



BANGLADESH ENERGY WHITE PAPER



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LIST OF ACRONYMS

A/R	Accounts receivables
ADB	Asian Development Bank
BAPEX	Bangladesh Petroleum Exploration Company
Bcf	Billion cubic feet
BPDB	Bangladesh Power Development Board
DESA	Dhaka Electricity Supply Authority
DESCO	Dhaka Electricity Supply Corporation
DSM	Demand side management
ESCO	Energy services company
FOB	Free on Board
GDP	Gross Domestic Product
GoB	Government of Bangladesh
GTCL	Gas Transmission Company Limited
HSFO	High sulfur fuel oil
IAS	International Accounting Standards
IPP	Independent power producer or project
Mcf	Thousand cubic feet
MDB	Multilateral Development Banks
MEMR	Ministry of Energy and Mineral Resources
Mmcf	Million cubic feet
MW	Megawatt
NGPFC	National Gas Pricing Formulation Committee
Oxy	Occidental Petroleum Corporation
PBS	Palli bidyut samites
PGCB	Power Grid Corporation of Bangladesh
PSC	Production sharing contract
PV	Photo-voltaic
R/P	Reserves to production ratio
REB	Rural Electrification Board
RPC	Rural Power Company
SAGQ	South Asia Growth Quadrangle
SCADA	Supervisory Control and Data Acquisition
Tcf	Trillion cubic feet
USAID	United States Agency for International Development

EXECUTIVE SUMMARY

Economic Growth in Bangladesh Has Been Constrained by a Lack of Commercial Energy

Bangladesh, despite some recent setbacks due to natural disasters, has begun to make some progress towards moving to a higher growth path. A critical factor in sustaining development in Bangladesh will be the production and consumption of commercial energy. Currently almost 65 percent of the primary energy consumed in the country is from biomass. Experience from other countries clearly shows that there is a strong correlation between the level of economic development and the amount of commercial energy the country consumes. In order for Bangladesh to modernize its economic structure, develop a viable industrial base and provide adequate infrastructure services for both the urban and rural populations, the key objective of the energy policy will have to be to increase the supply of sustainable sources of commercial energy.

Developing Bangladesh's Energy Potential

Unlike many developing countries that have only limited sources of commercial energy, Bangladesh is fortunate to have potentially vast reserves of relatively low-cost natural gas, both onshore and offshore. This potential, if realized, can provide a boon to economic activities in Bangladesh and can provide the basis for a strong export base to regional markets as well, especially neighboring India which has an extensive industrial base, just across the border in Calcutta. However, Bangladeshi authorities need to keep in mind that because of the existence of huge coal reserves near to Calcutta and because of other competing sources of natural gas supply, this market will have to be monitored and analyzed carefully to determine whether or not it is feasible to supply natural gas from Bangladesh.

Bangladeshi energy policy must create an environment in which national energy needs can be fully met by encouraging new, private investors to undertake prudent investments based on commercial considerations. Legal, regulatory and policy frameworks for reform and restructuring must therefore fully accept and embrace the concept that competition and free market factors will guide investments, promote private ownership, modernize industry and infrastructure, rationalize prices and increase end-user choices.

To be sure, there are major barriers and constraints that must be overcome for meaningful and lasting progress to be achieved. Investments in the natural gas and electric power sectors are immobile and in the Bangladeshi context extremely large relative to its economy. Another of the vital barriers is the lack of adequate legal and regulatory frameworks. Private investors, whether domestic or foreign, will require written, codified rules of engagement. For instance, the failure by the Government of Bangladesh to resolve outstanding issues with respect to operators of previously allocated concession areas and to suggest different operational terms has recently caused a slowing of the initial momentum and some potential loss of interest altogether. The lack of transparency and the lack of good governors increases the transactions costs of conducting business.

In addition, because of the very low income levels of the vast majority of the population and of the low revenue base of the Government of Bangladesh, there is great reluctance by the authorities to undertake large infrastructure and network-type projects without a clear and full understanding of how and who will pay for these projects.

Fully developing the country's energy potential will involve bilateral and multilateral assistance in the following areas:

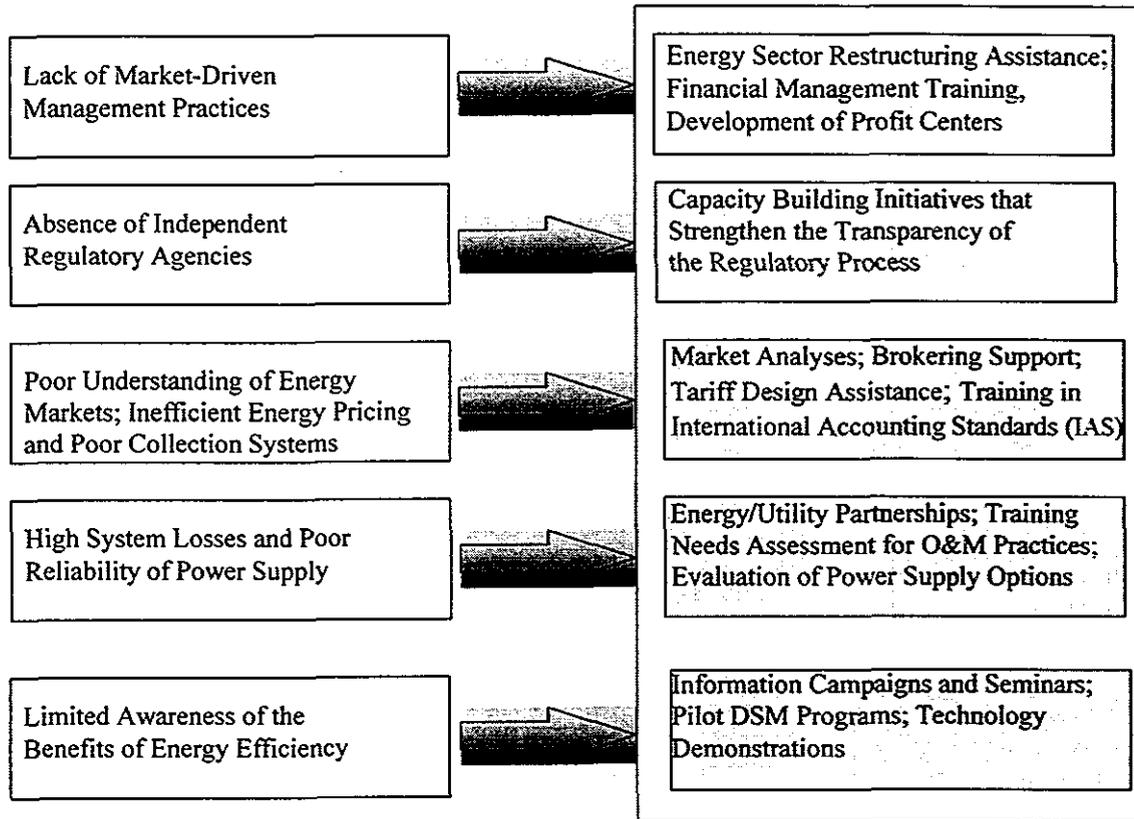
- Reform and restructuring of the natural gas and electric power sectors so that government acts as the regulator rather than provider of supplies and services;
- Support for unbundling of existing integrated public utilities, into functionally separate entities, to be operated and managed on a commercial basis with appropriate social safety nets;
- Implementation of enabling legislation that reflects free-market orientation and the establishment of an independent regulatory authority for both sectors;
- Technical assistance and support for developing a rationalized tariff structure;
- Technical assistance to help reduce transmission & distribution losses, rehabilitation of some existing facilities, and to develop more effective collections systems.

USAID Support for Energy Development in Bangladesh

Given the history of involvement in Bangladesh by the Asian Development Bank, the United Nations Regional Economic Commission, the World Bank and the bilateral aid agencies of Japan and the United Kingdom, USAID should consider a formal structure for linking macroeconomic policy discussions with energy capacity building and institutional reforms in order to leverage and maximize the intended outputs. USAID, because of its experiences in other developing countries, can also provide critical inputs to defining the roles and responsibilities of the public and private sectors. USAID has played and continues to play an active and catalytic role in energy and market transformation in a number of countries.

Based on these experiences and the particular needs of Bangladesh, Figure 1 outlines a broad paradigm of assistance that USAID, either separately or in conjunction with other donor institutions, should consider in terms of support for energy development in Bangladesh. Specific elements of a support program are contained within the subsections in the White Paper that follows.

Figure 1



Technical Assistance Recommendations

To overcome some of the barriers that constrain the development of the natural gas and electricity sectors in Bangladesh, USAID will need to consider the following:

- Technical assistance for the design of rules of operation and new implementation procedures for the legal and regulatory structures needed to promote private participation in the natural gas and electricity sectors;
- Institutional and capacity building support, including identifying training programs, energy/utility partnerships and development of operational & maintenance manuals designed to quickly assist Bangladeshi authorities adopt “best practices” for the electricity sectors; within the natural gas sector such support must also extend to areas such as environmental and safety aspects of hydrocarbon exploration and the operations of transport and network industries;
- Assistance in the corporate restructuring process, including the design of tariff structures, model licensing agreements, model intra-industry contracts, promotion of IAS and management accounting systems that will develop independent profit centers within the electricity sector;
- Educational training with respect to the dynamics of the natural gas industry; assistance with preparation of market studies based on realistic and viable opportunities for the exploitation of the country’s natural gas reserves;
- Support for energy efficiency awareness and promotion of new energy technologies through informational programs and demonstration pilot projects in selected industrial activities such as brick-making, manufacturing and textiles;
- Brokering and facilitating agreements between Bangladeshi electricity & natural gas authorities, U.S. companies and third-party consumers of electricity and natural gas within the region. This will assist authorities in Bangladesh to comprehend the viable opportunities available and how to overcome “parochial or traditional” concerns.
- Assistance to the Bangladeshi authorities in quantifying the potential financial and other resource implications to the GoB of the various energy and energy-related projects that are being proposed and/or implemented.
- Assist the Government in developing an understanding about the energy-economic interactions and price-elasticity factors with respect to their major economic development projects.
- Assistance to the GoB with respect to understanding the dynamics of independent power production and providing training in developing model contracts and production sharing agreements.

BANGLADESH ENERGY WHITE PAPER

1. INTRODUCTION

Bangladesh is situated on the north bend of the Bay of Bengal. It has a population of about 130 million people with most living on or near wetlands, with hills only in the extreme northeast and southeast. India surrounds it on the west, north and east and Myanmar is on the SE. The country covers 57,295 square miles in area, is very flat and wet with many large rivers running through it. The largest River is the Jamuna, which is joined by India's Ganges River slightly west of central Bangladesh. The Jamuna traverses roughly North-northwest to South-southeast and divides the country approximately in half. Dhaka City, in the eastern half of the country, is the capital with an estimated urban and rural population of between 7-9 million. The second largest city is Chittagong (the country's major port) in the southeast with a population of about 2 million followed by Kuhlna in the southwest with about 1 million.

Since independence in 1971, Bangladesh has received more than \$30 billion in grant aid and loan commitments from foreign donors. It is one of the poorest and most densely populated countries in the world. Although rapid urbanization is occurring, Bangladesh is still a mainly agricultural country, with the sector accounting for almost one-third of Gross Domestic Product (GDP) and two-thirds of national employment. Table 1 gives some national performance indicators for 1996 and 1997.

The challenges faced by the Government of Bangladesh (GoB) as it moves into the next millennium include:

- managing a much larger and more densely situated population;
- improving basic living conditions and the need for accelerated reductions in poverty;
- increasing sustainable agricultural and industrial production; and,
- developing viable export revenues.

During the 1990's, economic growth has generally been greater than growth in the previous decade. Political unrest in 1994/95 interrupted the upward trend in growth, but during 1996/97 and 1997/98, economic growth was 5.9 percent and 5.6 percent, respectively. Unfortunately, economic growth in Bangladesh is also often disrupted by natural disasters such as cyclones, drought and flooding. During July and August 1998, large-scale flooding devastated agricultural and industrial output, and economic growth for 1998/99 is now forecast to be around 3 percent. Various flood induced expenditures, such as those now required for food imports, post-disaster rehabilitation, and medical relief, along with reduced government revenue collections because of the disruption in economic activities will further strain the fiscal and balance of payments situation.

Successive Bangladeshi Governments have initiated structural reforms to try to ensure a level of economic stability which will assist in putting the country on a path toward higher growth. The current GoB, under Prime Minister Sheikh Hasina has indicated that it will continue the pattern of privatization and free market reforms. In recent years, fiscal reforms, a relatively conservative monetary policy and trade liberalization measures have resulted in careful macroeconomic management that have brought about lower inflation,

greater control over current expenditures, a broadening of the value-added tax and not-tax revenue sources and improved export performance.

Although there has been some progress in resolving structural problems within the economy, the pace of reform is uneven and slow, with a majority of enterprises still under government control. Certain improvements have occurred in the opening up of the infrastructure and energy sectors. Based on the Petroleum Policy of 1993 and the National Energy Policy of 1995 and through the development of production sharing contracts, foreign investments in the oil and natural gas sector had been increasing. During 1997, foreign investments, mostly in the natural gas, electricity and infrastructure areas reached \$3.3 billion – up ten times from 1996 levels. Foreign energy companies involved in Bangladesh include: the Anglo/Dutch group Shell, Ireland's Tullow Oil; Scotland's Cairn Energy; and Halliburton, Mobil, Occidental, Texaco and Unocal from the United States. But, within the banking and financial sector, public enterprises, and trade sectors, government agency presence needs to be reduced and overall regulatory and delivery capacities within government agencies needs to be strengthened. Without adequate and fully implemented reform measures, investor confidence and especially foreign investor confidence, which had begun to increase since 1996, will lose its momentum and the catalysts for economic growth which accompany such confidence will disappear.

Table 1

BANGLADESH
COUNTRY PERFORMANCE INDICATORS

Item	1996	1997	1998 est.
1. Key Economic Indicators & Ratios			
GDP (US\$ billions)	\$31.80	\$32.80	\$33.70
GDP per capita (US\$, current)	\$ 258.00	\$ 267.00	\$268.00
GDP growth (% in constant prices)	5.4	5.9	3.0
Gross Domestic Investment /GDP	17.0	17.3	-
Current account balance/GDP	-5.1	-2.7	-3.9
Total Debt/GDP	50.5	50.7	51.0
Total DebtService/Exports	12.0	9.9	-
2. Inflation (Consumer Prices-annual average %)			
	6.6	2.6	9.5
3. Structure of the Economy (as % of GDP)			
Agriculture	30.0	29.8	-
Industry	17.7	17.3	-
Manufacturing	9.6	9.3	-
Services (including government)	52.4	52.8	-
4. Balance of Payments (US\$millions)			
Exports of goods & services	\$4,508	\$5,096	-
Imports of goods & services	\$7,614	\$7,677	-
Resource Balance (negative balance)	(\$3,106)	(\$2,581)	-
5. Energy			
Proven Oil Reserves (1999 estimate)			5.4 million barrels
Oil Production (1998 estimate)			1,400 bbl/day
Oil Consumption (1997 estimate)			53,000 bbl/day
Crude Oil Refining Capacity (1999 estimate)			33,000 bbl/day
Natural Gas Reserves (1999 estimate)			10.0 tcf*
Natural Gas Production (1997 estimate)			270 bcf**
* tcf = Trillion cubic feet			
** bcf = billion cubic feet			

Source: Asian Development Bank, *Country Performance Indicators*, 1998.

United States Energy Information Administration, *Country Analysis Brief*, 1999.

2. ENERGY SECTOR OVERVIEW

Currently, almost 65 percent of Bangladesh's primary energy consumption is still based on biomass fuels. The lack of adequate and reliable supplies of commercial energy has not only acted as a serious constraint to potential economic growth, but the heavy reliance on biomass has adverse environmental implications. Only 14 percent of the total population currently has access to electricity, and the per capita consumption of commercial energy is very low. The country has only very small reserves of coal and oil that are not adequate for full commercial exploitation for industrial development. The country has encouraged foreign oil companies to undertake exploration activities and some foreign concerns are doing so under production sharing contracts.

The development of renewable energy resources (primarily hydroelectricity and solar energy) provide Bangladesh with an environmentally sound method to meet its growing electricity demand. Presently, the Bangladesh Power Development Board (BPDB) operates a 230-megawatt (MW) hydroelectric plant (approximately 6 percent of total installed capacity) located at the Karnafuli hydro station in eastern Bangladesh. The eastern region of the country, however, is estimated to have the potential for an additional 150 MW of conventional hydroelectric capacity.

The development of solar photovoltaic (PV) generation sources also represents an opportunity for meeting electricity demand, particularly in rural areas. The Rural Electrification Board (REB) has a renewable energy program that includes the implementation of a 62 kW solar PV pilot project at Narsingdi. The project area covers remote village areas with a total of 8,500 households. A recent study estimated that there is the potential to expand the use of PV applications to 4.5 million households nationwide. The Government of Bangladesh is considering the exemption of PV equipment from import duties.

Unlike many other developing countries, Bangladesh has the potential for the development of relatively low-cost natural gas, from fields both onshore and offshore. This abundance of a sustainable source of commercial energy could provide Bangladesh with a strong export base, generating major revenue streams that can lay the foundation for gross capital formation within the country. In addition, the development of natural gas has the potential to provide a clean alternative to energy hungry industries, locally and within regional economies.

In July 1998, the country completed a World Bank funded bridge over the Jamuna river, which will now connect northwestern Bangladesh to the capital and which is expected to save an estimated \$40 million in annual fuel costs. The bridge is part of a plan to deliver electricity to the region that is home to almost 50 million people. Adequate and reliable supply of electricity will help to reduce the current heavy reliance on firewood. A gas pipeline through the bridge will connect the eastern and western portions of the country

Overall responsibility for the energy sector, including the functions of policy formulation and investment decision-making, lie within the Ministry of Energy and Mineral Resources (MEMR). The GoB also has a unit within MEMR, the Power Cell, that acts as

a focal point to facilitate reform and restructuring in the electricity sector and the promotion and development of Independent Power Project (IPPs). As previously noted, Bangladesh's only major source of indigenous commercial energy is natural gas. With estimates of the country's recoverable natural gas reserves as high as 80 trillion cubic feet (Tcf) and current proved reserves of about 10 Tcf, Bangladesh is poised to become a major regional producing/exporting nation.

It is expected that the major internal markets for natural gas will continue, for the foreseeable future, to be the electric power and fertilizer industries (although it should be noted that there may be very little scope for expansion of the fertilizer industry). Major impediments to a more diverse industrial base are the relatively small segment of the population with sufficient disposable incomes that would allow the economic justification for development of a large capital goods sector. Unless and until the GoB broadens its economic horizons to effectively consider regional and other export markets as a means and mechanism by which revenues can be developed for the internal upgrading of capital stock and establishment of new industries, most investments of any kind will be severely limited.

3. The Natural Gas Industry

The major natural gas producing fields are primarily in the eastern half of the country, including the country's largest gas field (Titas). In June 1998 production began from the country's offshore Sangu gas field (about 30 miles southwest of Chittagong) in the Bay of Bengal. Upwards of 70 percent of the gas produced is currently consumed by the power and fertilizer industries. National gas demand has been forecast to grow by 6 percent a year over the next 20 years. Further development of a natural gas based industry in Bangladesh could involve the expansion of power generation and regional natural gas supply to major industrial areas in neighboring India and other parts of South Asia, providing a major new export revenue base. Independent analyses of the internal demand for natural gas may be required to verify the expected potential consumption requirements for electric power, the fertilizer industry and other end-users. It should be noted that Bangladesh, Bhutan, India and Nepal established the South Asia Growth Quadrangle (SAGQ) for economic cooperation in 1997. The SAGQ is expected to develop bilateral and trilateral projects for power exchange, railways and regional road projects, among others, that could form "growth corridors" for which the natural gas industry could provide significant feedstock. Presently no institutional framework exists for project development and it is still unclear whether the countries involved want one or will carry out project development on a case-by case basis.

Control of the gas industry is through the MEMR that establishes policy, sets prices and monitors all operations. Through its wholly owned company, Petrobangla and its subsidiaries, the Ministry controls prospecting, production, transportation and distribution. Dry gas is the dominant hydrocarbon resource with only one small oil field having been found. In recent years the GoB entered into production sharing contracts, (PSCs) with several oil and gas companies. Some have found gas and two, Occidental (Oxy) and Scotland's Cairn, have signed gas purchase and sales agreements with the Government. The country is divided into 23 mineral blocks of which 8 are currently under PSC contracts.

In the July 1997 Second Bid Round, oil and gas companies were invited to bid on the remaining 15 blocks and proposals were received from 21 companies involving 12 blocks. In late 1998 the GoB asked 9 of the companies to enter negotiations for contract on 5 blocks. The partnership groups and the partnership-share fractions for the blocks had apparently been accepted during private talks with the GoB. Unresolved are Blocks 9 and 11. Block 9 was proposed for sharing between Ireland's Tullow with Chevron and Texaco and Block 11 for Tullow, Mobil and Malaysia's Petronas. Tullow made aggressive work proposals for both blocks that are favored by GoB but did not have the financial strength to handle them. The GoB proposed fractions for the other more substantial companies to solve this problem. It also proposed a 25 percent share for the government exploration company, BAPEX. These disagreements remain unresolved with surface indications of additional bidders losing interest in working under the pattern of conditions developing from the GoB.

3.1 Gas Markets and Supply

The vast majority of the country's gas, upwards of 70 percent, is used to produce electricity and domestic urea fertilizer. The remaining gas consumption is accounted for by industry and commercial groups, domestic household needs, tea production and brick making, in that order. All the current gas production with attendant transmission facilities is in the eastern half of the country. With World Bank funding, a bridge and 30 inch pipeline were completed over the Jamuna River in 1998 and plans are being evaluated to construct additional lines for delivery of gas in the western part of the country. The new lines are to support new power and fertilizer plants being planned in the west. Actual average demand in FY 1997/98 was 862 million cubic feet per day (mmcf) including 343 mmcf for power and 259 mmcf for fertilizers.

Natural gas reserves on December 31, 1997 were 9560 bcf and annual production during FY 1997/98 was about 281 bcf or 770 million cubic feet per day (mmcf), a 10.7 percent shortfall versus demand. Overall annual growth in demand through 2005 is forecast at about 7 percent with two thirds of this in the power and fertilizer sectors. Production is currently obtained from 8 of the 17 onshore fields and 3 offshore fields. Some unscheduled appraisal drilling together with pipeline extensions are required before the non-producing fields can be brought on-stream. Relative need for the gas is another factor. In June 1998, production began in the commissioning phase from the offshore Sangu Field operated by Cairn under a PSC. Some 10 minor upsets were encountered during the first five months, which required adjustments in automation equipment controls. Such upsets are not out of line for startup of a fully automated offshore producing operation. During the 9-month commissioning period provided for in the contract, production is being limited to one or two of the four wells until Petrobangla is satisfied with the operation. The four wells are capable of meeting the 160 mmcf contract quantity the GOB has agreed to receive from Cairn.

Many in the international oil and gas industry have a high regard for the gas potential of Bangladesh. A material factors in this optimism is the relatively sparse drilling which has been required to develop the currently known resources. The first 17 fields were discovered and developed with only 54 wells over 45 years. One fourth of the 20 fields now known, are each demonstrated to have 1.1 to 4.1 trillion cubic feet (tcf) of expected recovery, and yet to-date they are meagerly appraised and developed, raising the possibility that their actual potential recoveries could in some cases prove greater by multiples thereof. The five or so field discoveries every 10 years, except during the 1970s when only two were fields were discovered, illustrates the slow exploration pace being followed by the GoB.

3.2 Gas Transmission

The current pipeline system grew out of three original regional systems, which have been joined to form an integrated trunk line and distribution network. The operational organization has not been ideal and imperfect planning precipitated some installations, which did not solve all the problems. The GoB has accepted that some changes in organization are due and that it may mean bringing all operations of the network under a Petrobangla company, the Gas Transmission Company Limited (GTCL). This will then

allow the production companies under Petrobangla and PSCs to feed the GTCL transmission system, which will in turn supply gas to the three distribution companies. GTCL can then focus on efficient transmission of gas and maintenance of the transportation system, and leave the distribution companies to deal with sales and expansion of the market.

There is no independent gas regulatory body with responsibility to ensure safe pipeline transmission and distribution system operation. However, one is being considered with support from the Asian Development Bank.

3.3 Gas Pricing

Prices are fixed by the GoB on an ad hoc basis and have not changed since March 1994. A five- percent per year escalation authorized to begin in FY 1995/96 has not yet been implemented. The prices are made up of fees and margins assigned to production, transmission and distribution plus an excise tax to arrive at the user price. The fees, excise taxes and margins, except for production, are adjusted up or down according to the market being supplied, so that fertilizer plants pay the smallest price and commercial entities the highest by a factor of 3.6. With currency conversion at approximately 45 Taka to the US dollar, delivered prices are \$0.92 per thousand cubic feet to fertilizer units and \$3.28 per thousand cubic feet for commercial fuel. In July 1995, a National Gas Pricing Formulation Committee (NGPFC) was set up to identify and recommend appropriate gas pricing policy and methodology. Members studied policies and methods of the United States, Pakistan, Argentina, Mexico and South Africa through presentations by World Bank experts and visits to the USA and Pakistan. The Draft Final Report of the Committee was completed in April 1997 but it has not been finalized and released. Recently, in December 1998, under pressure from the multilateral development banks (MDBs), prices were increased by 15 percent.

Gas purchase and sales agreements reached with Occidental and Cairn provide for the GoB to buy onshore gas at 75 percent of the energy equivalent value of FOB Singapore high sulfur fuel-oil (HSFO) and offshore gas for 93.75 percent of FOB Singapore HSFO equivalent energy value.

3.4 Problems and Possible Solutions

Relatively few of the 130 million people in Bangladesh are benefiting directly from the mineral wealth being developed (minimally) by the GoB. Decision-making is slow and decisions supported by economic and scientific realities are often missing. Government bureaucrats and agency personnel find it very difficult to take firm decisions with respect to investment risks incurred in developing and marketing gas resources. Placing such decisions under the control of private investors operating under balanced PSCs would benefit the country and the region. Most of the exploration and development has been accomplished with foreign donor funding. In fact, there are funds available from existing programs, previously endorsed by the Asian Development Bank and World Bank, to undertake some further needed development work in major fields. The GoB, for reasons of its own, has not moved forward with these field development efforts. While foreign donor funding mechanisms can help initiate and assist in some critical early activities, the

slow pace of GoB action suggests that private investment would produce faster and greater results. Achieving closure on contracts with additional private companies, as now pending, could significantly increase the pace of development of the gas fields, if the contract terms are sufficiently balanced to encourage investment.

The current reserve to annual production ratio (R/P) is greater than 30. This indicates that Bangladesh is in the fortunate position of having adequate natural gas resources to sustain its development effort and provide for a relatively strong export base, generating major revenue streams which can be further utilized for gross capital formation within the country. With the outlook for potential resources to grow substantially with further exploration and development, the regional markets, and India in particular, should provide attractive and competitively advantageous outlets for the surplus supply. Studies aimed at helping the GoB understand and evaluate realistic options for moving the economy forward on multiple fronts would be helpful. The immediate benefits of increased private sector involvement would include potential funding for pipeline construction over routes that are both valuable to Bangladesh and necessary for delivery to a broader regional market.

Current gas purchase agreements between the GoB and Oxy and GoB and Cairn provide for contract quantities of 100 mmcf/d and 160 mmcf/d, respectively. These purchases must be funded with hard currency at a price far higher than the apparent cost of gas from government wells. Both companies are capable of producing the gas now, although transmission capacity could at times be a problem for Oxy. This hard currency disincentive may be behind the GoB's willingness to drag its feet on the purchases and this problem also seems to influence the pace of new contracts being signed, as the private companies certainly need a market for their production at a satisfactory price. Acceptance by the GoB of external markets for the produced natural gas would make a lot of sense in resolving this situation. However, something is preventing the GoB from considering this very viable external market option. Nationalistic leanings, uncertainty, and/or possibly a poor understanding of the dynamics of natural gas supply/marketing may be constraining and impeding effective decision-making within the GoB. Some analytical assistance and education/training support may be very valuable for GoB officials with regard to fully comprehending the extent of the market opportunities available.

One problem which results from the control of gas-field operations as exercised by the government, is that operators are not permitted to close wells in for measurement of reservoir pressure or to obtain test data needed for prudent assessment and management of the resources. The GoB sets production quotas for each field at levels equal to the maximum flow possible from all wells. As a result, some major assets are being operated blindly and wells and reserves are at unnecessary material risk. In addition, the lack of measurement and test data leads to a poor understanding of the upside resource potential of the fields already in production. Decision-makers in the Ministry and Petrobangla are more influenced by political considerations than by resource economics, commercial and/or technical analyses. They are too far from gas-field sites and do not understand the urgency and value of prudent operations and management of resources. The upper ranks of personnel at Petrobangla could provide the basis for the staff of a regulatory agency, which would have environmental, safety and conservation oversight of the oil, gas and

transportation industry but not operational control. Gas-field operations should be undertaken by experienced operators, performing under production sharing contracts that incorporate sufficient incentive to achieve commercially prudent management of the assets. The current GoB operating personnel could probably be retained and used effectively, after appropriate training under competent management. Though such a change in the role of Petrobangla might require enabling legislation and might stretch out the implementation timeframes, in the short to medium term it can still be insulated from operations by inclusion of specific contractual provisions within the PSCs with the experienced private oil and gas companies.

3.5 Technical Assistance Recommendations

The principal impediments to developing Bangladesh's potentially huge natural gas resources are within the government. Some of these barriers and constraints may be overcome through informational and educational support, by building awareness with Bangladeshi stakeholders and key decision-makers of the prospective benefits from greater private participation in the development of the energy sector and of the integration of energy into the regional economic infrastructure. The GOB needs to see the value to Bangladesh of pursuing these paths and of moving from operational aspects of the natural gas industry to regulatory oversight, which is compatible with the world's private energy industry. Possible USAID and donor assistance includes:

- Preparation of a study that reviews the realistic prospect of regional markets for Bangladeshi gas, including the scope of costs and economic results for meeting the markets while satisfying the estimated Bangladeshi markets. This would include a critical analysis of potential export industries that could utilize natural gas as a feedstock or through combined power and heat systems use the available heat for industries such as food processing or ceramics;
- Analysis of the Bangladeshi natural gas sector with respect to adjustments needed to permit orderly and efficient development and disposition of available natural gas supplies;
- Support in developing an independent regulatory agency and assistance in preparing operational rules that will cover the environmental, conservation and safety aspects of the hydrocarbon exploration, production and transportation industries;
- Technical assistance in developing a methodology for rationalizing tariffs and assist the GOB in developing a commercial gas pricing policy based on market value, in order to fully develop potential regional and other export markets.

4. Electric Power Sector

Historically, the power sector in Bangladesh has been organized as a vertically integrated and centrally planned, state-owned monopoly. In an effort to move towards a more market-driven environment, the GoB has developed restructuring plans that call for the separation of power generation, transmission, and distribution functions. A primary objective of ongoing power sector restructuring in Bangladesh is to create a competitive industry structure that attracts private investment and expands local access to capital markets. This is critical given recent estimates that, over the next decade, Bangladesh will require approximately \$6 billion in investments to modernize its power sector infrastructure. Although the implementation of current restructuring plans represent an essential element in attracting new investment, the low level of private sector participation (especially in power distribution and transmission) reflects the need for further structural and regulatory changes and greater incentives. See Appendix A for a map of the power grid system for Bangladesh.

4.1 Regulatory Structure

Key Organizations. The Ministry of Energy and Mineral Resources (MEMR) and the MEMR's Power Cell.

The Government of Bangladesh (GoB) exerts direct control through the MEMR which develops the regulatory policies for the power sector. In 1995, the Power Cell was established as a transitional regulatory body that supports the MEMR in the development of IPP policies, power sector reforms, and electricity tariffs. The Power Cell prepared a draft electricity law that is pending parliamentary approval and includes the following regulatory provisions:

- Creation of a new independent regulatory body
- Licensing mechanisms (which will generate fees to fund the new regulatory body)
- Promotion of efficiency and competition in the power sector
- Pricing regulation and tariff design
- Consumer protection

The law also recommends the establishment of an electricity market that is based on the single buyer model where a designated entity would act as a central purchaser of all capacity and energy. Under this structure, the single buyer would have an obligation to ensure a reliable supply of power for the country, which would be enforced through a series of contracts with generation and distribution companies. It is anticipated that Parliament will approve a final version of the electricity law by the end of 1999.

4.2 Generation System

Key Organizations. Bangladesh Power Development Board (BPDB), independent power developers (see table below), and the Rural Power Company (RPC).

The low reserve margin of the power generation system coupled with increasing demand for electricity in Bangladesh, underscore the immediate need for new capacity. Total installed capacity in Bangladesh is 3,100 MW; however, actual available capacity is only 2,200 MW. Peak demand in 1998 was 2,136 MW and the total system load factor was approximately 64percent.¹ Demand forecasts for Bangladesh indicate that the potential for electricity growth could be as high as 10 percent per annum.

The development of independent power production (IPP) facilities in Bangladesh should help meet short-term power supply needs. Nevertheless, additional capacity will need to be installed to prevent continued load shedding which is common across Bangladesh during the summer. In 1998, it is estimated that power-rationing levels reached 700 MW during peak demand periods.

Despite the entry of IPP developers, the state-owned BPDB owns and operates almost all of the country's current installed capacity.² Over the next decade, however, the continued emergence of IPP will inject a high level of private sector participation in local power generation. Increased IPP development is being heavily relied upon to meet Bangladesh's growing electricity demand. Table 2 below illustrates the number of such projects. In addition, the construction of small power stations (ranging in size from 10 MW to 50 MW) is being pursued by the RPC (a new company formed with the assistance of the country's Rural Electricity Board).

Table 2
Planned Independent Power Production Facilities

Area/Project	Capacity (MW)	Turbine	Status	Start Date	Owner/Operator
Haripur	100	BMPP	Committed	1999/00	Smith Cogeneration (USA)
Haripur	360	CC	Planned	2001/02	AES (USA)
Meghnaghat	450	CC	Committed	2002/03	AES (USA)
Baghabari	100	CT	Planned	2000/01	MPI (UK)
Baghabari	100	BMPP	Committed	1998/99	Westmont (Malaysia)
Khulna	100	BMPP	Planned	2000/01	MPI (UK)
Khulna	100	BMPP	Committed	2000/01	Wartsila (Finland)
WRIP	350	CC/CT	Planned	2001/02	Unocal (USA)
TOTAL	1,660				

Notes: BMPP (barge mounted power plant); CC (combined cycle); CT (combustion turbine); and WRIP (Western Region Integrated Project); Sources: BPDB and Power Cell, 1998.

¹ Data presented in this paper is based on a review of recent documents prepared by the following organizations: Asian Development Bank, Bangladesh Power Development Board, National Rural Electric Cooperative Association, United States Agency for International Development, and the World Bank.

² The October 1998 commissioning of the 110 MW Khulna project represented the first IPP start-up in Bangladesh.

The emergence of a market for private power in Bangladesh coincides with the development of local natural gas reserves. Efficient gas turbine technology can be used by IPPs to leverage the country's estimated 10 trillion cubic feet of proven and developed natural gas reserves.³ Increased development of natural gas-fired power generation will displace the use of imported liquid fuels (predominantly in the western region of the country), providing significant economic and environmental benefits.

4.3 Transmission System

Key Organizations. The BPDB and the Power Grid Corporation (PGCB)

Bangladesh has an integrated transmission network consisting of 220 kV and 132 kV lines connecting the country's major load centers. Presently, the BPDB is the owner and operator of the national transmission network. As part of power sector reforms, the BPDB is scheduled to transfer control of its transmission and dispatch assets, liabilities, and staff to PGCB. The PGCB was established in 1996 as a subsidiary of BPDB. The transfer of BPDB transmission and dispatch assets (including substations) to PGCB is expected to occur in mid-1999. Once this transfer is complete, PGCB will operate as a common carrier responsible for the following:

- Ownership and operation of the transmission network
- Economic dispatch of power
- System planning, expansion, and investment

PGCB is also being considered as a potential candidate for becoming the "single buyer" for power in Bangladesh once a new market structure is officially adopted.

4.4 Distribution System

Key Organizations. The BPDB, the Dhaka Electricity Supply Authority (DESA), the Dhaka Electricity Supply Corporation (DESCO), and the Rural Electrification Board (REB).

The distribution of electric power in Bangladesh is carried out by three main organizations. BPDB and DESA are the country's two largest electricity distributors. In 1998, both companies sold approximately 3,486 GWh of electricity representing 82 percent of total national sales. The REB, established in 1978, and its network of 54 cooperatives called *palli bidyut samites* (PBSs) distributed the remaining electricity sales (18 percent) to rural areas.

DESA is responsible for power distribution in the greater Dhaka area while BPDB serves all other major urban centers. DESA was separated from BPDB in 1991 as a "transitional" company, which is transferring the ownership and control of its network to the newly formed DESCO. Although DESCO will eventually take total control of

³ At current natural gas usage rates, Bangladesh has a reserve to production (R/P) ratio of 30 (three times the R/P level that U.S. pipelines must maintain). However, the country's distribution network for gas is rather limited.

DESA's operations, to date, only a partial transfer has taken place (in December 1998, DESCO took over operations in Mirpur). The formation of DESCO and the outsourcing of limited billing and collection functions at both BPDB and DESA are initial steps in the GoB's planned restructuring of electricity distribution.

Since its creation in 1978, the REB has significantly increased rural access to electricity by connecting approximately two million customers to the national grid. To date, the operational and technical performance of the REB and PBSs has been strong. Despite the progress made in rural electrification, further expansion of electricity coverage is required to improve the quality of life and economic productivity of rural regions.

Overall, the current performance of the distribution network in Bangladesh is characterized by high levels of technical and non-technical losses and by limited electricity coverage in rural areas. System losses (approximately 30 percent) are due to inefficient management, outdated network equipment, and theft. The Power Cell is presently evaluating different scenarios for the consolidation of distribution functions (assessment of PBSs options).

4.5 Barriers and Potential Role for USAID and other Donor Agencies

The Asian Development Bank, the World Bank, and the bilateral aid agencies of Japan and the United Kingdom have played a significant role in advancing reforms and improving the efficiency of the power system in Bangladesh. USAID can contribute to continuing the removal of key barriers to power sector development. Current barriers that impede the creation of a more competitive and market-driven power sector in Bangladesh can be segmented into the following three categories:

- Technical
- Institutional
- Financial

4.5.1.1 Technical Barriers

The technical barriers that hinder the performance of the Bangladesh power system include:

- *Low efficiency of thermal power stations.* The high heat rate of older generation plants used by the BPDB has efficiencies ranging from 25 - 30 percent. Although the BPDB operates two newer stations (Ghorasal and Rauzan) with efficiency levels ranging from 33 - 35 percent, the overall low thermal efficiency of existing assets (compared to efficient combined cycle units) increases BPDB's annual operating costs.
- *Transmission constraints.* The transmission network is constrained by the limited capacity of the east-west connector (250 MVA) as well as by congestion in the southern region.⁴

⁴ Congestion in the southern region will be diminished when the 132 kV Chittagong-Comila connection is complete.

- *Grid failure.* During 1996, total grid failure exceeded 1,050 hours, which is approximately 12 percent of total annual operating hours.
- *Inadequate dispatch system.* The operation of the National Load Dispatching Center suffers from the use of outdated technology. The technology currently installed at the center does not provide controllers with access to real time information on critical operating conditions.
- *Large technical and non-technical losses.* In 1998, only 69 percent of electricity generated by power stations were recorded as final sales to end-users. The high level of losses result from a combination of antiquated equipment, theft, and poor operation and maintenance practices.
- *Limited electricity coverage.* Although almost 85 percent of the total population in Bangladesh live in rural areas and only 10 percent of them have access to electric power. Even those rural customers with access experience more frequent interruptions in their power supply than customers in urban areas due to load shedding decisions made at the national level.

4.5.1.2 Potential Role for USAID and other Donor Support

USAID and/or other donor agencies could develop assistance programs to help overcome existing technical barriers in the Bangladesh power system, including the following:

- Feasibility study for the rehabilitation of existing power generation plants.
- Needs assessment evaluating operation and maintenance practices in power generation, transmission, and distribution functions.
- Evaluation of IPP options in western Bangladesh to help ease transmission congestion.
- Preparation of a study that determines the technical and economic efficiencies from the consolidation of distribution functions.
- Development of training programs for National Load Dispatching Center personnel to facilitate the implementation and use of the new SCADA technology.
- Organization of international study tours to national grid companies for PGCB management. Development of management training programs for the PBSs (rural electricity cooperatives)⁵
- Evaluation of the development of small power plants (including those based on renewable sources) to service unmet rural demand.
- Promote the use of solar PV through technology demonstration projects and renewable energy information campaigns targeted at customers in rural areas.
- Conduct an assessment to evaluate local training needs related to energy efficiency equipment and emerging renewable energy technologies.

⁵ NRECA (as part of a USAID program) is assisting PBSs with financial and managerial independence programs.

4.5.2.1 Institutional Barriers

Institutional barriers in the Bangladesh power sector stem from the historical role of the GoB as owner, operator and regulator. Current institutional barriers include:

- *High degree of state ownership.* Despite the onset of reforms, the GoB still has the authority to develop regulatory policies, make major power sector investment decisions, and appoint key utility management and personnel.
- *Absence of an independent regulatory body.* An independent regulatory agency is needed to guarantee non-discriminatory open access to the power grid. Given that power sector investments typically involve the construction and/or operation of facilities with an economic life exceeding 20 years, the presence of a transparent and independent regulatory framework is a key driver in attracting private capital.
- *Delays in the divestiture of BPDB transmission and distribution assets.* Delays in transferring BPDB assets to PGCB and DESCO hinder the planned corporatization of the transmission and distribution system.⁶
- *Lack of demand side management (DSM) and energy efficiency programs.* Key power sector organizations in Bangladesh have not capitalized on the potential economic and environmental benefits of DSM and energy efficiency projects. Similarly DSM and energy efficiency projects within the fertilizer and other industrial end-users would point to potential cost reductions and operational gains.
- *Lack of market-driven management practices.* The implementation of power sector reforms will change the competitive landscape of the electric power market. To operate successfully in a more competitive and market-driven environment, new commercially oriented organizational structures and management practices must be implemented.

4.5.2.2 Potential Role for USAID and other Donor Support.

The mitigation of institutional barriers will help attract private capital by creating a business environment that provides investors with stable cash flows, which generate a return on investment commensurate with associated project and market risks. The removal of current institutional barriers in the power sector could be achieved through the implementation of the following technical assistance programs:

- Development of training programs that strengthens the transparency in the regulatory process by establishing an independent regulatory body.
- Provide legal support and assistance in the development of licensing agreements.
- Development of model contracts between distribution and generation companies.

⁶ To commence PGCB operations, it will also be necessary for BPDB and PGCB to conclude a power wheeling agreement to ensure that the new Transmission Company recovers its costs and earns an adequate return on investment.

- Sponsorship of energy efficiency awareness campaigns for targeted residential, industrial, and commercial end-users (including dissemination of information on new technologies).
- Development of a DSM pilot program at a selected electric distribution company.
- Evaluate the potential for solar PV applications through the development of a local energy services industry (ESCO concept).
- Assistance in the identification of profit centers at restructured electric utility companies.
- Incentive programs for utility managers, which promote changes in management practices.
- Development of utility investment planning capabilities through capacity building.

4.5.3.1 Financial Barriers

The Bangladeshi power sector is unable to raise or attract the investments needed to finance system upgrades and expansions because of its weak financial performance. The following elements are major contributors to the poor financial condition of the power sector:

- *Low electricity tariffs.* Electricity tariffs do not fully reflect economic costs because they contain pricing subsidies. Residential customers, who account for 42 percent of total electricity sales, are subsidized as compared to commercial and industrial end-users. Between 1994 to 1998, average tariffs increased by 10 percent while domestic inflation increased by 25 percent. The net result was an effective 15 percent reduction in the real level of tariffs in domestic terms.
- *High accounts receivable (A/R).* Poor collection practices at the distribution level flow back through the entire sector. In 1997, for example, DESA collected only 80 percent of total billings and its A/R was 340 days. This resulted in delayed payments by DESA to BPDB for electricity purchases. BPDB's A/R, in turn, was 320 days for DESA during that same period. The average value of BPDB's annual A/R is between \$40 to \$50 million.
- *Lack of transparent accounting and financial practices.* The absence of transparent accounting practices limits the ability of managers to make key business planning decisions. A lack of adherence to international accounting standards also inhibits private investment.
- *System losses.* Excessive levels of technical and non-technical losses (30 percent average losses) translate into a significant amount of annual forfeited revenue for Bangladeshi utilities.

4.5.3.2 Potential Role for USAID and other Donor Support

Financial barriers can be reduced by the implementation of the following technical assistance programs:

- Sponsorship of utility commercialization programs, including management seminars and international study tours.
- Training seminars to utility personnel in international accounting standards.
- Development of capital budgeting and asset management skills for utility financial managers.
- Strengthening of customer service operations at distribution companies, including improved customer relationship management practices.

4.6 Technical Assistance Recommendations

To overcome barriers to the development of a competitive and efficient power sector, it is recommended that a combination of the following technical assistance programs be implemented in business management, engineering, finance, information technology, and regulatory reform. Recommended methods of addressing barriers in these areas include:

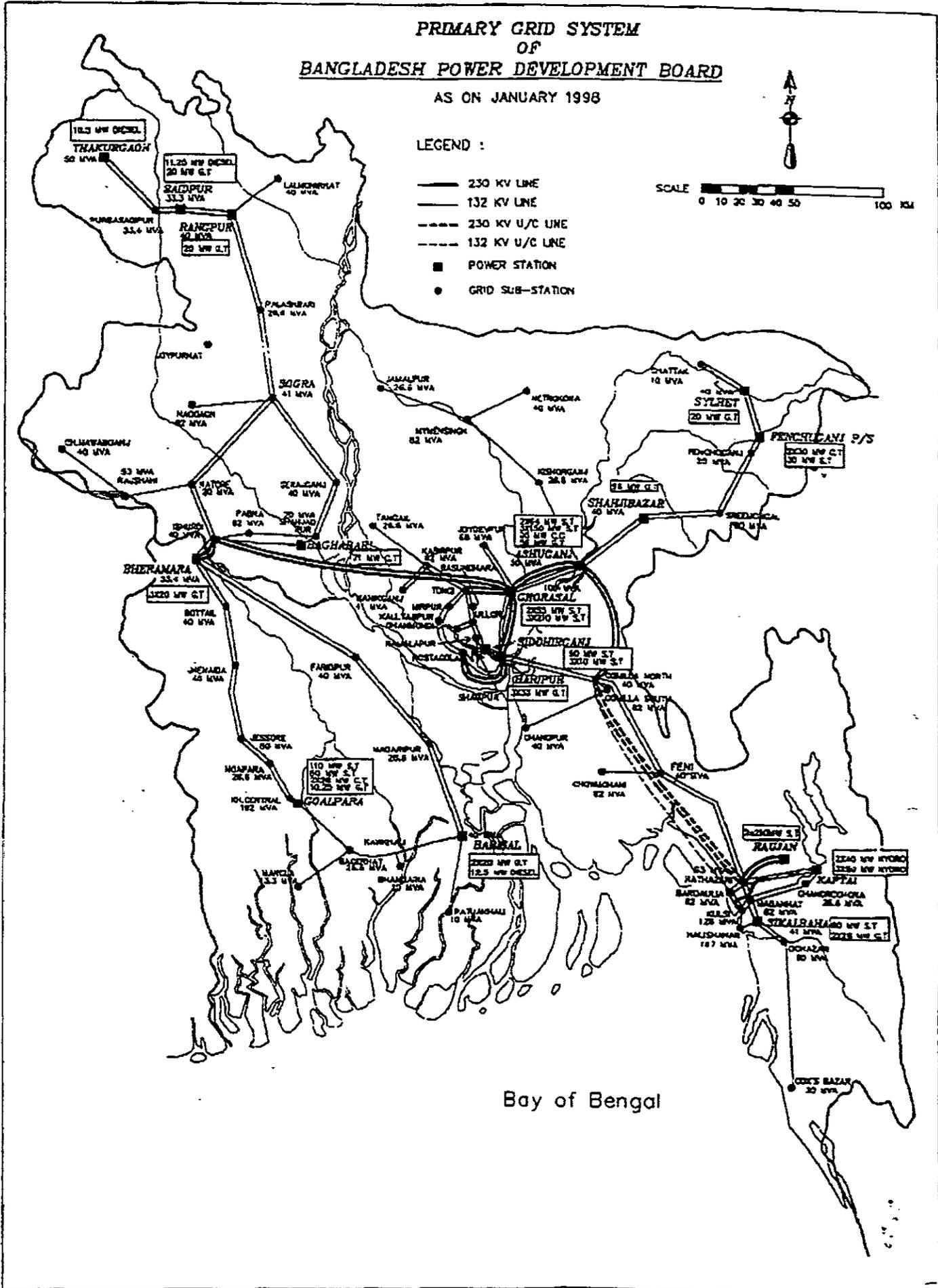
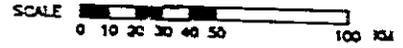
- *Capacity building.* Development of a wide range of training, education, study tours, and information transfer at both the local and international level.
- *Design of new market and legal structures.* Support of new regulatory and market systems, including tariff design, licensing, regulatory, and organizational development.
- *Corporate restructuring.* Assistance in the creation of new management structures, including: independent profit centers, consolidation, and employee incentive programs.
- *Information campaigns.* Development of information programs that support policy objectives, including: energy efficiency awareness, tariff reform, and customer service.
- *Pilot projects.* Establishment of demonstration programs designed to increase awareness and acceptance of new technologies and market systems.

**PRIMARY GRID SYSTEM
OF
BANGLADESH POWER DEVELOPMENT BOARD**

AS ON JANUARY 1998

LEGEND :

- 230 KV LINE
- 132 KV LINE
- - - 230 KV U/C LINE
- - - 132 KV U/C LINE
- POWER STATION
- GRID SUB-STATION



Bay of Bengal