veto over the laws adopted or decisions made by Great Hural. If executed, and if two thirds of the parliament members rejected the acceptance of veto, the power becomes invalid.

The government (Cabinet) is the supreme executive body of the Mongolian State and consists of the prime minister and state ministers. The prime minister discusses the organization and constituents of the government and their changes with the president, draws up a proposal and submits it to Great Hural. The prime minister has responsibilities to lead the governmental activities and to execute the laws. The term of government is 4 years. When the prime minister or more than half of the state ministers resign, the Cabinet also resigns in a body. In August 1996, administrative reforms came into force. As a result, the existing 13 ministries were combined into the current 9 ministries (Ministry of Foreign Affairs, Ministry of Finance, Ministry of Justice, Ministry of Defense, Ministry of Agriculture and Industry, Ministry of Infrastructure Development, Ministry of Enlightenment, Ministry of Environment, and Ministry of Health and Social Welfare). The number of governmental staff was drastically reduced from about 3,000 to about 800.

2.7 Local Government

The territory of Mongolia is administratively divided into 21 Aimag (province) and a capital city Ulaanbaatar. Aimag is subdivided into Sums (county), Sum into Bags (village), a capital city into Duuregs (district), and Duureg into Horoos (town). As of 1998, the nation has 333 Sums, 1,564 Bags, 9 Duuregs, and 117 Horoos.

The members of local parliament are appointed by elections for a period of four years. The head of each unit of local administration is assigned or discharged by the head of upper administrative unit, based on the recommendation of the local parliament concerned. For example, the mayor of Aimag and that of capital are appointed or discharged by the prime minister, the head of Sum and that of Duureg by mayor of Aimag or that of capital, the head of Bag and that of Hooroo by head of Sum or that of Duureg. It is characteristic that the direct election is not admitted even under the democratic regime when assigning the heads of local governing units. Most of the local governments depend upon the subsidy provided by the central government for more than 50 % of its financial resources. Currently, it is true that the local governments are less empowered.

At the general election for Great Hural held in June 1996, the change of regime occurred for the first time since the Mongolian state was founded. The former opposition party, the Democratic Alliance (DA), had a landslide victory in their grasp. Then the execution of the Mongolian nationwide local elections followed in October 1996. On this occasion, the DA revived the local election law to promote the democratization at local levels. Under the previous system, at first the parliamentary members at the lowest local level were determined through election, and then the elected members would cast a vote for the upper level parliamentary members among themselves. This system was done away with, and a new system of direct election was introduced to appoint local parliamentary members. As the result, out of 21 parliamentary elections held in Aimag and Ulaanbaatar city, the new governmental party DA achieved victory only in 6 Aimag while the new opposition party MPRP succeeded in holding a majority in Ulaanbaatar municipal parliament and 15 Aimag parliaments. The nationwide local elections had significant meaning in revealing the people's judgement on the rapid reform policies. The voting rate this time was 64.5% while that of the Great Hural general election was 92%. The declining rate shows that people have been losing interest in the expectation for the state democratization.

CHAPTER 3
ECONOMY

CHAPTER 3 ECONOMY

3.1 GDP Growth

After the democracy reform in 1992, the Mongolian economy has been undergoing a major transformation from a socialist to a market regime. The per capita GDP of Mongolia in 1993 showed 30% reduction in real terms to that in 1989. Between 1994 and 1997 the per capita GDP recorded an average annual growth of 1.9%, 0.8% during 1996, 1.5% during 1997 and 3% during 1998. The completion of the transition to a market based economy may foster a more rapid growth in the economy. However, with no apparent sign to change in the economic structure of monoculture, the predicaments of the Mongolian economy is unfathomable.

Figure I.3.1-1 shows GDP changes of Mongolia in recent years. Both export and import has fallen to half the peak level, indicating the difficulty of economic management of the country. During the period of socialist regime, Mongolia received large technical and financial assistance from the Soviet after the collapse of the Berlin Wall and the fall of the Soviet Union. The subsequent halt in financial flow through assistance plummeted the economy by 30% between 1989 and 1993. With the assistance from the western nations, the economy started its upturn.

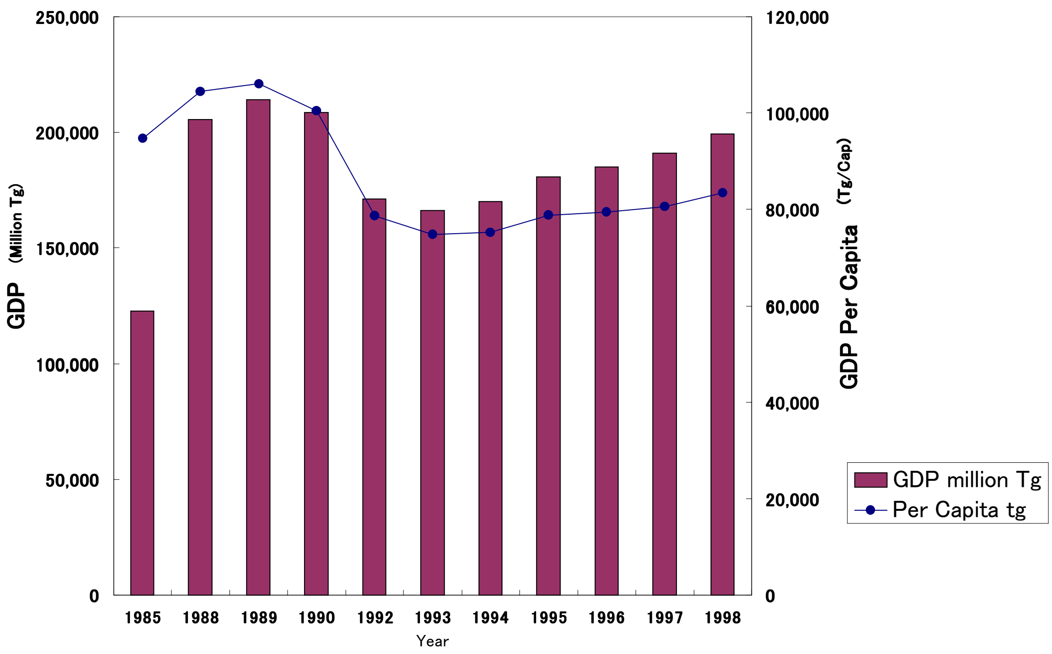


Figure I.3.1-1 GDP Changes of Mongolia

The recent economic growth is concentrated in the urban areas of Mongolia. In rural areas, a large proportion of the younger generation is jobless. Therefore, the rural areas including Sums are unable to attract sufficient private investment to spur economic growth. These problems are partly due to the lack of adequate social infrastructures including power supply. In 1999 two natural disasters coincided. A drought in summer inhibited the growth of grazing grass. A severe cold wave in winter brought a thick layer of snow that prevented the cattle from grazing. There is a growing concern for the rural economy to have further worsened.

3.2 International Trade

Figure I.3.2-1 shows the movements of Mongolian import and export in recent years. Both export and import has fallen to half the peak level, indicating the difficulty of economic management of the country.

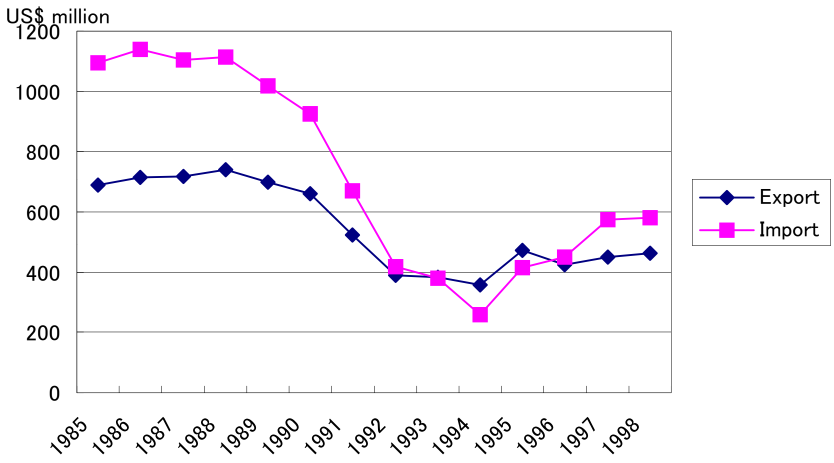


Figure I.3.2-1 Mongolian Export and Import

The Mongolian economy is characterized as a mono-culture. Fig I.3.2-2 shows the composition of Mongolian exports which are dominated by mineral products. The reliance on a limited number of products subjects the economy to commodity price movements which are quite volatile in the world market.

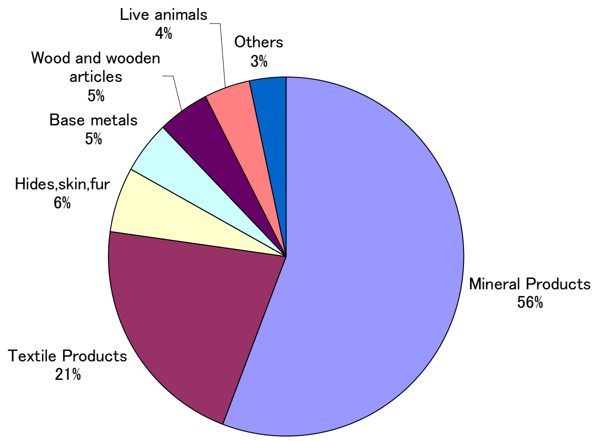


Figure I.3.2-2 Composition of Export from Mongolia

3.3 Administrative Structure

The administrative structure of Mongolia are three layered having Aimags under the central government, and Sums under Aimags. The Sums corresponds to villages in Japan in its size of population though the areas could reach over 10,000 km^2. The Sums sometimes have sub-units called Bags which correspond to more natural communities, especially in a large Sum.

With the assistance from ADB, the Mongolian government is promoting the decentralization of public administration. However, the revenue generation capacities of Aimags are limited and in reality Aimags need to rely on the central government. The financial capacity of the Sum relies heavily on the support of the central government. The push to increase efficiency in local administration has been realized as moves toward mergers between Sums and Aimags. Though the actual implementation is not reported, it is expected in the near future.

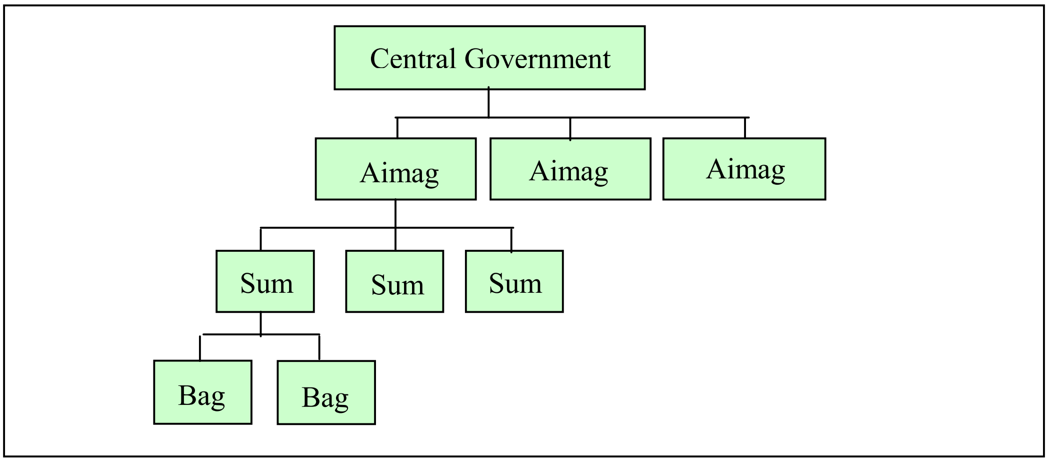


Figure I.3.3-1 Mongolian Administrative Structure

3.4 Public Finance

The public finance of the Mongolian government is undergoing a crisis. The fiscal deficit is on a continuous rise. The fiscal deficit was 65.1 billion Tg and rose to 102.1 billion Tg in 1998 which is equal to 40% of the total revenue. The tax revenue in 1998 declined by 10 billion Tg (6%) while the recurrent expenditure and subsidies continued to grow. Besides, the public investment that is indispensable for economic development rose and borrowing from overseas had to grow as a result. These factors all added up to the inflation of the fiscal deficit. The negative impact of natural disasters in 1999 on the economy may further deteriorate the public finance of Mongolia. It is generally known that the borrowing capacity of Mongolia is approximately 100 million dollars a year due to its small population size and low level of average income. Lack of infrastructure in a vast territory is the most critical impediment to economic development but at the same time there is a huge demand for the infrastructure development.

Table I.3.4-1 Revenue and Expenditure of Central Government of Mongolia

Unit million Tg

		1993	1995	1997	1998
Revenue	Tax	49,800	105,500	164,000	154,000
	Income Tax	28,400	48,500	62,600	41,500
	Sales Tax , VAT	14,100	28,100	63,300	76,900
	Other Tax	7,300	28,900	80,100	98,400
	Non-tax Revenue	2,000	34,100	52,500	77,400
	Grant	3,000	5,100	6,000	8,600
Total		54,800	144,700	222,500	240,000
Expenditure	Current Expenditures	41,600	101,500	192,600	222,400
	Current expenditures of which are subsidies	10,600	25,600	43,500	55,800
	Public Investment	8,300	26,700	95,000	119,700
	Public investment of which are foreign amortization	4,400	17,200	18,700	12,700
	Others	11,800	21,100	0	0
Total		61,700	149,300	287,600	342,100
Deficit		6,900	4,600	65,100	102,100

Though the progress in decentralization and privatization does not indicate major changes, but the field of public finance saw a major change. In 1997 the government abolished the import tax based on the awareness that huge transport costs in a land-locked country have been the impediments to development. At the same time, the adoption of VAT the system in place of sales tax was carried out at the same time. These reforms are expected to contribute to increases in efficiency in distribution systems of Mongolia.

Figure I.3.4-1 shows the comparison of financial statuses of governments in Mongolia. The Sum is only capable of financing 20% of its expenditure. The revenue sources for the Sum are limited to cattle tax, and land use tax which resembles a property tax in other countries. In spite of the push toward decentralization, the reality offers a limited number of options to the local government.

The government took a bold step in restructuring its tax system. In 1997 the government abolished import duties in recognition of the import costs as impediments to economic growth for a land-locked country. At the same time the government replaced the sales tax by value-added tax.

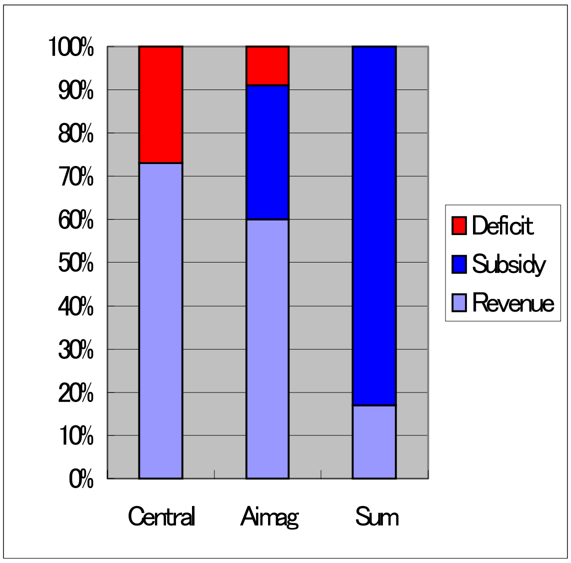


Figure I.3.4-1 Public Finance Structure of Mongolia

3.5 Population Trend

Figure I.3.5-1 shows the historic trends of urban and rural population in Mongolia. The total population of Mongolia was 772 thousand in 1950 which increased three-fold to 2.39 million in 1997. The urban population showed a seven times increase from 183 thousand in 1956 to 1.17 million in 1989. During the period prior up to 1989, the rural population remained constant. However, it started a sudden upturn in 1989 while the urban population stopped its growth. The switch indicates the impact of the collapse of the Eastern Economic Block. After the fall of the socialist regime, a large number of workers from urban areas returned to nomadic life in rural areas. The incident proves that the rural areas and nomadic life are the backbone of the Mongolian society.

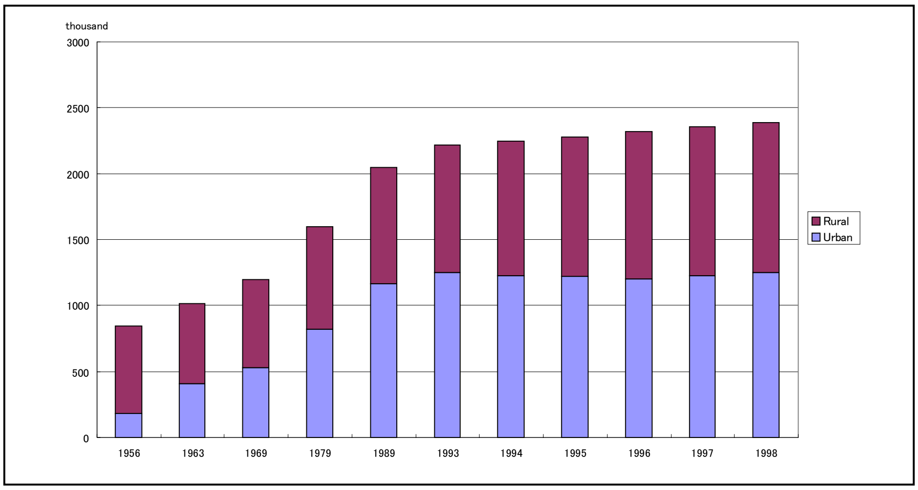


Figure I.3.5-1 Population Trend in Mongolia

The rural population in Mongolia showed a dramatic increase during the time of economic crisis after 1992 by precipitating the migration from urban centers to rural areas. The rural population increased 6.2% annually between 1993-1995. With an upturn in economy in recent years, the population increase in rural areas is rapidly converging to equilibrium with an increase of 1.1% in 1997 and 0.7% in 1998. The overall population increase of Mongolia is 1.5% per year. Given the fact that the rural areas are more productive in population than the urban areas, the convergence is evidence for the net-migration from rural areas to urban areas of Mongolia.

3.6 Population Trend in Sums

Though the overall population of rural areas is stagnating, a closer look at an individual Sum presents a far different picture. There is a conspicuous division between the Sums that are increasing in its population base and those that are on a decline. The Inventory Survey offers information on the populations in 1992 and 1997. The population data for 1997 and 1999 were available at the Statistical Bureau. Table I.3.6-1 shows a summary of the population movement at the Sum centers.

Table I.3.6-1 Population Trends of Sums under Study

		Annual Population Growth		
		Average	Max.	Min.
Between 1992 – 1997	Sum Center	0.2%	61.5%	-16.8%
	Sum	1.3%	18.8%	-13.9%
Between 1997 – 1999	Sum Center	-3.6%	29.0%	-28.7%
	Sum	0.3%	37.4%	-28%
Between 1992 – 1999	Sum Center	-1.25%	39.01%	-16.79%
	Sum	0.99%	13.15%	-10.35%

Source: JICA Master Plan Study for Rural Power Supply

The Sums and Sum centers under the Study had grown at 1.3% and 0.2% annually on an average between 1992 and 1997. However, each Sum shows a large variation from the mean. The fastest growing Sum center showed an annual growth of 61.5% while the fastest declining Sum center scored the annual growth of -16.8%. The Sums as a whole show similar variations with a maximum of 18.8% and minimum of -13.9%. There is a problem in applying these trends toward the future projection of the population. As mentioned before, the five years between 1992 and 1997 include an unusual period when there was a large influx of population from urban areas to rural areas. The population changes between 1997 and 1999 show that on an average the Sum centers had lost its population at 3.6% per year, whereas the Sum as a whole increased its population at a nominal rate of 0.3% per year, showing a remarkable consistency with nationwide statistics. One of the conspicuous features is that the Sum centers are losing population at a much faster rate than the Sum as a whole. However, it is not proper to apply an average rate of population change to every Sum center since there are some Sum centers that show increase in population.

Table I.3.6-2 shows the distribution of Sum centers according to the rates of changes in population. The overall distribution indicates that whereas the population changes between 1992 and 1997 shows a uniform distribution of the Sum centers from the category of above 10% annual increase to below –10% decrease, the distribution of the Sum centers during 1997-99 shows a bi-polarization toward below -10% category and above +5% category. The below -10% category increased to 41 accounting more than a quarter of the total and the over +5% category maintained 30 in spite of a general decline. Another feature is that the number of the Sum centers that showed a decline during 1992-1997 was 87, a little less than half of the entire project Sums but the number increased to 113, 65% of the project Sum centers. A similar trend is seen in the population changes of Aimag Centers. Between 1995 and 1998, ten out of 19 Aimag centers had shown a decline in population.

Table I.3.6-2 Distribution of Sums and Sum Centers by Population Growth

Population Growth Rate	Between 1992-1997				Between 1997-119			
	No. of Sum Centers	%	No. of Sum	%	No. of Sum Centers	%	No. of Sum	%
below - 10%	12	7%	1	1%	41	24%	2	1%
-10% to -5%	32	18%	6	3%	19	11%	1	1%
-5% to -2%	30	17%	6	3%	27	16%	17	10%
-2% to 0%	13	8%	24	14%	26	15%	53	31%
0% to 2%	22	13%	79	46%	21	12%	86	50%
2% to 5%	34	20%	45	26%	9	5%	12	7%
5% to 10%	16	9%	9	5%	14	8%	0	0%
Above 10%	14	8%	3	2%	16	9%	2	1%
Total	173	100%	173	100%	173	100%	173	100%

Source： JICA Master Plan Study for Rural Power Supply, *Inventory Survey*
Statistic Bureau, Population Census, 1997,1999

Table I.3.6-3 shows the population changes according to the size of the Sum center. There is a declining tendency in population decrease as the size of the Sum center increases. There may be economy of scale at work with these Sum centers. A small Sum center cannot financially withstand provision of public services including power supply, or offer enough job opportunities, thereby losing its population attraction. The Sum centers that were created as a planned local center are now faced with a natural force similar to market mechanism and are undergoing regional restructuring under a new economic regime. It is beyond the scope of the study to find out the underlying forces that cause attraction and detraction though there are many factors such as natural and topographical conditions, access to market. Nevertheless, it is more than a probability that the development of social infrastructure is one of the key factors in determining the population changes. Therefore it is imperative to restore the public services that are crucial to the basic needs of the rural population and establish a base for future industrial development.

Table I.3.6-3 Annual Average Population Growth by Sum Center Size

Sum Center Size	Average Population Growth		
(household no.)	1992-1997	1997-1999	1992-1999
below 150	-1%	-5%	-3%
150-200	1%	-4%	-1%
200-250	1%	-4%	-1%
250-300	-1%	-3%	-2%
300-350	1.1%	-5.2%	-1.0%
above 350	0.2%	-1.0%	-0.7%
average	0.2%	-3.6%	-1.3%

Source: JICA Master Plan Study for Rural Power Supply, Inventory Survey Statistic Bureau, Population Census, 1997,1999

3.7 Economic Situations of Sums Under Study

3.7.1 Family Size

The average size of one household is 4.3 persons per family, relatively small for a rural family. In Mongolia in many cases the two generations of families live together within the same plot but are regarded as independent households.

Therefore, there was no household that had members crossing three generations. There are a large number of unemployed people in the Sum center which reflects 0.77 unemployed per household.

Table I.3.7-1 Family Structure

Average size of household	4.3 per household
Average number of unemployed	0.77 per household

Source: JICA Master Plan Study for Rural Power Supply, Sample Survey

3.7.2 Income

Table I.3.7-2 shows the average cash income of the sample-surveyed families and its composition. The average annual cash income is a little less than 800 thousand Tog. The largest component of the cash income comes from the salary of public servants, 42%. There is a sign that the market economy is penetrating into the rural economy as well. The incomes from the private sector increased their share to 29%, private wages and commerce combined.

Table I.3.7-2 Annual Cash Income of Sample Surveyed Households

Cattle	143,799	18%
Agriculture	1,236	0%
Public Servant	329,946	42%
Private Commerce	142,522	18%
Salary/Private	85,623	11%
Pension	27,582	3%
Others	64,314	8%
Total	795,022	100%

Source : JICA Master Plan Study for Rural Power Supply, Sample Survey

Table I.3.7-3 shows the amount of in-house consumption of self- produced goods. The data relies basically on the memories of the respondents, thus the actual in-house consumption is anticipated to be larger than the data. On the average, the in-house consumption is as large as 32% of the average cash income. Generally, the residents of the Sum centers are not specialized in cattle herding, having jobs. Nevertheless, the level of self-sufficiency is quite high.

Table I.3.7-3 In-house Consumption

	Tog/year
Meat	163,299
Milk & Dairy	74,591
Fuel Wood and Dung	4,750
Other	15,551
Total	258,191

Source: JICA Master Plan Study for Rural Power Supply, Sample Survey

3.7.3 Electric Appliance Ownership

Table I.3.7-4 shows the ownership of electric appliances among the sampled households. Color TV ownership reaches 20% while B/W TV is owned by 70% of the households. A total of 90% of households have a TV, meaning that an overwhelming majority has access to information from TV. Even though its usefulness is limited without a 24-hour power supply, a refrigerator is owned by 32% of the households. In general a large percentage of electric assets owned by the household are held without being fully utilized.

Table I.3.7-4 Electric Appliance Ownership

Appliances	Ownership Ratio
B/W TV	70%
Color TV	20%
VCR	7%
Radio/Cassette	50%
Fluorescent Lamps	24%
Lamps	226%
Electric Stove	60%
Washing M/C	19%
Refrigerator	32%
Air Fan	2%
Air conditioner	0%
Computer	1%
Iron	72%
Electric Oven	7%
Electric Rice Cooker	2%
Vacuum Cleaner	10%
Generator	4%
Others	1%

Source: JICA Master Plan Study for Rural Power Supply, Sample Survey

CHAPTER 4
SOCIAL BACKGROUND OF MONGOLIA

CHAPTER 4 SOCIAL BACKGROUND OF MONGOLIA

4.1 Education

During the socialism era, the Mongolian government had put emphasis on education, spending large amounts of its national budget on education (in 1990, 25% of the budget and 14% of GDP) and providing free educational service, in spite of the difficult social condition that about 50% of population were herders. As a result, in the 1980's, the enrollment rate had reached almost 100% in the primary and secondary education (in 1989, the total enrollment rate became 98% for primary education, 85% for secondary education, and 15% for higher education). The literacy rate using Cyrillic characters among those ages 15 and above reached 96% (98% for male and 95% for female) in 1989. Thus educational development has shown a big success.

After 1990, along with the system change into democracy, capitalism, and market economy, Mongolia suffered from economic chaos which resulted in various confusions among the education sector. By the factors described in Table I.4.1-1, the number of students who do not attend class has been increasing. The number of students who dropped out from school before completion of the secondary education has increased from 6,133 in 1989 to 48,466 in 1992. The number gradually decreased to 14,272 in 1996, but still the fact that more than 10% of all the students do not attend the class became a serious social problem.

The Mongolian government enacted the new Educational Law in 1991. In the law, the following are specified:

(1) Elimination of Marxism-Leninism
(2) Adoption of a 10-year general educational system with 6-2-2 grades, emphasizing freedom and basic human rights (the first 8 years out of 10 are compulsory and free of tuition)
(3) Production of new textbooks based on an innovative historical view
(4) Revival of Mongolian characters

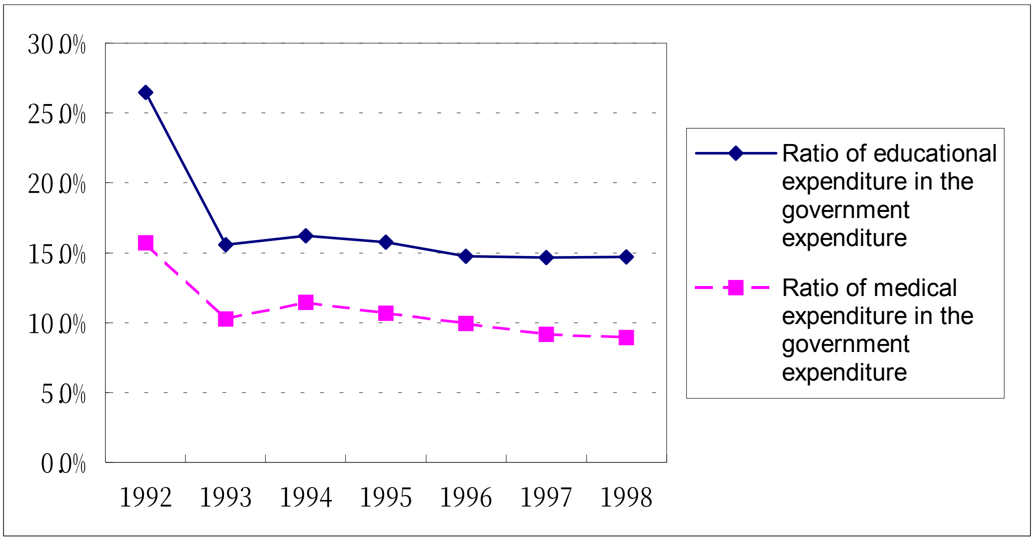
Table I.4.1-1 Problems in Education Sector after the National System Change

1. Actual decrease in educational budget
   (Ratio in the governmental expenditure in Figure I.4.1-1; Ratio in GDP in Figure I.4.1-2; Expenditure per capita in Figure I.4.1-3)
2. Shortage of educational materials and insufficient re-training to teaching staff, reflecting the changes by the new democratic system
3. Introduction of a user fee for food, educational material, and dormitory in primary education
4. Wage disparities and increase in poverty brought by introduction of market economic system caused increase in the number of households which cannot afford to send their children to school, especially in a household that has lots of children.
5. The privatization of livestock makes the number of livestock increase, and leads to the higher demand for boys as labor force to manage the livestock.
6. Shortage of teaching staff, as their working conditions are getting worse with low salary standards, unpaid salaries, or stopped salary raises.

In reality, however, as economic depression after the shift into democracy forced to curtail the educational budget, the former 4-4-2 system remained in many regions and new educational materials were not produced. The training system for teaching staff, teaching methods and class curriculum were also unchanged. In February 1995, the Educational Law was amended and the return to the former 4-4-2 from the current 6-2-2 was approved (the first 8 years are still compulsory). The decision was made in terms of these facts: the number of staff to teach technical classes for the fifth and sixth grader is not enough, the number of schools and dormitories to accommodate 1-6 graders is insufficient, the number of students who drop out from school is increasing, curriculums for the 1-6 graders were not clearly determined, etc.

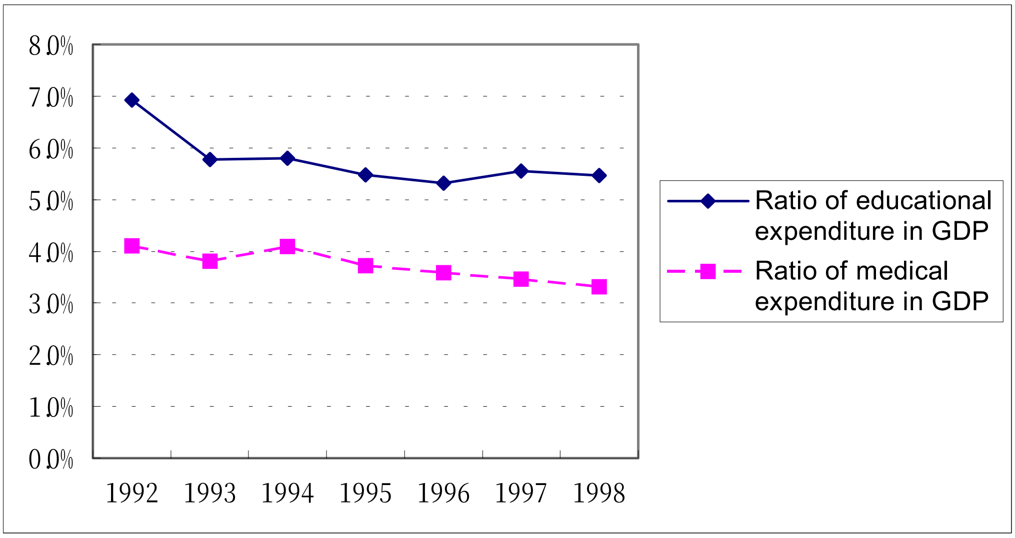
The return to the former 4-4-2 led to more confusion among the educational world.

Teaching Mongolian characters started in 1987 and in 1991 the government decided to complete the shift from Cyrillic characters to Mongolian characters by the year 2005. The staff to teach Mongolian characters, however, was not enough and in 1994 the government was forced to change the policy to teach both Cyrillic characters and Mongolian characters.



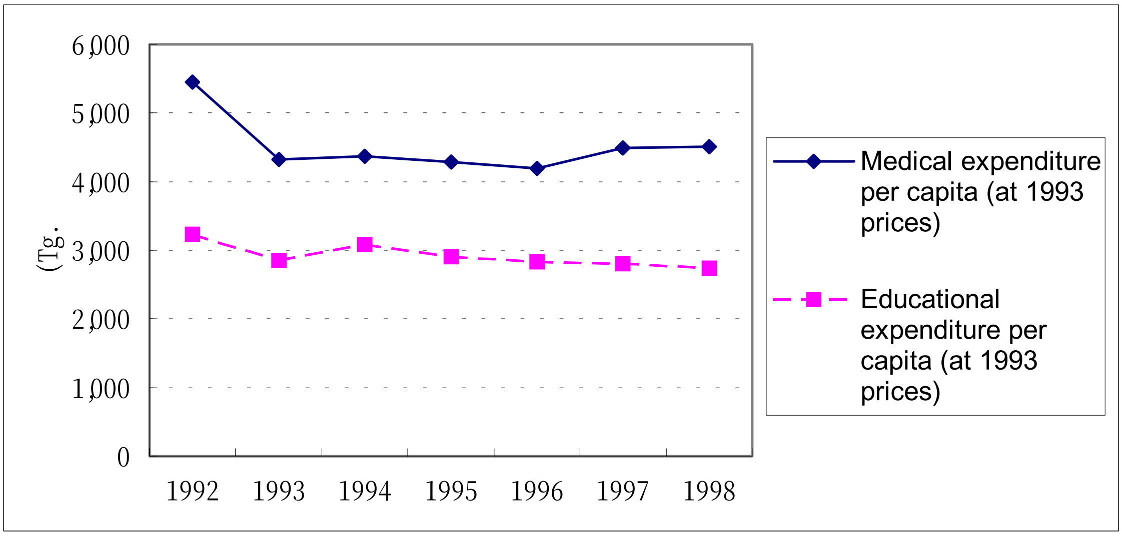
Source: Mongolian Statistical Yearbook 1998

Figure I.4.1-1 Change of Ratio of Educational and Medical Expenditure in the Government Expenditure (1992-1998)



Source: Mongolian Statistical Yearbook 1998

Figure I.4.1-2 Change of Ratio of Educational and Medical Expenditure in GDP (1992-1998)



Source: Mongolian Statistical Yearbook 1998

Figure I.4.1-3 Change of Educational and Medical Expenditure Per Capita (1992-1998)

Educational problems are more serious in rural areas: increasing number of students who do not attend the class, poor working conditions of teaching staff, less qualified teaching staff, shortage of schools and dormitories, shortage of educational materials, problems in teaching methods and curriculum, etc. These problems are especially found in the western area where the largest number of dropouts is reported, and Aimags in the extreme west and in the east show many dropouts among the lower grades. National statistics shows that two-thirds of the dropouts lie in the 1-4 grades and 70% of them are boys. The reasons why there are a lot of students who do not attend the class in the rural area are shown in Table I.4.1-2.

Our sample survey revealed that the educational service in Sum Center has been deteriorating these years especially in terms of facilities. At school, due to the limited supply of electricity during daytime, machine tools and language laboratories are hardly used. Heating has not been supplied sufficiently during the winter season since the individual heating system was introduced. Regarding personnel, many Sums point out that teaching staff has lost the enthusiasm for education, because of their low salary and delayed payment of wages.

Table I.4.1-2 The Reason why There are a lot of Students who do not Attend the Class in the Rural Area

1. Many of population in the rural area are herders. Along with privatization of livestock after the shift to market economy, many herders increased the number of livestock to keep by themselves and needed more labor force including children.
2. The school curriculums are almost the same as that of prior to the democratic era and do not meet the current social needs. These curriculums discourage the student to study. (Especially, due to the unstable supply of electricity to school, school cannot give technical lessons using electric-powered machine tools).
3. Employment after graduation is not always guaranteed, which makes parents unwilling to send their children to school.
4. Parents cannot afford to send children to school, buying clothes, shoes, and stationery, and paying for dormitory fees.
5. Children help in carrying goods, which are purchased in the neighboring countries such as China and brought to Mongolia to sell.
6. For herders, access to school is bad. In addition, the classrooms and dormitories are not enough, their facilities are poor (especially no heating system and electricity during the winter), and the dormitory fees are charged.

Instead of these situations, there are many Sums which recognize the importance of education and put emphasis on it as their major sector for development. This tendency is prominent especially in a Sum where a school principal became Head of Sum. In these Sums, various efforts have been made to improve their educational service. Some try to introduce computers at school, asking support from Soros Foundation which is an American NGO or a group of Sum natives living in Ulaanbaatar. Others prepare a house and livestock for the teaching staff who are sent to a Sum's school from the urban area. Their own efforts are, however, frustrated by no electricity supply.

During the socialism era, people could receive education without charge. After 1991 when the market economy system was introduced, the compulsory education at elementary and junior high school remained free of charge. But, the number of students who cannot afford to go to school has been increasing, because the students staying at a dormitory are required to bring meats instead of paying board and have to purchase stationary by themselves. Along with the market economy, the privatization of livestock was permitted, and the nomad could keep as many livestock as they wanted. Under this situation, as more livestock per household has been rapidly growing, more demand has been rising for children to help in keeping the animals. As a result, many parents were not willing to send their children to schools at Sum Center or Bag Center.

Thus, since 1991, the enrollment rate of elementary and junior high school has been declining. After 1995 to 1996 when the inflation and shortage of commodities had been gradually alleviating, the enrollment rate has been getting better and the students have been returning to school. Many Sum Centers are anxious that the electricity and heating is supplied in a stable manner for schools and school dormitories. Thus the establishment of basic infrastructure including electricity and heating system are a prerequisite to the educational development.

4.2 Medical Service and Social Welfare

In regional health and medical system in Mongolia, hospitals or health stations in each level of Aimag, Sum and Bag, as shown in Figure I.4.2-1, provide medical service.

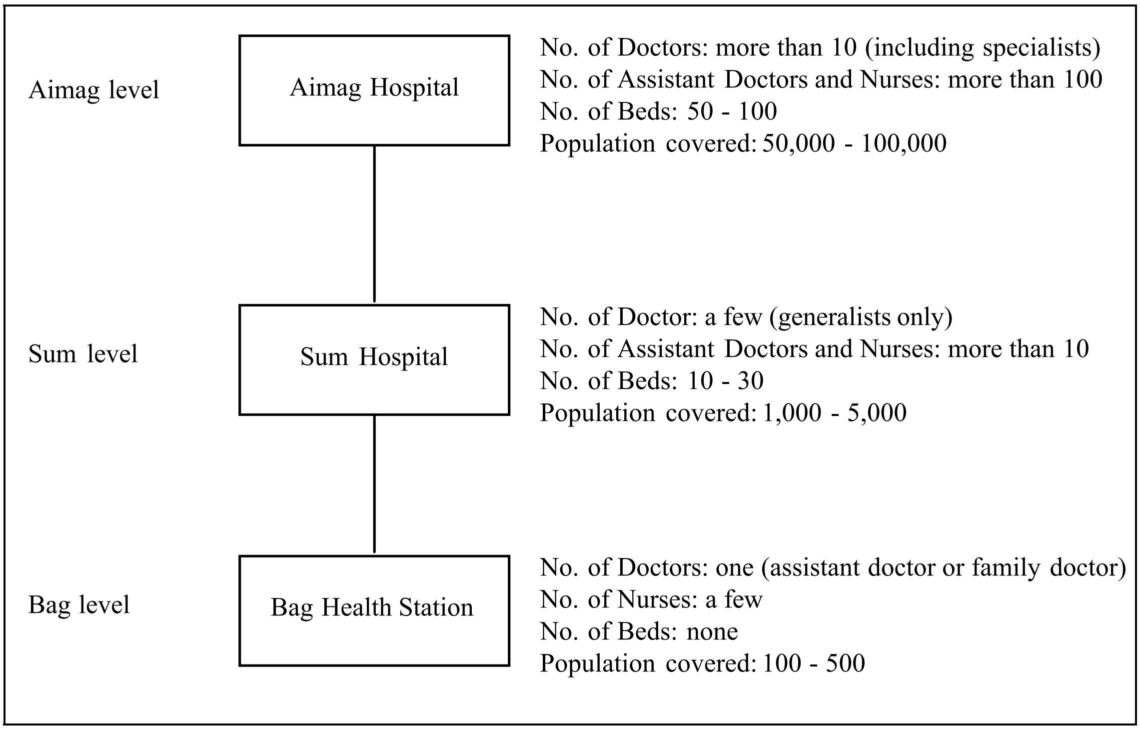


Figure I.4.2-1 Regional health and medical system in Mongolia

An Aimag hospital located in Aimag Center usually has scores of doctors and more than one hundred assistant-doctors[1] and nurses and provides medical service to ten thousand to hundred thousand people living in the Aimag.

The Aimag hospital is a general hospital with 50 to 100 beds, having specialists by each medical field such as internal medicine, surgery, obstetrics, gynecology, pediatrics, dentistry, and ophthalmology.

[1] Assistant doctors are graduates of former medical secondary schools which were reorganized into medical colleges after the medical education reform.

Some Aimag hospitals provide visiting clinical service for simple care without surgical operation such as physical checkups and immunization to the remote area. The average daily number of out-patients in an Aimag hospital is 10-50 patients in summer and 200-300 patients in winter.

A Sum hospital located in a Sum Center usually has a few doctors and about ten assistant-doctors and nurses and provides medical service for the treatment of flu, respiratory system diseases, slight wounds and childbearing for 1,000 to 5,000 people living in the Sum. The Sum hospital usually does not perform surgical and aborticide operations. The daily average number of out-patients in a Sum hospital is a few in summer and 10-50 in winter. Though most of the Sum hospitals accommodate hospitalization with 10-30 beds, they have fewer in-patients in summer, but get the beds full in winter.

The reasons why the hospital has fewer patients during the summer season are:

- Respiratory disease decreases in summer
- People are too busy with taking care of livestock to have time to visit hospitals in summer.

The health station located in Bag Center usually has one assistant doctor in residence who practices simple treatment, home visits for medical care, prescription, injection, physical checkups, etc. In 1991, the "family doctor" system was introduced, especially for the urban area. The family doctor resides in a clinic and provides medical service to out-patients, for which the fee is covered by public expense. The family doctor refers the patient to a specialized hospital when necessary, and visits a family in the region to give advice on childbirth and family planning as well as information on health care. Some of the family doctors work as a doctor at a Bag health station at the same time. Even in this case, the family doctor gets a salary from the Aimag hospital to which the doctor belongs.

In general, a herder at first visits the nearest Bag health station, and along with the seriousness of disease, goes to higher level hospital from that of Sum to that of Aimag.

As stated above, the medical service delivery system is well-established in Mongolia. But, more doctors are distributed to the urban areas, while private general practitioners are very few in the rural area. The assistant doctor who played a key role in medical service at a Bag level is expected to be replaced by the family doctor, along with the abolition of training new assistant doctors which was determined by the recent change of medical education system.

In 1991, Mongolia introduced the medical cost sharing system, instead of the free medical service. Under the new system, however, basic medical service such as out-patient treatment, emergency treatment, immunization, pregnancy and childbirth, chronic disease treatment are paid by public expense, and those who are categorized as below poverty line are exempt from medical cost sharing. In order to raise government revenue, improve income of medical staff, and enhance people’s consciousness of their own health, the Mongolian government enacted the National Health Insurance

Act in 1994. According to the Ministry of Health, 97% of all the Mongolian people are covered either by "Compulsory Health Insurance" or by "Optional Health Insurance". In the Compulsory Health Insurance that comprises 15-20% of all the insurance, government staff and employers and employees of private companies pay uniformly 6% of their salary as an insurance fee. The Optional Health Insurance covers children under the age of 16, farmers and herders, the aged, the retired, the invalid, the handicapped, mothers with below 2-year-old infants, etc. The government pays the monthly insurance fee for the Optional Health Insurance. In many local governments or local hospitals, the income through the health insurance fee is too limited to finance the medical expenditure. It is ideal that all the medical treatment fees and pharmaceutical fees should be covered by the health insurance fees, but many local governments depend upon the private payment by patients for treatment and pharmaceutical fee, because of the limited income from the health insurance and the financial pressure. There are many herders in rural areas who are not accustomed to the monetary economy system yet. They have difficulties in paying for the medical treatment fee or insurance fee in cash. It will be necessary to consider the possibilities to pay by goods or labors.

Like the educational budget, the national budget related to medical service has been actually decreasing since 1992 (refer to Figure I.4.1-1, I.4.1-2 and I.4.1-3). While Mongolia depends on other countries for most of medical and pharmaceutical goods and equipment, Mongolia cannot import them sufficiently, because of inflation and foreign currency shortage. Under the decentralization policy which started in 1992, each local government was empowered with autonomy for planning and budgeting. Compared with investment in non-industrial sectors such as health or education, the local government tends to prioritize investment in industrial sectors which are expected to make larger profits. This trend causes long-term problems in medical service in rural areas as shown in Table I.4.2-1.

Table I.4.2-1 Major Problems of Local Hospitals

(1) Financial crisis of hospital and its difficulty to purchase necessary drugs
(2) Shortage of doctors and their low morale due to low salary or delayed payment
(3) Shortage or deterioration of medical equipment such as x-ray machine, disposable injector, and instillator (There are many hospitals which are equipped with an x-ray machine, but cannot utilize it.)
(4) Nonfunctional refrigerator, disinfectant, and other medical equipment due to unstable electric supply, which causes trouble in childbearing at night or in emergency, especially in Sum hospitals.

According to the results of sample survey, these years health care service in Sum Centers has been getting worse in terms of facilities. This is caused by an unstable power supply in many Sums which prevents hospitals from utilizing electric appliances such as boiled disinfectors, refrigerators for vaccines, x-rays, and lighting. An unstable power supply also results in leaving facilities and equipment unrepaired. On the other hand, there are some Sum hospitals which started to take actions to increase personnel. Some Sums introduced a system to provide a scholarship for a student who is from the Sum and studies at a medical college, under the condition that after graduation from the medical college the student has to work at a hospital in the Sum. Other Sums, in order to encourage doctors at the Sum hospitals, carried out a system to give some livestock of Sum's possessions to the doctor in addition to the salary determined by the nation. Thus, these years, the number of doctors has been increasing in several Sums.

There are still many Sum hospitals to which only sub-doctors graduated from junior medical school are assigned. In these hospitals, medical equipment is not in operation due to the lack of electricity. Thus, the lack of doctors and electricity limit the hospitals to very simple surgical operations such as typhlitis. For more serious surgical operations, the hospitals can transfer the patient to a hospital in Aimag Center. Most Sum hospitals function as an emergency hospital and are open 24 hours a day throughout the year. Because no electricity is supplied at night, medical treatment or childbearing service must be given under candlelight. Thus the quality of medical service at night gets worse.

These years the budget for health care has remained the same in many Sums. But, the budget has been cut down in real terms, because the commodity prices have been rising due to inflation. The budget of hospital is at first allocated to the salary of the doctor and medical staff, and then to expenses for medicine and meals supplied to inpatients. It is actually difficult to allocate the limited budget to maintenance and management of medical care equipment.

During the socialism era, medical fee was free of charge. After 1991, a new system in which a patient partially pays the medical fee was introduced to some medical services. Although the basic services such as treatment of outpatient and emergent patient, physical checkup, vaccination and child delivery are free of charge as in the socialism era, inpatients are required to pay half of the hospitalization fee and medicine fee. Many Sum hospitals take measures to exempt the medical fee from the poor and the socially weak including children, handicapped, etc. In 1994, Mongol enacted the National Health Insurance Law, so theoretically, all the people had either obligatory insurance or voluntary insurance. The obligatory insurance is eligible to public officials, employers and employees. The employers and employees pay the insurance fee equally. The voluntary insurance are eligible to the children under 16 years old, nomads, the aged, the retired persons, and mothers with infants. The government and the insured pay the fee of voluntary insurance. Thus, the insured of obligatory or voluntary insurance are to receive medical care service without charge. The income from the health insurance, however, covers only less than one third of the budget of a Sum hospital. In most Sum hospitals, they cannot help but to fill the deficit by charging the patients for the medical and medicine fee, which should be paid primarily through the insurance.

While Sums are confronted with the serious financial problems of health care, the Ministry of Health started to examine the new management model called "consolidation", forming part of the health care reform. In this new model, the responsibility for supplying the service is decentralized to each local government, and the financial matters are strongly controlled by the central government. The recognition underlying this new model is that the management by the central government will be essential to compensate for the lack of organizational and technological ability in future. The "consolidation" model seems to be applicable to the electricity supply service where similar financial and technological problems are found.

4.3 Poverty

Based on the results of sample survey, household in Sum Center are roughly divided into the following three categories by income level, as shown in Table I.4.3-1

Table I.4.3-1 Income Level of Sum Center

Income level	Approximate monthly income per person of a household	Example of household
Wealth	more than 30,000 Tg	▪ Merchant (purchasing the commodities around the borders of China and selling at Sum or Ulaanbaatar. Or purchasing Kashmir, livestock, leather, etc. at Sum and selling them the Chinese borderland.) ▪ Cabotin (ex. Member of music and dance group) ▪ Household keeping more than 100 livestock
Average	15,000 - 30,000 Tg	▪ Civil servants (occupying about half of the population of Sum Center) ▪ Household keeping 10 to 100 livestock
Poor	less than 15,000 Tg	▪ Household living on pension ▪ The head of household is a female ▪ Householder is an unemployed young person ▪ Household with several children and less than 10 livestock ▪ Household with the handicapped member

Source: Survey by JICA Study Team

From May to June 1999, the definition of the poverty line by Aimag, Mongolia was revised as shown in the Table I.4.3-2. The poverty line was determined, based upon the amount required for purchasing the minimum food and commodities to satisfy 2,731 calories which is essential for an adult in a day. The amount differs from one Aimag to another, because the differences in the commodity prices are taken into consideration. A household whose income is less than the poverty line is called a "poor household", and those whose income shows less than 40 percent of the line is called "the poorest household."

Table I.4.3-2 Definition of the Poverty Line

Region	Name of Aimag	Poverty Line in 1997 (Tg/month and person)	Poverty Line in 1999 (Tg/month and person)
West	Bayan-Ulgii Govi-Altai Zavkhan Uvs Khovd	9,720	14,100
Middle	Arkhangai Bayankhongor Bulgan Uvurkhangai Khuvsgul	9,420	13,800
South	Govisumber Dornogovi Dundgovi Umnugovi	9,340	15,600
East	Dornod Sukhbaatar Khentii	9,250	14,500
Central 1	Selenge Tov	9,000	16,400
Central 2	Darhan-Uul Orhon (Erdenet)	10,380	16,400
Central 3	Ulaanbaatar	10,400	17,600

Source: National Statistical Office of Mongolia

The characteristics of a poor household in a Sum Center lie in the fact that most of them have little cash income and live greatly depending on livestock. They tend to get food, clothes, and commodities through exchange with their livestock. A poor household without sufficient livestock to exchange is faced with the hardship of poverty, and manages to support their daily lives with meat and dairy products such as cheese given by their relatives. Whether they are poor or not, there are many young unmarried mothers in their teens and twenties. One typical case involves a female student studying at a university in Ulaanbaatar who became a single mother and returned to her parents in Sum Center to live with her child. If the parents live on a pension or have a few livestock, they have to share their limited income with the unmarried daughter and her child, which makes them poorer.

As for electricity charge, there are many Sums which have a system to exempt or give a 50% discount of the charge for the poor or the poorest household. There is also the case where the same situation as the exemption exists because the poorest household remains in areas on the charge for several months. There are many households which can pay the electricity charge in kind such as livestock, not in cash. Along with privatization of electricity supply service, a private company in Bogd Sum, Bayankhongor, which took over the management of power plant, is now investigating the possibility of collecting the electricity charge of the poor household either in cash or in kind.

On the other hand, a different approach from the exemption or discount system for the poor has been taken by some Sums. They are seeking a solution by promoting the domestic industry and improving the income of the poor household. For example, in Bogd Sum, Bayankhongor, the poor are engaged in producing a carpet or saddle on a camel. In Khalium Sum, Govi-Altai production at a woodworking plant and felt shoes factory is on going. Financial sources for the anti-poverty projects are given by 1) small-size loans of nationwide projects to decrease the poor which is aided by the World Bank or UNDP (ex. Khalium Sum) or 2) loans of the Sum development fund which was established on the money uniformly given to all the Sums throughout the nation a few years ago (ex. Bogd Sum).

4.4 Human Resource Development

During the socialism times, Mongolia was proud of the high educational level and high progression rate to higher education. Many Mongolian youth received scholarships from the former Soviet Union and studied in universities and graduate schools in the former Soviet Union or Eastern European countries. However, after the introduction of the market economy, many Mongolians with high educational backgrounds lost jobs with the administrative reform and restructuring of state corporations, and they were forced to survive, for example, by going to the Republic of Korea in search of work or by being engaged in cross-border trade. In a rapid social change under the market economy, the demand for human resources has also changed, but unfortunately Mongolian government is very slow to respond to this new demand for human resource development and has not yet developed a long-term master plan for human resource development.

Under the market economy, not only are persons with entrepreneurship highly required, but also the experts in the fields of management / financial accounting / human resource management / law who are necessary to operate administrative organizations and business corporations effectively under the rule of capitalism. During the socialism times, people could work by following the objectives and budget which were decided at the top. But, in the times of the market economy, administration is planned to be decentralized, and a local administrative organization will be responsible for developing a local development plan which reflects local people's needs, secure the budget to implement the plan, and keep a healthy financial status under a democratic administration. However, unfortunately the present situations of Sum offices which are covered in this Study are far from such an ideal, and Sum officials still continue to follow the way of the socialism times by waiting for the order and the assistance from the center. In addition, the accounting system, human resource management and material management in Sum offices are very old-fashioned, and the financial records which are necessary for scientific management are often missing. So in many cases, it is very difficult to grasp the present situation of management without such financial records. In order to realize decentralization, capacity building of local administration is necessary, and the needs to develop the managers with scientific management techniques will be particularly high.

Another human resource problem which Mongolia is facing after the market economy is the lack of engineers who can cope with new technologies. As said in the above, many engineers lost their jobs after the introduction of the market economy, causing young students to prefer the non-technical departments in the universities and colleges. A lot of young students have showed interest in studying economics, management and foreign languages, because they considered these studies to be immediately useful for money making in business and tourism. After the introduction of the market economy, many state-owned factories experienced the loss of profit and were forced to reduce the number of engineers, and the number of students who want to study in technical universities, colleges and schools has decreased. In addition, existing engineers tend to know only old-fashioned technologies which were introduced by the former Soviet Union, and they often have difficulties in catching up with the up-to-date technical advancements these days. At the Sum level, the operators who are in charge of a power station are often the former drivers of tractors at cooperative farms during the socialism times. So they have some knowledge on machinery and its maintenance, but they have very little knowledge on electricity and the latest technologies such as renewable energy. In the short run, it is necessary to upgrade these operators' skill and knowledge through short-term concentration training or on-the-job training. In the long run, it is also necessary to revise and update the curriculum of technical education in universities, colleges and vocational schools in order to meet the needs of today's society by making it more practical.

4.5 Social Needs

Table I.4.5-1 shows the degree of satisfaction with current social infrastructure and services in the targeted Sums. In more than half of the targeted Sums, computers in schools, operation facility in hospitals, and factory are evaluated as poorly-served areas.

Table I.4.5-2 shows the priority needs for improvement in the targeted Sums. Each Sum was requested to list 5 items as priority needs for future improvement and prioritize them into Rank 1, 2, 3, 4, and 5. Rank 1 item gets 5 score, Rank 2 gets 4 score, Rank 3 gets 3 score, Rank 4 gets 2 score, and Rank 1 gets 1 score. Table I.4.5-2 shows the calculation by totaling all the scores for each item. Heating gets the highest score (338), Water supply the second (221), Computers at school the third (182), Operation facility at hospital the fourth (179), Telecommunication the fifth (173), Electric appliance the sixth (148), Electric appliance at school the seventh (118) and Lighting at school the eighth (108). This list of the priority needs of the Sums clearly indicates the needs for electricity in Sums, because without electricity most of the above-listed needs are not satisfied.

Table I.4.5-1 Degree of Satisfaction with Social Infrastructure and Service

		Good	Average	Poor	No Answer
Water Supply		68	50	49	7
Heating		10	89	69	6
Electric Appliance for School	General	13	91	59	11
	Lighting	32	89	46	7
	TV, video	16	73	77	8
	Computer	9	27	124	14
Electric Appliance for Hospital	General	10	101	47	16
	Lighting	45	84	38	7
	Refrigerator	31	58	71	14
	Sterilizer	17	69	79	9
Education	General	33	95	25	21
	Primary School (1-4 grades)	60	74	30	10
	Secondary School (5-8 grades)	48	87	31	8
	High School (9-10 grades)	22	55	37	60
	Student Dormitory	34	77	50	13
Health Service	General	23	101	19	31
	Out-patient Service	47	95	22	10
	In-patient Service	51	94	21	8
	Emergency Service (Night Service)	11	69	86	8
	Operation Facility	6	23	130	15
	Delivery Facility	14	100	50	10
Livestock Hospital		13	98	49	14
Telecommunication		27	89	48	10
Road		4	64	94	12
Market and Commercial Facility		8	101	52	13
Cultural Center		30	84	52	8
Factory		2	34	124	14
Tourism Facility and Hotel		11	57	90	16
Other		4	36	21	113

Source: Inventory Survey conducted by the JICA Study Team

As for health and educational service in Sum Centers, needs for a stable electric power supply system are high. This is because offices and personnel are prepared, but due to a unstable electric power supply, hospitals are forced to perform emergency operations and childbearing under candle light the during night, and various electric-powered machine tools cannot be used in schools.

Table I.4.5-2 Priority Needs for Improvement

Priority Item	Total
Water Supply	221
Heating	338
Heating (School)	3
Heating (Household)	5
Electric Appliance (School)	118
Lighting (School)	108
TV, video (School)	42
Computer (School)	182
Other (School)	3
Electric Appliance (Hospital)	97
Lighting (Hospital)	45
Refrigerator (Hospital)	13
Sterilizer (Hospital)	85
Other (Hospital)	1
Electric Appliance(not specified)	148
Analyzing apparatus	9
Computer	3
Copy Machine	1
Diagnosing apparatus	4
Electric Power Station	5
Source Power Supply	5
Education	20
Primary School (1-3 grades)	1
Secondary School (4-8 grades)	5
High School (9 - 10 grades)	7
Student Dormitory (Education)	25
Other	1
Health Service	36
Out-patient Service (Health)	7
In- patient Service (Health)	14
Emergency Service (Night Service, Health)	99
Operation Facility (Health)	179
Delivery Facility (Health)	67
Livestock Hospital	6
Telecommunication	173
Road	81
Market and Commercial Facility	56
Cultural Center and Meeting Hall	89
Factory	92
Tourism Facility and Hotel	77
Other Ambulance car	4
Bridge for Zavkhan river	2
Boiler	4
Construction	7
Electricity for Household	51
Electricity for Bath-house	5
Facility for Hospital	4
X-ray	3
Sanitizing apparatus	3
No Answer	56

Source: Inventory Survey conducted by the JICA Study Team

CHAPTER 5
CURRENT SITUATIONS AND ISSUES ON POWER ENERGY SECTOR

CHAPTER 5 CURRENT SITUATIONS AND ISSUES ON POWER ENERGY SECTOR

5.1 Development Policy, Organization, Functions and Power Demand

5.1.1 Development Policy

Mongolia has rich resources of coal with an estimated 20 billion tons of deposits. The major part of those is steaming coal and the coals are exploited in the open air. The major production center of coals is Baganuur of Tuv Aimag, but other centers are scattered all across the whole country. Regarding oil resources, as extremely cheap oil has been imported from the former Soviet Union, systematic exploitation had not been conducted. The oil deposits are estimated at around 400 million tons. In 1996, it was confirmed that Mongolia had crude oil deposits for production, through the oil exploration carried out in Zuunbayan area in Dornogovi Aimag and Tamusakhburag (near Choibalsan) in Dornod Aimag. When the price of oil products increases, Mongolia will set its production at a full scale. Even though oil production starts, however, production will not be enough to cover the total amount of fuel consumption by diesel engine generators or vehicles in Mongolia. Moreover, as Mongolia does not have the refinery, the crude oil exploited must be transported to Russia or China for refinement. At present, Mongolia depends mainly on Russia and China for oil products. Unlike oil, coal is abundant in Mongolia. Keeping in harmony with the international concerns about environmental problems concerning non-renewable fossil fuel, the Mongolian government made a resolution to address the issues positively.

In addition to coal and oil as mentioned above, Mongolia is affluent with renewable energy such as solar and wind power. Since Mongolia can provide energy resources for themselves utilizing such renewable power, it is expected to decrease the fuel import cost and the outflow of foreign currency. This also enables Mongolia to contribute to the protection of the global environment.

On the other hand, due to the hardship of the natural environment during the winter season, it is essential to supply people with electric energy in a constant and stable manner. The stable supply of electric energy is also recognized to be essential for the improvement of the economy which will be realized through industrial development under the market economy system.

Based on the basic thoughts stated above, the Ministry of Infrastructure Development which is in charge of policy-making for electric energy determined the policies below:

(1) Because of problems in the budget, a large-scale electric resource development will be postponed. Instead, to satisfy the increasing demands for the electric energy and develop the national economy, the government will take measures to repair the existing electric power facilities and improve the efficiency.

(2) To distribute electric energy widely throughout the nation, the government will expand the electricity transmission network, depending on the state budget.

(3) As measures against environmental pollution and the outflow of foreign currency, the government will gear up the renewable energy development, gradually shifting from fossil fuel to clean energy.

(4) While fostering the efficient use of energy, the government will implement fair collection of electric fee and secure the collection.

5.1.2 Administrative Organization

(1) Energy Section of Department of Strategic Planning and Comprehensive Policy in the Ministry of Infrastructure Development

The organizational structure of the Ministry of Infrastructure Development is shown in Figure I.5.1-1. The Energy Section of Department of Strategic Planning and Comprehensive Policy in the Ministry of Infrastructure Development is in charge of making policy on electric power supply and the energy sector. Under Head and Deputy Head, six specialists are assigned. Each specialist is respectively in charge of thermal power, transmission and distribution, heating, diesel power, renewable energy, and economic and finance.

(2) Energy Authority of Mongolia

The Energy Authority of Mongolia is an independent implementation organization affiliated to the Ministry of Infrastructure Development. Figure I.5.1-2 shows the organizational structure of Energy Authority of Mongolia. It is responsible for the operation and management of the electric distribution network in the western, central and eastern regions, as well as independent diesel power stations in Aimag Centers. The Authority is one of the leading large-scale state-owned enterprises which employs more than ten thousand staff at their discretion. Until recently, the energy sector had been excluded from the privatization program, and there was no plan of privatization in the energy sector. However, when the president of Mongolia visited the United States of America in August 1999, the American government strongly proposed to him to privatize power stations, and the Mongolian government changed its policy and decided to make the power stations under Energy Authority independent individually. It is planned that, the third thermal power station, the fourth thermal power station, a transmission section, and a distribution section in Energy Authority will become separate state-owned companies, 100% of whose stocks will be held by the government, as the first step towards privatization. (It is also planned that a state-owned power station repair company will be privatized first.) The concrete measures of privatization are still under consideration and not yet decided.

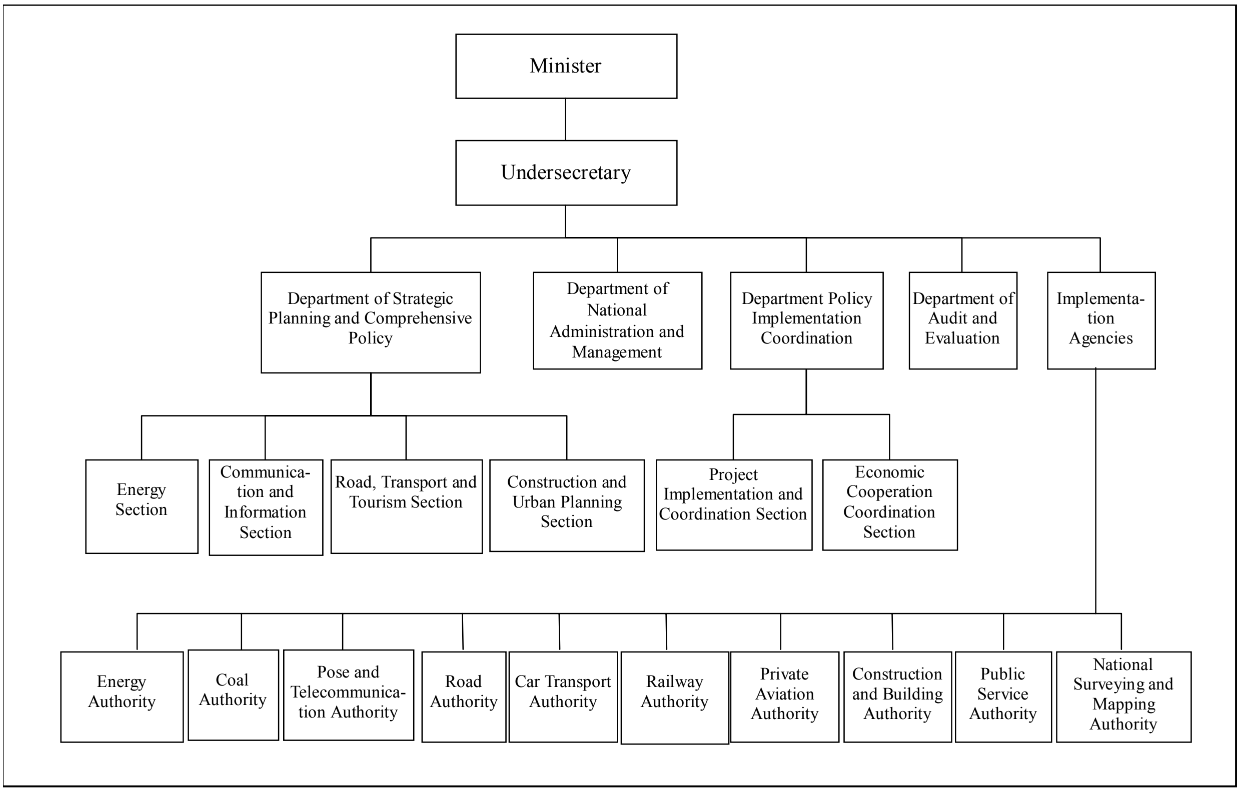


Figure I.5.1-1 Organizational Structure of the Ministry of Infrastructure Development

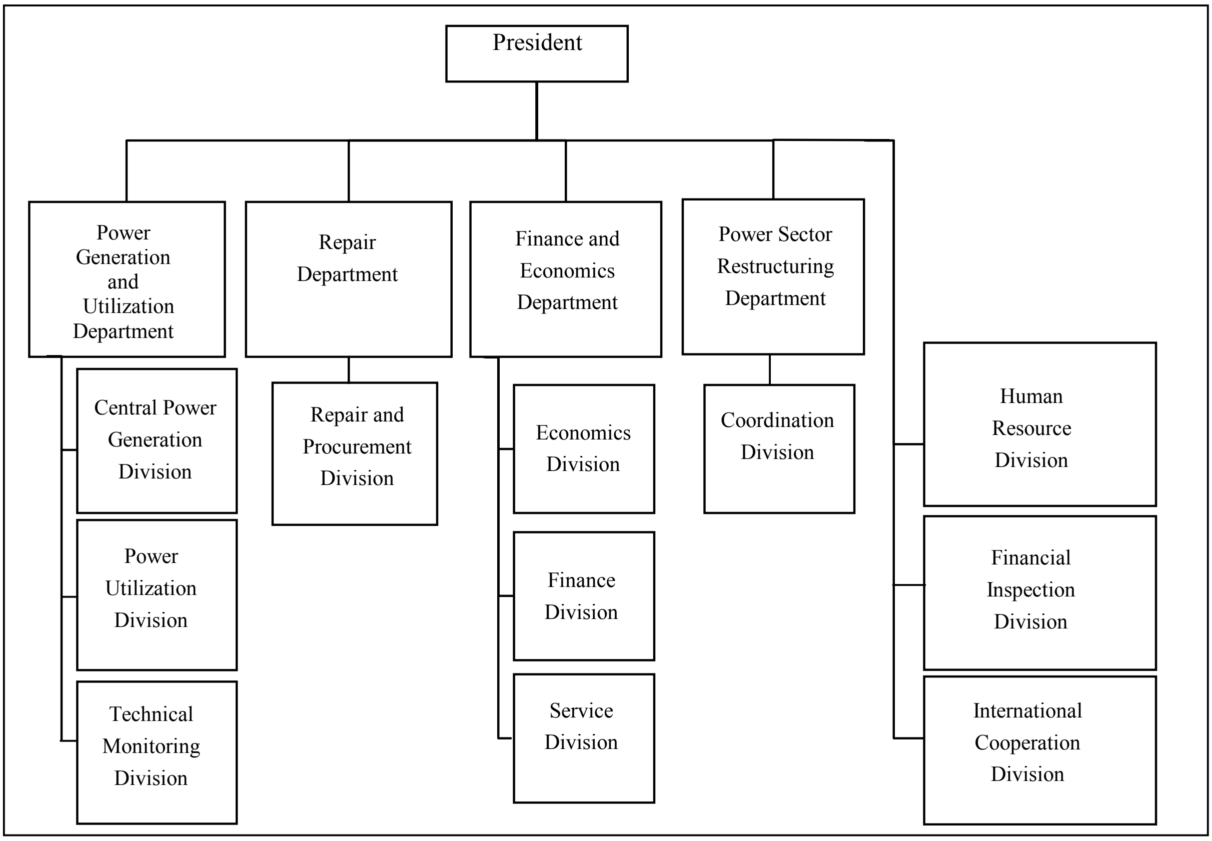


Figure I.5.1-2 Organizational Structure of Energy Authority of Mongolia

(3) Mongolian Academy of Sciences and Renewable Energy Corporation

The Renewable Energy Corporation under Mongolian Academy of Sciences conducts researches on renewable energy (photovoltaic power, wind power, hydro power, thermal energy, solar heat, geothermal energy, and bio energy), produces and imports experimental and commercial equipment and tools, and sells them.

The Mongolian Academy of Sciences (MAS) is a governmental body, which is independent from Ministries established by the Mongolian Academy of Sciences Law. While each Ministry is in charge of policy making, MAS conducts various basic scientific and technological researches and applies the research results. It also examines proposals of scientific and technological research. Approximately 30 % of the state budget for science and technology is applied to the basic scientific research in Mongolia, and all of them are allocated to MAS. The General Assembly in MAS comprises of 49 scholars or professionals and gives advice to the President. As shown in Figure I.5.1-3, under the President, a Vice President and Scientific Secretary are assigned. There are six divisions under the Scientific Secretary: Technology & Engineering Division, Physics, Mathematics & Chemistry Division, Geology, Geography & Ecology Division, Biology & Agriculture Division, Medical Division, Social & Humanity Division. The number of staff in divisions is approximately 120. Under MAS, there are 17 research institutes and centers which conduct basic scientific research, and 9 corporations which conduct not only applied scientific research to develop new technologies, but also production & sales activities in relation with these new technologies. The Renewable Energy Corporation belongs to the latter.

The organizational structure of the Renewable Energy Corporation is shown in Figure I.5.1-4. The Corporation comprises of two departments: Research Department and Experimentation, Production & Business Department. The staffs (about 34-35) of the Research Department are government employees, and the research is conducted under the state budget. On the other hand, the Experimentation, Production & Business Department is a private enterprise named Monmar Corporation which is run by the independent profit system and employs personnel at their discretion. The Monmar Corporation, as a part of the Renewable Energy Corporation, imports and sells photovoltaic power system and produces and sells wind power system. The office is located in the same building of the Renewable Energy Corporation.

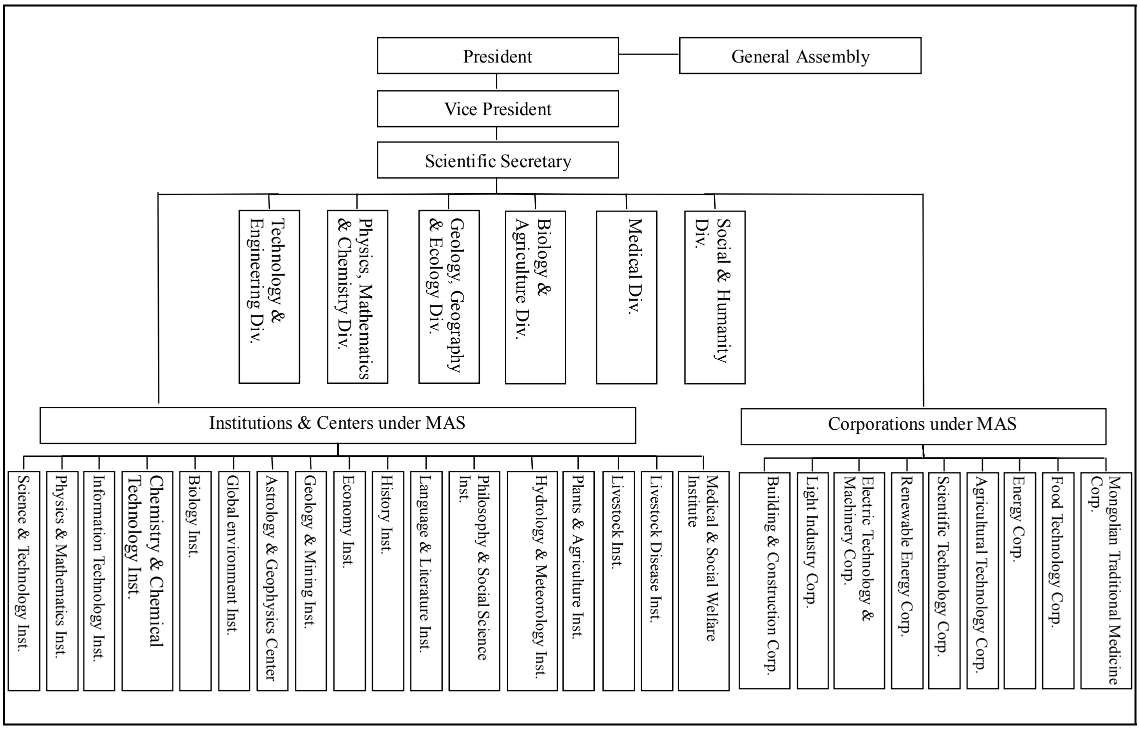


Figure I.5.1-3 Organizational Structure of Mongolian Academy of Sciences (MAS)

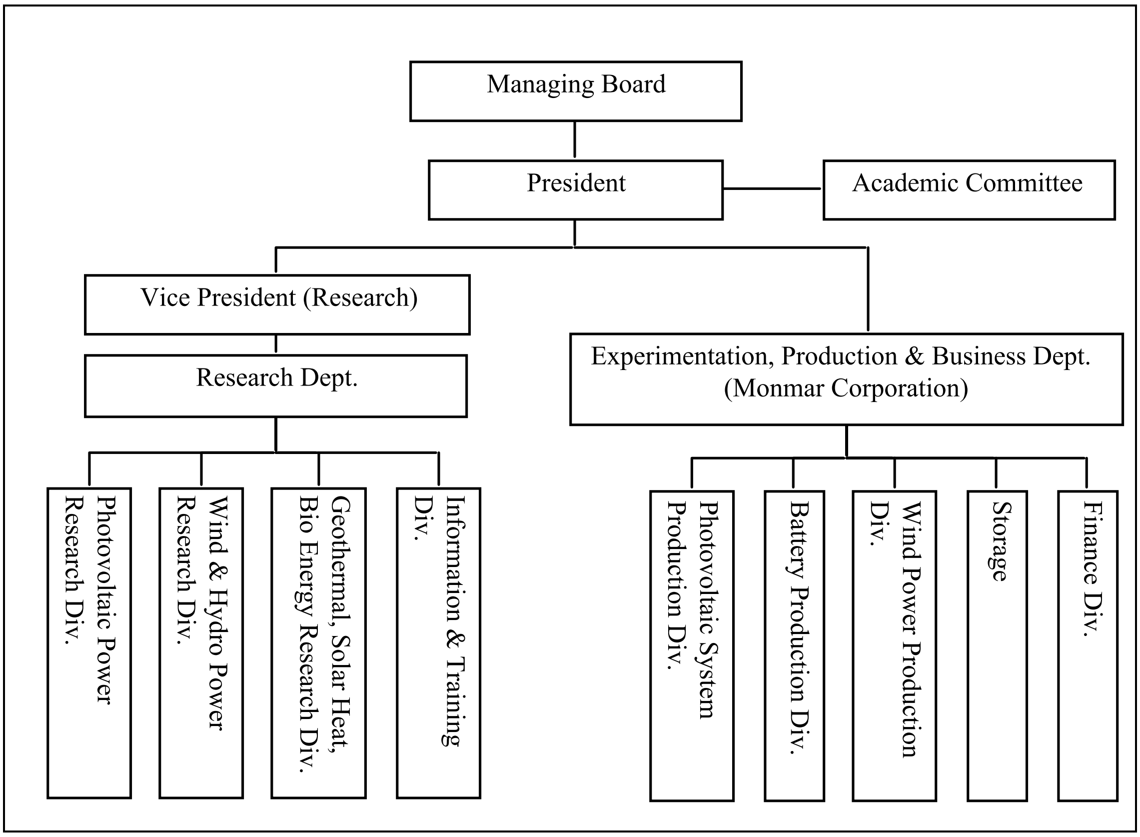


Figure I.5.1-4 Organizational Structure of Renewable Energy Corporation

The highest decision-making body in the Renewable Energy Corporation is the Managing Board, and the President of MAS takes chair of the Board. It comprises of the Head of Energy Department and the Head of Economic Cooperation in Ministry of Infrastructure Development, the person in charge in the Ministry of Education, and members of the State Financial Committee. The Academic Committee composed of 17-18 scholars or professionals gives advice to the President.

5.1.3 Roles

Table I.5.1-1 summarizes demarcation of roles of each governmental organization related to electric power supply and energy sector, which is described in the previous section.

The Energy Department in the Ministry of Infrastructure Development, as a rule, takes the role of policy-making, while the electric power supply is conducted by the Energy Authority. The Energy Authority runs three energy systems and operates independent diesel power stations in Aimag Center, while the Sum office runs an independent diesel power station in the Sum Center. Most hydropower stations in Mongolia are operated by the Hydropower Development Corporation (UCS) under Energy Authority, although there are some independent private hydropower stations. Originally the Hydropower Development Corporation (UCS) was established for Egiin river development in 1990, but since there is no other organization in charge of hydropower development and it is difficult to find a budget to establish a new organization, it has later become to cover hydropower development in the whole country.

Table I.5.1-1 Roles of Each Governmental Organization Related to Electric Power and Energy

Governmental Organization	Major Role
Energy Section of Department of Strategic Planning and Comprehensive Policy in the Ministry of Infrastructure Development	Policy making
Energy Authority (EA)	Administration and management of electric supply and heating systems and diesel power stations in Aimag Centers
Hydropower Development Corporation (UCS)	Development and management of hydropower
Sum Office	Administration and management of independent diesel power stations in Sum Centers
Renewable Energy Corporation	Research, experiment, production, and sales of renewable energy
Photovoltaic Power Division in Post and Telecommunication Authority (PTA)	Production and sales of photovoltaic power system (mainly for telecommunication facilities)

The Renewable Energy Corporation researches and conducts experiments about renewable energy as well as produces or imports and sells photovoltaic and wind power systems. As for production and sales of the photovoltaic power system, the Post and Telecommunication Authority set up the Photovoltaic Power Division in 1998 and started operation of the production line. Though this production line primarily aims at the supply of photovoltaic systems for telecommunication facilities, the division is eager to sell the photovoltaic system to schools and hospitals in Sum, taking advantage of the fact that the Post and Telecommunication Authority is run under the independent profit system, and they have telecommunication network and technical professionals at the level of Sum.

5.1.4 Power Demand

(1) National Power System Network

The power system network in Mongolia consists of three electric power systems. The largest electric power system is the Central Electric System (CES) which covers all consumers of such major cities located at the central region as Ulaanbaatar, Darkhan, Erdenet, etc. for power supply from the electric power system. The East Electric System (EES) covers the Choibalsan city and surroundings. The West Electric System (WES) established at the western region of the country for power supply to the consumers which covers each Aimag center of Khovd, Ulaangom and Ulgii and the surrounding Sum centers. In addition to the above, there are six Aimags which are not interconnected with the three national electric power systems as mentioned above, i.e. Khuvesgel, Zabkhan, Gobi-Altai, Umnugobi, Bayanhongor and Sukhbaatar. In these Aimag, several sets of diesel-generators are installed at the Aimag centers for power supply to the consumers in the Aimags. In the Sum centers, where power from the national electric power system is not supplied power from the diesel-generators at the Aimag center is also not supplied, the electric power is supplied by the independent diesel-generator sets made by the former Soviet Union or new diesel generator sets provided under the Japan's grant aid.

(2) Composition of Power Demands and Supply and Demand Balance

In Mongolia, power demand in the power system is generally classified into two types of demands that consist of general demand and industrial demand of the mining industry, manufacturing industry and commerce. Power facilities are being developed to meet the power demand consisting of the general and industrial demands in the national electric power system of CES, WES and EES. After democratization in 1990, a steady fall in the national electric power consumption has been observed due to the steep rise of fuel oil in price and economic hanging low, and power demand reached to the recorded minimum in 1993 under the influence of privatization of state-operated factories and economic hanging low. After that time the power demand gradually increased due to the activation of economic conditions by the development of the cashmere industry and mining industry, commercial industry and satisfactory management of privatized factories. The largest consumer in the power system is the mining enterprise located at Erdenet. Although various efforts for management rehabilitation were taken, the bad situation still remains unchanged until now. Therefore, the power demand of the mining enterprise in Erdenet has not been increased. On the other hand, power consumption of general consumers in urban areas is steadily increasing due to the high advancement of electrified home and development of industry. The attached Table I.5.1-2 shows the actual record of power demand in CES. Figure I.5.1-5 shows Supply and Demand Balance of Electric Power Energy in CES.

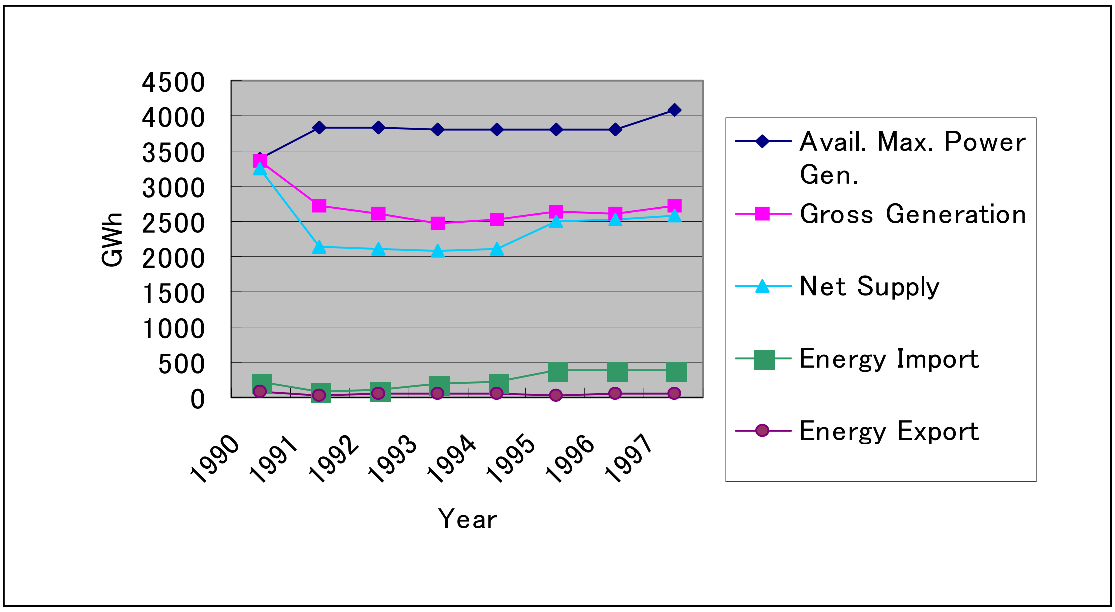


Figure I.5.1-5 Supply and Demand Balance of Electric Power Energy in CES

In six Aimags (Khuvsgel, Zabkhan, Gobi-Altai, Umnugobi, Bayanhongor, Sukhbaatar) where they are not interconnected with the national power system and have a independent diesel power plant, the power demand shows a steady fall from 1990 to 1994, and after that time the power demand seems to increase gradually. This trend is expected to ascend and the power demand should reach the limit of available power output of the diesel power plant in the near future. The attached Table I.5.1-3 shows the actual record of power demand in each Aimag. Table I.5.1-4 shows the actual record of power demand in each Aimag on 1999.

Table I.5.1-4 The Actual Record of Power Demand in Each Aimag on 1999

Aimag Center	Installed Capacity	1999	
		Available Power	Peak Power
	(MW)	(MW)	(MW)
1. Ulaangom	9.2	7.1	2.8
2. Ulgii	5.52	8.0	3.0
3. Khovd	12.9	9.2	3.1
4. Uliastai	11.04	4.6	3.0
5. Altai	11.01	5.3	2.8
6. Murun	11.7	7.0	3.2
7. Bayanhongor	8.25	6.1	1.6
8. Dalanzadgad	8.96	4.5	1.0
9. Mandalgobi	4.8	3.6	2.0
10.Undurkhaan	6.4	4.8	1.2
11.Baruun-Urt	6.4	5.3	2.5
12.Choibalsan	36.0	36.0	12.5

(Data Source: MOID in Apr. 2000)

5.1.5 Power Demand Forecast

The actual power demand in CES has increased gradually at an annual increase rate of 2 - 3 % during the past six years. This trend is in proportion with the urban economic growth. On the other hand, the future power demand in CES is forecasted by ADB to increase at an annual rate of 6 %. However, the power demand cannot be expected to increase at such a high rate as forecasted by ADB due to a slump of ruling copper price in the world and stagnation of tourism under the influence of the Asian Economic Crisis. This trend will continue for a few years in future. Power demand forecast in CES is illustrated in Figure I.5.1-6. As seen in this forecast it seems that the power demand in CES will exceed the limit of the possible maximum power output of the generating plants in 2001, whether power transmission and distribution systems are expanded as scheduled or not.

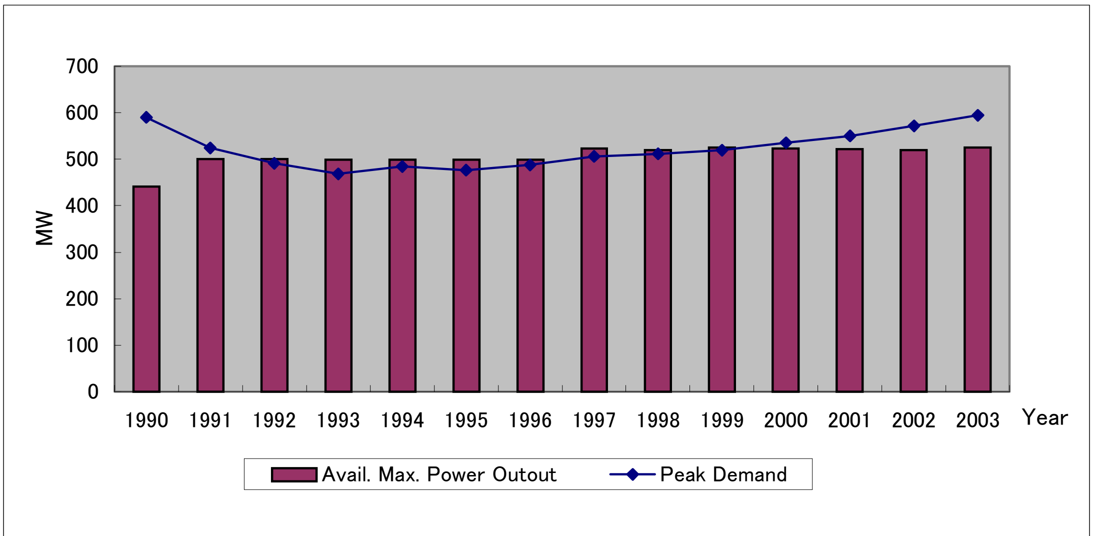


Figure I.5.1-6 Power Demand Forecast in CES

5.2 Generating Facilities

5.2.1 Current Situations of the Existing Generating Facilities

The main power generation plants in Mongolia are coal-fired thermal power plants which are designed for generation of base load electricity for the national power system. Electric power supply in the Aimag outside the national power system consists of isolated diesel power generation plants. In addition to those, hydro power plants are under operation for supplying generated power to the isolated Sum centers and Aimag center. A location map of the existing power plants is shown in the attached Figure I.5.2-1. The existing generating facilities are already deteriorated. For meeting the system power demand it is required that new power stations be constructed or electric power from foreign countries be imported. Table I.5.2-1 shows the inventory of the existing generating facilities.

Table I.5.2-1 Inventory of Existing Generating Facilities

Item	P/S No.	Rated	Available	Intercon. W/Russia
CES thermal	5	753 MW	633.3 MW	Intercon.:Peak supply
WES thermal	3 (Diesel)	(27.62 MW)	(24.3 MW)	Intercon.:All power
EES thermal	2	38.5 MW	9.2 MW	Independent
Aimag diesel	14	91.38 MW	71.3 MW	Independent
Mini-hydro	5	3078 kW	2078 kW	Independent

(Data Source: MOID in Mar. 2000)

Current situations of the existing generating facilities are described below.

(1) Thermal Power Plant

Most of the existing power plants in Mongolia are coal-fired type thermal power plants because of abundant resources of coal (estimated to be around 200 billion tons). Five coal-fired thermal power plants exist in CES and one in EES and the existing thermal plants are designed for generation of base-load electricity for the national power system. The existing thermal power plants are also designed for co-generation of not only powers but also steam production for district heating and process steam for industry. The thermal power plants inventory in CES and EES is shown in the attached Tables I.5.2-2 and I.5.2-3, respectively in Data Book.

(2) Hydro Power Plant

In Mongolia hydropower development has been worked on for 30 years ago under the technical and economic assistance of Russia. The first assistance project of the hydropower development was the Kharkhorin hydropower plant (1959 commissioning) and this power plant has been operated satisfactorily until now. Although there are lots of hydropower potentials in the country, the implementation of the projects is difficult due to the shortage of a development budget.

All the existing hydro power plants are constructed at the central and northwestern region which are mountainous and forest areas. At present, there are five hydro power plants in operation in Mongolia. The following are the existing conditions of the hydropower plants.

(a) Although small repairs are required for two hydropower plants, the hydropower plants are operating in good condition. Most of the existing hydro power plants are constructed in an irrigation channel and the installed capacity is small because of location and available head.

(b) Most of the existing hydro power plants may possibly operate in summer only because the river freezes over in winter. Therefore, the rate of operation is quite low.

(c) The existing generating equipment and materials are imported ones made by foreign manufacturers. The hydro power plant inventory is shown in Table I.5.2-4.

(d) Most of the hydro power plants were constructed some years ago, except for item 1 in Table I.5.2-4, and are comparatively brand-new. It seems that the power and energy have been generated satisfactorily by the hydro power plants.

(e) The generated power is transmitted to the nearest Sum centers and Aimag center. The power generated at the Bogd power station is transmitted to the distribution network in the Zabkhan Aimag center. The capacity of this power station is not so big, therefore, frequency control of the distribution network is not possible at all.

Table I.5.2-4 Hydropower Plant Inventory

	Name of P/S (Aimag name)	Unit No. x Capacity	Operation	Completion Time	Generation	Present Condition	Manufacture country	Remarks
1	Kharhorin (Uburkhangai)	2 x 264 kW	Summer only	1959	0.5 GWh	1-unit only operation	China	Headrace repair
2	Chigge (Uvs)	2 x 100 kW	Summer only	1984	0.4 GWh	Good	Vietnam	OK
3	Bogd (Zabkhan)	2x1,000kW	Summer only	1997	6.0 GWh	Good	China	Intake repair
4	Mankhan (Khovd)	2 x 75 kW	All the year	1998	0.5 GWh	Good	China	OK
5	Guulin (Bayanhongor)	2 x 100 kW	Summer only	1997	0.8 GWh	Good	China	OK

(Data Source：UCS in Oct. 1998)

(3) Diesel Power Plant

The existing middle class diesel power plants are installed at each Aimag center for supplying power to the centers under the economic assistance by Russia. These power plants are essential for power operation at each Aimag center and operate at present. The existing conditions of the diesel power plants are described below.

(a) The existing diesel power plants for emergency power supply are installed at the Aimag centers in WES for power supply of the rural areas and the isolated Aimag centers from the national power system.

(b) From the diesel power plants installed at the Aimag centers power supply to most of the Sum centers located in the Aimag territory by distribution lines are not performed due to economical and technical view points.

(c) At the Aimag centers hot water for district heating and process steam for industry have been provided from the existing heating plants.

(d) Power supply at each Sum center, where the electric power is supplied neither from the national power system nor from the Aimag center diesel power plant, has been made by the small scale diesel generator sets (30kW, 60 kW and 100 kW) which have a function of independent power supply facility.

(e) The fuel oil for the small scale diesel generator sets and the Aimag center diesel power plant uses an imported diesel oil from foreign countries.

(f) All the existing diesel power plants installed at the Aimag centers are made in Russia and Czechoslovakia and are in a serious and rapidly deteriorating condition due to inadequate maintenance and difficulty of spare parts availability. In addition to the above, the electrical utilization factors of diesel plants have been low during the last few years when diesel fuel supplies have been interrupted, and sharp increases in the price of diesel fuel and lack of funds for maintenance have resulted in severe load shedding in most provinces and resulted in a condition of management crisis of the diesel power plants. The diesel power plant inventory at the Aimag centers is shown in the attached Table I.5.2-5 in Data Book.

5.2.2 Current Issues on Operation and Maintenance

(1) Thermal Power Plant

The Energy Authority pointed out the current issues on the operation and maintenance of the thermal power plant as mentioned below.

(a) Electrical efficiency is low due to deterioration of the plants.
(b) Plant factor is unacceptably low due to increase of station use

(c) Shortage of spare parts.
(d) Difficulty of local purchase of maintenance tools and parts.
(e) Lack of funds for operation and maintenance.
(f) Lack of technology of staff for operation and maintenance.

(2) Hydro Power Plant

As there is not a lot of existing hydro power plants, so many serious problems have not been occurred in operation and maintenance. The major issues pointed out by UCS are listed as follows.

(a) Difficulty of availability of maintenance parts in Mongolia.
(b) Lack of spare parts and the fund for operation and maintenance.
(c) Lack of technology of civil engineer.

(3) Diesel Power Plant

The Aimag center diesel power plants are managed by the assigned provincial centers under the control of the Energy Authority. The urgent renewal of the existing diesel power plants is impossible due to the lack of adequate funds. The existing diesel power plants have the following issues on the operation and maintenance.

(a) Electrical efficiency is low due to deterioration of the plants.
(b) Plant factor is unacceptably low due to increase of station use.
(c) Increase of unit cost of power generation due to increase of price of imported fuel oil.
(d) Shortage of spare parts.
(e) Difficulty of availability of maintenance parts in Mongolia.
(f) Lack of funds for operation and maintenance.
(g) Lack of technology of staff for operation and maintenance.

5.2.3 Rehabilitation and Development Plan

(1) Thermal Power Plant

Most of the existing thermal power plants are aged and deteriorated so the thermal power plants are required to be rehabilitated under the foreign economic assistance. In some thermal power plants rehabilitation of boilers and turbine generators are planned to be made in the near future. Table I.5.2-6 below shows the rehabilitation projects of thermal power plants to have been carried out.

Table I.5.2-6 Rehabilitation Projects of Thermal Power Plants

	Rehabilitated Thermal P/S	Finance	Rehabilitation Time	Total Cost
1	Choibalsan Coal Thermal P/S	ADB	Sep. 1998 - Mar. 2000	30 M.US$
2	Ulaanbaatar Coal Thermal P/S No.3	ADB	Sep. 1998 - Mar. 2000	30 M.US$
3	Ulaanbaatar Coal Thermal P/S No.4	OECF	Oct. 1997 - Dec. 1999	44.9 M.Yen

(Data Source: Energy Authority in Oct. 1998)

The development plan of the thermal power plants is recommended in the Master Plan Study Report made by ADB in 1996. According to the report the recommended development plan is to install 50 MW - 100 MW class power plants step by step. The Government of Mongolia was very negative towards the development of many thermal power plants notwithstanding to the ADB recommendation by the reasons of lack of funds for construction, difficulty of arrangement of local budget for procurement of coal and environmental protection measures. Therefore, the Government suspended the development plan and recently abandoned a part of the development plan. On the other hand, MOID has a opinion that construction of new thermal power plants is required to cope with the increasing system power demand and for improvement of electricity quality. Even considering such situations as mentioned above, MOID considers that new thermal power plants should be constructed in time to meet the system power demand. At present, MOID plans to construct some new thermal power plants within the limits of the Government loan capacity. For the development of thermal power plants, the plan shall abide by the law of environmental protection which was established in 1997. Apart from the governmental development scheme, US investors proposed to purchase the thermal power plants in Ulaanbaatar in 1999 for independent power production (IPP). This IPP project aims at sound management effect of power operation by effective operation and maintenance of the plants.

(2) Hydro Power Plant

Large-scale hydropower plants have never been developed yet in Mongolia. There are only five (5) small-scale hydro power plants in the northwestern area at present. Most of the existing hydro power plants were constructed recently, except one (1) hydro power plant constructed by China in 1959, so extensive rehabilitation work is not required at present. Most of the existing power plants are scheduled to stop power generation in the winter season because of the river water freezing. During this period the power plants plan to conduct check and maintenance work of the facilities. By periodical checks and maintenance of the facilities, the power plants will be in proper operation condition in summer time. Meanwhile, a part of civil structure is required to be repaired and UCS suggests repairing to the management authority little by little in every year obtaining the necessary budget. However, there are some accidents in the plant every year even after repairing the facilities. UCS suggests repairing to the management authority to have repair work done every year for repeating accidents. To stop the accidents, radical rehabilitation of the power plants is required. The rehabilitation plan of the small hydro power plants is shown in Table I.5.2-7.

Table I.5.2-7 Rehabilitation Plan of Small Hydropower Plants

	Rehabilitated Mini-HEPP	Aimag Name	Completion Year	Required Rehabilitation Work	Finance	Rehabilitation Time
1	Kharhorin Mini-HEPP	Uburukhangai	1959	Intake Channel and 1-Water Turbine	Government Budget	Every Year Step by step
2	Bogd Mini-HEPP	Zabkhan	1997	Intake Structure and Irrigation Channel	Government Budget	Every Year Step by step

(Data Source: UCS in Oct. 1998)

According to the data and information from UCS (UCS State Owned Co., Ltd.), there are about 3,800 rivers including all small streams in Mongolia, and the total length of rivers is about 65,000 km. In the northern and northwestern forest areas and the mountainous area in Dornod Aimag, UCS has identified that there are several numbers of promising hydro potential sites in twelve (12) Aimags. According to these data and information from UCS, investigated hydro potentials are seventy-six (76) sites in total and power output of 1,793 MW is available. Ten (10) sites out of 76 sites have been surveyed or are under survey by the foreign donors and UCS. The development plan of hydro power plants is shown in the attached Table I.5.2-8. The summary of development plan of hydro power plants is shown in Table I.5.2-9.

Table I.5.2-9 Summary of Development Plan of Hydropower Plants

Name of hydro P/S	Aimag	No. x Output	Situation	Total Cost
1. Egiin	Bulgan	4 x 55.5 MW	F/S	283 m.US$
2. Chargait	Khuvsgul	2 x 4 MW	Pre-F/S	28 m.US$
3. Taishir	Gobi Altai	4 x 2 MW	F/S	39 m.US$
4. Baruunturuun	Uvs	2 x 100 kW	F/S	0.36 m.US$
5. Monkhairkhan	Khovd	2 x 75 kW	Pre-F/S	0.32 m.US$

(Data Source: MOID and UCS in Mar. 2000)

(3) Diesel Power Plant

The existing diesel power plants, which are essential for provincial power supply facilities and for a column of important social infrastructure in the province, are under rehabilitation by the assistance of a foreign institute (USAID). Table I.5.2-10 shows the rehabilitation plan of the diesel power plants.

Table I.5.2-10 Rehabilitation Plan of Diesel Power Plants

Rehabilitated Diesel P/S	Aimag	Scope of Work	Finance	Rehabili. Time
1 Bayanhongor Diesel P/S	Bayanhongor	650 kW x 2	USAID	1997-1998
2 Bayanhongor Diesel P/S	Bayanhongor	650 kW x 2	USAID	1998-1999
3 Altai Diesel P/S	Gobi-Altai	650 kW x 2	USAID	1997-1998
4 Altai Diesel P/S	Gobi-Altai	650 kW x 2	USAID	1998-1999
5 Murun Diesel P/S	Khuvsgul	650 kW x 2	USAID	1997-1998
6 Murun Diesel P/S	Khuvsgul	650 kW x 3	USAID	1998-1999
7 Dalanzadgad Diesel P/S	Umnugobi	650 kW x 1	USAID	1997-1998
8 Uliastai Diesel P/S	Zabkhan	650 kW x 1	USAID	1997-1998
9 Uliastai Diesel P/S	Zabkhan	650 kW x 3	USAID	1998-1999

(Data Source: MOID, Energy Authority and USAID in July 1999)

All the diesel generator sets in the above table are to be installed newly in addition to the existing diesel generator sets. Some deteriorated diesel generator sets are scheduled to be retired in near future. Therefore, augmentation of the power plants capacity cannot be expected even after the rehabilitation work is completed.

The Government of Mongolia has never considered constructing new diesel power plants at each Aimag center and also in the national power system for the reasons of lack of funds and low economic return. Therefore, there is no development plan at present.

5.3 Transmission Line Facilities

5.3.1 Current Situations of the Existing Transmission Line Facilities

The existing transmission line system consists of 220 kV, 110 kV and 35 kV transmission systems. The system established in the whole country as the national power system is constituted of three (3) isolated systems which are called as (1) Central Energy System (CES), (2) West Energy System (WES) and (3) East Energy System (EES). Table I.5.3-1 shows the inventory of transmission line facilities.

Table I.5.3-1 Inventory of Transmission Line Facilities

Voltage	O/H line	U/G line	Total line	S/S No.	Total MVA
220 kV	1145 km	(-)	1145 km	7	708 MVA
110 kV	3021 km	(-)	3021 km	58	2211 MVA
35 kV	3677 km	(-)	3677 km	162	390 MVA

(Data Source: MOID in Mar. 2000)

Current conditions of the transmission line facilities are described below.

(a) At present, three electric systems are not interconnected with each other.

(b) CES and WES are interconnected with the Far East Russian Power System. In CES power circulation has been made between Russia and Mongolia.

(c) CES and WES have been managed by the Load Dispatching Center (LDC) installed at the Energy Authority. The power system diagram is shown in Figure I.5.3-1 and the transmission line route map as of October 1998 is shown in Figure I.5.3-2 in Data Book.

(d) The support of the existing 220 kV transmission lines are steel square towers, and a mixture of steel square towers and round steel framed concrete poles for 110 kV transmission lines. The conductor arrangement of both 220 kV and 110 kV transmission lines is basically vertical stringing for double circuits and horizontal or a triangle arrangement for single circuits with overhead ground wire.

(e) The support for 35 kV transmission lines are concrete poles for the lower part to prevent against corrosion and wooden poles for the upper part to reduce the construction cost. The upper portion of wooden pole is connected with the lower concrete pole by binding by steel wire. The overhead ground wire is basically not arranged on the 35 kV transmission lines, except the round steel framed concrete pole sections which have been constructed by the assistance of the former Soviet Union.

(f) The direct grounding system is applied at the points of the neutral terminals of 220 kV and 110 kV main transformers.

(g) The grounding system of 35 kV transmission lines is a non-grounding system preventing radio effect from the lines. The insulator for all transmission lines uses a toughen glass insulator, and the conductor is ACSR.

Following are the current situations of the existing transmission line facilities in each energy system.

(1) CES (Central Electric System)

CES is the backbone national power system supplying electric power to the major three cities (Ulaanbaatar, Darkhan, Erdenet) and the surrounding eight Aimag in the central region of Mongolia. One double circuits of 220 kV transmission line is interconnected with the Far East Russian Power System from the Darkhan substation in Mongolia to the Selendum substation in Russia. In this system there is no big hydro power station for peak power demand of the system at present. Peak power is sometimes imported from Russia through the 220 kV interconnection line in case of shortage of peak power. On the contrary, surplus power in midnight is exported from Mongolia to Russia to prevent light load operation of thermal power plants. The settlement of account shows a loss due to the difference of unit rates of power and energy prices, and the Energy Authority is in difficulty of payment. The rated frequency is 50

Hz in the system. The major features of CES are shown in the attached Table I.5.3-2 in Data Book.

(2) WES (West Electric System)

WES is a national power system that supplies electric power to the major three Aimags (Ulaangom, Khovd, Ulgii) and the surrounding Sum centers in the northwestern region of Mongolia. One single circuit of 220 kV transmission line (designed) is interconnected with the Far East Russian Power System from the Ulaangom substation in Mongolia to the Chadan substation in Russia. The operation voltage of this interconnection line is 110 kV in winter and 35 kV in summer. In this system large scale power stations have not been constructed yet for supplying power for the system demand, so all the electric power has been imported from Russia through the 220 kV interconnection line. In case of power outage due to the fault or accidents on the interconnection line facility, operation of the diesel power plants installed at each Aimag center is made as an emergency power supply. The rated frequency is 50 Hz in the system. The major features of WES are shown in the attached Table I.5.3-3 in Data Book.

(3) EES (East Electric System)

EES is a national power system that supplies electric power to the Dornod Aimag center (Choibalsan) and the surrounding Sum centers in the eastern region of Mongolia. One single circuit of 220 kV transmission line is interconnected with the Far East Russian Power System from the Mardai substation in Mongolia to the Kharnuur substation in Russia. The 220 kV transmission line is mainly used for power transmission for the uranium mining industry. The 220 kV transmission line has not been interconnected with EES of which the electric center is Choibalsan. The rated frequency is 50 Hz in EES. The major features of EES are shown in the attached Table I.5.3-4 in Data Book.

5.3.2 Current Issues on Operation and Maintenance

The Energy Authority, who has the responsibility of managing the system, pointed out the current issues on the operation and maintenance of the transmission facilities as mentioned below.

(a) In the national power system, a static capacitor for compensation of system voltage drop has not been installed yet. Quite a large voltage drop has been observed in some points in the system.

(b) As the route length of 220 kV and 110 kV transmission lines is very long, power loss rate has been observed as 2 - 3% for transmitted power.

(c) Power system stability is quite low and voltage fluctuation is severe.

(d) There are some points at which synchronous operation of the system is not possible due to distortion of phase angle.

(e) A single circuit of transmission line is constructed as a standard for reducing the construction cost. Power supply reliability is quite low in case of power system faults and accidents. Photo I.5.3-1 shows a fallen 35 kV transmission line pole caused by a traffic accident.

Photo I.5.3-1 35 kV Transmission Line Pole fallen down by Traffic Accident

(f) The existing manual type load dispatching facilities are superannuated. A computer aided SCADA system has not been applied yet. It is impossible to restore system faults and accidents quickly and to manage multi data and information immediately.

(g) As the existing communication system facilities are superannuated, adequate communication is interfered.

5.3.3 Rehabilitation and Development Plan

A long term rehabilitation plan of the transmission facilities has never been made. In case of an accident and fault of the facilities, repairing work is performed. There are lots of work items on the repairing works such as repair of galvanizing of steel towers, replacement of clamps, replacement of damaged insulators, etc. These works are not able to be performed immediately due to lack of funds. This work was also not able to be carried out until now due to financial problems. The existing substation facilities are also superannuated, and the performances of the substation equipment and insulation oil of transformers have been deteriorated so power losses in substations increase every year. Although rehabilitation work is needed immediately, the master plan of the rehabilitation work has not been formulated yet.

The existing transmission facilities installed at Aimags, which are isolated from the national power system, have been rehabilitated by the branch office in the Aimag of the Energy Authority obtaining necessary budget for the work in every year.

In Mongolia long transmission lines are required for extending the power system because Mongolia has a wide area and less population density. Long transmission lines involve such problems as low stability and large power loss. In addition to the said, a high economic internal return cannot be expected. Therefore, the expansion of the transmission lines is performed with the Government funds at a rate of 4 - 5 lines per annum. The development plan of transmission lines by the Government fund is shown in attached Table I.5.3-5 in Data Book.

5.4 Distribution Line Facilities

5.4.1 Current Situations of the Existing Distribution Line Facilities

(1) The Existing Distribution Facilities

The inventory of distribution line facilities to be connected to the main power system is shown in Table I.5.4-1.

Table I.5.4-1 Inventory of Distribution Line Facilities

Voltage	O/H line	U/G line	Total line	S/S No.	Total MVA
10 kV	8999 km	664 km	9663 km	2494	605 MVA
0.4 kV	3931 km	1260 km	5191 km	(-)	(-)

(Data Source: MOID in Mar. 2000)

Current conditions of the distribution facilities are described below.

(a) The existing 10 kV and 6 kV facilities are operated as high voltage distribution systems and three phase 400 V and single phase 220 V as low voltage distribution systems.

(b) The 6 kV distribution system is the former system that cannot transmit electric power for the consumers. At present, the 6 kV distribution system is upgraded to a 10 kV distribution system. The former system remains unchanged the voltage at some places of CES and EES.

(c) The underground distribution system is applied in the urban areas considering the harmony of a spectacular sight and overhead distribution system in suburban areas and rural areas by the reason of economic construction cost.

(d) A non- grounding system is applied for the existing high voltage distribution system.

(e) Arrangement of conductors for the overhead distribution lines are in a triangle configuration, and overhead ground wire is not supported.

(f) The conductor arrangement of low voltage overhead lines is in a zigzag configuration of a three-phase four-wire system.

(g) Support for both high and low voltage lines is a wooden pole. Insulators of high voltage lines use pin type insulators and glass type suspension insulators for high voltage overhead lines, and low voltage line insulators use pin type insulators and spool insulators. The existing power cable for old underground lines is a paper insulated cable (Belt cable), and recent power cable to be buried under the ground is butyl rubber insulated cable. Both power cables as mentioned above have less performance than the latest plastic power cable. As the existing power cables have been used for a long time, plenty times of faults and accidents are occurred on the power cable lines.

(h) The major feature of the distribution facilities in each electric system is shown in the attached Table I.5.4-2 in Data Book.

(2) Devices for Power Tariff Collection

For each consumer living in the urban areas a trading meter (Watthour meter) made by the former Soviet Union is used for power tariff collection every month. Small consumers are applied the rate tariff contract. The power tariff is collected by an authorized staff every month after a meter check.

5.4.2 Current Issues on Operation and Maintenance

The Energy Authority pointed out the current issues on the operation and maintenance of the distribution facilities as mentioned below, except for the Sum centers where they have not been supplied electric power from the national power system.

(a) Voltage drop of the overhead distribution line is extremely high. Especially for Gel camp lines that are quite long lines, the voltage drop is very high when heavy load is taken on the line.

(b) Distribution loss is extremely high. The average distribution loss in Ulaanbaatar has been recorded at about 18 - 19% including non-technical loss and about 30% in Uliastai of Zabkhan Aimag. Non- technical loss is estimated at about 2 - 3%, but the actual rate of this portion is not possible to hold at all.

(c) The wooden poles of overhead lines sometimes fall down by a sudden gust of wind or traffic accidents which causes wide area power outage for long time.

(d) The existing underground power cables are superannuated. The deterioration of the existing power cable causes short circuits at the straight joint portion and cable end portion, and power outage for a long time is brought to the consumers.

(e) Lack of funds for repair work and expansion work.

(f) The power tariff system and collection systems are not functioning, and tariff income is short at present. Modernization of the power tariff system and collection system shall be required to be improved urgently.

5.4.3 Rehabilitation and Development Plan

The existing distribution systems interconnected with the national power system have been rehabilitated by the Energy Authority obtaining the necessary Government budget for the work every year. Meanwhile, the distribution facilities installed at the isolated Aimags from the national power system have been rehabilitated by the branch office in the Aimag of the Energy Authority obtaining the necessary budget for the work every year. A long term rehabilitation plan of the distribution facilities has not been made.

Development of distribution systems has been implemented by the Energy Authority taking the Government annual budget based on the request from the consumers. In addition to the above, a part of distribution system has been developed by the Energy Authority with financial assistance from foreign donors. This is the reason to loan foreign funds for implementation of projects since special equipment and materials must be imported from the foreign countries. The development plan of the distribution system proposed by the Energy Authority and accepted by the Government is listed in the attached Table I.5.4-3 in Data Book.

5.5 Relations with Upstream Plans of the Power Sector

5.5.1 Power and Energy Balance

(1) Power and Energy Balance in CES

Future power demand in CES is forecasted to increase gradually. At present, power supply and demand is barely balanced. When the peak power demand in winter exceeds the power generation capacity in CES, short power is obliged to be imported from Russia through the 220 kV interconnection line. The increase of power demand in CES will be brought from the drift of population from rural areas to urban areas, leveling up of home electrification and development of medium and small enterprises. At present, the reserve power of 2 - 3% of the generation capacity is maintained in CES for the system power demand. However, this rate is quite less for reliable and stable operation of the system. In case of step out or falling off of a large unit of thermal power plant from the system, power supply and demand condition is in unbalance and in unstable condition. In such a case as mentioned above, load shedding operation or stop of a part of system operation might be made.

(2) Power and Energy Balance in Independent System

In the isolated six (6) Aimag centers where the electric power is generated by diesel generators, the same bad conditions as the said resulted in the case of step out or falling off of a large unit of diesel power plant from the system. This causes inconvenience to the consumers in the isolated Aimag centers. The power demand in the isolated six (6) Aimag centers is not increased rapidly so the power supply and demand is barely balanced by the effective operation of the existing generating facilities. However, high distribution loss is observed in each isolated Aimag center. For keeping the power and energy balance at each isolated Aimag center, not only the effective operation of generating facilities but also the reduction of distribution losses is required for the future.

5.5.2 Expansion Plans of Power Transmission System

(1) Rural Power Supply Plan by Transmission Line Extension

The Energy Authority has commenced the construction and extension of the transmission and distribution lines according to the MOID's plan. Furthermore, the extension of the transmission and distribution lines up to the year 2000 is planned by MOID. The construction and extension plans of the transmission and distribution lines are determined by the Government considering inhabitants needs, availability of budget, political and economical matters, etc. The planned lines are utilized for stable power supply to each Sum center from the national power system or diesel power plant in the isolated Aimag centers or newly constructed mini-hydro power plant.

On the contrary, some Sum centers, which would be scheduled to be supplied the electric power from the national power system by extension of power transmission line by 2000, have not been supplied the electric power yet due to the suspension of the extension work of power transmission line because of the lack of budget. As the extension of power transmission line for these Sum centers cannot be expected by 2000, these Sum centers are included in the Study.

(2) Stable and Reliable Power Supply Plan

As Mongolia has wide land area, power demand points are dotted in the country and power demand density is quite low. Most transmission line extension projects are not feasible to develop. However, electric power and energy is one of the important elements of the social infrastructure in the rural areas, and these days inhabitants' living is highly dependent upon electric energy.

In asking for the economical construction cost of a transmission line, especially for the construction of a 35 kV transmission line, circuit arrangement of the transmission line is designed to be single circuit and branching configuration. At the power demand point, the line is tapped by T-branch for reducing the construction cost. For good management of the electric enterprise the enhancement of the system's stability and reliability is essential. However, necessary technology and funds for the study is inadequate now. The improvement work should be performed in the future. By such present conditions as mentioned above, once a line fault occurs, then it results in wide area power outage. The system reliability on power supply in rural area is in poor condition at present. In addition to the above, the system stability is very low due to low regulation of line voltage caused by the abnormal long transmission line and load fluctuation.

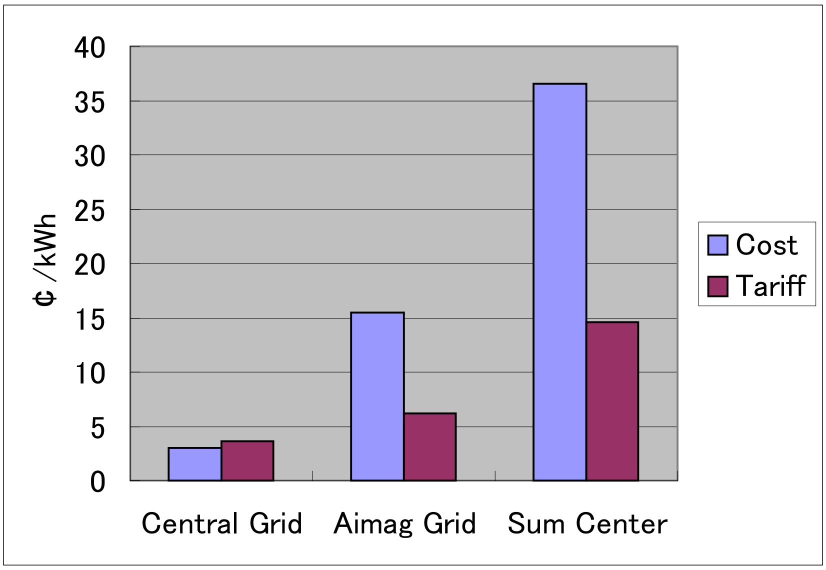
Under the above situations in power transmission system, the following studies shall be made for the expansion of the power transmission line.

(a) Economic assessment
(b) Power system stability and reliability
(c) Needs of consumers

5.6 Electricity Tariff and Collection System

5.6.1 General

In understanding the electric tariff systems of Sums in Mongolia, it is necessary to review the overall structure of electricity tariff systems in Mongolia. Figure I.5.6-1 shows the overall structure of electricity tariff systems in Mongolia. The production cost of electricity rises as we move from central authority to rural power producers as well as electricity power prices. Except for the central grid, all rural power suppliers suffer from systematic financial deficit[*1].



(Source : JICA Master Plan Study for Rural Power Supply)

Figure I.5.6-1 Electricity Power Prices and Production Cost

The independent electricity supply businesses in Aimags in fact receive subsidies from the Energy Authority. The deficit at Aimag grids per kWh is twice as large as the electricity price. The difference is entirely covered by the subsidy from the Energy Authority. In 1997, the independent Aimag grids ran a total deficit of 3.5 billion Togrug which was entirely covered by the subsidy from the Energy Authority.

The reason why the gap between revenue and cost in the electricity supply business becomes wider as it goes down the ladder of hierarchy is firstly, that the operation loses the economy of scale. The number of users in Aimags are in the range of thousands where as in the Sums it is in the range of a few hundred. It is natural that the operation would lose economic advantage as the size of its users shrinks. The graph does not incorporate the depreciation costs as it is not a local norm. However,

[*1] On the financial statement, the Energy Authority made a surplus of 3－4 billion Togrug in 1997.

such conversion to international accounting practice would reveal much larger deficits of electricity supply in Mongolia.

5.6.2 Electricity Tariff Structure

An ordinary practice in electricity pricing is to differentiate pricing according to the volumes of Ampacity in addition to normal classification by the types of users. Furthermore, pricing would include a fixed charge and variable charge on a monthly basis. In Mongolia, CES and Aimags charge only on a variable basis in accordance to consumption volume whereas nearly all of the Sums charge on a fixed basis. The interviewed officials in charge of billing at the central level had no knowledge of the combinatory charges with both fixed and variable charges.

As discussed in the previous section, the electricity business in Mongolia is operating on a deficit. The price increases in electricity tend to lag behind the inflation rate in Mongolia. Under its technical assistance program, ADB has suggested the Energy Authority to adopt an automatic formula method to increase electricity prices in accordance to on-going inflation. The formula is to add on 4-5% normal profit onto the production cost. The law on electricity businesses endorses the price changes with the approval of the Ministry of Infrastructure Development. However, in reality, due to large impacts on the life of the people and the basic industries, the price hikes are largely influenced by political forces.

In 1998 the electricity tariff was revised. The current price for household users is set at 32 Togrug/kWh. With VAT, the actual payment comes to 35 Togrug/kWh. The pricing mechanism for industrial users is more complicated with different prices according to time zones. Such time-based pricing is common and varies between Aimags. For instance in Dornod Aimag, the tariff for industrial users is 57 Togrug/kWh between 6:00 and 17:00, 114 Togrug/kWh between 17:00 and 22:00, and 21 Togrug/kWh between 22:00 and 6:00.

Table I.5.6-1 Electricity Tariff System of Central Grid System

a. General Tariff

User		Unit	Fee（Excluding VAT）
Business	Dornod	Tog/kWh	57
	Others	Tog/kWh	46.4
Household		Tog/kWh	39.6

b. Time-based Tariff

Category	Period	Fee (Tog/kWh: Excluding VAT)		
		Dornod	Other	Household
Daytime	6:00-17:00	57	41	34.6
Evening	17:00-22:00	114	82	51.8
Late night	22:00-6:00	21	15.2	3.5

C. Fixed Tariff

Targeted Items	Output	Unit	Power Tariff（Excluding VAT）	
			Household	Private Company
Outlet		Tg/Outlet/Mo	6411	12821
Incandescent Lamp	25W	Tg/Mo	241	482
	40W	Tg/Mo	392	784
	60W	Tg/Mo	597	1193
	75W	Tg/Mo	751	1501
	100W	Tg/Mo	991	1982
	150W	Tg/Mo	1484	2968
	200W	Tg/Mo	1982	3964
	500W	Tg/Mo	4958	9915
	1000W	Tg/Mo	10121	20042

Source：Energy Authority 1998

In CES, it is a common method to rely on meters for tariff calculation. However, there are some ten thousand Ger users which have no meters installed. These non-metered users pay a monthly charge calculated according to a formula which adds charges on the number of electric appliances and outlets.

5.7 Energy Law

The new Energy Law, which became effective on January 1, 1996, regulates the electric supply in Mongolia. The Law specifies each item shown in Table I.5.7-1, keeping harmony with internationally agreed energy laws.

Table I.5.7-1 Major Rules in the New Energy Law

- All the rights in the energy sector reserved by Cabinet, State Central Administration (Ministry of Infrastructure Development), Heads of Administration in Capital, Aimags, Sums and Duregs.
- Licensing procedures (application, appraisal and approval) for a corporate body which wants to build energy production facilities or energy supply network, or produce and sell electricity.
- Rights and obligations of producers and suppliers of energy (safe operation, assurance of safety in supply).
- Rights and obligations of energy users.
- The way to decide energy price and tariff system and the procedure to change them.
- Measures to encourage investment in energy sector (tax exemption for investors).
- Promotion of saving energy.
- Energy supply contract, payment for the bill, penalty, and suspension of supply.
- Liabilities to supervise execution of the Energy Law, settle down disputes, compensate for damages, and charge penalty for offenders.

The contents of the new Energy Law are well-considered in the light of the international standard, but it is advisable to make some vaguely specified items more clear by adding bylaws and others. For example, the law stipulates that the electric rate is "the sum of cost and profits calculated correctly." Because the law does not specify the correct way of calculation, in many cases the electric rate is actually decided without accounting for depreciation.

Even though the contents are excellent, it is useless if the law is not observed. In Mongolia, there are many problems on the system in executing the law. The Law has penalty regulations for a person and a corporate body. But no effective penalties have been charged on the person or the corporate body who did not pay for the bill, which gives pressure on management of electric services. The agency for supervision and control cannot execute their duties because of insufficient personnel and the limited budget.

In August 1999, the Mongolian government announced a new policy to transform power stations under the Energy Authority into state-owned corporations and the future possibility of privatization of these corporations. Along with this new policy, the government is preparing a new electricity law.

CHAPTER 6
THE PRESENT CONDITION OF THE DEVELOPMENT OF RENEWABLE ENERGY IN MONGOLIAN COUNTRY AND THE FUTURE MOVEMENTS

CHAPTER 6 THE PRESENT CONDITION OF THE DEVELOPMENT OF RENEWABLE ENERGY IN MONGOLIAN COUNTRY AND THE FUTURE MOVEMENTS

6.1 Overview

Sample surveys and inventory surveys have been conducted to clarify the situation of renewable energy usage in Mongolia. The result of the surveys shows that there are high solar and wind potentials in large regions and high hydraulic potentials in some parts of Mongolia. And the results of power output estimation show that PV energy potential and wind energy potential are 211 GWh/year and 81.7 GWh/year in Mongolia respectively. A lot of small-PV systems and small-Wind systems are being used by Nomads mainly in the south Gobi region.

6.2 Photovoltaic Generation and Solar Thermal

6.2.1 Photovoltaic Generation

In Mongolia, Renewable Energy Corporation (REC) had imported some kind of PV module and PV system from foreign countries and conducted demonstrations to herdsman, schools, hospitals etc, although REC does not conduct PV projects anymore. Two years ago, PTA had established a PV division and began the sales promotion and production of PV modules and other related components.

On the aspect of sold and manufactured PV system in the Mongolia, PTA has the largest number. The number of small type PV systems that are used by nomads has not exactly been researched but a large number is being used. Besides these projects, grass roots assistance of the Japanese government, research and demonstration plant of NEDO, by foreign donation such as TACIS and pilot plants of this master plan are reported. Recently, the Mongolian government has announced that the government decided to extend small size PV generation systems to Nomads.

6.2.2 Solar Thermal

Renewable Energy Corporation (REC) had conducted pilot tests for solar thermal systems as same as that of the photovoltaic generation few years ago, although REC does not conduct the test anymore. The reasons for the limited number of solar thermal extensions are, the cost of system operation became high especially in cold winters, and difficulty of effective operation by only a solar thermal system. It seems that, Mongolian people have been interested in solar thermal systems recently, especially for green houses or other systems. The technology of the solar thermal water heating system has developed and the cost has become reasonable. This made it possible to use solar thermal systems under the extreme environmental conditions of Mongolia. Due to the weather condition most of the generated power is consumed by room heating systems in cold winters. To introduce the solar thermal system, warm air production before operate direct room heating system is better .For example, use a vinyl house for warm air production in the daytime, then send the warmed air to the hospital before operating the room heating system in the building. This system will reduce the required energy of room heating at the hospital. This system can be used with water heating systems in the same way as the room heating system. Solar thermal system has possibility to be used for other purposes with invention.

6.3 Wind Power Generation / Systems Using Wind Power

A pilot test for each type of wind turbine and wind pump imported from Russia or China was being carried out by the pilot test plant in the city of Ulaanbaatar, led by the Institute of Renewable Energy. However, lack of funding and other difficulties mean that no pilot test on the use of wind power is currently being carried out.

The majority of wind turbine generation systems in Mongolia are accounted for by market base small wind turbines used by nomads. The remainder are accounted for by the wind turbines being installed in Sum public facilities by this investigation and TACIS, and by the small wind turbines being installed in hospitals by Japanese NGOs. All the wind turbines installed in Mongolia are small wind turbines in the 5 kW or below class.

Examples of systems using wind power are wind pumps for milling, or yachts as transport, but these are rarely used in Mongolia.

6.4 Mini-Hydropower Generation Plants

In Mongolia a hydropower development study was conducted 30 years ago under the technical assistance of Russia. As discussed in Chapter 5, 5 hydropower plants are in operation and prospective hydropower potential sites exist in the country.

The mini-hydropower generation plant is one of the generation plants used natural energy resources and does not negatively affect the environment. The mini-hydropower generation plant has various advantageous characteristics. Table I.6.4-1 shows the comparison of major features of mini-hydropower generation plants and diesel power generation plants.

Table I.6.4-1 Comparison of Major Features of Mini-Hydropower and Diesel Power Generation System

Mini-Hydropower Generation System		Diesel Power Generation System	
1	Long construction time (1-1.5 years)	1	Quick delivery of facilities (5-6 months)
2	No fuel use and no environment effects	2	Need of exhaust gas countermeasures
3	Need of large initial investment	3	Comparatively less initial investment
4	Cheap running cost	4	High running cost by fuel consumption
5	Long life time	5	Limited life time due to high speed and temperature
6	Easy operation and maintenance	6	Need of frequent inspection and maintenance
7	Totally economic generation system	7	Economic operation is due to fuel price
8	Easy operation, but need of water management	8	Easy start and stop operation

As seen in the above table, mini-hydropower generation plant needs a large initial investment, but running cost is cheaper than the diesel power generation plant. The mini-hydropower generation plant is a totally economical system. In the northwest region, energy density of solar and wind potentials is observed to be poor and it is not possible to generate the full power to meet for the required power demand. Therefore, it is reasonable to take up the mini-hydropower plant for the Study as an alternative power source. According to the collected data, unit generation cost of diesel power plant is about 40 cent/kWh and unit generation cost of mini-hydropower plant is about 6 cent/kWh. The mini-hydropower plant is a more economical system than the diesel power generation system.

Mini-hydropower generation plants may be taken into consideration to the Master Plan Study, only if any existing feasibility study reports in English is available to the Study after review of the existing feasibility study reports. The detailed data and information collected were reviewed and analyzed in detail for confirmation whether the development is technically effective or not. The development plan of hydropower plants is shown in the previous Table I.5.2-8 attached in Data Book.

Following five hydropower plants where are located in the northern and northwestern areas are feasible for development, and feasibility study reports in English are available.

(a) Egiin hydropower plant (interconnection with CES)
(b) Chargait hydropower plant (interconnection with Aimag center system)
(c) Taisir hydropower plant (interconnection with Aimag center system)
(d) Baruunturuun mini-hydropower plant (independent Sum center)
(e) Monkhhairkhan mini-hydropower plant (independent Sum center)

Among the five power plants the Egiin hydropower plant is used for power supply to CES as a composition of system power plants. This power plant is not used for power supply to the isolated Sum centers. Therefore, the Egiin hydropower plant is not considered for further study in this Master Plan. In addition, the Chargait and Taisir hydropower plants plan to supply the generated power to the distribution network in the Aimag centers. These power plants are also eliminated from the Study. The remaining two mini-hydropower plants are useful for the power supply to the targeted Sum centers. Therefore, 2 mini-hydropower generation plants are taken into consideration to the Study. Table I.6.4-2 shows the major features of the mini-hydropower generation plants to be studied.

Table I.6.4-2 Major Features of Mini-Hydropower Generation Plants to be Studied

Name of Hydro-P/S	Aimag	Installed Capacity	Dam Type	Average Flow	Gross Head	Average Energy Gen.	Capital Cost	Average Gene. Cost	Demand Point
		(kW)		(m^3/sec.)	(m)	(GWh/year)	(US$)	(USc/kWh)	(Sum name)
Monkhhairkhan	Khuvesgul	2 x 75	Weir	2.5	8.0	0.3	317,000	6.0	Monkhhairkhan
Baruunturuun	Uvs	2 x 100	Weir	3.5	11.0	0.6	360,000	6.0	Baruunturuun

(Data Source: UCS in July 1999)

In addition to the above mini-hydropower plants, the existing mini-hydropower plant (Mankhan mini-hydropower station) is effective for power supply to the Sum center. This power plant will be used for power supply after rehabilitation. Therefore, the total number of mini-hydropower plants to be studied is three sites.

6.5 Market Base Small Scale PV Generation System

There are Business Corporations doing import sales and production sales of the small scale Photovoltaic generation system in Mongolia. From the information provided it is known that they have actual sales results of 700 sets and more in total after 1992. Besides these, in the south Gobi regions there is a case in which an individual turns to China and purchases the system. The small-scale PV generation system is mainly used as the power source for lights, radio, television and other small equipment. Under the above mentioned installation, it is reported that MONMAR company has sales of the PV system to herdsmen of the size around 30 Wp - 200 Wp and also to the schools, and hospitals under the government’s budget. On the other hand the PV division of PTA which lies under the MOID has the installation record of few watts to 5 kWp systems under their own budget or under donation programs at many hospitals and Telecom center of Sum centers, at microwave repeater centers etc. Mainly there is two types of business promotion of small scale PV generation system, one is the set sale of system and related equipment based on capacity, and the other is the independent sales of each component based on users choice or demand basis. The selling price of the system is around 6.3～9.5 US$, depending on the choice of the PV module capacity, related components and size of the battery.

The Mongolian government announced the "100,000 Solar Ger" program as a policy to provide electricity for Ger of herdsmen in the ‘National Assembly’ on October 6, 1999 and which was passed as a State Great Khural Resolution No. 158. The program covers the period of the years 2000～2010 having the main provision to provide electricity to entire households in the rural areas to be activated by solar home system. To supply the required power demand of herdsmen, schools, hospitals, tourism, culture and service centers together with individual households in the rural areas and also for border guards etc. individual or hybrid power generation system of Solar, Wind, Small hydro and also by combination with diesel generator will be developed.

For implementation and to finance the program the Mongolian Government processes a budget from foreign organs by such methods as soft loans, grant aids etc. The budgets will then be allocated to purchase a system on 50% soft loan for general inhabitant and for research and development in the country. The power generating system distributed by this program will be used as the main power source for lights, radio, television, telecommunication center and other small equipment. From this program base for the small business, reduction of unemployment, improvement of the life level etc. are expected to be covered. However, the standard of the power generating system and related equipment, way of applying, budget of each system/project etc. is not yet decided. The concerned detail contents of the program are attached to the collection materials.

6.6 Market Base Small Wind Power Generation Systems

As far as small wind turbines are concerned, Monmar Co. Ltd. manufactures and sells inside Mongolia, while MARCHIN Ltd. imports from China. Table I.6.6-1 shows the number of sales made by both companies. Since many individuals also go to China to purchase small wind turbines directly, it is believed that an even higher number of such turbines are currently being used in Mongolia.

Table I.6.6-1 Sales of Wind Power Generation Systems (1992-1998)

Company	No. of Sales	Sales Price
Monmar Co. Ltd.	Approx. 4000	Tg196,500[1]
Malchin Ltd.	Approx. 560	Tg17,000－Tg300，000[2]

[1] Wind turbine set（50W wind turbine, battery, battery charge and discharge controller、electric light、tower, Mar.2000.）
[2] Wind turbine set. Sales price varies depending on size of wind turbine.
（Source: JICA Master Plan Study for Rural Power Supply, Oct. 1998）

6.7 Other Systems Using Renewable Energy

Besides photovoltaic and wind power, and the use of small hydraulic power, other examples of systems that use renewable energy are stoves fueled by the dried dung of sheep or yaks, widely used in Mongolia, and stoves fueled by biomass resources such as firewood, used in mountainous regions. A further possible technique is biogas, which uses cattle dung, but low average temperatures in Mongolia mean that this is unlikely to be an efficient or widely-used method. As far as the use of biomass resources such as firewood is concerned, this must be implemented in a planned fashion, since many forests in mountainous regions have been and continue to be fallen. In some of the hot spring areas, the water could be used for hothouse cultivation, heating, and so forth.