CHAPTER 7
CURRENT SITUATIONS AND PROBLEMS OF ELECTRIC SUPPLY IN THE TARGETED SUM CENTERS

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7.1 Transition of Electric Power Supply Service

7.1.1 Organization of Electric Power Supply

In Mongolia, electricity is supplied to Sum either by the grid of the Energy Authority or by an independent power source (small-size diesel power generator) if the Sum is not connected to the grid. In general, electric power supply in Sum is managed by the Sum Office. Legally, the diesel power generator is regarded as a possession of the Central Government, even though the generator was provided through the aid from Russia or Japan. The electric power supply service is financed by the state budget, but the operation is thoroughly managed by Sums.

7.1.2 Necessity of Electric Supply

A Sum Center was originally established in the socialism era to provide the minimum cultural and public services such as electricity, heating, education, medical care, and banking services for the herders. Along with the recent deterioration of economy and finance, the public service provided by the Sum Center has become worse in its quantity and quality. Among the service, the electric power service at Sum shows the worst. Electricity enables the herders to get income from a side job such as processing agricultural products, producing handicrafts, working under the light at night. Needless to say, electricity is also essential when children study at night and people get useful information through radio or TV. There are about 10 Sums where no electricity was provided during the past year.

It requires heavy workload to collect water needed for people's daily life as well as for livestock. In general, it is children's job to smash the ice of frozen river and carry water using buckets. It is obvious that it will be easier for children to attend school lessons if an electric pump is available. Heating is essential for people to survive during the winter when the temperature gets below 30C degree, but in most regions, the heating system is not functional. There are many Sums which use heating systems which distribute the heat in the room by sending warm water into a heating pipe using a hand pump, or by directly burning fuel. If electricity is supplied in a constant and stable manner, it will be possible to serve heating in a modern way.

A hospital to serve the basic medical service is established in almost all the Sums. Because electricity is not available during the daytime, basic medical treatment apparatus has not been used in the clinic. At night, an emergency operation is conducted under candle light.

In a Sum Center, industries such as flour milling, furniture manufacturing, and wool processing were once incubated, but at present, many of their plants have not been operated. A stable electric power supply is a prerequisite for the industrial growth. Under the circumstances that electricity is supplied only during the night, even such prerequisite is not satisfied.

Electric power supply does not solve all the problems mentioned above, but in general, it is essential to assure the stable supply of electricity in order to provide public service constantly on a certain level and improve a Sum's economy.

7.2 Current Situations and Problems of Operation, Maintenance and Management

Table I.7.2-1 summarizes major problems on operation, maintenance and management of electric facilities in targeted Sum Centers.

Table I.7.2-1 Major Problems on Operation, Maintenance and Management of Electric Facilities in Targeted Sum Centers

(1) Problems of the organization to conduct operation, maintenance and management
- In many cases, the operator is the only one in charge of maintenance and management.
- Depending on the operator's characters, many power stations lack daily cleaning.
- No system to monitor operators' work.
- Maintenance and repair is taken only after an accident or damage has occurred.
- Lack of preventive maintenance activities including daily checkup of machinery.

(2) Problems of personnel for operation, maintenance and management
- Many operators were formerly tractor drivers.
- Operators are temporarily employed during operation period (often only in winter) by Sum Office.
- Operators are accustomed to handling engine and machinery, but are not knowledgeable about electricity.

(3) Problems on finance for operation, maintenance and management
- The power station is short of money, and has difficulties in paying for fuel and staff. The budget required for maintenance and management is not appropriated in a Sum budget (Traditionally, depreciation of the machinery is not appropriated in the government budget.)

Existing diesel power stations in Sum Centers are usually staffed by one head of the power station (many of them are officials of the Sum Office), one to three operators (many of them are former tractor drivers and employed only during operation period by the Sum Office), and one collector of electric fee (many of them are officials of the Sum Office). The maintenance and management situations of the power station greatly depend upon the characters of the operators. There are some power stations where the diesel power generator remained dusty in a building like desolation, and parts were scattered over the floor, without being cleaned.

Many telecommunication stations in Sum Centers are equipped with a photovoltaic system. The staff of the telecommunication station is not taking care of batteries at all, and calls for technical experts in Aimag Center when the battery is damaged or when a problem arises.

As for the maintenance and management system, the preventive maintenance and management system should be emphasized from now on, focusing on daily and periodic checks to avoid damage in machinery and keeping it clean and in order. It is also important to change operators' attitudes to maintain and manage by themselves, without completely depending upon technical experts in Aimag Center. For this purpose, it is necessary to train the operators on what is required for daily preventive maintenance and management.

The accounting of the power station is usually separate from that of the Sum. The power station purchases diesel and oil and employs operators using the income from the electric fee. Many power stations do not appropriate the cost of maintenance and management in their budget. When necessary and if they can afford it, they will purchase parts, spare parts, and others they need. Under these circumstances, in many power stations the machinery remains damaged due to the lack of money for repair. Because the finance to purchase a diesel engine is short in many power stations, they cannot operate the station at full scale. It is ideal to appropriate the budget for maintenance and management in the accounting of the power station, and it is more important to raise the revenue by setting a proper electric rate and organizing the rate collection system.

At pilot plant sites, operators in existing diesel power stations of each Sum are expected to operate, maintain and manage the plant. Most operators who are former tractor drivers are accustomed to handling engine and machinery, but are not always knowledgeable about electricity. Therefore, basic training about electricity will be required before the project is implemented, especially for maintenance and management of the photovoltaic power system. It is also important to give advance training so that the operators can conduct simple daily checks. As for the finance to maintain and manage the pilot plant, it should be covered by the budget of the Sum Office, because electricity produced at the pilot plant is supplied to public facilities such as hospitals and schools. The targeted Sum agrees to this point.

7.3 Current Issues in Financial Management of Sum Power Supply

7.3.1 User Base for Sum Power Supply

The most prominent feature in the Sum power supply system is that its user base has large seasonal fluctuations. The Sum center offers essential public and administrative services to the rural population including nomadic households. Education and medical care are the two most crucial public services. The Sums usually have primary and middle schools whose term starts in September and ends in June. During the school term, the nomadic families with school age children would return to the Sum center. Some centers offer rental Gers to the families if they need to be separated from the herding father. After the school year, these families leave for rich grazing grounds. This population movement causes large seasonal fluctuations in the user base. As shown in Table I.7.3-1, the fluctuations range under 20%, implying summer users above 80% of the winter user base comprise only 30% of all the Sum centers.

Table I.7.3-1 Ratio of Summer to Winter User Base in Sum Centers

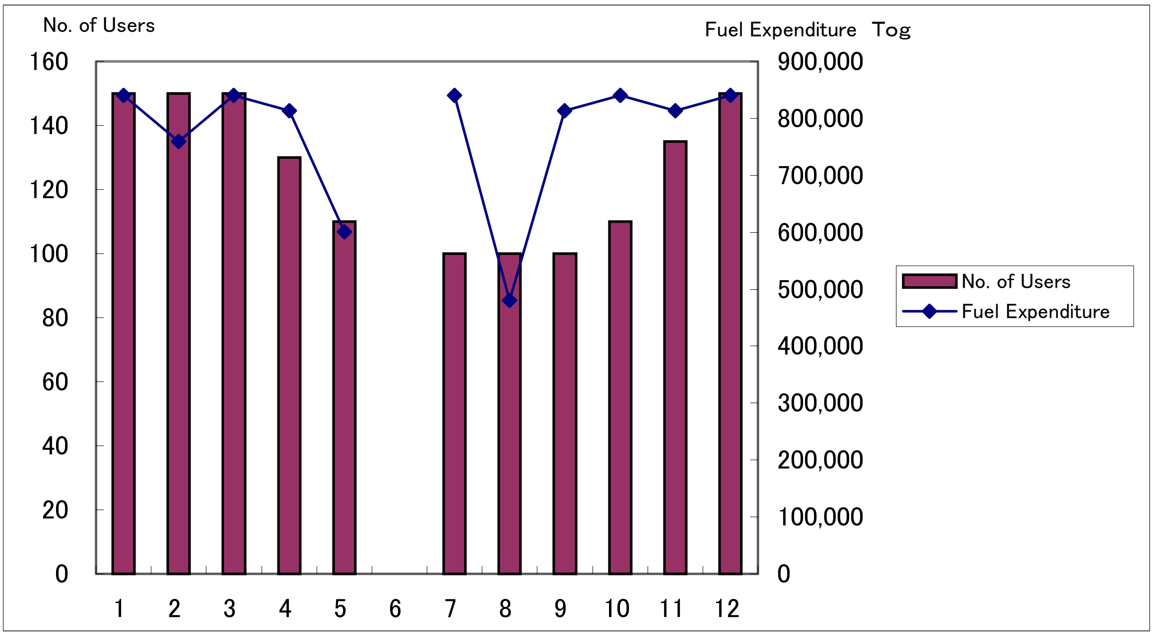
User Base Summer/Winter ratio	No. of Sums	%
Under 30%	8	4.6%
Between 30-50%	29	16.8%
Between 50-80%	83	48.0%
No less than 80%	53	30.6%
Total	13	100.0%

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

7.3.2 Sum Power Supply

As described in the previous section, the user base changes drastically in the Sum center according to the season. These changes make the management so much more difficult. Figure I.7.3-1 shows the monthly changes of users and fuel expenditures of a typical Sum center. The fuel expenditure does not match the fluctuations in the user base. In June when the user base hits the bottom, the Sum center abandon the power supply altogether. The fuel expenditure tends to remain at the same level even during summer months. In July the annual festival of Nardam takes place making a similar expenditure necessary.

As many Sum centers have only one generator, they cannot adjust to the fluctuations in output demand by the number of generators in operation, thus necessitating the same level of fuel expenditure. The only way to reduce fuel expenses it to reduce the operation time. However, many Sum centers only provide power peak hours such as 5 hours during winter months and further reduction makes substantial loss in quality of services without any change in the expenditure.



Source: Statistic Bureau, Annual Statistics 1998

Figure I.7.3-1 Changes in Monthly User Base and Fuel Expenditure

7.3.3 Electric Supply Conditions

The next two tables, Table I.7.3-2 and Table I.7.3-3 summarize the current conditions of electricity supply at the Sum centers. In general, the majority of the Sum centers provide only during the peak hours in winter, not supplying electricity during the daytime or any time during the summer. In reality, 33.5% of the Sum centers provide power during daytime in winter and 54.3% of the Sum centers provide some electricity during the summer. 4.6% of the Sum centers provide no electricity at all. The statistics are based on the Inventory Survey which describes the operations in 1998. During one year after the survey, the conditions surrounding electricity supply in the Sum centers were deteriorating rapidly and there are a few Sum centers falling into a no electricity condition. There was one Sum center which listed itself as providing electricity year round but is no longer supplied electricity at the time of the survey.

Table I.7.3-2 Electricity Supply at Sum Centers during Summer

type	No. of Sums	
night&day	22	12.7%
night only	70	40.5%
no elec. Supply	79	45.7%
daytime only	2	1.2%
total	173	100%

Table I.7.3-3 Electricity Supply at Sum Centers during Winter

type	No. of Sums	
night&day	58	33.5%
night only	106	61.3%
no elec. Supply	8	4.6%
daytime only	1	0.6%
total	173	100%

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

The electricity supply plan for the year 2005 should be based on the current conditions and the prospect to improve the current conditions.

7.3.4 Electrification Ratio

The ratio of electrification within the Sum centers is relatively high. On the average, 80% of the Sum households have access to electricity as shown in Table I.7.3-4. Even this figure of 80% is misleading since the power distribution network is installed there to supply power to any household which is willing to pay for it. The problem is not the development of the distribution network but rather economics where the Sum cannot pay for the fuel to supply power at all hours.

Table I.7.3-4 Electrified Ratio at Sum Centers

Average		80%
	Max	100%
	Min	0%
No. of sums with 100% coverage		58
No. of sums with over 90% coverage		80
No. of sums with 0% coverage		3
Total number of sums		173

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

7.3.5 Distribution Loss of Electricity

A general definition of distribution loss of electricity is the difference between generated power and consumed (paid for) power. It requires 100% monitoring of electricity consumption through meters and also accurate power generation records to measure the loss. However, there is hardly any Sum that has both records in place. At the time of survey in Khotont Sum, an interview with the technician in charge of transmission revealed that the distribution loss of electricity in the Sum center reaches 50% of the received power (this Sum is connected to the central grid.) Though the Sum too could not produce the record to prove the validity of the account, it is generally accepted that the distribution loss of electricity runs fairly high at local levels. At Buutsagan Sum in Bayanhongor Aimag which implemented the meter rated tariff system recently, the Sum center measures the distribution loss which averages around 17% of the tariff revenue. Many Sum centers have only a few households, but the cluster of households are often separated apart. The distribution facilities are outdated and poorly maintained, thereby incurring a large amount of distribution loss.

7.3.6 Finance and Electricity Tariff

(1) Finance

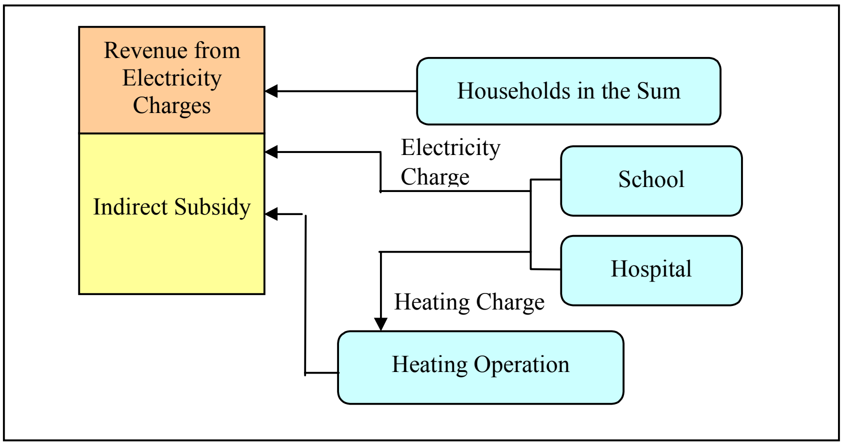
Table I.7.3-5 shows the financial status of electricity supply operations in the Sums under the Study. Obviously the expenditure exceeds the revenue. In reality, since the Sum government does not have credibility, the Sum cannot borrow from a bank to meet the financial obligation. The only way to meet the deficit is to delay payment. It is generally reported that 80% of electricity is consumed by households as electricity is supplied only at night, but the actual revenue share of household payment is only 36.7%. Non-fee revenue including subsidies consists 37.2% of the total revenue. A large portion of the revenue from public facilities is a cross-subsidy for electricity operation. Of the total expenditure, fuel comprises 85.8% whereas repair and maintenance comprises only 4.4% and investment 1.9%. The financial statement depicts the marginalized operation of a Sum's electricity supply which is basically disinvesting the current facilities.

Table I.7.3-5 Average Profit/Loss Statement of Sum Electricity Supply Operation

Annual Revenue	Tg	%
Households	2,915,866	36.7
Public Facilities	1,444,219	18.2
Private Business	625,877	7.9
Industry	6,395	0.1
Subsidy (except electricity fee from public facilities)	1,150,452	14.5
Other ____________	1,803,197	22.7
Total	7,946,006	100.0
Annual Expenditures		
Personnel	706,584	7.9
Fuel	7,625,694	85.8
Repair and Maintenance	389,453	4.4
Investment	167,240	1.9
Other ____________	0	0.0
Total	8,888,971	100.0
Deficit/profit	(942,965)	-10.6

Sources: JICA Master Plan Study for Rural Power Supply, Inventory Survey
Sample No. of Sum = 44

Figure I.7.3-2 shows a schematic financial structure of the Sum electricity supply operation. As mentioned above, the Sum electricity operation is in a huge red. Many Sums provide cross-subsidies to electricity operations to maintain a balance of the accounting book. The Sums which still maintain the regional heating system would have a unified operation of electricity and heating supply. The deficit in electricity supply is added onto the heating charges which mostly go to schools and hospitals. The heating charges are calculated on the basis of the floor space of the user. The school and hospital have a large floor space among Sum facilities, thus the heating charge is so much higher. The Sums without the regional heating system would have to directly charge public facilities with large electricity bills. Often the electricity charge for public facilities is calculated as the balance of the required revenue to cover the expenditure after collecting fees from households. One of the reasons why the school and hospitals have become the target sources for the cross-subsidy is that even under the current tight fiscal policy, the Mongolian government gives priorities to education and health care which constitutes the core of Basic Human Needs. Some hospitals and schools spend nearly 50% of their annual budget on heating. Regardless of necessity of cross-subsidies, this misrepresentation in accounting tends to create misallocation of resources. Some aid agencies promote energy saving project for schools and hospitals but the judgement is not based on entirely accurate data.



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

Figure I.7.3-2 Financial Flow in Electricity Supply Operation

(2) Electricity Tariff System

There are only a few Sums that adopt meter-rated tariff system among the Sums under the Study. The rest of the Sums charge fixed fees to households. At 27% of the Sums under the Study more than 50% of the household users are installed with a meter. However, the majority of such Sums do not calculate electricity charge on a volume basis. According to some interviewed officials from Sums, it is not possible to collect enough revenue for the operation as large percentage of the households consumes a minimum amount of electricity even though the consumer prefers to switch to the variable charge system. In fact the majority of households at Sums have a limited need for electricity such as light and radio. However, these comments include contradictions. Currently the Sum electricity supply operations spend 95% of the budget on fuel. If a higher volume-based tariff is implemented, the revenue may not rise but the consumption of fuel may be saved. Some of the Sum households own high consumption appliances such as electric heaters, refrigerators, and color TVs. Under the fixed tariff system, it is synonymous to transferring a subsidy from the poor to the rich. Such distortion needs to be addressed in view of social welfare as well.

Table I.7.3-6 shows the summary of power tariff charges data collected during the Inventory Survey. The tariff for the household is divided into the 2 categories of highest and lowest. The Sum center very often has 2-3 different tariff categories to support low income or pension households. The power tariff charges for the public facility vary largely since the heating charge is often included in the power tariff or simply the balance of the operation cost after collecting the tariff from the households charged on the public facility. The prices are based on the prevailing prices in the winter of 1998. 1n 1999, however, the price of petroleum products skyrocketed due to its shortage. Since then, many Sum centers have revised their power tariff as well. A rough estimate would be a 50% increase in power tariff.

Table I.7.3-6 Summary of Sum Center Power Supply Tariffs (1998)

Unit: Tg/month

	Fixed Tariff			Meter-Rate Tariff	
	Household		Public Facilities	Household	Public Facilities
	Highest Category	Lowest Category			
Average	4,043	2,824	63,029	91	163
Max	7400	5000	800,000	150	400
Min	1500	800	1,100	40	55

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

7.4 Current Conditions and Issues of Generating Facilities

7.4.1 Current Conditions of Generating Facilities

As of 2000, power sources of the off-grid Sum centers are all diesel generators except five hydro power stations. Power station buildings are mostly made of bricks, cement blocks, stones, concrete and wood; it varies depend on the region of the Sum center. The buildings are commonly superannuated with rain leaks from the roof and drafts from the wall. Photo I.7.4-1 indicates the building of a power station in Mankhan Sum center of Khovd Aimag.

Photo I.7.4-1 Power Station Building in Mankhan Sum Center

Before 1997, all the diesel generators were Russian made, which were standard type with the capacities of 60 kW and 100 kW and in partial 30, 200, 315 and 800 kW. After 1998, the new diesel generators have been provided in 74 Sum centers by Japan's grant aid. The same grant aid to 25 Sum centers is also being executed as of September 2000. All the diesel generators are Japanese made and around two to three sets of the generators with the capacity of 50 or 100 kW are installed in a Sum center. Therefore, 99 Sum centers will be fed with power by Japanese made diesel generators. Besides that, the basic design study for the same grant to 80 to 90 Sun centers is proceeding as of May 2000.

Photo I.7.4-2 Russian Diesel Generator in Uulbayan Sum Center

Photos I.7.4-2 and I.7.4-3 indicate the Russian diesel generator in Uulbayan Sum center of Sukhbaatar Aimag and Japanese diesel generator in Sevrei Sum center of Umnugovi Aimag, respectively. The attached Table I.7.4-1 indicates the Sum names and capacities of the diesel generators which have been granted and to be granted by Japan.

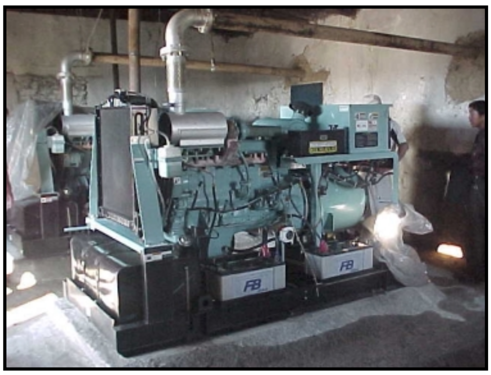


Photo I.7.4-3 Japanese Diesel Generator in Sevrei Sum Center

The running conditions of Japanese diesel generators are considerably well. However, Russian diesel generators are running well only in 31 Sum centers out of 173 according to the sample survey. Something is wrong with almost all of the Russian generators due to the overage condition since they were manufactured from 1970 to 1980. In a Sum center, usually three to five Russian diesel generators are installed. However, just one or two are operational in most Sum centers.

Operation of the generators are carried out by one operator in a Sum center, and 24 hour-power-supply is limited in a few Sum centers.

7.4.2 Current Issues of Operation and Maintenance

The major problems of operation and maintenance for generating facilities are mentioned below.

- The damaged Russian diesel generators are not able to be repaired because those were manufactured in the times of the former Soviet Union and the spare parts are now not supplied.
- The cost for inspection, repairing and renewal of the facilities are not included in the budget of the power supply in Sum centers. Then, the generating facilities would not be recovered or renewed if the facilities were to break down once. As the Russian diesel generators are very deteriorated, the possibility of the power supply in the Sum centers to be stopped within two to three years is extremely high.
- Due to the lack of the budget to purchase the fuel of diesel generators, the power supply is very limited at present. 102 Sum centers out of the 173 surveyed Sum centers completely cease the power supply in summer. Even in winter of high demand period, only 24 Sum centers execute a 24 hour power supply and the other Sum centers supply electricity for a limited period, only in the morning and/or evening.
- The ability of operators is not high enough for conducting appropriate maintenance, it is reducing the life of the generating facilities. Nevertheless, any training for operators is not conducted nor planned.
- As it often becomes lower than minus 40°C in the winter season, the operators shall give special attention to the diesel engines when they start them up, such as heating the power stations.

7.5 Current Conditions and Issues of Distribution Facilities

7.5.1 Current Conditions of Distribution Facilities

The distribution system in the Sum centers is unified as 400/230 V, 3 phase 4 lines and single phase 2 lines of low voltage lines. The outputs of diesel generators, 400 V 3 phase, are connected directly to the distribution lines in almost all of the Sum centers. The system voltages of high tension distribution lines are 10 kV and 6.3 kV. The numbers of Sum centers out of 173 surveyed Sum centers with high tension distribution lines are as follows.

- 10 kV Distribution Lines : 16 Sum centers
- 6.3 kV Distribution Lines : 16 Sum centers
- 10 kV and 6.3 kV Distribution Lines : 5 Sum centers

The distribution facilities principally consist of overhead lines, of which the conductors are aluminum bare and poles are wooden. Photo I.7.5-1 indicates the low voltage distribution lines in Tolbo Sum of Bayan-Ulgii Aimag.

Photo I.7.5-1 Low Voltage Distribution Lines in Tolbo Sum of Bayan-Ulgii Aimag

7.5.2 Current Issues of Distribution Facilities

Current issues of the distribution lines are as follows:

- Overage conditions
- Lack protection system
- High distribution losses and voltage drop

Table I.7.5-1 indicates the results of a visual inspection and investigation on the distribution system in 15 sample Sum centers.

Table I.7.5-1 Sample Survey Result of Distribution System

	Results (average of 15 Sum centers)
Degree of deterioration	
Deterioration of conductors	38% of conductors are disconnected and rejoined
Decline of poles	43% of poles are declined
Rot of root part of poles	7% of poles are rotted
Damage of insulators	36% of insulators are damaged
Protection system	
Existence of fuses	No fuse for distribution system in 50% of power stations
Existence of relays and disconnecting switches	No relay and disconnecting switch in 33% of power stations
Presence of lightning arresters	No existence totally

Source: JICA Master Plan Study for Rural Power Supply, Sample Survey, July 1999

As the result of sample survey, it is found that the distribution lines are deteriorated, many poles are declined and many insulators are damaged. If this situation is kept intact, some problems are expected to occur in the stable power supply within five to ten years. In order to avoid the problem and keep the steady power supply, rehabilitation or renewal of the distribution system, starting from the most deteriorated part, is essential.

Besides that, there is no any protection on the distribution system against the lightning surge, which proves the reason of frequent reports of generator faults due to incoming lightning surge.

The records of generated energy and sold energy are usually needed in order to work out the distribution losses. According to the inventory survey, four Sum centers adopted a charge-on-metering tariff system and have more than 80 % installation of watt-hour meters.

Table I.7.5-2 shows the distribution loss rates of the four Sum centers.

Table I.7.5-2 Distribution Loss Rates

Sr.No	Aimag Name	Sum Name	Generation (kWh)	Sale (kWh)	Loss (kWh)	Loss Ratio (%)
1	UMNUGOBI	TSOGT-OVOO	191,600	84,855	106,745	55.7
2	SUKHBAATAR	TUMENTSOGT	200,478	182,252	18,226	9.1
3	UVURKHANGAI	NARIINTEEL	529,200	500,000	29,200	5.5
4	ZAVKHAN	BULNAI	856,000	727,600	128,400	15.0

Source: JICA Master Plan Study for Rural Power Supply, Inventory Survey, December 1998

The distribution loss rates in the above table are uneven. There is no other choice but to suppose the average distribution loss rate of the target Sum centers. Because distribution loss rates in the developing countries rise to the 30 % level in many cases, the average loss rate of the target Sum centers seems to be 20 to 30 % considering the loss rates of the four Sum centers. Besides that, it can be supposed that the voltage drop is extremely high since the low tension distribution lines extend far long over some kilometers.

7.5.3 Watt-hour Meter

The result of sample survey shows that 80 % of Sum centers, 12 Sum centers out of 15, have watt-hour meters for domestic consumers. However, a power tariff is collected based on meter reading in just one Sum center out of 15. The reasons why a meter rated tariff system is not applied in many Sums are mentioned below:

- It is difficult to collect tariff appropriately based on meter readings (7 Sums)
- Reliability of meter is low (3 Sums)
- Job for tariff collection increases, like meter reading, by applying a meter rated tariff system (2 Sums)

As mentioned above, many Sums attribute not applying a meter rated system to the difficulty of collecting tariff by meter reading. However, judging from the present situation of power supply operation, especially from the financial condition, it seems that the actual reason is to avoid a job increase for the tariff collection work.

7.6 Power Demand and Tariff System

7.6.1 Current Status of Power Demand

The residents in the Sum centers received unlimited power supply during the socialist regime for a nominal price. The residents have owned a number of electric appliances including refrigerators, electric stoves, and irons since prior to 1990. Similarly factories and public facilities own a number of electric appliances that are left idle. The power demand in the past was only sustained with a large dose of subsidies and cross-subsidies during the socialist regime and cannot be sustained under the capitalist regime. The demand under the capitalist regime is determined by the interplay of the purchasing power of the user and the power tariff set by the supplier.

The provision of the services for BHN is the vital element to sustain a community. However, these public services have deteriorated in quality due to lack of access to a continuous supply of electricity. There have been projects aimed at restoring access to electricity by solar power systems and portable diesel generators. However, it is rather rare to see the installed equipment operating properly due to lack of expertise at BHN institutions. It is more desirable to let these BHN institutions concentrate on their core services instead of power generation. In other words, the Sum centers need to re-establish a power supply system itself instead of implementing a piecemeal solution.

The Sum center office is the center of the exchange of information for rural people. However, the administrative function of the Sum center offices is limited due to lack of access to electricity. Though some Sum offices have a computer, copier, and facsimile, it is difficult to produce official documents at Sum centers without access to electricity.

Among 78% of the project Sums the population showed some increase between 1992-1997 whereas 50% of the Sum centers showed some increase during the same period. However, during the last 2 years between 1997 and 1999, only 58% of the Sums and 35% of the Sum centers showed any increase in the population. In other words the decrease in the population is becoming more predominant in the project areas. It is no longer the case to see a flow of migrants from the urban areas to rural areas as was the case after the collapse of the socialist regime. Rather, the rural areas, Sum centers in particular, have become the supply center of migrants once again. The phenomenon is synonymous to the loss of attractiveness of the Sum centers as a population concentration. Most of the Sum centers lack in power supply during summer and hence, do not offer readily available access to information through TV or telephone. This precipitates the depopulation of the Sum centers which leads to the decrease in power demand.

7.6.2 Tariff Collection

The most rational way of collecting electricity charge is to use wattmeter which almost all the users stated their preference to. However, the majority of the Sum centers collect electricity charges with fixed tariff system on a monthly basis. The Sum centers that use meters comprise 12.1% and those which only use meters are 5.2% of all the Sums. The use of meters for the public facilities is 20.8% and 17.9% for those with some use and exclusive use, respectively. The installation of the meters is higher than these figures. Among the 69 Sums with the available data, those with more than 80% installation comprise 25% and those with more than 60% comprise 68%. During the socialist regime, the majority of the Sums were equipped with meters, indicating a large setback in electricity supply at the Sums. In view of demand forecast, the lack of meters implies no availability of power consumption. Thus it is possible to use the data from the Sums which use a meter rated tariff system for the purpose of demand forecast.

Ways of Collecting the Tariff to the Targeted Sum Center are investigated as follows.

Table I.7.6-1 Ways of Collecting the Tariff to the Targeted Sum Center

	Household		Public facilities	
Use of Meter	21	12.1%	36	20.8%
Meter only	9	5.2%	31	17.9%
Meter/fixed charge	12	6.9%	5	2.9%
No Use of Meter	152	87.9%	137	79.2%
Total	173	100.0%	173	100.0%

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

7.6.3 Impact of Meter Rated Tariff Collection on Power Demand

Meter rated tariff collection has a much larger impact on power supply management than just the collection of accurate data on consumption. Meter measurement is synonymous to volume based tariff, and offers a strong incentive to the users to avoid unnecessary use of electricity. In the Mongolian society where power is in short supply, energy saving is the most economical way to meet the power demand. In that respect, the conversion to a meter rated tariff system is the first measure to be taken and it is regarded as a prerequisite prior to any new investment. However, it is necessary to show that there is a substantial merit in the conversion.

There was one Sum center within the samples of the Sample Survey that adopted both the meter rated and fixed tariff systems. In this Sum center the users were given a freedom to choose between the two systems. Some users would change the tariff systems within one season. The following table shows the outline of the tariff system in this Sum center.

This Sum center reduced the tariff in February across the board. The results of revenue collection in November 1998 and February 1999 are as shown in the following Table I.7.6-2.

Table I.7.6-2 Tariff System in Sum A

Type	November	February	Unit
Fixed Fee A	6000	4500	togrug/month
Fixed Fee B	3000	2250	togrug/month
Meter	150	120	togrug/kWh

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

The average consumption by user category is shown in Table I.7.6-3.

Table I.7.6-3 Estimated Average Power Consumption by User Category

kWh/household·month

Fee Category	November	February
Overall	62	47
Metered consumption	19	20
Fixed payment consumption	90	60

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

From the total tariff payments and power consumption, the average tariff that each user paid by the user category per unit power consumption reveals a large difference by the user category as shown in Table I.7.6-4

Table I.7.6-4 Tariff per kWh by User Category

Unit: Tg./kWh

Fee Category	November	February
Total Generated Power	78	80
Estimated Distribution Loss	0	0
Public and business sector consumption	200	200
Metered consumption	138	115
Fixed payment consumption	51	55

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

From the data, the fixed tariff users consume 3-4.5 times more than the metered users. In this Sum center, the freedom to choose the tariff system allows large volume consumers to turn to the fixed charge. Thus a simple comparison ignores the bias in the analysis. On the other hand, the households in the two categories do not have significant differences in income or ownership of electric appliances. In Sums the change of the systems should lead to a substantial reduction in power consumption.

7.7 Market Base Small Photovoltaic (PV)-Wind Generation Systems

(1) Photovoltaic Power Generation System

The results of the inventory survey showed that the PV power generation is being used in 73 out of 173 targeted Sums. In these 73 Sums, it was found that 109 PV generation systems are being used. Figure I.7.7-1 shows the number of PV generation system installations by Aimag. Arkhangai Aimag has the highest number of installations at 25, including the 21 systems installed at the time of the NEDO field demonstrative research project. Zavkhan Aimag has the next highest number, with 19 installations, and it was found that most Sums in the Aimag are using these. Figure I.7.7-2 shows the number of PV system installations by user facility. A majority of 43 systems are being used for telecommunications, followed by 27 for private use, 25 for hospitals, 9 for schools, and 5 for other purposes. Cases where it is unclear what type of facility is using the system are included in the category of 'other'. The inventory survey showed that breakdowns prevented the use of the systems in 10% or more of the Sums. The most frequent cause of breakdown related to the storage battery, accounting for 80% or more of such cases. Technical problems therefore include the maintenance and control of the storage battery, the procurement of an efficient battery charge/discharge controller and the procurement of new storage batteries once they reach the end of their life. A further problem is the failure of companies that sell small PV generation systems to ensure that trained people are stationed at the Sum center level to sell, publicize, and maintain the product.

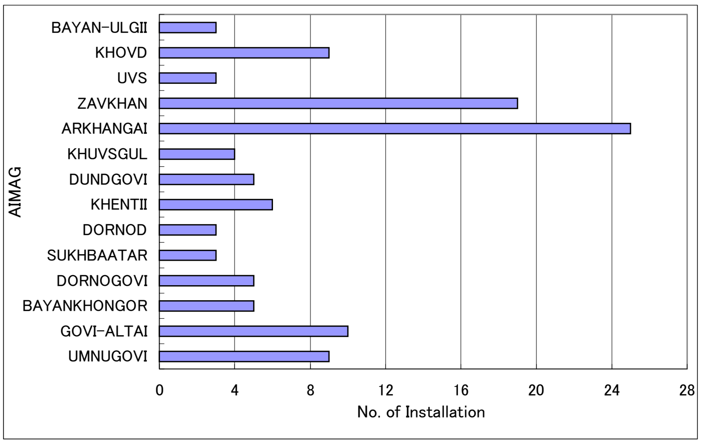


Figure I.7.7-1 No. of PV Generation Installation by Aimag

(Source : JICA Study Team Inventory Survey Oct. 1998)

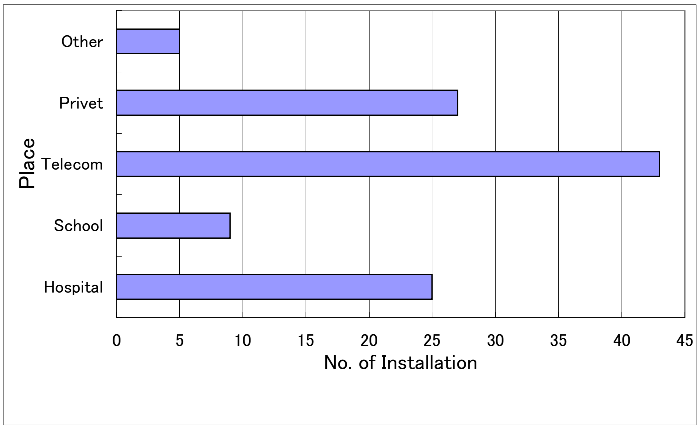
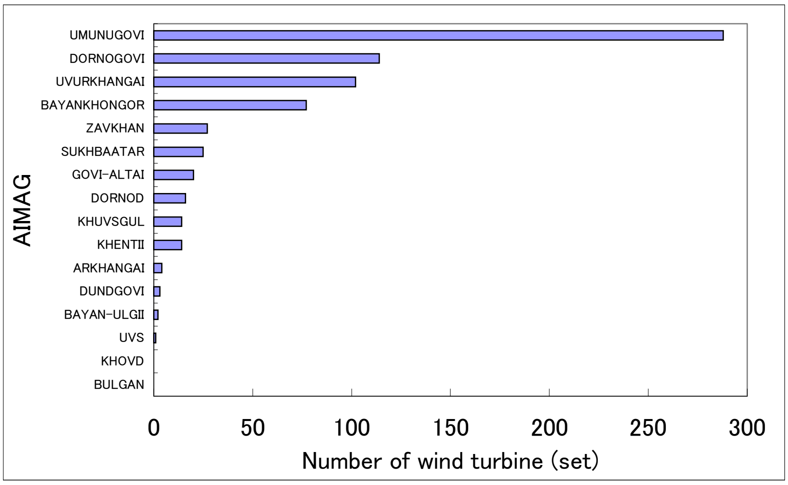


Figure I.7.7-2 No. of PV Generation Installation by Users Facility

As far as production is concerned, PV modules have been manufactured and sold in Mongolia since February 1998, but all the peripheral materials necessary for the production of module and PV generation systems are dependent on imports. Therefore, unless such goods are imported in large quantities in order to benefit from international prices, the unit cost will not decrease. In addition, once the necessary products have been imported, high Value-added Tax is charged at the point of sale, creating a large burden on the consumer. The high sales price therefore makes it difficult for the general user to purchase a PV generation system even if they have a need for one. Factors such as these slow down the introduction of small PV generation systems. In order to remedy this situation, government subsidies, soft loans, hire purchase systems, and so forth must be considered. Furthermore, public corporations selling PV systems need to ensure that adequate maintenance support is available at the Sum level. Currently, every company is making an independent effort to develop peripheral devices, which is exerting a strong influence on the introduction of small PV systems.

(2) Wind Power Generation Systems

The results of the inventory survey showed that 706 small wind turbines are being used in the Sums targeted. Figure 7.7-3 shows the number of small wind turbines by Aimag. Many of these are being used in the southern Gobi region. Umnugovi Aimag has the most, with 288, followed by Dornogovi Aimag with 114, and Uvurkhangai Aimag with 102. By contrast, it was found that small wind turbines are hardly used at all in the northwestern region, with Bayan-Ulgi Aimag having 2, Uvs Aimag having 1, and Khovd Aimag having none. Of the 706 wind turbines reported in the inventory survey, only 33 are installed permanently in the Sum. This shows that herdsmen are using many portable wind turbines. Further, it was found that Chinese small wind turbines account for 72% of the investigation results, with the use of Mongolian-made wind turbines low by comparison at 15%.



(Source : JICA Study Team Inventory Survey Oct. 1998)

Figure I.7.7-3 No. of Wind Generation Installation by Aimag

A problem of market base is the market place. The potential customers are herdsman families, who move around in remote places, making it difficult not only to sell the product but also to maintain and service it. Further, sales are restricted to the domestic market, which is limited. What is required is a distribution system that would enable users to purchase wind turbines and peripheral devices easily and in volumes that accord with their individual needs and financial resources.

7.8 Possibility of Demand Side Management

The generation pattern of renewable energy is not steady in general; only hydro generation can provide relatively steady power. It is difficult for renewable energy to follow the fluctuation of demand and perform efficient use of energy without large storage system or hybrid system with diesel generator. Therefore, Demand Side Management (DSM), which is the idea to control demand to meet the generation pattern, is especially important for renewable energy to be used in off-grid condition.

DMS is not intentionally applied to the power supply in the Sum centers at present. However, it was found that the potential demand in the daytime in summer is high; Sum residents are eager to use refrigerators and electric stoves for cooking in the daytime in summer. As solar power is higher in the summer season, the potential demand may meet with good potential of power supply. Then, the possibility of DMS is considerably high by means of making a good match of demand and supply. Besides that, shift of peak demand and creation of new demand are also effective way of DSM. In order to apply the peak shift and creation of new demand, it is important to strengthen tariff collection system and realize the actual needs of power in the Sum centers.

From the view points of peak shift and creation of new demand, the possibility to apply DSM to Sum centers is mentioned below.

(1) Shift of Peak Demand

The present peak time demand appears in the morning and/or evening. If this peak is shifted to the daytime or the time of strong wind, it is possible to utilize renewable energy efficiently.

The most effective way to shift the peak time of demand is to apply a lower tariff in the time of generation by renewable energy. In order to apply this method, the following will be the themes to be carried out.

- The tariff collection system shall be enhanced since the tariff system will become complex.
- A double rating energy measuring or the alternative of that shall be contrived and applied. For example, the energy from diesel generator in the morning and evening is charged on measured value by means of an energy meter, the energy from solar panels in the day time.

bypass the energy meter and charge based on a cheaper monthly fixed rate. In order to realize this, the reliable changeover switch must bypass the energy meter only in some designated period or in case of receiving the energy from some renewable energy sources.

- Solar power is generated in daytime. However, it is difficult to estimate the period of wind generation without reliable observation data of wind. The present available data of wind is the data from observations three times per day. It is necessary to observe wind 24 times per day and to obtain the precise data to apply the different tariff rate to wind power.

By executing the above, the peak power deems to be shifted to some levels. However, the actual needs of electricity for the domestic consumers exist in the morning and evening, and eventually there is a limit of value for shifting peak. For further control of power demand, it is one method for a battery to be installed in each consumer house as a consumer's property. As personal properties are usually maintained carefully and seriously, it is expected to alleviate the problem of maintenance compared with keeping battery at supply side.

(2) Creation of New Demand

For demand side management, creation of the following new demands are effective.

- Demand is not affected by intermittent power supply
  (such as pump up water, heating water)

- Demand meets generation pattern
  (such as washing and dyeing of wool and cashmere, timber work)

93 out of the 173 surveyed Sum centers have a pump for water supply including a hand-powered pump according to the inventory study. Since many Sum centers give a priority to water supply as a basic human need, the water supply is the promising demand for the new creation.

For creation of the new demand including the above, the following are key points.

- Finding of the essential needs of the Sum center

- Establishment of operation and maintenance organization after installation of facilities

- Existence of a competent entrepreneur in case for the creation of a new industry

7.9 Heat Supply

Photo I.7.9-1 Boiler House of Central Heating System (Naran Sum Center of Sukhubaatar Aimag)

There was a central heating system to supplying heat to all of the Sum centers in the time of socialism. One boiler house still exists in each Sum center without an exception. Photo I.7.9-1 shows the boiler house in Naran Sum center of Sukhbaatar Aimag. The central heating system is not working now in many Sum centers due to financial difficulty. According to the inventory study, the central heating system of 43 out of the 173 surveyed Sum centers is working. However, from the result of the said inventory study, there was no Sum center which answered that the heating means of domestic houses were central heating. Judging from the inventory study result and the actual situation of the boiler house observed, there seems to be a few Sum centers where the central heating system is working.

For the domestic houses, a usual stove to heat one room is utilized. For the school, hospital and the Sum office, besides the stove, the individual central heating system to heat each building is applied in many Sum centers. There are two kinds of systems applied to the individual central heating, one is a forced circulation system to circulate hot water by pump, and the other is a natural circulation system for the hot water to be circulated by heat convection. The natural circulation system is increasing these days because power supply is not steady and the payment of electricity tariff has become difficult.

Photo I.7.9-2 and 3 indicates the stove for a domestic house and the boiler of the individual central heating system (natural circulation), respectively.

Photo I.7.9-2 Stove

Photo I.7.9-3 Boiler for Individual Central Heating System (Natural Circulation)

The major problem of heat supply in the Sum centers is a lack of budget to purchase the fuel. Although dry dung can be used as fuel for the stove, the major fuel for the individual central heating system is coal and regionally firewood. Dry dung is available in Sum centers. However many Sum centers have to purchase coal and firewood and this cost becomes a heavy financial burden of the Sum centers.

One solution of the above is to utilize renewable energy. Solar heating is the most promising source of heating. The weather in the winter season is usually fine. Then it would be possible for houses to receive much heat from sunshine through large windows and conserve heat by increasing heat insulation and the airtightness of the houses. The most effective measures to increase heat insulation and the airtightness is to apply the high quality windows, high insulation and the airtightness. In the region where there is much potential for wind, the surplus energy of wind generation may be available for heating. The combination of the renewable energy and the boiler for the individual central heating will cause the reduction of fuel cost.

Geothermal is a suitable source for heating. But the potential areas are very limited and the geographical confinement exists far from the demand center. Therefore some contrivance, like using it as a greenhouse, is important for the effective use of geothermal energy.

7.10 Economic/Social Needs

In Mongolia where most of the population living in rural areas are nomadic, Sum centers play a very important role as a base for social services for nomadic households. In general, hospitals and schools in Sum centers are well equipped in terms of personnel and facility, but unfortunately due to the unstable electricity supply and the budget shortage in Sum offices, hospitals and schools are unable to utilize existing medical and educational equipment. This situation of deteriorating social services in Sum centers makes many households, especially young people, leave Sums and move to urban centers such as Ulaanbaatar.

If Mongolia aims at rural development, it has to improve social services in Sum centers as the first step, for which stable electricity supply is a prerequisite. In Sums which are not connected with the grid, Sum offices set electricity tariffs independently and collect tariffs from users to operate a power station. But many Sums are now facing the difficult situation in which they cannot supply sufficient electricity due to a remarkable rise of diesel oil cost.

In Sum centers, around 10-30% of households are poor households whose annual income per person is less than 15,000 Tg. Most of these poor households are pensioner's households, female-headed households, unemployed person's households and households with many children but little livestock. Their cash income is very limited, and they are surviving by relying on a small number of livestock they own or their relatives. Some Sum offices offer these poor households lower electricity tariffs or exemption of electricity tariff, but it is also important to implement income generation projects for these poor households to solve the poverty problem at its root.

Seventy-nine percent (79%) of the households interviewed answered that they were not satisfied with the services that they receive from the Sum center power supplies. The largest percentage of the complaints was that there was no electricity supply. With regard to the power supply hours, 81% of the respondents answered that they would like to have the hours extended. Table I.7.10-1 shows the answers to the questions asking which time period of the day the interviewee wanted to extend the hours if the extension hours are limited to 3 hours. For summer, there is a strong request for the night time extension as there is no power supply during summer in the majority of the Sum centers. Even for winter, the largest segment asked for night time extension. This is because the families are not being able to view TV during off-peak hours such as early in the evening for children's educational programs or late night movies. Forty-one percent (41%) of the interviewees requested winter morning time extension, because the families need light for breakfast preparation as the sun rises at 8 - 9 am during winter. For the summer, there is a substantial request for lunch time extension. There is a need for using electric stoves to avoid heating the rooms by burning fuel during lunch preparation.

Seventy percent (70%) of the interviewees answered that they were satisfied with the current tariff charges or can pay the bill even though they feel it is expensive. When asked for the maximum amount of contribution for the generator if it was broken down, households answered they are willing to pay 15,130 Tg on average. Table I.7.10-2 shows monthly willingness-to-pay for extension of power supply time, ranging from 4,945 Tg./month for summer night time extension to 6,873 Tg./month for winter 24 hours extension. This table reveals the tendency that people are more willing to pay for electricity in winter than in summer, and it is quite understandable since the night is longer in winter. Willingness-to-pay for extension of power supply time in summer night time is about 1,500 Tg. lower than that in summer 24 hours, and this balance is considered to reflect the value of power supply during the day time.

Table I.7.10-1 Time of Day Desired for Power Supply Extension

	Summer	Winter
Morning	19%	41%
Lunch Time	13%	11%
Night	68%	48%

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

Table I.7.10-2 Average Maximum Willingness-to-Pay Per Month

Unit: Tog/Month

	Average Maximum Willingness-to-Pay Per Month
Summer Night	4,945
Summer 24-h	6,563
Winter 24-h	6,873

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

CHAPTER 8
POWER DEMAND FORECAST FOR SUMS

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8.1 Outline

8.1.1 Approach For Power Demand Forecast

Tower consumption and output of the Sum centers are the most basic data necessary for the power demand forecast. However, as only few Sums use electric meters for tariff collection, there are no measurement data of electricity consumption in most of the Sums. Since the future power demand can be forecasted only with the measurement of the current demand, the first step is to estimate the current demand. As we have shown in 7.6.3, there is a large difference in power demand between meter-rated and fixed tariff systems. Therefore, the current demand needs to be estimated on two different tariff systems. From rational electricity supply system in the Sums in the future, it is imperative to adopt a meter rated tariff system. At present, the user is consuming a larger amount of power without feeling much benefit of it. Therefore, the future forecast of the power demand for the project Sums should be based on the use of the meters.

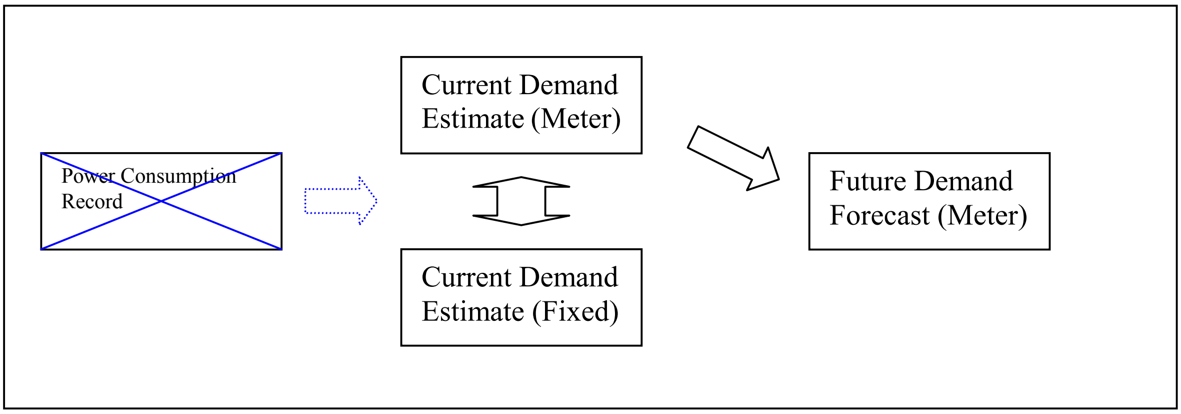

Figure I.8.1-1 Preconditions For Power Demand Forecast

In general, the consumption patterns of a household and business establishment are quite different. The demand estimate needs to be conducted separately for different type of users. According to our proposed plan in Chapter 10, the plan for the year 2005 mostly caters to the public facilities serving BHNs. Therefore, the power demand for the BHN service facilities needs to be separated. A comprehensive demand forecast should include the scope of future development in the Sum such as industrial development or rises in household incomes. However, the course of development and its potential differ among the Sums. As a common denominator, the introduction of water supply was incorporated into the future demand elements. The implementation of water supply will dramatically improve public health and contribute to the productivity of the Sums. In addition, the renewable energy sources have intermittence in supply, but the water supply can adjust to this deficiency by storing water. From a supply viewpoint, the water supply is very fitted to the renewable energy systems.

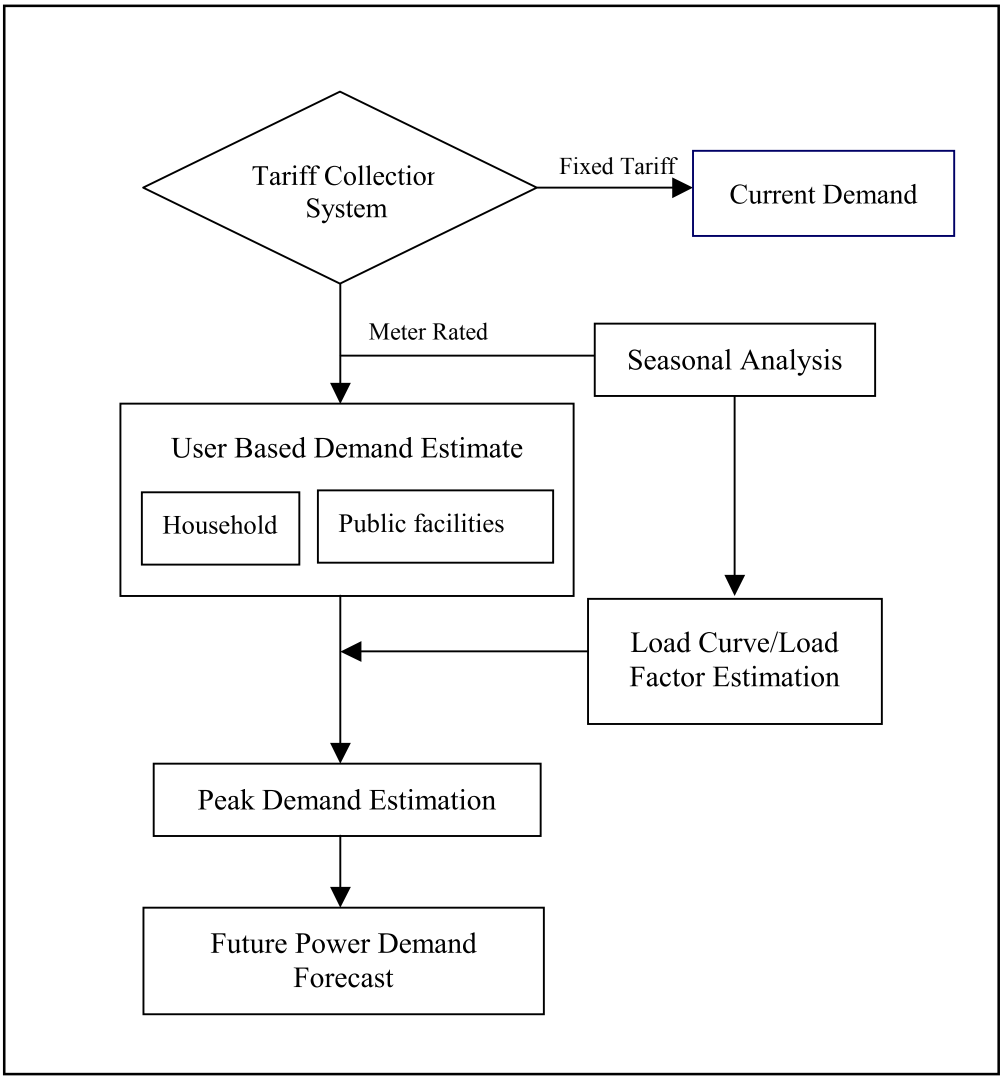

Figure I.8.1-2 Flow Chart of Power Demand Forecast

Currently, power supply is limited in the nighttime during winter. In other words, there is no data available for the operation of a power station for 24 hours throughout the year. Major seasonal changes in power demand arise not from changes in individual consumption pattern but from changes in the number of consumers. In general, the number of households at a Sum center reduces during summer as much as half the number during winter[*1]. The main reason for not supplying power during summer is economic as the per user cost of power supply increases dramatically. However, it is essential to supply power during summer in terms of the long-term development of the Sums. Therefore, it is also necessary to estimate the size of power demand during summer in the project Sums as well as in winter.

*1 The study here defines winter and summer as the following duration;

Summer : April 1 to September 30

Winter : October 1 to March 31.

Under the assumption of the adoption of a meter rated tariff system, it is necessary to estimate the current demand for 24-hour supply of power both during winter and summer. It is necessary to estimate the peak load in order to determine the capacity requirement for the power generation systems for each Sum. Figure I.8.2.-2 shows the schematic flow of power demand estimation to forecast.

8.1.2 Power Consumption Estimation

The demand function (electricity consumption) for the general household was derived from the database created from the Sample Survey. The demand function should be expressed as the function of price and income, but the data collected through the Sample Survey did not prove that income and price could not effectively explain the actual variations in consumption. Electricity is an essential commodity which is likely to show little sensitivity to price or income in terms of consumption. On the other hand, there was a strong correlation between ownership of electric appliances and electricity consumption. Therefore, the demand function that has been adopted incorporates the ownership of electric appliances as the variables. The Inventory Survey collected the data on the extent of the ownership of color TV, black & white TV, radios, lamps, electric stoves and others that exist in the Sum center. The Sample Survey covered a much wider range of ownership of appliances. In order to estimate the power demand of all the Sums to be covered, the data obtained in the Inventory Survey were given priorities. As a result the variables that have been selected are the ownership of color TVs and electric stoves. On an average, 80% of the households subscribe to electricity. The latent demand for power was estimated by assuming 100% subscription of all the households at each Sum center.

8.1.3 Load Curve and Load Factor

The load curve is derived from the operation hour records obtained through the Inventory Survey. The load factor is estimated from the electricity sales records and also annual operation hours for all the Sums during the Inventory Survey.

8.2 Current Power Demand Estimation

8.2.1 Estimation of Number of Households during Winter and Summer

In order to derive the power demand of the households during summer, it is necessary to incorporate reductions in the number of households during summer in addition to the reductions in power consumption by each household. In reality, in the majority of the Sums, there is no power supply during the summer. Therefore it is necessary to estimate the number of the household subscribers during the summer as well. The only available data at hand are the number of households during winter and summer. For the Sums that do not supply power, it is necessary to estimate the number of the household subscribers. The average subscription ratio of 0.7861 is applied to the number of the total households. For the Sums that do not supply during the summer, the subscription ratio of each particular Sum during winter is applied to the summer time.

The actual and estimated numbers of subscribers are summarized in Table I.8.2-1.

Table I.8.2-1 Summary of Household Users

Unit no.

	No. of Household		No. of Users	
	Winter	Summer	Winter	Summer
Average	250	169	197	128
Max	1,483	1,315	1,210	1,048
Minimum	72	30	22	24

8.2.2 Power Demand Estimation of Household

The following demand functions for winter and summer at Sum centers have been derived.

Winter

kWh = 22.36 x Number of Winter Households + 21.76 CTV + 4.7 HET

Summer

kWh = α [*1] x (22.36 x Number of Summer Households + 21.76 CTV + 4.7 HET)

kWh : Monthly kWh consumption at Sum center
CTV : Number of color TVs owned at Sum center
HET : Number of electric stoves owned at Sum center
α : Summer reduction parameter

The estimation for the current demand is based on the number of the subscribed households at each Sum center while the potential demand is based on the entire households. Table I.8.2-2 shows the summary of the demand estimates for all the Sum centers.

The monthly average power consumption of all the Sums at present is estimated to be 5,223 kWh during winter and 2,212 kWh during summer as shown in Table I.8.2-2. These figures are based on meter-based tariff collection; therefore they undercut the current demands that are based on fixed tariff systems. The potential demands based on the entire households at Sum centers are estimated at 6,690 kWh/month during winter and 2,952 kWh/month during summer.

*1 Please refer to the attachment for the derivation

Zamin-Uud has the largest power demand, followed by Tosontsengel while Erdenetsagan has the smallest power demand.

Table I.8.2-2 Household Power Demand Estimation for Sum Centers

unit:kWh/mo

	Current Demand		Potential Demand	
	Winter	Summer	Winter	Summer
Average	5,223	2,212	6,690	2,952
Max	38,885	26,947	40,857	26,947
Minimum	695	357	1,987	480

8.2.3 Power Demand Estimation for Hospital, School and Sum Office

This section analyzes the power demand of the users other than households. The power demand excluding general households is dominated by public facilities. Furthermore, hospitals and schools share the majority of the demand by the public sector. The unit consumption based on the capacities of hospitals and schools is estimated for each Sum. The basic assumption of the demand estimation is power demand based on a 24-hour operation. As there is no explicit capacity data in the Sum offices, all the Sum offices are assumed to be of the same capacity in terms of power demand. The unit consumption values are applied to the actual size of the facilities in each Sum and also the summer parameter derived from reduced hours of darkness during summer is applied to the winter power consumption. The estimated results are shown in Table I.8.2-3 and Table I.8.2-4 according to the size of the capacities.

Table I.8.2-3 Hospital, School, and Sum Office Power Demand Estimates (Winter)

Hospital	Range	Below 10 beds	10-20 beds	Over 20 beds	Average
	kWh/day	6.3	11.0	24.4	10.9
	Sample No.	52	104	17	173
School	Range	Below 400 students	400-600 students	Over 600 students	Average
	kWh/day	4.9	7.1	12.5	7.9
	Sample No.	50	78	46	174
Sum Office	Range	-			
	kWh/day	2.0			

Table I.8.2-4 Hospital, School, and Sum Office Power Demand Estimates (Summer)

Hospital	Range	Below 10 beds	10-20 beds	Over 20 beds	Average
	kWh/day	4.7	8.1	18.0	8.0
	Sample No.	52	104	17	173
School	Range	Below 400 students	400-600 students	Over 600 students	Average
	kWh/day	3.0	4.4	7.7	4.9
	Sample No.	49	78	46	173
Sum Office	Range	-			
	kWh/day	1.4			

8.2.4 Power Demand For Water Supply

Based on the household interview survey database, water consumption per person was set at 40 L/day in winter and 50 L/day in summer. The specifications of the pump were the pump head: 30 m, efficiency 60%. In general, Sum center residents travel to a remote water source such as a river. The average distance is around 1 km but there are many Sum centers farther away. Therefore it was assumed that 84 Sum centers within one km distance to the source will have access to running water by the year 2005 and 128 Sum centers within two km distance by the year 2010 and all by the year 2015.

8.2.5 Other Power Demand

There are a number of service facilities at the Sum center that require power supply besides households and BHN facilities. Those are veterinary hospitals, shops and restaurants. The power demand from these facilities is not negligible. Therefore, the same sample used in 8.2.3 was used to estimate the power demand since these facilities differ among Sum centers in number and size. Therefore, the demand was averaged per household. The estimated power demand was 4.4 kWh/household/month.

8.2.6 Power Demand under Fixed Tariff System

The demand estimation under the fixed tariff regime is synonymous to the estimation of the current power consumption. However, the fixed tariff regime is not an acceptable practice as mentioned in this chapter.

The Year 2005 plan includes the installation of watt-meters under the meter-rating regime. To analyze the economic and financial impact of the meter installation, it is necessary to measure the reduction in electricity saving between two tariff regimes. To simplify the estimation, the peak demand at each Sum center is estimated from the current available capacity of power supply[2]. After deriving the peak

[2] Using the supply capacity as the peak demand is a crude approach in theory. However, in most sums, overload during peak

demand from the demand estimated with meter-rating, the ratio of the peak demands between fixed and meter tariff systems is calculated. The estimated ratio is 1.5 on the average. The ratio is lower than the value estimated in 7.6.3 but is a conservative and robust value.

8.2.7 Estimation of Load Factor (Load Curve)

There is no power station in the Sum center that has a kWh meter to monitor the output continuously. The generator has a kW meter but no Sum center power station records the output level continuously. During the Sample Survey there was no Sum center that had power supply, as summer season is usually off-season. The load curve of the central grid system may be available but does not reflect the totally different demand pattern comprising of large segments of business and manufacturing in urban areas. Hence it is not accurate to apply the central pattern to the Sum power system. The only available data at hand is the data on the current and past operation patterns. The data basically rely on the memories of the operators at the power station, but the accuracy is rather high as it is repeated every day. However, the operation pattern is not equal to demand pattern as the generator is at work during the daytime without full needs.

The actual load factor level was estimated from the Inventory Survey data. The sample Sums were drawn according to the criteria of having meters for public facilities and other users (33 samples) based on the reliability of the data. From the sales and tariff rates, kWh consumption can be calculated. The division of kWh consumption by the annual operation hours and the operating capacity arrives at the load factor of the power station. The estimated load is 0.2 (Please refer to attachment.) The load curves for weekdays and holidays during winter and summer are derived from actual operation hour records to maintain the consistency with the estimated load factor of 0.2.

hours is universally common. Therefore it will be a conservative estimate.

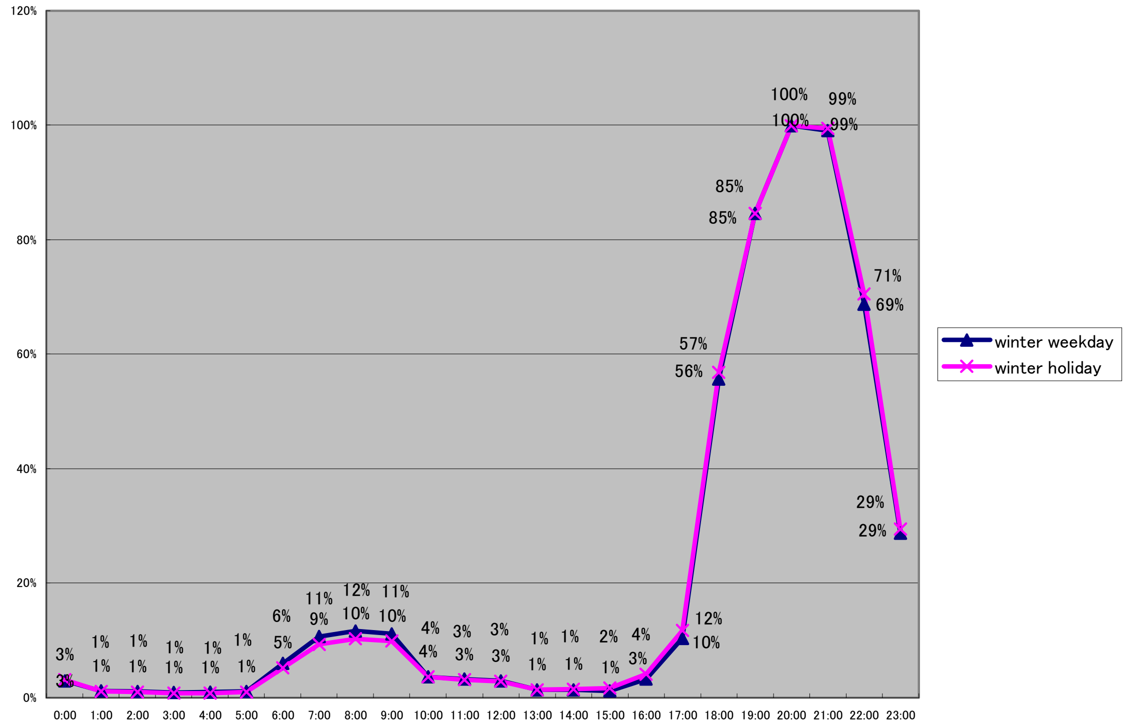

Figure I.8.2-1 Estimated Daily Load Curve of Sum Center (Winter)

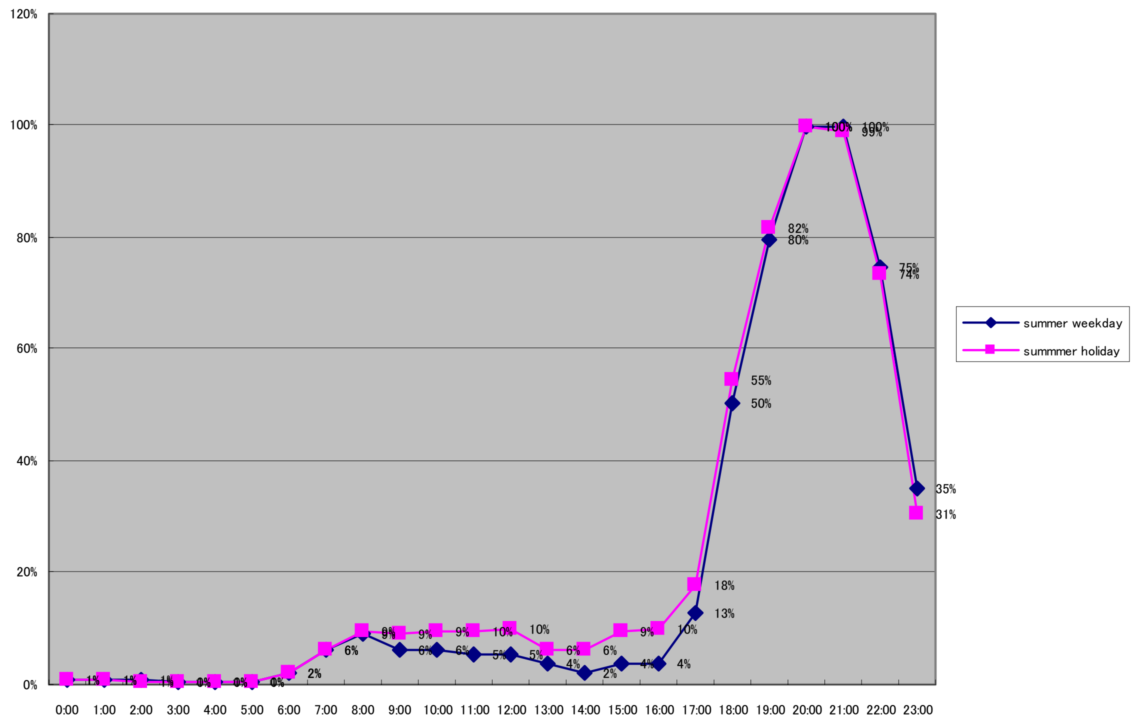

Figure I.8.2-2 Estimated Daily Load Curve of Sum Center (Summer)

8.3 Power Demand Forecast for Sums

Future power demand relies on the changes in population, increase in incomes and rate of electrification. As is mentioned in the section I.3.6, the population size of the Sum centers is changing rapidly. The majority of the Sum centers are on a decline and yet some Sum centers are on the rise. There are many social factors such as access to the market that contribute to the population changes. Definitely the deterioration of the social infrastructure is making the Sum centers less attractive to the rural population.

The assumptions for the future power demand forecast are as follows; 1) The current demand will persist in the year 2005, 2) by the year 2010, the electrification ratio would reach 100% from the current level of 80% on the average. 3) For the demand forecasts of 2015 the changes in population would manifest to some extent. For the Sums centers that showed a decline in its population for the last 2 years they would stop losing its population, i.e. 0% growth. For the Sums that showed smaller population increase during the last 2 years than during the 1992-1997, they would continue the population growth rate of the last 2 years with the upper ceiling of 10% per year. For the Sum centers that have a faster population growth for the last 2 years than the previous 5 years, they would have an averaged population growth of both periods with the upper ceiling of 10% per year. Figure I.8.3-1 shows the average monthly power consumption forecast during winter at the Sum and Figure I.8.3-2 shows that in summer. Table I.8.3-2 is the summary table of the forecasts.

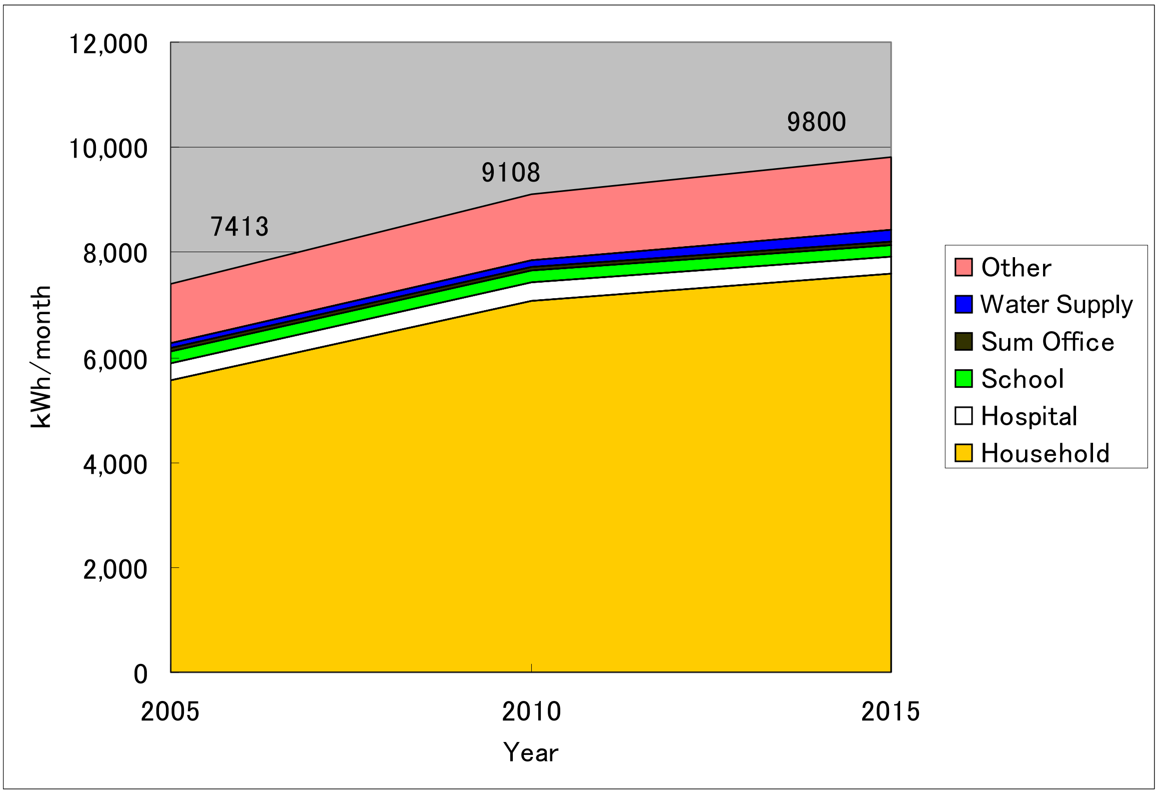

Figure I.8.3-1 Sum Average Monthly Power Demand (winter)

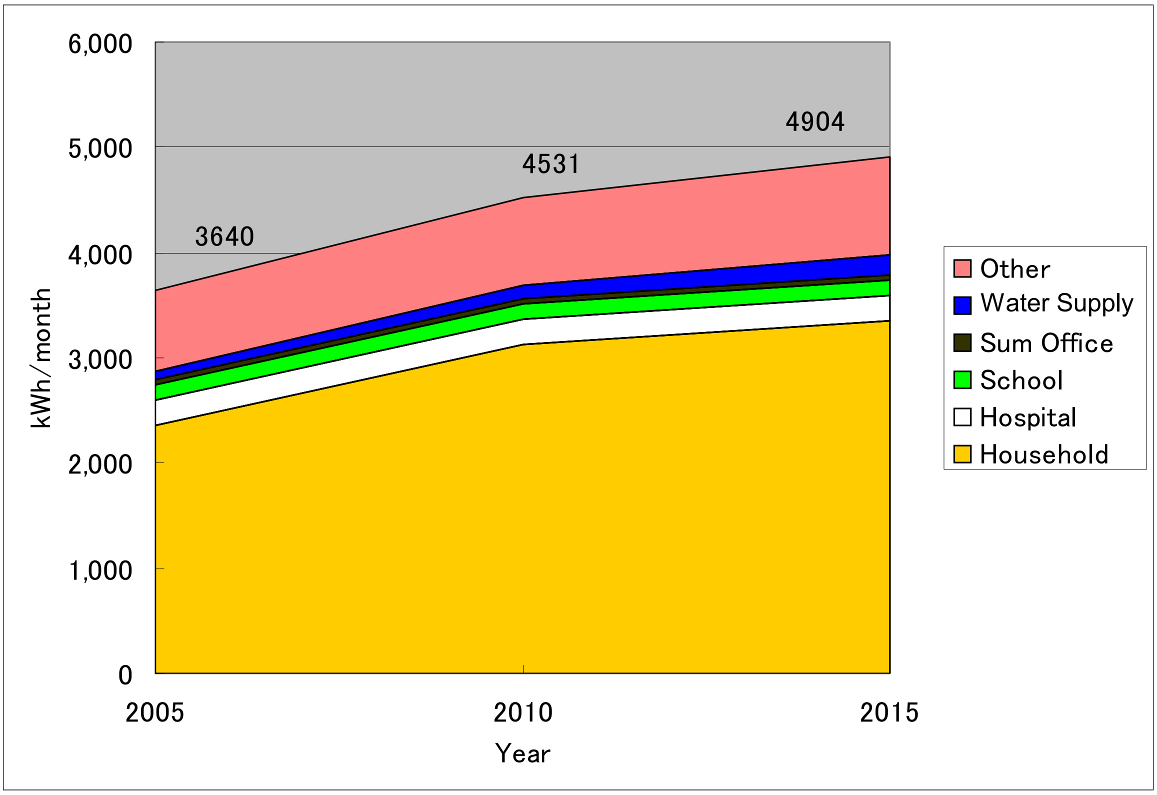

Figure I.8.3-2 Sum Average Monthly Power Demand (summer)

Table I.8.3-2 Sum Average Monthly Power Demand Forecast

Unit: kWh/month

			Household	Hospital	School	Sum Office	Water Supply	Other	Total	BHN
2005	winter	total	960,818	56,678	40,941	10,380	14,957	198,693	1,282,467	108,000
		average	5,554	328	237	60	86	1,149	7,413	624
		max	49,628	2,160	893	60	676	6,465	56,909	3,113
		min	695	43	50	60	0	198	2,954	261
	summer	total	407,761	41,722	25,258	7,266	13,874	133,895	629,775	74,246
		average	2,357	241	146	42	80	774	3,640	429
		max	34,392	1,590	551	42	1,167	6,560	41,512	2,183
		min	357	32	31	42	0	65	847	184
2010	winter	total	1,227,137	56,678	40,941	10,380	24,033	216,502	1,575,671	108,000
		average	7,093	328	237	60	139	1,251	9,108	624
		max	52,145	2,160	893	60	918	8,251	61,212	3,113
		min	2,431	43	50	60	0	198	3,436	261
	summer	total	541,826	41,722	25,258	7,266	22,316	145,416	783,803	74,246
		average	3,132	241	146	42	129	841	4,531	429
		max	34,392	1,590	551	42	1,208	8,373	43,324	2,183
		min	480	32	31	42	0	65	952	184
2015	winter	total	1,312,933	56,678	40,941	10,380	35,932	238,564	1,695,429	108,000
		average	7,589	328	237	60	208	1,379	9,800	624
		max	66,552	2,160	893	60	1,439	10,531	79,337	3,113
		min	2,730	43	50	60	0	198	3,573	261
	summer	total	580,172	41,722	25,258	7,266	34,343	159,671	848,432	74,246
		average	3,354	241	146	42	199	923	4,904	429
		max	43,894	1,590	551	42	2,610	10,686	57,749	2,183
		min	480	32	31	42	15	65	952	184

8.4 Demand Side Management Plan

Electric power is consumed synchronously with generation by its nature. At present, a generation is usually controlled to meet the fluctuation of demand. This is generation side management. Recently, it has become conspicuous that the control at the generation side is not economical. Under the circumstances, the idea to control demand, namely, demand side management is being noted.

Renewable energy, of which generation is intermittent in its nature, has the difficulty of controlling generating power. Therefore, the demand side management plays an important in efficient energy use.

As an effective measure of the demand side management in this Master Plan, (i) energy use synchronized with the generation pattern, (ii) peak shift, (iii) creation of new demand is explained in the next chapter.

In connection with the demand forecast, only the new demand for pumping up water is incorporated in the forecasted demand because the effect of DSM usually appears as leveling of load and it is difficult to forecast the practical increase of load by means of DSM.

(1) Education and Enlightenment

Education and enlightenment to the consumers focusing on the following themes is effective for the dissemination of DSM.

1) Understanding a generation pattern of renewable energy
2) Learning the technology and way of energy use in line with generation pattern

Power should be supplied to hospitals, schools and Sum office by renewable energy by 2005 and to all the consumers in 2010 through 24 hours with batteries and to all the consumers in 2015 by fuel cell and hydrogen system. It is effective for reducing charge and discharge losses of batteries and production and storage losses of hydrogen to consume the power simultaneously with generation.

For example, it is easy for the Sum people to learn through educational seminars that work involving electric appliances, such as washing with electric washing machines, press with electric irons, cooking with electric stoves, should be done in the daytime. However, it is difficult to control the load of refrigerators because of continuous load. It was found that refrigerators are a large potential demand in the summer season. One measure can be proposed for solving this problem, which is to make ice in the daytime using solar power and to keep the refrigerator cool with the ice. Such technology transfer is available through the seminar for the efficient use of energy.

(2) Shift of Demand (Battery Charging Station)

The battery charging station is proposed in Sum centers as an effective measure to shift the demand.

By the system in the stage 2005, the power will not be supplied to domestic consumers in the summer season if the diesel generators are not operated. According to the inventory survey and the sample survey, it is expected that no power will be supplied to domestic consumers in many Sum centers. On the other hand, the irradiation in the summer season is high, so the surplus energy from PV panels is much expected.

For the effective use of this surplus energy for TV or lighting, domestic consumers, if they want, may possess a battery and inverter. The batteries and inverters are purchased by the applicant consumers with their own money. A simple charging station is prepared and operated by Sums in each Sum center. The users bring their batteries to the charging station in the daytime, pay the charging fees and charge the battery by the power from PV panels and wind generators. The batteries feed the power to TV or lighting in the houses in the nighttime. This means the shift of demand viewing from the distribution system.

As the charging fees are able to be surely collected in this way, this plan financially supports the management of power supply in the Sum centers. The people's wishes for watching TV are very high and some of the Sum people possess portable generators mainly to watch TV. Therefore, it is expected for the people to purchase batteries and inverters on the market basis.

A 24 hour power supply in the summer season is the power supply level in the stage 2010. Although the people receive power at home in the nighttime, the battery charging system is still effective considering charging and discharging losses.

Figure I.8.4-1 shows the generation pattern of PV system and the demand pattern of domestic consumers.

Major load during peak time is lighting and television, and it is difficult to shift this load to another time slot. The recommendable measure to shift this load is to construct the charging station and set the batteries and inverters in the consumers' houses. In this case it is necessary to set the charging tariff lower than power tariff of the distribution

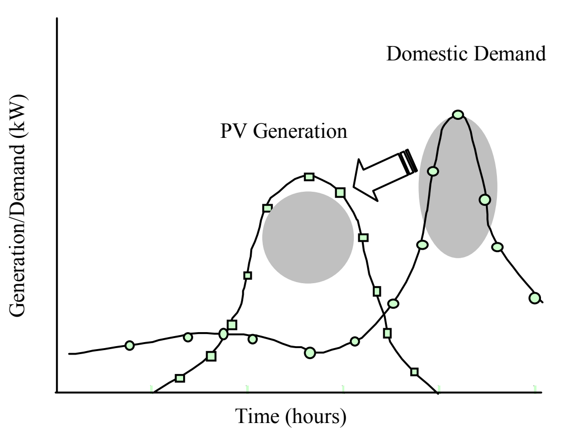

Figure I.8.4-1 Pattern of PV Generatior and Domestic Demand

system to keep the incentive for using the battery station.

(3) Creation of New Demand

Creation of new demand is also an effective measure for DMS. The nature of the new demand are mentioned below:

- Demand in the off-peak time (day time) (industrial demand such as lumbering, grain mill or washing wool)
- Demand not affected by the intermittent nature of renewable energy (demand such as water pumping or heat water supplying)

It was said by a large number of Sums that stable power supply is essential for the activation of industry. Although it is difficult to say that the industry in Sum centers can be activated only by a stable power supply, it is sure that a stable power supply is a vital factor for activating industry. Therefore, there is a high possibility of increase in the industrial demand.

94 out of the 173 target Sum centers have manually driven water supply pumps. Almost all of the Sum centers give high priority to water supply as BHS. If the water pumped up is reserved in a tank, this load is promising, as the demand is not affected by the intermittent.

CHAPTER 9
DEVELOPMENT PLAN AND TREND ON INTERNATIONAL ASSISTANCE AGENCIES

CHAPTER 9 DEVELOPMENT PLAN AND TREND ON INTERNATIONAL ASSISTANCE AGENCIES

9.1 Economic Development Plan and Donors

There is no long-term development plan in Mongolia such as five-year development plans. UNDP and USAID have been giving technical assistance in the field of public administration as well. However, the angle of this assistance is more focused on single objective programs such as "Promoting Democratization", "Decentralization", "Privatization", and "Governance." The transition from a planned economy to a market based economy has not been easy. The facilities granted by Russia are nearing their retirement or need rehabilitation badly. The lack of finance is making even the maintenance of the existing facilities difficult. Under such circumstances it has not been possible to establish a forward looking development plan but the projects have been formulated on an ad hoc basis to meet the urgent needs arising at this time.

9.2 Social Development Plan and Trend of International Assistance Agencies

(1) Education

The most important development plan in the education sector is the master plan of educational reform prepared under the assistance of Asian Development Bank (ADB). The master plan determines specific priority programs in major educational categories; basic education, higher education, vocational education, social education, educational management, and personnel training system. The Ministry of Education announced to implement the specific programs from now on, based upon the master plan. But they did not examine the contents of the master plan sufficiently and have not achieved a consensus in detail yet within the Ministry. For example, the master plan suggests expanding the years in primary education, while the number of years in Mongolian primary education was decreased from six to four. This shows that the government has not approved even the basic direction of the master plan yet. The problem stems from poor ability of planning and implementing a policy and lack of coordination within the Ministry. Another problem is that the educational policy is changed every time when the political regime changes. Thus the lack of a uniform educational policy makes teachers lose confidence in giving lessons. At present, many educational projects carried out by international donors are sort of an emergency measure. They tend not to be coordinated mutually with each other, thus they fail in giving systematic assistance in the education sector.

First, it is necessary for the Mongolian government to achieve a national consensus, by thorough discussion with national people, scholars, and professionals, about the fundamental problems such as desirable educational system for the herders, the way to revive vocational education, and the measures to recover the confidence in the value of education. Based on the consensus, the government should revise the master plan of ADB, call donors, and carry out the plan through well-coordinated cooperation among donors.

(2) Medical Service

In health and medical services, there is no master plan such as that of education. Among donor agencies, they have agreed to shift the focus to primary health care in rural areas from specialized medical services in urban areas. The policy to replace assistant doctors with family doctors along with the abolishment of assistant doctor training contributes to the improvement of the quality of primary health care. It is also proposed to put more stress on prevention through health education and periodical physical checkups than on treatment.

The most serious problem that the Ministry of Health has is its financial difficulties. The Ministry expects to expand its medical service by involving the private sector. The private sector includes not only general practitioners specialized in western medical care but also those of traditional Mongolian medical care. After the shift to democracy, as various Mongolian cultures have been revived, traditional Mongolian medical care has been rapidly appreciated. Traditional Mongolian medical care is based on various ethnical medical cares such as Tibetan medical care, Ayurveda in India, Chinese medical care, and traditional medical care of the Uighur people. It has been changed and developed uniquely, meeting the natural environment of Mongolia. In recent years, the government established the Mongolian Traditional Medicine Corporation under the Mongolian Scientific Academy in order to give positive support for the revival of traditional medical care.

In the Alma-Ata Declaration, which was resolved by the World Health Organization (WHO) to promote the primary health care, the importance of the traditional doctors who practice traditional medical care are emphasized, because they often are the health workers closest to the local people. In primary health care from now on, it will be necessary to find out the successors of traditional medical care, which is mainly kept in rural area, give them re-training, and make them responsible for primary health care.

9.3 Power Development Plans and Donors

The power sector is not an exception to the lack of long term plan either. There is no long term plan or industrial master plan. The only official document to base an investment on is the Energy Law. It only indicates the possibility of privatization but does not define concrete policies. As a general policy the government has announced that 20% of the public investment will be allocated to the power sector. The current ruling party has made an election commitment to the construction of transmission line extensions to 40 Sums between 1996 and 2000. However, the actual implementation has been limited to 4-5 Sums per year. As an usual practice, 10 Sums are listed in the budget in the beginning of the year for implementation but lack of finance always limit the actual implementation to less than half. The commitment needs to be discounted to some extent as an official one.

9.3.1 Power Development Plans and Donors

The major projects in the power sector are the loan projects by Asian Development Bank (ADB), the survey and planning projects by TACIS and USAID and also grant projects by them. All the projects are located around Ulaanbaatar and Aimag centers and do not cover rural Sums, thus consistent and no overlaps.

The list of aid projects by other foreign donors is shown in Table I.9.3-1.

Table I.9.3-1 Foreign Aid Agency Projects

Agency	Project	Current Status	Period	Amount
USAID	1. Aimag Centers Diesel Power Power Plant Rehabilitation Plan (Phase I)	Completed	1997 - 1998	Grant
	2. Aimag Centers Diesel Power Power Plant Rehabilitation Plan (Phase II)	Completed	1998 - 1999	Grant
ADB	1. Ulaanbaatar Heat Supply Energy Efficiency Improvement Plan	Ongoing	1997 - 2002	Loan (US$40 million)
	2. Ulaanbaatar Heat Supply System Rehabilitation Plan	Planned	1999 - 2000	Loan (US$10 million)
	3. Ulaanbaatar Thermal Power Plant No. Rehabilitation Plan	On-going	1997 - 1999	Loan (US$30 million)
TACIS	1. Renewable Energy Plan (Weather measurement and demonstration)	On-going	1997 - 1998	Grant
	2. Mini-hydro power generation feasibility study	On-going	1997 - 1998	Technical assistance (Grant)
WB	1. Energy Project	Planned	1999 - 2000	Loan (US$ 3.5 million)
	2. Choibalsan Thermal Power Plant Rehabilitation Plan	On-going	1998 - 1999	Loan (US$ 3.5 million)
	3. Ulaanbaatar Distribution and Tariff Collection System Improvement Plan	On-going	1998 - 1999	Loan (US$17 million)
	4. 7 Aimag Center Diesel Power Power Plant Rehabilitation Plan	On-going	1998 - 1999	Loan (US$13 million)
Others GTZ (Germany)	Solar Energy Development Plan	Ongoing	1998 - 2005	Grant (US$3.5 million)
KFW (Germany)	Electricity Supply Remote Control System Plan	Ongoing	1998 - 1999	Loan (US$3.5 million)

9.3.2 Japanese Programs and Projects

The aid from Japan showed a dramatic increase in 1991 and has grown to be the largest among bilateral aids. The financial assistance to Mongolia from Japan started with 8.5 billion yen in 1991, 7 billion yen in 1992, 9.6 billion yen in 1992, 9.6 billion in 1993, 12.9 billion in 1994, 12.6 billion yen in 1995,10.7 billion in 1996, and 9.2 billion yen in 1997. Major cooperation from Japan was the financial aid for economic stabilization (import loan, non-project grant), humanitarian aid under financial crisis (food aid, food production aid), mid-term economic development infrastructure development grant and loan, development study and technical assistance. The cooperation projects undertaken in the power sector are listed as follows;

(a) Ulaanbaatar Thermal Power Plant No. 4 Rehabilitation Plan

JICA provided grants to the rehabilitation of No. 4 Thermal Power Plant. JBIC continued to finance the rehabilitation. In 1998 JBIC plans to sign a contract to re-finance the rehabilitation for this continuation. A summary of all the assistance programs is as follows;

Table I.9.3-2 No. 4 Thermal Power Plant Assistance Projects

Period	Amount (100 million yen)	Activities
1991	0.4	(Grant) Emergency repair equipment grant of repair tools of 11 categories such as oscillation meters, and AC electric arc welders.
1992 - 1995	20.0	(Grant) No. 4 Thermal Power Plant Rehabilitation Plan (Phase I) Anti-abrasion measures and environmental protection measures for powdered coal supply
1996 - 1998	11.7	(Grant) Thermal Power Plant No. 4 Rehabilitation Plan (Phase II) Equipment renewal for hot water supply, and equipment renewal for in-plant communication system.
1997 - 1999	44.9	(Loan) Heat Efficiency Improvement of No. 1-4 Boilers No. 1-4 True-false equipment

(b) Grass Root Grant Assistance

- Period : 1997 – 1998
- Requested Amount : 38 million yen
- Activities : procurement and installation of diesel generators
- Covered Sums : 4 Sums
- Installed Units : 60 kW 9 Units、100 kW 3 Units

(c) Sums Center Diesel Power Plant Rehabilitation Plan (Phase I)

- Period : 1997 – 1998
- Requested Amount : 297 million yen
- Activities : procurement and installation of diesel generators
- Covered Sums : 25 Sums
- Installed Units : 60 kW 46 Units、100 kW 12 Units

(d) Project for Rehabilitation of Power Plants of Sum Centers (Phase II)

- Period : 1998 – 1999
- Activities : procurement and installation of diesel generators
- Covered Sums : 45 Sums

- Installed Units : 60 kW 48 Units、100 kW 74 Units

(e) Project for Rehabilitation of Power Plants of Sum Centers (Phase III)

- Period : 1999 – 2000 (ongoing)
- Activities : procurement and installation of diesel generators
- Covered Sums : 25 Sums
- Installed Units : 60 kW 55 Units、100 kW 15 Units

9.4 Development of Renewable Energy Program and Movement of International Donor Agencies

USAID and TACIS have been conducting wind potential surveys in Mongolia. The target goal of the USAID project is create a wind map of Mongolia. TACIS has installed pilot plants that consist of wind, PV and diesel generators and is conducting pilot tests in three Sums. The three Sums have been selected out of five wind monitored Sums in the southern region of Mongolia and completed the installation work of pilot plants at the end of October 1999. Table I.9.4-1 shows the detail of pilot plants of the TACIS project.

Table I.9.4-1 Installed Power Generation System under TACIS Program

Aimag	Sum center	Pilot System	Pilot facilities
Bayankhongor	Bayan - Undur	Wind generator：4 kW x 2 No. Battery bank：3000Ah, 24 V	Hospital, School, Dormitory
Uvurkhangai	Guchin - Us	Wind generator：4 kW x 2 No. Photovoltaic array：500 Wp Battery bank：3000Ah, 24.V	Hospital, Dormitory
Bayankhongor	Bogd	Wind generator：4 kW x 2 No. Photovoltaic Array：840 Wp Battery bank：3000Ah, 24 V Diesel generator：6 kVA	Hospital

（Source：Renewable Energy Corporation (REC), October 1999）

The project on "Development of Renewable Energy" by Germany (GTZ) was launched September, 1999 as a technical assistance project to Mongolian government. The period of the project is 30 months and the purpose is to improve the level of local public welfare by using renewable energies. The main target area of this project is Zavkhan Aimag and their plans are to conduct the feasibility study of renewable energies for power plant and mini- hydro plants, to improve the quality of production, manpower training, introduction of the new technology and to create cooperation between the other international donor agencies.

A Japanese agency, NEDO (New Energy and Industrial Technology Development Organization) has conducted demonstration project from 1993 to 1997. Under the project 200 sets of portable PV systems (200Wp) were provided mainly to the Nomads to monitor their system operation. Renewable energy PV generation systems are provided to primary or secondary schools for the power source of audio visual equipment for education by grass root assistance of Japanese embassy.

9.5 Mini Hydro and Geothermal Power Plant Development Plan and Foreign Assistance

9.5.1 Mini Hydro Power Plant Development Plan and Foreign Assistance

(1) Development Plan and Planned Location

As discussed in the previous Section 6.4, Sum people living in the north-western region are requested to include the study of hydro power development in this Master Plan Study, as there are rich hydro potentials and suitable locations for the development in the north-western region. In the north-western region, as discussed in the previous Sections 2.5 and 2.6, energy density of solar and wind potentials is observed to be poor and it is not possible to generate the full power to meet the required power demand. To cope with the required power demand in the region the hydro power development study (Pre-F/S, F/S, detailed design, etc.) had been carried out by the foreign institutes. Regional economic development through industrialization is the desire of regional inhabitants and one of the government policies. It seems to be included in the Master Plan Study as the alternative potential of solar and wind potentials. However, the detailed study on mini-hydro power development should be performed separately.

(2) Current Situation and Issues on the Development

In the list of the prospective hydro power development plan, few projects have already been studied under the foreign financial and technical assistance on the basis of the master plan study on the hydro potential in the whole country made by the former Soviet Union (Russia). At present, there are lots of prospective projects for future development of which the projects have been confirmed to have sufficient hydro potentials but not studied in detail yet.

(3) Foreign Assistance on the Development

The Mongolian Government requested the financial assistance for the detailed design and construction to the foreign institutes for the implementation of few projects which have already been studied based on the project feasibility. The financial settlement for the project implementation has not been committed yet. As the most of the previous surveys of the projects had been completed several decades ago, review of the study is required for the project implementation.

9.5.2 Geothermal Power Plant Development Plan and Foreign Assistance

(1) Development Plan and Planned Location

For the development of the geothermal power plant, the Mongolian Government made a request letter to the Government of Japan for the development of a geothermal power plant in cooperation with NEDO (New Energy Development Organization), Japan in January 1997. However, the application document for the development of geothermal power plant has not been finalized yet internally. According to MOID, there are lots of prospective locations for the development of a geothermal power plant in Mongolia. NEDO recommended to take up two projects of geothermal power plant at the Chuluut hot spring area (Arkhangai Aimag) and the Shargaljuut hot spring area (Bayanhongor Aimag). In this application document, hot water of 45 ^{o}C and 90 ^{o}C is available at Chuluut and Shargaljuut, respectively.

(2) Current Situation and Issues on the Development

As discussed in the above paragraph, the development study for the geothermal power plant has not been implemented yet, though there are plenty of development potentials. The present situation of the utilization of geothermal resources is that the resources are utilized effectively for district heating and hot water supply. A key point for the development of geothermal resources for power generation plant that is the transportation system of hot spring water to the power plant and scale of the power generation plant are to be studied carefully.

(3) Foreign Assistance on the Development

As discussed in the above paragraph, the development study for the geothermal power plant has not been implemented yet.

9.6 Development Plans in Telecommunications Sector and Donor Assistance

The Law on Telecommunications, which was enacted in November 1995, is the principal legislation on the telecommunications sector in Mongolia. The Mongolian Telecommunications Sector Policy Statement was announced in September 1998 as the national policy. As for the long-term development plan, the Network Development Master Plan up to 2010 was determined in 1994 under the assistance from Asian Development Bank (ADB). For mid-term development, Network Development Plan (NDP) 1998-2003 was prepared by the Ministry of Infrastructure Development

(MOID). Table I.9.6-1 shows the development plans in the telecommunications sector which are now put into action or under review.

Table I.9.6-1 Development Plans in Telecommunications Sector (1998-2003)

No.	Project Name	Year	Source of Fund	Amount
1	Ulaanbaatar Telecommunication Network Expansion Project (E-10 Exchange)	1998-1999 (completed)	Mongolia (Public Investment Program)	3.5 M US$
2	Rehabilitation and Extension of Backbone Network Facilities for Western and Eastern Provincial Centers Project (Telecom 2 & 3 Project)	1998-2002 (on-going)	KfW, Germany	37 M DM
3	VSAT Project for Rural and Remote Areas in Mongolia (Selected 9 Provincial Centers)	1997-1998 (completed)	KfW, Germany	0.93 M US$
4	Establishment of Optical Fiber Transmission Network along Mongolian Railway	(on-going)	JBIC, Japan	17 M US$
5	Rehabilitation of Eastern Route's Backbone Network and Towns along the Eastern Network	(negotiating)	EDCF, Korea (negotiating)	14 M US$
6	Rehabilitation of the Government Telecommunication Network	(negotiating)	EDCF, Korea (negotiating)	5 M US$
7	Privatization of Mongolian Telecommunication Sector (Phase 2)	will start in March 2000 (8-9 months)	ADB and JBIC	1.04 M US$

Source: Ministry of Infrastructure Development (March 2000)

Based on the Law on Telecommunications in 1995, the policy-making body (MOID) and execution body (Mongolian Telecommunication Company) were separated, and the Communication Regulatory Commission (CRC) was established to give authorization for a private company's participation in the telecommunication sector and to coordinate the prices. In accordance with the privatization plan (the first phase), the Mongolian Telecommunication Company was divided into two organizations in 1995; the Post and Telecommunication Authority (PTA) for investment in telecommunication sector, and Mongolian Telecom (MT) for the supply and sales of telephone services. Both PTA and MT are expected to become self-financing organizations. PTA built telecommunication facilities and network systems by borrowing loans from foreign countries, and leasing them to MT. The Mongolian government has a 50% stock holding in MT and Korea Telecom 40%. MT had the exclusive right to provide basic telephone services such as telephone, facsimile and telex on December 31, 1998. MT's exclusive right for international telephone service was renewed until December 31, 2001. As for cellular phone services, Mobicom Corporation was given the exclusive right by December 31, 1998.

In the second phase of privatization plan assisted by ADB and JBIC, the Ministry of Infrastructure Development aims to merge PTA with MT again to form a new company named New Mongolian Telecom (NMT) for the exclusive supply of telephone services. Like Mongolian Telecom, the Mongolian government will have a 51 % holding in NMT and the rest will be put on the stock market. Korea Telecom which has a 40% holding in MT will acquire the equities corresponding to the evaluation of property value of MT and PTA. The second phase development plan was made in response to the review of the first phase results: management efficiency of PTA was not improved under the first phase plan. Since PTA has been running in the red, the plan intends to strengthen PTA's financial power through the merger, so that it can afford for payment of loans from ADB which will started in 1999.

Among the telephone businesses in Mongolia, international operation and local operation within Ulaanbaatar city has been making a profit. On the other hand, local calls and long-distance calls in rural areas have suffered huge deficit. Thus the telecommunication services in rural areas is supported by income gained through local service in urban areas and international operation. This system which allows cross-subsidy is one of the reasons why Mongolian Telecom are permitted to monopolize the telephone business. At the same time, the exclusive operation prevents the company from improving the efficiency of management. There are some who insist on increasing the charge of international calls for the improvement of all telecommunication services. The idea, however, seems to be difficult to implement, because it will probably negatively affect the investment in Mongolia by foreign companies. In 2002, the private sector will be permitted to enter into the international telephone market and the price competition will reduce the charge of international calls. Because MT's profit will decrease under the reduced charge of international calls, it is also anticipated that the cross-subsidy system to make up the deficit of telecommunication service in rural areas may not continue to work. On the other hand, there is another prediction that few private companies will enter into the international telephone market, because the market size in Mongolia is small and a considerable amount of the initial investment is required for starting the service.

At present, the Mongolian government is implementing the plan to complete the modernization of a network system which links with every Aimag Center via ground network or VSAT telecommunication satellite, using a loan from Germany. As for telecommunication service at the Sum level, no plan is designed so far, because the service at the Sum level is expected to make no profit. The entry into telecommunication service at the Sum level by private companies is not projected either.

Under the current situation that the privatization plan is promoted, there is little possibility that the telecommunication service at the Sum level will be improved in the near future. But, improvement of telecommunication service as well as electricity power supply is a prerequisite to the economic and social development for Sums, so it is necessary for the Mongolian government to put considerable efforts into improving the social services in Sum Centers. In the near future, it is highly expected that the innovative technologies including cellular phone and internet may be put into commercial use in Mongolia, and the cost for providing telecommunication services in rural areas will be reduced. Therefore, it must be useful to investigate the possibility of improving the telecommunication service in Sum Centers through introduction of various advanced technologies such the use of satellite.