DRAFT

A SUSTAINABLE ENERGY STRATEGY

MINISTRY OF INFRASTRUCTURE

GOVERNMENT OF MONGOLIA

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UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

DEVELOPMENT ALTERNATIVES, INC.

TABLE OF CONTENTS

A DRAFT SUSTAINABLE ENERGY SECTOR STRATEGY, 2002-2011

1. INTRODUCTION

1.1 Introduction

Energy has a vital role in economic and social development—it provides lighting in classrooms, refrigeration for medicines in hospitals, and heating for our homes. When electricity and fuels are efficiently available at reasonable prices, most people take energy for granted—and forget that it has a central role in business operations, government and our daily lives. But if the last three decades are any guide, when there are rapid energy price increases such as oil price shocks, the world then rediscovers the importance of energy as it finds itself entering an economic recession. The vulnerability of Mongolia's economy and energy sector to external shocks sets an important parameter for future development. Other parameters for the energy sector include the security of supply, energy efficiency, and energy fairness.

This chapter first presents socioeconomic characteristics of Mongolia. The following section discusses the purpose and objectives of the draft Sustainable Energy Sector Strategy, 2002-2011. The final section outlines the organization of the draft Strategy.

1.2 Socioeconomic Characteristics of Mongolia

Mongolia is a land-locked country in central Asia, with a total land area of 1,564 thousand square kilometers—the seventeenth largest country in the world. Its northern border with Russia is 3,485 kilometers and its southern border with China is 4,677 kilometers. Mongolia is 2,392 kilometers from east to west, and 1,259 kilometers from north to south. The country is known for its steppes and the Gobi desert, but it also includes numerous mountainous areas, rivers and lakes. The average altitude is 1,580 meters above sea level. An important feature of the country is that it has continental weather patterns and four seasons, including winters with temperatures that often fall below C –30°.

Mongolia is divided into 21 aimags (provinces), and a further 334 soums (counties). Ulaanbaatar is the national capital, and had a population of 786,000 at the end of 2000. The national population totaled 2.41 million, with 57 percent living in urban areas and 43 percent in rural areas. Population average annual growth rates have been below 1.5 percent since 1995 but there has been a net loss in rural areas.

Since the collapse of the Soviet Union and COMECON in 1990 (withdrawn Soviet assistance was equivalent to 30 percent of GDP), Mongolia has been faced with restructuring and

transforming its previously centrally planned economy into one that is market-based and private sector driven. This formidable task has been met with commitment to change and the results have been impressive. Real (1995 prices) GDP ($1.04 billion in 2000) annual growth rates varied from 2.4 to 4.0 percent during the last half of the 1990s, despite the effects of the 1997-1998 Asian Financial and the Russian Banking Crises. Growth has slowed in 2000 and 2001 to 1.1 and an estimated 1.4 percent respectively, largely because of the harsh winters and the intervening drought that resulted in huge livestock losses in the agricultural sector. With an economy that is highly concentrated in export mining (copper, gold and minerals account for roughly 40 percent of exports) and livestock raising and cashmere production (cashmere and other textiles account for approximately 41 percent of total exports), it is obvious that the loss of nearly 20 percent of the assets (livestock) in a key sector over the last two years, will have major negative impacts. The energy sector accounts for roughly 13 percent of GDP, and because of its inefficiencies drains resources away from other economic activities. .

Exports totaled an estimated $533 million in 2000, and imports totaled $679 million. However, the trade deficit has been increasing. Positively, inflation has slowed from 45 percent in 1997 to 8.6 percent by the end of 2000. Although there has been some currency depreciation, it was only 2.3 percent against the US dollar in 2000—far less than for many Asian neighbors. There has also been a positive downward trend in the Bank of Mongolia loan rates (to 8.6 percent at the end of 2000), but commercial lending rates have fallen more slowly and are still over 20 percent.

An important factor in the growth and transformation of the economy over the last decade has been the impact of external assistance, including loans. Public guaranteed external debt totaled an estimated $908 million at the end of 2000, and it has since risen to nearly $1 billion—nearly 100 percent of GDP. Although many of the foreign loans are on concessionary terms (grace periods of 5 to 10 years, and interest rates of 1 to 1.5 percent), the heavy reliance on and high levels of external debt means that there will be limits placed on the Government's ability to borrow over the next decade. In very simple terms, if the economy grows at 7 to 9 percent per year over the next decade, then it would be possible to maintain the recent rate of borrowing. If economic growth is slower, and this is the more realistic scenario, then it will have to restrict borrowing for priority projects. By the end of 2001, the energy sector accounts for roughly $200 million of the total external debt—and, this may not fully reflect all loans to all components of the energy sector (see Chapter 3).

However, there are other financing options including the conversion of external debt to equity in assets that can be partially or totally privatized. Government has established a set of privatization guidelines for 2001-2004, and has also developed a privatization program for 2001.

The 2001 program includes a list of 27 state owned enterprises and 66 facilities that are to be privatized. In addition, the 2001 program includes 25 organizations that are to be restructured. The list of state owned enterprises and facilities includes many from the energy sector, such as power plants, power transmission and distribution networks, and coal mines. The proceeds from the sales of partial or total equity in these assets could then be used to decrease the level of external debt.

The Government's budget as a percent of GDP is indicated in Table 1.1. As the table shows, revenues have been increasing in recent years, reflecting Government's efforts to increase tax collections. Expenditures including net lending, have also been increasing. Although there have been improvements in the current balance and reduced levels of deficit in the overall balance, it is possible that the respective balances could move in negative directions because of the current global economic downturn. Government has attempted to pursue prudent fiscal policy but the combined effects of the recent harsh winters and the slowing global and (Asian) regional economies will negatively impact the domestic economy including projected levels of tax receipts and other revenue generating measures.

Table 1.1 Key Components of the General Budget, 1997-2001
(as a percent of GDP)

	1997	1998	1999	2000 (prelim)	2001 (estimated)
Total Revenue and Grants	25.8	27.6	27.2	33.6	33.6
Current Revenue	24.7	26.5	26.5	33.2	33.1
Total Expenditure and Net Lending	34.5	41.9	39.2	40.4	41.1
Current Expenditure	23.1	27.2	26.7	30.2	30.6
Current Balance	1.6	-0.7	-0.2	3.0	2.6
Overall Balance	-9.2	-14.3	-12.0	-6.8	-7.4

Source: *The Government's Medium Term Strategy and Policies to Deepen Economic Reform and Restructuring*, May 2001.

Poverty is an important issue. Transforming the economy from one that was centrally planned to one that is market-based within the relatively short span of a decade has led to some social dislocation. There are several important characteristics: 1) a considerable portion of the rural population is employed in herding and vulnerable to natural disasters such as the recent harsh winters; 2) although registered unemployment approximates 7 percent, unofficial estimates suggest that real unemployment levels could approximate 18 to 20 percent; and, 3) GDP per capita is roughly $400-450. Taken collectively, these characteristics verify estimates that there is a substantial share of the total population living below the poverty line—36 percent nationally,

with 39.4 percent of the total in urban areas and 32.6 percent of the total population in rural areas.

Clearly, additional effort and resources have to be focused on alleviating poverty. Thus, it is essential that the energy sector rapidly becomes more efficient and self-sustaining so that its subsidies and grants from Government can be reallocated to other initiatives that facilitate economic and employment growth, and/or directly assist those living below the poverty line.

From the above, it is obvious that Government has successfully undertaken many of the essential steps to transforming the economy. However, Mongolia has a small population base and a limited domestic market, it is dependent on a narrow range of exports, and it is subjected to natural disasters. All of these characteristics point to the economy's vulnerability to global and natural events that are beyond Government's control. Recognizing this level of vulnerability requires adopting measures such as prudent fiscal and borrowing policies, to reduce exposure and potentially negative impacts.

Finally, it can be noted that aside from the prospect of privatizing assets, the economy could benefit from other potential opportunities. During 2001, an oil field containing an estimated 300-500 million barrels has been located and, while current production is only 1000 barrels per day, could result in a major increase in Government revenues. Also in 2001, a large (750 million tons) copper deposit with very attractive grades of copper and gold has been discovered. Again, this could provide Government with additional revenue, employment creation, and foreign exchange earnings. Mongolia has a number of resources that can be developed, and these will further assist transforming the economy.

Importantly, a number of these potential developments could become major consumers of energy. Copper mining and its associated processing of the ore into exportable copper concentrate, is an energy intensive industry. There are prospects for the development of additional gold mines that would also consume considerable energy. Thus, the energy sector has to be aware of the economy's potential for growth and be prepared to assist as needed.

1.3 Purpose and Objectives of the Draft Strategy

This section outlines the purpose and objectives of the draft Strategy. The first part of the section discusses national development objectives. The section concludes with a presentation of critical issues that are addressed in the Strategy.

The purpose and objectives of the draft Sustainable Energy Sector Strategy, 2002-2011, have to be considered within the national context. *The Government's Medium Term Strategy and Policies to Deepen Economic Reform and Restructuring* (May 2001) outlines key policies, including:

- Provide stability in the macro-economy under the umbrella of the Poverty Reduction and Growth Facility;
- Intensify structural reforms, including a new push with privatization;
- Develop sound banking and financial sectors;
- Revive national industry and support export development;
- Pursue regional development, including efficient development of infrastructure;
- Reduce poverty and unemployment and develop appropriate policy towards income distribution;
- Enhance environment preservation and reduce natural disasters impact;
- Set up responsible "Good Governance," with improved systems of public sector management.

The draft Sustainable Energy Sector Strategy, 2002-2011 is based on these policy guidelines and provides an outline of the priorities and steps for the energy sector to continue its successful restructuring and transformation into a dynamic partner in the nation's development.

Purpose of the Draft Strategy

The draft **Sustainable Energy Sector Strategy, 2002-2011** is aimed at developing an energy sector that is self-sustaining and that also provides our communities, citizens and businesses with reliable and reasonably priced energy services. The draft Strategy provides an opportunity for a broad range of stakeholders to consider how the sector is evolving, as well as what measures are needed to facilitate its development. Thus, this document is but a first step, and it will be revised as required over the coming months and years.

Objectives of the Draft Strategy

The objectives of the draft Strategy can be outlined with the following:

- Develop a comprehensive yet concise statement of the Government of Mongolia's goals, objectives and programs that are aimed at taking concrete steps towards an energy sector that is financially and environmentally sustainable while at the same time providing the services necessary for economic and social development.
- Provide a basis for comment from development partners, the private sector—both domestic and foreign investors, and the public at large as to how best a sustainable energy sector strategy can be developed and effectively implemented.
- Establish a mechanism to measure the progress to develop a sustainable energy sector.

A sustainable energy strategy that achieves these objectives should ensure energy security, energy fairness and energy efficiency for all Mongolians.

Critical Issues to be addressed by the Draft Strategy

As noted above, the draft Strategy provides an outline of the requirements and actions to be taken as well as the steps to implement these actions over the next decade. Specific attention is given to the critical issues listed below. These are classified as "critical" because if they are not adequately addressed, then the energy sector will not achieve its stated objectives. The critical issues include:

- Continued commercialization of key components of the energy system.
- Continued restructuring of the energy sector.
- Privatization of selected components of the energy system.
- Investment requirements and financing options for the energy sector over the next decade.
- Capacity building requirements for the energy sector over the next decade.
- Future energy supplies including the role of energy efficiency.

1.4 Organization of the Report

Following this introductory chapter, the report is separated into the following chapters:

Chapter 2 Energy Sector: Accomplishments and Issues, 1990-2001
Chapter 3 The Role of External Assistance in the Energy Sector
Chapter 4 Restructuring the Energy Sector
Chapter 5 Rural Access to Energy
Chapter 6 Investment Requirements in the Energy Sector, 2002-2011
Chapter 7 Energy Sector Development from the Stakeholders' Perspective
Chapter 8 Towards a Sustainable Energy Sector Strategy

All figures are in US $s unless otherwise noted.

2. ENERGY SECTOR:

ACCOMPLISHMENTS AND ISSUES, 1990-2001

2.1 Introduction

Since 1990, Mongolia has attempted to rehabilitate, upgrade and expand its energy systems because it recognizes that without efficient, reliable and reasonably priced electricity and fuels, the economy cannot grow and people's lives and opportunities will be limited. A high priority has been placed on energy by successive governments. And, there have been numerous accomplishments, including:

- Rehabilitation of Ulaanbaatar's #3 and #4 power plants, Dornod and Darkhan power plants.
- Partial renovation and upgrading of Ulaanbaatar's heating system.
- Installation of a new power plant at Dalanzadgad.
- Installation of diesel electric stations in 5 aimag centers and more than 100 soum centers.
- Rehabilitation and upgrades of the Baganuur, Shivee Ovoo and Sharyn Gol coal mines.
- Enactment of the 2001 Energy Law that provides a basis for the restructuring and privatization of the energy sector.

While these accomplishments are significant, much remains to be done with respect to developing the dynamic energy sector that is needed for continued development. This chapter provides a basis for defining what needs to be accomplished in the future. The chapter describes the current status of the energy sector with respect to resources, operations, and economic performance. In addition, the chapter outlines the current legal and institutional framework for the sector. Importantly, the chapter's final section presents the broad goals and objectives for the energy sector for the 2002-2011 period. A list of completed, on-going and proposed projects that provide more details on achievements over the last decade are included in Chapter 3.

2.2 Energy Supply and Demand

This section provides information on the current status and operations of the energy supply and demand components of the sector. The section begins with a discussion of current and potential energy resources, including renewables. The section then describes components of the electricity and heat systems, and their operating performance.

2.2.1 Coal

Mongolia has significant coal resources. Inferred coal reserves are roughly 150 billion tons, of which 20 percent is coking coal and 80 percent is lignite or steam coal. The reserves are located in 240 deposits and occurrences in 12 major coal basins, and approximately 25 percent of these deposits have been confirmed by geological survey.

Table 2.1 shows a coal balance for 1990 to 2000. As the table indicates, production is well below current capacities, and production can be increased to meet rising demand. The bulk of demand is by the heat and power generating companies.

Table 2.1 Coal Balance, 1990-2000 ('000 tons)

	1990	1995	1996	1997	1998	1999	2000
Stocks	183	82	106	98	87	193	170
Imports	73	211	23	100	38	30	43
Production	7157	5019	5110	4924	5057	4964	5185
Total Supply	7413	5312	5239	5122	5182	5187	5398
Heat & Power	4324	3883	3925	3673	4193	4127	4449
Other End Users	2325	1321	1214	1362	793	890	763
Exports	490	1	1		3		
Stocks	151	107	99	87	193	170	186
Total Demand	7290	5312	5239	5122	5182	5187	5398

Currently, there are 32 coal mines operating, of which 13 have been established as joint stock companies and 19 as private companies. Coal accounts for 95 percent of the solid fuel consumed by heat and power generating plants. The small scattered mines provide rural residents with a fuel source for heating and cooking. Recent production has totaled approximately 5 million tons per year.

The bulk of production comes from three mines that supply the combined heat and power generating plants. It is 125 kilometers east of Ulaanbaatar. Baganuur opened in 1978 with a designed capacity of 6 million tons per year. It is currently producing 3 million tons. The reserves for this open pit mine are 300 million tons. Loans and technical assistance from Japan and the World Bank have led to improvements in operating efficiencies over the last several years.

Sharin Gol open pit mine is located 240 kilometers north of Ulaanbaatar, and near Darkhan. It is producing roughly 700,000 to 1 million tons per year. Shivee Ovoo open pit mine is being upgraded with the assistance of a Japanese loan. It is located 240 kilometers south of

Ulaanbaatar. It produced 600,000 tons in 2000, and has reserves of nearly 600 million tons. The other 29 mines produce an estimated 600 to 700,000 tons per year.

Coalbed Methane Gas

Over the last 6 years, the coalbed methane gas industry has developed in Canada and the USA, where it now accounts for 6 percent of total natural gas production. In fact, it is the fastest growing source for natural gas in the USA. This is a major achievement because the technology let alone the industry, did not exist until the mid 1990s. The technology is based on drilling a well in a low grade coal field that collects the naturally occurring methane emissions. The methane gas is then pumped to a facility where it is cleaned and then compressed at low pressure levels so that it can be piped into the natural gas pipeline network.

Given Mongolia's considerable coal reserves, this could be another source of fuel for heating and/or power generation. Resource assessments need to be undertaken, and if they indicate financial viability then pilot plants developed. However, it should also be noted that the quality of methane is very site dependent, and this will affect a project's viability. It has been suggested that small scale networks could be economic to supply neighboring soums. The Government will continue to explore this opportunity, and welcomes support for the necessary resource assessments and, if viable, pilot plants.

2.2.2 Liquid Fuels and Gas

This section describes the supply and demand for petroleum products. In addition, the section discusses prospects for trans Mongolian pipelines from Russia to China that would carry crude oil and natural gas. The section also presents a brief comment on recent initiatives to develop markets for liquified petroleum gas and compressed natural gas in Mongolia.

Petroleum

Mongolia received 95.5 percent of it petroleum products from Russia and 4.5 percent from China in 1999. Table 2.2 shows the volume of petroleum imports for the period 1997-2000, and Table 2.3 indicates projected demand for 2005 and 2010. As the table indicates, gasoline and diesel have been the major imported petroleum products. In 1998, 5.0 percent of diesel imports were consumed by road transport, 22.3 percent by railway transport, 11.3 percent by electricity generators—mostly by the small generating stations in off-grid aimags and soums, 8.1 percent by agriculture, 24.9 percent by mining operations, and 28.4 percent by miscellaneous consumers including construction. It is likely that diesel demand will rise because 1) both the number of soume generating stations as well as their hours of operation are expected to increase,

and 2) railway and vehicle traffic will continue to grow. With respect to gasoline demand, it is also expected to rise because of a growing vehicle fleet: car imports were 6,210 in 1995, 4,862 in 1999 and 11,509 in 2000. The expanding vehicle fleet has meant a marked increase of A-93 gasoline from under 2 percent of gasoline's total share to over 13 percent in 1998.

Table 2.2: Volume of Petroleum Product Imports, 1997-2000 ('000 tons)

Products	2000	2000 Percent (%)	1999	1998	1997
Gasoline	233.6	52.5	193.2	199.9	194.2
Diesel	161.7	36.3	159.4	134.1	128.5
Jet	18.4	4.1	15.9	20.7	20.9
Avgas	8.7	2.0			
Fuel Oil	14.6	3.3	22.7	24.2	29.4
Lubes	8.3	1.9	2.5	7.8	
Total	445.3	100	393.7	378.9	373.0

The 80 percent government-owned Neft Import Concern (NIC) handled 100 percent of petroleum imports in 1993, but its share was only 54.3 percent in 1998. More than 20 small firms now handle the remaining imports, with the largest having less than a 10 percent share of the market. Government is planning on selling the bulk of its shares in NIC during 2001-2002

Petroleum products have traditionally been imported from Russia via rail. However, there have been problems with supply in recent years because of several factors. These include high consumption levels within Russia during peak harvest periods and when Russia builds up stockpiles before winter. In addition, there have been maintenance and operating problems at some Russian refineries. But the major factor has been that NIC has not been paying its bills with the result that by the end of 1999, Russia would not supply products without advance payment.

Table 2.3: Petroleum Product Projections, 2010 ('000 tons)

	2000 (actual)	2005	2010
Gasoline	233.6		
High		289	364
Low		238	269
Diesel	161.7		
High		194	245
Low		153	164
Jet Fuel	18.4		
High		25	29
Low		21	23
Fuel Oil	14.6		
High		28	32
Low		24	25
Total	445.3		
High		536	671
Low		437	481

Source: Feasibility Study and Investment Component for the Zamyn Uud Transshipment Facility, Progress Report-Executive Summary, ETC Transport Consultants, European Union-TACIS, September 1999.

According to some consultancy studies, petroleum product storage capacity has fallen below desirable levels and when combined with NIC's financial problems, the stockpile has fallen to dangerous levels. The stockpile fell at one point to approximately 10 days of consumption. The International Energy Agency recommends a 90-day stockpile. As a near-term compromise, it has been proposed to develop a 30-day stockpile and tank farm. The approximate cost for this project (near Ulaanbaatar) is $40 million for 69,200 meters^3. A second option would be the development of a petroleum transshipment facility at Zamyn Uud, near the Chinese border, approximately $13 million for 5,000 meters^3. Government has decided to develop the transshipment facility in order to both increase storage capacity and to provide a means to increase imports from China in the event of supply interruptions caused by weather in Siberia.

Current petroleum product storage includes 22,000 meters^3 for gasoline, 9,400^3 meters for diesel, 7,500^{3}meters for aviation gasoline. Most of the storage tanks were built between 1962-1970, and are in need of considerable rehabilitation or replacement. In-ground drums are used for lubes and fuel oil storage.

Table 2.4: Proposed Petroleum Product Storage ('000 tons)

Products	Volume	%	Proposed 30 Day Stockpile				
			tons	Meters^3	Tank Capacity Meters^3	Tank Number	Storage Capacity Meters^3
Gasoline	233.6	52.5	26,933	31,686	5,000	7	35,000
Diesel	161.7	36.3	18,622	21,908	5,000	5	25,000
Jet	18.4	4.1	2,103	2,474	2,000	2	4,000
Avgas	8.7	2.0	1,026	1,207	2,000	1	2,000
Fuel Oil	14.6	3.3	1,693	1,992	2,000	1	2,000
Lubes	8.3	1.9	954	1,060	600	2	1,200
Total	445.3	100	51,300	60,327		18	

Source: Japan External Trade Organization, September 2001.

Trans Mongolian Pipelines

Since 1997, discussions have been held regarding the construction of both a natural gas and a crude oil pipeline carrying fuels from Russia to China. The pipeline routes would likely transit Mongolia. While it is clear that the oil and gas resources are available in Siberia and there is demand for these fuels in China and Korea, it is less obvious when the pipelines would be built. There are a number of companies involved in the discussions, and there are competing proposals. In addition, construction cost estimates have varied from $1.7 to $5.9 billion for the natural gas pipeline—which suggests that the proposal to build the two pipelines side-by-side would yield better economics for both.

At this stage, it is difficult to determine how either pipeline will evolve—the various companies have to agree on certain development parameters and then conduct a feasibility study. Developing petroleum processing facilities in Mongolia would require a substantial capital investment, but small refineries have proven financially viable in a number of areas. The Government will continue to monitor the pipeline negotiations, and will explore development options once it becomes clearer how these projects will evolve.

Liquified Flammable Gas

In addition to coalbed methane, the Government is pursuing other gas supply options. On 29 November 2000, the Government approved a program promoting the use of "liquified flammable gas." The purpose of the program is to provide the legal basis to establish an industry

that would provide compressed natural gas (CNG) for vehicles and liquified petroleum gas (LPG) for household consumption. This effort is aimed at diversifying energy sources as well as providing more efficient, less polluting and, in the case of LPG, possibly cheaper fuels. To date, four private companies have been working out the details of how they would like to develop the market for these products but data on their current levels of investment and future plans are unavailable.

CNG has been used as a vehicle fuel in a number of countries. Its use is increasing in a number of large cities, where it has been made mandatory for taxis and in some cases, buses and other fleet vehicles to run on CNG. The mandatory policy has been enacted in order to reduce vehicle emissions and thus air pollution. Istanbul has had a successful CNG program operating for several years. New Delhi has been trying to establish one but there has been considerable resistance by taxi and bus owners. CNG would reduce vehicle emissions but the infrastructure required to handle this fuel as well as the cost to install different fuel tanks in vehicles could result in problems developing the market.

LPG is used for household cooking and heating throughout the world. It is far cleaner than coal or wood for household heating, and generally cheaper and more efficient than electricity for cooking. Household costs to purchase one- or two-burner cooking plates and room heat reflectors would not be major expenditures if an adequate supply system is developed. LPG canisters are, for example, trucked across the Sahara and tossed around on small boats supplying scattered islands—they are durable and safe as long as they are replaced every few years. Infrastructure requirements would be similar to those setting up a CNG compressing station. However, one LPG station could supply a fairly large distribution network, which means that the economics for LPG would be more attractive than for a CNG operation.

It has been reported that the companies currently handling LPG are importing canisters by rail from China and then trucking them throughout Mongolia. Importing canisters is an expensive method of handling LPG. However, it should be considered only the first step in developing the market. Government supports the development of the LPG market.

Domestic Petroleum Resources

As noted in the first chapter, oil production has recently started at one field. Although only 1,000 barrels per day are being extracted, the field is estimated to contain 300-500 million barrels. The development of this field would be a major stimulus to the Mongolia economy—aside from reducing imports, government would considerably increase its tax base.

Importantly, the development of one oil field could lead to the development of additional fields. Although it is extremely difficult to predict whether a particular field will be economic,

some estimates of total national oil reserves in the range of 5 to 8 billion barrels. This would be a substantial asset.

2.2.3 Other Energy Sources

This section discusses the supply of energy from other energy resources. Resources included in this section are hydropower, solar, wind, and geothermal. The section begins with a discussion of energy efficiency. Although this is not an energy resource in a strict sense, it should be noted that improvements in energy efficiency can produce considerable energy savings from existing generation facilities. By reducing energy demand, existing generation facilities would not have to be expanded or new plants added until a later date. This results in substantial savings to the generating companies, consumers, and the country as a whole.

Energy Efficiency

As noted above, energy efficiency can result in considerable savings—both in terms of energy production but also costs. There are a number of projects that have been implemented or are beginning that will address major energy efficiency problems in the grid systems. The Central Energy System has losses reaching 32 percent (14 percent "technical" and 18 percent "non-technical"). Heat system losses could be as high as 40 percent. Obviously there is a need to reduce losses for both categories.

Beyond these supply-side or energy system issues, energy efficiency has to be considered from a different perspective—the demand-side. A key question to consider is whether it is possible to produce the same quality product using less energy by changing management techniques or by utilizing a different technology in the production process. Currently, there are no programs that are assisting the private sector or government facilities in reducing their energy consumption, or the demand side. Moreover, at this stage, there are no incentives for the generation and transmission companies to assist the private sector or government in reducing energy consumption.

Over the next 5 years and once appropriate tariff and regulatory policies have been implemented, Government intends to place a high priority on establishing an Integrated Resource Planning and Demand Side Management framework that will facilitate reductions in energy consumption. Attention will be given to energy efficient buildings and appliances as well as to the training and implementation measures that are needed for a successful energy efficiency program. Technological and design advances over the last several decades have resulted in major energy savings that clearly demonstrate the value of energy efficient investments based on life-cycle costs. Innovative financing methods for energy efficiency investments such as energy

savings performance contracts have helped to spur the development of an energy services industry that is market-driven and environmentally beneficial. Energy efficient building designs and management systems are producing net energy savings of more than 20 percent over the life of the facility. Retrofits of facilities for heating and cooling systems are achieving similar savings. Thus, the potential to reduce energy consumption is considerable and should be pursued at the earliest possible moment.

However, it should also be noted that energy efficiency does not rest solely in the hands of suppliers and larger consumers. Individual consumers and households can also make a tremendous difference. For example, simple actions such as making sure lights are turned off, adding adjustable control valves to pipes feeding steam radiators, and tuning up a car's engine and inflating tires to their correct pressure will all help to save energy and money. In other words, people can change their behavior and become more efficient users of energy—and save money in the process.

Hydropower

With an estimated 3,800 rivers and streams and a total length of 6,500 kilometers, Mongolia has significant hydropower potential. There are currently 5 small hydro plants operating (and installed capacity):

Khar-horin	528 kW
Chigjiin	200 kW
Bogdiin	2.0 MW
Mankhan	150 kW
Guulin	480 kW

The small hydro plants are run-of-river designs that provide electricity to neighboring rural areas except during the winter. Consideration is being given to further develop small hydro plants in order to reduce diesel imports.

A number of larger hydro projects have been identified and are shown in Table 2.5. Because of the demand loads of the Central Energy System, serious consideration is being given to developing the Orkhon project. It would provide peaking capacity for the CES and eliminate the need for Russian electricity imports. Although the current cost of Russian imports is below Orkhon's estimated cost of power generation, the project is viewed as being able to provide the necessary capacity to better manage the CES load. The Orkhon project would require a 20 kilometer transmission line to the 220 kV Erdenet-Ulaanbaatar line. Government is promoting the development of the Orkhon project as a priority over the next 5 years.

In the Western Energy System region, a loan agreement has been signed with the Kuwait Fund to develop the Ulaanbom/Taishir project. The project would supply electricity to two aimag centers and 8 soums. Although the energy cost is high because of the size of the dam and the low capacity, the feasibility study determined a 13.2 percent economic internal rate of return (EIRR). The Durgun project has an even higher EIRR (24.7 percent) and would connect to the WES grid. Government would like to see this also developed within the next 5 years. Government would like to see the Delger/Chargait project developed because it would save $4.6 million in diesel imports per year, and provide a power source not subject to the breakdowns and interruptions experienced by the diesel sets.

Solar

Known as the "land of eternal blue skies," Mongolia has substantial solar potential. Approximately 71 percent of the total land are receives solar insolation at a rate of 5.5-6.0 kWh/m^2 per day, and 2900-3000 sunshine hours per year. An additional 18 percent of the country receives insolation at the rate of 4.5-5.5 kWh/m^2 per day, and 2600-2900 sunshine hours per year. Solar energy could be a suitable source for electricity for lighting and possibly cooking in rural areas. But it is likely that heating and most cooking would be based on other energy sources.

Government has programs and plans to exploit the solar resource. Currently, there are an estimated 4000-5000 photovoltaic units operating in the country. Most of these are used to provide lighting and power for a limited number of other appliances in scattered rural areas. A photovoltaic panel assembly plant in Ulaanbaatar has the capacity to produce 1.5 MW of solar panels per year.

However, there are more aggressive programs being developed. The 100,000 Solar Gers program has been established. Mechanisms to accelerate participation in this program are being considered. One of the key issues is that while costs of the smaller household units vary from only $300-$500, many households would still require a loan for this amount. Banks tend to require payback periods of 3 to 6 months for small loans. Government has initiated discussions with commercial banks willing to provide credit terms for 1 to 2 years. This would be an important step given that many rural households are experiencing the after-effects of the recent two harsh winters and the intervening drought.

Table 2.5 Potential Hydropower Projects

Project Name	Installed Capacity (MW)	Production/year (GWh)	Capital Cost ($ millions)	Energy Cost (US ¢/kWh)
Central ES				
Orkhon	100	219	160	4.60
Egiin	220	484	277	5.72
Burin	161	760	464	6.11
Shuren	205	957	747	7.81
Artsat	118	553	302	5.46
Western ES				
Durgun	12	36	25	6.94
Erdenburen	69	347	128	3.72
Buyan Nuur	58	281	405	14.41
Ulaanbom/Taishir	8	37	39	8.78
Maikhan	12	36	Not available	Not available
Other Regions				
Delger/Chaigat	23	114	84	7.37
Khatgal	3	15	6	4.00
Zeergent 1	7	33	43	13.03
Zeergent 2	5	23	64	27.83

Of particular importance, Government is also working with JICA in the development of a comprehensive program for off-grid aimags and soums. This would be phased in over a 15 year period. The first phase (2002-2005) calls for diesel sets to be placed in 38 soums, diesel + photovoltaic hybrid sets in 77 soums, diesel + photovoltaic + wind sets in 45 soums, diesel + small hydro in 2 soums, diesel + small hydro + photovoltaic units in 1 soum, and grid extension for 4 soums. This first phase would target supplying electricity to basic public services such as clinics, schools, soum offices at a cost of $23.8 million. Government is discussing the possibility of grant funding for this first phase.

The second phase for the 2006-2010 period, calls for expansion of the systems to include general consumers and other public offices. This would cost approximately $44 million and require use of a loan. The cost of this project suggests that there will have to purchase arrangements by individual consumers and/or soum power generating companies rather than a Government loan. The third phase for the 2011-2015 period calls for the introduction of fuel cells and hydrogen production at a cost of $80 million.

Wind

Up to 70 percent of the country has wind resources that may be suitable for development. In particular, the Gobi desert area, Dornot and Sukhbaatar provinces have wind regimes of 150-200 W/m^2 with a wind duration of 4000-4500 hours per year.

As noted in the discussion on photovoltaics, wind power is anticipated to play a major role in the rural electrification program. Government intends to pursue wind power development where viable.

Geothermal

A geophysical study has identified 42 small hot springs in Hangai, Hentii, Huvsgol, Altai Mountains, Dornot-Darigangiin Steppe, and the Orhon-Selenge region. Although the local population makes some use of the hot springs, no commercial power or heat development has occurred.

2.2.4 Electricity

Table 2.6 shows key operating statistics for the combined grid power systems (Central Energy System, Western Energy System, and Eastern Energy System). Key successes include:

- Energy imports have been falling as a result of upgrades and rehabilitation of the combined systems.
- System reliability especially in the major grids, has improved significantly, with few outages recorded.

Table 2.6 Power Demand Statistics for the Energy Authority

	Item	1995	1996	1997	1998	1999	2000
1	Installed capacity (MW)	777.5	777.5	777.5	796	796	802
2	Avail.Max.Power Output (MW)	499	499	523	565	565	573
3	Avail.Max.Power Gen. (GWh)	3.814	3.814	4.087	4.305	4.305	4.317
4	Gross generation (GWh)	2.628	2.614	2.720	2.572	2.740	2.898
5	Station use (GWh)	598	579	608	569	587	616.3
6	Net Generation (GWh)	2.030	2.035	2.112	2.002	2.153	2.263
7	Energy Imports GWh)	381	383	376	355	194	183.8
8	Energy Export (GWh)	28	69	42	60	59	24.9
9	Net Supply (GWh)	2.507	2.515	2.589	2.298	2.288	2.461
10	Increment to the previous year (%)	+15.6	+0.3	+2.8	-11.2	-0.4	+7.6
11	T&D + Non-tech losses (GWh)	502	482	507	784	589	571.5
12	Net Sales (GWh)	1.909	1.936	1.939	1.513	1.699	1.744
13	Peak demand (MW)	477	488	506	513	499	526
14	(Output-Peak)/Output x 100(%)	4.37	2.16	3.17	9.2	11.68	7.88
15	Annual Load Factor (%)	69.0	68.6	71.4	37.6	37.6	32.9

However, there are still several outstanding issues, including the need to substantially reduce technical and non-technical losses and to increase collections. Measures are being undertaken to address these and other problems through technical assistance and external borrowing. Thus, while much remains to be done, the overall performance by the generating, transmission and distribution systems is improving—and it should continue on this positive track.

The Central Energy System (CES) supplies Ulaanbaatar and 11 surrounding aimags, or 53 percent of the national population and 40 percent of the country's total land area. Current demand is approximately 475 MW and supplied by coal-fired Combined Heat and Power (CHP) generating stations. The grid is connected to the Russian grid at the Selendum substation. The CES grid includes 7,685 kilometers of transmission lines.

The Western Energy System (WES) is connected to the Russian grid at the Chadam substation, and does not have local generation capacity. The WES currently provides service to only the main urban areas in the Altai aimags of Uvs, Bayan-Ulgiy and Khovd. Transmission lines are 729 kilometers in length. During winter, total import approximates 10 MW with maximum demand of slightly more than 8 MW. During summer, maximum demand is less than 1.5 MW.

The small Eastern Energy System (EES) includes 304 kilometers of transmission lines that are supplied from the coal-fired CHP Choibolsan power plant (36 MW installed capacity). Maximum demand is roughly 12 MW.

Energy Authority Demand Forecasts

The Asian Development-Bank supported Master Plan should be available for review by the end of 2001. The Interim report indicates that demand is scheduled to increase at an annual average growth rate of 2.9 percent between 2001 and 2020. This growth rate assumes that there will be improved efficiencies in the operating power and heat systems as well as energy savings resulting from conservation and energy efficiencies on the demand side. However, the assumptions are not yet available, and the Master Plan is scheduled to be released in the near future. As a result, more detailed forecasts have not been presented at this time. Preliminary indications are that the total capital costs for the expansion of the central power and heating systems will approximate $870 million over the 20 year period.

Electricity in the Soums and Aimag Centers Not Connected to the Grids

There are 4 aimag centers with diesel stations not connected to grids. They have a combined installed capacity of 35.3 MW, and a rated capacity of 27 MW. Of the 334 soum centers, only 126 are connected to grids. Of the remaining soums, their average capacity approximates 200 kW per station, or more than 40 MW. 40 of these soum centers are scheduled for connection to grids. Most of the aimag and soum centers with their own generation capacity have had problems maintaining operations beyond 4 to 5 hours per day. The aimag centers have had their 10 to 25 year old diesels recently rehabilitated. The soum centers are having their old diesels replaced with new generating sets. The Government intends to continue improving the quality and quantity of energy supply to off-grid centers and rural areas. As discussed in the section on other energy sources, plans are moving forward to utilize solar, wind and small hydropower resources in conjunction with diesel generating sets as a basis for increasing electricity supply in rural areas.

Russian Electricity Exports

As noted above, Russia currently exports electricity to Mongolia. In addition, negotiations have been conducted between Russian and Chinese companies about constructing large transmission lines for the export of electricity from Russia to China. As with the natural gas and crude oil pipelines, it is not clear what the outcome of the negotiations will be—Siberia has excess generating capacity, available hydropower, natural gas and oil resources, and produces electricity 25 to 50 percent more cheaply than China. However, China is also developing more of its domestic generation options. As noted, it is not clear if or when a transmission line would be built. Government will continue to monitor the progress on the negotiations, and consider various development options as appropriate.

2.2.5 Heat

Because of the cold winters, heating is especially important in Mongolia—it is necessary for survival. This section discusses central heating systems in the urban areas as well as the situation in rural areas. This section discusses heating in the central urban systems and the soums and rural areas.

District Heating

In terms of heat supply sources for central or district, systems, Mongolia has combined heat and power (CHP) thermal power plants in Ulaanbaatar, Darkhan, Erdenet, and Choibalsan. Most of the boilers are Russian, model BZUI-100, HP-18. In addition, there are some boilers of medium capacity produced in China. In the smaller urban areas, many of the plants are boiler only heating (BOH) and are model KE 25/14, KVTS 20/150. Table 2.7 shows capacity and demand for district heating systems. As the totals indicate, while capacity can meet demand in the near term, there will

have to be some expansion. However, it should also be stressed that heat losses can be as high as 40 percent and typically in the 15 to 30 percent range, which means that if efficiencies can be improved, plant expansion can be deferred.

The heat network and lines use steel pipes with insulation within the channel. As noted, heat network losses typically range from 15 to 30 percent. Thus, there is a need to upgrade insulation to the standard specified in the Ministry of Infrastructure directive on 1 March 1997.

The heat distribution centers accept hot water from the CHP plants, and then filter and transmit the hot water to customers for heating and consumption. The system is designed to operate on a constant-flow basis, so it is not possible to adjust supply in accordance with the customer's demands. In addition, individual metering would be very difficult, and while

improved system metering would improve system management, it would not resolve all the problems. There is considerable need to upgrade the systems, and these are being undertaken.

Table 2.7 District Heating Systems

City	Type	Capacity MW_{th}	Demand MW_{th}	Population ('000)
Ulaanbaatar	CHP	1,524	1,222	691.0
Darkhan	CHP	185	243	72.6
Erdenet	CHP	139*	172	65.7
Sukhbaatar	BOH	51	21	21.3
Choibalsan	CHP	84	112	30.4
Baganuur	BOH	82	105	Included in UB
Khovd	BOH	44	23	27.9
Ulgii	BOH	51	24	23.7
Ulaangom	BOH	44	23	24.2
Dalandzadgad	CHAP	8	6	11.8
Sainshand	BOH	38	14	16.8
Zuunmod	BOH	18	12	15.1
Total		2,268	1,977	1000.5

* Erdenet Copper heat generation capacity is not included.

As noted above, the Ministry of Infrastructure approved standards for insulation and buildings on 1 March 1997. This has been a major step because it has been estimated that due to improper insulation, the heat load is 8 to 10 times greater than many European countries. By improving insulation, it would be possible to reduce heat losses and to:

1) Decrease the *heat/heating area* ratio;
2) Decrease the *fuel/heating area* ratio in order to decrease the amount of fuel necessary for heat production;
3) Improve working conditions;
4) Noise reduction; and,
5) Decreasing the *fuel/heating area* ratio could enable increased use of renewable energy sources.

In order to improve efficiencies, Government has initiated the ADB-financed Heat Efficiency Project. In addition, Government is promoting the adoption of a number of key measures to increase efficiencies, including:

- Replacing old pipelines.
- Installation of efficient exhaust systems.
- Installation of individual meters.
- Install demand regulation devices.
- Upgrade insulation in existing buildings.

Heat loads are forecast to increase at the same rate of power demand in the district systems. According to the draft ADB Master Plan, the average annual growth rate will be 2.9 percent for the period 2001-2020. This means that demand will basically double over the figures presented in Table 2.7 but this would not fully reflect the impact of increased efficiencies and energy savings measures.

Heating in Soums and Rural Areas

Typically, gers use small stoves for cooking and heating. The stoves are small, simple in design, and tend to produce high levels of air pollution because they rely on short chimneys and are continuously in use. Wood, coal or dried dung are the primary fuel sources.

Only 35 of 170 soum centers have small central heating systems, with 86 using stove heating for individual rooms, and 45 use an unclassified heating system. 107 soums use coal as the main source of fuel. 121 soums use wood and 41 use dried dung—the number is greater than 170 because multiple fuels are used. Only 4 soums use electric boilers.

2.2.6 Economic and Financial Performance of the Energy Sector

The energy sector has made considerable progress over the last decade, changing from a state-owned supply-side agency into a number of commercialized entities. However, the transformation of these entities into dynamic companies that are working with consumers to ensure that there needs are met, has not yet occurred.

There are problems that are being addressed or remain as serious obstacles to becoming a dynamic energy sector. First, is the issue of the "cycle of debt" (tariffs have traditionally been too low, customers have not been paying their bills, and generators have not been able to pay for their fuel—so, the coal mines have not been able to maintain the necessary levels of operation because they could not afford spare parts or other basic charges). Tariffs have been increased but need to be raised further. Generators are working with the coal mines to develop an appropriate repayment schedule. It is likely that this will result in a tariff surcharge to reflect that consumers were not paying sufficient rates to cover costs. Distribution companies are increasing their collection efforts. All stakeholders will have to take some responsibility for the problem

and accept a role in its resolution. Resolving the above situation is clearly the energy sector's most critical issue, and Government is committed to ending the problem.

Table 2.8 shows the build up of debt to coal suppliers by the generating companies. Although coal prices increased 48 percent between 1997 and 2000, electricity tariffs increased by 9 percent over the same period. However the key issue is that customers owe the distribution companies $20 million (about 2 percent of GDP), of which $2.4 million is uncollectable, and will be written down. The distribution companies in turn owe the generating companies $21.8 million, and the generating companies owe the coal suppliers $22.7 million.

Table 2.9 presents technical and financial operating statistics on the grid systems (CES, WES, EES). As the table shows, production has increased, imports have been reduced, and sales revenue is rising. In addition, the unit cost of electricity production has remained relatively steady.

And it is likely that there will not be a loss on operations for 2001. The unit costs of heat production have increased. Importantly, while technical losses are decreasing, the level of unaccounted or non-technical losses seems to be increasing. In addition, receivables, or bills owed to the grid systems by consumers, increased sharply in 1998, and remains too high.

Table 2.8 Debt to Coal Suppliers (Tog millions)

Supplier	Decem 1997	Decem 1998	Decem 1999	Decem 2000	July 2001
Baganuur	1193	4359	9927	16053	19565
Sharin Gol	241	466	437	859	1190
Shivee Ovoo	21	286	1286	2627	3871
Other	897	848	1025	1251	694
TOTAL	2352	5959	12675	20790	25320
Fuel Expenses		34400	36600	40400	43957

Given the issues identified with respect to the grid systems, coal mines, and consumers, one can point to achievements but also to the major work still to be completed. If the energy sector is to meet its goal of providing reliable and reasonably priced energy over the coming decade, then the various components of the energy sector will have to improve their productivity, ensure that their bills payable are collected in a timely manner, and eliminate their dependence on the Government for budgetary support.

2.3 Legal and Institutional Framework

This section provides an overview of the past and current legal and institutional framework for the energy sector. The section concludes with a discussion of challenges facing the sector as it undergoes restructuring.

The Previous Structure: Energy Authority and its Role

In 1922, Government approved the transfer of the Nalaikh coal mine to state ownership and under the budget of the State Power Committee, and it is considered the date when an energy sector was established in Mongolia. The Energy Authority (EA) was established in 1965, and since then served as the implementing agency responsible for Government's policies for utilization of energy and related resources. Previously the EA was called Central Energy System (CES).

Table 2.9 Operating Statistics for the Grid Systems

#	Main Indicators	Unit	1996	1997	1998	1999	2000	2001 est.
1	Electricity Production	Mln.kWh	2474.7	2618.7	2666.6	2832.4	3096.4	3134.6
2	Own Consumption	Mln.kWh	562.7	584.2	587.6	604.8	634.9	640.3
	(percentage)	%	22.7	22.3	22.0	21.4	20.5	20.4
3	Distributed Electricity	Mln.kWh	2247.9	2352.9	2381.1	2386.4	2620.4	2642.9
	Heat	thous.Gcal	5002.4	4913.0	4924.3	4965.3	5318.0	5378.7
4	Import	Mln.kWh	375.8	360.3	362.4	218.2	183.8	180.0
5	Export	Mln.kWh	39.9	41.9	60.3	59.4	24.9	31.4
6	Total Sales Revenue	Mln.$	63.9	87.0	92.0	78.1	76.2	99.1
	Electricity	Mln.$	47.9	68.4	66.6	59.2	57.7	76.4
	Heat	Mln.$	14.6	17.0	19.4	16.5	16.4	22.6
	Other	Mln.$	1.3	1.6	6.0	2.4	2.1	0.2
7	Technical losses	Mln.kWh	448.9	487.4	527.6	494.5	571.5	501.2
	(percentage)	%	20.0	20.7	22.2	20.7	21.8	19.0
8	Sold Electricity	Mln.kWh	1463.7	1526.1	1543.8	1699.3	1744.0	1914.2
	Heat	thous.Gcal	5002.4	4913.0	4821.7	4833.9	5257.1	5316.2
9	Average Price Electricity	$/kWh	0.033	0.042	0.044	0.035	0.033	0.040
	Heat	$/Gcal	2.927	3.463	4.029	3.314	3.081	4.193
10	Total Expenditures	Mln.$	72.6	75.2	96.2	82.4	85.3	98.7
	Electricity	Mln.$	37.6	51.3	57.6	50.8	54.4	64.4
	Heat	Mln.$	33.6	22.0	32.9	28.2	27.6	34.0
	Other	Mln.$	1.4	1.9	5.6	3.4	3.3	0.3
11	Profit (loss)	Mln.$	-8.8	11.8	-4.2	-4.3	-9.2	0.4
12	Unit cost (electricity)	$/kWh	0.026	0.034	0.038	0.030	0.031	0.034
	Heat	$/Gcal	6.718	4.477	6.832	5.832	5.257	6.403

13	Liabilities	Mln.$	28.7	12.8	31.5	28.2	37.9	
14	Receivables	Mln $	12.3	13.1	21.7	20.0	19.2	
	US dollar rate		504	791	837	1023	1097	1100

The main objective of the EA was to provide a reliable supply of electricity and heat, based on the most effective means of generation and distribution. In the Energy Authority's code set by the Government there was a provision: "… The Energy Authority has the right to acquire assets, to utilize them and own them . . . ". There was also the provision that the Energy Authority had the authority to supervise and monitor all professional activities regarding power production, dispatching, transmission and distribution. The main functions of the Energy Authority included ownership, operations, and supervision functions. It operated as one large company, exercising authority over all power plants, transmission and distribution companies of the Central Energy System (CES), and the major diesel stations in aimags (provinces) which were not connected to central grid. The Energy Authority was responsible for all aspects regarding financial performances, such as collection of revenues, payments for coal, railway transportation, and tax settlements. Energy Authority (EA) power plants used to follow a pre-set plan, which determined monthly minimum limits for power and heat production based on a planned number of boilers and turbines.

During the period 1996-2000, state involvement in the energy sector was implemented through two agencies, the State Property Committee, which was responsible for all aspects concerning property issues, such as the return on equity, profitability, and increasing dividends to state equity, and the Energy Authority, which was responsible for all technical and professional aspects in energy sector, such as establishing rules and regulations of service and operations of power plants and networks, licensing and technical expertise, supervision and maintenance services.

Since 1992, the role of public sector run entities has been declining, but their continued presence and deteriorating performance increasingly weakens the budget and the economy as a whole. This is the heritage of a centrally planned economy: Government strictly controlled retail prices for electricity and heat, and as a result the energy sector became unable to cover expenses, let alone the costs of developing into an efficient and competitive industry. Thus, every year foreign aid and technical assistance have been thrown at the problems of inefficiency and weak performance. However, major policy and tangible changes are occurring: tariffs have been increased, the problems relating to payments between different components of the energy sector are going to be resolved, and the companies that have been established are going to become more accountable to their shareholders and their customers.

Energy Sector Restructuring

The energy sector is going through the challenge of restructuring, and with the adoption of a new Energy Law, the legal framework has been established. The Government of Mongolia is working to create an institutional framework that draws on the global standards of rules and regulations, and it recognizes that it should be based on an overall energy sector strategy and long-term strategic planning. The main objectives of energy restructuirng are to introduce competition among companies, to increase private sector participation, to unbundle the energy sector (division into separate enterprises, generation, transmission & distribution companies), to create open access to transmission and distribution grids for new entrants, and the creation of an independent regulatory body for licensing, pricing and monitoring.

The Energy Law was enacted by the Parliament of Mongolia on February 1, 2001 and went into force on April 15, 2001. The law is based on economic principles, commercial (market) relationships and on rights and obligations for both the industry and the consumers. This law fundamentally changes the operations and regulations of the energy sector. On the sector's structural side, the law is based on the concept that the Mongolian energy industry should be unbundled into component elements, namely, generation, transmission, dispatch, distribution and supply entities, and this is supported on the regulatory side by the provision that each of these new entities will have to apply for and be issued licenses for operation, and at that, separately for power and district heat. The Law calls for the establishment of an Energy Regulatory Agency (ERA) that will be responsible for administering the Law's provisions.

Corporatization and Commercialization

The Government of Mongolia passed Resolution #164 on July 9, 2001, which was the first step to corporatize existing state owned enterprises in the energy sector. By passing the resolution, the Government created 18 joint stock companies in each stage of the energy cycle, such as generation, transmission and distribution. According to the resolution, 8 power plants, 3 transmission companies, 6 electricity and heat distribution companies were restrucutured into state owned joint stock companies, with share entitlements distributed as follows: Ministry of Infrastructure received 41 percent, State Property Committee received 39 percent, and 20% of the shares were allocated to the Ministry of Finance and Economics. In addition, the National Dispatching Center (NDC), a company responsible for dispatching regulation, was created as a limited liabilities company (LLC), and shares of this company were distributed to the Ministry of Infrastructure (51 percent) and the State Property Committee (49 percent).

The Government of Mongolia recognizes that in order to have successful restructuring, it is necessary to create cost efficient enterprises. With the assistance of the international community, Government is taking steps to assist these newly born enterprises achieve their needed efficiency levels. Considerable resources are being injected to ensure that plant and equipment are in sound working order, that personnel are able to provide the necessary leadership and management, and that past financial problems are resolved in a satisfactory manner for all stakeholders, including consumers. The Government recognizes that there can be some major benefits from commercialization including that a cost efficient company will 1) have to improve energy efficiency, 2) when appropriate, draw on a broader range of renewable energy technology in order to capture additional savings, 3) implement appropriate rural electrification, and 4) to utilize international standards and practices with respect to environmental protection, safety and operating regulations, and enforcement mechanisms.

Challenges of the Institutional Reform

The energy sector is going to face following issues during the energy sector restructuring implementation. The list is long but probably not exhaustive—it provides an outline of the challenges and conflicts ahead.

Energy Sector Reform

- Poverty alleviation and the social impact of energy sector restructuring in the face of tariff increases.
- Environmental management while at the same improving operating cost structures.
- Private sector participation in a small market.
- Improving the overall efficiency of the energy sector with limited budgets.

Energy Sector Inefficiencies and Remedies

- Introducing competition is a priority but the reality is that only one power plant produces almost 70 percent of total electricity, which will limit competition.
- Regulating existing companies while trying to attract new ones.
- Inter-regional energy trade opportunities to develop such projects as gas and oil pipelines and high voltage electricity transmission lines—all of which could provide cheaper energy, while at the same time encouraging domestic producers to become more competitive in a small market. For example, the Western Energy System (WES) buys electricity from Russia but if it generated its own electricity by using diesel fuel it would be five times more expensive.

Expanding access to energy for the poor

- The cost of supplying electricity is almost always less than that of supplying kerosene but it is still expensive to provide these services.
- Subsidies may be needed but generally they are a wasteful use of scarce resources. Thus, life-line tariffs would have to be very carefully targeted (and transparent) to help only those that need assistance.
- Subsidizing access could be one method of assisting low income households, and the subsidy could take the form of prolonged but scheduled repayments or extending micro-credit facilities.
- Cross subsidies to pay for increased access could be provided by increases in fuel taxes for coal, petroleum products, and even firewood and dung in rural areas.

Energy and environment

- Promoting demand side management as companies try to improve their operating cost structures.
- Facilitating the development of an energy services industry as generating and transmission companies try to increase profits.
- Privatization and market reforms that should reduce technical and non-technical losses in the context of a small market.
- Environmental standards are comprehensive but organizations are still to weak to enforce these regulations.
- Kyoto agreement requirements could increase costs.

2.4 Goals and Objectives, 2002-2011

The following are the goals of Government for the energy sector and the actions and commitments that will be undertaken to achieve them.

1. *Improvement of the reliability, quality and efficiency of existing coal, heat and power delivery systems*. Projects have been and will be implemented to meet this goal.
2. *Restructure ownership and regulatory framework aimed at full commercial accountability and asset management approaching comparable international best practice*s. Entities have been corporatized, they are operating increasingly as commercial entities, and once operating on a sound financial basis, they could be partially or fully privatized.
3. *Strengthen institutional regulatory capabilities in policy formulation and in their implementation.* The Energy Regulatory Authority will be given the commitments needed to become an independent body that will provide transparency in its operations and decision-making processes.

4. *Facilitate transformation of energy sector management*. The principles and rules of the Energy Law will be implemented and supported.
5. *Electricity Access Development.* Providing rural energy opportunities will be undertaken through:
    - Rural electrification by increasing grid connections for appropriately located soums.
    - Rural electrification where appropriate by developing renewable energy sources.
    - Rehabilitate selected diesel generators in remote soums.
    - Finance "100,000 solar ger" program by attracting international financial and non-governmental organizations under the umbrella of the poverty reduction program.
    - Find financing sources for the Bayanteeg thermal power plant.
    - Conduct feasibility study for the construction of the high voltage transmission line between Erdenet and Moron.

3. THE ROLE OF EXTERNAL ASSISTANCE IN THE ENERGY SECTOR

3.1 Introduction

This chapter discusses the role of external assistance in the energy sector. The first section describes projects implemented during the 1992-2001 period. The second section presents information on projects being undertaken or proposed for the 2002-2006 period. The chapter's final section identifies potential impacts of loans and grants to the energy sector in the context of the national economy.

3.2 Donor Assisted Projects, 1992-2001

With the collapse of the Soviet Union and withdrawal of assistance (roughly one-third of GDP), Mongolia faced a range of problems. In the energy sector, the situation was especially acute because all of the plant and equipment were Soviet-built, money to purchase spare parts was next to non-existent, and there were a host of competing demands for the few budgetary resources. As a result, energy sector components were run down and became unreliable. Thus, the Government decided to utilize external assistance in order restore operations.

Initially, Russia provided credits to complete construction of facilities such as the extension of Power Plant #4. This was followed by assistance from USA, Japan, Germany, Republic of Korea, the Netherlands, Sweden, Denmark, the European Union (TACIS), as well as from the multilateral agencies including the World Bank, the Asian Development Bank, and ESCAP. Obviously donor assistance has played a key role in returning reliability to the energy system. It has also required an upgrading of management—from dealing with primarily one donor (the Soviet Union), there are now a considerable range of bilateral and multilateral donors.

Table 3.1 shows the list externally assisted projects completed during the 1992-2001 period. A total of 12 projects with a value of $147.81 million were funded through loans, generally on concessionary terms. A total of 34 projects with a value of $121.5 million were funded through grants. The total value of the completed projects was $269.31 million.

The key foci of the implemented projects was on rehabilitating existing facilities and sector planning and management. In addition, there were grants used to purchase diesel fuel on an emergency basis and parts for some of the sector's operating components.

Table 3.2 shows the list of projects that have been started but not completed during the 1992-2001 period. A total of 10 projects have been funded through loans valued at $313.97 million. 8 projects have been funded through grants valued at $21.22 million. In addition, domestic resources valued at $49.4 million have been provided. The total value of on-going projects is $384.5 million.

The bulk of the loans for on-going projects have been targeted at rehabilitation works at the major coal mines as well as upgrades of the main combined heat and power plants. Grants have been used for sector planning and management activities as well as providing power in soum centers.

In total, the energy sector secured $461.78 million in loans for 22 projects during the period. Grants provided $142.72 million for 42 projects. An additional $49.4 million was funded from domestic budget resources for the construction of transmission lines to 76 rural areas.

3.3 Scheduled Donor Assistance Activities, 2002-2006

Table 3.3 shows projects proposed for the 2002-2006 period. While some of the costs have not yet been determined, it is suggested that $65 million will be sought through grant funding. It is hoped that the private sector will invest $300 million, the bulk of which would be for the Eigiin hydro facility and the Ulaan Ovoo coal mine. Loans will be sought for $297 million, of which $160 million would be for the Orkhon hydro facility.

A high priority during 2002-2006 is rural electrification. Rural electrification programs include the 100,000 Solar Gers primarily for herding families ($5.3 million), and the use of renewable resources for soums. The first 5-year phase of this program will cost $23.8 million, and grant funding is being sought. A third program is the development of smaller hydro schemes.

Another high priority is improving the reliability and efficiencies of the CES. Projects that will contribute to these objectives include the Orkhon hydro facility, rehabilitation of Power Plant #4, and upgrading the transmission network.

3.4 Debts, Subsidies and Opportunity Costs

Public guaranteed external debt increased rapidly over the last half of the 1990s. The International Monetary Fund (IMF) collected data during June 2001 for its September 2001 publication*, Mongolia: Request for a Three-Year Arrangement Under the Poverty Reduction*

and Growth Facility—Staff Report. The June data indicated that public guaranteed external debt would total $912 million, or 89.4 percent of GDP. It seems likely that with the recently signed loan for $30 million with the World Bank (upgrading distribution network in Ulaanbaatar and other aimags) and a $60 million loan with Japan (rehabilitation of power plant #4), the June totals have been exceeded. Moreover, based on the data presented in the previous sections, it also seems likely that external debt will continue to rise, and the energy sector will play a leading role. It should also be noted that the IMF report indicated that not all debt associated with state-owned enterprises such as in the energy sector, have not been "properly recorded in the Bank of Mongolia's accounts." This could help to explain why the totals presented in sections 3.2 and 3.3 appear considerably higher than anticipated. Another explanation is that there have been delays in implementing projects, which has resulted in loan amounts not being shown in year-by-year totals.

A key question arises as to how much debt, even if on concessional terms, the Government in general, and specifically the energy sector, can sustainably manage. A "rule of thumb" measure is that financial institutions become "nervous" when debt approaches 100 percent of GDP. The issue is that even with concessional loans, principal has to be repaid, and this will negatively impact Government's budget unless the entity that has received the loans is able to repay them. As the financial data in Chapter 2 on the coal mines and the grid systems indicates, none of the entities would be able to repay their debts at this time. This means that over the next 7 to 10 years, when the concessionary grace periods end, the various components of the energy system have to become financially viable and self-sustaining enterprises. If they do not, then Government will have to meet the debt service on these guaranteed loans by reallocating budgetary expenditures.

One could argue that if the economy grows at the targeted rate of 6 to 7 percent, then Government would be able to continue borrowing at the recent pace (from 1996 to 1999, external increased from $500 million to $850 million, or from 46 percent of GDP to 94 percent). However, if the economy does not grow as rapidly as targeted, then borrowing will have to slow or the entities that have received the loans will have to demonstrate that they can repay them. If not, then budgetary reallocations will occur.

Given limitations of the budget, if the Government reallocates budgetary expenditures to subsidize inefficient operations in the energy sector, other sectors will be negatively impacted. This means that budgetary resources that could otherwise be allocated to investments that would directly result in economic growth and/or improve the quality of life

for low income groups, would be used to subsidize the inefficient operations in the energy sector. Simply, a dollar spent subsidizing inefficient energy entities is a dollar taken away from education, health or economic growth.

Moreover, the issue of subsidizing inefficient entities in the energy sector results in other economic distortions. The World Bank report (*Mongolia—Confronting Twin Challenges: Strategic Options for Rapid Growth and Reducing Poverty*) for the May 2001 Consultative Group Meetings, states "One sector in which the distribution of subsidies primarily benefits high income groups, for example, is in energy, where low tariffs mainly benefit industrial and commercial users. Subsidies to residential users also mainly benefit high income urban groups inasmuch as 50% of poor families lack access to electricity. Furthermore, the poor pay the equivalent of Tog 20,000 per ton for coal to fire their indoor stoves, or a price that is double that paid by the Energy Authority's power plants." In other words, the dollar taken away from income generating or welfare targeted investments to subsidize inefficient energy entities, is then being given to high income groups in the form of energy subsidies from which low income groups cannot proportionately benefit.

Government recognizes the tremendous opportunity costs that would result from continued subsidization of the energy sector. Thus, the Government is committed to ensuring that the energy sector becomes more efficient, more accountable and more dynamic so that it will be able to directly contribute to economic growth rather than subtracting from it. As noted in the previous chapter, the issues of payment of arrears, tariffs, and improved productivity are being addressed. Clearly, energy has to become a self-sustaining sector.

Table 3.1 List of implemented projects in Fuel and Energy sector under grant and Loans of Donors (US$millions)

Project names	Donors	Implemented period	Foreign financing	Domestic financing	Breif scop of work
1. LOANS					
FUEL SECTOR					
1. Purchase equipment and spare parts for coal mines	World bank Soft loan	1992-1995	5.0		Purchased heavy machines and its spare partsfor Baganuur and Sharyngol coal mines
2. Study for Institution and management of coal mines	World bank Soft loan	1994	1.02		Made a study for planning, maintenance, enviroment, hydrogeology and technology (technique) of the Baganuur and Sharyngol coal mines and provided a training for employee of the coal mines. Issued a recomedation to increase the price of coal.
Subtotal	**Projects= 2**		**6.02**		
ENERGY SECTOR					
1. Extension of Power plants and transmission network	Russia Credit	1992-1993	19.1		Installed new 2 boiers and 1 turbine and extended ash pond, water treatment system at PP#4, purchased equipment for some substations of electricity distribution network, and machines for workshop to manufacture steel-concrete pillars
2. Purchase equipment and spare parts	World bank Soft loan	1992-1993	3.4		Supplied deisel generators with capacity of1800 kW and 630 kW , 4 pieces of each typy and spare parts
3.Extension of PP#3	Russia Credit	1992-1994	10.5		Costructed tupping device (coal unloading facilities), heavy oil unloading and service system, heating facilities for received freezed coal at PP#3
4. Purchase equipment and spare parts / 2 mln DM /	Germany Soft loan	1992-1994	1.34		Purchased spareparts for energy equipment and 300000 is used for the consulting service of ÊÀÂ.
5. Rehabilitation project Darkhan-1, 2	Germany (KfW) Soft loan	1993-1995 1994-1996	9.8		Rehabilitation of 4 boiers and 1 turbine and its auxiliary equipment, control system facilities at Darkhan PP.
6. Egiin nydro power project	ADB soft loan ÌÎÍ-1152	1994-1995	2.75		Prepared detailed design and Bid document for Egiin hydro power project
7. Extension of 'Heat' boiler only plant	Russia Credit	1994-1995	2.3		Extended the 'Heat' only boiler plant in Nalaikh district
8. Rehabilitation project for PP#4 (I phase) MON-Ð3	Japan Soft loan	1997-1999	(4.49 bln yen) US$41	620 mln Tug	The coal preparation system converted into Direct firing for the first 4 boilers and rehabilitated the control system and heating surfaces of the 4 boilers

9. Power rehabilitation project MON-1334	ADB Soft loan NDF Soft loan	1996-2000 1997	37.124 5.409	8.300	The coal preparation system converted into Direct firing for the 4 boilers and rehabilitated the control system and partial heating surfaces of the 4 boilers Rehabilitated 2 turbines and its auxiliary equipment
10. Rehabilitation project of the Choibalsan PP (phase – 1)	Germany (KfW) Soft loan	1998-2000	(15 mln DM) $ 9.1	650 mln tog	Rehabilitated 3 boilers and 2 turbines and its auxiliary equipment, control system of Choibalsan PP.
Subtotal for Energy sec.	**Projects = 10**		**14179**	**$9.57**	
Total for Fuel & Energy	**Projects = 12**		**147.81**	**9.57**	
GRANTS					
FUEL SECTOR					
1. Improvement of management structure in the Mineral sector	World bank Technical assismance	1991-1993	0.6		Issued the draft of Mineral Law, provided a study to improve the structure of Mineral sector, management of mines, environment, technique and technologies of mines
2. Coal sector Master plan	Japan(JICA) Grant	1993-1995	3.0		Worked out the Coal sector Master plan and on the base it issued the request to rehabilitate Baganuur and ShiveeOvoo coal mines.
3. Imrovement of accounting system of Baganuur coal mine	World bank Technical assismance	1995	1.15		Worked out a recommedation to use International accounting system at the Baganuur coal mine
4. Improvement of coal mine	USAID grant	1997	2.4		Purchased heavy machines for Sharyngol coal mine
Total	**Projects=4**		**7.15**		
ENERGY SECTOR					
1. Feasibility study for PP	Japan (JICA) Grant	1991-1992	1.3		The Feasibility study for Mine mouth power plant at Baganuur coal mine is done.
2. Improvement of control system	USAID Grant	1992	0.6		The Feasibility study to improve the control system at PP#3, Darkhan PP and Dispatch center of CES is done
3. Utization of wind power	DANIDA Grant	1992	0.07		Provided a study for utilization of wind power in Umnugobi, Dundgobi and Dornogobi provinces and the report is transferred to the Renewable energy institute
4. Egiin hydro power project	ADB TA	1992-1993	1.4		The Feasibility study for the Egiin Hydro power station is done.
5. Supply of liquid fuel	DANIDA Grant	1993	1.59		The deisel oil is purchased and delivered to the consumers of western regions

6. Review of Energy sector planning	New Zeland Grant	1993	0.08		The study for the financial planning in the energy sector is provided and the report is issued
7. Energy Audit, Efficiency and Coservation Study	ADB Grant MON-1750	1993-1994	0.41		Measured the energy loss in energy generation, transmission, distribution systems and some endusers, provided analyses on it and provided training on energy conservation.
8. Feasibility study for PP	Japan (JICA) Grant	1993-1994	1.0		The Feasibility study to convert the 'Heat' only boiler plant to cogeneration power station at the Erdenet Copper mine is done.
9. Reduction of pollution at PP#4	Japan (JICA) Grant	1991-1995	15.0		Improved ESP, reduced the wear of pipes for transportation of coal dust and ash removing system at PP#4
10. Institutional and tarif study for CES	ADB TA (MON-2035)	1993-1995	0.5		The study is done and recommendation is given to the CES
11. Feasibility study for Power rehabilitation project	ADB TA (MON-2093)	1994-1995	0.1		Prepared the Bid document for the Power rehabilitation project that implemented at PP#3 and UB District heating system
12. Power system master plan	ADB TA (MON-2095)	1994-1995	0.47		The Power system Master plan is done
13. Training Energy sector personal	Å-7 group Grant	1995	0.3		20 engineers have been envolved for the training in Italy, Germany and France
14. Provide relaible operation	USAID TA	1992-1996	40.5		Supplied equipment, spare part to the Power plants and coal mines to provide stable and relaible operation of the fuel and energy sector
15. Improvement of Energy supply	TACIS grant EMON9401	1995-1996	1.2		Reviewed generation and transmissio, distribution of heat energy, recommended efficient utilization options, provided training program at darkhan and Choibalsan cities
16. Energy Conservation	ADB TA (MON-2350)	1996	0.1		Defined the scope of work for Energy Conservation project and the Bid document is prepared
17. UB Heat efficience	ADB TA (MON-)	1996	3.8		Defined the scope of work for UB Heat Efficiency project and the Bid document is prepared
18. Improvement deisel generators	USAID TA	1997	2.94	0.36	Purchased 10 deisel generators and installed in 4 province centers
19. Improvement of district heating equipment	Japan (JICA) Grant	1997	11.0	0.01	Improved the eqipment at PP#4 for district heating
20. Preparation for Egiin hydro project	ADB TA (MON-1653)	1997	0.5		Used legal advicer for contract negotiation

21Taishir Hydropower project study	Kuwait Fund Grant	1997	1.0		The Feasibility study is done.
22. Improvement of accounting and management system of CES	ADB TA (MON-2571)	1997-1998	0.5		Improved of accounting and management system of CES and 3 energy enterprices
23. Power rehabiltation project	DANIDA Grant	1996-1997	5.0		Partial rahabilitaion at UD distivt heating system
24. Power reahbilitation project of soum centers	Japan (JICA) Grant	1997-2000	20.36		Rehabilitated deisel generators of 134 soum centers by phase I, II, III and IVa
25. Feasibility study for PP	ROK Grant	1998-1999	0.5		The feasibility study for mine mouth PP at Bayanteeg coal mine with capacity of 40 mW
26. Support for Mongolian energy sector	TACIS grant EMON9601	1999-2000	2.1		Studied wind energy resources at Bayankhongor province and implemented energy conservation projects at several industries of UB and Darkhan
27. Renewable energy project	USAID grant	1998-2000	0.2		Studied solar energy resources in Molgolia
28. Renewable energy project	Germany GTZ Grant	1998-2001	0.8		The study of renwable energy resource in Zavkhan province and extended capacity of Bogd hydro power plant by 400 kW
29. Loss reduction of district heating and electricity network	World bank ESMAP	1997-1999	0.53		The study for the loss at the heating and electricity network is done and defined scope of work of Energy project funded by World bank
30. Improvement of Billing and collection system of CES	ADB TA MON-3029	1998-1999	0.5	0.01	The study and design to improve the bill collection system of CES are done
Sub Total	**Projects=30**		**114.35**	**0.38**	
Sum in Fuel and Energy sector	**Projects = 34**		**121.5**	**0.38**	
Total of loan & grants					
ENERGY SECTOR	**Projects= 40**		**256.14**	**9.95**	
FUEL SECTOR	**Projects= 6**		**13.17**		
TOTAL FOR FUEL AND ENERGY SECTORS	**Projects = 46**		**269.31**	**9.95**	
		Loans=$147.81	Grants=$121.4		

Table 3.2 List of ongoing projects in the Fuel and Energy sector

Project names and period	Loan agreement	Donor's name	Financing US$ mln	Consulting company	Contractor	Scope of work
ENERGY SECTOR						
À: LOAN						
1. Energy Conservation project	MON – 1492 Soft loan	ADB Mongolian portion	10.0 3.9	COWI	BERIS MCS	Installation of 1137 Heat meters, 141 electric meters, 167 current transformers, insulation of district heating pipes COMPLETED
2. Heat efficiency project **/1998-2000/**	MON – 1548 09.12.1997	ADB Mongolia Spain	40.0 12.7 3	COWI (Denmark) Fichtner (Germany)	Package 1 BERIS	Installation of 22 variable flow pumps at power stations and separation of internal heating system of PP from district heating system of UB
3. Construction of Cogeneration power plant in Dalanzadgad	MON-2	ROK Mongolia	8.724 0.150	Hyundai Engineering Construction	Hyundai Engineering Construction and its Subcontractors	Constructed Cogeneration power plant with capacity of 6 mW at Dalanzadgad city of Umnugobi province
4. Rehabilitation of Choibalsan PP (phase-II)	HPS-20-8-1059	Germany Mongolia	(6 mln DM) $ 3.3 0.6	KAB (Germany)		Improvement of Ash pond, Fire protection system, Deaerator

5.Rehabilitation project for PP#4 **(phase – 2)**	MON-P6	Japan Mongolia	(6139 bln Yen) $58mln 9.0	EPDC		Rehabilitate remaining 4 boilers Convert into direct firing system Improve control system Replace heating surface
6. Energy project		World bank Mongolia	30 5			Improve distribution network in UB, Choibalsan and other
7. Taishir Hydro power station		Kuwait Fund Abu-Dabu fund Mongolia	20 14 5			Construction of Hydro power station with capacity of 8 mW
Total credits/loans **Mongolia** **Total amount** **Quantity of project**			**187.024** **36.35** **223.374** 7			
B. GRANT						
1. Rehabilitation of Power plant of soum centers IV-1		Japan JICA	(1138 mln Yen) US$10 mln/	PCI	Mitsue	Installation of 93 deisel generators with capacity of 60 and 100 kaw in 45 sou centers
2. Economic Policy Support: Sub-project: Energy Sector Commercialization and Privatization	1998-1999	USAID	-	DAI	DAI and PA	Work out tariff calculation method and other legal documents
3.Energy Training Project	1997-2005	Germany GTZ	**10 mln DM**	Decon Bewag		Supply equipment of 7 laboratory install it ant provide training for trainers

			(US$8 mln)			
4.Rehabiltation of PP#4	2001-2006	Japan JBIC	51 ñàÿ èåí (0,42 ñàÿ $)	EPDC		Work out the Bid document for the rehabilitation project
5.Capacity building for energy planning	2000-2001	ADB MON 3299	0.5			Work out new Energy master plan
6. Purchase energy equipment and spare parts for PP#4	2001	Japan Non-project grant	**10790600 0 Yen (US$0,9 mln)**	Marybeny Techmatek corporation		Purchase equipment that not included in the project scope of work
7. Purchase energy equipment and spare parts for Dalan-zadgad PP	2001	Japan Non-project grant	**47474400 Yen (US$0.4 mln)**	Mongol-Altai trade		Purchase and supply machines for transportation ash and coal
Amount for grant Quantity			**20.22 7**			
Total loan and grant amount Domestic investment TOTAL Total projects			**207,244 36,35 243.594 14**			
2. FUEL						
À. LOAN						
1. " Coal" project **\1996 – 2001**	ÌÎG/2854 1996.10	World bank Mongolia	35.0 10.4	Norwest (USA) Artur Anderson (Australia) Vardell Armstrong (British)	Baganuur coal mine	Improve the technique and technology of Baganuur coal mine
2. Baganuur and Shivee-Ovoo Coal mine Development Project (I).	MON-P4 1997.2.28	Japan JBIC	5827mln Yen	TAIHEIE ÌÈÍÊÎÍ	Coal Authority Baganuur and ShiveeOvoo coal mines	Rehabilitation of technique and technology of coal mines Baganuur and ShiveeOvoo \2422mln for BN (US$ 22mln, 3405 mln for

\1997 – 2001						ShO(US$ 30.95mln)\
3.Shivee-Ovoo Coal mine Deve**lopment Project (II).** **\1998 – 2003**	MOON-P5 1997.12	Japan JBIC	4298mln Yen(US$ 39.0 mln)			Extension of MON-P4 project for ShiveeOvoo
Loan amount **Domestic investment** **TOTAL AMOUNT** **Quantity of projects**			**126.95** **10.4** **137.35** **3**			
1.1.1.						
1.Zamyn Uud transshipment facility **\1998-2001**	TNMON 9801	TASIC Mongolia	1.1 mln ECU /US$1.0mln/ 2.7	ETC (Germany)		Provide study for a transshipment and supply equipment
Grant amount **Domestic resource** **Quantity of project**			**1.0** **2.7** **1**			
Total for Fuel sector			**127.95**			

Domestic resource **TOTAL AMOUNT** **Quantity of projects**			**13.1** **141.05** **4**			
Total for loan in Fuel and Energy sector **Domestic resource** **Total grant** **TOTAL AMOUNT** **Total projects**			**313.974** **49.45** **21,22** **384,544** **18**			

Table 3.3 List of Expected Projects in Fuel and Energy

No	Project names	Period	Required financing			Donors	Scope of work	Comments
			Domestic	Foreign	Total			
	2. FUEL				US$ mln			
1	Establish coal testing laboratory	2002-2004	0.5	4.5	5.0	Japan grant	Utilize new coal testing equipment	
2	Development of UlaanOvoo coal mine	2002-2005		20.0	20.0	Foreign investment	Utilize new coal mine	
3	Training for coal sector personal	2002-2004		3	3	World bank TA	To traine coal sector persoals and preparation of legal document	
4	Petrolium product transshipment and storage holding facilities at Zamynuud station	2002-2004	1.0	13,0	14,0	Japan Grant		
5	Extension of Bayanteeg coal mine	2002-2003		1.3	1.3	ROK Grant		
	Sub total		1.5	41.8	43.3			
	ENERGY SECTOR							
1	Power rehabilitation projec for Soum centers IV-2	2002		693 mln Yen	5.77	Japan Grant	Rehabilitation of deisel generators in 25 soum centers	Agreed by Governments of Japan and Mongolia in December 2001
2	Durgun Hydro Power project	2002-2005		24.0	24.0	China (Credit)	Construction of Hydro power project with capacity of 12 mW	Agreed with Chinese Government and not approved by the Parliament yet
3	Feasibility study for Orkhon Hydro power station	2002-2003		0.5	0.5	Japan Grant	Detailed investigation for a Orkhon Hydro power station with capacity of 100 MW and work out a Feasibility study	Pre-feasibility study is done in 2000

4	Constuction of Orkhon Hydro Power Station	2002-2006		160	160	Japan Soft loan	Construction of Hydro power station with capacity of 100 MW	
5	Rehabilitation of ash pond for PP#4	2002-2003	0.5	4.0	4.5	Japan Grant		
6	Rehabilitation of turbines for PP#4	2002-2004	1.5	5.0	6.5	Japan Soft loan		
7	Bayanteeg Power station	2002-2004		52.6	52.6	ROK Soft loan	Construct a Mine mouse power station with capacity of 40 MW	The cost of US$ 52.6 mln is high for the ROK to give an assistance, So we are considering to reduce the capacity to 12 MW and cost to US$ 17mln
8	Rehabilitation of transmission network and monitoring system for dispatch center	2001-2002		4.797 mln DM	3	Germany Softloan	Rehabilitation of 13 substation and its monitoring system connect to monitoring system of the Dispatch center 8 rehabilitation of 27 oil breaker and high frequency communication system	Signed the Memorandum with KfW bank's mission in July 2001
9	Power rehabilitation project for low pressure boilers	2002-2004	5.0	25.0	30.0	ADB Soft loan	Rehabilitation of boilers with capacity of 75 ton/h	
10	100000 Solar Powered Nomadic families in rural areas of Mongolia	2000-2010	1.1	5.3	6.4	Japan Germany Soft Loan	It is expected to provide 167 off-grid Sum centers by Solar PV/ Wind/Diesel Renewable energy power systems (up to 200kW capacity)	The Propsal was submitted to the Donor's meeting in Ulaanbaatar held June, 2000 and "Mongolia Consulative Group Meeting" held in Paris, 15-16 May, 2001

11	Improvement of Rural Power supply using Renewable Energy Sources - First Stage - Second Stage - Third Stage	2002-2015 2002-2004 2005-2009 2011-2015		148.162 23,814 43,858 80,490	148.162 23,814 43,858 80,490	Japan Germany The Netherlands Grant/Soft Loan	It is expected to provide nomadic families by Solar Home System (SHS): 5 000 set of SHS by 2002 45 000 set of SHS by 2005 50 000 set of SHS by 2010	The Propsal was submitted to the "Mongolia Consulative Group Meeting" held in Paris, 15-16 May, 2001
12	5 Small and Mini hydropower Plant	Grant	0.55	4.75	5.3	Grant		The Propsal was submitted to the "Mongolia Consulative Group Meeting" held in Paris, 15-16 May, 2001
13	Chargait Hydro power project	2002		27.35	27.35	Chine Credit	Construct Chargait Hydro power station with capacity of 8 MW including Feasibility study for this station	
14	Egiin Hydro power station	2003-2007		280	280	Foreign investment	Hydropower station with capacity of 220 MW	To find financial resourse
	Sub total		8.65	319.77	336.82		The cost for Egiin hydro project is	
	TOTAL		**10.15**	**362.57**	**380.12**		not included.	

4. ENERGY SECTOR RESTRUCTURING

4.1 Introduction

This chapter presents an overview of energy sector restructuring. Considerable progress has been made, especially as a result of the 2001 Energy Law. However, the process is far from complete and the performance of the unbundled energy companies needs to improve. Restructuring is a lengthy process that will not necessarily provide magical results overnight. Instead, it involves changing the manner in which companies operate—a different way of thinking.

Following the introduction, the chapter discusses restructuring in a broader global context. The next section describes the status of the energy sector. The following section provides an update on key elements of sector reform. The final section presents an outline of the emerging regulatory framework.

4.2 The Global Context for Restructuring

This section discusses restructuring from the perspective of how state-owned energy companies evolved, their problems and how these have been addressed by restructuring the energy sector. Implicit to the discussion are the various obstacles and challenges that have limited the effectiveness of restructuring, while at the same time clearly showing that restructuring is essential to the efficient delivery of energy services.

The development of the economy of any country, regardless of its political system is heavily dependent on a well-functioning infrastructure particularly energy supply. Public utilities, such as companies that generate, transmit and distribute electricity and heat, are a significant part of the infrastructure and major contributors to the national product. The utilities are traditionally large, capital-intensive entities, are generally not subject to competition. Due to their critical role in the economy they are considered strategic. Historically they have been exceptionally vulnerable to political interference in their activities such as tariffs and investments. This has frequently led to the imposition of low and controlled prices, subsidized services, and has endangered the financial viability of the power enterprises and introduced inefficiencies into the economy.

In the last few decades, the declining economic efficiency in and lack of reliability of power supplies has been notable worldwide. In most of the cases this decline was brought about by the prevailing sector models—monopolies that were often state-owned, which encouraged ever-increasing government interference dictated by conflicting social, economic and political objectives. In addition, the companies operated in a noncompetitive environment so the incentive for economic efficiency was extremely limited.

The nature and seriousness of the problems varied from country to country, but very few escaped them completely. The political and social framework that defined the economic model of a country and the state of its development influenced the nature and the extent of the problems, but they did not provide immunity against them. Frequently similar problems plagued the power sector in both the market and in the centrally planned economies.

In Mongolia, as in other ex-socialist countries, the government role was overwhelming. Rigid institutional structures were maintained in the entire economy, including the power sector. Plans for development and operation were centrally developed and controlled with the main objective to meet pre-established performance targets. Economic criteria were considered in the context of overall plans, and decision making by and large, was based on political and technical considerations. Appropriate economic and financial evaluations did not support decision-making, which included the design and determination of electricity tariffs. As a result the revenues often did not cover investment requirements, and/or the operating costs of the power companies. In turn, these led to an unhealthy reliance on government funds, further increasing the scope for government interference.

The built-in inefficiencies of central planning gradually became evident worldwide. Planning often became a personalized bargaining process and together with the absence of legitimate incentives had a devastating impact on the economies, which stagnated at best. By the late 1980s it became evident to many of the countries that their socialist governments had lost the ability to maintain an acceptable economic framework and to provide critical services efficiently. Their response was the rejection of the political systems associated with central planning. In most of the ex-socialist countries

this involved changes such as establishing a democratic political system with a strong mandate to dismantle central planning and begin the transformation to a market economy.

During the last decade a consensus evolved in Mongolia, to reform the country's political and economic system and as part of the reform to put the power sector on a technically and financially viable basis. Since the country's budgetary conditions do not permit the badly overdue re-capitalization of the sector entities, the government has been looking for other means to ensure the sector's continuous operation, supporting the further development of the economy. Restructuring, including the privatization of some of the components, appears to be the obvious answer and the government has been evaluating various options regarding ownership arrangements and structures.

The most significant reason to modernize the sector is to improve its efficiency. However, neither the power sector itself nor the Mongolian government has the financial capacity to provide the needed resources. Capital inflow is needed from strategic investors with the professional knowledge and resources to operate the entities. In fact, due to resource constraints, renewal of vital facilities has been increasingly postponed and deferred maintenance has increased at an alarming rate. Although, apart from the rural areas, there is no significant unmet demand as yet, the cost of power produced is increasing and the sector is consuming its capital. The urgency for remedial actions is increasing and even if tariffs, which are deficient both regarding structure and level, could be corrected instantly, there would be not be sufficient time to accumulate the needed resources for the re-capitalization.

4.3 The Current Status of the Energy Sector

This section describes the current energy sector with respect to its operations and issues. Particular attention is given to coal supply because it is the primary fuel source for the heat and power systems. Coal supply has encountered many problems in recent years, and these problems have limited the effectiveness of restructuring.

Despite successes in moving beyond the generation, distribution and financing crises over previous years, the power and energy sector faces additional efficiency, structural and financial problems. These include continuing low levels of energy use efficiency, inadequate resource mobilization, poor performance efficiency of assets,

indebtedness of the energy enterprises, an incomplete legal and regulatory framework, continuing financing and technical problems in coal mining, and ineffective institutional and asset management arrangements.

Large electricity tariff adjustments have been implemented since 1990 and electricity prices have kept pace with inflation. The present average tariff for power is still relatively low and further tariff increases are required especially for heat supply and by electricity produced by diesel power plants in rural area.

Since 1989 electricity generation dropped steadily as a result of the economic downturn. However, during 1994 sales began increasing, rising to 1,939 GWh in 1997, reflecting growth of the economy. Sales then fell to 1,513 MWh but have risen since to 1,744 GWh in 2000. Industrial demand accounts for 62 percent of all sales and residential demand represents about 20 percent. Peak demand in 2000 was around 525 MW with installed capacity at 802 MW.

District heating schemes exist in all major cities and towns. Ulaanbaatar, Darkhan and Erdenet. Eastarn part of Mongolia and Dalanzadgad have separate coal fired power plants operated by local utilities. Due to low available capacity of existing power plants and combined with high losses in heat transmission systems, heat demand cannot be met fully when outside temperatures are very low. Electricity and district heat supply in the five provinces outside of the centralized grid is provided by isolated diesel generators and small coal fired heat only boilers.

In view of replacing the high cost small diesel stations, grid extensions including in Choibalsan (10/35/6 kV substation and electricity transmission lines of 110kV of Choibalsan- Baruun-Urt of 186 km length) and Baruun-Urt (110/35/10 kV substation) have been completed since 1997. These extensions provide cheaper and more reliable energy to consumers in Sukhbaatar aimag and adjacent districts by using surplus capacity from the Choibalsan heat and electricity stations.

Sharp increases in the price of diesel fuel and the lack of funds for maintenance have resulted in severe load shedding in aimags not connected to the grids. The present electrical peak demand in each aimag is relatively small at between 2.0 to 3.5 MW.

Because of the near collapse of the energy system by the mid 1990s, he Government's strategy has focused, with external assistance from the Japan, Germany,

USA, World Bank, ADB and Russia on the stabilization of existing energy systems to improve capacity utilization and reliability of the power plants. Some of these projects are still ongoing—and the energy system needs to become more efficient as a whole before it can be realistically privatized. Structural change and the reform of asset management have also been supported by technical assistance—and assistance with restructuring is expected to be required for several more years..

Coal Supply: An Obstacle in Restructuring

One of the major primary energy resources in Mongolia is coal. Mongolia has abundant reserves of coal, and proven reserves are estimated at about 5 billion tons. Most of the deposits consist of lignite, however substantial volumes of high coking coal are also available. Demand for coal at present is around 4-5 million tons per annum of which power plants are the largest consumer purchasing more than 70 percent of all coal mined.

The problems at the coal mines seriously affect the power stations in relation to both quality and quantity of coal supplied. The use of non-design coal causes operational problems for the power plants.

Existing coalmines have the potential to supply the country's coal needs for at least 80 years. The three major sources are large-scale, open-cut operations at Baganuur, Sharyn Gol and Shivee-Ovoo, supported by medium scale operations in Aduun Chuluun. These account for 90 percent of production.

The problems in the coal industry are caused by the familiar cycle of poor condition of coal mining equipment combined with the obsolete rail haulage system, lack of spare parts and inadequate treatment facilities. The problem is compounded by continual arrears owed by the power plants to the coal mines.

The lack of adequate resource mobilization in state owned organizations, due to inadequate pricing arrangements, low productivity and lack of effective accounting and financial management, makes financing equipment purchases and maintenance a significant problem without resorting to Government budget resources through credits and transfers.

During the last few years, $50 million was invested in the main coal mines to improve production conditions. This has raised capacity utilization to 49 per cent at Baganuur and Sharyn Gol mines. However, additional actions are required to consolidate production and improve efficiency of, and quality in, these mines and in Shivee-Ovoo.

The crisis in coal production and supply, financing and asset management systems mirror those of its end user. The cycle of low productivity and margins, lack of adequate resource mobilization due to the indebtedness and delayed payment from the EA and consequent inefficient assets management cannot be addressed by the partially state managed "care and maintenance" methods previously used. For example, coal quality in some mines is declining as a result of improper de-watering caused by lack of operational funds. As a result of improper de-watering coal was submerged and became frozen, causing difficulties both at the coalmines and the power stations. This has required extra financial resources to address the problem and has reduced efficiency and returns in the power stations.

These conditions illustrate basic structural problems of the sector, including oligopoly in electricity demand, monopoly in electricity and heat supply, oligopoly in coal demand and monopoly in coal supply. A holistic approach to sector transformation is required including privatization of coal mines in conjunction with structural reforms in the power sector. The most difficult task in forging a strategy in such markets is how to identify appropriate price levels and asset management structures that lead to the optimal allocation of resources, through market forces, and result in efficient and internationally comparable cost structures.

The cost structure of each energy option should be examined, based upon internationally accepted financial standards as a preliminary step to achieving optimal allocation of resources. Thus, identification of costs, together with the enhancement of financial transparency on the part of energy related concerns, will be imperative. However, under the influence of both monopolistic and oligopolistic structures, this alone does not necessarily guarantee the optimal allocation of resources. Oligopoly business entities tend to take advantage of their dominant power in the market and lack incentives to reduce costs. These immediate priorities have not been addressed previously in a holistic manner.

4.4 Reforming the Energy Sector in Mongolia

This section discusses key elements of the energy sector restructuring process. Included is a description of the legal framework that enables restructuring. The discussion also presents the roles of the new companies and agencies resulting from the unbundling of the energy sector.

A major immediate priority is to complete the restructuring of the sector within the framework of the 2001 Energy Law, including the development of a new industry structure based on the privatization of generation and distribution assets and improved commercial operations of the transmission assets that would remain in state hands. A new regulatory structure will be established. Public expenditure will be focused on improving the asset base of the sector supported by technical assistance for policy reform and preparation of privatization transactions. The new Energy Law provides a framework for the transformation of the sector and strengthens tariff reform and structural change.

In other words, the main purpose of energy sector reform lies in addressing the current organization of energy production, transmission, distribution and consumption in the most effective way, and creating conditions that enable coverage of actual costs in all stages of production and consumption. Moreover, energy reform and its accompanying regulatory system and pricing structures, has to take into consideration national security and the country's overall development efforts.

In connection with energy sector restructuring, relevant changes have made by resolution on "Establishment, Change and Abolishment of Some Organizations and Approval of some Rules" based on comments provided from the different Government agencies.

Unbundling

According to the Energy Law, shareholding in the unbundled state-owned companies will be distributed as follows: the Ministry of Infrastructure 41 percent, the State Property Committee 39 percent, and the Ministry of Finance and Economy 20 percent. The Energy Law tasks the state-owned companies with representing the Government, and directing corporate policy on energy production and supply, increasing

asset effectiveness in a way that optimizes technology, and providing short and long term policy directives.

In addition to establishing separate generation and distribution companies, the National Dispatching Center and the Electricity Transmission Company have been established. The National Dispatching Center is responsible for ensuring reliable and continuous operation of joint activities of energy production, transmission, and distribution by independent business entities in order to meet national requirements.

The local utilities in the 3 western aimags have been transferred to local government ownership, and energy enterprises of the 5 aimags into companies with stock ownership issued by local authorities.

The Energy Regulatory Authority is responsible for approving rules, regulations, instructions and methodology, setting production and service procedures to be adhered to by independent business entities without interfering with their commercial relations, and setting energy prices and tariffs.

The Government has successfully addressed the crisis in power supply; however it now needs to consolidate and improve efficiency, reliability and sustainability through a combination of policy and institutional reforms, including privatization of generation and distribution assets and a long-term investment program.

Achieving this will require completion of a sustainable ownership and asset management structure, and establishing a best practice legal and regulatory framework for full commercial operations of the sector. This would be achieved through a combination of expenditure and policy interventions.

4.5 Regulation

This section describes the role of regulatory agencies in restructuring. In addition, the section discusses regulatory instruments and their objectives.

Generally electric utilities are large entities, often operating without effective competition even in a market economy. Due to their dominant role and to their indispensable services, their position is considered strategic. Often due to their size, but basically because of their overall importance, the entities' monopolistic position is tolerated within a certain (regulatory) framework. In these cases the entity's operation is

"regulated" to ensure that consumers are protected from possible monopoly abuses and that the absence of competition would not adversely influence the quality of the services provided and the utilization of economic resources.

The regulatory framework essentially consists of technical and economic regulations. Technical regulatory matters pertain to the operation of the industry, including matters such as safety, assets and other property, environmental regulations, and acceptable standards for operation of the electrical system. Economic regulations aim to ensure appropriate pricing, and the financial viability of the energy companies.

The specific duties of the regulatory agencies, ideally with independent authority in regulatory oversight, include:

consumer protection against discriminatory pricing equitable cost recovery for the suppliers;

assurance that prices are not based on excessive and imprudent costs;

maintenance of appropriate conditions (mainly through pricing) for the energy companies' continued financial integrity and for high quality of service;

maintenance of a sufficiently attractive technical and commercial environment for the entry of additional, efficient service providers in the case of an open access market structure;

promotion of safe and economic use of electricity (demand side management);

arbitration in cases of disputes among sector entities; and

to generally secure the orderly and economic operation of the energy sector.

Regulatory Instruments

Apart from the tariff, the main regulatory instrument is the license issued to the energy companies. The licenses are issued by the regulatory body and only to technically and financially competent companies. Usually separate licenses are issued to production, transmission, and distribution companies and often they are valid only for a definite period. The more prominent areas covered by the licenses include:

rights and obligations of the licensee reflecting its operational profile;
regulations covering significant investment in new assets;
obligations to establish and meet quality of service standards;
approval of tariffs and conditions of service;
rules for financial discipline including the creation of financial reserves; and
regulations governing emergencies.

As the sector restructuring moves forward, it may be warranted to introduce incentive mechanisms into the tariff structures. In many countries it was found that licensees could make significant improvements in the quality of service, given the proper incentives. Common incentives for power generators include improvements in heat rates or improvements in the availability of efficient generating units. In the case of distributors, improvements in the quality of service, as measured by the frequency and/or duration of outages, are factors that could be rewarded as well as a reduction in the level of technical or commercial losses. The reward could be in the form of an incremental increase in the allowed return on equity or a certain increase in the allowed energy charge based on achieving certain levels of performance.

While it appears from the above that the regulatory body oversees the entire operation of the power sector, in fact some specific areas are often regulated by other agencies (or regulations) than the power regulatory agency. These may include:

environmental agencies (for water, air and waste pollution);
unfair trade practices and antimonopoly agencies;
standards and measurement agencies (controlling metering and e.g. installation / connection standards);
regulations governing building codes, job safety, accounting practices and information disclosures.

Consequently, to effectively regulate the energy companies, close coordination among the various agencies is imperative. In terms of phasing in of priority actions, the first phase is the privatization of energy sector assets, followed by a focus on improving commercial operation of energy enterprises, and thereby enhance the financial viability of the sector in short term.

A second priority phase is that in the medium term, the policy objectives of the regulatory framework will be focused on the management of assets and improving their efficiencies, productivity, and returns to the sector. The third priority phase is the development of a long-term expenditure program that enables an appropriate matching of supply and demand resources that optimizes energy efficiencies, while at the same time providing a vehicle for the energy companies to achieve their return on investment targets.

As the above indicates, considerable progress has been made in restructuring the energy sector despite inefficiencies in coal production, run down plant and equipment, and the heritage of a centrally planned economy. External assistance has enabled the upgrading of coal production and the energy system more generally. While these important steps have been taken, the energy companies that have emerged as a result of restructuring need to improve their performance. Only then will they become viable assets that will benefit the nation.

Energy Sector Donor's Meeting:
PRELIMINARY WORKSHOP ON THE DEVELOPMENT OF ENERGY SECTOR

Ulaanbaatar, Mongolia, December 11 - 12, 2001

5. Rural acces to Energy: An important Social issue

Issues and Options
for
Decentralized Electricity Supply

Abbreviations

ATP	Ability To Pay
AU	Energy Authority
CES	Central Energy System
DE	Decentralized Electrification
DFE	Department for Fuel and Energy
EES	Eastern Energy System
ERA	Energy Regulatory Agency
IRR	Internal rate of return
kWh	kilo Watt hour
MFI	Micro Finance Institutions
MFP	Micro Finance Programs
MOI	Ministry of Infrastructure
NPV	Net present value
UB	Ulaanbaatar
WES	Western Energy System
WTP	Willingness To Pay

Currency:

US$ 1 = Tg 1100 (October 2001)

I. Existing Situation

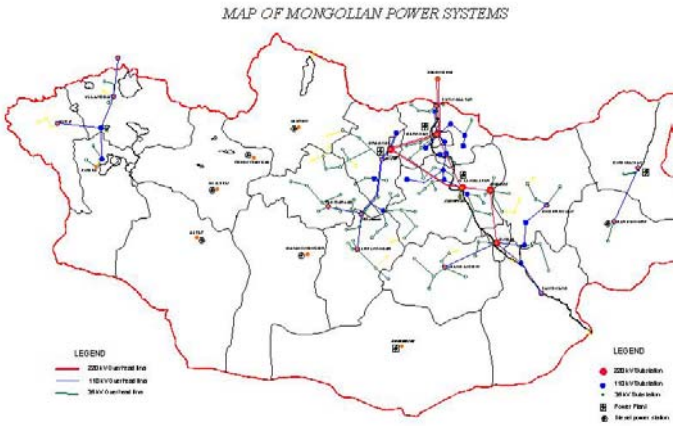
Introduction

This report deals with three different electricity issues in Mongolia. First, access to electricity is not equal for all Mongolians. Given climatic and geographic conditions, the country has come a long way in providing service to a majority of the population. However, a substantial part of the population still does not have access and not much is done to provide this in the near future. Second, part of those who enjoy access to electricity receive unreliable service. Major improvements were implemented during the past few years particularly in the interconnected central energy system, but those supplied by the western energy system and isolated diesel systems continue to receive inconsistent service. Three, the current approach to supply electricity is financially not sustainable. Large subsidies are provided, for equipment as well as operating costs, and there is no mechanism to manage these subsidies or to bring them under control. Each of these issues will be discussed in more detail in what follows, as well as options for providing more and faster access, more reliable service in a more sustainable way.

The current electricity supply can be characterized as follows:

(i) In the large cities (Ulaanbaatar, Erdenet, etc) and Aimag centers, electricity is supplied 24 hours per day and the supply has become fairly consistent. The Central Energy System (CES) supplies more than 94% of all electricity in the country and interconnects the main cities. Up on completion of recent rehabilitation work to the plants in UB, the supply has become fairly reliable. Although not as reliable as the CES, the Western Energy System (WES) provides about 1.2% of the electricity in the country (Hovd, Bayan-Olgii, Uvs Aimags) through an interconnection with Russia. Diesel back up capacity exists in case Russia cannot supply the required power and energy. The Eastern Energy System (EES) also provides about 1.2% of the electricity in the country. The Choibalsan Combined Heat and Power (CHP) plant supplies Dornod Aimag and in the future also Bayan-Urt.

(ii) Five out of the 21 Aimags centers (Altai, Bayanhongor, Dalanzadgad, Murun, and Uliastai) are not connected to either CES, WES, EES. Four of these Aimag utilities operate isolated diesel sets[1] that provide 24 hour per day service, albeit not always reliable. This diesel generation accounts for about 1.8% of the electricity supplied in the country. A subsidy of more than $5mln per year is provided by the Government to cover the gap between costs and revenues.



(iii) In smaller towns and villages, out of 314 Soums centers, 142 are connected to the CES, EES, or WES to date. Although these Soum centers have 24 hour per day service, it is somewhat less reliable than the network they rely on because of their remoteness. The 172 Soum centers that are not connected to a network and operate isolated diesel sets. Of these 172 non-connected Sums, 144 has received new generators under a Japanese grant aid program during the past few years; And 28 more Sums are under consideration for deployment in the year 2002. Most Sums have more than one generator, each with a capacity of around 60kW and 100kW. Total installed capacity is around 25,92MW now (2001) now and it will be 30MW by the 2002 after completion of the Japanese grant aid program. Although the Grant Aid Program of the diesel generators solved the urgent problems of power supply in Sum centers, the fundamental problems

[1] In Dalanzadgad a 6 MW coal fired CHP plant was recently installed.

are still remained; the major problem is the shortage of budget for the power supply management. Due to an unforeseen oil crisis which Mongolia facing last years, diesel price drastically rose and is still twice as much as the previous price as of September 2000. This huge price escalation of diesel oil is hampering the power supply management of Sum centers. The service varies widely, from Soum centers with only 3-5 hours only in the peak time in winter season to no supply at all during the summer time because of the shortage of budget to purchase the diesel fuel.

(iv) Those who do not live in any of the above areas do not have access to electricity, unless they made their own arrangements.

Institutionally, the responsibility for supplying electricity switched hands a few times since the introduction of the market economy in the early '90s. Until the Energy Authority was created in 1997, Aimag utilities were responsible for the generation, supply and distribution of electricity. Unfortunately they failed to live up to expectations. The Energy Authority also could not prevent further deterioration of the infrastructure of the sector. In early 2001 the new Energy Law was enacted that transferred the responsibility back to the local communities. It is doubtful that they will be able to do a better job than the EA, and alternative approaches should be explored and supporting mechanisms developed.

Until now the strategy for increasing access has been to connect Aimag and Soum centers to the CES, EES, or WES, and annually a sum of about …. US$ is made available from the budget. As a result of this, some 67% of all households now have access to electricity, which is fairly good by most standards. However, most non-connected centers are far from the existing network, and estimated loads are very small. For these reasons, it will become increasingly difficult to continue the process of connecting new centers in the way it is done until now, and alternative solutions should be explored. Financially the sector is not in a very good condition. The EA is no longer able to pay suppliers on time and is incurring substantial commercial losses. It provides fairly large subsidies to users as tariffs do not cover all costs, particularly in the isolated systems

In summary, Mongolia has come a long way in providing electricity to all, and a considerable infrastructure for the supply of electricity exists. However, the approach followed until now appears no longer sustainable, and it is opportune to look for alternative approaches. In what follows, first an analysis of the existing situation is given, after which alternative directions are proposed.

This document is a step in the direction to develop a strategy to coordinate activities with respect to increasing access to electricity in rural Mongolia. It is expected that guidelines for further intervention will be agreed during the upcoming Donor Conference in February 2002 in Ulaanbaatar.

Electrification Rate and Urbanization

The most appropriate type of electricity supply depends heavily on the degree of urbanization. Technical and organizational solutions therefore will differ considerably for cities, Aimag centers, Sum centers, and rural areas.

In fact, access to electricity is declining. While in '85 some 95.2% of the urban population still had access to electricity, in '98 it is only 89.3% [2]. This is in part due to an increased migration to urban areas (high urban population growth), and in part due to declining performance of electricity supply companies. In rural areas access to electricity has reduced from 46.1% in '95 to 22.5% in '98. The impact is the largest in rural areas where households now have to endure lower living standards than they were accustomed to during the socialist era. Severely reduced health and education services seem to provide enough reasons to drive the observed urban migration.

For a country with one of the lowest population densities in the world (around 1.5 person per km2), electrification rates are fairly well developed, with over all some 67% of the population (363,965

[2] Living standards measurement survey, 1998

households out of 541,149) having access to electricity [3] (See Table 1). The more so since only some 49% of the population live in conventional housing, while 51% live in tents (ger). Many of the ger households are migrating herders, who live part of the year near an urban area and camp out part of the year near their herds. Some ger households permanently settled around cities or villages, but continue to live in their ger.

Table 1: **Total Households and Percentage Electrified**

	total	% with electricity	**house**	% with electricity	**ger**	% with electricity
Ulaanbaatar	161,273	98%	126,043	99%	35,230	92%
Aimag center	118,104	92%	73,797	98%	44,307	81%
Village	17,021	85%	12,586	93%	4,435	63%
Soum center	85,281	80%	36,948	86%	48,333	77%
Rural	159,470	9%	16,171	28%	143,299	7%
	541,149	67%	265,545	92%	275,604	43%
% of total in housing class	100%		49%		51%	
of which % electrified	67%		92%		43%	

Source: **NSO, Census 2000**

Of those living in a house or apartment, 92% have access to electricity. Of those living in a ger, 43% have access to electricity. Electrification rates in urban areas are high: 98% in the Capital, 92% in district capitals (Aimags), and 80-85% in villages and Soum centers (Census 2000). Some 92% of households in conventional housing and 43% in ger have access to electricity. Having access to electricity does not necessarily mean that users enjoy a steady supply of electricity. In fact, most non-interconnected villages and many Soum centers so not supply more than 3-4 hours of electricity per day, and some nothing at all during the summer months.

Table 2: **Households without Electricity**

	Households without electricity			
	total		**house**	**ger**
UB	3,643	*2%*	938	2,705
Aimag ctr	9,881	*6%*	1,524	8,357
Village	2,478	*1%*	830	1,648
Soum ctr	16,630	*9%*	5,281	11,349
Rural	144,552	*82%*	11,711	132,841
Total	177,184	*100%*	20,284	156,900
%	33% of households in Mongolia		11% Of non-electrified	89% of non-electrified

Source: **NSO, Census 2000 (tables 7-11)**

Table 2 shows the 33% of the population that does not have access to electricity. Of these, 11% live in a house and 89% live in a ger. Some 2% of the non-electrified live in UB, 6% live in an Aimag center, 10% in a Soum center, and 82% in rural areas. This means that any effort to reach as many people as possible should be directed to rural areas; the second largest effort should be towards Aimag and Soum centers.

Affordability of Electricity

[3] Census 2000

Table 3 shows monthly expenditures for households in Ulaanbaatar, Aimag centers, Soum centers, and rural areas, as reported in the Living Standards Measurement Survey (1998). Two observations are important: (i) rural household spend a considerable amount of their money on non-food items, even more so than their urban counter parts. This shows that rural life already is highly monetized, and does not depend so much on bartering anymore; (ii) the share of electricity in the total expenditures is small. Although there are many complaints about the burden of electricity on household budgets, LSMS data do not show that this is a real problem. The issue could also be partly psychological: energy used to be almost for free whereas people now have to pay for it; they could perceive it to be expensive for this reason.

Table 3: **Expenditures by degree of urbanization ('000 Tg/household/month)**

	Expenditures (1000 Tg/household, month)				*Percentage of total exp.*	
	total	**nonfood**	**electricity**	**hh size**	**Nonfood**	**electricity**
Ulaanbaatar	167.9	67.6	4.7	4.6	40%	2.8%
Aimag	126.0	44.2	2.9	5.0	35%	2.3%
Sum center	197.5	34.6	2.0	5.0	18%	1.0%
Rural	227.9	58	2.4	4.8	25%	1.1%
National	179.8	51.1	3.6	4.8	28%	2.0%

Source: **Living Standards Measurement Survey, 1998**

It is not known to what extent electricity poses a burden on people's budgets. The Willingness To Pay (WTP) and Ability To Pay (ATP) levels have not been assessed. Given the urgent need to increase tariffs and the fact that people already complain about the current tariff levels, it would be good to carry out such a survey for all three markets. The results could form the basis for setting appropriate tariff and determining subsidy levels.

Table 4 shows indicative consumption and payment levels for households in the different supply systems, in CES, diesel supplied Aimag, and Soum centers. For rural areas the costs of using a PV system is included. These data are for illustration purposes only, as reliable statistics were not available[4]; production costs are partly based on averages found elsewhere for similar systems (Soum level). Soum level production costs are the highest, and this is inherent to the size of the system and load characteristics. The more convenient the service, the higher the electricity consumption and the lower the unit costs. However, the monthly bill is the highest also. The way that households with poor and expensive service can keep their expenditures low is through low consumption.

Table 4: **Estimated Electricity Consumption Data (indicative only)**

[4] The Energy Authority no longer collects data from Aimag centers or Soum centers; Aimag centers are supposed to provide an overview from time to time, which is done to a varying degree. Soum centers have a hard time collecting the data even for themselves.

	average tariff (Tg/kWh)	*Estimated costs (Tg/kWh)*	*kWh/m*	*total expenditure (Tg/month)*
Ulaanbaatar	55	60	80	4400
Aimag	75	167*)	40	3000
Soum	100	250	10	1000
Rural (PV system)	n.a.	1600	1	**)

*) not including depreciation

**) There are no monthly costs, just up-front investment costs plus battery replacement costs; financially, it would cost about Tg 1900/month in case the equipment lasts 20 years.

Source: DFE, EA, JICA, ADB, and WB reports

Renewable Energy Utilization

It is likely that renewable energy will play an increasingly important role in the further electrification of Mongolia. There already is a beginning market for solar and wind electricity equipment. Low-cost PV systems and wind generators bought in China are used in the country, without (donor) assistance, mainly in rural areas, for use with lights, satellite TV's, and radios. Mongolian production of PV modules and wind generators also takes place. UNDP studied the feasibility of a PV module manufacturing plant; In February 1998 a Photovoltaic Division of the Post and Telecommunications Authority of Mongolia has established state-of-the-art manufacturing facility for PV module assembly facility with assistance from the Nordic Development Fund. Its production capacity of 0.5 MW per year (for one shift) runs at the moment at 5–10% of capacity. Mono and polycrystalline modules are made for $3.8 – 4.0/Watt and are sold for about $4.5/Watt.

The Monmar (private) firm has manufactured small wind generators of 50–200 Watt for some time but reportedly it ceased activities because of the availability of lower-cost Chinese wind generators.

At present, at least more than 5000 independent solar PV systems reportedly are in use by herders for operating radios, TVs and satellite dishes. The PV systems have capacities in the range of 5 to 200Wp. Over 4500 wind generators reportedly also are in use in rural areas with capacities mainly between 50 and 200W. In fact, the only way that herders will ever get electricity is from the wind and the sun. Alternatives, such as small petrol and diesel generators, although technically possible, are cost-prohibitive, as they require regular and expensive supplies of fuel from urban areas.

The Mongolian Government has decided to implement the "100 000 Solar Ger" program to provide electricity to Gers of migrating herders. The program covers the period of the years 2000 to 2010, and the main purpose is to provide electricity to households in rural areas through solar home systems as well as to schools, hospitals and for tourism, culture, service centers and also for border guards etc. Individual or hybrid power generation system of solar, wind, small hydro and in combination with diesel generators will also be developed. For implementation and to finance the program, the Mongolian Government expects to rely on foreign donor organizations with soft loans, grant aid etc. The available budget will be allocated to purchase a system on 50% soft loan for general inhabitants and for research and development in the country. So far, the Government has made some $200k available from its own resources, which have been fully used up. Participating households were requested to take a loan with Zoos Bank to benefit from the program. The interest rate applied is 1% per month, well below market rates.

SELCO, a subsidiary of the Solar Electric Light Company (SELCO) that has operations among others in the USA, Vietnam, China, India, Uganda, started operating in Mongolia in October 2001. It carried out a limited market survey, and sold within two weeks 30 solar systems. It carries mainly 5, 12 and 20 Watt amorphous systems, emphasizing their modularity (i.e., more generating capacity can be added at a later point in time). It intends to provide larger systems also, particularly 50 Watt. A complete system that can be used for lighting and a radio (PV panel, battery, charge & load controller, a light, cables plus connectors) costs around $180, or the value of one cow.

There have been, and are, considerable donor assistance activities dealing with renewable energy sources in the country:

- A Japanese agency, NEDO (New Energy and Industrial Technology Development Organization) has conducted a demonstration project from 1993-1997, under which 200 sets of portable 100Wp Solar home system equipped with datalogger were provided mainly to the nomadic herders to monitor their system operation.
- JICA carried out a study to develop an ambitious Rewable energy Master Plan for all non-interconnected Soum centers. It envisions to phase out diesel generators over 10 years and gradually increase renewable energy generation capacity and electricity storage through fuel cells. The plan calls for average investments of $0.8m per Soum over a ten-year period. Within Rewable energy Master Plan study there were installed pilot plant of Wind and Solar hybrid systems with the capacity of 5kW for rural hospitals have been installed in Bayan-Undur Soum of Uvurkhangai Aimag, Adaatsag Soum of Dundgobi Aimag, Tariat Soum of Arkhangai Aimag.
- Natianal Renewable Energy Laboratory (NREL) DOE USA under the USAID supported project has conducted a comprehensive study of wind potential of Mongolia and recently it has been completed Mongolia wind resource atlas by NREL.
- EU Tasis project has conducted wind and solar potential survey in five sites and based on their study they has installed pilot 1kWp Solar/8kW wind hybrid systems in Guchin-Us Soum of Uvurkhangai aimag, 0.5kWp Solar/8kWwind hybrid systems in Bogd soum of Bayanhongor Aimag, and 8kWwind hybrid systems in Bayan-Undur Soum.
- GTZ is active in one western Aimag (Zavkhan aimag), creating an institutional framework conducive to the use of renewable energy, developing a marketing campaign and financing mechanism, and pilot projects.
- Some five mini hydropower stations with capacities ranging from 200kW to 2 MW are operating in various places in the western part of the country, and hydropower stations with a total capacity 254.2 MW are planned to be built in seven areas.
- Various donors, Bavarian Government, Germany, Danida Denmark has provided PV systems to Rural Hospitals, schools, bags or other rural communities. The Education Foundation allocated funds for providing 2 bags with 100Wp solar PV systems in 1997. In 1998, 20 bags school were provided with 200Wp solar PV systems supported by ADB.

It is neither possible to provide a complete overview of everything that is going on in this sector, nor is it necessary.

Existing Markets for Electricity

There are essentially three separate markets for electricity in Mongolia. ***The first and largest is the urban market***, where grid connections provide low-cost electricity to the majority of households. This market accounts for some 97% of the total electricity supply, and about 2% - 5%[5] of the non-electrified live in here. ***The second market is non-connected Aimag and Soum centers***, where stand-alone diesel generators provide limited service. This market accounts for about 3% of the electricity supply and about 13% - 16% of the non-electrified live here. The cost of electricity is higher while lower service is provided than in the urban market. In fact, this should be considered a pre-market for the first: as soon as the demand at an Aimag or Soum center is sufficiently large, it would become justified to connect it to the grid. One could separate this second market in two parts: centers with 24 hours per day service, and those with less hours per day service. ***The third market consists of individual electrification solutions for rural areas,*** for which

[5] Some 6 % of the population live in Aimag centers and do not have electricity; a breakdown of those in interconnected Aimag centers and isolated diesel Aimag centers is not available.

no public assistance is provided and users are on their own. Some 82% of the non-electrified live in rural areas.

As the electricity supply in the CES, EES, and WES, which are three separate large transmission and distribution systems, are discussed in separate session, the main thrust of this review mainly concerns decentralized electricity supply, and identification of major constraints as well as options to increasing rural access to energy. For this reason in the following sections, the first matket concerning the CES, WES, and EES will not be further considered and second and third markets is described in more detail.

The First Market: Energy Authority Electricity Supply

Table 5 shows the installed capacity for the different supply systems as well as net supply of electricity in 2000 when the EA still was in charge of supplying electricity. The Central Electricity System (CES) that connects the main cities in Mongolia and provides the bulk of electricity in the country, all generation is thermal, using coal from Mongolia's vast coal reserves (200 billion tons). The power demand in the CES accounts for 94% of the total and Aimags outside the interconnected system for about 6%. Some of the generation capacity in UB is currently being considered for private operation under twinning or management contract arrangements. Total demand for electricity (CES) was around 2.8 TWh in 1999; it is expected to increase only slightly; net sales amount to about 1.7 TWh. For the CES, tariffs on average cover costs plus a margin. The rates vary by time of day; the household tariff is Tg4.5 per kWh at night, Tg 45 during the day, and Tg 68 during the evening peak. The 130 existing industrial clients have higher tariffs (Tg 17/kWh at night, Tg 65/day, and Tg 90/evening peak). The average costs of production were Tg 71 per kWh (USAID, EPSP, 2000).

Table 5: **Installed Generation Capacity (1999)**

	Rated (MW)	**Available (MW)**	**Net Supply (GWh)**
CES thermal	753	633	1699
WES thermal	27.6	24.3	21.1
EES thermal	38.5	9.2	21.2
Aimag diesel	28.8	19.3	31.2
Minihydro	3.1	2.1	n.a.
Soum diesel	20-40	20-30	n.a.

Source: MFE, JICA, World Bank

The Western system (WES) is supplied electricity from Russia at bulk rates of $0.0375/kWh (98); a diesel back-up exist in case of outages. Tariffs charged were Tg 50/kWh. The average costs of production were Tg 71 per kWh (USAID, EPSP, 2000). In October 2001, a project of construction of the Durgun Hydropower plant (with 12MW capacity) was approved by the Cabinet Minister that would reduce Russian electricity imports or the need to run the diesel generators. The Eastern system (EES) is supplied from a combined heat and power (CHP) plant in Choibalsan; average tariffs were about Tg 56/kWh, or not much different from those in the CES. The average costs of production were Tg 52 per kWh (USAID, EPSP, 2000).

The Second Market: Non-interconnected Aimag systems

The non-interconnected Aimag centers of Altai, Bayanhongor, Dalanzadgad, Murun, and Uliastai operate diesel generators 24 hours per day. USAID provided new generator sets to replace aging and inefficient Russian sets during the period of 1997-1999 in all non-interconnected Aimags. Problems that continue to plague these utilities include high technical losses, non-technical losses, and financial losses. Technical losses are addressed under the WB financed Energy Project (Aimag component). Non-technical losses including billing and non-payment problems are a major problem. Tariffs do not cover the operating costs (see below) and include only part of a provision for replacement of generators when they exceed their

service life. Maintenance is limited to the most urgent tasks only.

There are no data on the willingness (or ability) to pay, but it is generally accepted that people cannot afford to pay more than they do now. In the absence of hard data to prove this, it is impossible to determine if indeed tariffs limit people's use of electricity or that other factors play a role. It was earlier observed that temporary (substantial) tariff increases (prior to 1997) had no real impact on consumption levels. Also, as will be shown below, people living in Soums or rural areas often pay more than double the Aimag or CES kWh price – for much worse services. Load curve data show that households consume about 50% of the total energy supply; they use about 1-1.5 kWh per day or 30 – 45 kWh per month.

Table 8: **Diesel Station Commercial data**

Aimag Diesel Stations	1997	1998	1999	1999
				%
GWh sales	-	-	31.2	-
Commercial losses	5.4	4.4	5.1	16% of sales
Operating costs (Mln.Tg)	-	-	5,241	
EA subsidy provided (Mln.Tg)	-	-	4,598	88% of costs
Value of commercial losses (Mln.Tg)	337	253	297	-

*) source: Cost Analysis of EA, Shaaluu, Bolor (April 2000), USAID/EPSP

Table 8 shows that commercial losses are approximately constant and amount to about Tg. 300m; in 1999 they amounted to 16% of the total sales, which is high compared to the average for Mongolia (7%, Table 6). It also shows the magnitude of subsidies: 88% of the total costs are paid for by the EA. This amounts to Tg 147.2 out of 167.78 per kWh paid by the EA. In 1999, the five diesel Aimag plants together produced 31.2 GWh, at a total cost of Tg. 5.2B, which translates into an average cost per kWh of about Tg. 167, of which fuel accounts for more than 80% (See Table 8). Diesel prices have increased steadily and are approaching Tg 500 per liter in the most remote places, and this is becoming a real burden for the Aimag utilities. The long run marginal costs of electricity have been estimated at over Tg 200 per kWh. Tariffs have been set by the Energy Authority in 1997 at Tg50/kWh for residential customers and Tg 90/kWh for organizations. Since then there have not been major changes in the tariffs, except that some utilities started charging a small transformer-loss fee. Aimag utilities are allowed to propose their own tariffs, but they have not actually done so. The EA historically made up much of the difference between costs and revenues collected.

From 1997 on, EA provided financial support by paying 1.4 – 1.9Tg for every Tg spent by the Aimag utilities. As shown earlier, the total support in 1999 provided by EA was Tg 4.6Bln, or on average $800k per Aimag. As an alternative to paying $800k per year for the operational costs per Aimag center, one could consider investing in wind generation. This amount would buy about 800kW of wind generation capacity that under conservative estimates could save, annually, $240k worth of diesel. See Annex 1 for more details.

As an indication of the severity of the problems, one of the Aimags that received new generator sets some 4-5 years ago now needs to carry out the first major overhaul on two of the generator sets. There is no money budgeted for this necessary task. The Aimag utility also estimates that it needs to install one additional generator set to be able to retire the oldest Russian generator set, money for which it hopes to receive donor assistance. Given the high diesel prices and the relatively good wind regime, it would be a good idea to carry out a least-cost analysis comparing wind and diesel generation. See Annex 1for more information.

Table 9: **Overview Isolated Diesel Aimag Utility Issues**

Nature of the Problem	Potential Solutions
Technical - High technical losses, particularly in the distribution system. - Existence of old Russian generators that are inefficient and for which increasingly difficult to obtain spare parts - Heavy dependence on fossil fuels - Not enough maintenance provided - Low plant factor	- Increase efficiencies throughout the system - Rehabilitate distribution system - Increase load and load factor - Look for substitute sources of electricity (hydro, wind) when economically justified, particularly wind generation. - Develop phased solutions that increase the demand until it becomes feasible to connect a demand center with the interconnected grid
Financial - High financial losses - tariffs well below operating costs - billing problems (non-payment, but also clients are not billed) - no provision for depreciation of assets - High operating costs, in particular diesel prices are increasing rapidly - Low revenues - Heavy dependence on subsidies	- Increase tariffs; they should over time begin to cover operating costs plus depreciation - Decrease commercial losses (send bills for all usage of electricity) - Reduce accounts payable (faster payment of bills, better collection rates) - Penalize non-payment (public announce-ments, disconnection, etc) - Agree on schedule to reduce and possibly abolish subsidies over time (5-10 years)
Institutional - Utilities should operate more commercially	- Training, capacity building of key personnel (bookkeeping, system planning, client public relations) - Involvement of competent private partners need to be reviewed. - Provide technical assistance to enable the utilities to operate efficiently.

Aimag utilities appear to be in a vicious circle, with low household demand for electricity caused by perceived high prices, and very small industrial or commercial demand. The large and automatic EA contribution to the costs does not give much incentive to reduce losses. In one way or another, Aimag utilities will need to increase the demand and they also need to increase tariffs to cover total cost. The Government is aware of the continued need for subsidies, and indicated that it is willing to continue financing these for some time to come. Nevertheless, local governments are expected to solve the electricity supply problem on their own; they also have to pay for this through their regular budgets. Without external assistance they are not likely able to do this, and electricity services could deteriorate even further. This continues to feed a vicious circle in which more people are likely to permanently move to grid connected urban areas, further exacerbating the urban problems. It is clear that financial problems will persist for as long the utilities are not run in a fully commercial mode.

The emerging long-term solution for diesel Aimags is that eventually they will be connected to the CES. It becomes justified when the costs for such connection are offset by the benefits of having access to a lower cost supply of electricity. Until this is the case, the Aimag utilities will have to manage themselves as stand-alone utilities. Most investments to improve efficiencies will be useful for preparing for larger scale supply. This may involve operating as efficiently as possible, trying to increase the load & load factor as much as possible, and carefully review the utilization of renewable energy (wind, hydro) in the generation

mix, as well as private sector involvement in the management of the utilities. They are likely to have continued support from the national budget, but under more specific terms then before. To provide incentives for commercial operation, subsidies for operational costs should be as low as possible and phased out in the medium term. Subsidies for capital investments to further improve the operating efficiency and/or reduce operating costs are likely to persist for some time.

The Second Market Continued: Soum systems

Soum center power generation closely resembles that of Aimag centers, except for the scale of the operations. Soum center plants are much smaller (10x or more) than Aimag center plants, are operated less professionally, and they provide less service. Soum centers provide an important role in the life of the herders: they will visit Soums from time to time to obtain basic services and necessary supplies. Primary health care is provided through Soum hospitals, and children are educated in Soum schools. Essential supplies are bought at Soum centers, while livestock and other goods can be sold there. Most administrative procedures take place here as well. With the decreasing supply of electricity, education and health services deteriorated. Lack of operational equipment is an important reason why school and hospital personnel are unable to provide better services.

There are about 314 Soums, of which 142 are connected to the CES. Of the 172 non-connected Soums, 144 received new generators under a Japanese grant aid program during the past few years; 28 more Soums are under consideration for deployment in the 2002. The total costs for equipping 172 Soum centers with new diesel generator sets are estimated at $25-35mln. Most Soums have more than one generator, each with a capacity of around 60 - 100 kW. Total installed capacity in the country is around 30MW. It is not uncommon for quite a few Soums however, that the installed capacity is larger than the present demand, leaving room for growth if and when that materializes. Most generators operate 3-5 hours at night, and many do not operate at all during the summer months. JICA carried out a survey among 173 diesel Soums and found (Table 10) that in the summer 46% do not operate and 40% provide service at night only (this increases to 61% in the winter). Only 13% operate on a 24 hour basis in the summer and 34% in the winter.

Table 10: **Operating Conditions of Soum Diesel Plants**

	Summer	**Winter**
no	46%	5%
day	1%	1%
night	40%	61%
all	13%	34%

Source: JICA

Technical losses are high, although in part this is due to the specific load characteristic experienced by most Soum systems (no operation during the summer except for public services, and a strong evening peak during 4 hours in the winter due to household lighting & TVs. In addition, the number of people in living in Soum centers fluctuate much, with much smaller populations during the summer. During the school year (winter) there can be 2 or 3 times as many people than during most of the productive season when herders are out in the fields. Although the hospital and the school as well as a few commercial or administrative buildings should receive electricity during the day (the hospital even 24 hrs per day), in reality this does no longer take place. Under these conditions, it is difficult to operate a power plant efficiently, even for the most experienced operator. Non-technical losses are also high, as Soums do not put much emphasis on collection, there are no repercussions if customers do not pay for their consumption. Many customers are not metered but are billed for estimated consumption, a practice that is not conducive to rational consumption.

The main reason quoted for providing limited service is the high operating cost (diesel fuel). Diesel fuel prices have been increasing steadily and now reached a level of Tg 480 per liter in the most remote locations. This translates to Tg160 per kWh just for diesel fuel, which is perceived as a real burden. However, it would be useful to operate at as high a load as possible due to the specific fuel consumption characteristics of diesel engines: incremental fuel costs for operating with a load factor of 100% instead of 50% are very small, while the number of units generated double (See Annex 2).

Under the recent electricity sector reform the Soum government is now fully responsible for providing electricity. It is not certain if all Soum governors fully appreciate this. As long as they do not feel real ownership, they will not take proper care of maintaining and operating the plants. The fact that new diesel generators are provided free of charge under grant programs does not help much to change this attitude. In addition, tariffs traditionally have not been set high enough to cover all the operating costs (let alone depreciation costs). Many Soum governors have not changed their tariffs, putting further strains on their budgets, hoping that the State will continue to provide the required financing to pay for the subsidies. Nevertheless, households and organizations (firms) in Soums are charged more than their counterparts connected to the CES, WES, or EES. Some tariffs observed ranged from Tg 100 – 200 per kWh for households, with some 50 – 60% more per kWh for organizations. An expenditure survey or a willingness to pay survey (WTP) has not been carried out, and it is not known for what level of service people are willing to pay. Consumption levels rarely exceed 10 kWh per month per household. The supply of electricity at the Soum level is highly discriminatory: urban clients receive reliable service 24 hours per day and pay much lower tariffs, while Soum clients receive poor service during a few hours per night only and often only in the winter, and pay high tariffs.

Table 11 shows four Soums that are expected to be connected to the WES. An analysis in Annex 3 shows that it is not obvious that the line extension always is the lowest-cost alternative.

Table 11: **Cost of Extension in Bayan – Ulgii Aimag**

Soum	Voltage KV	Connected To	Length Km	Load KW	Initial Investment thousand US$
Altantsugts	35	Ulgii	45	350	636
Altai	10	Buyant	37	170	454
Bayannuur	15	Umnugovi	55	280	673
Buyant	10	Sagsai	45	170	167

Source: **ADB Draft Electricity Master Plan, 2001**

In fact, the situation for Altai and Bayannuur were reviewed, and preliminary conclusions are that Altai should remain isolated and start adding wind to the generation mix, while Bayannuur should be interconnected with the WES grid. A more detailed economic analysis should be carried out systematically, looking at the various alternatives for providing electricity at a site: line extension, diesel generation, and hybrid diesel-wind (and/or hydro) generation. As it is now, there appears to be an ad-hoc approach to line-extension. As an example, the Soum of Bayan-Ondor obtained a solar-wind hybrid system, to supply the clinic and a few other institutions. Within two years the Soum was electrified through line-extension, making the investment in the renewable system a waste of money. A master plan should be made to determine the lowest-cost electrification options for all remaining non-grid electrified centers. The JICA renewable energy master plan for rural electrification can be used as a basis to compare line extension, diesel and diesel-renewable hybrids.

Several things must improve if efforts to connect more households and provide better service are to take place: in one way or another, Soums must find a party who feels responsible for operating the generation plant. Institutionally, different options are possible, to name a few: through a contracted operator or firm, by inviting a private firm to run it on their behalf (for a cost, or under some sort of a lease), or they can operate it through themselves a community organization. Secondly, even though subsidies require to be paid for some time to come, the plants need to be run commercially, and proper statistics need to be

collected as to all cost and revenue elements (fuel, spare parts, maintenance, operator, management, payments from uses, subsidies, etc) of the operation of the whole system (i.e. generation, distribution, storage). Thirdly, the load should be increased rather than decreased. The higher the load, the lower tariffs can be and the more easily alternative solutions become feasible. Fourthly, wind generation provides an excellent opportunity to decrease tariffs: operating costs are minimal, and electricity would be available throughout the day depending on the wind regime.

The emerging solution for Soum diesel plants does not differ much from the Aimag diesel plants. Eventually they will be hooked up to the interconnected grid, and until then they will have to become an efficient operation that supplies much more electricity than it does now. The two top priorities are increasing the load and operating efficiently. There could be an important role for private operators in this. Subsidies for capital investments are likely to persist, while subsidies for operational costs should be reduced as much as possible.

Table12: **Overview Isolated Diesel Soum Utility Issues**

Nature of the Problem	Potential Solutions
Technical - Extremely low loads, - Operation during part of the day only - Over-capacity of generation - High technical losses, particularly in the distribution system. - Heavy dependence on fossil fuels - Not enough maintenance - Non-professional operation	- Increase load factor - Operate more hours - Increase efficiencies throughout the system - Rehabilitate distribution system - Look in addition to diesel also for renewable energy sources of electricity, particularly wind in hybrid systems - Develop phased solutions that increase the demand until it becomes feasible to connect a demand center with the interconnected grid
Financial - High financial losses - tariffs well below operating costs - billing problems (non-payment, but also clients are not billed) - no provision for depreciation of assets - High operating costs, in particular diesel prices are increasing rapidly - Low revenues - Heavy dependence on subsidies	- Increase tariffs; they should over time begin to cover operating costs plus depreciation. Since tariffs are (much) higher than in Aimags, they can raise less quickly. - Make best & creative use of subsidies, but time-bound (how to target, how to administer, how to phase out) - Develop viable local solutions, to be incorporated in national system only when economically justified - Develop, or use existing, financing mechanisms; cross-subsidies to transfer from urban to rural users - Cost-recovery mechanisms should be developed
Institutional - Utilities are on their own, and generally not professional enough to should operate more commercially	- Involvement of competent private partners need to be reviewed. - Training, capacity building of key personnel (bookkeeping, system planning, client public relations) - Technical assistance to enable the utilities to operate efficiently.

The Third Market: Rural Areas

For migrating herders and others living in rural areas, there is no possibility to hook up to an electricity supply network, even if they financially can afford it. When and for as long as they are near urban centers, they can connect but while migrating they are on their own. Herders have adapted to modern life, in the sense that they already use several appliances that give equivalent services as enjoyed in urban areas. First of all, most have a radio – with or without a cassette or CD player - that operates on drycell batteries. Secondly, many will have a flashlight, also operated on drycell batteries. These batteries are purchased in urban areas, and amount to a substantial cost. As can be seen in Table 3, there already are considerable expenditures for electricity in rural areas. More recently, some herders have started to use satellite TV systems. These are run off car batteries that can be charged in different ways: through a small wind generator, a PV (solar) system, or a motorcycle or car (tractor) engine. Particularly wind and solar generators can frequently be been along the main roads. Both are locally manufactured and are available from China. In UB there are several suppliers of small generators (petrol, diesel) from Russia, China, and Western countries. Stories circulate that some ger households use their motorcycle or tractor to charge a battery for their TVs. This only confirms that rural households have a certain amount of disposable income, and want to be closer tied into the modern world. There are no statistics available as to the extent of this and whether it is just the top few percent, or a larger part of the migrating ger population. The LSMS shows that 7.3% of rural ger households have access to electricity, which is a large number in the absence of any promotional programs. It also means that some 133 thousand are still without electricity.

Aimag and even Soum customers receive better electricity service than people in rural areas. What is more, they effectively receive large subsidies. Rural people do neither benefit from such subsidies, nor from any programs specifically addressing their unmet demands for electricity. It is conceivable that a mechanism be developed whereby urban (CES) customers provide a small cross-subsidy or a universal access charge to alleviate prevailing electrification problems for rural (including Soum) households. As an example, a 1% rural development surcharge on urban electricity consumption (CES- 3000 GWh per year) would sustainably raise on the order of $1,2m per year. Although this would not pose a financial burden on most households, it would go a long way in assisting rural households to obtain electricity. Until now, the Government has only been involved in enlarging the first and second markets. The only effort to assist rural people to obtain electricity has been through the “100,000 Solar Ger Program” but it failed to make this a sustainable program.

Table 13: **Electrifying the Rural Non-Electrified**

Nature of the Problem	Potential Solutions
Technical - Standard only two choices: line extension, and isolated diesel generation - In addition, there is the need to electrify individual ger households	- The question is not a technical one, but an economic and institutional one - Renewable energy (solar, wind) appear the main technical solutions
Financial - Solar and wind systems means high upfront cost, low operating costs - Need for financing mechanism - Commercial interest is very high 50-60%/year	- Develop, or use existing, financing mechanisms; cross-subsidies to transfer from urban to rural users - Make best & creative use of subsidies, but time-bound (how to target, how to administer, how to phase out) - Cost-recovery mechanisms should be developed
Institutional - No government involvement until now - Private sector reacts slowly to emerging demand	- Encourage & support private mechanism and channels to develop the decentralized (PV & wind) market - Role for the Government limited to promotion, awareness, providing subsidies, and above all, create an enabling environment

In summary, the business as usual scenario is neither sustainable nor does it address the largest group without electricity. Alternative approaches that lead to more sustainable operations should be pursued. In the next section, we look at the mechanisms needed to realize this, and also look at how this is done in other countries.

II. Towards A New & Additional Energy Supply

As a first step to realizing better electricity access in Mongolia, energy sector policies, technical electricity supply options that realistically can be developed, and the existing organizational and financial infrastructure are reviewed. This is limited to the existing regulatory environment (the energy law), relevant local energy resources, and potential organizations that could play a role, as well as coordination between them. Without an enabling environment, alternatives to grid electrification will never materialize and most who are in the dark now will also be in the dark many years from now. The current rural electrification programs, while financially unsustainable and not affordable, do not reach far enough to provide access to all households soon. Therefore, it is desirable to create circumstances under which private investments supplement public funds to give a new push to electrification efforts. Such private investments will only materialize when the right enabling environment exist for investors to feel safe. Minimum criteria are conducive energy, legal, and fiscal laws, an appropriate financing mechanism for both investors and beneficiaries, and technical assistance for the realization of the first activities.

Energy Law

A few important checkmarks that describe a good enabling environment are: liberal tariffs should be allowed; for low-consumption customers, electricity should allo be provided in fixed-price packages, without metering; other firms than utilities should legally be allowed to supply electricity; for small and low-power networks, different technical standards should be allowed; a good electricity law and accompanying decrees are necessary, but they are not enough to guarantee the institutional capacity to promote decentralized electrification; the decentralized electrification sub-sectors should be governed by specific rules, other than those in the electricity conventional sector; The framework for decentralized electrification must both stimulate investments by the private sector and also profiting the poorest

populations. In the absence of a clear framework, success will only be obtained on a small scale and without durable long-term prospects whereby only some " profitable niches " will attract the private sector (and those are almost by definition typically not the poorest).

The Energy Law was enacted by the Parliament of Mongolia in February 2001 and went into effect in April 2001. The law is a great improvement over the old law as it is fully based on economic principles. It describes rights and obligations for both the industry and consumers based on commercial relationships. This law, if fully applied, will fundamentally change the operations of the energy sector. Separate generation, transmission, dispatch, distribution and supply companies will now exist that need to obtain licenses for operation. Power and district heat operations are fully separated. The Ministry of Infrastructure's responsibility is now mainly limited to energy policy matters. The law establishes the creation of an independent regulatory agency, the Energy Regulatory Authority (ERA). ERA, among others, will issue licenses and approve tariffs, will approve and regulate commercial relations between companies, and will provide consumer protection.

The Energy Law introduces a shift in responsibilities to non-interconnected Aimag and Soum governors. The intention is that local (Aimag) regulatory bodies will be established for issuing licenses and supervising tariffs, but in reality it may take some time before this can be achieved. In any case, Governors need to begin taking responsibility for managing the energy consumption at their level, rather than relying on subsidies for the difference between costs and revenues. The Government is aware of the real problems in the non-interconnected Aimags (and Soum), and currently examining ways minimize the pain from the phasing out subsidies. Funding for these substantial subsidies earlier came from EA and has now been transferred to the central budget.

There is a 1.5 MW cut-off point, under which no licenses are required for construction and operation of power plants, while also the construction and operation of transmission and distribution lines is not subject to licensing for as long as there is not any adverse impact on the environment and the normal living conditions of people, and are designed for own use. This has implications for Aimag and Soum operations, as they could operate their own plants in an unregulated fashion.

Operators submit tariff proposals to the ERA or to Aimag Regulatory Boards which can review on a semi-annual basis. Tariffs need to be based on historic performance data, and should be sufficient to ensure the survival of the utilities. ERA or Aimag Regulatory Boards are not allowed to prepare tariffs for use by the utilities. As it is now, not many Aimag utilities have proposed their own tariffs.

It appears that most of the important and required rules to promote rural electrification are covered in the new electricity law. However, organizationally the rules could have been more clear as there is not a specific agency in charge of promoting rural electrification. It would be good if the decrees explicitly describe the most important rural electrification aspects and not are just limited to the conventional electrification sector.

Fiscal Environment

Any investor or firm interested in developing rural electrification activities in Mongolia should be welcomed. He should be given full support to develop his activities. Import taxation laws should allow exceptions or minimal tariffs for all relevant rural electrification equipment; similar rules should apply to the VAT. Relaxed rules should exist for income taxes, corporate taxes of firms and people who actively engage in rural electrification activities. Technical assistance and a financing mechanism should be available to develop appropriate solutions.

Local Energy Resources

Mongolia is endowed with ample energy resources, both fossil and renewable. Abundant coal reserves, good solar and wind regimes make it possible to use a variety of energy sources where justified from

technical and economic points of view. There appears to be a solvable market for decentralized energy solutions, both conventional (diesel, petrol) and renewable (solar, wind) energy systems. The infrastructure, albeit rudimentary in a way, exists as there are several private firms that supply equipment at non-subsidized prices. In addition to these local activities, it was observed that people visit China to import similar systems. Since this market is being developed in the absence of facilitating mechanisms, it is likely that the number of transactions can be accelerated would a conducive environment exist. Aspects that could create such an environment are a promotional campaign, a financing mechanism, and technical back-up to develop a more capable infrastructure for design, installation, repair, and maintenance.

Financing Institutions

Several banks exist that traditionally have provided urban finance for productive, and more recently for consumptive products. However, at interest rates of 3-5% per month not many people can afford loans, and even then only for productive purposes and very short-term loans. The banks suffered long-time from several problems (non-repayment, political interference) and public confidence has only recently been restored. Not long ago banks "discovered" rural areas, probably because the market for urban finance is getting saturated, and micro-finance, and there are now branches in all Aimag centers and some Soum centers: Agricultural Bank[6], Zoos Bank, Golomt Bank, XAC[7] all started to provide rural credit. Micro-finance products were introduced less than two years ago, and received tremendous demand from users. Loans of around $100 - $500 are frequently asked, and repayment rates appear better than the average urban loan. Agricultural Bank, which managed the first tranche of funds under the 100,000 solar ger project, is quite satisfied of the results; if requested by users, it will continue to provide loans for solar home systems.

In addition to banks, there are also Micro Finance Institutions (MFI), Micro Finance Programs (MFP), and NGO's [8] that provide credit to rural areas. They have been very successful in developing products that people want. The observation that this is booming business is supported by the fact that two new MFI were recently established: Credit Mongol, and Goviin Ekhlel. Several projects also created (or are creating) mechanisms that extend credit to rural households, among them the UNDP Sustainable Grassland Management project and the supporting Rural Micro-finance project, and the World Bank's Sustainable Livelihood project that has a Community Investment Fund and a Micro-Finance component.

Thus, there appears a nascent financial infrastructure that could and should be further developed to nurture decentralized rural electrification. There appears to be a willingness to realize such mechanisms. Without appropriate financing mechanism rural electrification solutions are not likely to make much of an impact.

Donor Assistance & coordination

Community based programs will be important vehicles both for improving the electricity access problem as for increasing the reliability of electricity supply. As shown above, reasons for leaving rural areas are the lack of and decreasing quality of (community-based) services. As electricity is not an end in itself, but a means to facilitate many basic services, it will be important to identify how ongoing and planned projects and programs can be assisted to properly include the provision of electricity. As an example, schools will be able to perform better if they can rely on the supply of electricity during the day and possibly during part of the evening; rural health clinics also need to be able to rely on electricity for cold storage, lighting for night consultations and emergency procedures. Among the more important initiatives in this field are the ADB's Education Sector Development Project (rural school rehabilitation), Health II (establishment of family doctors, bag level), and Secondary Towns Basic Services, as well as Agricultural Development project (development of distribution chains, coops, finance, etc). UNDP also has two important programs

[6] Is present in most Soum centers.
[7] XAC started under UNDP's MicroStart Mongolia project is expanding to all Aimag and has applied for a license to become a Bank.
[8] Women's Federation; Credit and Savings Cooperatives.

in the planning: a sustainable grassland management activity that will address collectivities of herders, and a rural finance project. Such projects are developed to work with rural people on a structural level and are justified in their own rights; such projects will be in a good position to include the concept of rural electricity as a side activity and provide a support mechanism for the private sector to realize the technical parts, such as installation of equipment, organization of after-sales service, etc.

Projects are frequently implemented in an ad hoc fashion, i.e. without properly taking into account overall sector planning. The way Soums are electrified is a good example. It would be more effective if an overall development plan existed to guide all investments in this sector, whether through grants, loans or credits. It should not happen that a Soum receives a solar-wind hybrid generation system only to be interconnected within a year or two to the CES system, removing all justification for the Soum to operate the hybrid system. This is inefficient use of scarce resources, whether obtained through grants or credits. A Master Plan for Rural Electrification by Renewable Energy was completed (JICA) for all non-interconnected Soums, and ADB is carrying out a Master Plan for the Electricity Sector that should also include rural electrification but through more conventional means (diesel, grid extension). The results of both exercises could form the basis for the analysis of the least-cost solutions for electrifying all remaining non-electrified Soums.

III. The Way Forward

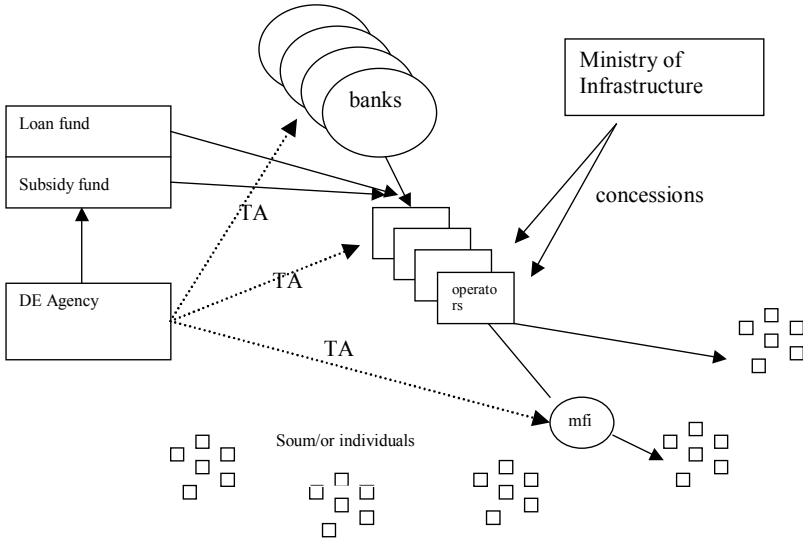
Today, one-third of the population of Mongolia is lacking access to modern energy services. Energy in particular is a key catalyst to economic development: without energy access, people do not have power for agricultural and livestock production and processing, for human and livestock watering, for household lighting, for non-farm income generation and micro-enterprise development, for medical refrigeration, etc. There have been many technological advances in the last decade, and the challenge to rural electrification is no longer technological, but the ability to develop an enabling environment that ultimately fosters rural electrification to take place -- institutional, policy, regulatory, and financial. Addressing this challenge will require raising awareness and developing the links between energy and rural development. It will also require creating markets for electricity delivery in areas that have been neglected until now. Instead of simply interconnecting more and more demand centers, the emphasis should be to improve services at the decentralized centers and focus on increasing the demand for electricity. Until the demand grows to the point that it is economically justified to interconnect with the grid, local development should be pursued.

Institutional Issues

As shown before, the most appropriate supply of electricity in Mongolia mainly depends on the degree of urbanization. Technical solutions will therefore differ considerably for cities, Aimag centers, Soum centers, and rural areas, and will mainly be determined by the outcome of an economic analysis. Irrespective of the ultimate choice, emphasis should be on efficient and commercial operations, as envisioned in the new Energy Law, in which private firms are likely to play an increasing role. There are two distinct possibilities: (i) operators providing electrification services to one or more Soum (Aimag) centers, or (ii) to a group or several groups of individual Ger households. It is expected that there will be some 40-80 Soum projects each dealing with three to five individual Soum centers and more than one thousand GER group projects each dealing with about 100 individual Ger households. The operators will be obliged to electrify a minimum percentage of households in the Soum or in the group. As seen in the rural electrification examples, operators are often awarded small concessions for the supply of electricity.

Organizationally, other countries often create separate institutional mechanisms to better support rural electrification. The national utility usually is not much interested - or not capable - to deal with rural electrification. Utilities are normally good at generating and transmitting electricity on a large scale, and distributing it in urban settings. They are not good at small-scale decentralized generation, with the supply of small loads over large distances, etc.

Graph 1: **Possible Institutional Setup**.



Often a rural electrification agency is created that specifically promotes decentralized solutions for the delivery of modern energy services. Alternatively, an APEX organization of small providers can be founded. An efficient choice is a not-for-profit, private organization, as it bypasses the bureaucracy usually associated with a public agency. The agency will have distinct different roles during three subsequent phases: (I) during the preparatory phase, it needs to take the lead in developing the infrastructure for rural electrification delivery, and realize a few demonstration activities; (II) during the initial market development phase, it needs to provide guidance to actors who are developing the activities, leaving much over to the initiatives of the individual actors that have now become more professional; and (III) regulatory phase, where the agency acts as the Regulator for rural electricity and monitors performance of the actors in the sector.

The two main roles of the Agency are that of a Regulator and of a TA unit, and these should be two units independent of each other and independent of the Ministry of Infrastructure. MOI will issue concession agreements to operators through a process that is fast and easy. The Agency will recommend MOI to award concessions to certain operators, based on the details and facts of the operator's business plan. The MOI will officially award the concessions. The Agency will decide how much subsidy should be awarded to the operator. The distribution of the responsibilities then is simple: the TA unit works with operators (rural populations, private operators of electric services and trade banks) and develops links of confidence between them, while the Agency maintains the independence necessary to judge the final proposals. The TA unit is on the ground with the actors of decentralized electrification while the Agency acts as a referee. The TA unit will have an independent Board that oversees its operations. It is the Agency, which decides whether or not to allow a subsidy for the DE project and notifies the commercial bank of its decisions, communicates with the Board as to its decision and submits proposals for improvement of DE mechanisms.

Should the Agency be placed under the EA? The EA has been set-up to oversee, or even operate, the power sector in the country. Its frame of mind is not geared towards decentralized electrification, even though it provided assistance to Soum operations and even was responsible for operating these during a certain time. A priori there is nothing against attaching the Agency to the EA as long as it has its own rules and means (operational manual, budget, and independent Board to oversee its operations and approve its budget). To minimize political influences, the Agency should be responsible for its own operations, accountable only to its Board.

What should then the role of the Government be? First and foremost, the Government's responsibility is political. There is not one successful example of an electrification program achieved without the backing of strong political will. The organization of the electricity sector has always been structured around the electric grid. But there are limits to this, and in Mongolia these limits appear to have been reached. With an electricity sector that is network based, Ministries, Utilities, the EA, and populations have certain expectations regarding the arrival of network services to their villages. It is not necessarily in this way that the electrification will occur, as is becoming more clear to many Mongolians. To widen the access to electricity, the current system must evolve: it is the role of the Ministry for Infrastructure to facilitate this change with support from Government. Actions include: coordinate DE activities once Government policy is established; develop favorable conditions for private sector involvement; mobilize financing for the DE financing mechanism, both international and national; award concessions to private operators for the realization of DE projects; and raise awareness among target groups as well as the Government and its agencies.

DE Financing Mechanism

A financing mechanism specifically designed to facilitate rural electrification activities will be crucial. Subsidies will be an integral part of the financing mechanism as it is likely that subsidies will need to continue for a long time to come. Subsidies should be awarded following clear rules, benefiting there where their impact can be the largest. Subsidies for operational expenditures (such as diesel fuel) should be limited as much as possible, and enabling subsidies (or smart subsidies) should be designed to facilitate the electrification efforts. In principle, the financing mechanism assists operators to finance their DE activities. The possible assistance will be determined by the DE Agency based on the business plan that the operator prepared. The operators should bring some equity and cash (typical numbers in other are: some 15-35% of their own, 10-15% from future users) and can make use of the financing mechanism for the rest of the required funds. The financing mechanism consists of three parts: (I) a subsidy that will be used to buy down the upfront costs of DE equipment; (II) a concessional loan part, which will need to be better defined but which in principle is used to provide longer-term credit at reasonable rates; and (III) short-term commercial credit.

The mechanism itself should ideally be managed by a local bank that is interested in DE and that is expected to eventually provide its own funds for this purpose. Different sources of funds could enable such a mechanism: public funds, donor funds, private funds, etc. The advantage is that all funds are used in the same fashion as the rules are clearly described and do not depend of the origin of the funds; this effectively ends the ad-hoc way of planning activities. One of the sources of fund could be a cross-subsidy or a "universal access charge" on conventional electricity. Stemming from a small surcharge levied on urban and industrial electricity use, this provides a sustainable and substantial source of funds. This mechanism is budget neutral for the Central Government, and does weigh neither heavily on the Utility nor on the end-user. A surcharge of 1% would increase urban bills by about Tg 40 per month (less than the equivalent consumption of one kWh), an amount that is not expected to pose problems for many people. However, it would provide about $1.2 million per year that could be applied to rural electrification efforts. This amount exceeds the total subsidy provided for each of the isolated diesel Aimags utilities.

Technical Assistance

For developing the three different electrification markets, TA will need to be made available. Operators, banks, and communities will be able to make use of this TA. Minimal charges will initially be applied, increasing when project nears approval. The TA team will not need to have the ability to grow at the same rate as DE, but rather will create a local capacity to develop electrification approaches. The TA team will be partly based in Mongolia, partly rely on modern communications for questions that do not require the presence in the field of a specialist. This intervention methodology prepares for an efficient transfer of responsibilities, which will have to take place throughout project. Thus, TA will be provided for a limited time only, until essential missions for continuation of DE are ensured, technically and financially.

Aimag Centers not connected to CES, WES, EES

The five Aimag centers that generate their own electricity in a non-interconnected mode have several high priority issues to deal with: high technical losses, low loads, and high operating costs. Operating costs well exceed revenues from tariffs. In addition, substantial non-technical losses still exist, although they are now less than before. As an example, the Bayanhongor Utility estimated that its operating expenses in 2000 were Tg. 1.0 B., of which Tg 330B. was covered by revenues from users and Tg 670 B. from central subsidies; roughly 80% of the operating costs was for buying diesel fuel. Only the minimum amount is spent on maintenance. It claimed that non-technical losses were 20% of generated energy (down from 40%) and that transmission losses are about 12%. Of the 3200 households in the Aimag center, 2800 are connected (88% connection rate). If the utility is operated as efficiently as possible, potential annual savings could amount to $0.45m from adding 400 clients and reducing losses to normal standards (non-technical, technical). This simple calculation shows why it is interesting to pursue private management of the utility. The management fee can easily be offset by the obtained efficiencies. The economic interest is clear also, as the higher the efficiency, the lower the subsidies to be paid, and users are likely to consume more electricity when tariffs are lower.

Unrelated to the access problem, but potentially interesting for the financial condition of the utility is the option to add wind generation capacity. Lack of investment capacity is a problem for the Aimag utilities. Until now, they relied on the Central Government or donors for investments in their generation capacity and distribution networks. The Bayanhongor Aimag utility needs to rehabilitate one 4 year old American diesel generator and replace one older Russian one, but it does not have the funds for either of this. Rather than obtain the funds for an additional diesel generator, it should evaluate the economic and financial feasibility for adding one or more wind generators to the existing park of diesel generators. Wind generators have come of age, and initial investment costs are now less than twice that of diesel generators on a rated kW basis[9]. Avoided diesel fuel costs could pay for the investments within a 2-3 year period, yielding a 25% rate of return. See Annex 1 for a more detailed analysis.

Mechanisms exist whereby developed countries provide green funds for avoided carbon emissions associated with wind electricity generation in developing countries, and this could be an effective way to add additional generation capacity at Aimag utilities while mitigating their financial situation. One possibility would be to consider replacing diesel with wind capacity in all five Aimag centers simultaneously (depending on the prevailing wind regime), possibly on the order of 10-20% of installed capacity, as a large contribution to reduce Mongolia's contribution to greenhouse gas emissions. Several international environmental or donor parties could be interested in such an activity.

The three main issues that need to be tackled for more sustainable Aimag diesel operations are the following:

- The basic condition for sustainable operation is that Aimag utilities operate as much as possible as commercial businesses. This requires, at the minimum, that clients pay for their consumption and that tariffs reflect their economic costs of production. Appropriate tariffs need to be established, based on ability to pay and demand elasticity, which are crucial input parameters for commercial operation, but they are basically unknown at the moment. Subsidy levels should also be determined.
- Since diesel fuel constitutes the largest cost factor, ways should be found to reduce the consumption per unit produced. Because of the excess generation capacity, increased consumption would lead to lower costs, and possibly lower tariffs. Substitution of wind for diesel fuel should also be studied, both for all five centers combined or for each individually.
- A plan to interact with private firms for the management and operation of the five Aimag utilities should be discussed and finalized, including the bidding documents to select the most appropriate firm(s). Interested firms will be requested to submit a proposal for running the Aimag utility(ies), including the investments they intend to realize to improve operations, and including the amount of subsidy required to sustain their operations.

[9] Roughly US$ 550 per kW for diesel versus US$ 1000 for wind generators.

Soum Centers & Villages

The range of Soum center operating costs vary from $10k to $0.5m per year. The question whether to build a transmission line for connecting the Soum center to the CES, WES, or EES grid, or to arrange for an operator, should be guided by the outcome of an economic analysis of the alternatives. The decision should be based on a least-cost analysis of the possible alternatives. Until now, this analytical phase has not systematically been carried out, and uneconomic investments are known to have taken place. All investment costs plus operation and maintenance costs of the decentralized power generation need to be evaluated over the lifetime of the plant and compared to the costs of building and operating a transmission line. Such analysis needs to be performed on a case-by-case basis because of the vastly different local circumstances and the technical constraints of supplying a low demand over long distances.

The following serves as an example: the Soums listed in Table 5 are within the Aimag of Bayan-Ulgiin in the west of the country and are being considered for connection to the Western Electrical System under Central Government financing. The distance between the Soum centers and the substation to which they will be connected is on average about 45 km, and the average costs for each extension line are about $480k. The initial investment includes the cost of the overhead line, the cost of the substation equipment, construction and installation and commissioning. A least-cost analysis should be carried out over a period of 15 or 20 years, taking into account expected load growth. The NPV of the line extension should be compared with that of using a diesel generator over the same period of time, and with renewable energy alternatives and hybrid diesel-renewable solutions. The master plan for rural power supply by renewable energy also studied the energy supply for the same Soum centers, and recommended initial investments ranging from $180 - $ 740 thousand for the first step only. [10] See Annex 2 for a more detailed analysis.

There are in total some 197of such centers, and all depend on subsidies for about 80% or more of their revenues. Soum connection rates are much lower than for Aimag centers: ranging from 44% to 80%, depending on what data is used (LSMS or Census). Whatever the number, there are proportionally less people connected in Soum centers than in Aimag centers. To increase access to electricity in Soum centers, several steps need to be considered. First, the system need to be operated commercially, and the demand need to be as large as possible compared to installed capacity. Tariffs need to be revised, the actual demand needs to be better estimated, including willingness to pay and ability to pay (WTP/ATP). Several complaints were voiced that 3-4 hours per day of electricity in the winter is not enough and that service is required in the summer also, but current high tariffs were criticized also and people complained about the height of the total bill. The total amount of subsidies that can be expected over the next few years will need to be assessed.

Second, with the anticipated DE financing mechanism and TA to develop Soum-based operations through the private sector, different management solutions become possible. In addition, wind-based generation options will also need to be looked at (in regions with a good wind regime). Although Soum Governors have become the default operators of their generation plants, this is not really the best organizational solution. They are not equipped to deal with real technical issues; for as long as the plants operate normally there are no problems, but what if the generator breaks-down? The Energy Authority is no longer there to provide troubleshooting, and any financial shortfall will appear on the governor's administrative budget. It is not difficult to imagine that there are more efficient solutions for operating Soum generation plants: operation and maintenance could be contracted or leased out directly to a private firm which has the technical capacity to repair the generators or the distribution systems; the generation plants can be sold to firms or individuals who commit to providing electricity. More than one plants in one region could also be

[10] The master plan envisages three steps: (i) satisfy immediate energy needs through a hybrid diesel-wind-solar system; (ii) increase renewable energy contribution to power supply; and (iii) further increase renewable supply, retire diesel generation, and apply fuel cell storage. The average investment per Soum (over all 197 Soums) is roughly $0.8m.

operated by a private firm under a concession or a franchise arrangement. Key to these changes is that a professional firm will be able to do a better job in managing and operating the generation plants than a village association, and it will have better resources in case of technical problems.

In principle there is nothing wrong with Soums operating their own plants, and some will be more capable to do so than others. The Central Government can continue to pay the high subsidies to operate these plants, or as an alternative it can also assist all 197 non-connected Soums (plus additional villages with their own supply) to improve their operations. The inefficient operation is a real economic problem that need to be addressed: on the one hand services have deteriorated leading to user complaints, and on the other hand costs have increased. Assisting all Soum centers individually does not provide much room for economies of scale, since tailor-made solutions are needed and training is required for every Soum operator. When a private firm is responsible for operating a number of the Soum plants at the same time, such efficiency improvements are possible as one only need to assist the firm that will then implement solutions in a number of Soums.

With the anticipated financing mechanism private operators as well as Soum Centers (or villages of certain size) will be assisted to supply and use electricity under enhanced conditions. A few countries developed such types of financing mechanisms, in which generally an operator ("provider") commits to supply electricity to a village association (or in this case, the Soum Government) or several groups of village associations. The operator receives contributions from users for the use of and the connection to electricity, from the Government for his contribution to increase access of electricity in rural areas (concessional funds or subsidies), and he uses his own equity as well. Any funds further required will need to be borrowed from commercial banks. The operator has two contracts, one with the village association (Soum Government) for the bulk supply of electricity (the village association or Soum Government collects bills from its members), and another with a commercial bank for the loan. The regulatory aspects of such operations need to be carefully crafted, as to leave neither the operator nor the Soum in the cold.

The three main issues that need to be tackled for more sustainable Soum diesel operations are the following:

- The basic condition for sustainable operation is that Soum utilities operate as much as possible as commercial businesses. This requires, at the minimum, that clients pay for their consumption and that tariffs reflect their economic costs of production. Appropriate tariffs need to be established, based on ability to pay and demand elasticity, which are crucial input parameters for commercial operation, but they are basically unknown at the moment. Subsidy levels should also be determined.

- Since diesel fuel constitutes the largest cost factor, ways should be found to reduce the consumption per unit produced. Because of the large excess generation capacity, increased consumption would lead to much lower costs and possibly lower tariffs. Substitution of wind for diesel fuel should also be studied.

- A plan to interact with private firms for the management and operation of the Soum utilities should be discussed and finalized, including the bidding documents to select the most appropriate firm(s). Interested firms will be requested to submit a proposal for running the Soum utility(ies), including the investments they intend to realize to improve operations, and including the amount of subsidy required to sustain their operations.

Peri-urban areas around Aimag and Soum Centers

Areas that have not been discussed so far are peri-urban areas. These are defined as zones on the outskirts of urban centers, where households constructed homes (or durably installed gers) in a dispersed mode. Normally it is not cost-effective or economically justified to extend the distribution network to these

individual homes, as distances are large and the resulting electricity demand is small. However, other solutions can be found, and it is recommended to take a closer look at these. Three different technical options are distinguished: Pre-electrification, individual electrification, and community solutions. Some of these solutions will also be viable for rural areas.

(i) Pre-electrification solutions concern primarily households that use electricity sparingly for lighting, TVs and radios. The sole purpose is to assist them to have this electricity now, as opposed to several years from now, if and when the Aimag/Soum utility is ready to connect new clients. The kWh price will be high, but since the consumption is so low, the total monthly bill will still be affordable. This mainly concerns car batteries that have to be brought to a location for charging (in the Aimag, Soum center). Households could possibly add a small solar panel to their battery to prevent too frequent trips to the charging place. Another such solution is the lease or rent of equipment for a limited time. A herder who stays at the Soum center for a few months during the winter could rent or lease a solar lantern.

(ii) The second solution consists of this too, although a larger capacity solar panel is used to make the user self-sufficient in electricity use. He still cannot use other appliances that he would be able to use with grid electricity (although maybe not with Soum grid electricity), such as irons, room heaters, etc. This second solution is the individual electrification, which requires a higher financial outlay than with the first, but a lower resulting kWh price. Many different ways to realize this are possible: the operator can lease the solar systems to users, he can charge a fee-for-service, he can provide the systems on credit, or he can sell them directly. All these options can be used with or without pre-payment meters that are now available for individual solar systems. It is not possible to indicate the best way without finding out what people's preferences are.

(iii) The third solution consists of a different approach, whereby the utility provides one bulk connection to a number of clients. The utility sells electricity (against the normal tariff) to one operator, who develops his own distribution network, sells electricity to his own clients for a higher tariff. As with the two previous solution, the idea is to provide electricity now to clients that normally cannot be profitable utility clients. Over time, they will become better clients and at one point it will be justified to connect them as regular clients. The kWh prices will be higher than what is charged in the Aimag/Soum center, but lower than what clients under (i) and (ii) pay.

Delivery mechanisms for these three solutions are important. They could well be developed along the same lines as what described above for operating Soum center plants, whereby private operators ("providers") take the lead in developing these solutions. These operators could possibly be associated with equipment manufacturers, importers, etc. The operators should be able to use the anticipated financing mechanism, including the use of subsidies. In addition, in the case of SHS only, it could be useful to also provide financing assistance to end-users. It is possible that these activities are developed by the Utilities instead of by an operator.

Rural Areas

Solutions for households in rural areas are pragmatically limited to renewable energy systems, which provide a good match with people's demand for electricity. The demand is usually limited to lighting, radio, and TV (with or without satellite receiver), which translates to only some 300 – 500Wh per day for the household that is used to the highest level of comfort. Such demands can easily be supplied by a small solar or wind system of 100 – 200 Watt and can be obtained for less than $1000. Although this does not exist, 100-200Wp hybrid wind-solar systems could be an excellent combination for Mongolian conditions. A wind generator is more expensive than a PV modulee, but it also operates at night (as long as the wind blows), reducing the need for storage and allowing lower capacity generators to be used. Both systems require storage of electricity, in the form of a battery. This battery is the weakest link in the system, and it

deteriorates quickly if abused (i.e. when people do not know how to operate and maintain it). On the lower limit of the demand spectrum, households use only one lamp for five hours per night - which already makes a major difference in the ger. The daily demand is around 50Wh and a PV module of 50-75Watt should be sufficient most of the time, except in times of extended cloud cover. Such small panels can be bought in Ulaanbaatar for around $300. Other companies also sell solar equipment, and wind equipment is available as well. Therefore, a certain infrastructure to sell rural electricity equipment already exists, serving an existing demand. To put current prices in perspective, a complete small solar system that comfortably operates a light and a radio will cost some $180, or the value of about one cow.

Issue	Action	Means
Set up Institutional Environment for DE to take place	MOI (DFE) to study options for Agency; develop Operational Manual for Agency; ensure legal rights for Agency and operators;	1.5 m.month of international expertise Outputs: clear institutional plan; operational manual completed
Set up Financing Mechanism	Review & discuss with banks; develop the mechanism; identify the Government's contribution in terms of direct financial support (contribution to financing mechanism) and indirect support (VAT, import duties, etc). Carry out a willingness to pay study.	2.0 m.months of international expertise 1.0 m.month of national expertise Outputs: clear long-term financing mechanism, incl. Distribution of subsidies. Financial operational manual completed. Willingness to pay study completed for all three energy markets.
Diesel Aimag Intervention	Study wind option for (i) all five diesel Aimag stations; (ii) for individual diesel Aimag stations. Interconnection with CES should be evaluated also. Discuss with local banks and the Government, as well as with donors (green fund mechanisms).	3.0 m.months of international expertise Outputs: proposal for wind investment plan for those Aimag systems that will not be connected to the CES, including bidding documents and submission documents for (green) financial assistance
Soum Intervention	Study wind option for Soum systems and determine how many Soum centers should fall under one concession; develop procedures for assistance to Soum Governors to attract an operator; develop procedures for assistance to operators to deal with Soum Governors	1.5 months of international expertise Outputs: clear procedures for setting up concessions among Soum centers
Rural herder intervention	Develop linkages with rural development projects and identify the most appropriate to work with; develop procedures for assistance to operators within the framework of these rural development activities to realize rural electrification among groups of herders. In addition, peri-urban groups of households will be addressed also.	1.5 months of international expertise Outputs: clear procedures for setting up concessions among groups of Ger households/herders.

There is not a single solution for the rural electricity problem, but several options that co-exist; people need to choose the best possible option conform to their demand and ability to pay. The question then becomes

how to accelerate this process, and how to develop initiatives to deliver equipment and services to as many ger households as possible. It would be better to look for ways to address many households at the same time rather than try to solve every household's individual problem.

The anticipated financing mechanism would be helpful or even necessary to accelerate the flow of equipment. People now complain that the loans they obtained (under the 100,000 solar ger program) were too limited, they want to reimburse their loans over longer periods (1-2 years). Although this is normal behavior for people who just obtained their first loan for non-productive purposes, in fact they have been paying off their 3-6 month loans in a decent fashion without many defaults. As an alternative to an end-user financing mechanism, it could well be more effective to assist private firms to operate on a larger-scale (venture capital). The firms then could provide different support mechanisms such as fee-for-service, lease, hire-purchase, etc.

Rather than concentrate only on private sector delivery of equipment to directly to potential users, it will be useful to create links with existing programs and initiatives among the target population: health, education, social services. This has a high demonstration value, reaching the population where they need essential services, while developing an infrastructure for further delivery of equipment. As an example, the sustainable grassland management project will be much more effective in reaching groups of rural herders than any private sector-based program that is set-up from scratch to promote solar or wind equipment to individuals. Creating a direct link between an operator who wants to supply equipment and the rural implementing agencies under the sustainable grassland management project will be beneficial for all involved.

Action Plan to further prepare for a rural electrification program

The following are concrete steps proposed to develop activities for increasing access to electricity for all households in Mongolia. This consists of obtaining more basic information (about willingness and ability to pay) and testing promising approaches in practice, with special attention to institutional set-up and financing mechanisms.

Willingness to pay/expenditure survey

This is baseline information needed for many different purposes, whether for adjusting electricity tariffs in all zones of Mongolia, for developing financing mechanisms, and for developing the appropriate institutional solutions. This study should be carried out in all areas, ranging from modern urban (Ulaanbaatar) to deep rural (migrating herders). The willingness to pay/expenditure survey should quantify people's actual expenditure level for energy other than for heating and cooking (drycell batteries for flashlights and radios, petroleum fuel for lamps, candles, batteries for TVs, electricity from the (local) grid if available, etc.); qualify the desired level of services (how many hours per day, weeks per year), estimate power requirements (how many light points, radios and other equipment); and determine the preferred way to pay for the energy bill and the connection (if not already connected). Terms of Reference and estimated costs for such a study are presented in Annex 4.

Setting up the Institutional Environment and Financing Mechanism for DE

This study will develop the modus operandi for the DE Agency and the Financing mechanism. Terms of Reference and estimated costs for such a study are presented in Annex 5.

Aimag Wind Generation Study

Although not required for better access to electricity, this pre-feasibility study provides an interesting opportunity to increase the viability of non-interconnected Aimag utilities. The study will determine the prospects for adding wind generators to the existing diesel generating park in Aimags and identify the best mechanism to realize this. Different project alternatives such as wind generation at one Aimag only to a project that considers all five at the same time will be investigated. Mechanisms to assist with the financial closure of such project will also be identified. The outcome will be the tender documents for the procedure to identify the wind generator suppliers. Terms of Reference and estimated costs for such a study are presented in Annex 6.

Annexes

Annex 1: Aimag with additional diesel or a wind generator
Annex 2: Aimag with additional diesel or a wind generator
Annex 3: Illustration of Soum center electrification choices (line ext, diesel, 100% renewables, hybrid)
Annex 4: Terms of Reference Willingness to Pay Study
Annex 5: Terms of Reference Delivery Mechanisms for Non-grid Electricity Supply
Annex 6: Terms of Reference Wind Generation Study
Annex 7: Local fossil and Renewable Energy resources

Lessons From Other Countries

In what follows, the experiences of five different rural electrification mechanisms are described that could play a role in further electrifying rural areas in Mongolia. These mechanisms mainly rely on private sector involvement for implementation of activities. Two deal with concessions to a firm or operator who engage to provide electricity to a certain number of clients in a certain geographical area over a certain period of time. In Cambodia, Laos and several African countries solutions are developed that address one or more communities at the same time, for the core of a village a small decentralized power generation system plus low-cost distribution network, while for the surrounding areas individual solutions are being pursued. In case there are more than one operators for one concession, the one who has the best business plan and intends to cover the largest number of clients will prevail. In Laos the initiative for proposing an activity lies with the community whereas in Cambodia and the African countries the initiative can be with the community or private companies. A similar model is used in Argentina, with the difference that concessions are awarded to the private bidder who asks the lowest amount of subsidy from the Government. Then, in Indonesia a dealer-financing model was used to promote solar electric systems to individuals. Dealers were assisted to create a better technical and financial infrastructure for the promotion of solar electric equipment. They can extend credit to end-users in a number of forms, including leasing of equipment and end-user loans. Finally, in Kenya a financing mechanism was developed to give loans to groups of people instead of to individuals for the purchase of individual solar electric systems. The lessons learnt from these models can be used for individual solar or wind systems in rural areas, but also for community solutions such as at the Soum or bag level.

Laos[11]

Large segments of the rural population (some 3.8 million in 1997) in Lao PDR are without electricity from national or provincial grids and they will not be connected even in the distant future. Only 8% of the rural population has access to electricity. As a consequence, in parallel with the development of grid electrification in Laos, there is a great need to provide institutional support for local microgrids and other small electricity systems. Few local microgrids have been developed in the past, however, and without the proper regulatory framework and adequate institutional and financial support, it is unlikely that many more will develop on their own. At present, there are few institutions in Laos to support the development of microgrids for rural electrification.

To support sustainable off-grid power service, the government of Lao PDR has directed Electricité du Laos to undertake an off-grid pilot program as a component of the World Bank's Southern Provinces Rural Electrification Project. The development of off-grid electrification in the Laos project would require a decision by rural communities and entrepreneurs to develop local enterprises to distribute electricity. The key functions and institutions that would be involved in the implementation of such programs are summarized in Box 1. This should be considered as an initial blueprint for institutional support and for the distribution of functions in the development of off-grid electrification in Laos; one which is anticipated to change and evolve over time.

Responsibility for providing technical assistance should lie with an off-grid electricity unit within Electricité du Laos. This unit will promote the pilot program in various regions of the country. Prospective system operators should have a choice of technologies ranging from a microgrid, to battery charging, to photovoltaic household systems. To obtain a loan or the lease of equipment, prospective local operators would have to submit their business plans to a committee for off-grid rural electrification composed of representatives from government, the electric power industry, and non-profit groups. Once approved, the loans would be supervised by the Electricité du Laos unit specializing in off-grid electrification. Units within this off-grid unit would be available to

[11] From: ESMAP Report No 215/99

Box 1: Laos
Key Institutions and Responsibilities

1. Electricité du Laos Off-grid Unit. Promotes and seeks business plan proposals to provide off-grid electrification to villages and households in rural areas.

2. Village committees, entrepreneurs, and non-governmental organizations. Develop business plans and submit applications for loans to off-grid rural electrification committee.

3. Committee for Off-grid Rural Electrification. The committee reviews and approves applications for loans or leases to provide off-grid electricity to rural consumers.

4. Financial institutions and Electricité du Laos. The financial institutions implement loan agreements or Electricité du Laos executes the leasing arrangements.

5. Private or independent contractors. Community or private entrepreneurs utilize financing to select contractors to construct systems according to planned designs.

6. Electricité du Laos Off-grid Unit. Supervises loans or leases and reports findings to lending and leasing agencies. Results in identification of best practices that feeds into off-grid promotion.

provide technical support to projects, particularly in cases of problems or difficulties. However, the operation of the enterprises and the repayment of their loans would be entirely the responsibility of the local system operators.

For the construction of microgrid systems, either Electricité du Laos company or private contractors will supply the materials and carry out system construction. Many failures of similar programs in the past can be traced to retailers and private contractors out of touch with local markets making deals with donors and "installing" equipment in rural areas which ultimately provided insufficient demand, or which found the installed technology unacceptable. However, contractors and manufacturers will be more likely to adapt and adjust their products to meet real needs if they must sell their services and equipment to local system operators who are more knowledgeable about local customers and their preferences. This skewing of incentives toward bona fide local requirements and ability to pay will be especially important in helping local operators to keep their costs low.

African countries (Côte d'Ivoire, Guinea Mauritania, Senegal) use similar approaches, with one difference: there is less reliance on the utility for the realization of activities. Usually a rural electrification organization (a not-for-profit organization) is created to promote and oversee the development of off-grid activities. The utility concentrates on urban areas where as rural and peri-urban activities are developed through the intermediary of the rural electrification agency in the way described for Laos. Private operators need to take the initiative for developing the electrification activities. In case of Mongolia, one can imagine that concessions are issued to operators who run several Soum diesel systems in one region, or who cover a region with solar and wind equipment for individual use.

Argentina[12]

Argentina has made great progress thus far in its efforts to reform and privatize the power sector. While it has a relatively high overall rate of electrification (95%), substantial numbers of the rural population still remain without either electricity services (30%) or other basic infrastructure. In 1995 the Argentine

[12] From: Off-Grid Rural Electrification in Developing Countries; Reiche, Covarrubias, Martinot, 2000

Secretaría de Energía (SE) created the *Programa de Abastecimiento Eléctrico a la Población Rural de Argentina* (PAEPRA) for the provision of off-grid electricity to the dispersed rural population and to provincial public services such as schools, police stations and health centers. This program aims at ensuring electricity supply to a rural population of about 1.4 people million living in 314,000 households and 6,000 public services distributed in 16 provinces, which are distant from the power distribution grids. PERMER, *Proyecto de Energía Renovable en el Mercado Eléctrico Rural*, is a component of the PAEPRA in 8 participant provinces. It aims at providing electricity for lighting and social communication (radio and TV) to about 70,000 rural households and 1,100 provincial public service institutions through 8 private concessionaires using mainly renewable energy systems.

In PAEPRA and PERMER, a concession approach has been chosen for rural electrification, mainly because of the country's ample experience with concessions for the provision of infrastructure services (e.g. telecommunications, water). The concessionaire obtains the monopoly of a given province in turn for the obligation to connect the service when requested by the customers, and to maintain its continuity over the duration of the concession. The concession contracts are tailored to the condition prevailing in each particular province and awarded through a competitive bidding process that minimizes subsidies. Concessions are eligible to re-bid for their business every 15 years up to a total of 45 years, competitively against other eligible firms. Tariffs are renegotiated every 2 years. The financial rate of return to be obtained by the concessionaires has been estimated to be close to 14%.

Average willingness to pay in the PERMER target provinces for basic lighting and communication varies between 10$ and 20$ per month. Four income classes have been defined, each with a service level using different sizes of solar electric equipment, as seen box 2. As an illustrative example, a 100 Wp SHS would supply about 7.5 kWh monthly. This would allow the household to have four daily hours of light from two high efficiency light bulbs of 15W each, listen to a 10W radio during three hours, operate a 20W radio-cassette recorder during one hour and watch a 80W TV set during one hour. For this service level a household with a monthly income of $250 of which $15 are currently used to pay for conventional energy would require a monthly subsidy of about $12 to cover the $27 tariff.

BOX 2: Argentina
User Categories and Service Levels

INCOME DISTRIBUTION AND ENERGY EXPENDITURE

	Population Segment	Monthly expenditure in energy	
Monthly income category	Percentage	Amount	Percentage
Low income: less than $150	42%	$9/month	> 6%
Low to medium income: between $150 and $250	31%	$15/month	6% - 10%
Medium to high income: between $250 and $400	17%	$18/month	5% - 7%
High income: more than $400	10%	$21/month	< 5%

Source: World Bank

THE INITIAL INSTALLATION COSTS OF SOLAR HOME SYSTEMS (SHS) IN PERMER 1999.

SHS size	Initial installation cost	Lifetime O&M Cost	Lifetime battery Cost	Lifetime total cost	Monthly recovery cost
50 Wp	764	390	216	1370	16.8
70 Wp	1074	390	299	1763	23.1
100 Wp	1347	390	418	2155	26.7

Source: World Bank
Note: assumed are: 14% concessionaire's return on investment, 15 year SHS life, battery replacement every 3 years, O&M, controller replacement every 7 years.

A regulatory agency calculates tariff schedules for off-grid electricity for each level of service. It is assumed that the concessionaire will invest at least 40 percent and the household will pay up front 10 percent of the installation cost. The balance 50 percent is the base subsidy. The concessionaire receives this balance "up front" from the provincial Government. The concessionaire's investment (40 percent of lifecycle costs, including operation and maintenance costs) is recovered from the consumer through a monthly tariff from the consumer. Under this arrangement, it is estimated that the low- to medium-income rural households will receive equivalent subsidies in the range 8-10 US$ monthly. High-income rural households will pay tariffs recovering the cost of service in full. The subsidies will phase out over time to account for expected cost reductions along the learning curve. As this is a variation of the Laos case that was described above, and since it is clear that subsidies will be needed for quite some time to come, it can be imagined that innovative ways to reduce subsidies are incorporated in the efforts to electrify rural Mongolia.

Indonesia[13]

Even with some of the richest reserves of oil, natural gas, coal, hydro, and geothermal energy in the world, Indonesia has been unable to extend electrical power to nearly 60 percent of its population. Most of these people live on remote islands in Indonesia's huge archipelago in some 39,000 villages on 13,600 islands other than the two largest, Java and Bali. Despite Indonesia's quest to raise rural standards of living through electrification, the government recognizes it cannot afford to supply conventional energy sources to rural areas over vast distances. It knows that, with inaction, its large and growing rural population will consume increasing amounts of inefficient forms of fossil fuels that pollute and emit greenhouse gases. The government seeks to diversify to more economic and renewable alternative energy sources, encourage private sector involvement in energy supply, spread development benefits evenly throughout the country, and protect the environment.

Box 3
Indonesia – Project Details

Activities

- World Bank loan and GEF grant to enable rural purchase of low-cost solar systems on an installment plan
- Technical assistance on implementing the project, developing policies in the form of a strategy and action plan, and strengthening BPPT's testing and certification capabilities for solar home systems.

Benefits

- Mitigate greenhouse gas emissions and provide electricity to many rural residents who now do without
- Involve private sector in commercializing renewable energy
- Promote environmentally sound energy resource development
- Strengthen national capacity to support decentralized rural electrification through solar photovoltaics

The dealer-credit model was introduced partly because of the prior success of a private dealer in Indonesia selling systems on credit. This entrepreneur was able to sell more than 4000 solar systems on credit. In the original project concept, business financing would be extended by commercial financiers to dealers, and then in turn dealers would extend consumer credit, at terms of up to four years, to their customers. The commercial banks would bear the dealer credit risk, and the dealer would bear the consumer credit risk. Unfortunately, the project was never fully implemented because of Indonesia's macroeconomic crisis and has been canceled halfway. The project started to commercialize solar photovoltaic home systems in Indonesian rural areas and catalyze market acceptance of solar home systems as part of a least-cost rural

[13] From: GEF, ASTAE

electrification strategy that relies on private sector delivery and installation. The intent was to create a sufficiently large market for solar home systems to accelerate wide-scale purchase of solar home systems and broaden product offerings. The project intended to support installation of about 200,000 such systems in up to four regional markets, focusing on areas too remote to connect to existing electrical power grids but reasonably close to urban centers. The project would also develop a strategy and action plan to meet the energy needs of rural populations for whom solar home systems are the least costly alternative.

The ideas behind this activity are also clearly applicable to Mongolia: part of the dealer infrastructure already exists, and creating an enabling environment so that these dealers can work more effectively clearly goes a long way in accelerating their activities. This would mainly be limited to solar and wind systems for individuals.

Kenya[14]

In Kenya less than 0.5% of rural households have access to grid electricity while population growth exceeds the rate of rural connections despite major investments in the rural electrification program. Kenya has been an active market for solar home systems for almost a decade, during which more than 150,000 units have been installed on a commercial basis and an estimated 15 -25,000 new systems being installed yearly. The private sector has responded quickly to this growing consumer need, offering an increased and diversified supply of solar energy components and technologies on the market. At present there are more than ten solar module distributors and at least five companies manufacturing balance of system components (BOS). Scores of agents market, install and service solar electric equipment in rural areas. Presently the estimated size of the Kenya solar PV market is valued at about US$5 million and has been growing at more than 25 % per year for the last 7 years. Today, there are more rural Kenyan households with solar electric systems than the government's Rural Electrification Programme customers, despite the fact that PV equipment is taxed and REP equipment is subsidized. This demand has created and sustained a growing market for solar products and services, mainly from households with ability to meet initial costs of purchase and installation. Most of these relatively well to do households have acquired systems on a cash basis, indicating that affordability, among other considerations, is an important factor in the solar energy technologies uptake among rural households.

Different financing mechanisms for SHS were tested in an attempt to create a conducive environment for accelerated use of SHS in rural Kenya. At the moment, some dealers provide lay-away service, whereby clients reserve their equipment and can take it home when their accumulated deposits equal the agreed purchase price. This is applied mainly to solar modules only; the end-user has the responsibility for installing the system. End-users often cut corners to save money, e.g. charge controllers are seldom purchased as they are deemed unnecessary, or systems are under-designed with poorly matching components. This affects the quality of the installations and end-users are likely to experience performance problems much earlier than necessary. The same problems are valid for cash purchased systems. With a financing mechanism these problems can be addressed. People that find it difficult to pay a large sum of cash up-front will often be able to pay a monthly fee over a certain period to purchase a properly designed system. Financing mechanisms will ultimately allow for (i) a better control of the quality of the solar systems, thereby reducing the chances of early equipment failure; (ii) a spread-out payment that makes it more affordable for the end-user to purchase this higher quality equipment; (iii) an increase in the number of people that can enjoy services by SHS; and (iv) scale-economies through bundled procurement and installation, which will also off-set some of the costs of the loan and the costs of quality control.

The approach adopted was based on the co-operation of a finance partner and a technical partner with communities that desire solar electric systems. The finance company makes loans available to qualifying households and small businesses that desire lighting and small power systems. The technical partner insures that all systems are well designed, installed, inspected and maintained. Loan agreements stipulate that the borrower follow technical guidelines set up by the technical partner to insure maximum system life (i.e. battery life). Rural based service companies install and service the systems, while local artisans fabricate

[14] From: ESMAP 213/00

battery boxes and module mounts. Two different types of finance institutions that were already active in rural areas were involved. In fact, both are recognized as leaders in their field. One is oriented towards giving business loans to small, well-organized rural groups and small businesses. Members of such groups are to guarantee each other and lower defaulting risks (i.e. peer pressure as collateral). The second type of finance group is an organized co-operative bank with experience loaning to individuals through rural-based Savings and Co-operative Credit Organizations.

Several ways exist to identify target groups and co-operating technical and financing partners. If the initiative is starting at the community level, then interested groups must organize themselves and identify finance organizations. The groups must be legally recognized. If the initiative is starting from the financing institution, then target communities should be identified though outreach and promotional meetings. The target group is informed of the (in) capabilities of solar electricity during awareness meetings. Minimum data on energy requirements is collected to establish needs of the group in the target region. In areas where people do not have an understanding of PV technology, demonstrations were held to show how solar electricity works, and what the costs and benefits are. Groups or co-operative societies discuss the particulars of the loan program with the financing institution, and ensure that there are no further questions lingering.

Group members apply collectively for loans from the finance partner. Loan application procedures should be those already established and tested by the financing institution and the credit group. With advice from a technical partner or selected local technicians, applicants choose a system size that best fit their needs. A limited number of standardized system packages are preferred for logistical reasons[15]. For each applicant, the credit group approves a loan amount equivalent to the desired systems as per the technical partner's standard designs and the applicant's credit rating. Vetting and approval procedures should be those established by the individual groups. The group submits a single request to the finance partner once it has established its total loan requirements. Each group collects deposits and payments from individual members using established procedures and makes regular payments to the finance partner.

Equipment is tendered for by the finance partner or the loan group, with support from the technical partner. Who organizes the tender process is a decision to be taken by the finance partner; quality control is easier when the finance partner keeps this in-house, although the process may be more sustainable if it is done directly by the credit group. After evaluation of the tender bids, the successful supplier(s) delivers equipment directly to the group. The solar electric systems are installed by technicians selected by the credit groups and approved by the technical partner. In case the group cannot nominate a technician, the technical partner identifies and trains technicians based within the project area. During the installation technicians are further trained on minimum installation code and standards[16]. Inspections are held on completion to confirm system compliance with minimum standards. The group should be fully involved and where possible a nominee from the group trained as inspector. Monitoring, repairs and maintenance should be built-in into the technical packages, and provided for at least the duration of the loan repayment period. After this, clients can buy additional coverage.

Although it proved difficult and laborious to organize, once the right partners were identified and clear procedures were established indicating each partner's responsibilities, financing mechanisms for solar electric systems for use in households and small business are feasible. This is so despite the fact that solar systems are consumer goods that do not generate income in a short time period. The desire to have access to some electricity is so deeply rooted, that households that have a chance to obtain a loan to acquire a solar electric system will do so. The financing mechanisms existed before and were in use by the organization that offered them, but had never been applied to non-income generating equipment (i.e., solar systems). In order to apply these financing mechanisms to solar equipment, a certain amount of technical assistance for training and quality control was necessary, as was a limited financial assistance to slightly reduce the costs of the loans offered. Applied to the situation in Mongolia, it appears more efficient to identify existing mechanisms that already operate in rural areas, and modify these to include solar equipment rather than create new mechanisms from scratch.

[15] In this project 3 sizes of systems were offered, ranging from 20 – 60 Watt.
[16] Minimum installation code and standards cover issues from installation practice to user training.

Annex : Local fossil and and Renewable Energy Resources

Mongolia is endowed with ample energy resources, both fossil and renewable. *Coal* deposits with proven reserves of about 5 billion tons exist. Although most of the deposits are lignite with a calorific value of between 10.4 and 14.6 MJ/kg, substantial volumes of bituminous coal have also been found with a calorific value of about 21.2 MJ/kg. The major reserves are in the Tavantolgoi deposit, at 540 km south of Ulaanbaatar in the Omnogobi Aimag. Some 26 open cast mines are active, the closest to Ulaanbaatar is in Baganuur at 120 km distance and in Shivee Ovoo at 260 km. Coal will continue to play a crucial role in generating electricity for the urban markets.

Petrol was found in Mongolia, but is not actively being developed. One American firm, Soko[17], is continuing the exploration and organized pilot extraction. It is unlikely, however, that petroleum will contribute in a significant way to solving rural access problems.

About 70 % of all *hydro energy* resources are concentrated in the Mongolian Altai ranges, in the Tagna and Khan Khukhii ranges, in the mountainous areas of Khuvsgul, Khangai, Khentii and Khalkh gol river. More than 1 GW of potential hydro power capacity has been identified, and some 250 MW are planned to be built. In addition, there is much potential for mini-hydropower plants of up to 1 MW capacity, which could be used to supply Soum centers with electricity, as an alternative to diesel plants. Several locations have been studied. One complicating factor is that many rivers freeze over during the winter and cannot provide year-round electricity. One 20 MW plant has been approved by Cabinet in October '01 for supply to the WES and reduce Russian electricity imports. There is a call for developing a hydro power master plan.

The land of eternal blue skies enjoys a favourable *solar energy* regime, ranging from a low insolation of 4.5 kWh/m^2 per day and less than 2600 sunshine hours in the Tagna and Khan Khookhii mountain ranges, the mountainous areas in the northern parts of Khuvsgul and Khangai as well as the Khentii mountain ranges, to a high of 5.5-6.0 kWh/m^2 per day with a sunshine duration of 2900-3000 hours in the Post-Altai Gobi area, the Steppe and the Gobi dessert. The high insolation regime covers some 70% of the territory. Intermediate insolation of 4.5 – 5.5 kWh/m^2 per day with an annual sunshine duration of 2600-2900 hours is found in most parts of Dornot Steppes and Khangai ranges, some parts of Khentii mountain ranges, some parts of Ikh Nuuruud as well as Altai ranges, representing some 18 % of the territory. Solar energy was monitored by DFE and JICA, and sufficient data are available. Solar energy could play a useful role in the electrification of rural areas. Although the kWh costs will remain high, in low-use circumstances it will often be the lowest-cost alternative. In remote sites, it might be (with possibly wind) the only solution.

Wind energy resources vary from low in the northern part of the country to high in most of the southern parts. The Mongolian Altai ranges, the Tagna and Khan-Khentii mountain ranges, and the mountainous areas of Khuvsgul (about 1/3 of the territory) are considered areas with low wind energy resources of less than 100 W/m^2. Average windspeeds of 3.5 m/s are obtained less than 3000 hours per year. The Gobi desert zone, Dornot and Sukhbaatar provinces (some 40% of the territory) enjoy high wind energy resources with intensities of 150-200 W/m^2. Average windspeeds of some 5 m/s are obtained 4000-5000 hours per year. Intermediate wind energy resources of 100-150 W/m^2 are found in the Steppe zone, Ikh Nuuruud and Post Altai Gobi areas (28 % of the territory). Average windspeeds of 4.5 m/s are obtained 3000-4000 hours per year. NREL recently produced a wind map for Mongolia that indicates how much energy potentially is available throughout the country. These data show that wind could play an important role in the development of both rural areas (individual wind generators) and small urban centers (Soum, or even Aimag).

Geothermal Energy Resources are found in the central and western part of the country, Hangai, Hentii, Huvsgol, Mongolian Altai Mountains, Dornot-Darigangiin Steppe and Orhon-Selenge region; there are about 42 known small hot springs. There are limited resources where the water flow has sufficient thermal capacity (the higher temperature the better, but at least 50 C and 40 – 50 m3 per hour) and is located close

[17] Not sure - check

to a potential demand center. Some hot springs are used for a heating in Shargaljuut of Bayankhongor and in Hujirt of Uvurkhangai. It is unlikely that geothermal energy will contribute to the electrification of Mongolia.

6. INVESTMENT REQUIREMENTS IN AND FINANCING THE ENERGY SECTOR, 2002-2011

6.1 Introduction

Mongolia is undergoing transition from a centrally planned economy to a market oriented economy, and this process will need to be supported by private sector investment. Mongolia has developed a range of opportunities for foreign direct investments, and the Government is working to create favorable conditions for investors—both foreign and domestic. Unfortunately, the effects of the 1997 Asian Financial Crisis and the current global slowdown have reduced investor interest. In addition, and reflecting the economy's transition, investment in Mongolia is only 40 percent as productive as that in the fast growing East Asia economies (*Mongolia: Confronting Twin Challenges, Strategic Options for Rapid Growth and Reducing Poverty*, World Bank, CGM, Paris). There are other factors that have impacted foreign direct private investment:

- The economic growth rate is low.
- Returns on investments are low, and falling.
- Dependence on foreign capital.
- Productivity of public investments is low.
- GDP per capita is $450, and the domestic market is limited.
- Increasing poverty, and decreasing consumption.
- Property and land rights still need to be clarified.
- Landlocked location adds transportation costs.

Thus, while many steps have been taken to promote private investment, there are problems and some barriers. None of these are insurmountable, but they are not necessarily going to be resolved in a matter of days. Nor should it be expected that some of these complex issues can be resolved in a short time frame. What this means for the energy sector is that whenever opportunities are available for private sector investment, then they will be pursued. But on other occasions, the energy sector will still be reliant on Government and international support—both technical assistance and loans for the near future.

This chapter discusses national investment policies, investment requirements in the energy sector, and identifies financing gaps that need to be filled. It should be noted that the chapter does

not present all the financing requirements for 2002-2011, because details for some proposed projects have not yet been developed.

6.2 National Investment Policies

The Mongolian Parliament adopted the Law on Foreign Investment in 1993, and established the legal framework for foreign investment. The law aims to encourage foreign investment, to protect the rights and assets of investors, and defines the scope and duration foreign enterprises and their investments.

The Parliament also passed Resolution #140 on June 27, 2001, which approves a list of favored industries in which foreign investment and involvement will be encouraged. Investments in infrastructure, and specifically in the energy sector for the following will be encouraged:

- Oil and gas production, and the provision of water supply.
- Electricity generation, transmission, and distribution, including hydro power plants, electricity network, thermal and diesel generating stations.
- Steam production and hot water supply including heat lines and distribution network.
- Water filtration and water pipeline
- Petroleum and gas transmission pipeline construction.

6.3 Investment Requirements in the Energy Sector and Government Resources

Given the combined effects of the recent two harsh winters and intervening drought, the current global economic downturn and falling commodity prices, and until recently, rising oil prices, Government has had to readjust priorities to meet immediate survival needs of the rural population and curtail new expenditures. As a result, Government has limited scope to increase budgetary allocations to the public-owned energy and mining (e.g., coal) sectors. Some funds have been set aside for capacity building and selected research and development activities (e.g., wind monitoring) that will further the exploitation of indigenous energy resources and improved management of the sector.

However, the basic reality is that in the near term, Government will be reliant on external assistance for support of the sector. Technical assistance and other grants will have to play a leading role in capacity building and, in certain cases, the implementation of projects that are targeted on alleviating poverty and rural development. Concessionary loans will be utilized to meet capital requirements when appropriate, including for upgrades of the grid systems. But it should also be

stressed that when concessionary loans are provided to state-owned companies, these projects will have to 1) justify that the funds are essential to the successful operations of the sector, and 2) prove their viability by demonstrating that they can repay the loans. Without these assurances, Government will not be able to secure additional loans without compromising overall national development objectives.

As noted in Chapter 3, there are 14 on going projects funded by external assistance totaling $243 million, of which $187 million has been provided by loans, $20 million in grants, and $36 million from budgetary resources (see Table 3.2). Government has proposed an additional 19 projects totaling $378 million for 2002-2006, of which $302 are intended for loan financing, $66 million through grant funding, and $10 million from domestic budgetary resources (see tables 3.3 and 6.1). These figures do not include Phase II ($43.9 million) of the Rural Power Supply Program (project #11, Table 3.3), which is slated for 2010, nor Phase III ($80 million) which is scheduled for 2015. Neither do the figures include financing ($280 million) for the Egiin Hydropower facility or the Ulaan Ovoo coal mine ($20 million) for which private investment will be sought. In addition, there will be other projects from the soon to be completed Master Plan, the details of which are currently not available.

The figures also do not include other projects that will be provided by the forthcoming Master Plan because the details are not available. Other projects such as establishing a national energy management program for demand side improvements, will also be added as needed.

6.4 Private Investment Opportunities in the Energy Sector

As discussed above, the Government is promoting private investment in the energy sector when appropriate. This section describes various projects and opportunities in the energy sector that may prove attractive to private investors.

Egiin hydropower plant

The Egiin hydropower plant could be used as a energy source to meet both peak demand as well as provide a basis for expansion of the grid system, and thereby make Mongolia independent in terms of power generation. Electrowatt of Switzerland and Electro-consult of Italy conducted the feasibility study of Egiin hydropower plant in 1996. Installed capacity would be 220 MW, and the estimated capital cost would be $280 US dollars. The Government has proposed a BOT scheme to a joint group of investors, including Malaysia Mining Corporation (MMC) and the Czech company, Technoart. Although interested in financing the project, the group was unable to raise the necessary

funds. Government believes that using a BOT approach would be beneficial because it does not want to take on the level of borrowing required for the project, and because it has no experience constructing and operating a hydro facility of this magnitude.

Orkhon hydropower plant

The Orkhon hydropower facility is a high priority for Government because it will address the need to meet current peaking deficits that have been met by electricity imports from Russia. This would help to stabilize the CES. Government has sought foreign investment for the project but it now appears that the $160 million facility will likely be constructed using concessionary loans.

Chargait Hydropower

The Chargait hydropower project is included in the Government's list of priority projects. The project site is located approximately 40 kilometers from Moron, in the center of Khovsgol aimag on the Delgermoron River. Moron is one of four aimag centers that are not connected to a power grid. Current electricity demand is 2.5 MW, which could substantially increase if the Khovsgol-Dulaankhaan phosphate mining operations begin. Another option that was also considered was to build a 220 kV transmission line from Erdenet to Moron. While this would provide electricity at a far cheaper rate than the Chargait facility, it would also need to be supplemented by additional supply if developments in Khovsgol eventuate. For this reason, Government has decided to pursue a concessionary credit scheme with China unless a private investor is identified.

Liquefied Petroleum Gas (LPG) evelopment

Four Ulaanbaatar companies have recently begun importing LPG. There could be substantial opportunities to develop LPG as a leading fuel for household heating and cooking in rural and semi-urban areas, and Government is promoting private investment in this market. Government will assist the private sector as it develops the market but believes that private investment has to be the vehicle for market development.

Trans Mongolian pipelines and grids

As described in Chapter 2, Mongolia could play a major role in the development of regional oil and pipelines and electricity grids. Russia has and is further developing oil and gas fields and electricity generating facilities. There is increasing demand for all of these energy sources in China,

North Korea and South Korea, and it is likely that pipelines and grids connecting these countries would transit Mongolia. Several groups of private companies are discussing options with the various countries. If the pipelines and/or grids are constructed and transit Mongolia, then this would provide several opportunities for downstream development. Mongolia could opt to receive a transit charge for the energy passing through our borders. Another opportunity would be to secure oil and gas from the pipelines in lieu of a transit charge—or, there could be a combination of a transit charge and oil and gas supplies. If Mongolia decides to take energy supplies, then the natural gas could be used to power generating stations and private sector participation would be considered for such projects. In the case of the crude oil pipeline, this would require construction of a petroleum refinery, and again, the Government would promote private sector participation in developing this industry.

Oil Fields

As noted in Chapter 2, exploitation of an oil field has recently started. Although the current extraction rate is only 1,000 barrels per day, it has been estimated that the field contains approximately 300 to 500 million barrels of oil. If these estimates prove correct, then Mongolia will become an exporter of crude and/or petroleum products, in addition to meeting domestic demand. Government supports current efforts to develop the field.

In addition to this field, other estimates of Mongolia's oil resources suggest that there could be 5 to 8 billion barrels of oil in the country. Although not yet proven, these preliminary estimates suggest that there are tremendous opportunities for oil and gas exploration, and ultimately development. Mongolia neighbors countries with expanding oil markets, so it would be well-placed to enter these markets if the resource estimates prove correct.

Privatization of Energy Sector Enterprises

The Government has taken major steps towards energy sector restructuring by passing the 2001 Energy law as well as the necessary rules and regulations to promote private sector investment in the sector. There will be two key phases in the restructuring process.

The first phase will include the separation of regulation from operations, the unbundling of operations (generation, transmission and distribution), and corporatization and commercialization. The main objective of this phase is to introduce market principles into the energy market. As the emerging operating companies achieve commercial levels of operation, then the second phase will be implemented.

The second phase will include a gradual privatization of power generation and distribution companies. There are some ongoing projects funded by external loans, such as at Power Plant #4, with the energy transmission company, and in conjunction with the national dispatch center that are likely to remain state-owned.

The Government is also considering the management contracts for running power and/or heat generating plants, including at Nalaikh and Baganuur starting from 2002. The State Property Committee (SPC), is the government agency in charge of managing and privatizing state-owned assets, and has indicated that it would utilize an open international tender basis for selecting management contracts.

In addition to opportunities related to power and heat generation and transmission, there are future opportunities for private sector participation in coal mining. However, according to "Privatization Guidelines for 2001-2004," the state-owned shares in the Baganuur joint stock company (JSC) and the Shivee-Ovoo JSC will not be privatized until the technical renovation projects being implemented with soft loans (from World Bank and the Government of Japan) are completed.

6.5 The Role of External Assistance

Excluding phases II and III of the Improvement of Rural Power Supply, a total of $66 million in grants and $302 million in loans are being sought for the 2002-2006 period (Table 6.1). This does not include the $10 million that will be supplied from domestic resources, nor the $300 million that is being sought from the private sector. Some of the grants and proposed loans have either been signed or are well along in negotiations. For example, the Chargait and Durgun hydro facilities credit arrangements with China, and the transmission and dispatch center project with Germany have all moved forward—either to formal agreement or in later stages towards finalizing agreements. In addition, Japan has shown interest in phase I of the Improvements of Rural Power Supply program as well as the Orkhon hydro facility. Thus, major steps have been taken to implementing the list of expected projects.

The 19 projects listed in Table 6.1 (and Table 3.3) are considered Government's priorities during the 2002-2006 period, but it is not exhaustive. As mentioned above, the forthcoming Master Plan will include additional capital projects that will have to be funded through loans as well as selected technical assistance projects for which grants will be sought. Importantly and aside from the Ulaan Ovoo coal mine ($20 million) and the Egiin Hydro facility ($280 million) that are slated for private sector investments, nearly all of the other projects in Table 6.1 have already received expressions of

interest from the donor community. As a result, there is a more exhaustive list of possible projects shown in section 6.7, many of which have not been funded.

Table 6.1 Priority Projects, 2002-2006

(Figures in millions of USD)

Project	Domestic	Grant	Loan	Total
Coal Testing Lab	0.5	4.5		5.0
Ulaan Ovoo Coal Mine*				20.0
Training-Coal		3.0		3.0
Petroleum Transshipment	1.0	13.0		14.0
Bayanteeg Coal Mine		1.3		1.3
Soum Power Rehab		5.77		5.77
Durgun Hydro			24.0	24.0
Orkhon Hydro Study		0.5		0.5
Orkhon Hydro Power Plant			160.0	160.0
Rehab PP#4	0.5	4.0		4.5
Rehab PP#4	1.5		5.0	6.5
Bayanteeg Power			52.6	52.6
T&D Rehab			3.0	3.0
Power Rehab	5.0		25.0	30.0
100,000 PV Gers	1.1	5.3		6.4
Rural Power		23.5		23.5
Minihydro	0.55	4.75		5.33
Chargait Hydro			27.35	27.35
Egiin Hydro*				280
Total	10.15	65.62	301.98	377.8

Note: * not included in totals because these projects are intended for private investment.

However, it is important to recognize that the grants and loans acquired during the 1990s were focused on ensuring the energy sector's ability to meet safety and survival needs by stabilizing its operations. The currently proposed projects are aimed at transforming the sector to a sound level of operations—both technical and financial, so that the sector can meet Mongolia's future needs. Although private investment is being sought, external assistance will play the vital role during this transformation period. It is anticipated that the private sector and the commercial operations of state-owned enterprises will play far greater roles in future stages of the sector's evolution.

Thus, external assistance will be required in the near-term to ensure the long-term viability and evolution of the energy sector. There have been tremendous strides made but much remains to be done if the energy sector is to assume its necessary role as a dynamic and self-sustaining leader in national development. The Government hopes that the donor community will continue as partners in the evolving the energy sector to this end.

6.6 Resource Gaps and Potential Impacts

The Government is currently running a budget deficit, and economic growth targets of 6 to 7 percent have not been achieved. Although the deficit and the unrealized growth targets can be attributed to 1) the recent harsh winters and intervening drought, and 2) the current global economic downturn combined with the lingering effects of the 1997 Asian Financial and 1998 Russian Banking crises, the fact remains that Mongolia has needs to meet as it transforms into a market oriented economy and insufficient resources to attain this goal. Thus, the gap between needs and resources has to be met by external assistance over the near-term, and hopefully, private investment over the longer term. In addition to the energy sector, Government has other priorities that could compete for limited resources, including:

- Policies, strategies and programs to reduce poverty.
- Improving productivity of investments in the public sector, including in state-owned energy enterprises.
- Broadening and implementing policies aimed at attracting foreign investment.
- Addressing and enacting reforms in the trade regime, and in land and property rights (Mongolia: Confronting Twin Challenges, Strategic Options for Rapid Growth and Reducing Poverty, World Bank, CGM, Paris)

One of the barriers to expanding the role of private investment has been the fact that Mongolia has received lower volumes of investment (on a per capita basis) than other transition economies. Obviously, the small domestic market has influenced some investor decisions for substantive reasons. However, when this is combined with the low levels of productivity in public sector investment, investors become understandably hesitant—and pursue risk-averse options. This means that state-owned enterprises including in the energy sector, will have to demonstrate by concrete achievements that Mongolia can offer investors a solid opportunity to meet productivity objectives and financial returns. Only through performance will Mongolia be able to increase

foreign investment; and only with the assistance of foreign investment will Mongolia be able to achieve its economic growth targets.

External assistance will be required by the public sector including state-owned enterprises in the energy sector, to meet this challenge. There are no other resource options available. The next 5 years will be a critical transition period—critical to providing the economy with the basis for long-term sustainable growth, and critical to implementing programs that reduce poverty for the 36 percent of the population living below the poverty line.

6.7 Developing the Energy Sector: Other Key Projects and Actions

Although the draft Energy Sector Strategy covers the period 2002-2011, the emphasis in this section is on 2002-2006. This limitation is a result of several factors. As noted in previous chapters, the ADB-funded Master Plan will soon be completed, and this will provide a comprehensive perspective on the sector's financial requirements over a 20 year period. Details of the Master Plan are currently unavailable. In addition, project proposals for the 2007-2011 period have understandably not been developed. Thus, attention has been given to issues at hand rather than projections that would soon be rendered obsolete. This section describes priority needs and actions for energy resources, the power and heat systems, rural energy, and improving the institutional framework.

6.7.1 Energy Resources

Coal

- Resolve arrears from generation companies.

Action period: 2002. Action Agencies: Ministry of Infrastructure, State Property Committee.
Needs: Technical assistance is being provided by a number of sources to facilitate resolution, and should be continued.
Funding: resources have been made available under energy sector restructuring projects, and no additional funds are required at this time.

- Increase efficiency of operations.

Action period: 2002-2006. Action Agencies: Ministry of Infrastructure, State Property Committee.

Needs: several external agencies are providing funds and technical assistance to upgrade operations in the mines. External support should be continued until the mines are able to achieve commercial viability.
Funding (see Table 3.2, Fuel, project # 1, 2, 3): $126.95 million in loans, plus $10.4 million in domestic resources.

- Address dewatering, ash and overburden problems at key mines.

Action period: 2002-2004. Action Agencies: Ministry of Infrastructure, State Property Committee.
Needs: Current external support is assisting with these problems, and should be continued.
Funding: included in efficiency projects above.

- Establish pricing system that reflects full costs of operations including maintenance and replacement, exploration and development, transportation, training, and administration.

Action period: 2003-2006. Action Agencies: Ministry of Infrastructure, State Property Committee.
Needs: Once the issue of payment of arrears is resolved, an improved pricing formula should be designed and implemented. Technical assistance will be sought for this activity.
Funding: costs are currently unavaible.

- Assess Coalbed methane resources.

Action Period: 2003-2006. Action Agencies: Ministry of Infrastructure.
Needs: Assess coalbed methane resources. If results satisfactory, prepare feasibility study for pilot plant.
Funding: approximately $100,000 for resource assessment and $100,000 for feasibility study.

Petroleum and Gas

- Restructure and privatize NIC.

Action Period: 2002. Action Agencies: Ministry of Infrastructure, State Property Committee.
Needs: NIC has been approved for privatization. Process to be completed in 2002.
Funding: no additional funds are required.

- Promote competition in the supply and distribution of petroleum products.

Action Period: 2002-2006. Action Agencies: Ministry of Infrastructure, Ministry of Trade and Industry. Needs: Actions to facilitate new entrants and upgrading of facilities. Technical assistance could be required.
Funding: cost estimates have not been developed. However, transshipment facility at Zamynuud ($13 million grant and $1.0 domestic) will assist development of industry.

- Facilitate increased oil production.

Action Period: 2002-2006. Action Agencies: Ministry of Trade and Industry.
Needs: Private sector is responsible for actions but Government may require technical assistance.
Funding: cost estimates have not been developed.

- Promote increased exploration for oil and gas.

Action Period: 2002-2006. Action Agencies: Ministry of Trade and Industry.
Needs: Some technical assistance may be required to assist in developing appropriate databases and their distribution.
Funding: cost estimates have not been developed.

Hydropower

- Develop appropriate medium/large-scale hydropower resources in order to optimize electricity generation.

Action Period: 2002-2006. Action Agencies: Ministry of Infrastructure.
Needs: loans are being sought or secured for the hydropower projects identified in tables 3.2 and 3.3. Additional technical assistance may be necessary as the projects move towards implementation.
Funding: Loans being sought or in place for Orkhon ($160 million), Durgun ($24 million), Chargait ($27.35 million) Taishir ($34 million external and $5 million domestic). Private investment being sought for Egiin ($280 million).

- Develop appropriate mini/micro hydropower resources as a basis for rural electrification in selected regions.

Action Period: 2002-2006. Action Agencies: Ministry of Infrastructure.
Needs: Discussions have been held regarding grant funding for isolated rural projects. Additional technical assistance may be required.

Funding: $5.3 million ($4.75 million external and $0.55 domestic) being sought.

Other Renewables

- Facilitate the use of photovoltaics for the 100,000 Solar Gers program.

See Rural Energy below.

- Promote the use of hybrid systems (solar, wind and diesel) for the non-grid Aimags and soums.

See Rural Energy Below.

Energy Efficiency

- Continue with projects to improve supply-side efficiencies.

Action Period: 2002-2006. Action Agencies: Energy Authority, Ministry of Infrastructure. Needs: Several projects are ongoing or soon to be implemented. Further funding and technical assistance will be sought as additional needs are identified.

- Develop energy efficiency programs for government facilities.

Action Period: 2002-2006. Action Agencies: Ministry of Infrastructure, Ministry of Finance and Economics. Needs: Government should develop programs that reduce energy consumption in public facilities. These programs would provide a basis for development of the energy services industry and energy services companies. The establishment of a national energy management program would be an appropriate objective. Technical assistance will be sought to develop the necessary policies and programs.
Funding: estimated $750,000 plus seed money.

- Promote energy efficiency activities by the transmission and distribution companies for households and the private sector.

Action Period: 2002-2006. Action Agencies: ERA, energy EDO companies.
Needs: Technical assistance will be required to assist the EDOs develop appropriate mechanisms and programs that will positively impact energy consumption by end users.
Funding: cost estimates have not been developed.

- Establish the necessary legal, regulatory and procurement guidelines to facilitate energy efficiency programs and activities.

Action Period: 2002-2006. Action Agencies: Ministry of Infrastructure, ERA.

Needs: Technical assistance will be required to support the establishment of planning and demand-side management programs that complement the establishment of the national energy management program as well as those by the energy companies.

Funding: costs have not been developed.

6.7.2 Power and Heat Systems

Plant Operations

- Resolve arrears with transmission and distribution companies.

Noted above under Coal.

- Reduce technical losses.

Action Period: 2002-2006. Action Agency: EA, ERA, energy operating companies.

Needs: Several projects are ongoing or beginning that will assist with the reduction of technical losses. Additional technical assistance may be required as further needs are identified.

Funding: see tables 3.2 (Energy Sector loans and grants) and 3.3 (Energy Sector loans).

- Establish pricing system that covers the full cost of operations including fuel costs, maintenance, replacement, training, and administration.

Action Period: 2003-2006. Action Agencies: ERA, energy operating companies.

Needs: Some technical assistance has already been allocated towards this effort. Once the current arrears situation is resolved, then more assistance may be required to establish a full market pricing system.

Funding: cost estimates have not been developed.

Transmission and Distribution

- Resolve arrears with generation companies.

See Coal and Plant Operations under Power and Heat Systems.

- Reduce technical and non-technical losses.

Action Period: 2002-2006. Action Agencies: EA, EDOs.

Needs: combined technical and non-technical losses for power over 30 percent, and 30-40 percent for heat sytems.

Funding: ADB $10 million and domestic $3.9 million (Table 3.2, project #1); ADB $40 million, Spain $3 million and domestic $12.7 million (Table 3.2, project #2); World Bank $30 million and domestic $5 million (Table 3.2, project #6.

- Establish pricing mechanism that covers full costs of operations.

Action Period: 2002-2004. Action Agencies: ERA, Ministry of Infrasturucture.

Needs: as with fuel/coal prices, formulas need to be put in place that provide for full operating costs and a reasonable return on investment.

Funding: cost estimates have not been developed for technical assistance.

- Continue upgrading systems, including customer metering.

Action Period: 2002-2006. Action Agencies: EDOs, ERA, Ministry of Infrastructure.

Needs: Included in above projects on reducing system losses.

Funding: cost estimates have not been developed beyond above projects.

Management

- Improve bill collection.

Action Period: 2002-2006. Action Agencies: EDOs, ERA, Ministry of Infrastructure.

Needs: as noted, bills have to be paid by consumers.

Funding: no additional resources required—included in projects improving T&D.

- Continue upgrading management systems in order to increase the efficiency of operations.

Action Period: 2002-2006. Action Agencies: EDOs, ERA.

Needs: management systems are being upgraded but will require further assistance.

Funding: cost estimates have not been developed but will be included in forthcoming ADB Master Plan.

- Accelerate capacity building.

Action Period: 2002-2006. Action Agencies: EDOs, ERA.
Needs: management and business skills need to be upgraded.
Funding: cost estimates will be included in ADB Master Plan.

6.7.3 Rural Energy

Off-grid Aimags and Soums

- Develop and implement 3-phase rural energy program based on JICA's master plan for renewables over a 15 year period.

Action Period: 2003-2015. Action Agencies: Ministry of Infrastructure.
Needs: soum power supply needs to be improved.
Funding: (Table 3.3, project #11) $23.5 million for first phase.

- Facilitate the development of local renewables companies and industries.

Action Period: 2002-2006. Action Agencies: Ministry of Infrastructure.
Needs: the development of soum power systems utilizing renewables and diesels will require appropriate support companies to assist with maintenance and operations.
Funding: cost estimates have not been developed.

100,000 Solar Gers

- Develop and implement 100,000 Solar Gers program based on private sector financing.

Action Period: 2000-2010. Action Agencies: Ministry of Infrastructure.
Needs: program will assist rural households acquire power source through loan arrangements.
Funding: (Table 3.3, project #10) $6.4 million.

- Develop appropriate training and maintenance operations.

Action Period: 2000-2010. Action Agencies: Ministry of Infrastruture.
Needs: although relatively straight-forward, there are essential maintenance steps for operating small photovoltaic systems, including battery replacement and disposal. Could link with the development of support companies under the renewables program above.
Funding: cost estimates have not been developed.

Other

- Develop appropriate small-scale hydropower plants to meet electricity demand in selected regions.

See Hydropower above.

6.7.4 Institutional Framework

Legal Framework

- Enact the appropriate legal mechanisms that will enable a much greater private sector role in energy.

Action Period: 2002-2006. Action Agencies: ERA, Ministry of Infrastructure, Ministry of Finance and Economics:

Needs: legal including tax structure is still evolving, and will need to be reviewed and possibly revised as new players enter the sector.

Funding: cost estimates have not been developed.

- Ensure that consumers and energy companies adhere to the principles set forth in the 2001 Energy Law.

Action Period: 2002-2006. Action Agendcies: ERA.

Needs: to date, focus has been on supply side issues; ERA will also have to address demand side issues, and provide environment for consumers to benefit from their actions to reduce energy consumption.

Funding: cost estimates have not been developed but should be limited.

Policy and Planning

Action Period: 2002-2006. Action Agencies: Ministry of Infrastructure, ERA, energy companies.

Needs: responsibility for policy rests with the Ministry of Infrastructure. Responsibility for systems planning has not been determined—it has been with the EA. Directly transferring responsibility to ERA may lead to some conflicting roles between regulating and planning for energy companies.

Funding: cost estimates have not been developed.

Commercialization

- Commercialize/corporatize remaining components of the energy sector, including mining and other resource exploitation companies.

Action Period: 2002-2006. Action Agencies: ERA, Ministry of Infrastructure, State Property Committee.

Needs: continue with efforts to commercialize/corporatize energy sector components.

Funding: technical assistance will be required but cost estimates have not been developed.

- Increase "commercial behavior" by components of the energy sector through increased transparency, increased review, and more detailed audits.

Action Period: 2002-2006. Action Agencies: ERA, Ministry of Infrastructure.

Needs: business, management and legal skills need to be upgraded so that ERA regulations are appropriately enforced.

Funding: technical assistance will be required but cost estimates have not been developed.

Private Investment

- Establish the necessary legal and regulatory framework that will enable private sector investment in energy.

Action Period: 2002-2006. Action Agencies: ERA, Ministry of Finance and Economics.

Needs: the Energy Law is being implemented but there will be a need to review whether resulting regulations are supportive of and will attract private investment.

Funding: cost estimates have not been developed.

- Promote private investment in the energy sector.

Action Period: 2002-2006. Action Agencies: Ministry of Infrastructure, Ministry of Trade and Industry, ERA.

Needs: attract private investors in the energy sector.

Funding: some technical assistance may be required to assist in development of appropriate materials.

- Establish mechanisms for the use of energy savings performance contracts for government facilities.

Action Period: 2002-2006. Action Agencies: Ministry of Infrastructure, Ministry of Finance and Economics, ERA.
Needs: energy savings performance contracts have proved valuable vehicles for demand side management programs that result in energy efficiency retrofits or installations. Procurement and other rules need to be adjusted in order to facilitate use of these financing mechanisms.
Funding: included as part of above Energy Efficiency, establishing a national energy management program.

Capacity Building

During the last decade, the energy sector has had to build up power and heat systems from the point of near collapse, and then to place its emphasis on restructuring. These rapid changes have not allowed adequate attention to be given to capacity building—on an institutional as well as an individual level. Efforts have been undertaken to address capacity building needs. For example, the forthcoming ADB Master Plan is a capacity building project. However, much needs to be done. Although cost estimates have not been developed, three key training areas will be addressed over the 2002-2006 period.

- Training for the use and maintenance of new plant and equipment will be increased.
- Training in the use of upgraded management information systems will be expanded.
- Management training in order to upgrade commercial skills and strategic planning will be undertaken.

6.8 Conclusions

Although Mongolia has a relatively low GDP per capita and its external debt has grown considerably in recent years, the prospects for its economic development are quite strong over the next decade. It has abundant natural resources including coal, oil and gas, and a range of non-fuel minerals. In addition, there is potential to develop trans Mongolian pipelines and grids to supply one of the world's largest markets, China. Importantly, the population has a high literacy rate, it is trainable, and wage rates are relatively low. New tax and company legislation provide investors with the environment necessary for large long-term investments.

7. ENERGY SECTOR DEVELOPMENT FROM THE STAKEHOLDERS' PERSPECTIVE

7.1 Introduction

Although there have been many positive developments in the energy sector in recent years, there are also some negative ones—especially with respect to specific consumer groups. For example, in urban and peri-urban areas there has been a decline in access to central heating that can be partially explained by the growth of urban ger communities that are not connected to utilities. There have also been similar declines for electricity, with 50 percent of the urban population using electricity for lighting. In rural areas, the percent using electricity for lighting fell from 40 percent in 1995 to 22 percent in 1998. Some of this decline can be attributed to production problems, and another portion to tariff increases. (*Mongolia: Elements for an Energy Strategy*, World Bank, May 2001).

Recent economic problems combined with increasing tariffs have also resulted in other problems. Heating and electricity costs account for 26 percent of government's expenditures on goods and services excluding salaries; and, account for roughly 20 percent of the total education budget. The costs of heating and electricity are seriously impacting school operations in a number of rural areas. Finally, nonpayment of electricity and heating bills is increasing, and this has had a major impact on generation companies, transmission and distribution operators, and the coal mines. Government considers the nonpayment issue to be critical because this indirect subsidy negatively impacts the economy as a whole. In terms of nonpayment, business units account for 41 percent of the money owed, residential consumers account for 29 percent, and government organizations account for 10 percent.

Identifying consumer groups, or stakeholders is an important consideration as the energy sector shifts its focus from supply to demand issues. Whether in an open competitive market or in a more regulated one, understanding and meeting the needs of various consumer groups is essential to developing demand side programs that benefit these groups as well to the energy companies as they match supply to fit the needs. To date, there has been limited assessment of the energy requirements of various consumer groups. This chapter briefly reviews some of the energy issues related to selected identified consumer groups.

7.2 Rural Consumers

Nearly 80 percent of the rural population do not have access to electricity. Operating costs per kWh average about 5 to 10 times higher in aimag centers than for central grids, but tariffs are only double the price, and internal cash generation covers only about 40 percent of operating costs. The coal distribution network is inefficient, and coal costs in rural areas are roughly three times mine-mouth costs—an excessive mark up in prices. (*Mongolia: Elements for an Energy Strategy*, World Bank, May 2001).

Out migration further complicates operating cost structures in rural areas. The issue is that there are fixed costs (e.g., the cost of facilities, generation sets) combined with a declining market, or population base, which means that revenues will also decline and the cost per person served will increase. Thus, the operating cost structures in many rural areas is deteriorating rather than improving.

As described in more detail in Chapter 5, because of a range of factors (lack of funds for diesel fuel, spare parts, maintenance and other operating problems), diesel sets in rural areas generally operate for only a few hours a day in winter, and may not run during the summer. Lack of reliable supply is obviously a problem.

Government's strategy is to increase the supply of energy and other infrastructure as well as to create more income generating activities, in order to reduce rural-urban migration (*The Government's Medium Term Strategy and Policies to Deepen Economic Reform and Restructuring*, May 2001). The Rural Power Supply Improvement Program and the 100,000 Solar Gers Program described in Chapter 5 would clearly assist in implementing this strategy. And, as Chapter 5 also indicates, some of the rural population have already been utilizing photovoltaic sets and other power generating options—this is important because it indicates that there is demand for energy services as well as the ability to pay for these services. The World Bank has also advocated the use of an improved stove for cooking and heating that would increase efficiencies and reduce costs by 20 to 30 percent.

7.3 Urban Consumers

In ger areas in and around Ulaanbaatar, one-fourth of annual household expenditures is for coal for heating and cooking, which directly contributes to increasing air pollution. Ger households pay on average 100 percent more for heating than those connected to the grid. For the urban population as a whole, electricity and heating expenditures account for 21 and 12 percent

respectively, or one-third of annual household income. (*Mongolia: Elements for an Energy Strategy*, World Bank, May 2001).

An important issue is that the poverty rate is higher in urban areas (see below). However, it should also be noted that while the rate of poverty (36 percent of the total national population, 38.5 percent of the total urban population, and 32.6 percent of the total rural population) does not seem to be increasing, the severity of poverty is rising, with about 20 percent in the "very poor" category. There are several on going projects that are aimed at providing basic infrastructure and services to the ger areas. But it is not clear that a sizeable portion of the lower income group would be able to benefit from these projects because they may have difficulty paying for an additional expense.

7.4 Low Income Consumers

Because the incidence of poverty is high, the Government considers efforts to reduce the poverty rate as a "critical issue" (*The Government's Medium Term Strategy and Policies to Deepen Economic Reform and Restructuring*, May 2001). The poverty rate increased dramatically as a result of the dislocations caused by the break up of the centrally planned economies in 1991, and the subsequent cutbacks in full employment and social welfare programs. As noted, 57.2 percent of those below the poverty line are in urban areas, where poor households tend to be headed by unemployed females. Social programs have helped to ensure that the poor have access to health and education services.

However, the indirect subsidies for energy through nonpayment of bills "is helping the better-off in business organizations and apartment dwellers, but not the poor in the ger area" (*Mongolia: Elements for an Energy Strategy*, World Bank, May 2001). The World Bank has recommended using lifeline tariffs with three blocks to enable low income households affordable energy. Government programs are aimed at providing decentralized and affordable household energy.

7.5 Business Units and Industrial Consumers

The private sector is playing an increasing role in the nation's economy, accounting for 60 percent of GDP in 1998, and an estimated 70 percent in 2001—and starting from 0 in 1991. Other data are somewhat limited because there have been only a limited number of business surveys. Interestingly, a November 2001 business survey (by the Economic Policy Support Project and the Competitiveness Initiative) indicated that most businesses used internal cash generation, savings and family and friends to finance business operations—interest rates have been very high and this has

clearly limited access to domestic commercial lending. Although no questions regarding energy were asked as part of the survey, other questions on the general business environment and the adequacy of government support, suggest predictability and reliability of services are important considerations. These comments could be related to energy supply as well. It should be noted that informal reports indicate that while blackouts are generally in the past, there are still local area problems because of, for example, transformer failures.

In other countries, larger business enterprises tend to receive better service from utilities—simply because they consume more energy. Energy companies often design reliability and demand side management programs specifically for a large consumer in order to ensure that the consumer is satisfied with the power supply. In certain cases, large consumers even receive lower tariffs because of competition, excess generation capacity, and/or their demand curve fits the energy company's system load. Smaller businesses are generally given limited attention except through programs that have been designed for certain types of consumers (e.g., restaurants) or small business associations.

Except for large industrial consumers, energy costs approximate 5 to 10 percent of business operating expenses. Businesses are interested in reducing expenses, so they are receptive to measures that will reduce energy costs. However, as energy is only a small component of operating expenses, businesses are generally more interested in reliable and quality energy supply.

7.6 Conclusions

At this stage, identification of various energy consumer groups has been limited. The energy sector should consider liaising with the National Statistical Office to determine if additional questions on energy consumption and end uses can be included in the household income and expenditure surveys that it periodically conducts. This would provide additional information on energy uses and the needs of households. Evidence from other countries predictably indicates that as income rises, energy bills increase because the household has purchased more energy consuming appliances and tools. This supports the World Bank's statement above that subsidized tariffs for all households are benefiting "the better off rather than the poor."

The World Bank also states that it is a priority to "reverse the financial slide of the energy sector or it will jeopardize any poverty reduction strategy." This statement is based on the premise that subsidies for an inefficient energy sector are a drain on scarce resources that could otherwise be utilized for social and economic growth programs. The World Bank comments that the Energy Authority effectively lost nearly 55 percent of every kWh generated because of technical and nontechnical losses. It further recommends that all new investment should be carefully scrutinized

to ensure that it contributes to increasing internal cash-generation and bill-collection capacity, reducing costs, and reducing inter-company arrears" (*Mongolia: Elements for an Energy Strategy*, World Bank, May 2001).

8. A DRAFT SUSTAINABLE ENERGY SECTOR STRATEGY, 2002-2011

8.1 Introduction

The energy sector has achieved numerous accomplishments over the last decade: plant and equipment have been rehabilitated, replaced or upgraded, and shortages in the main grid systems have essentially been eliminated. Importantly, the legal and institutional framework enabling the commercialization and/or privatization of major components of the energy system has been established through the enactment of the 2001 Energy Law and the transformation of the Energy Authority into the Energy Regulatory Authority.

However, as the preceding chapters indicate, the needs of the energy sector are still considerable. On the supply side, the "cycle of debt" caused by non-payment by customers, EDOs, and generators, has led to major problems at the coal mines. Energy efficiencies and productivity need to be improved throughout the sector. On the demand side, programs still have to be developed to meet end user needs. Price formulas for energy—both for supply and demand—have yet to be developed. The restructuring and transformation of the sector is far from complete.

Addressing these issues will be a formidable task, especially given the limitations of the economy as a whole as well as the recent weak financial performance by the energy sector. Moreover, the evolution of the energy sector has been based on external financing, and loan commitments are approaching levels that could impact future economic growth. Future loans and other resource allocations to the sector need to become more strategically targeted on projects that yield more benefits than simply keeping the sector operating. They need to be focused on transforming the sector into a dynamic economic force—business as usual cannot be the bottom line.

The next section of this chapter provides a context for a sustainable energy strategy. The following section highlights the evolution of the energy sector. The next section discusses financial and funding issues confronting the sector. The final section outlines elements of a sustainable energy sector strategy.

8.2. The Context for a Sustainable Energy Sector

The Government is attempting to provide a sound basis for the long term development of the country by strengthening the institutions and sectors that are fundamental to sustained and equitable economic growth. These are best exemplified in *The Government's Medium Term Strategy and*

Policies to Deepen Economic Reform and Restructuring (May 2001) that was mentioned in Chapter 1. The key policies include:

- Provide stability in the macro-economy under the umbrella of the Poverty Reduction and Growth Facility;
- Intensify structural reforms, including a new push with privatization;
- Develop sound banking and financial sectors;
- Revive national industry and support export development;
- Pursue regional development, including efficient development of infrastructure;
- Reduce poverty and unemployment and develop appropriate policy towards income distribution;
- Enhance environment preservation and reduce natural disasters impact;
- Set up responsible "Good Governance," with improved systems of public sector management.

The goals and elements of these national policies are implicit to the critical issues that are confronting the energy sector:

- Continued commercialization of key components of the energy system.
- Continued restructuring of the energy sector.
- Privatization of selected components of the energy system.
- Investment requirements and financing options for the energy sector over the next decade.
- Capacity building requirements for the energy sector over the next decade.
- Future energy supplies including the role of energy efficiency.

These issues are "critical" because for the energy sector to develop into a dynamic national leader, the sector has to become a more economically efficient producer of energy. Thus, there is the need to continue commercializing the operations of the various components of the sector, and privatizing assets when appropriate. Commercialization and privatization will force the sector to make decisions that are based on economics rather than centrally planned production targets. Moreover, improving efficiencies in the sector needs to be accomplished within the broader context of restructuring, which means that regulatory and legal institutions and mechanisms supporting the sector have to become more transparent and more responsive to various stakeholders as well as to national development requirements—an inefficient energy sector drains scarce resources from other development objectives such as improving health and education.

To effectively deal with these critical issues over the next decade, capacity building in the sector's agencies and companies has to receive increased attention. Simply, whether an executive or a coal miner, people have to acquire the skills and experience that will enable them to become more productive. Making decisions based on economics won't impact the sector's performance if productivity is not improved and institutions are not more responsive to meeting the nation's future needs.

The energy sector will also have to make decisions on the use of various energy resources. These decisions again, will have to be based on economics, and not supply targets. If these critical issues are dealt with in an open and business-like manner, then financing should be available for the needed improvements.

8.3 The Evolution of the Energy Sector

Over the last decade, there have been obvious successes as well as problems in the energy sector. However, if one looks back to the situation in 1992 and considers where we are today, then one could only conclude that we have taken tremendous strides towards developing a dynamic energy sector. With the break up of the centrally planned economies, Mongolia's energy sector was run down and struggling to meet the survival needs of the population. Thus, efforts in the first part of the 1990s were focused on preventing the sector from collapsing.

As these early efforts succeeded, more attention was given to rehabilitating and upgrading the energy sector's supply assets—the coal mines, generation plants, and transmission and distribution systems. While not all of these recent efforts have been completed, focus is now shifting to upgrading the reliability and quality of the energy supply systems. This process began several years ago, and will continue for several more years as assets are added to the energy system in order to ensure reliability and quality of supply.

Concurrent to these efforts, the energy sector has been undergoing restructuring so that it can provide reliability and quality in a cost-effective manner. Without efficient economic production, the energy sector cannot develop to meet the nation's future needs, and this is the key rationale for restructuring. For the sector to evolve to financial viability, economic efficiency is essential, and it cannot be achieved without establishing an environment that rewards success and penalizes failure. The restructuring process will provide the needed "carrots and sticks" for the sector in the coming years.

Thus, we are now facing another evolutionary stage for the energy sector. Energy supply will continue to be important but energy demand by consumers will also become important. And, this will require a different operating method to meet longer term needs.

8.4 Financial and Funding Issues

Before addressing the sustainability of the energy sector, financial and funding issues need to be considered. Several sets of data are important. GDP was an estimated $1 billion in 2000. Foreign loans (including concessional) to the government nearly equal if not exceed GDP. Total government expenditure (approximately $410 million) exceeded revenues by $60 million, or 6 percent of GDP. The trade deficit (imports $614 million, exports $466) was nearly 15 percent of GDP. These data indicate that the energy sector will have to utilize different financing arrangements than what it has used in the past because there will be limitations on what can be borrowed or obtained from traditional domestic and external sources. Options for future funding of the energy sector are discussed below.

Limited Public Sector Resources

A key starting point is to understand that there are few public sector resources available to fund the energy sector. Included in government expenditures and contributing to the budget deficit are transfers to local governments and subsidies. Under both of these categories, scarce public sector resources are being used to pay for the inefficiencies of the energy system. In addition, loan interest charges and repayment of loan principles are included as a budget expenditure rather than assigned to specific operating companies—which would make them accountable for the loans. Importantly, funds that are used to subsidize electricity and heat, coal mining and other components of the energy sector, cannot be used for education, health services or economic development. Thus, the opportunity costs of an inefficient energy sector are substantial.

Limited Public Sector Borrowing Capacity

Currently, the government is able to manage its debt. However, it is anticipated that borrowing levels will increase over the next decade in order to meet national development priorities. If the economy grows by an average annual growth rate of 7 percent over the next decade, then GDP would approximate $2 billion and the rate of borrowing for the last decade (roughly $900 million in 2000) could be maintained. However, if the economy grows at 3 percent per year, which is probably more realistic given the global downturn, then it would total only about $1.5 billion and

the rate of borrowing would have to be reduced. While major investments are required in the energy sector over the next decade, it would appear that public sector borrowing for the energy sector will have to become more strategically targeted to investments that are self-sustaining. Simply, new investments will have to be justified on economic rather than supply criteria.

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Convert Loans to Private Equity

A major and priority initiative should be the conversion of Government loans to equity through the sales of equity shares in energy sector assets. In other words, privatizing components of the energy sector in order to reduce government's debts for the sector. Government could then borrow for other sectors or at minimum, reduce expenditures for loan interest charges and repayment of loan principle. Privatizing components of the energy sector is incorporated into the Government's *Privatization Guidelines for 2001-2004*, and this policy will be pursued.

Attract Private Developers

Another option is to pursue private investors to develop projects. This option has already been included in the list of priority projects for 2002-2006, with respect to the Ulaan Ovoo coal mine and the Egiin Hydro facility. Increased use of this option could be utilized for the development of other fuel resources and generating stations.

Maximize Grant Opportunities

A number of international agencies and donor countries have programs that provide grants for technical assistance, training, and pilot projects. The Ministry of Infrastructure utilizes grants whenever possible, and this implicit policy will be emphasized over the next decade.

There are opportunities to diversify funding, and these need to be more fully exploited. Because of the energy sector's restructuring, more use can be made of private investment resources—which are far lager than those of the public sector. But private investment will only be forthcoming if the projects are financially viable. In the near term, it is likely that external borrowing from donors will continue to play the leading role. However and as noted, investments that are based on external borrowing will have to be justified on economic criteria.

8.5 Towards a Sustainable Energy Sector

The energy sector has evolved to a stage where it has to become a dynamic national leader rather than a drain on resources. The energy sector has to broaden the scope of its services so that more consumers from throughout the country have access to energy supplies, and consumer needs are better addressed. In order to achieve these objectives, the sector has to become more productive, more economically efficient, and more accountable for its investments. Business as usual cannot be accepted if there is a weak performance.

Adjusting to these changes will require considerable upgrading of personnel and institutions. Much more attention has to be given to capacity building within the sector. Particular attention has to be given to developing programs that address consumer needs.

Inherent to meeting consumer needs is the fact that the sector has to broaden its perspective beyond supply side issues. Energy efficiency and conservation programs that reward consumers for more productive use of energy need to be established. This will require adjustments to the regulatory and legal framework. Importantly, Government can assume a lead role in this effort by establishing a national energy management program that encourages partnerships with the private sector to profitably invest in energy savings measures in public facilities, and ultimately results in the development of a viable energy services industry.

Energy efficiency and demand side management technologies and techniques can greatly reduce energy consumption and increase returns to investors. This means that money can be used for more productively, and the resulting savings can be invested in other economic sectors. However, reaching this dynamic situation will not be an easy or rapid process because the energy sector still needs to resolve its current financial problems. But these problems will be overcome, and mechanisms that promote energy savings will be developed—they have to be for the economy to succeed.

But demand side issues cannot be considered in isolation. Important supply side issues remain. One of the key supply issues is broadening the geographic scope of the sector's services. As earlier chapters indicate, Government is developing programs to greatly increase the access to energy supplies in areas not connected to the grids. These programs include improving rural power supply to soums and aimags, and 100,000 Solar Gers. With these programs, the energy sector can reach the more than 100,000 rural households that either do not have electricity or only receive it for a few hours per day.

A complementary supply issue is that the energy sector needs to broaden its energy sources. As the 100,000 Solar Gers program suggests, use of solar energy will greatly increase. In addition,

wind and hydro power will play larger roles. But decisions to utilize these resources will be based on economics. Aside from the environmental benefits from using renewable resources rather than hydrocarbons, funds will not be used for imported fuels that are subject major price fluctuations.

In summary, a sustainable energy sector needs to be based on:

- A broad customer base that covers the entire country.
- Efficient economic production of reliable and quality energy supplies.
- A legal and regulatory framework that rewards consumers for their efficient and productive use of energy.
- A legal and regulatory framework that rewards energy companies for assisting consumers to become more efficient users of energy, and penalizes failures.
- The use of a broad range of energy of resources, including renewable resources.
- Agencies and companies that place a high priority on capacity building.
- Agencies and companies that are accountable for their financial transactions.
- Stakeholders that welcome the challenge of a competitive market.

If the energy sector can develop these characteristics over the next several years, then it will be transformed into a dynamic sector that is a leading contributor to national development. If the energy sector fails, then the national economy will be negatively affected. Thus, failure cannot be accepted because the energy sector has to prominent a role in the economy's future.

This is a draft Strategy—it is but one step in evolving a comprehensive and integrated approach to develop a sustainable energy sector. In coming months, additional meetings will be held with donors to further define the actions that need to be taken to this end. Comments from energy consumers, energy companies and other stakeholders will be welcomed. Participation by all stakeholders and donors in the development of a sustainable energy sector is important, because only with this type of partnership can the sector become more responsive to consumer needs and market driven. These are basic ingredients to a dynamic, successful and sustainable energy sector.