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ENERGY SECTOR: CHALLENGES OF ADDING NEW CAPACITY

Keynote paper by

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I. Introduction

Energy is an absolutely contemporary but somehow perennial topic (Solow, 1974). The continued wave of interests on economics of natural resources, particularly energy, emanates mainly from the exhaustible nature of important commercial energy resources resulting in antagonistic relationship between today's and tomorrow's production. Even before the publication of Harold Hotellings' seminal article "The Economics of Exhaustible Resources," in 1931, Adam Smith, Ricardo, Henry Carey, J.S. Mill, W.R.Sorely, Marshall, Lewis Gray and Gustav Cassel made significant contributions to this literature. The recent spike in oil prices is a stark reminder of the famous *Hotelling rule* which states that the price of an exhaustible resource must grow at a rate equal to the rate of interest, both along an efficient extraction path and in a competitive resource industry equilibrium (Hotelling, 1931). However, the *demand destruction* subsequent to the spike in oil prices reminded us of the simplest lesson from microeconomics that even the monopolist can choose a price or a quantity, but not both. If the prices are too high, consumers may choose to buy nothing at all.

The added dimension to the energy economics for developing countries is the *resource curse* exemplified by Nigeria (Auty, 1993) reminding us that abundant resources are no guarantee and in fact there could be a link between natural resource abundance and poor economic growth (Sachs and Warner, 1997). In their paper they show that economies with a high ratio of natural resource exports to GDP in 1970 (the base year) tended to grow slowly during the subsequent 20-year period 1970-1990. Nigeria, classified as the sixth largest exporter of oil, which was one of the 50 richest countries in the early 1970s, has retrogressed to becoming one of the 25 poorest countries at the threshold of the twenty first century. In the context of Bangladesh, the resource curse issue is important since from the notion of "floating on gas" and desire for "exporting gas" we have now moved on to severe gas shortage-interrupting power generation, hampering production, and causing discomfort to public life..

The energy sector in Bangladesh is capacity constrained both in terms of energy resources and energy commodities. Energy resources such as crude oil, natural gas, coal, biomass, hydro, uranium, wind, sunlight, and geothermal deposits – can be harnessed to produce energy commodities such as petrol, diesel, natural gas, coal, and electricity. The energy commodities can be used to provide energy services such as lighting, space and water heating, cooking, motive power, and electronic activity. Table A1 provides a taxonomy of energy resources and commodities.

The purpose of the paper is to initiate an informed debate about the energy sector and to prioritize a set of actions for implementation by the government. The paper begins with a summary of the National Energy Policy of Bangladesh, followed by an overview of the energy sector in section 3, Section 4 reviews recent developments in the energy sector. Based on the review, we highlight key energy sector issues in section 5. In section 6, we consider challenges and opportunities for the new government and outline some silver linings. The final section has conclusions and recommendations for the newly elected government.

II. National Energy policy of Bangladesh

The National Energy Policy (NEP), adopted in 1996, identifies constraints in the development of energy sector including shortage of capital; lack of private participation; inefficient management of utilities; administered pricing of energy products; inadequate attention to energy needs of rural areas; constraints on the development of energy consuming sectors; and lack of adequate human resources. Based on the identified constraints, NEP outlines the following objectives to remove the existing energy constraints on the development of economy: optimum development of all indigenous energy resources, satisfying energy needs of different geographic zones, improvements in performance of utilities and promoting private sector participations in the energy sector.

NEP discusses currently available known energy resources and present consumption patterns. It also estimates demand scenarios, future demand for commercial energy under two sets of assumptions of economic growth rate. It also considers two alternative supply scenarios for meeting the projected demand. These are current option and reference option. The current option is basically a "business-as-usual" scenario. The reference option is quite similar with additional emphasis on intensified exploration of oil and natural gas, greater development of coal reserves, harnessing new renewable energy sources and effective conservation of energy and biomass fuel.

NEP made a good beginning to address the issues that beset the energy sector in a non-oil exporting developing country such as Bangladesh. The energy scenario in Bangladesh has undergone considerable changes since adoption of the policy. For example, significant progress has been made in the area of private participation, particularly in the area of electricity generation. Recent experience shows that lack of primarily fuel rather than capital has emerged as the binding constraint in the development of energy sector. For example, in 2007-2008, 24 contracts were awarded for 1,125 MW of power plants. Out of which 735 MW is in the private sector.[1] All the private sector projects achieved successful financial closure. On the other hand, 500-700 MW capacity electricity generation is stranded everyday due to lack of primary fuel, i.e. natural gas.

In addition to the NEP, the successive governments have issued other policy documents at different times. These policy documents cover wide range of issues, including, providing access to electricity to all citizens by 2020; participation of private sector in power generation; and policies for the promotion of renewable energy. A number of policies and laws are at draft stage, the most important one being Bangladesh Coal Policy.

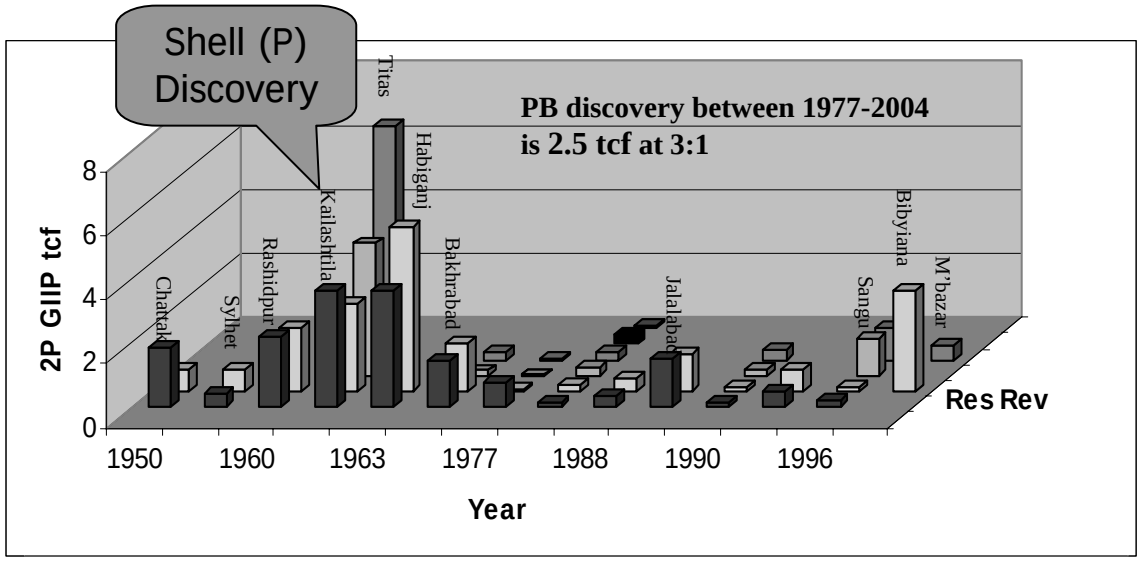
III. Energy Sector Overview

Energy Resources of Bangladesh

Natural Gas

The key natural resource of the country is natural gas, used for generation of electricity, production of fertilizer, and running vehicles. Natural gas has other domestic and industrial use as well. Natural gas accounts for 76 percent of commercial energy used by the people. In addition, natural gas also insulates the economy from volatility of energy prices (see Table 1) in the world market.

Figure 1: Bangladesh Gas Discoveries



Source: Petrobangla

The chart above shows the status of Bangladesh gas discoveries for the period 1950- 2004. The first commercial gas discovery was made in Haripur in 1955. Ever since then, exploration efforts have resulted in discovery of 23 gas fields of which 16 are currently in production, 4 are non-producing, and 2 are suspended as partially depleted. Most of the initial discoveries took place in the late fifties and early sixties when the Rashidpur, Kailashtila, and Habiganj gas fields were discovered by Shell during 1960-1963. At a smaller scale, a second spurt of discovery took place in the late nineties, Bibiyana with a proven reserve of 2.5 tcf gas being the most important. The latest discovery of gas took place

[1] If one includes small IPPs, short and long-term rental power plants, private sector accounts for about 30 percent of the total installed capacity. Out of total 5560 MW of installed capacity, private sector operates power plants of about 1743 MW capacity.

in May 2006 with small discovery of 0.44 tcf of gas at Bangura. There has been no major gas exploration effort since 1998 and hence no major discovery of gas also happened thereafter.

Offshore Gas Exploration

Third round bidding for Bangladesh's gas exploration hit snags as out of the 20 deep-sea blocks, some international oil companies (IOCs) have submitted bids for only 8 deep-sea blocks which are not disputed by the neighbors. Myanmar and India have influenced major oil companies not to participate in the bidding, warned them about the consequences of their investments, asked them not to sign production sharing contracts (PSC) in the disputed blocks, and asked Bangladesh not to award the offshore blocks without resolving the issue of Maritime boundary.[2] As a result, oil majors like Chevron, Exxon-Mobil or Shell shied away from submitting bids.

India offered 55 blocks for exploration to the IOCs in the Bay of Bengal in 2006. The map published by India clearly showed that blocks D-23 (8,706sqkm) and D-22 (7,790sqkm) have overlapped Bangladesh's block 21 declared in 1991. Myanmar on the other hand made significant gas discovery in A1 and A3 gas fields/block, in the Rakhaine coast that lies in the Bay of Bengal, offshore from the Myanmar town of Sittwe and is only about 100 km from Teknaf coast of Bangladesh. Daewoo of Korea is the operator of A1 and A3 gas fields with gas reserves of around five to six trillion cubic feet. India and Myanmar arbitrarily drew the maritime boundary under equidistance principle, which in effect is allowed only up to 12 miles of TS.

On the 1st of November 2008 four drilling ships from Myanmar started exploration for oil and gas reserves within 50 nautical miles south west of St. Martins Island, in Bangladesh. A South Korean company was awarded the oil and gas exploration contract and two Myanmar naval ships escorted the drilling ships. Myanmar stopped oil and gas exploration in deep-sea blocks in disputed waters in the Bay of Bengal after Bangladesh reportedly asked China for help over the row.

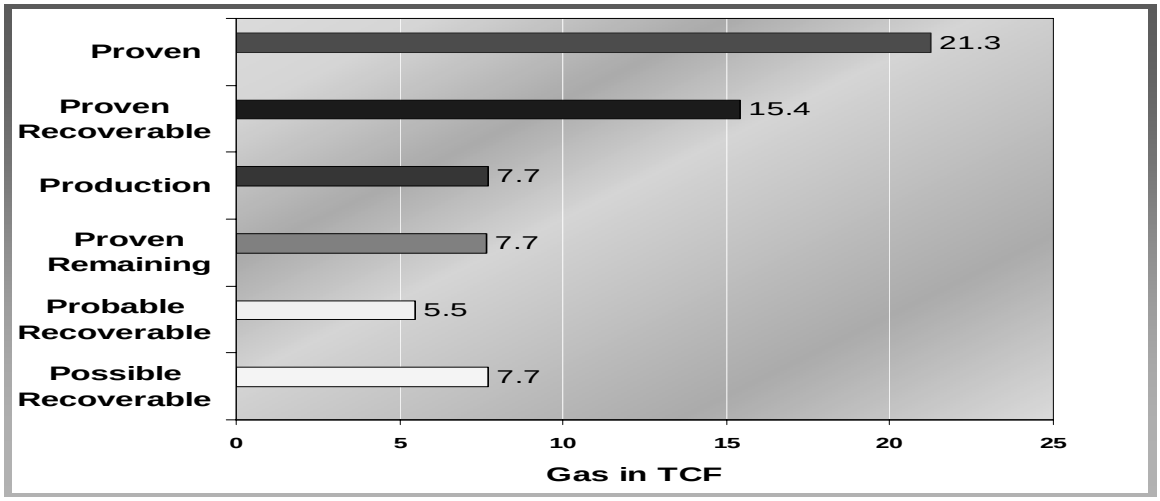
The current Prime Minister raised the issue of the maritime boundary at her first meeting with officials from the energy ministry, and wanted to know the latest situation as well as what the surveys the ministry had conducted in order to demarcate the boundary. She has plans to sit with foreign ministry and other relevant departments to discuss the issue of the country's maritime border so that Bangladesh could lodge its claims with the United Nations before 2011.

Gas Reserve

Figure 2 below shows gas reserves as of June 2008. According to the Gas Initially in Place (GIIP) data below, Bangladesh has 21.3 tcf of proven gas (P1; proved or with probability of 90percent of greater or equal volume). Out of which 15.4 tcf is recoverable and 7.7 tcf of gas has already been produced. Another 7.7 tcf gas is proven remaining. In addition, there is 5.5 tcf of gas as probable recoverable (P2: probable or with probability of 50percent exceeding) reserves. There is also 7.7 tcf of gas as possible recoverable (P3: possible or with probability of 10percent exceeding) reserves. Titas, Habigonj, Kailastila, Rashidpur, Bakhrabad, Jalalabad, and Sangu are the major gas fields of Bangladesh.

[2] Under the United Nations Convention on the Law of the Sea (UNCLOS) 1982, Bangladesh is entitled to claim 200nm of sea area as its Exclusive Economic Zones (EEZ) and all living and non-living resources within these areas are exclusively the property of Bangladesh. Out of this, the first 12 miles are called Territorial Sea (TS) and the next 188 miles are its EEZ. Bangladesh could also claim another 150-miles or more from the limit of the EEZ based on the geo-physical characteristics of the seabed as the extended Continental shelf (CS). However, to claim the CS, Bangladesh has to complete various surveys as prescribed by the UN and submit our claim before 2011.

Figure 2: Gas Reserve of Bangladesh (as of June 2008)

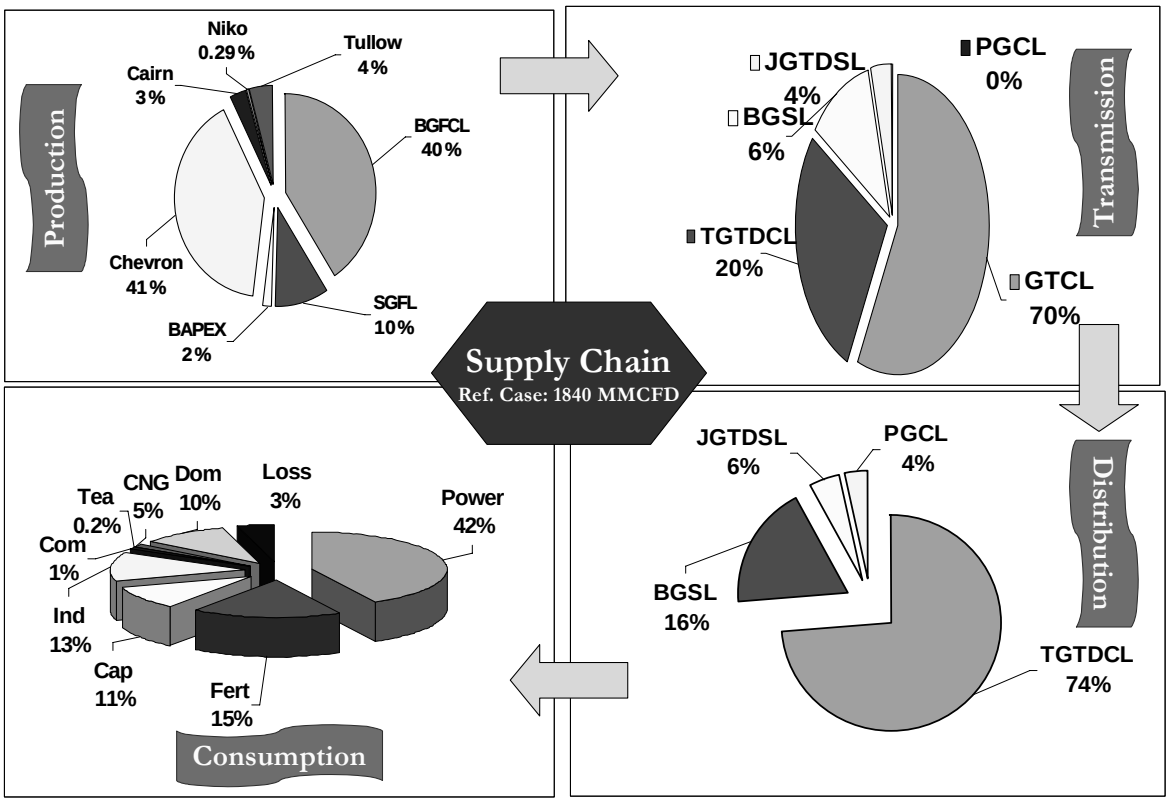


Source: Petrobangla

Gas Production, Transmission and Distribution

The supply chain in figure 3 shows production, transmission, and distribution of gas on a day in October 2008. Chevron with 41percent of the share of the days' gas production is closely followed by Bangladesh Gas Fields Company Limited (40percent). The other significant producer is Sylhet Gas Fields Limited (10percent). Other minor producers include Tullow (4percent), Cairn (3percent), and Niko (0.29percent).

Figure 3: Gas Supply Chain



Source: Petrobangla

On the transmission side, Gas Transmission Company Limited (GTCL) accounted for 70percent of gas transmission, Titas Gas Transmission and Distribution Company Limited (TGTDCL) carried 20percent. Other transmission companies' shares in gas transmission were: BGSL (6percent); JGTDSL (4percent). Poshchimanchol Gas Company Limited (PGCL) was responsible for an insignificant amount.

On the distribution side, TGTDCL is the dominant player with 74percent of the market share; followed by Bakhrabad Gas Supply Limited (16percent); JGTDSL (6percent) and PGCL(4percent). Notably, 94percent of the gas is distributed by companies in the eastern region of the country.

On the consumption side, the leading consumer is the power sector (42percent). Consumption share of the sector would be higher if one includes gas consumed in captive power generation (11percent). The power sector is followed by Fertilizer (15percent), Industries (13percent), Domestic Consumers (10percent), and CNG (5percent). Other minor consumer categories include Commercial (1percent) and Tea sector (0.22percent).

Petroleum Products

Petroleum products constitute about 23 percent of the commercial energy used in the country. Bangladesh has insignificant domestic production of petroleum products. Petroleum products are imported by Bangladesh Petroleum Corporation (BPC), the designated authority for the purpose. Bangladesh imports about 1.2 million tons of crude and 2.5 million tons of refined oil each year. Total imports, including lubricants, vary from 3.2 to 3.7 million metric tons per annum. **Table A2** shows the quantity and value of imported petroleum products from FY 2003-04 to 2008-2009.

Table 1 below shows the sudden increase in the import prices of petroleum oil and Lubricants (POL) products in recent years. The prices show increasing trend since 2004, but then increased very sharply, particularly since 2007. Failure to align domestic prices with the international market price has led to huge liabilities on the shoulder of BPC and created a severe liquidity crisis for the organization. The current financial status of BPC is precarious. Against total receivables (on Nov 30, 2008) of Tk. 211 crore, BPC's payable (on Feb. 28, 2009) was Tk. 14,270 crore on account of loans and deferred taxes.

Table 1: Average Import Price of Petroleum Products 2003-2004 to 2008-2009

FY	Crude	Refined	Lube Oil
	USD/bbl	USD/bbl	USD/bbl
2003-04	33.41	39.32	67.47
2004-05	45.85	56.96	86.22
2005-06	59.04	75.92	140.43
2006-07	63.59	78.31	119.03
2007-08	95.70	141.10	122.16
2008-09 (Up to Feb)	108.84	101.21	-

Source: Bangladesh Petroleum Corporation

Coal

Coal Reserves of Bangladesh

The total coal reserves in 5 coal fields of Bangladesh are estimated to be 2.9 billion metric tons (table 2). This is energy equivalent to 67 tcf of gas. Recovery rate of coal from reserves varies with the choice of technology and method of mining. Assuming a modest recovery rate of 30percent coal, the available reserve will translate to about 20 tcf of natural gas equivalent.

Table 2: Coal Reserves in Bangladesh

No.	Place/ Field (Discovery)	Depth (Meter)	Area (Sq. Km.)	Proven Reserve (Million Ton)
1.	Barapukuria, Dinajpur (1985)	119-506	6.68	390
2.	Khalishpur, Rangpur (1995)	257-483	12.00	143 (GSB), 685 (Hosaf)
3.	Phulbari, Dinajpur (1997)	150-240	30.00	572
4.	Jamalganj, Jaipurhat (1965)	900-1000	16.00	1050
5.	Dighirpar, Dinajpur (1995)	327	Yet to be known	200 (Partly evaluated)

Source: Petrobangla

The discovered fields differ in respect of depth ranging between 119-506 meters and 150-240 meters in Barapukuria and Phulbari respectively. The depth of the coal field discovered in Jamalganj is 900-1000 meters. The area covered by coal fields are rather limited and is about 70-80 square kilometer area.

Coal Mining in Bangladesh

Out of the five coal fields discovered in Bangladesh, production is ongoing at Baropukuria Coal Mines only. Table 3 below shows quarterly coal production at the mine since its inception in 1995. A total of 1.73 million metric tons of coal has been extracted from the mine till December 2008.

Table 3: Production of Coal at Baropukuria Mines Limited

Period	Production (Metric Ton)	Cumulative Production (Metric Ton)
Sep-Dec/05	77,444	77,444
Jan-Mar/06	110,847	188,291
Apr-Jun/06	114,725	303,016
Jul-Sep/06	168,325	471,341
Oct-Dec/06	56,637	527,978
Jan-Mar/07	64,055	592,033
Apr-Jun/07	99,359	691,392
Jul-Sep/07	112,341	803,733
Oct-Dec/07	85,088	888,821
Jan-Mar/08	219,288	1,108,109
Apr-Jun/08	185,375	1,293,484
Jul-Sep/08	114,001	1,407,485
Oct-Dec/08	320,864	1,728,349

Source: Baropukuria Mines Limited.

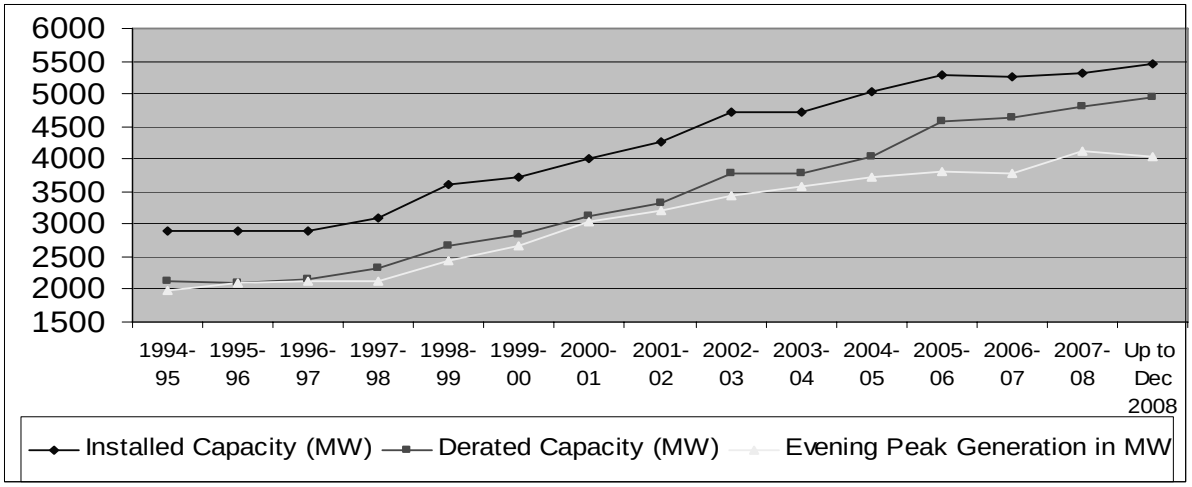
The Bureau of Mineral Development issued a license to BHP, Australia in 1994 for exploration of Phulbari Mine. The license was transferred to Asia Energy in 1997. Asia Energy is yet to obtain mining license. However, the mining could not proceed due to alleged lack of transparency in award of the license and unrest in the area leading to death of 6 protesters in police and paramilitary troops firing. Coal mining at Phulbari and other coal fields now hinges on the Coal Policy under consideration of the government. Approval of the Coal Policy is pending for quite some time due to disagreements on two main issues, namely, (a) open pit versus deep shaft mining; and (b) compensation and rehabilitation of affected families.

Energy Commodities of Bangladesh

Electricity generation

Installed, derated capacity and evening peak electricity generation have increased over the period 1994-2009. Compound annual growth rates (CAGR) during this period were 4.59percent, 6.17percent and 5.26percent respectively for installed capacity, derated capacity and evening peak generation respectively. From figure 4 it can be seen that a yawning gap has been created between derated capacity and evening peak generation since FY 2005-2006. This is due to (a) gas shortage (table 4), (b) ageing of power plants, and most recently (c) due to lack of rainfall in Kaptai Lake, sending the rule curve (80 feet above mean sea level (msl) instead of 90 feet above msl, standard for this time of the year) to a historic low. The data relating to ageing of power plants are shown in table A3. From Table A3 it can bee seen that 39 power plants with an installed capacity of 1252 MW are more than 20 years old. Some of the power plants are more than 40 years old.

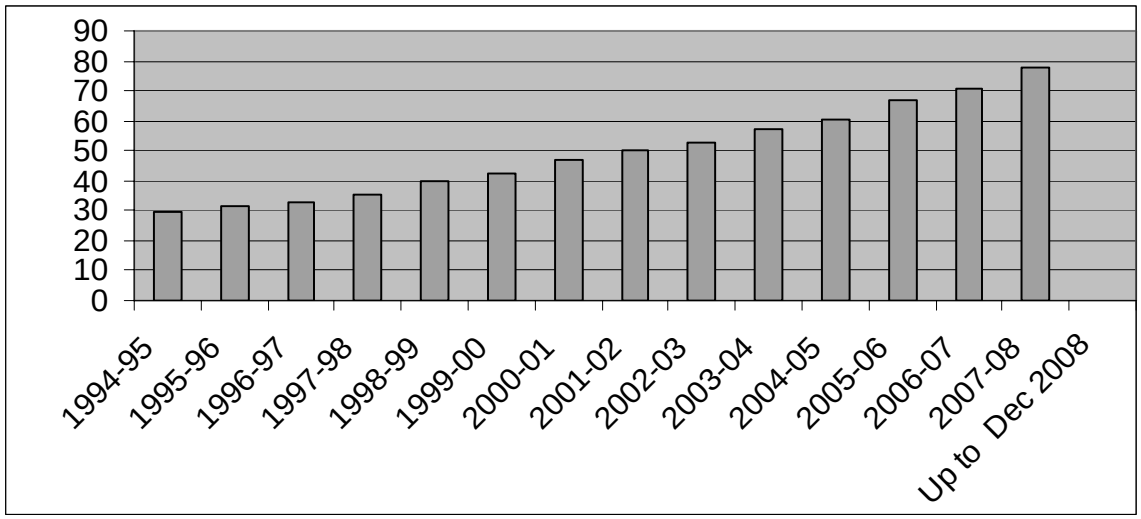
Figure 4: Installed, Derated Capacity and Evening Peak Generation 1994-2004 (in MW)



Source: Powercell

In line with the increase in generation capacity, average daily electricity generation has increased steadily from 29.61 MKWhr in FY1994-1995 to 77.64 MKWhr in 2007-2008 as shown in figure 5. This represents a CAGR of 7.70 percent over the period.

Figure 5: Average of Daily Electricity Generation 1994-2004 (in MkWh)



Source: Powercell

East-West Divide

Most of the electricity generation capacity of the country is located in the eastern region, mainly due to availability of gas. Of the total generation capacity, 4070 MW is located on the eastern side of Jamuna and the remaining 863 MW on the western side. Compared to the demand of 3470 MW of electricity in the eastern region, there is a small surplus of 330 MW of electricity in the eastern region. The western side with a demand of 1760 MW has a shortfall of around 897 MW. The divide on the transmission side has recently been mitigated with the addition of second East-West interconnector of 1000MW capacity. Together with the old interconnector with a capacity of 400 MW, there is no transmission constraint in transferring surplus electricity from eastern region to the western region. The mitigation of this east-west divide in electricity generation is imperative, not only to realize the growth potential of the western region, but also to achieve self-sufficiency in foodgrain production since the granaries of the country are located in the western region.

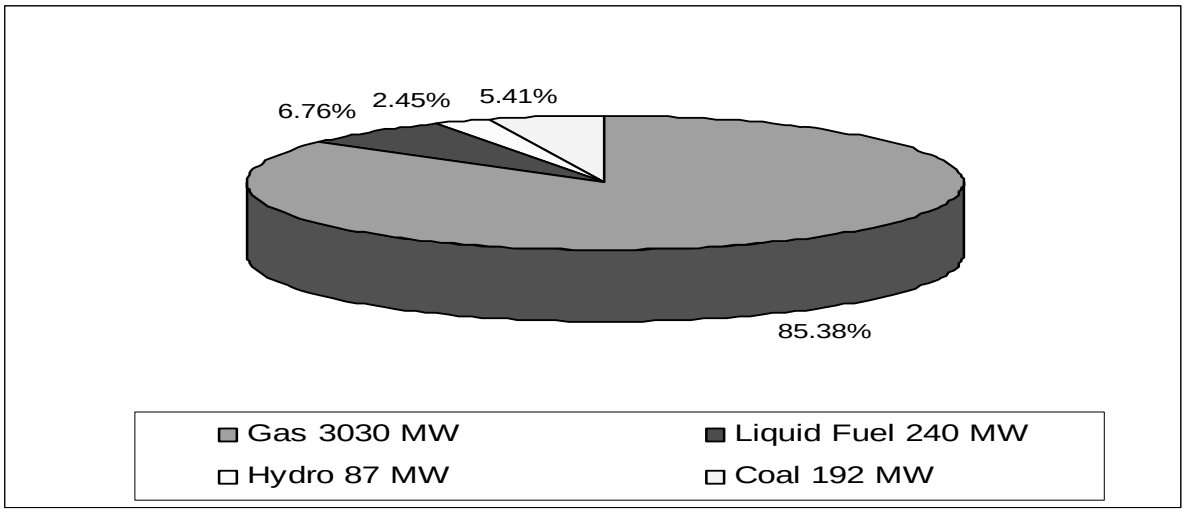
Figure 6: East-West Divide in electricity generation

Capacity of the East-west Interconnector 1400MW

Fuel-mix of Electricity Generation

Electricity generation in Bangladesh is overwhelmingly gas based. More than 85percent of evening peak electricity is generated by using natural gas (Figure 7). This is followed at a distant by liquid fuel, and coal with generation shares of 6.76percent and 5.41percent respectively. Hydro accounts for paltry 2.45percent of generation. When we recalculate the fuel mix using the derated generation capacity, share of gas based generation reduces marginally to 83.45percent; share of liquid fuel and hydro based generation increases to 7.55percent and 4.60percent respectively.

Figure 7: Fuel-mix of Power Generation (Based on evening peak generation on 12 March 2009)

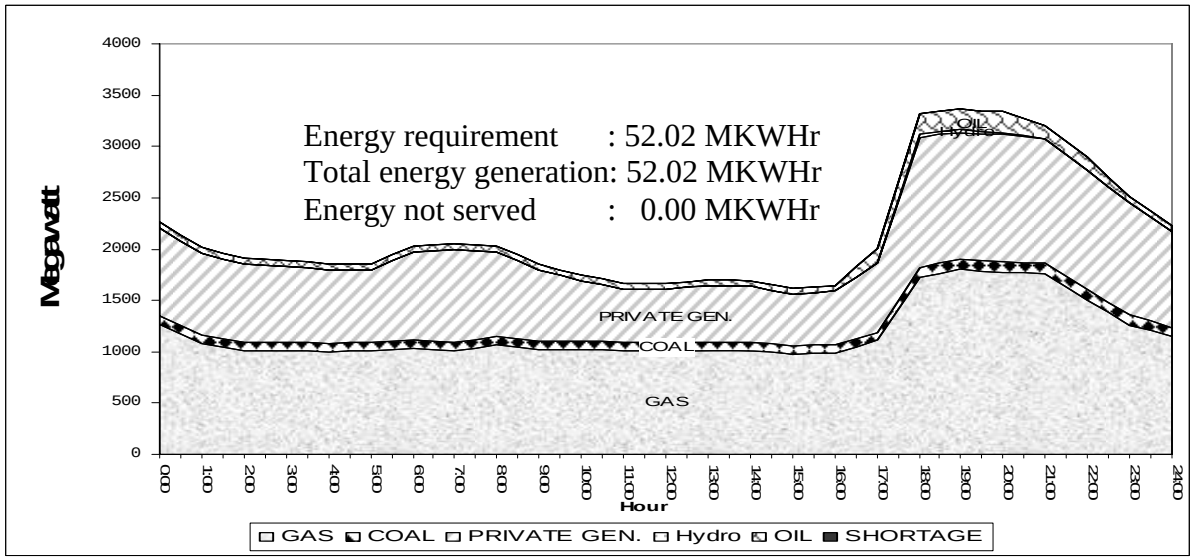


Source: Powercell

Load pattern

Perennial shortage of electricity generally precludes depiction of daily load pattern. However, one such opportunity was offered on the national Election Day of 29 December 2008. Since most of the industrial and commercial load was absent on the day, the demand was low. Moreover, being a winter day there was no demand for air conditioning. There was no load shedding anywhere in the country on that day.

Figure 8: Daily Load Curve, 29 December 2008



Source: Load Dispatch Center, PGCB

It can be seen from the figure 8 above that at 16.00 hours demand was 1647MW and the evening peak demand at 17.00 hours was 3366.6 MW- a difference of 1720 MW. The difference is due to the lighting load plus TV program watched by people in the evening to follow the election result. Note the valley and the peaks in the load curve. Peak clipping and valley filling remains the major challenge for the power sector. We have also analyzed the two other load curves shown in the Figure A1 and A2 to determine air conditioning and fan load. The load curves relate to 12 September 2008 (representative of summer) and 16 January 2009 (representative of winter). Electricity generation on 12 September 2008 at 17:30 hours (one hour before sunset) was 3487 MW in summer compared to electricity generation of 2715 MW on 16 January 2009 at 16:00 hours (one hour before sunset) was in winter

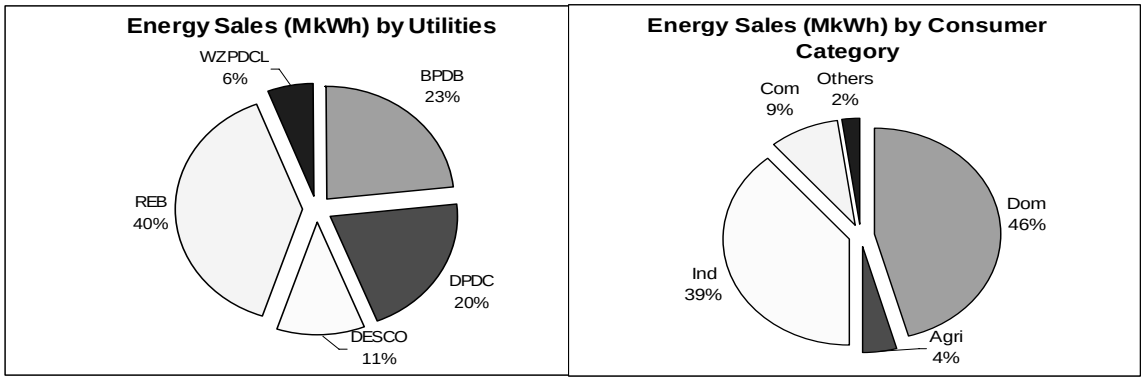
season. The difference of around 800 MW is estimated to be air conditioning and fan load. These numbers are approximations since there are some processing plants that require continuous operation, irrespective of seasonal variations.

The load pattern noted above has important policy implications. If we want to decelerate the growth of demand for electricity, an imperative in view of the prevailing generation deficit, we have to reduce the lighting load. This can be done through use of energy efficient bulbs, electronic ballast etc. We discuss the issue relating to energy efficiency and conservation in section 5. In addition, to decelerate the growth of air-conditioning load, separate billing system for air-conditioners and national standards for thermostat settings may be considered.

Electricity consumers and consumption

Domestic consumers overwhelmingly dominate the consumer categories (83percent), followed by commercial consumers (12percent), industrial and agricultural consumers constitute a paltry 2percent of consumer categories. From the pie charts below (figure 9), we can also see that REB serves 69 percent of the consumers, followed by BPDB (18percent), DPDC (6percent), WZPDCO (5percent), and DESCO (4percent) respectively.

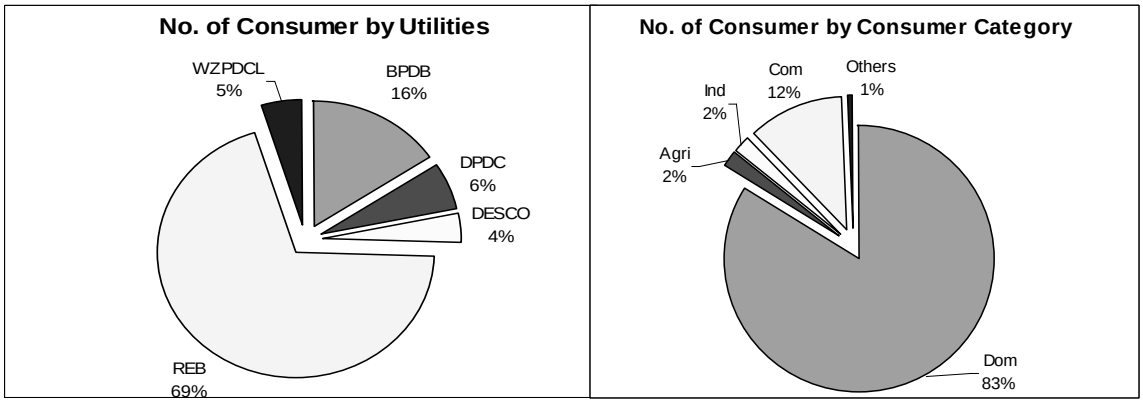
Figure 9: Number of Consumers by Utilities and Consumer Category



Source: Powercell

The above picture is somewhat changed when we consider the energy sales data in figure 10.

Figure 10: Energy Sales by Utilities and Consumer Category



Source: Powercell

Domestic consumers, 83 percent of all electricity consumers account for 46percent of electricity sales; 2 percent industrial consumers purchase 39percent of electricity; commercial consumers; commercial and agricultural consumers use 12percent and 2percent respectively. Based on the energy sales, REB still dominates with 40percent of energy sales, followed by BPDB (23percent), DPDC (20percent), DESCO (11percent), and WZPDCL (6percent) respectively.

The figures also show the rural-urban difference in electricity use. Rural customers are located mainly in REB and WZPDCL areas. While together, they account for 75percent of the consumers; their share in energy consumption is limited to 46percent. Predominantly urban consumers of DESCO and DPDC, 10percent of the consumers, use 31percent of electricity.

The shares by consumer category, energy sales, and utility, have remained largely unchanged over the period 2006-2008, suggesting that there had not been much change in rural-urban distribution of electricity (Tables A4 and A5).

Load Shedding

Load dispatch center (LDC) of the Power Grid Company of Bangladesh processes the data for load-shedding. Based on historical data, experience, weather condition, seasonal change; social and political activity and BPDB's long term demand forecast, day to day demand is projected by LDC. An addition of 8-10percent demand to the previous year's demand is made in practice. LDC underestimates the extent of load shedding. The press and the media on the other hand use Power System Master Plan (PSMP) demand forecasts to estimate load shedding. This comparison again overstates the extent of load shedding because PSMP demand forecast estimates the highest demand (demand on a hot summer day). To illustrate, for FY 2009, according to PSMP estimate peak demand is 6066 MW based on the base case.

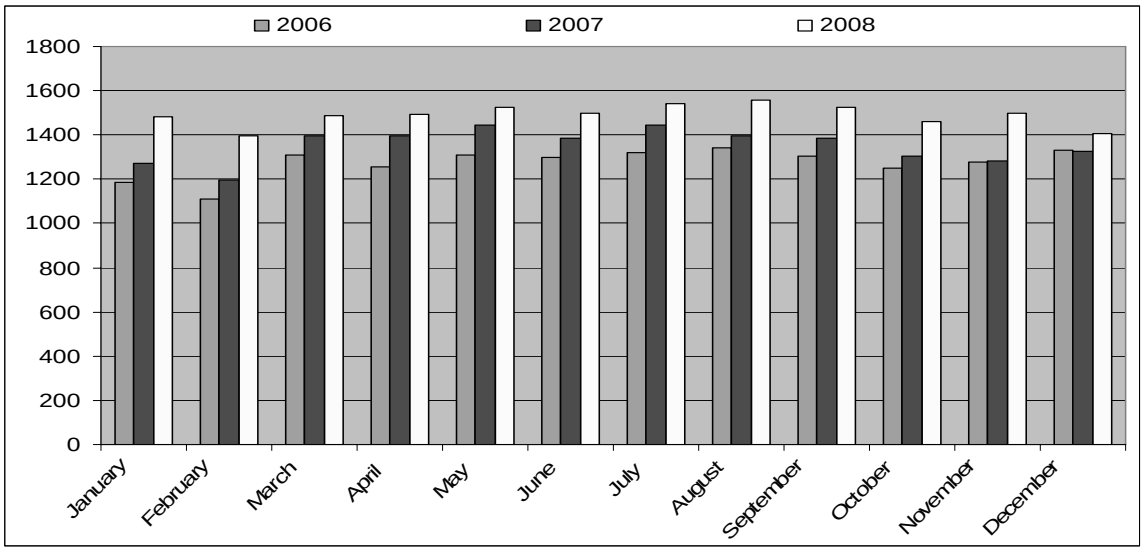
IV. Recent Developments in the Energy Sector

Energy Sector

Natural Gas

Although short of demand, month- wise gas production data show steady increase in 2007-2008 over the production in 2006.

Figure 11: Month-wise Gas Production (in MMCM)



Source: Petrobangla

Coal

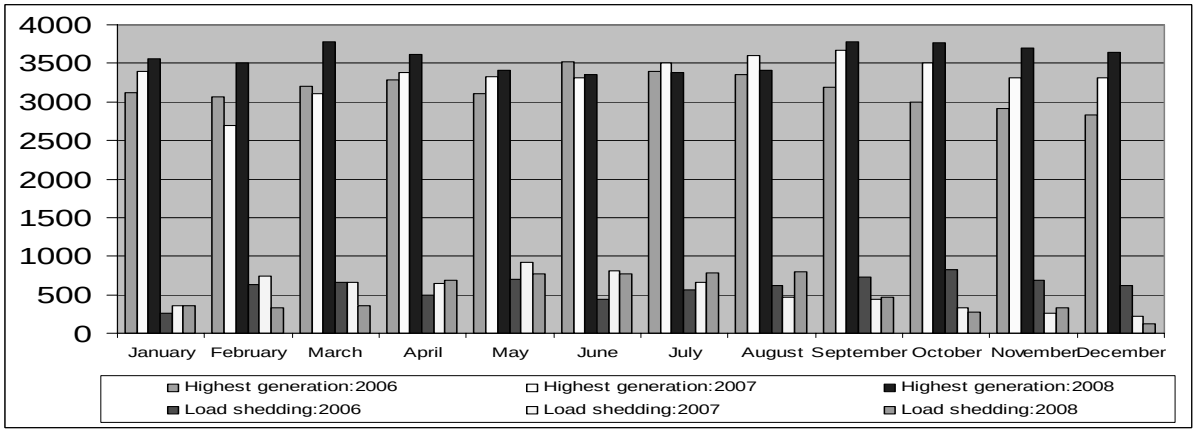
Coal production at Baropukuria has shown remarkable turnaround during 2007-2008. Out of total 1.73 million tons coal production from September 2005 to December 2008, 1.2 million tons (nearly 80percent) was achieved during the period.

Power Sector

Electricity generation

Electricity generation increased in both 2007 and 2008 compared to 2006. There are two measures of electricity generation that are relevant. Peak-hour generation is usually recorded at 7-30 p.m. in the evening, when the demand is at maximum and is measured in megawatts. Load shedding is also measured at the same time. The data for peak generation and load shedding is given below in figure 12.

Figure 12: Daily Average Peak Electricity Generation and Load Shedding FY 2006-2008(in MW)

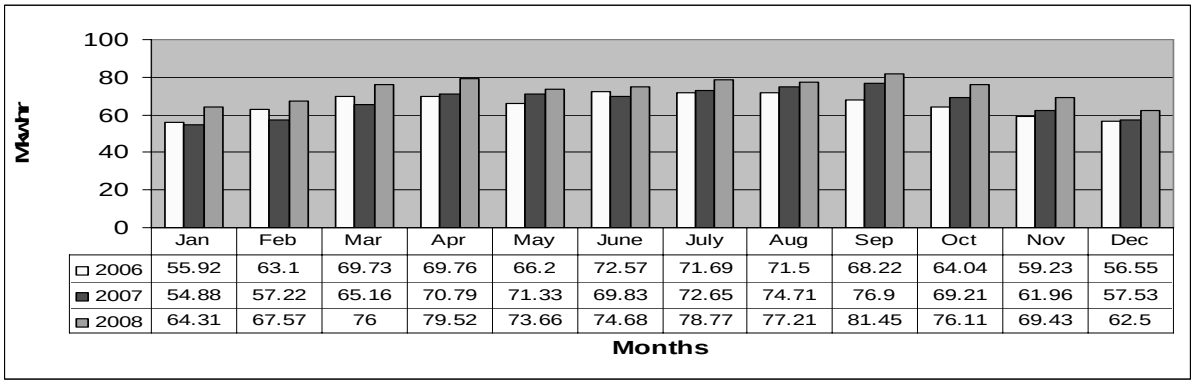


Source: Powercell

For example, in February 2007, average peak monthly power generation was 2693 MW. Electricity generation increased to 3647MW in December 2008- an increase of 953 MW. This was achieved through a combination of addition to generation capacity (425 MW) and maintenance and rehabilitation of old and inefficient plants. These improvements were reflected in 11percent higher monthly average peak generation (MW). In spite of growth in demand, average, peak hour load shedding fell from 605 MW in 2006 to 540 MW in 2008. The full benefit of addition to installed and available capacity could not be realized due to shortage of primary energy i.e. gas supply. Due to gas shortage, around 600 MW generation capacity remained stranded in the year 2008. Clearly, if supply of primary energy could be ensured, the power sector would be capable of meeting peak electricity demand in the country.

The other measure is average electricity generation during the day- measured in million kilowatt hours. Notably, such generation data also reflect the seasonal variation in demand as well as the factors such as increase in demand due to irrigation during the boro season from January to April.

Figure 13: Daily Average Electricity Generation FY 2006-2008 (in MkWHr)



	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
2006	55.92	63.1	69.73	69.76	66.2	72.57	71.69	71.5	68.22	64.04	59.23	56.55
2007	54.88	57.22	65.16	70.79	71.33	69.83	72.65	74.71	76.9	69.21	61.96	57.53
2008	64.31	67.57	76	79.52	73.66	74.68	78.77	77.21	81.45	76.11	69.43	62.5

Source: Powercell

From figure 13 it can be seen that 14percent higher average monthly total energy generation was achieved (Million KWh) in 2008 compared to 2006.

New generation contracts for a total of 1125 MW were awarded in 2007-2008. Out of 24 public sector power plants, small IPP, and rental power plants (RPP) awarded in 2007-2008, 9 power plants have come into operation and the remaining 15 power plants are expected to be commissioned by June 2009. While awarding the contracts, lowest responsive bidders were selected through a transparent competitive process. The only notable disappointment was the outcome of procurement process of Bibiyana 450 MW IPP. The tender attracted a single bid (due to global economic turmoil) and was not approved due to high tariff, compared with selected quantitative and qualitative criteria Tenders have also been invited for 1360 MW power generation in public and private sector. Besides, financing for six public sector power plants of total capacity of 1470 MW have been confirmed.

Transmission

During 2007-2008, around 1061 kilometer transmission lines (230 KV and 132 KV), which is 13 percent of the total transmission line length, was constructed. Substation capacity of 1890 MVA was added in 2007 and 2008 which is 11 percent of total sub-station capacity. The second East-West Interconnector, with a capacity to transfer 1000MW power, was completed in 2008 and it will play a vital role in the stability of high voltage grid network and remove the existing power divide between the east and western part of the country.

Distribution

In the years 2007 and 2008, a total of 14,654 km new distribution lines (33KV and below) were constructed by the power utilities and the number of new consumers connected to the system was 1,053,044. This somewhat lower performance in the expansion of distribution network and acquisition of new consumers is attributable to the embargo on line construction by REB, imposed following reports of corruption and politically influenced expansion of uneconomic REB lines. The embargo has been withdrawn and selective expansion of line based on prudent economic rationale and technical feasibility is now underway.

Renewable Energy

To meet the challenges of electrification of remote rural areas, electricity shortage and climate change, renewable energy expansion was the government's priority in the agenda in 2007 and 2008. Installation of Solar Home System (SHS) in Bangladesh is one of the fastest in the world. More than 180,000 new households and small businesses in rural areas (mostly in non-grid areas) were provided electricity by SHS during this period.

Commercial Performance

Commercial performance of the sector improved significantly during 2007-2008. The average distribution loss of power utilities was reduced by 2 percent from16 percent in 2006 to 14 percent in 2008. Collection of retail electricity bill in 2007 increased by 869 crore Taka compared to the previous year. Reduction of bills outstanding from 3.95 equivalent month of dues in 2006 to 2.46 (in October 2008) was a significant achievement during this period.

Financial Performance

The financial performance of the power sector has also improved significantly. PGCB, DESCO, DPDC earned profit in 2008. BPDB's net loss remained static and net loss of REB decreased. The total aggregate net loss for the sector came down to about Taka 431 crore in 2008 and Taka 594 crore in 2007 compared to Taka 816 crore in 2006. Recent tariff adjustment in October 2008 will help BPDB to reduce its loss in the coming years.

Policy Reforms

The caretaker government has approved "Policy guidelines for Enhancement of Private Participation in the Power Sector." The policy will enable the private sector to set up commercial power plants, sell electricity to bulk consumers at mutually agreed prices, rehabilitate power plants, and set up power plants along with power sector utilities on a joint venture basis. Due to this policy, private generators will have open access to transmission and distribution lines for wheeling the power generated.

The caretaker government also approved "Renewable Energy Policy" to accelerate the use of renewable energy through fiscal incentives, withdrawal of tax tariff for suppliers of renewable energy and institutional support through creation of Sustainable Energy Development authority. In addition, the Power Division has also prepared a final draft of "Energy Conservation Act" for the consideration of the newly elected government.

Institutional Reforms

The process of unbundling the power sector is almost complete: three generation, one transmission and six distribution companies have been created. Unbundling of distribution sub-sector is fully complete. In the generation sub-sector, North-West Power Generation Company (NWPGC) was created in 2008.

The management of power sector companies have been re-organized through appointment of independent Chairmen and increased representation of stakeholders in Company boards, creation of Board committees for i) Audit ii) Recruitment and Promotion and iii) Procurement to ensure transparency and accountability.

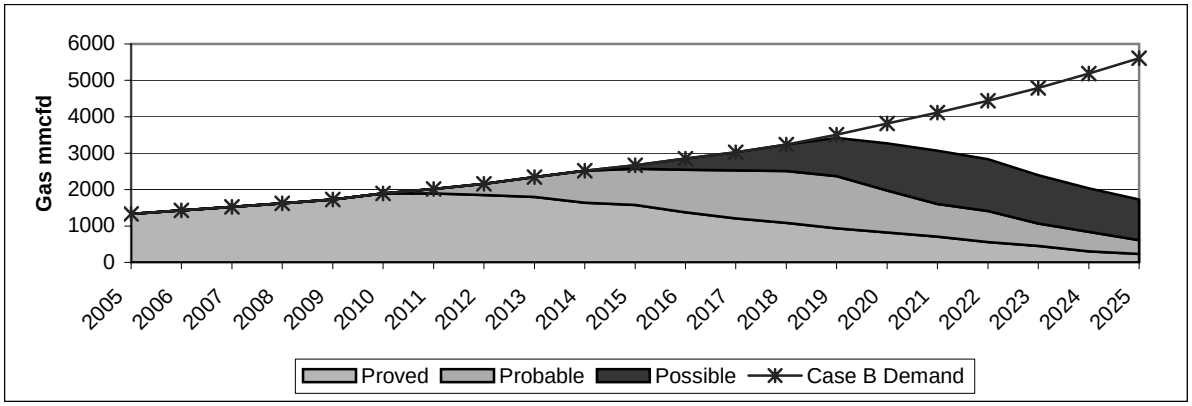
The caretaker government has laid the foundations of sustained growth in the power sector through policy and institutional reforms. An addition to the generation capacity of over 1000 MW should provide the new government with the breathing space to contract out large low-cost base load plants in a more conducive global procurement environment. Significant improvements in the transmission and distribution network achieved during this period would improve reliability of the system and provide quality power.

V. Key Energy Sector Issues

Allocation of Limited Gas between Current and Future Consumption:

Against the estimates of gas reserves in Bangladesh, and based on the projected gas demand, according to Bangladesh Gas Sector Master Plan (Wood and Mackenzie, 2006) a shortfall would commence in 2011 against proved reserves. 2P reserves will meet demand until 2015 and 3P reserves will meet demand until 2019. The shortfalls in volume in 2025 for the 1P, 3P reserves are 13.1 tcf, 8.5 tcf and 4.6 tcf respectively. The details are shown in figure 14 below.

Figure 14: Supply Demand Balance



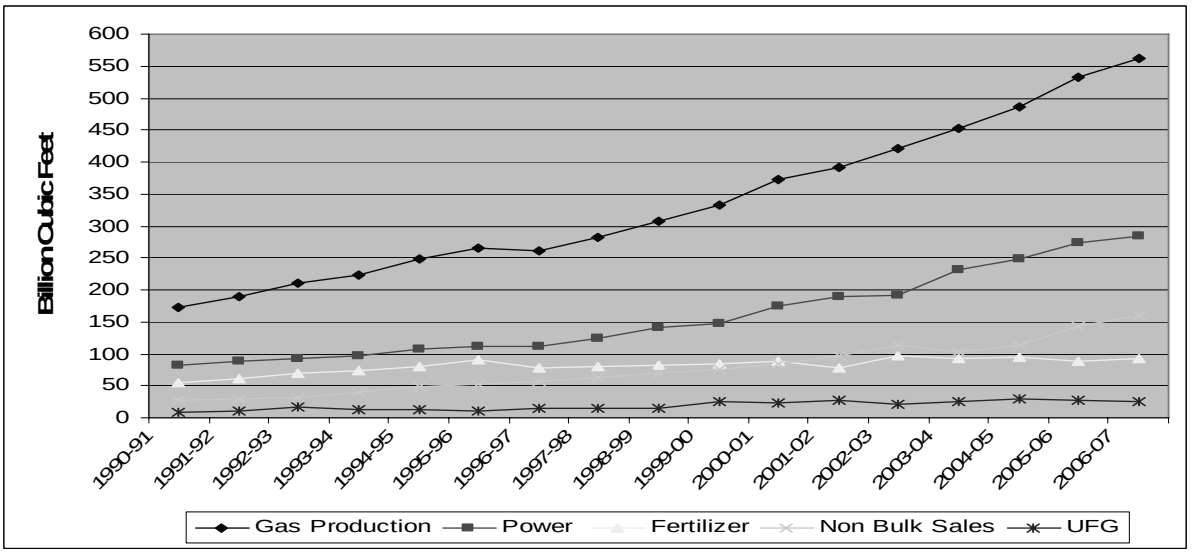
Source: Gas Sector Master Plan

Hotelling's study mentioned earlier concluded that contrary to the concerns that the monopolist will restrict output and raise price, monopoly price path is flatter and rate of depletion is retarded (Devarajan and Fisher, 1981). However, a substantial quantity of gas in Bangladesh is produced under production sharing contracts (PSC). Early recovery of investments in exploration clause of PSC's[3] creates incentives for faster depletion of reserves. The inter-temporal choice of gas production is particularly important, since gas production at faster than the optimal rate may affect the reserve itself. This was noted in case of Sangu gas field operated by Cairn. Production of gas in excess of optimal rate has brought down average daily production of gas from about 150 MMSCFD of gas in 2005 to 52 MMSCFD of gas in 2008, creating severe gas shortage in Chittagong region under Bakhrabad Franchise area. There is also the problem of asymmetric information between IOCs and Petrobangla. Cairn energy reportedly has shown a higher reserve of 1 tcf gas for Sangu whereas the actual reserve was ½ tcf gas. Higher reserve estimates prompted Petrobngla to go for higher production.

Allocation of Limited Gas among Various Uses

Figure 15 below shows year-wise gas sales. The CAGR of gas production from 1990-91 to 2007-2008 was 7.14 percent. Sector wise CAGR were 7.52 percent, 3.26 percent, and 10.92 percent respectively for power, fertilizer and non-bulk consumers. Notably, sales to non-bulk customers experienced the fastest growth during this period.

Figure 15: Category-wise Annual Gas Sales



Source: Petrobangla

Technical Interface between Gas and Energy Infrastructure

Lack of coordination between Energy and Power Division is a favorite subject for discussion in popular press. In fact, the human interface between energy and power division officials is quite good. The technical interface on the other hand is rather weak, mainly because of undeveloped gas production, transmission and distribution infrastructure and its very limited storage capacity. The system allows for very limited line packing and is incapable of rapid increase in production to meet peak demand. The system also lacks flexibility in diverting gas from an area where demand has fallen to an area where demand remains strong. To illustrate, let's say a particular power station experiences a force shutdown thereby lowering demand for gas. But such gas cannot be diverted to another power plant where there is unmet demand. On the electricity generation side there are similar limitations as there is no automatic generation control system. As a result, power plant managers cannot lower generation quickly in response to sudden shortage of gas supply, sometimes threatening the gas infrastructure.

[3] . Production sharing contracts provide for 55 percent cost recovery from production. The remaining 45 percent is distributed between Petrobangla and IOCs.

In the event of gas shortage, the system cannot allocate the shortage among various consumer categories proportionally.

Table 4: Present Demand and Supply Balance (2008-09) (***in MMSCFD)***

Sector	Customer Type	Demand	Supply Balance	Shortfall
Bulk	Power	830	680	150
	Fertilizer	289	235	54
	Non-grid Power (SPP)	35	22	13
	Sub-total	1,154	937	217
Non-bulk	Captive	280	270	10
	CNG	78	78	0
	Industry	297	273	24
	Domestic	260	250	10
	Commercial & others	26	22	4
	Sub-total	941	893	48
Grand Total		**2,095**	**1,830**	**265**

Source: Petrobangla

Table 4 above illustrates this point. Out of the total shortage of 265 MMSCFD of gas on a hypothetical day, nearly 82 percent is borne by bulk purchasers such as power and fertilizer. While non bulk consumer receive nearly 50 percent of the total gas supply, their share is less than 20 percent of the shortage. This is contrary to the recommendations of several studies that the preferred method of recovering energy stored in gas is by converting it into electricity, which then opens a broad range of opportunities for improvements in home conditions; use of electric equipment in small manufacturing; climate control of buildings, hospitals and schools, and street lighting; and the manifest relationship between GDP growth and electricity generation in Bangladesh.

Coal Policy

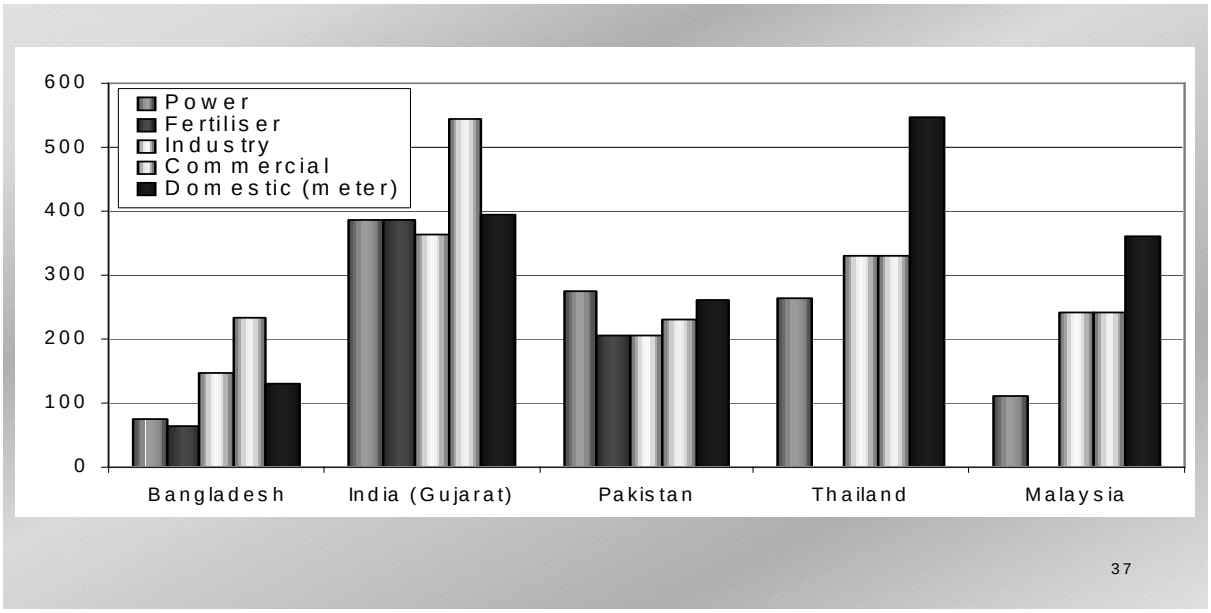
Given the prevailing shortage of natural gas, Coal Policy needs to be finalized. Several committees have worked on the policy and reviewed the draft policy. Given the strong electoral mandate, the newly elected government is in a position to balance the concerns of various groups (e.g. affected persons, prospective investors, environmentalists etc). A coal mine will need about 5 years to be built and coal based power plant will take about three years to construct. Even if these two activities are carried out simultaneously, allowing about a year for procurement of contractors for coal mine and plant, we are six years behind from producing coal from new mines even if the Coal Policy is approved today.

Energy Pricing

Gas Tariff

Natural gas prices ($/mmbtu) in the region is shown below in figure 16. From the figure it can bee seen that natural gas tariff in Bangladesh is the lowest for all consumer categories. Prices provide signal to the producers in deciding the amount of energy supply they would bring into the market and facilitates consumers' choice of optimal fuel consumption mix. The current level of prices distorts both producers and consumers incentive. An artificially low price stimulates an increase in demand and encourages waste. However, given the differences in levels of development of other countries in figure 16, the impact of gas prices on electricity and industrial production, a phased increase would be desirable. The Bangladesh Energy Regulatory Commission (BERC) has concluded hearings on gas prices but in its judgment did not approve price increase sought by Petrobangla. With the ripples of global recession reaching Bangladesh shores it will be a difficult yet necessary decision for BERC to announce a phased increase in gas prices in the near future.

Figure 16: Regional Gas Price Comparison



Source: Wood Mac., UK Study, 2005

Electricity Tariff

Clearly, as shown in table 5 below, electricity tariff in Bangladesh is also the lowest in the region.

Table 5: Electricity Tariff ($cents kWh) in Selected South Asian Countries, 2006

Country/ Consumer category	Bangladesh	India (Delhi)	India (West Bengal)	Nepal	Pakistan	Sri Lanka
Households	4-16-8.33	6.03-9.45	4.75-8.02	5.4-13.4	2.33-12.35	2.89-16.64
Irrigation	3.06	N.A.	4.15	-	5.47	-
Commercial	8.4	10.04-11.42	7.89-13.01	10-10.4	7.65-12.68	7.7- 8.18
Industrial	3.53-6.38	11.9-12.19	9.62-10.91	6.2-8.9	5.25-9.37	7.7- 8.18
Other	3.41	11.25	9.87	-	9.48	-

Source: Potential and Prospects for Regional Energy Trade in the South Asia Region, ESMAP and South Asia Regional Cooperation Program.
Note: In addition, typically power utilities have some fixed/demand charge per $/kW/month.

The care-taker government activated Bangladesh Energy Regulatory Commission (BERC) to implement its mandate to regulate Gas, Electricity and Petroleum products. BERC has issued its first tariff order for bulk electricity supply tariff effective from October 1, 2008**.** Subsequently, it issued orders relating to petroleum products. It has received application from the power distribution utilities and completed hearing on Dhaka Electric Supply Company's (DESCO's) application. Decision on DESCO's application will be the most significant judgment to be delivered by BERC so far.

DESCO is one of the few profitable companies in the power sector. Its shares are listed in Dhaka Stock Exchange (25 percent of the shares are owned by the members of the public).

BERC will determine tariff for power distribution utilities according to draft Electricity Distribution Tariff Methodology (BERC Website). The methodology does not take into consideration electricity tariff of competing and different utilities. For example, according to the methodology, DESCO being

profitable may not qualify for a tariff hike. On the other hand, other loss making utilities will be eligible for increase in their tariff under the methodology. DESCO customers comprise relatively well-off customers and the load is mainly lighting and air conditioning. Therefore, BERC may like to take the following additional factors into consideration in determining DESCO tariff:

(a) Tariff in DESCO areas should not be less than tariff paid by less well-off customers residing within the jurisdiction of loss making utilities. In fact, it would be expected that customers paying Tk. 20,000 per sq. ft. for commercial spaces or paying rent of Tk. 100 per sft or more in some DESCO areas properties should be asked to pay tariff in line with the tariff paid by similar customers in other south Asian countries. This is necessary not only on equity grounds but also to provide lower tariff for more productive industrial and agricultural use.

(b) The dilemma for BERC, however, would be that such tariff increase will result in a windfall profit for DESCO. This can be mitigated by lowering the tariff for lifeline customers (consuming less than 50/100 units of electricity) residing in DESCO areas. Moreover the government /and or BERC may require DESCO and other profitable urban utilities to contribute a percentage of their revenue to a common fund that would be dedicated for cross-subsidization of less well-off consumers and productive industrial and agricultural activities in poor suburban and rural areas.

(c) BERC's tariff determination methodology should also take into account the demand management needs of the power sector. It should not send any negative signals to private DESCO shareholders and discourage efficiency in operation of distribution utilities by granting higher tariff to loss making utilities and denying reasonable tariff increase to well performing utilities.

Delay in Procurement

Gas Transmission Company Limited initiated the process of procurement for installation of compressor stations at Muchai, Ashugonj, and Elenga in July 2005. After completion of first-stage bid evaluation it was sent to ADB. In September 2007, the Integrity Over-sight Committee of ADB opined that technical specifications, prepared by an ADB approved consultant, favored a particular manufacturer. Re-bidding commenced in November 2007. The final status of the project as of March 17, 2009 is that technical evaluation committee (TEC) reviewed the consultant's report and prepared a preliminary evaluation report recommending to seek clarifications from both bidders. This is a typical example of procurement in the energy sector using donor funded project. Table A6 shows the timeline of procurement of the project. Such delays are attributable to (a) weaknesses in the government's public procurement rules, (b) centralization of donor decision making relating to procurement, and (c) lack of capacity in the energy sector to evaluate complicated projects.

Delay in Power Project Implementation

A serious constraint of development in the energy sector is the delay in implementation of projects in the public sector. A typical list of delayed power projects is shown in table A7. It can be seen from the table that 210 MW Siddhirgonj Power Plant implemented by Russian company TPE experienced a total delay of 6 years 9 months. Delay for Ghorashal 210 MW Power Plant 6th unit was by 2 years and 3 months; Tongi 80 MW Power Plant, implemented by a Chinese Company Harbin was delayed by nearly six months. Similar pattern of delay is emerging in cases of implementation of Sylhet 90 MW power plant by Harbin, and Siddhirgonj 220 MW peaking Power Plant by Indian Company Bharat Heavy Electric Limited. The delays are attributable to near total reliance on foreign companies in public sector power project implementation; incomplete and/or ambiguous contracts; lax in the implementation of delay liquidated damage (DLD) or performance liquidated damage (PLD) related provisions; and delay in land acquisitions.

Bangladesh Power Development Board (BPDB) has set a good example of recovering DLD's and PLD's as per contract from short-term rental power companies. BPDB also needs to enhance its capacity to take-over badly delayed power plants and complete the remaining work by engaging third parties or on its own by deducting the expenses from the original contract value.

Governance of the Energy Sector

Outside interference, multiple authorities, undesirable fragmentation are perhaps the most important factors inhibiting the development of the energy sector. For unknown reasons, successive governments have kept Ministry of Power, Energy, and Mineral Resources (MPEMR) under the head of the government. Because of the large project costs involved, most of the procurements by the Ministry require approval of the cabinet subcommittee on purchase and ultimately approval of the head of the government. Similarly, most of the development projects require consideration by ECNEC and thereby, approval by the head of the government. Any policy decisions of the ministry require approval of the cabinet, which is again chaired by head of the government. In spite of all these checks and control levers available to the head of the government it is not clear why head of the government should remain in charge of (MPEMR). Given the preoccupations of the head of the government, in the past, persons having no knowledge or responsibility of the energy sector interfered in the decision making by invoking the authority of the head of the government.

The present government needs to be credited for placing both power and energy division under the same State Minister. Given the interdependence of power and energy divisions, there is no justification of separating the functions at the ministry level. Notably, both energy and power division used to be headed by a single Secretary in the past.

The present government has introduced an unorthodox governance structure for the energy sector as follows: (a), the Prime Minister remains the minister-in-charge; (b) there is an energy adviser, (c) there is a State Minister, and (d) the Prime Minister also announced formation of a cell. In addition, there will be oversight by the parliamentary committee. There are some apprehensions that the new model may cause delay in decision making and result in bad compromises and diffuse the process of accountability. However, we note the remark made by German Prussian politician Otto Von Bismarck in 1867 that “Politics is the art of the possible.” Encouraged by the remarkable turnaround of Indian Railway achieved under Laloo Prashad Yadav, we will look forward to the performance of the new governance model for the energy sector with keen interest.

Corporatization of the Energy Sector

The energy sector has been corporatized in different degrees. In the power sector, there are three power generation companies, one transmission company, and six distribution companies. In addition, there is BPDB carrying out both power generation and distribution functions and is the main bulk purchaser of electricity from independent power producers (IPP). REB is carrying out distribution functions in rural areas, owns a power generation company, and also buying electricity from some small IPPs. Recently, autonomy of power sector companies was ensured by withdrawing power secretary as chairmen of these companies to avoid conflicts of interest. Persons of integrity and/or deep knowledge of the sector have been put in charge of these companies. However, the corporatization process remains incomplete: (i) BPDB needs to complete power purchase agreement with the newly created generation companies and transfer manpower, assets and liabilities to such companies; (ii) it also needs to complete the vendors agreements with distribution companies created out of BPDB and transfer manpower, assets and liabilities such companies; and (iii) following completion of the process, corporatization of the remaining BPDB should be undertaken. With introduction of independent management of power sector entities, technical coordination of the sector has emerged as an important issue.

The main factor inhibiting the performance of the energy sector was that the managers in the sector were not allowed to perform independently in the interest of the sector. Moreover, the sector managers were not provided with necessary support necessary for their smooth functioning. The government through the ministry should adopt appropriate policies, set targets, and strengthen its monitoring functions, but must leave day to day functions to the managers and hold them accountable for their deeds. Completing the corporatization process and granting necessary autonomy to the energy sector managers will constitute the major challenges for the future development of the sector.

Energy Conservation: Negawatts and the Fifth Fuel

Negawatt power is a term coined and introduced by Amory Lovins in a 1989 speech. The term emphasizes investment to reduce electricity demand instead of investing to increase electricity

generation capacity. This "virtual generation" method can increase supply of electricity by improving the efficiency of existing electrical equipment rather than by building new power stations. For example, by setting thermostat to air conditioners to a higher level (say 22 degrees instead of 18 degrees) during the peak electrical load hours - summer afternoons - peak electricity consumption can be reduced, avoiding the need to construct a new power station. This reduction in consumption is referred to as a negawatt.

While analyzing the patterns of energy use in the world today, Amory Lovins also found that the typical rich country is almost three times as energy efficient as the typical poor country. He believes that a typical poor country ought to be able to grow its economy roughly ten-fold without increasing its energy use at all, if it leap-frogs over mistakes of western nations and does it right the first time. Otherwise, poor countries will find itself in the dilemma of China, which decided some years ago that it was time for people to have refrigerators. So they built over 100 refrigerator factories. The fraction of Beijing households owning a refrigerator went from 2 to 62 percent in six years. Unfortunately, without paying attention, China chose a very inefficient kind of refrigerator to build, and has therefore committed itself to spending several billion dollars to build power plants to run the refrigerators, thus creating power shortages in the name of development. According to Lovins, if countries gave away energy efficient light bulbs in cities like Mumbai, one-third of peak load demand in the evenings could be reduced. One can achieve remarkable leverage for development by increasing the reliability of supply, and by avoiding heavy investments in expanded supply, through emphasizing efficiency.

The “Fifth Fuel” on the other hand refers to energy efficiency as an alternative to four traditional fuels, namely, coal, natural gas, hydropower and nuclear fuel. Bangladeshis are a frugal nation and recycle almost everything. However, this national trait does not extend to the area of energy use. We are imitating western lifestyle, turning on gas stove to save a match stick, using energy inefficient bulbs, appliances, and boilers etc. These are some of the typical examples of waste of energy.

The Energy Audit Cell of the power division estimates that national annual natural gas savings due to 5 percent improvement of efficiency of boilers would lead to a gas saving of 18.2 bcf, based on 2006-2007 gas production and use in boilers. Some of the options for natural gas savings proposed by the Energy Audit Cell include: insulations of bare steam lines, repair steam leaks; improvements in condensate recovery, generator operating efficiency, power factor; installation of intelligent motor controller; and installation of co-generation plant.

They also estimate national annual natural electricity savings of 1059 GWh through demand side management policies such as, installation of intelligent motor controller, use of compact fluorescent lamp(CFL), electronic ballast, daylight savings, reducing use of electricity during peak hour, closing shopping malls by 7pm, separate billing system for air-conditioners, and setting standards for electrical appliances. Energy Cell estimates of National Gas and Electricity Savings through energy efficiency improvement measures are shown in table A8 and A9.

As already mentioned, Power Division has prepared final draft of “Energy Conservation Act” for consideration of the newly elected government. Enactment of such an Act will institutionalize energy savings measures.

VI. Challenges and Opportunities for the Newly Elected Government

Power and Energy Sector in Awami League’s (AL’s) Manifesto:

The manifesto promises to adopt a comprehensive long-term policy on electricity and energy; ensure economic usage of oil, gas, coal, hydro power, wind power and solar energy; and give priority to big and small power generation stations, coal extraction, and oil and gas exploration. It proposes to undertake a three-year crash program for quick implementation of the ongoing and under consideration power generation stations; import of electricity from neighboring countries; arrange 100/150 MW gas turbine projects on urgent basis; and reactivate the past AL initiatives for constructing 10, 20 and 30 MW power stations. The manifesto promises to prepare a schedule for repair, maintenance and overhauling or salvaging of old power stations to increase and stabilize power production; increase supply of gas and LPG; and implement the Rooppur Nuclear Power

Project. Coming to specifics, the manifesto targets n the next three years or power production increase to 5000 MW by 2011 and to 7000 MW by 2013.

The party will give priority to exploration and exploitation of oil and new gas, coal fields and other mineral resources make arrangements for supply of gas in the north and western regions of the country and significantly increase supply of gas and LPG. The party, if elected to power, will formulate a Coal Policy safeguarding the national interest, take special initiatives to ensure economic use of the coal and also to develop coal-based power plants.

The power generation target in the manifesto is ambiguous. It is not clear whether it targets additional generation of 5000MW of electricity by 2011 and 7000 MW of electricity by 2013 or targets to increase the present electricity generation to 5000 MW by 2011 and 7000 MW by 2013. The arithmetic differences between the two are huge. In 2007 highest electricity generation was 4130 MW. Contracts for additional 1000 MW power projects have also been awarded. Thus, implementation of the projects in the pipeline alone would result in total generation of 5000 MW by 2009. Therefore, the promise is nothing significant. On the other hand if the target is to achieve additional generation of 5000 MW by 2013, the target is not only ambitious but also not achievable given the gas supply constraint.

Gas and Electricity Generation Arithmetic

The table 6 below shows the present electricity generation scenario based on gas supply on 12 March 2008.

Table 6: Maximum Possible Generation under Current Gas Availability Scenario

Gas	675 MMSCFDx4	2700 MW
Combined Cycle		415 MW
Non-gas		
Liquid Fuel		377 MW
Coal		220 MW
Hydro		87 MW
Total		3799 MW
Routine Repair and Maintenance		380 MW
Plants under rehabilitation		140MW
Net Generation		**3279 MW**

Note: The thumb rule is 1 MMSCFD of gas is used to generate 4MW of electricity.

The above table allows us to simulate power generation scenarios by applying simple Gas and Electricity Arithmetic. To generate additional 5000 MW of electricity, even under the most efficient combination of base and peak load plants and best non-gas electricity production scenario, will require 750 MMSCFD of additional gas, which is unlikely to be available even under the most optimistic gas supply scenario.

Even to raise total generation to 5000 MW under the current scenario will require 1000 MMSCFD of gas, more than 40 percent increase over the current supply of 675 MMSCFD.

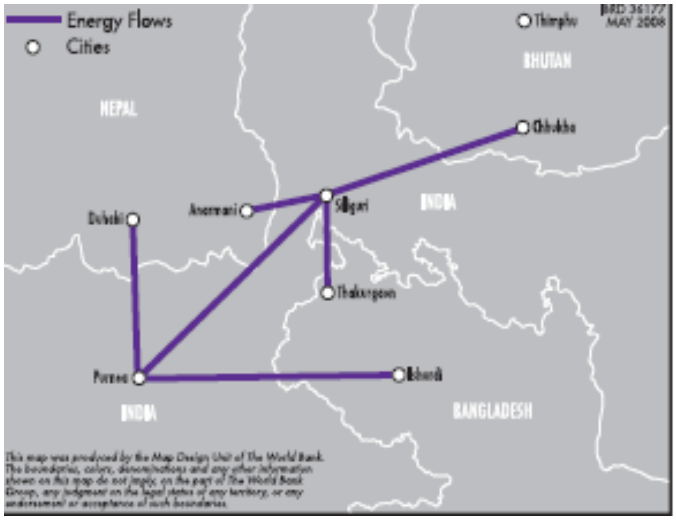
Gas Supply to New Power Projects

Table A10 shows the status of gas supply to power plants proposed by BPDB and REB. Out of the 16 projects in the list with proposed capacity of 3230MW, Petrobangla has confirmed gas supply for 3 base load plants with a total capacity 750MW and 2 peaking power plants of 240 MW capacity. It has indicated that, based on the proven gas reserve, gas supply will not be possible for 5 power plants with proposed capacity of 1480 MW, and that gas supply may be possible after the expected commissioning date proposed by BPDB for 6 power plants with proposed capacity of 1260 MW.

Energy Trade through Grid

The AL manifesto also talks about the prospect of importing electricity from neighboring countries. Technically this can be achieved by proposals as outlined in the SARI-E program of USAID that suggested connecting Siliguri (India) to Anarmmani (Nepal), and Thakurgaon (Bangladesh).Initially these would be132 kV lines and will be upgraded to 220kV as volume of interchange increases. It also suggested the alternative of connecting Purnea(India) to Duhabi(Nepal) and Ishurdi(Bangladesh. Notable the connections from Chhukha (Bhutan) to Siliguri and then to Purnea already exist (see figure 17).

Figure 17: Suggested Interconnections among India, Nepal, Bhutan and Bangladesh



Source: USAID SARI-E Program Study carried out by Nexant (February 2002).

However, the prime constraint for electricity trade is that in spite of tremendous potential, none of the countries in the region have surplus electricity to offer at this time. All the countries except Bhutan, are experiencing power shortage of magnitudes greater than Bangladesh. In addition, at the prevailing tariff, power utilities of Bangladesh may find it uneconomic to import electricity from neighboring countries without receiving subsidy from the government.

Possibility of importing hydropower from Myanmar was also considered. Unfortunately, potentially larger hydro-electricity production sites, such as the one in Lemro is situated at a few hundred kilometers of difficult terrain away from Bangladesh. Sites nearer to our borders, such as Sittwe, have very limited hydro-electricity generation potential.

A similar attempt to import gas from Myanmar was also unsuccessful. As Myanmar had already committed supply to China and India. Therefore, in spite of the noted complementarities in the energy sector among the countries of the region (Murshid and Willig, 2001) the immediate prospects for energy trade between Bangladesh and its neighbors do not appear to be bright.

Nuclear Power Plant

Bangladesh considered building a nuclear power plant for the first time in 1961. Since then, several feasibility studies have been carried out, affirming the feasibility of the project. In 1963 the Rooppur site was selected for setting up a 600MWe power plant. Successive governments have pledged that they would build a nuclear power plant to meet electricity shortages. With growth in demand and grid capacity since then, a much larger plant looked feasible, and the government in 1999 expressed its firm commitment to build this Rooppur plant. In 2001 it adopted a national Nuclear Power Action Plan and in 2005 it signed a nuclear cooperation agreement with China. Bangladesh Atomic Energy Commission estimates setting up nuclear reactors for Rooppur by 2015 would cost US$ 0.9-1.2 billion for a 600 MWe unit and US$ 1.5-2.0 billion for 1000 MWe. In April 2008 the caretaker government reiterated its intention to work with China in building the Rooppur plant and China reportedly offered funding for the project. Bangladesh's plan to install its first nuclear power plant by 2015 to meet the

country's increasing electricity demand has been received positively by the International Atomic Energy Agency (IAEA). The International Atomic Energy Agency (IAEA) has approved a Technical Assistance Project for Rooppur Nuclear Power Plant to be initiated between 2009 and 2011.

Russia and South Korea had earlier offered financial and technical help to establish nuclear power. Bangladesh has had a Triga 3 MW research reactor operational since 1986 and has necessary trained manpower for running a nuclear power plant.

Alongside setting up nuclear power plants, areas having prospects of uranium and thorium deposits need to be appraised and, studies may be conducted on the techno-economic viability of production at prospective sties.

Renewable Energy

The AL manifesto rightly emphasizes the development of renewable energy. The government's recent decision to exempt solar equipment from all duties and taxes is a bold one. An earlier attempt, under the caretaker government, to obtain such tax exemption was only partially successful. However, mere exemption for duties and taxes will not be enough to achieve renewable energy targets mentioned in the Renewable Energy Policy adopted under the caretaker government. Agriculture Minister Mrs. Matia Choudhury has hit the right button when she urged our scientists to develop solar powered irrigation pumps. Notably, the long-term average sunshine data indicates that the period of bright (i.e. more than 200watts/sq.m intensity) sunshine hours in the coastal region of Bangladesh vary from 3 to 11 hours daily. The global radiation varies from 3.8 kwh/sq.m/day to 6.4 kwh/sq.m/day. These data indicate that there are good prospects for solar thermal and photovoltaic application in Bangladesh. With good to excellent solar resource available in the country throughout the year, there is a good potential for furthering IDCOL's successful PV program in un-electrified villages. Already, nearly 300,000 solar home systems have been installed in remote rural areas under the program. The World Bank has offered to provide additional $100 million for the solar program. It is necessary that a part of the assistance be used for setting up of a solar panel manufacturing plant in the country to insulate the ongoing solar program from rising prices and uncertainties of supply of solar panels in the international market.

The long term wind flow of Bangladesh (specifically in the islands and the southern coastal belt of the country) indicate that the average wind speed remains between 3 to 4.5 m/s for the months of March to September and 1.7 to 2.3 m/s for the remaining period of the year. Given the danger from cyclones, it is important that the survivability of wind turbines be investigated. Therefore, further investigation of the potential wind power development is warranted.

For a long time, Dhaka City has been suffering from a tremendous environmental pollution caused by municipal solid waste, medical waste and various industrial wastes. Such wastes can be used for electricity generation. In addition to providing much needed electricity such a project will save the city from environmental pollution.

The Silver Linings

There are a few silver linings in this rather lackluster energy sector scenario. We will cite four examples here.

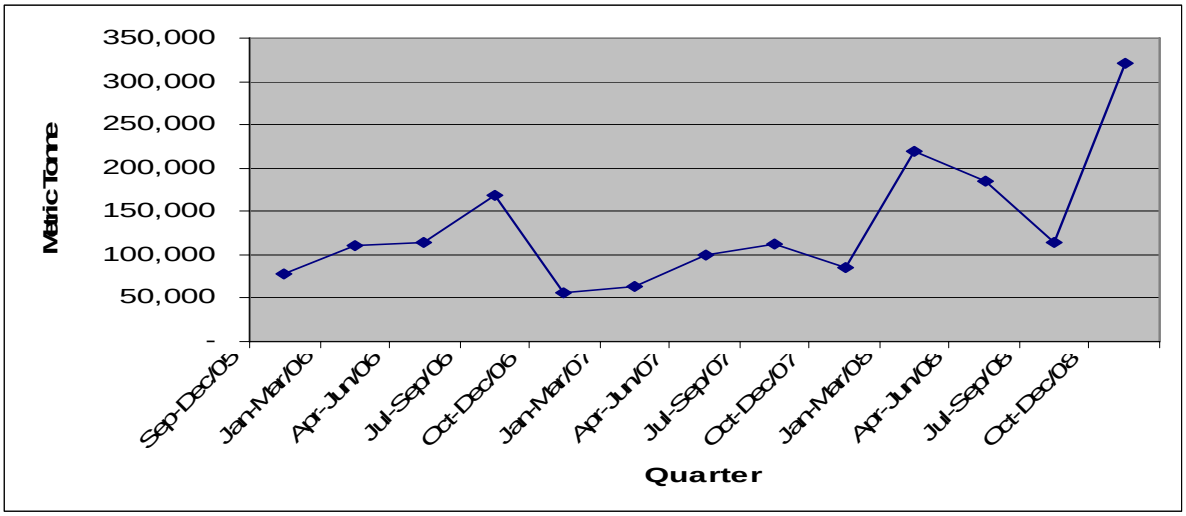
Restoration of Power after Cyclone Sidr

Cyclone Sidr wreaked havoc on the power system of the southern Bangladesh: the national grid failed and three major transmission lines were disrupted. 31 upazillas were disconnected and more than 50,000 poles were either broken or partially damaged. Several hundred towers including river crossing towers, substations were damaged and power supply to 2714 rice mills, 324 ice factories, and 1176 saw mills were interrupted. Nearly 3 million households and businesses were affected. Power connection with all the upazillas were restored within a month. The entire power system in the south-western zone was rehabilitated within three months. In fact, the USAID mission Director remarked that restoration of power in the US following hurricane Katrina took much longer time (more than six months) and that US could have learnt lessons from Bangladesh experience.

Turnaround of Boropukuria Coal Mine

In an aptly titled article "A wakeup call for politics: once graft-ridden Barapukuria coal mine expects record production, profit first time this fiscal year" the Daily Star wrote how a white elephant for the government revitalized from January 2007 and was poised to hit operational profit. This was possible because the mine was performing well as the government in the last two years paid serious attention to the mine, the company's management performed professionally, mine's environment was less hazardous, and necessary adjustment was made in the price of coal. As can be seen from the figure 18 below, the quarterly production of the mine shot up from an average of low 100,000 tons to about 300,000 tons in October –December 2008. The lessons from Boropukuria are rather simple. Without meddling, the government should support energy sector entities and let these be run by professional staff and hold the staff accountable for their performance.

Figure 18: Baropukuria Coal Production



Source: Petrobangla

Power Entrepreneurs

Earlier, the power sector in Bangladesh was dominated by foreign contractors and their local agents. Except for Summit Power Limited, there was hardly any Bangladeshi entrepreneur in power generation. Now a number of Bangladeshi entrepreneurs have gained experience in implementation of small IPPs, short and long-term rental power plants of more than 800MW. A list of Bangladeshi companies operating and implementing power plants is given in table 7 below. Hopefully, these entrepreneurs will learn from their experience and compete with foreign companies to end the latter's total domination in the power sector. Clearly, Bangladesh needs a few more entrepreneurs to implement energy generation, transmission and distribution projects.

Table 7: Small IPPs, Short and Long-term Rental Power Plants Implemented by angladeshi Companies

Power Company	Location and Capacity (MW) of Power Plant(s)	Total Capacity
Summit Power	Ashulia(44), Madhobdi(33), Chandina(25), Maona(33) , Ullarpara(11MW), Jangalia(33), Rupgonj(33), Mohipal(11)	223 MW

EnergyPrima	Kumargaon(50), Shajibazar(50),Fenchugonj(50), Bogra(20)	170 MW
Doreen Power	Tangail(22), Narshingdi(22), Feni(22), Shikolbaha(55), Mohipal(11)	127 MW
Shahjibazar Power	Shajibazar	86 MW
Venture/GBB Energy	Bogra(20), Bhola(34.5)	54.5 MW
Regent Power Limited	Barobkundu(22)	22 MW
Barkatullah Electrodynamics Limited	Fenchugonj (50)	50 MW
Desh Energy	Kumargaon(11)	11 MW
Precision Energy	Ashugonj (61)	61 MW
Energypac	Habigonj	11 MW
Total		**826.5 MW**

Source: Powercell

Note: Summit Group also owns 47 percent share of 100 MW Khulna Power Company Limited.

Water for Irrigation: Boro season 2008

Finally, we will cite an example of combined efficiency of Energy and Power Divisions. Following the loss of crop in cyclone Sidr and the skyrocketing price of food crops and their unavailability in the world market, a bumper Boro crop became imperative. This required uninterrupted supply of fuel and electricity for irrigation. In a situation of electricity shortage and sharp increase in price of petroleum products in the world market, it was a difficult task. Both energy and power sector officials faced the challenge remarkably and there was hardly any complaint from the farmers. This together with supply of agricultural inputs ensured the desired bumper Boro production during the season.

VII. Conclusions and Recommendations

We need a national catharsis to deal with major issues facing the nation, including energy sector development. We cannot afford to continue the blame game- each government blaming the previous government for problems of the sector. A recent statement by Mrs. Matia Chowdhury, Minister for Agriculture is a case in point. In a recent meeting organized by Bangladesh Unnayan Parishad, she said “It is easy to give advice; even caretaker government could not implement a single power plant.” Such fabrications by a senior Minister of the government are hardly consistent with AL’s manifesto “A charter for change.”

The other issues that we need to grapple with are issues of corruption and terrorism. The trial and conviction of corrupt individuals and terrorists improves image of the country and encourages investors. However, we should be careful not to hype up corruption and terrorism as political rhetoric too much as it might affect the overall image of the country and deter serious investors from considering Bangladesh as a good place for doing business and hurt our prospects of acquiring nuclear power generation technology. We should strengthen institutions dealing with corruption and terrorism and upgrade our judicial system. To paraphrase Israeli politician Shimon Peres we should economize on the politics of terrorism and corruption.

Bangladesh’s NEP, adopted in 1996, made a good beginning to address the issues that beset the energy sector. However, the document is old and the energy scenario in Bangladesh has undergone considerable changes. The policy, therefore, needs updating. A draft dated May 2004 is available at Petrobangla website.

Gas and Coal are the main energy resources of Bangladesh. The country has modest reserves of natural gas. Availability of natural gas, in addition to meeting bulk of the country's commercial energy needs, insulates the economy from volatility of energy prices. Based on the currently available evidence, by no means the country is "floating on gas." With currently known reserves shortfall would commence in 2011 against proved reserves. 2P reserves will meet demand until 2015 and 3P reserves will meet demand until 2019. Therefore, the country cannot conceivably encourage foreign investments that would utilize gas resources (e.g.Tata's proposal) or think of exporting gas.

However, there are opportunities for expanding available gas resources by converting some of the possible and probable reserves into proven reserves and further exploration. Petrobangla has short, medium, and long-term production augmentation activities planned to bring additional 100 MMSCFD, and 208 MMSCFD of gas in the system in FY 2008-2009 and FY 2009-2011 respectively. Long-term production augmentation activity, if successful, would bring an additional 1000 MMSCFD of gas.

Future gas exploration of gas is constrained by disputes on maritime boundary with India and Myanmar. Under the United Nations Convention on the Law of the Sea (UNCLOS) 1982, Bangladesh is entitled to claim 200nm of sea area as its Exclusive Economic Zones (EEZ) Out of this, the first 12 miles are called Territorial Sea (TS) and the next 188 miles are its EEZ. Bangladesh could also claim another 150-mile or more from the limit of the EEZ based on the geo-physical characteristics of the seabed as the extended Continental shelf (CS). However, to claim the CS, we have to complete various surveys as prescribed by the UN and submit our claim before 2011.

Limited gas reserves of the country calls for rational policies covering both inter- temporal choice of gas production and allocation among various uses. To meet the current gas shortage we should not resort to gas production at a rate faster than the optimal rate, as it might affect the reserve itself- to the peril of our future generation. We agree with the recommendations of several studies that the preferred method of recovering energy stored in gas is by converting it into electricity, which then opens a broad range of opportunities for improvements in home conditions and use of electric equipment in small manufacturing and the manifest relationship between GDP growth and electricity generation in Bangladesh. The prevailing asymmetric information between IOCs and Petrobangla may be narrowed down through training of Petrobangla, particularly BAPEX officials.

Allocation of limited gas would require up gradation of technical interface between gas and power infrastructure. This would require significant investments in gas and power infrastructure, such as compressors and automated generation control at power stations. Procurement and project implementation capacities in energy sector entities need to be improved. This will also require review of public procurement regulations. Power sector officials need to be trained in modern digital control system based newer power plants to be able to complete tasks left incomplete by delinquent contractors.

Bangladesh has significant coal reserves that remain to be exploited. The energy equivalent of these reserves is most likely to exceed the gas reserves of the country. The recovery rate of coal from these reserves will depend on choice of technology and method of mining- a contentious issue in Bangladesh. Open cast mining promises higher coal production and greater environmental impacts. Given the strong electoral mandate, the new government is in a better position to balance the concerns of various groups- affected persons, prospective investors, environmentalists etc. Coal policy needs to be finalized immediately so that the country may proceed with mining.

Currently at second place as source of commercial energy, petroleum products are mostly imported and have recently been subject of sharp increase in prices in recent years. Failure to align domestic prices with the international market price has led to huge liabilities on the shoulder of BPC and created severe liquidity crisis for the organization. The strategy to mitigate such crisis would include creation of strategic petroleum reserve, participation in commodities futures and option markets and most importantly gradual adjustment of domestic prices of petroleum products in line with international prices. Participation in commodities futures and options market will require changes in our public procurement regulation. Allowing participation in commodities futures and options market will also serve as a hedging tool in environments of rising prices of other products such as fertilizer and food grains.

Production of electricity, the most important energy commodity, has increased over the years but at a rate falling behind its growth in demand. Although both evening peak generation and average of daily

electricity generation have increased, a yawning gap is opening up between derated capacity and evening peak generation since FY 2005-2006. This is due to (a) gas shortage; (b) ageing of power plants, and most recently (c) due to lack of rainfall in Kaptai Lake.

There is a clear east-west divide in the country in respect of availability of electricity in two sides of the river Jamuna. The divide on the transmission side has recently been removed with the addition of second East-West interconnector of 1000MW capacity. Together with the old interconnector with a capacity of 400 MW, there is no transmission constraint in transferring surplus electricity from eastern region to the western region. The mitigation of this east-west divide in electricity generation is imperative not only to realize the growth potential of the western region but to achieve self-sufficiency in foodgrain production: since the granaries of the country are located in the western region. Given the increasing gas shortage in the eastern region, it is necessary that coal resources of the western region be developed urgently for use in electricity generation and meeting the shortfall in the region.

There exists significant rural-urban difference in energy use. For example, rural customers located mainly in REB and WZPDCL areas account for 75 percent of the consumers; but their share in energy consumption is limited to 46 percent. Predominantly urban consumers of DESCO and DPDC, 10 percent of the consumers, use 31 percent of electricity. This bias may be removed gradually by expanding electricity network in rural areas based on sound economic criteria.

Electricity generation in Bangladesh is overwhelmingly gas based. More than 85% of evening peak electricity is generated by using natural gas. Diversification of fuel-mix for power generation is a must and can be archived in the medium term through coal based generation and setting up of nuclear power plant. Given the long gestation period of these projects, the newly elected government must act without further delay.

A review of load curves indicate that bulk of our load is lighting and air conditioning and fan load. Our national trait of being frugal with resource use (through recycling) does not extend to the use of scarce energy resources. In the short run, to meet the shortage we must decelerate the growth of demand for both energy resources and commodities through gradual increase in gas and electricity prices. The government /and or BERC may require DESCO and other profitable urban utilities to contribute a percentage of their revenue to a common fund that would be dedicated for cross-subsidization of less well off consumers and productive industrial and agricultural activities in poor suburban and rural areas. We recognize that with the ripples of global recession reaching Bangladesh shores, it will be a difficult yet necessary decision for BERC to announce a phased increase in gas and electricity prices.

A more direct approach would be to promote energy conservation and energy efficiency taking the negawatt and fifth fuel approach. This should start with the enactment of the Energy Conservation Act., a draft of which has been finalized by the power division. To provide necessary impetus to energy conservation, energy audit may start from the office and official residences of the President, the Prime Minister, Speaker of the Parliament, Chief Justice, and high civil and military bureaucrats, FBCCI, MCCI, CPD and such similar offices. All available energy efficiency and conservation options need to be pursued vigorously

There are important lessons that may be drawn from the experience of energy sector under the caretaker government. Electricity generation capacity was enhanced by 500-600 MW by better maintenance and 24 contracts with total generation capacity of 1,125 MW was awarded. Out of which 11 power plants of 344 MW have already been added to the grid, and the remaining 14 power plants will be added by June this year. This was possible because there was no political interference in the process of awarding contract and professional conduct of the sector managers. Inability to restrain the politically inclined officials, employees, and the unions in the power sector could lower availability of power by 500-600 MW. Similarly, addition to new generation capacity hinges on setting up a transparent process and subjecting the politically inclined businessmen to play by the rules of the game. Energy sector should not be used for raising finances for political parties or building up private fortunes.

AL's manifesto covers a broad range of issues relating to the energy sector but is ambiguous in some places. The present gas-electricity arithmetic would suggest that to achieve the target of generation of 5000 MW electricity by 2011 would require 1000 MMSCFD gas, more than 40 percent increase over the current supply of 675 MMSCFD of gas. To generate additional 5000

MW of electricity even under the best non-gas electricity production scenario will require 750 MMSCFD of additional gas, unlikely to be available even under the most optimistic gas supply scenario.

Given the gas supply situation three projects for which Petrobangla has committed gas supply; Bibiyana 450 MW Combined Cycle IPP, Sylhet 150 MW Combined Cycle Power Plant, Bhola 150MW Combined Cycle Power Plant may be implemented on a fast track basis. The government may provide bridge financing for Bhola 150MW Combined Cycle Power Plant and negotiate with Islamic Development Bank for retroactive financing and proceed with tendering the project. This will require a waiver from present planning discipline. In addition, third unit of coal based power plant of 125MW capacity may be set up at Baropukuria. Completion of procurement of these 4 power plants with total capacity of 875 MW will constitute a significant achievement of the government.

Under the present gas supply situation, setting up of smaller gas based plants may not be feasible. Liquid fuel prices have come down in the international market. Therefore, the government may consider setting up a few liquid fuel based co-generation (e.g. HFO engine and steam turbine combined) power plants in the western region of about 200 MW that would be run only during peak hours and the irrigation season.

In the area of energy, we must keep all the options open. It is now globally recognized that diversity is the backbone of a robust, less vulnerable energy system, even if the optimum mix would vary according to the local conditions. It is now realized that an electric utility sells two classes of products: electricity delivery services (transmission and distribution) and electricity. Although these two classes of products traditionally are bundled together into price per kilowatt hour of electricity, in principle, these two classes could be unbundled and sold by separate companies. Electricity delivery services are characterized by increasing returns to scale, but electricity itself is not. Thus the possibility of competition in electricity generation has been recognized and the possibility is open for a competitive market structure to sell electricity to consumers, separately from electricity delivery services. With this principle in mind, “Policy Guidelines for Enhancement of Private Participation in the Power Sector” was issued in 2008. This will enable the private sector to set up commercial power plants, sell electricity to bulk consumers at mutually agreed price and rehabilitate and setup power plants along with power sector utilities on joint venture basis. Due to this policy, private generators will have open access to transmission and distribution lines for wheeling power. With the necessary government support, commercial power plants would be able to add about a 500 MW of electricity within a very short period.

Given the limited prospects for energy trade between Bangladesh and its neighbors, we should be open to import of energy resources. Parallel to the development of local coal, we should also be open to importation of coal. In order to do this the draft of channels at Chittagong and Mongla ports needs to be improved so that high tonnage vessel could berth in these ports. To facilitate setting up of port-mouth plants, land needs to be identified, coal unloading facilities such as conveyer belts, development of rail-tracks for internal movement and other arrangements needs to be made. Development of such infrastructure will also facilitate export of energy from Bangladesh, should situations permit.

Given the integrated nature of power sector operation, requiring seamless functioning of generation, transmission and distribution entities, it has become imperative to assign this critical coordination function to one of the power sector entities. In a fully automated system, such function is carried out by the transmission company. However, until the system is fully automated, BPDB, the parent organization of all power sector entities and companies, may be assigned with the responsibility of technical coordination. Gradually, with full automation national load dispatch center and introduction of automated generation controllers at power generating units, the responsibility may be transferred to PGCB.

To ensure smooth functioning of the energy sector companies, the Companies Act 1994 needs to be suitably amended to recognize the special nature of the government owned companies, specifying composition, qualification criteria, and tenure of the Board of Directors, appointment of chief executive and other key officials, remuneration of employees, and supervisory role of the ministries. This is necessary to insulate the companies from vagaries of the change in government, top officials in the ministry, and to bring some uniformity among energy sector companies.

To promote renewable energy and to provide momentum to the renewable energy program in Bangladesh, Sustainable Energy Development Authority under the Renewable Energy Policy may be activated. In addition, use of solar energy may be made mandatory in large apartment buildings for lighting of common areas and water heating. As proposed by the Agriculture Minister, research grants may be given to universities and research institutions for coming up with a solar based low lift pump for irrigation purpose.

Table A1: Taxonomy of Energy Resources and Commodities

	Depletable		**Renewable**	
Energy Resources				
Crude Oil		Non-storable		
Natural Gas		Non-storable		
Coal		Non-storable		
Trees/Biomass			Storable	
Wind				Non-storable
Hydro			Storable	
Geo-thermal		Non-storable		Non-storable
Uranium	Storable			
Solar Radiation				Non-storable
Energy Commodities				
Refined Petroleum Products	Storable			
Processed Natural Gas	Storable			
Coal	Storable			
Battery	Storable			
Electricity		Non-storable		

Table A2: Quantity and Value of Imported Petroleum Products from 2003-04 to 2008- 09

FY	Crude		Refined		Lube Oil		Total	
	Quantity ('000 MT)	Value (Cr. Tk.)	Quantity ('000 MT)	Value (Cr. Tk.)	Quantity ('000 MT)	Value (Cr. Tk.)	Quantity ('000 MT)	Value (Cr. Tk.)
2003-04	1,252	1,848	2,262	4,016	7	18	3521	5,882
2004-05	1,063	2,262	2,692	7,214	10	38	3765	9,514
2005-06	1,253	3,751	2,381	9,383	5	36	3639	13,170
2006-07	1,211	3,985	2,537	10,446	4	25	3752	14,456
2007-08	1,140	5,660	2,136	16,821	9	51	3285	22,532
2008-09 (Up to Feb'09)	386	2,172	1,427	7,467	0	0	1813	9,639

Source: Bangladesh Petroleum Corporation

Table A3: Age of Power Plants

Age Group (Year)	Number of Units	Capacity in MW
40+	5	84
31 – 40	11	395
21 – 30	23	1,129
11 – 20	19	1,563
1 – 10	69	2,098
Total	**127**	**5,269**

Source: Powercell

Table A4: Consumer Percentage and Percentage of electricity sales by Utilities (FY 2006-2008)

Year	2006		2007		2008	
Utility	Consumer Percentage	Percentage of electricity sales	Consumer Percentage	Percentage of electricity sales	Consumer Percentage	Percentage of electricity sales
BPDB	15.60	22.41	15.81	23.57	15.87	23.47
DPDC	6.18	21.15	5.86	20.85	6.08	20.32
DESCO	2.86	9.28	3.33	10.11	3.57	11.23
REB	70.57	40.84	70.27	39.64	69.65	39.11
WZPDCL	4.79	6.33	4.73	5.83	4.83	5.87

Source: Power Cell

Table A5: Consumer Percentage and Percentage of electricity sales by Consumer Categories (FY 2006-2008)

Year	2006		2007		2008	
Consumer Category	Consumer Percentage	Percentage of electricity sales	Consumer Percentage	Percentage of electricity sales	Consumer Percentage	Percentage of electricity sales
Domestic	83.12	42.73	83.46	43.50	83.76	45.43
Agricultural	2.22	4.40	2.17	4.63	2.17	4.48
Industrial	1.90	43.33	1.83	33.98	1.82	38.90
Commercial	12.27	7.75	12.00	8.10	11.72	8.88
Others	0.48	1.78	0.54	9.79	0.53	2.32

Source: Power Cell

Table A6: Time-line of Installation of Compressor Stations at Muchai, Ashugonj, and Elenga.

FIRST-BIDDING

- July to Aug 2005 : Data collection by the ADB's individual Consultant to draw technical specifications for Compressor Stations.
- Sept 2005 : Draft Bidding Document (without technical specifications) examined by ADB and was advised to follow two stage bidding procedure.
- Feb 2006 : (i) Final Technical Specifications submitted by the ADB Consultant to GTCL.
  Draft Bidding Document for Muchai and Ashuganj (South & West) sent to ADB for no-objection.
  ADB's Estimated Cost was US$ 41.00 million
- March 2006 : ADB approved Draft Bidding Document.

- April 2006 : Invitation for Bids issued.
- Sept 2006 : First Stage Bids opened. 3 (three) bids were received (Time extension upto 3-9-2006 given upon bidder's request).
- Dec 2006 : Project Consultant firm engaged (after loan became effective).
- June to July 2007 : First Stage Bid Evaluation completed, approved by GTCL Board, forwarded to ADB with Modified Bid Document.
- Sept 2007 : IOC (Integrity Over-sight Committee) of ADB raised complaint against Bidding Documents complaining manipulation of technical specifications in favor of a particular manufacturer.
- Oct 2007 : ADB advised for Re-Bidding.

RE-BIDDING

- Nov 2007 : ADB provided no objection against incorporation of Elenga Compressor Station with Ashuganj and Muchai Compressor Station in a single package.
- Dec 2007 : Final Re-bidding Documents sent to ADB for approval.
  ADB's Estimated Cost was US$ 55.00 million for all three Compressor Station locations.
- Jan 2008 : (i) ADB approved Re-bidding Documents and advised to follow Two-Stage, Two- Envelop bidding procedure
  (ii) Invitation for bids (IFB) was issued accordingly.
- June 2008 (4-6-2008) : First Stage Technical & Price proposals were opened.
  04 (Four) Bids were received.
- July to Sept 2008 : Clarification Meeting was held with the two responsive bidders (ABB SpA, Italy and Hyundai Engineering Co. Ltd, Korea).
- Oct 2008 : First Stage Technical Bid Evaluation Report completed and sent to ADB for approval along with Modified Bids.
- Jan 2009 : Second Stage Bidding invited from the 2 (two) Responsive Bidders upon ADB's clearance.

Feb 2009

- 9-2-2009 : (i) Second Stage Bid with Price Proposals opened (9-2-2009).
- 18-2-2009 : (ii) Board was informed about estimated vs. quoted prices in the 243rd Meeting (18-2- 2009).

March 2009

- 4-3-2009 : Status Report was placed in the 244th Meeting for decision on additional fund requirement
- 5-3-2009 : Project Consultant Submitted a Revised Clarification List recommending to obtain clarification from both the bidders.
- 9-3-2009 : Status Report was sent to Energy and Mineral Resources Division through Petrobangla for allocation of additional fund.
- 16-3-2009 : Project Consultant submitted Final Technical Evaluation Report of the Second Stage Bid.
- 17-3-2009 : TEC reviewed the Consultant's Report and prepared a Preliminary Evaluation Report recommending to seek clarifications from both bidders subject to approval of GTCL Board.

Source: Petrobangla

Table A7: Delay in Commissioning of Power Plants

Sl. No.	Name of Power Station	Date of signing of Contract	Commissioning date as per Contract	Actual date of Commissioning	Delay in Commissioning
1.	Siddhirganj 210MW Thermal Power Station	(a) Supply of design & equipment/ materials Contract signed on: **26.06.1995**	31.08.1998	30.06.2003	4 years 10 months
		(b) Technological Erection, Testing & Commissioning Contract signed on: 31.5.2000	28.09.2002	03.09.2004	1 year 11 months
2.	Ghorasal 210MW Power Station (6th Unit)	15.01.1992	Original: Sept,1996 Revised: 1998-99	30.01.1999	2 years 3 months
3.	Fenchuganj 90MW Combined Cycle Power Plant (Unit-2)	12.09.2005	Gas Turbine 1&2, 03.05.2007 Steam Turbine 03.01.2008	Not yet commissioned	Not applicable
4.	Siddhirganj 2x120MW Peaking Power Plant	31.01.2007	1st Unit October/2008 2nd Unit November/2008	Not yet commission-ed. It is expected that 1st Unit will be comm-issioned in June'09 & 2nd Unit in Sept'09	1st Unit-8 months 2nd Unit-10 months
5.	Tongi 80MW Power Plant	08.06.2003	15.10.2004 (450 days)	28.03.2005 (622 days)	172 days
6.	Baropukuria 2x125 MW Power Plant	12.07.2001	21.01.2006 (38 months)	22.03.2006 (1st Unit) 10.06.2006 (2nd Unit)	1st Unit-60 days 2nd Unit-140 days

Source: Bangladesh Power Development Board

Table A8 : National Electricity Savings by Demand Side Management (DSM)

Year	Total Electricity Generation			Technical System Loss	Net Total Sales	National Annual Savings (5% of total sales) by DSM	
	By BPDB	By IPP	Total (BPDB+IPP)			Electricity Savings	Financial Savings*
	GWh	GWh	GWh	GWh	GWh	GWh	Crore Tk.
1	2	3	4 = 2+3	5	6 = 4-5	7 = 6 x 0.05	8 = 7x0.4
2006-07	14,539.00	8244.54	22,783.54	1,601.95	21,181.59	1,059.08	423.63

* Considering, average electricity price = Tk. 4.00/kWh = Tk. 0.4 crore/GWh

Some options for demand side management:

1. Proper load management
2. Installation of intelligent motor controller
3. Use of CFL
4. Use of electronic ballast
5. Day light savings
6. Reducing use of electricity in peak hour
7. Closing all shopping malls by 7.00 PM
8. Separate billing system for air-conditioners
9. .Standardization of local & imported domestic & commercial electrical devices & equipment
10. Restriction for single cycle future power plants should be enacted

Source: Energy Audit Cell, Power Division

Table A9: National Natural Gas Savings through Improvement of Boiler Efficiency Only

Year	Total Gas Production in the Country	Total Gas Used in Power Plant, Fertilizer Sector & Other Industries	Total Gas Used in Boilers of Power Plants & All Industries	National Annual Savings by 5% Improvement of Efficiency in Boilers of the Country	
				Gas Savings	Financial Savings*
	BCF	BCF	BCF	BCF	Crore Tk.
1	2	3 = 2 x 0.80	4 = 3 x 0.70	5	6 = 5 x 9.5
2006-07	552.80	442.24	309.57	18.21	172.99

*Considering natural gas price = Tk. 9.50 crore/BCF

Some options of natural gas savings:

1. Improvement of boiler efficiency
2. Insulate bare steam lines
3. Repair steam leaks
4. Improvement of condensate recovery
5. Improvement of gas generator operating efficiency

6. Improvement of power factor
7. Replacement of inefficient motors by intelligent motor controller
8. Proper load management
9. Installation of co-generation plant

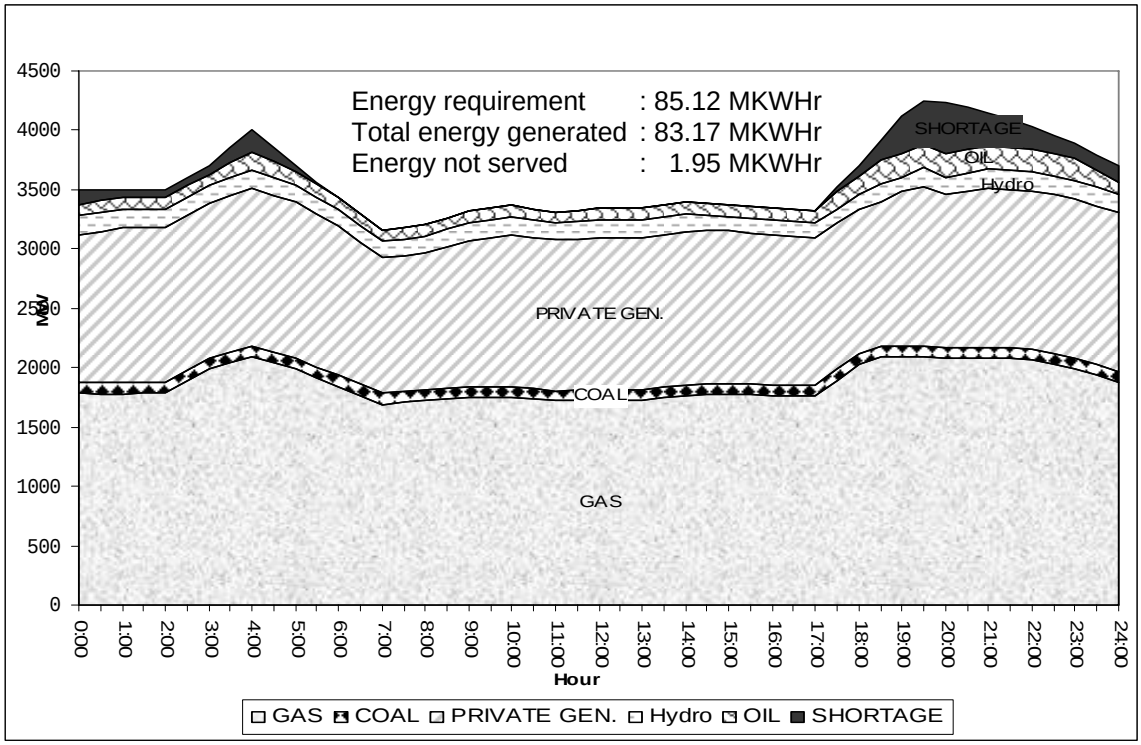
Source: Energy Audit Cell, Power Division

Table A10: Gas Supply to New Power Plants

Sl No	Name of the Project	Gas Demand (mmcfd)	Expected date of Commissioning as per BPDB	Petrobangla's Position on Supply of Gas
1.	Siddhirganj 2x120 MW GT	20	December 2008	Gas Supply will be made on adjustment against existing power plants.
2.	Sylhet (Kumargaon) 150 MW CCPP	25	June 2010	Gas supply will be made.
3.	Chandpur 150 MW CCPP	25	January 2011	Gas supply may be possible after June 2012
4.	Bhola 150 MW GT	30	June 2012	Gas supply possible.
5.	Shikalbaha 150MW GT	15	September 2009	Gas supply may be possible after June 2012
6.	Sirajganj 150 MW GT	15	December 2010	Gas supply may be possible by June 2013.
7.	Khulna 150 MW GT	15	December 2010	Gas supply may be possible by June 2013.
8.	Siddhirganj 2x150 MW GT	30	December 2010	Gas supply will be made available in June 2011.
9.	Haripur 360 MW CCPP	50	October 2011	Gas supply may be possible by June 2014.
10.	Khulna 210 MW TPS	48	December 2011	Gas supply not possible based on proven gas reserve.
11.	Bheramara 450 MW CCPP	75	December 2012	Gas supply not possible based on proven gas reserve.
12.	Sirajganj 450 MW CCPP	75	December 2011	Supply of gas may be possible by June 2013.
13.	Bibiyana 450 MW CCPP	75	December 2011	Gas supply possible.
14.	Meghnaghat 450 MW CCPP (2^{nd} unit)	75	December 2011	Gas supply not possible based on proven gas reserve.
15.	Konabari 350 MW (REB)	-	-	
16.	Chandpur 20 MW (REB)	-	-	

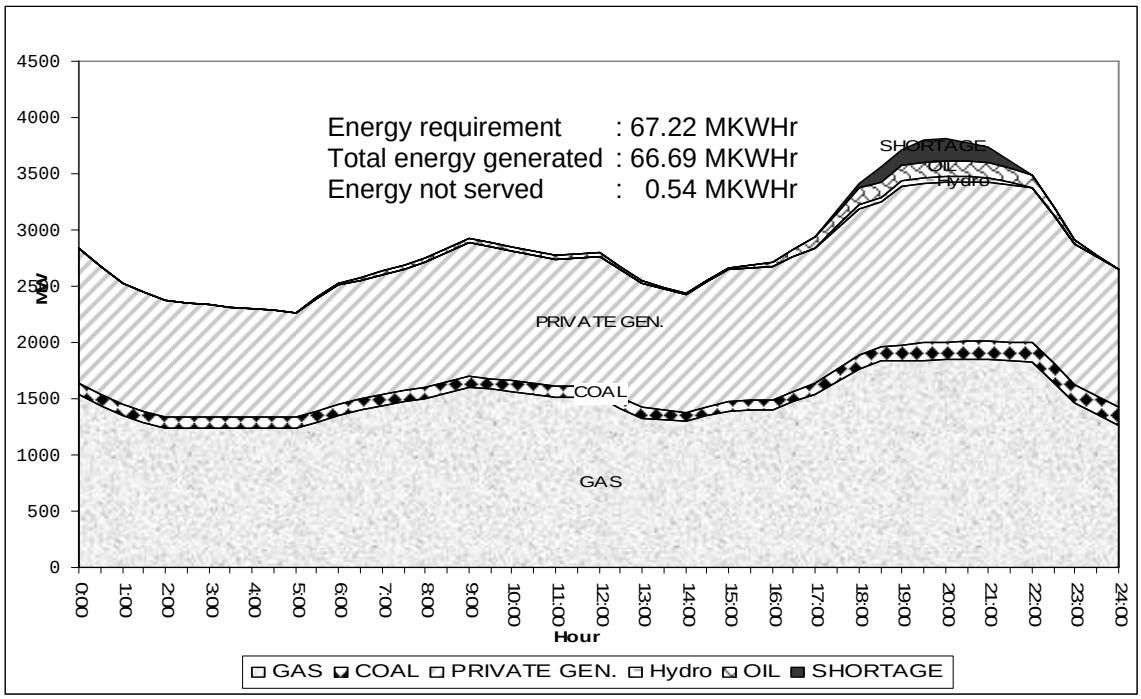
Source: Petrobangla

Figure A1: Daily Energy Curve, 12 September 2008



Source: Load Dispatch Center, PGCB

Figure A2: Daily Energy Curve, 16 January 2009



Source: Load Dispatch Center, PGCB

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