Study on the Present Power Supply Situation

and

its Impacts on the Readymade Garment Sector in Bangladesh

Table of Contents

Tables:

Figures:

Annexure:

ABBREVIATIONS

AC	:	Alternating Current
ADB	:	Asian Development Bank
AMP	:	Ampere
APPAREL	:	Designed Dresses Like Coats etc.
BGMEA	:	Bangladesh Garment Manufacturers and Exporters Association
BKNEA	:	Bangladesh Knitwear Manufacturers and Exporters Association
BBS	:	Bangladesh Bureau of Statistics
BAPEX	:	Bangladesh Petroleum Exploration and Production Company Limited
BDT	:	Bangladeshi Taka
BOGMC	:	Bangladesh Oil, Gas, and Mineral Corporation (Petrobangla)
BPDB	:	Bangladesh Power Development Board
CFL	:	Compact Fluorescent Lamp
CC	:	Combined Cycle
DESA	:	Dhaka Electric Supply Authority
DESCO	:	Dhaka Electric Supply Company Limited
FY	:	Financial Year
FGD	:	Focus Group Discussion
FTL	:	Fluorescent Tube Lamp
KII	:	Key Information
GDP	:	Gross Domestic Product
GJ	:	Gigajoule
GOB	:	Government of Bangladesh
GTCL	:	Gas Transmission Company Limited
GWH	:	Gigawatt Hour
IOC	:	International Oil Company
IPP	:	Independent Power Producer
kA	:	Kiloampere
KCAL	:	Kilocalorie
kJ	:	Kilojoule
km	:	Kilometer
KNITWEAR	:	Knitted Fabrics
kV	:	Kilovolt
kVA	:	Kilovolt Ampere
kVAR	:	Kilovolt Ampere Reactive
kW	:	Kilowatt
kWH	:	Kilowatt Hour
MJ	:	Megajoule
MMSCFD	:	Million Standard Cubic Feet per Day
MVA	:	Megavolt Ampere

MVAR	:	Megavolt Ampere Reactive
MW	:	Megawatt
MWH	:	Megawatt Hour
NPV	:	Net Present Value
OPEC	:	Organization of Petroleum Export Countries
O&M	:	Operation and Maintenance
PBS	:	Palli Biddut Samity (a form of rural electrification cooperative)
PCB	:	Project Concept Paper
PGCB	:	Power Grid Company of Bangladesh Limited
PP	:	Project Pro-forma
REB	:	Rural Electrification Board
SCF	:	Standard Cubic Foot
SCGT	:	Simple Cycle Gas Turbine
TSCF	:	Trillion Standard Cubic Feet
TOR	:	Terms of Reference
UK	:	United Kingdom
US	:	United States
WOVEN	:	Fabric Clothes
EU	:	European Union
USA	:	United State of America
RMW	:	Ready Mode Warmth
PSMP	:	Power Sector Master Plan
ENS	:	Energy Not Served
USAID	:	
BPDB	:	
SPP	:	Small Power Plant
CCPP	:	Combined Cycle Power Plant
MMCFD	:	
RPCL	:	
NEPC	:	

Chapter-1

The Study

1.1 Background

Ready-made Garments (RMG) sector is grappling with looming power crisis. The impact of frequent outage of electricity has been detrimental to growth of this sector as well as national economy. Bracing all odds, the sector made significant strides despite serious power interruptions.

Bangladesh suffers from a chronic shortage of electric power, caused by a large gap in demand and supply. The situation is deteriorating progressively with time, being caused by the natural growth of the demand for power at one hand and retiring of depreciating power generation plants on the other.

Presently, the power situation has further deteriorated, due to a shortfall in supply of natural gas which is reportedly depleting fast. The country is reeling under a daily 'load-shedding' that ranges between 600-1,200 MW, the average being of the order of about 1000 MW.

Energy and power, on the other hand, are very basic inputs to industrial production in general and to the Readymade Garment (RMG) industries in particular, in which over 20% of the production costs are on account of the costs for energy. The power consumption in a typical RMG industry is predominantly divided into lighting and sewing operations, both of which are critical to productivity.

The cost of power failures/load-shedding are very high and its impacts are reflected through loss of production, machinery depreciation, cost of alternative (emergency generator) fuels, like diesel, impact on the continuity of production lines and a series of high cost consequential damages, including delays in shipment schedules, loss of commitment and business goodwill, which can often be irreversible. The cost of not supplying power to the production units is as high as Tk.15-30 per kWh. However, surveys/studies need to be conducted with reference to specific and nationally important production sectors as the RMG, to quantify such economic/ financial impacts, which are necessary as valuable feedback for a 'course-correction' for nationally initiating appropriate strategies and action plans to improve such unacceptable power/energy situations.

With this end in view, Bangladesh Garments Manufacturers Association (BGMEA) decided to take up a study in order to measure and gauge the impacts of power situation on the readymade garment sector in Bangladesh. The study has been administered in 650 garment factories in Dhaka and Chittagong. However, 319 responded and analysis was carried out based on the data collected from responsive factories. This also indicates to limitation of the study with regard to elicitation of information from the samples and alludes to complexity of such a study.

650 factories were selected at random during this study for sample survey. From the survey data, database was prepared and on the basis of this data were generated for 2509.

For the study, BETS Consulting Services Ltd. was engaged by BGMEA as a consultant under the following terms of reference (TOR):

(1) **To identify and quantity the National Demand-Supply for Power** vis-à-vis the same specific to the 'micro' sector under question i.e. the **RMG Industries.**

(2) Estimate the power consumption of RMG Industries, based on **representative sampling of 25% of the operating RMG Industries** (taking the total updated number of operating RMG industries in the country). Also, work out the specific power consumption.

(3) **Typical 24-hour load-profile** (Sub-station support in a sampling area of populated RMG Industries may be geared up for this).

(4) **Typical Electrical load and consumption** (with approximate average hours of operation of the following in RMG factories:

- Lighting (Type of lights, their numbers, type of ballasts used, i.e. whether magnetic electronic etc.)
- Electric Motors (with production/sewing machines)

- Fans/Blowers (e.g. Exhausts, Boiler forced draft fans)
- Air-conditioners
- Other Electrical loads (to be specified)

(5) **Capacity & Consumption profiles** of other Primary and Secondary Energy (Natural Gas, Petroleum Fuels, Steam, Hot Water etc.)

- Natural gas for Captive Power Generation (e.g. Gas Engines); kW and kWh
- Diesel (Standby or Emergency) generators-Capacity (kW) and Consumption kW including the volume of diesel and costs (average litres/costs).
- Steam requirements/consumption, including natural gas use/cost for same
- Hot water requirements, if any (e.g. for Washing Plants).

(6) **'Load-shedding' – its frequency and profile** (over typical production routine of RMG industries), vis-à-vis national 'load-shedding' and also seasonal profile of load-shedding (e.g. summer/winter, irrigation seasons etc.), based on last 2-3 years operational experience.

(7) **Collect information/data from the sampled RMG operators and analyze/evaluate and study the Impacts of the present Power & Energy supply situation,** including, but not limited to the following aspects, both in physical/technical and/or financial terms:

- Loss of production caused by power interruption
- Interruption due to holiday staggering policy in different areas
- Production & financial losses and machinery depreciation due to use of standby generators.
- Damages of equipment
- Other consequential losses, such as:
  - Labor and line managers' motivation and productivity
  - Loss of goodwill due to commitment failure
  - Impact and lead time

(8) **Potential Threats** to sustainable growth of RMG sector due to lack of power

(9) **Relevant Policy Analysis in the light of interest of the RMG sector**

(10) **Recommended Strategies & Action Plans for improving the Power & Energy supply situation (energy security) in the RMG sector:**

- 'Fast-track' (short term) solutions (example: Energy Efficiency)
- Medium Term measures (example; Cogeneration-captive power & steam/hot water from waste heat of captive power plants
- Long term solutions/best practices (Industrial Parks/Mono-economic Zones).

1.2 The Study

The basis of the report is the survey and study that was taken up by the consultants during the period, August through October 2008. The study was supported by BGMEA and Gtz, German Technical Assistance Programme. However, this does not include the factories under BKMEA.

This report is an account of looming power crisis and its consequential effect on the ready made garment sector of Bangladesh. The report presents the effect on Bangladesh Readymade Garments/ Apparel industry in the wake of power interruptions and frequent outage. This report also establishes relationship between power outage and growth of the industry. Further, it presents the outcome of the study assessing the economic impact of power interruptions on garments industry. The survey was conducted among 650 factories - large, medium and small. The report presents the correlative factors affecting the RMG sector and describes the scenario in the light of power demands and fallouts of frequent power interruption the sector is experiencing. It also evaluates the cost to the country's economy in terms of the loss due to power interruptions and cost of energy not served (ENS).

1.3 Methodology

Methodology is the most important component in any study since it explains the procedure and methods through which a particular study was carried out. The chapter includes a discussion on study population, sampling frame, sample size, stages of sample selection, methods of data collection, data compilation, data analysis and data quality etc.

1.3.1 Data / Information Collection

Data are the raw materials for any study. Relevant data for the study were collected from both secondary and primary sources. Secondary data were collected from BGMEA, BBS, PDB, DESA etc. The collected secondary data were reviewed and analyzed in the office by the consultants. The consultants also reviewed all sorts of RMG/Industrial operation, impacts due to power interruption, scope for improvement and measures to be undertaken for it.

Two types of primary data were collected in the study-quantitative and qualitative. Quantitative data were gathered from survey of active RMG factories using random sampling procedures. Qualitative data were collected from Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs).

1.3.2 Study Population

As of June 2008, there are about 4075 members of BGMEA. Out of them, about 60% are woven manufacturers, 22% knitwear manufacturers and the remaining 18% sweater producers. But all these members are not active, 64% of them are active. The active BGMEA members constitute the main study population of our study.

1.3.3 Study Area

The RMG factories constituting study population are mostly located in and around Dhaka and Chittagong. In Dhaka Region, the districts of Dhaka, Narayanganj and Gazipur are the concentration of RMG firms. The following table prepared according to the address provided in the Directory of BGMEA Members shows the concentration of RMG industries.

Table 1.1- Concentration of RMG Industries

	Woven	**Knitwear**	**Sweater**	**Total**
Dhaka	1769	657	535	2961 (72.7 %)
Narayanganj	34	70	11	115 (2.8 %)
Gazipur	73	48	67	188 (4.6 %)
Subtotal: Dhaka	1876	775	613	3264 (80.1 %)
Chittagong	521	86	73	680 (16.7 %)
Others	67	19	45	131 (3.2 %)

Total	2464 (60.5 %)	880 (21.6 %)	731 (17.9 %)	4075 (100 %)

Source: *BGMEA Member List, Supplied by BGMEA*

1.3.4 Sample Size

According to the Terms of Reference (TOR), the survey should cover at least 25% of the active RMG manufacturing factories at Dhaka and Chittagong. There are 2,600 factories in operation (BGMEA Members). Hence the sample size is 2600 * 0.25 = 650. Hence 650 BGMEA members were selected for the study purpose.

1.3.5 Allocation of Samples and Calculations

The samples for the survey were selected using three stage stratified sampling scheme (proportional allocation). In the first stage, the samples were selected proportionately according to the region- that is the stratums are Dhaka and Chittagong. In the 2nd stage, the RMG were selected proportionately according to their sizes considering number of machines that is small, medium and large. In the third stage, the RMG were selected proportionately according to their type that is woven, knit, sweater and woven-knit mixed.

Survey was conducted over 319 RMG factories and average load was calculated over 319 factories. The total population size was 2509 active factories. However, the area wise list of RMG factories was available and all calculations were done in accordance with area.

Loads for lighting, machines, fans and blowers, air-conditioners and other electrical loads were also calculated. Load of different items as above, were calculated from field survey data, averaged over 319 surveyed factories, and applied to 2509 active factories

Factories were classified as K1-knitting small, K2-Knitting medium, and K3-knitting large S1-sweater small, S2-sweater medium, and S3-sweter large and W1-Woven small, W2-woven medium, and W3-woven large, WK1-woven-knitting mixed small, WK2-woven-knitting/mixed medium, and WK3-woven-knitting mixed large. City wise factory list was available and so calculations were done area wise.

Number of Machine wise distribution of Knitting, Sweater, Woven and mixed (Woven-Knitting) are represented graphically in **Annexsure-6**.

Group samples are defined as follows:

Knitting small	(K1) - Small knitting factories having up to 150 machines,
Knitting medium	(K2) - Medium knitting factories having 150 to 400 machines,
Knitting large	(K3) - Large knitting factories having 400 machines and above,
Sweater small	(S1) - Small sweater factories having up to 150 machines,
Sweater medium	(S2) - Medium sweater factories having 150 to 400 machines,
Sweater large	(S3) - Large sweater factories having 400 machines and above,
Woven small	(W1) - Small woven factories having up to 150 machines,
Woven medium	(W2) - Medium woven factories having 150 to 400 machines,
Woven large	(W3) - Large woven factories having 400 machines and above,
Woven-knitting mixed small	(WK1) - Small woven-knitting mixed factories having Up to 150 machines,
Woven-knitting mixed Medium.	(WK2) - Medium woven-knitting mixed factories having 150 to 400 machines,
Woven-knitting mixed large	(WK3) - Large woven-knitting mixed factories having 400 machines and above,

1.3.6 Instruments Used

Checklist was used which provided pointers to the type of information being sought. Also it was used to check compliance with certain procedures, where 'yes' or 'no' answers can be given.

Focus Group Discussion (FGD) was organized with owners and workers of RMG manufacturers. A total of 5 Focus Group Discussions were organized with workers in Dhaka and Chittagong.

Key Informants' Interviews (KII) was also conducted and information was collected by interviewing knowledgeable persons in various fields associated with RMG export. Apart from informal consultations with a number of stakeholders, three main interviews were carried out.

1.4 Implementation

For implementation the study consists of 4 broad activities: planning, field work, data management and report writing. Planning stage includes recruitment and training of field staff; design, pretest and finalization of instruments, and determination of study samples. Field work includes data collection and quality control. Data management includes registration of filled in instruments in the office, editing of filled in instruments, preparation of data entry format, data entry and its verification, and data analysis.

1.4.1 Planning

1.4.1.1 Design, Pre-test and Finalization of Survey Instruments

Study instruments (survey questionnaire, FGD guidelines and KII checklist) were designed after giving due attention to the objectives and scope of the study. Before design the consultants reviewed the similar studies and also arranged some brain-storming session. After design the instruments were sent to BGMEA for comments. Meetings were arranged between consultant team and BGMEA to discuss about the instruments. The instruments were pre-tested with some of RMG factories near Dhaka. After incorporation of feedbacks from pre-test and comments from BGMEA, the instruments were finalized and printed in required number.

1.4.1.2 Recruitment and Training of Field Staff

In order to undertake field work, a total of 20 enumerators were recruited for a period of 5 weeks including training period. 10 teams were formed, each consisting one engineer and one statistician. For conducting FGDs, two teams consisting of two FGD facilitators and two note-takers were formed. Note takers were recruited from among the graduates with some experience, while FGD facilitators were recruited from semi-professionals working in survey research. Key Informants' Interviews were conducted by the consultants.

The consulting firm organized an orientation and training course for the field staff describing the objectives, importance and methodology of the study. The training also conducted on collection, identification, verification and recording of data on questionnaire/instruments prior to sending the field staff to the project areas. The trainees were guided to arrive at solution of filling up questionnaire, compilation and to fetch real information from the survey population using personal skills and expertise. After completion of the training the field enumerators were led to the project areas.

1.4.2 Field Work

The field staff collected data according to the set program by personally visiting, observing, interviewing and recording data from relevant respondents. They did not deviate from set program. The collected data were sent to the office every week, where in turn each filled in instrument were checked for consistency. Errors, if detected were rectified. Besides, the consultant team members also undertook some field visit for quality checks.

1.4.3 Data Management

Data management consists of 4 activities, which were performed under the leadership of Data Management Specialist. Team Leader provided some guidance. Data management activities were as follows:

- recording of filled in instruments in the office
- editing of filled in instruments
- preparation of data entry format
- data entry
- data analysis

1.4.3.1 Recording of Filled Instruments

Each filled in instruments were duly recorded in the office of BETS Consulting Services Ltd. In Dhaka in a record book according to enumerator, date of interviews, status of interviews etc.

1.4.3.2 Editing of Filled-in Questionnaire

Field edit was done by the enumerator administering the questionnaire; verification of information is also conducted by survey coordinator. Each and every filled in questionnaire were checked for error and consistency in the office. For serious error if detected, the questionnaire were re-administered.

1.4.3.3 Preparation of Data Entry Format

The data entry formats were prepared with the help of MS ACCESS, versatile data entry software. The format ensured correct entry of the data. For open-ended responses the editors assigned code numbers.

1.4.3.4 Data Entry

Data from the filled in questionnaires were entered by the trained entry operators according to data entry plan. At the end of the day operators handed over the data to the Data Management Specialist, who prepared up to date situation for information. Using some consistency check, data entry was verified.

1.4.3.5 Data Analysis

The data analysis was carried out using SPSS. The team leader prepared the format of output tables and the data analyst brought out the analytical output in tabular as well as graphical form where required.

The machine loads for different type of factories like knitting, sweater, woven and woven-knitting mixed for respective large, medium and small sizes were calculated using database and are compiled in **Annexure 5.1**. With average values from **Annexure 5.2**, the category-wise present demand for machine loads of active industries was calculated.

It may be mentioned here that, this survey did not include the factories under BKMEA. From the sample survey carried out in 319 factories, demands of each factory were determined by counting method applying appropriate demand and diversity factors. Counting was applied on every element of power consuming devices such as lights, fans, machines, exhaust fans, air conditioners etc. The database of the survey is presented in **Annexure-3.1**.This includes the terms B code and the name of RMG industry, its location, type size TS i.e. small, medium and large, types of RMG industry, i.e. knitting, sweater, woven and woven-knitting mixed. The power demand in watt (TPDW) has been calculated in accordance with types of devices.

From the survey data, database was prepared and on the basis of this data were generated for 2509 active factories classified into small, medium and large, under respective types of i) woven, ii) knitwear iii) sweater and iv) woven-knitting mixed. The mixed are where weaving, knitting, dying, calendaring and readymade garments are prepared.

Further classifications were made on the basis of number of machines, which are supposed to be determinant variables for other electrical loads such as lights fans, etc. Accordingly, different types of factories were further grouped in small, medium and large factories to include their respective average demands. The calculated average load demands for knitting, sweater, woven and woven-knitting mixed industries for small, medium and large groups have been applied to total population.

1.4.3.6 Focus Group Discussion

Five Focus Group Discussions were held with workers. The sessions were attended by 15-20 workers representing different garment factories. The study team also organized an interactive session with RMG stakeholders in order to validate and share some of the key findings of the study. A Focus Group Discussion (FGD) was held at Hotel Lake Castle, located in Gulshan-2 on 15th November at 11 am. (The findings of FGD has been summarized in **Annex-A**).

1.4.3.7 Key Informant's Interview

Eight key informants were interviewed from DESA, DESCO and Power Cell. The Key Informant Interview (KII) was conducted in order to elicit relevant information on issues being investigated. Interviews were undertaken with key personal, having sound knowledge on power sector, in a dynamic and interactive environment. Discussion went on in an exploratory fashion. The selection criteria for interviewees were based on their responsibilities and function and involvement in the sector. Key Informant Interview didn't provide much information and enabled the study team to gain further insights into the pertinent issues. (The findings of Key Informant Interview has been summarized in **Annex-B**).

1.5 Limitations of the Study

The study resulted in huge number of non-responses. Out of 650 samples, information of only 319 was obtained, the other factories refused to give any information. The enumerators visited those non-responsive RMG factories several times, but due to non-cooperation from the authorities of the selected RMG factories, they failed to collect any information.

Chapter-2

National Power Demand and Supply Situation in Bangladesh

2.1 Market Composition, Spread and Saturation

Investment Climate Assessment (2004) report describes that seventy–eight percent of firms have identified electricity as a major impediments on their road map to expansion. However, the garment industries rely heavily on small scale back-up generators for keeping their production ongoing and avert the consequential effects. It was revealed during key informant interview that more than 30% generation capacity is “captive”. There is a huge gap between incremental growth of demand and generation. The power sector reform policies have crept onto agenda since 1996. Over the years, several changes have taken place. Independent Power Producers (IPP), alongside state-owned facilities, came forward since 1997-1998. However, IPP investment was thwarted and made no meaningful progress to9 make up deficits.

Electric power supply is provided by various utility organizations in their respective areas. The market is composed of residential, agricultural, commercial, industrial and institutional consumers. The respective shares of energy are 43%, 4%, 7.5%, 43.6% and 1.9%, as of 2005. Garment industries are included in industrial category.

Consumers are also classified for voltages such as low tension, high tension, extra high-tension etc. Consumers having demand above 49kW must receive their supply at 11kV, those above 2500kW at 33kV. There exists peak hour tariff from 5 pm to 11pm. Small garment factories receive power at low voltage (400/230 volts) and large to medium factories at high voltage (11kV).

Electricity supply has been extended to about 33-35% of population so far. From per capita generation of 170kWh, it may be assumed that the electricity market is far from saturation, and demand will therefore to increase at the stipulated rate.

2.2 Power Demand and Generation Capacity

Power Sector Master Plan-1995 would be referred to for comparison according to which generation expansion programme is supposed to have taken up for implementation.

Power Demand

The actual power demand against forecast demand by PSMP (Power Sector Master Plan) 1995 from FY 1995 to 2007 are shown in the Table 2.1.

Table – 2.1:
Demand Forecast and Demand Served

FY	PSMP 1995 Demand Forecast Gross (MW)	Predicted Growth Rate	Demand Served (MW)	Actual Growth Rate
1995	2,038.00		1,970.00	
1996	2,220.00		2,087.00	
1997	2,419.00		2,114.00	
1998	2,638.00		2,136.00	
1999	2,881.00		2,449.00	
2000	3,149.00		2,665.00	
2001	3,394.00		3,033.00	
2002	3,659.00		3,217.50	
2003	3,947.00		3,428.00	
2004	4,259.00		3,592.00	
2005	4,597.00		3720.80	
2006	4,967.00		3782.00	
2007	5,367.00	8.40%	3717.80	5.43%

Source: *PSMP-1995*

It may be seen from the historical data of demand served that weighted average compound rate of growth has been only @5.43% per annum during the last 13 years. The growth is much lower than the forecast (8.4%) as per Power System Master Plan-1995 study. This is due to shortage of supply (generation) to meet the demand that existed. Actual demand is seen to have gone down in 2007 from that of 2006, which was obviously due to shortage of available generation capacity. It may be concluded that generation capacity is too short to meet the demand of the market.

Generation Capacity

The total installed capacity as of August 2008 was about 5405 MW including IPP in utility service. There are about 550 MW in captive generation capacity (excluding those having unit capacity less than 500 kW) owned by industries. The plants are predominantly thermal, and natural gas fired. Natural gas is an indigenous fuel. The largest size is 450MW of combined cycle power plants and smallest is of 10MW unit of diesel generators. Since power sector reforms in 1998, Independent Power Producers (IPP) have been investing capital to build, own & operate power stations. Total capacity under private ownership for utility service is 1542 MW including small IPP and rental, i.e. 28% of total. The largest power station so far built is the Meghnaghat Power station with a capacity of 450MW in one block. Estimated capability is about 4300 MW, out of this, daily availability is only about 3700 MW.

2.3 Shortfall in Generating Capacity

Against current demand of about 5000 MW estimated, an average of about 1000 MW has fallen short in capability out of 5400 installed capacity due to old age. Additionally, about 1300 MW has fallen short in availability out of 4400 MW of capability due to lack of maintenance and shortage of gas supply.

Table-2.2 shows that Maximum available generation capacity were fully utilized to meet only part of the demand, since FY2000, that is, demand had remained supply constrained during eight years since FY2000. It is interesting to note that generation capability available has constrained the supply. It is further seen that in FY 2006-2007, maximum load shedding was

1345 MW. This is attributed to failure in implementing the proposed power plants, over the years.

Table – 2.2:
Installed Capacity, Generation Capability, Demand Forecast, Demand served and Load Shedding.

Year	Installed Capacity (1) (MW)	Generation Capability (2) (MW)	Total Demand Forecast (3)	Demand Served (4) (MW)	Load Shedding (MW) (5)	
					Max	Min
1994-95	2,908.00	2,133.00	2,038.00	1,970.00	537	10
1995-96	2,908.00	2,105.00	2,220.00	2,087.00	545	10
1996-97	2,908.00	2,148.00	2,419.00	2,114.00	674	20
1997-98	3,091.00	2,320.00	2,638.00	2,136.00	711	32
1998-99	3,603.00	2,850.00	2,881.00	2,449.00	774	16
1999-00	3,711.00	2,665.00	3,149.00	2,665.00	536	10
2000-01	4,005.00	3,033.00	3,394.00	3,033.00	663	15
2001-02	4,230.00	3,217.50	3,659.00	3,217.50	367	5
2002-03	4,680.00	3,428.00	3,947.00	3,428.00	468	5
2003-04	4,680.00	3,592.10	4,259.00	3,592.00	694	2
2004-05	4,995.00	3,720.00	4,597.00	3720.80	770	7
2005-06	5,245.00	3,782.00	4,693.00	3782.00	1312	15
2006-07	5,202.00	3,717.80	5,367.00	3717.80	1345	40

Source: *BPDB Annual Report 2006-2007*

1 Installed capacity as of June of the fiscal year

2 Generation capability is the maximum available generation capacity in the year.

3 Gross Demand forecast is the Base Forecast of Power System Master Plan, 1995.

4 The dates of maximum demand served and maximum available generation capacity may not be the same.

5 Load shedding is the range of maximum and minimum throughout the year.

A comparative study of load forecast, generation additions plan (PSMP-1995), and actual achievement between 1995 and 2007 shows (Table-2.3 and **Chart- 2.1**) a wide gap between planned generation capacity and actual achieved. This explains the present crisis.

Chart-2.1:
Installed Capacity, Generation Capability, Demand Forecast, Demand Surveyed and Planned Capacity

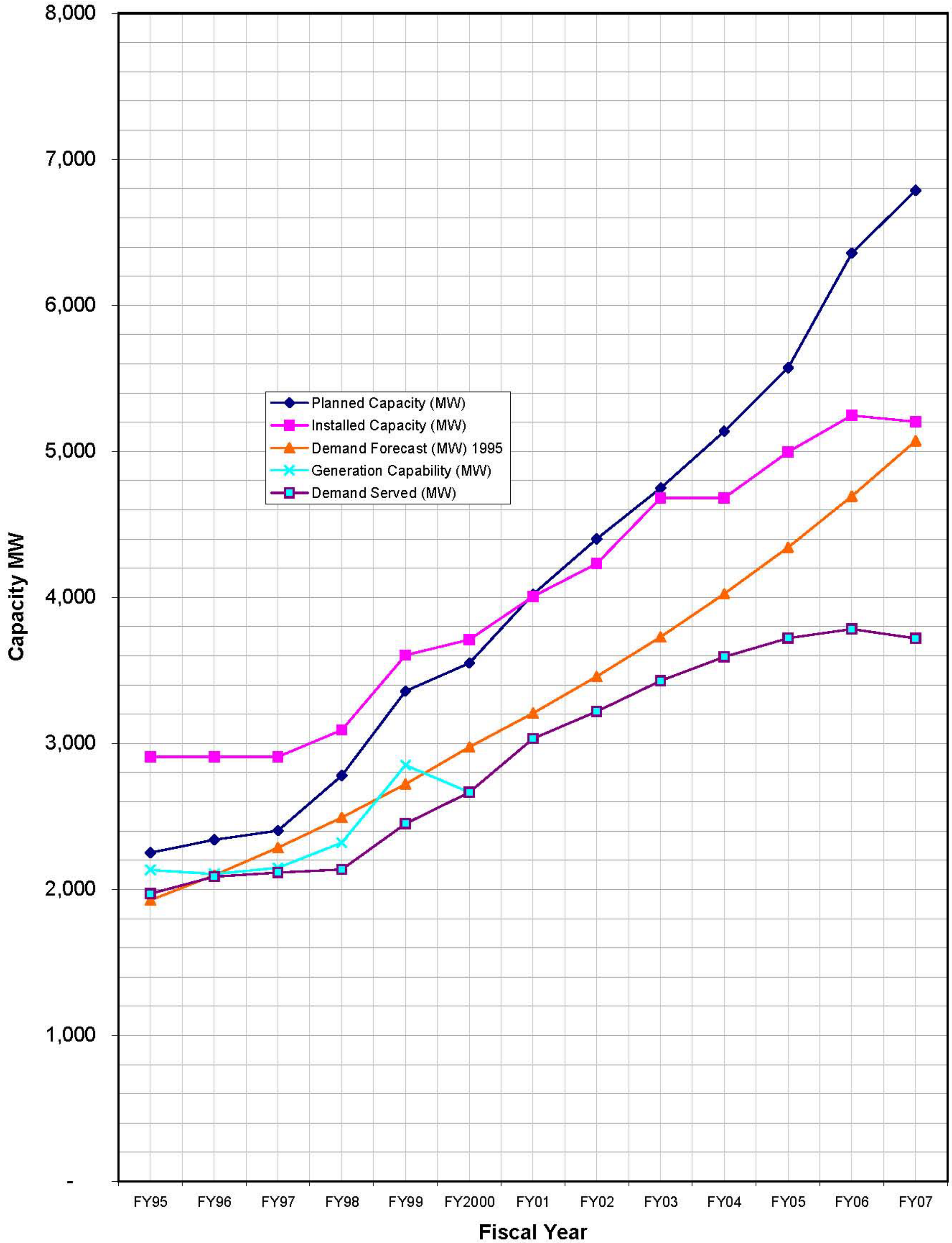


Chart-2.2: DAILY LOAD CURVE   Date : Sun 06-Jul-08

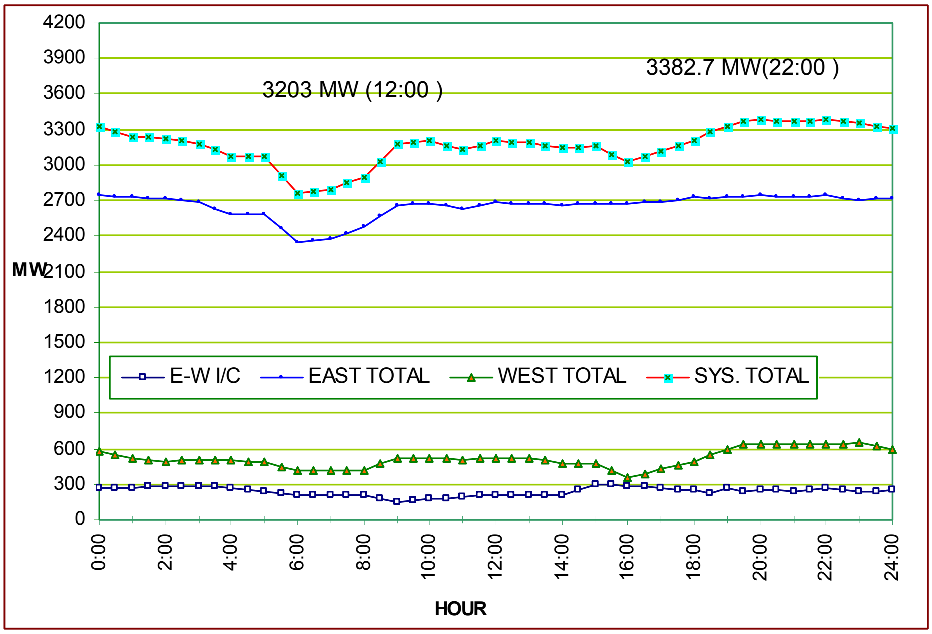


Chart-2.3: DAILY LOAD CURVE   Date : *Tue 06-Jan-09*

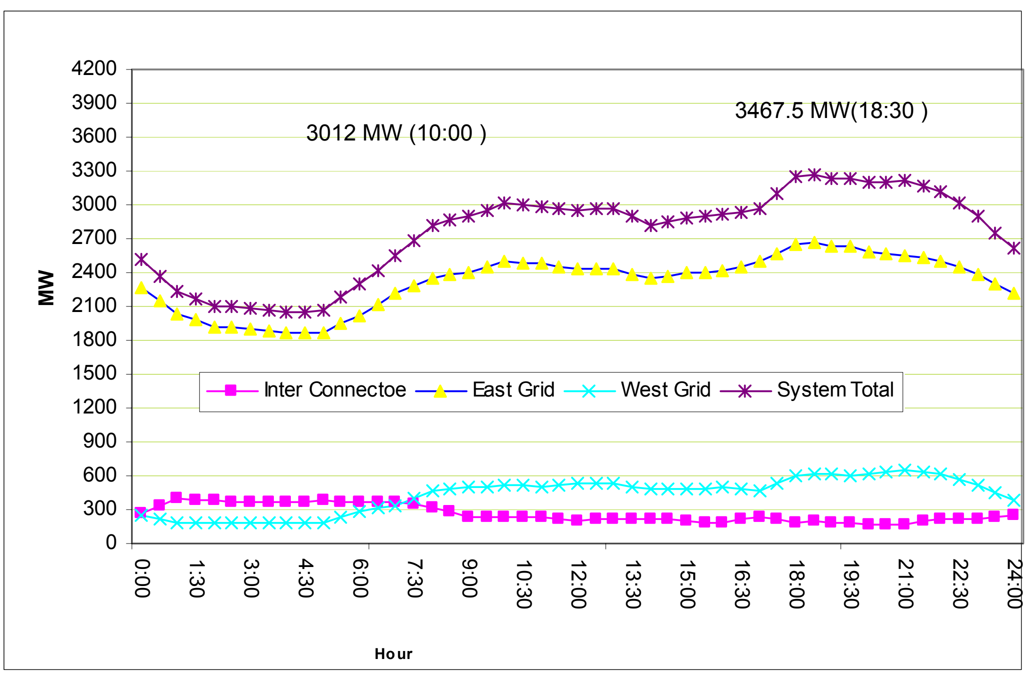


Chart-2.4
Greater Dhaka Area
Daily Load Curve

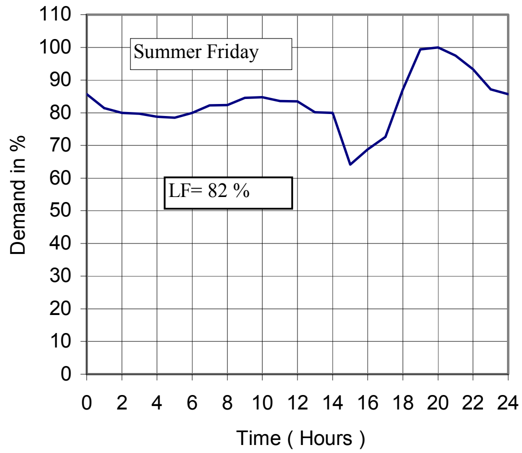


Chart-2.5
Greater Dhaka Area
Daily Load Curve

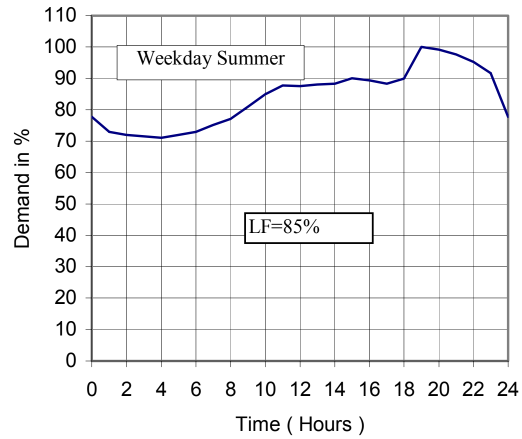


Chart-2.6
Greater Dhaka Area
Daily Load Curve

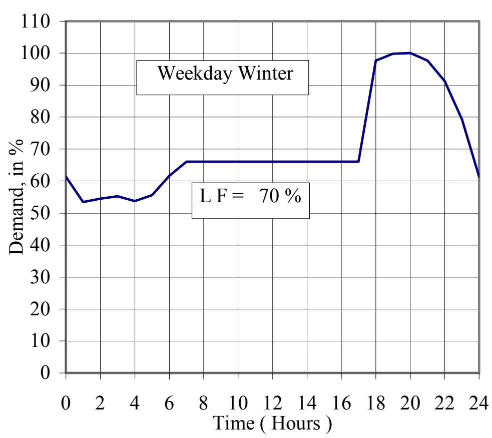


Chart-2.7
Greater Dhaka Area
Daily Load Curve

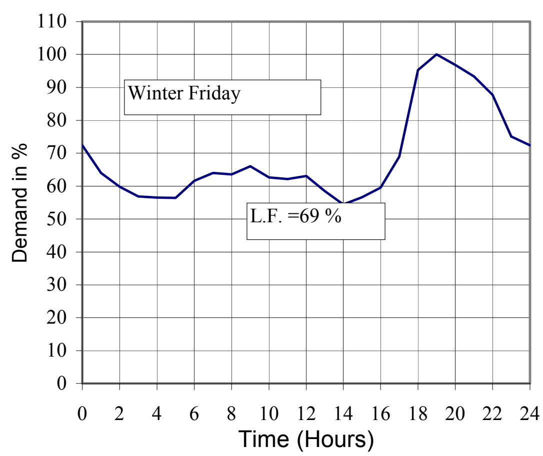


Table-2.3:
Load Forecast and net planned Generation Capacity
(As per Power System Master Plan Study, 1995)

FY	Load Forecast Gross MW	Growth Rate %	Planned Generation Capacity (1) MW	Growth Rate %	Actual Capacity (2) Achieved MW	Growth Rate %
1995	2038		2251		2908	
1996	2220		2339		2908	
1997	2419		2402		2908	
1998	2638		2780		3091	
1999	2881		3358		3603	
2000	3149		3550		3711	
2001	3394		4021		4005	
2002	3659		4399		4230	
2003	3947		4748		4680	
2004	4259		5137		4680	
2005	4597		5572		4995	
2006	4693		6356		5245	
2007	5367	8.4%	6786	9.6%	5202	5%

(1) Net after station use.
(2) Gross generation capacity

2.4 Load Shedding and its Impact on National Economy

The power supply is now in a crisis. This will continue to worsen further beyond 2008. Steps taken now for increasing generation capacity can not make up the lost opportunities of past years.

There has been prevailing an acute generation shortfall vis-à-vis power demand of the country for the last 7 years. So, nationwide power supply system is facing inevitable load shedding. Load shedding has to be resorted to in order to save the generators from damage due to over load. No consumer groups are spared except the agricultural consumers during irrigation season from February-March. To effect load shedding the 11kV and 33kV feeders are switched off from the substations by the distribution companies as required by the National Load Dispatch Centre when situation arises.

<u>Impact of Load Shedding</u>

The load shedding implicates among others, energy shedding as well. This attributes to Energy Not Served (ENS) to all categories of consumers. The overall cost of ENS in the amount of ENS times its unit cost. The unit cost is a measure of the economic impact of not meeting the electricity demand. In other words, the unit cost of ENS is the costs that a consumer does incur when electricity is not available that he would avoid if electricity were available, divided by his amount of ENS. The economic impact that may come from interruption to industrial output, commercial activity, residential services and public safety are extremely costly and some are inherently difficult to quantify. A simple approach is to find out the cost of alternative generation for all the aforesaid activities to be sustained. The Power System Master Plan (PSMP) study, 2005 adopted the above method to quantify the unit cost of ENS which is $0.43 per kWh i.e. equivalent to about Tk.30.00 per kWh (1US$= Tk.70.00). This implies that if a consumer is deprived of one unit of energy (kWh) he has to incur a cost of Tk.30.00 for that. This study estimates for unit cost of ENS for garment industries of about Tk.15.00/kWh.

2.5 Load Management

Load management is the tool to modify energy usage to maximize energy efficiency. It derives benefit out of existing energy resources.

Load management is no doubt a good initiative for meeting demand in the peak hours. It is a method meeting the demand without new investment. Load shedding by switching off feeders is not really load management. Rather, load management helps reduce load shedding to a minimum level and improve load factor. Power usage pattern determine load factor. It also depends on socio-economic as well as cultural pattern of a society or country. In Bangladesh, evening activities are pronounced and prolonged over 4 to 5 hours. Winter and summer day light period are not much different. These factors influence the peak accentuation in the evening between 6-30 and 7-30 depending on winter and summer.

Historically daily load curve was characterized by two peaks, smaller peak occurring in the mid-morning and the higher one in the early evening. It is never practical to achieve a technically ideal flat load curve for the electric utility. BPDB took efforts in the past to improve performance of the system by adopting measures to shift the peak and to reduce capital investment on peak power generation.

Measures taken for Load Management

The following are some measures that have been taken to control peak hour demand:

a) Shifting irrigation load from peak hour to off peak hour.

b) By rationalizing the use of electricity by all consumers by switching off the non-essential loads e.g. iron, air-conditioners, welding machines etc. during peak-hour.

c) Operating industries having two shifts during off peak hour.

d) Operating large commercial customers like shopping malls using own Generation.

e) Closing the commercial establishments at 8 P.M.

f) Staggering the holidays area-wise in different weekdays for different category of consumers.

g) Motivating the consumers to use Compact Fluorescent Lamps (CFL) replacing the conventional incandescent lamps.

Some effect of the above must have taken place, but it is difficult to identify the same as simultaneous load shedding at peak hours over-shadows the effect of load management. However, from the daily load curves of recent years it appears that usage pattern of electricity has taken place quite significantly. From the fact that loads are being shed in the mid-night, it is concluded that many consumers have shifted from evening to mid-night.

The present load curve of April 21, 2007 and previous load curves of 1994 and 2000 may be seen in **Chart-2.2, 2.3, 2.4, 2.5, 2.6 and 2.7**.

2.6 Seasonal Variation of Load Factor

An investigation of daily load curves of year 2000 (**Chart-2.3**) was carried out. Past seven years were excluded from the study. From the seasonal variations in load curves, it is seen that nightly load was much depressed in winter and load feeder was also lower by 15 percentage points than in summer. Winter weekday nightly load appears to have fallen to 65%

of peak. Thus more load i.e. more consumers could be accommodated in the nights from 12mn through 4pm. That means, more load from evening peak hours (5 pm-11pm) could be shifted to 12mn to 8am to 4pm. However, this is a short period of two months- mid-December to mid-February next year only.

Domestic loads cannot be shifted, only industrial loads, such as garment factories if any, operating in the evening, could be shifted to mid-night. However, due to acute shortage of generation capacity in the recent years, the daily load curve pattern has changed. Therefore, seasonal variation has no significance any more.

2.7 Prospect of Mitigation

In the midst of this dismal situation, investigation was made in order to understand the prospect of mitigating this situation. Foreign direct investment has been taken place since 1998 by participation of foreign IPPs. This has also slowed down since 2001. Thus the generation addition programmes have suffered an unprecedented set-back due to fund shortage. In 2000, BPDB undertook a program to raise generation capacity to 7463MW, 5413MW in public sector and 2050MW in private sector, but this program could not be implemented. Later on, Government developed a Power Sector Master Plan in 2005 for addition of 17,700 MW of generating capacity by 2025. This envisaged a short-term programme of setting up 3500 MW new capacity during 2005-2010. But no significant progress has been made towards this. To overcome this situation, a new 3-year generation addition plan was undertaken in 2007.

The plan stipulates a total of 4322 MW to be added by 2012. Out of these, some small IPP and rental power plants have been commissioned so far (200MW). The effect of generation addition of about 537MW by December 2008, on present load shedding problem would be partial and will not last long. Due to uncertainties of large plants including 150MW projects, only about 1802MW may be implemented by 2012. With increasing load demand, currently estimated at about 450 MW per year, this cannot raise the generation capacity to desirable level to improve power supply by 1012.

Gas Constraint for Power Generation

Recent report of power system operation of 22 Sept, 2008 shows Haripur 100MW, Raozan No.1 210MW, Sikalbaha steam 60MW have been kept out of operation on account of shortfall in gas supply. In addition, a total of **444MW was short generated** at 6 power plants of Ghorasal, Raozan # 2, RPCL, Siddhirganj 210MW, Haripur 360MW combined cycle, NEPC Haripur barge-mounted power plants.

Future Prospect for Gas

Gas situation may improve by 2011 marginally, when about 320 MMCFD would be added to the existing production. This is not sufficient for the generation capacity (over 400 MW) remaining out of stream and new demand to come up. However, as per Petrobangla substantial improvement is expected by the year **2016**. Therefore, prospect of new gas fired power plant is bleak.

Coal Resources

It is estimated that an annual production of 1.0 million tons of coal will be available from to feed 2x125 MW at the power plant of Barapukuria for 30 years which is already in operation producing about 5% of total utility sector electricity.

Extensive use of coal is essential to substitute for gas. Addition of coal-fired power plant depends on further mine development which will take time. It took about 8 years to develop the mine at Barapukuria. A coal fired steam power plant takes about 4-5 years to implement after work order.

2.8 Prospect for Improvement of Power Supply

From the foregoing facts it may be concluded that power supply situation could not be improved unless fuel supply is ensured i.e. before 2016. On the other hand long gestation period for development of coal mines will also retard the desired power development. Therefore, other alternative may be investigated in to.

The shortage is attributed to non implementation of generation addition programme due to lack of adequate finance, delay in implementation, lack of maintenance, aging of machines and shortage of natural gas, the prime fuel for generation.

The fragile power supply situation will continue to worsen further beyond 2008 even if steps are taken now for increasing generation capacity. Program that is required to make up for lost opportunities is too much to implement in too short a time. This would continue to affect the industrial growth and the economic development of the country. However, substantial improvement is not expected before 2016.

Myriad of policies being framed up by the government has not brought about any marked changes in power generation scenario. Until 2006, the policies being adopted by the government includes IPP policy, Small Power Plant Policy, Captive Power Policy, Power Sector Master Plan and Power Sector Reform Road Map. However, most of these policies have either been shelved or gaining dust. In stead of creating an ambience for investments by private sector, deeply entrenched institutional barriers shied away the investors who came forward to make up the gaps in the market. Having reviewed policy guidelines and plans, we would like to identify the key factors which may trigger the policy lobbying in order to ensure uninterrupted power supply in RMG as well as other industries.

Chapter-3

Demand and Supply of Power in RMG Factories

3.1 Present Electrical Load

Database was compiled on the basis of agreed classification (Chapter-2 sec-2.3.5) with regard to types of factories such as (i) knitting (ii) sweater (iii) woven and (iv) woven-knitting mixed. From the sample survey, average demands for machines, lighting etc. of a group of factories (say, small knitting) have been calculated as representative models. Then, this was multiplied by the number of factories of this group, to calculate the total demand of the group. The calculated average load demands for knitting, sweater, woven and woven-knitting mixed industries for small, medium and large groups are presented in **Annexure 3.2**.

Findings of sample survey of garment industries are summarized below.

3.1.1 Lighting

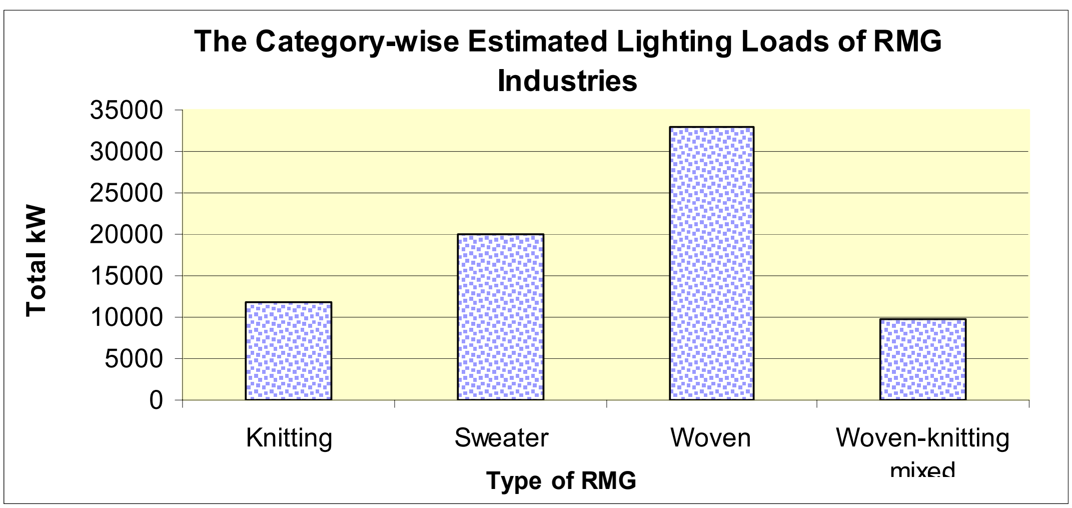
Lighting load for the different type of industries like knitting, sweater, woven and woven-knitting mixed for large, medium and small size were calculated based on survey data. (**Annexure 3.1)**. The average lighting load demands for all categories of industries were also calculated (**Annexure 3.2**.). However, illumination recommended for such factories at working level is 700 lux as per Bangladesh National Building Code (1993).

The category-wise present demand for lighting of 2509 active industries was ascertained based on average values (**Annexure 3.5**).

The total present lighting load demand for 2509 active industries comes to 74605 kW i.e. about 75 MW and the corresponding energy consumption comes to about 224 MkWh per year **(Table-3.1)**.

Table-3.1:
The Category-wise Estimated Lighting Loads

Sl No.	Item	Small kW	Medium kW	Large kW	Total kW	Energy Consumed MkWh
1	Knitting	1260	2535	7975	11770	35
2	Sweater	66	693	19272	20031	60
3	Woven	986	4017	27936	32939	99
4	Woven-knitting mixed	323	1394	8148	9865	30
Total:					**74605**	**224**



Typical lighting load for large, medium and small size RMG industries may be seen in **Table-3.1, 3.2 and 3.3 (Annexure 3.10)**.

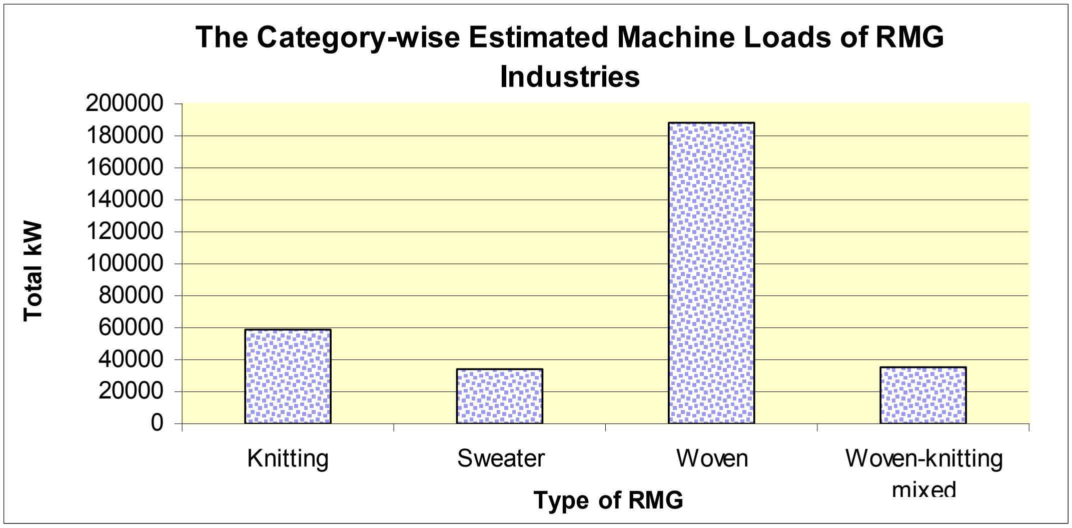
3.1.2 Machines

The machine load is predominantly the motor load of the different types of machines used in an RMG factory. In an RMG factory, the major load is required for the sewing section. The sewing section is composed of a production line having 20-30 sewing machines each rated 0.25 kW at 220volts ac in one line to complete a particular job. Cutting and ironing section is also an integral part of the sewing section. So, any shortage of power supply results in shut down of a line of the sewing section resulting stoppage of production. The motors are single-phase motors with direct on line starting.

In RMG industries the cutting section, sewing section and the ironing section constitute total machine load. The machine loads for different type of factories like knitting, sweater, woven and woven-knitting mixed for respective large, medium and small sizes were calculated using database and are compiled in **Annexure 3.1**. The average machine load demands for cutting, sewing and the ironing sections for each of all types of industries were calculated and compiled in **Annexure 3.2**. With these average values from **Annexure 3.2**, the category-wise present demand for machine loads of 2509 active industries were calculated and shown in **Annexure 3.6**. The total present machine load demand for the 2509 active industries come to 316609 kW i.e. 317MW and the corresponding energy consumption come to about 950 MkWh per year **(Table-3.2)**.

Table-3.2:
The Category-wise Estimated Machine Loads

Sl No.	Item	Small kW	Medium kW	Large KW	Total kW	Energy Consumed MkWh
1	Knitting	2590	9464	47025	59079	177
2	Sweater	108	1176	32850	34134	102
3	Woven	5046	25956	157140	188142	565
4	Woven-knitting mixed	238	9020	25996	35254	106
Total:					**316609**	**950**



Typical machine load for large, medium and small size RMG factory may be seen in **Table 3.4, 3.5 and 3.6 (Annexure 3.11)**.

3.1.3 Fans and Blowers

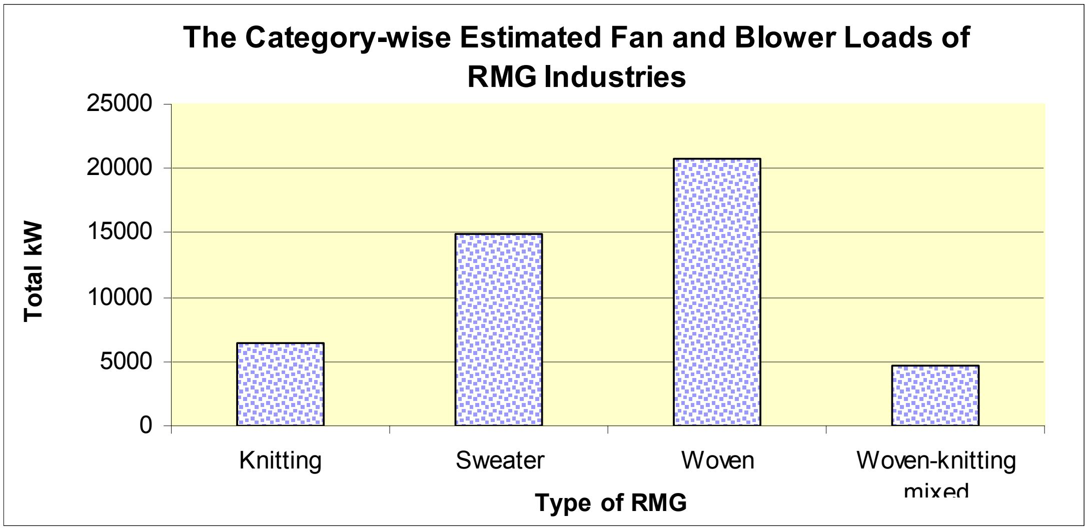
In an RMG factory a large number workers are engaged in sewing and operating machines continuously. The internal temperature of the factory therefore rises to a great extent for which a large numbers of ceiling fans as well as exhaust fans and blowers are required for proper ventilation. These fans and blowers remain are in continuous operation in different sections of the factory, and as such, consumes some energy. This power consumption is also very essential for the factory workers to maintain their health.

The load of fans and blowers in different type of industries likes knitting, sweater, woven and woven-knitting mixed for large, medium and small size were calculated. (**Annexure 3.1**) The average load demands for cutting, sewing and the ironing sections of all types of industries were calculated (**Annexure 3.2**.) The category-wise present demand for fans and blowers for 2509 active industries were calculated (**Annexure 3.7**). The total present fan load demand for the 2509 active industries come to 46821kW i.e. 47MW and the corresponding energy consumption comes to about 140 MkWh per year **(Table-3.3)**.

Table- 3.3:
The Category-wise Estimated Fan and Blower Loads

Sl No.	Item	Small kW	Medium kW	Large kW	Total kW	Energy Consumed MkWh
1	Knitting	630	1690	4125	6445	19
2	Sweater	45	462	14454	14961	45
3	Woven	1102	3090	16587	20779	62
4	Woven-knitting mixed	272	1066	3298	4636	14
Total:					**46821**	**140**

Source: *Field survey, 2008*



3.1.4 Air Conditioners

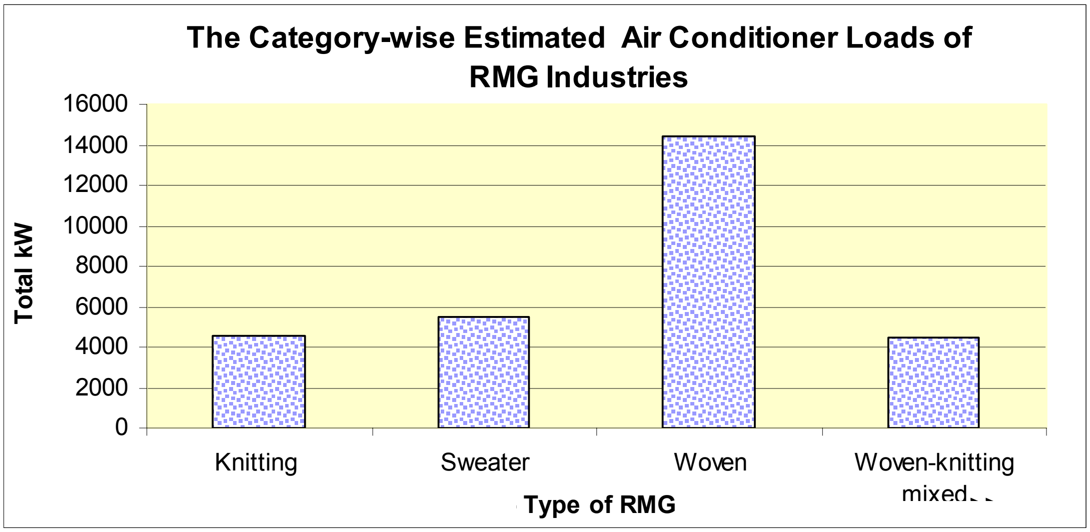
Air conditioners both window type and split type are generally used in the office rooms. This constitutes only a small part of load. Power supply to the air conditioners is essential during the office hours only.

The average load demands for air conditioners of all types of industries were calculated and compiled in **Annexure 3.2**. With these average values from **Annexure 3.2**, the category-wise present demand for air conditioners for 2509 active industries were calculated and placed in **Annexure 3.8**. The total present Air-conditioners demand for the 2509 active industries come to 28897 kW i.e about 29MW and the corresponding energy consumption comes to about 86 MWh per year **(Table-3.4)**.

Table-3.4:
The Category-wise Estimated Air Conditioner Loads

Sl No.	Item	Small kW	Medium kW	Large kW	Total kW	Energy Consumed MkWh
1	Knitting	280	1014	3300	4594	14
2	Sweater	18	168	5256	5442	16
3	Woven	580	2472	11349	14401	43
4	Woven-knitting mixed	170	410	3880	4460	13
Total:					**28897**	**86**

Source: *Field survey, 2008*



3.1.5 Other Electrical Loads

In an RMG factory the major electrical loads are consumed by the lightings, fans & blowers and motors, which cover more than 95% of the load. Other than this, only a very small load is there, for security lights and office equipment etc. The average load for office equipment from the **Annexure 3.2** was used to calculate the category-wise present demand for office equipment of 2509 active industries and are shown in **Annexure 3.9**. The total demand for other electrical loads for 2509 active industries come to about 9561kW i.e. about 10 MW and the corresponding energy consumption comes to about 29 MkWh per year.

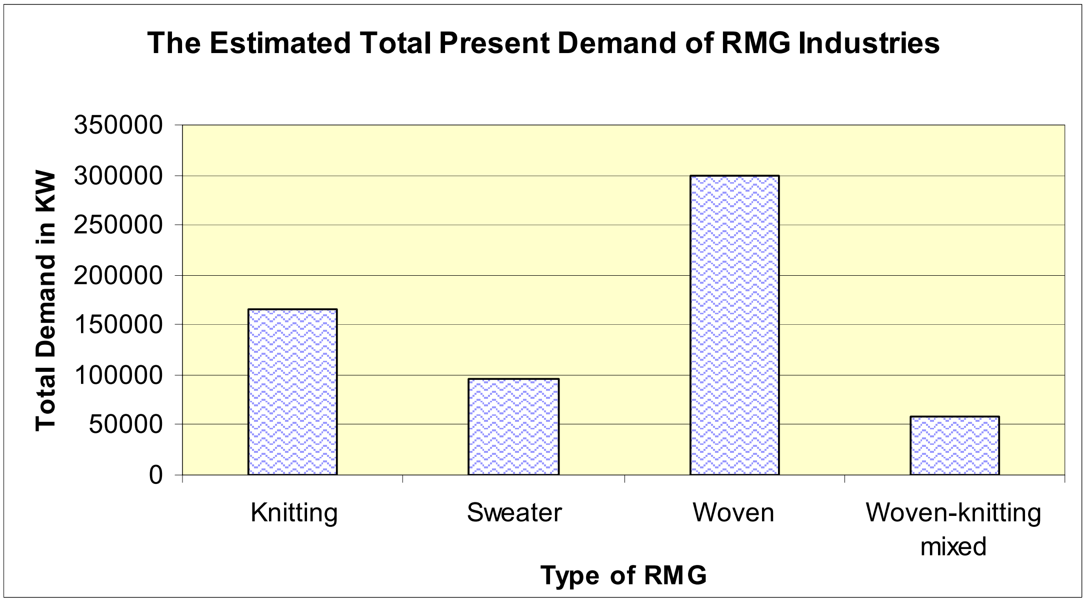
3.1.6 Estimation of total present demand of RMG Industries

The total present maximum demand for 2509 active industries was calculated from the above average values. The calculated total maximum demand comes to be 619771 kW i,e 620 MW and the corresponding energy consumption per year is 1858 MkWh. The category-wise present kW demand for knitting, sweater, woven and woven-knitting mixed industries for small, medium and large factories and the corresponding energy consumption per year for each type of industry have been calculated (**Annexure 3.3)**. The results of these calculations are shown in **Table-3.5**.

Table-3.5:
The Estimated Total Present Demand

SI No.	Item	Small kW	Medium kW	Large kW	Total kW	Energy Consumed MkWh
1	Knitting	4550	40560	121000	166110	498
2	Sweater	312	3297	91542	95151	285
3	Woven	10382	64581	224361	299324	898
4	Woven-knitting mixed	1326	12464	45396	59186	177
Total:					**619771**	**1858**

Source: *Field survey, 2008*



From the above, area-wise present demand for 2509 active RMG industries have been calculated considering demand factor of 0.9 which are shown below:

Chittagong	-	119	MW
Dhaka	-	448	MW
Gazipur	-	33	MW
Narayanganj	-	20	MW
		620	**MW**

The area wise coincident present demands at power station terminals for above 2509 active garment factories have then been calculated by considering diversity factor of 1.6 which are shown below.

Chittagong	-	74	MW
Dhaka	-	280	MW
Gazipur	-	21	MW
Narayanganj	-	13	MW
		388	
		389	
		390	**MW**

3.1.7 Future growth of power Demand of RMG Industries

The forecast for future load is based on 10%-15% annual growth in all categories of factories in operation. For the purpose of forecast both future and reactivated factories have been considered. Load has been calculated on the basis of average load of each category as found from sample survey for the next 5 (five) years. Future maximum demand has been calculated for each category of factory after applying a diversity factor of 0.9. The total future demand upto next 5 years thus calculated as 1000MW. The maximum coincident demand at generation end has been calculated, considering diversity factor of 1.6, as 625 MW.

3.2 Power Supply to Garment Industries

The garment industries, according to respective sizes, receive power supply from the public utility services at 400 volt or 11000 volt. Consumers having demand over 49 kW have to get their supply at 11000 volt or above. However, supply voltages are always poor and continuity of supply has all along been interrupted by system disturbances. From the survey it was further learnt that for the last few years the factories have been facing frequent load shedding due to power cuts. Previously there was no schedule for such cuts. But now a day the utilities seem to follow some routine. However, power cuts had become so intolerable that the garment factories were compelled to establish standby diesel/gas generators to maintain production to meet the orders of their foreign buyers at a higher production cost. Average price for each unit of electricity (kWh) that they have to pay to utilities was found to be Tk.3.70.

3.3 Power Demand and Supply Situation of Garment Factories

a) Lighting Demand

The total present lighting load demand for 2509 active industries comes to about 75 MW and the corresponding energy consumption comes to about 224 MkWh per year.

b) Machine load

The total present machine load demands for the 2509 active industries come to 317MW and the corresponding energy consumption come to about 950 MkWh per year.

c) Fans and Blowers

The total present fan load demand for the 2509 active industries come to 47MW and the corresponding energy consumption comes to about 140 MkWh per year.

d) Air Conditioners

The total present Air-conditioners demand for the 2509 active industries come to about 29 MW and the corresponding energy consumption comes to about 86 MkWh per year.

e) Other Electrical Loads

The total demand for other electrical loads for 2509 active industries come to about 9561kW i.e. about 10 MW and the corresponding energy consumption comes to about 29 MkWh per year.

f) Estimation of total present demand of RMG Industries

The total present maximum demands for each of 2509 active industries were calculated with demand factor of 0.9. The aggregated respective maximum demands come to be 620 MW and the corresponding energy consumption per year is 1858 MkWh.

g) Future growth of power Demand of RMG Industries

At an increase of 10%-15% per year the aggregated future load demands for RMG sector comes to be about 1000 MW as compared to existing demand of 620 MW and the maximum coincidental demand at generation end comes to 625MW.

Chapter-4

Capacity of Captive and Standby Generation and Consumption of Primary Energy by RMG sector and its Financial Implication

4.1 Capacity of Captive and Standby Generation of RMG Sector

Most of the RMG Factories have installed their own Captive or Standby Generators to protect their production during load shedding. The captive generators use gas as the fuel and the standby ones use diesel oil.

Presently, active factories are 2509 in numbers and almost all of them have their own generators to maintain production target as well as to fulfill the contract requirement for the buyers.

During the sample survey of 319 garment industries it was observed that about 304 industries have installed standby diesel generators having total capacity of 73459 kW, the average capacity of each being 242 kW. On this basis, out of the total active 2509 industries, the number of industries having standby diesel generators is 2391, the total capacity estimated as 578622 kW i.e. 580MW.

Further, 30 industries have installed captive generators using gas as fuel. The total capacity of the standby generators are about 60MW.

4.2 Use of Diesel for Own Generation as Standby Power

Most of the RMG factories have installed their own standby Diesel generators, in view of load shedding by utility companies. This requires space for storing at least 3-months requirement of Diesel. The price for diesel is Tk. 55/- per litre at the time of survey. This obviously has a great influence on the unit cost of production and causes high cost for electricity generation. The cost of fuel (Diesel) alone comes to about Taka 11.00 per kWh generated.

4.3 Use of Gas for Own Generation as Captive Power

Due to major shortfall in generation, RMG sector is facing acute load shedding. To protect the industrial production, some of the RMG factories installed their own gas fired captive generation. The main benefit of using gas is it does not require storage facility and easy to use. The production cost of electricity by Gas is about 3/- per kWh. However, this rate is higher than the unit cost supplied by different utilities. The cost of gas will be further increased in future.

4.4 Financial Implication due to use of Diesel for Own Generation

The cost of own electricity generation by the RMG factories is much higher than the billing rates of different utilities. The cost of fuel (Diesel) alone comes to about Tk. 11.00 per kWh generated. Moreover, the RMG factories require a large amount of investment for electricity generation. This adds to the fuel cost to inflate it further. Total cost of own generation by diesel oil including O&M cost has been calculated to be Tk. 15/- per kWh. The RMG market being very much competitive, the contract rates with the buyers for cost of production declines by a large amount causing a critical situation for the RMG factories. As a result, a good number of small RMG factories have been closed during last few years. According to BGMEA, the number of closed RMG factories is 1542, which is about 38% of the total 4051.

Chapter-5

Load Shedding and its Impact on RMG Industries

5.1 Load Shedding

There has been prevailing an acute generation shortfall vis-à-vis power demand of the country for the last 7 years. So, nationwide power supply system is facing inevitable load shedding. Load shedding has to be resorted to in order to save the generators from damage due to over load. No consumer groups are spared except the agricultural consumers. Even in the midnight, load shedding becomes necessary almost everyday.

Load shedding has been created by acute generation shortfall as generating capability has continuingly fallen short of the forecast demand as discussed in **Chapter-2**. As a result, indiscriminate load shedding has been resorted to by the utilities causing great distress to the industry

5.1.1 Frequency and Impact

From the survey it is observed that the feeders supplying power to RMG factory are switched off 3 to 5 times a day during the production time of the factories. Some factories particularly in Chittagong area suffer from severe load shedding. Records of one of the factories in Chittagong area is shown in **Annexure-5.1** as a sample. In each power cut, the shedding time is almost fixed to one hour. During the period stand-by generators are run.

Almost all the RMG factories are now equipped with their own captive generation to maintain their supply order in proper time and saving loss of reputation among international buyers. However, small factories without such standby generators face production loss.

It is also found that, even if there is captive power generation having full capacity, the RMG factory suffers loss of about half an hour for the workers to restart and came to full production.

The cost of electricity produced by diesel oil has been estimated to be Tk.11 to 15 per kWh which is 3 to 4 times higher than that supplied by utilities. This additional cost of electricity generation has significant impact on the cost of production of RMG sector.

Normally a supply order follows a tight schedule for a particular time period. So a continuous and reliable power supply is very much essential for a garment factory.

Unless there is captive power generation having full capacity as required by the factory, the main production line gets stopped.

5.2 Loss of Production

Load shedding causes both time and production loss for the RMG factories and as a result they fail to maintain timely production and contract schedule for shipment.

Financial implication of load shedding can be explained by ENS or 'energy not served'. The implication of ENS has been discussed in **Chapter-2 (Section 2.1.4)**.

The situation of load shedding is such that it happens 3 to 5 times or even more a day causing 3 to 5 hrs. of interruption to the RMG Industries. Daily working hours are 8 hours. So loss of 3 to 5 hours during a period of 8 hours shift obviously creates a difficult situation for the RMG Industries. As a result, the cost of production increases. As a consequence, most of the factories have installed standby diesel generators to avoid production loss. Small factories however, suffer, as they can not afford to such alternatives for various reasons.

5.3 Interruption due to Holidays/Strikes

The workers in RMG Industries enjoy the national holidays. To cope with tight shipment schedule, if the workers are engaged in works in national holidays, the RMG industry needs to pay them overtime. During strikes, the workers seize to work and as a result the RMG industry faces loss of production. To overcome this situation the RMG industry need to engage the workers beyond working hours and pay in overtime. This causes increased production cost for the RMG industry.

5.4 Investment in Standby/Captive Generation

Increasing reliance on captive or stand by power supply, results from frequent load shedding, costs have increased about 1.75% during 2007-2008. As a result, the total production cost has increased substantially. Most of the factories are forced to shutdown part of the production and assembly line during load shedding which has a direct bearing on production rates and production volume. Against backdrop of the situation, all categories of factories have invested in standby/captive generating stations.

Investment in these standby and captive power varies in accordance with types of factory.

5.5 Higher Production Cost in a Competitive Environment

The power interruption due to load shedding has the direct impact on cost of production. The production cost increases is due to decrease in productivity which is attributed by increase in idle manpower, corrective maintenance and the diverting of resources.

5.6 Cost of ENS (Energy Not Served) to Garment Factories

A significant loss of industrial output can be directly attributed to energy shortages. A USAID study of the impact of power outages resulted in a substantial economic loss in the industrial sector amounting to US$778 million a year. This translates into 11.54 percent of the industrial sector GDP or 1.72 percent of national GDP. The scale of shortages has increased as demand continues to outstrip supply, and power cuts are long and frequent. Garment factories have been suffering from direct financial loss on account of generation from stand-by diesel sets. This study has found the cost of energy not served (ENS) to garment industry as Tk. 15/ kWh.

From the sample survey it appear that the loss of production due to load shedding in the RMG sector is made up by own generation of electricity at a higher cost of production. A few small factories would do not have standby generators have to face loss of production. This accounts for a fraction of the total. The total cost of generation incurred by RMG sector due to load shedding has been estimated to be Tk. 6138 million per year as shown below **(Table-5.1)**:

Table-5.1 Estimation of Total Cost of Generation due to Load Shedding

Summation of estimated demands at Factories end: (For Factories in operation, 2509 Nos.)	620 MW
Operating days	300 days per year.
Lost hours due to load shedding	3 hours per day
Total hours lost due to load shedding	300×3= 900 hours
Total whir lost due to load shedding	$620 \times 900 \times 10^3$ =558,000,000 kWh.
Unit cost of Energy not served (ENS) due to load shedding.	Tk 15/ kWh.
Differential cost per unit Tk. (15-4) for energy not served (ENS) due to load shedding on top of unit price of utilities (Tk. 4/kWh).	Tk. 11/kWh.
Total estimated cost incurred by RMG industries due to load shedding	Tk. 11 x 558,000,000.00
	= Tk. 6138, 000, 000.00 per year
	= Tk. 6138 million per year

5.7 Loss of Revenue

The power interruption has direct impact on loss of revenue.

Cost of energy produced by gas and diesel for running the captive and standby generators has been estimated which could have been averted if the industries were given the uninterrupted power supply from the existing sources. This is about 6138 Million Taka in a year which is 1.75% of total cost of production of 350 billion Taka.

The garment factories also incur revenue loss due to delayed production schedules, failure to meet deadlines and delayed shipment.

5.8 Decreased Competitiveness and Lost Opportunity

Power interruptions are deemed to be a menace to any production environment. Most of the small factories are forced to shut down their production line due to power outage and inability to afford alternative power cost for the whole production process. With regard to uninterrupted power supply, the reliability factors also contribute with regard to increasing dependence on alternative power generation.

The production environment is seriously hampered due to power interruptions. Load shedding has forced the factory management to take alternative measures like holiday staggering and re-arrangements in shifts (production schedule). Power interruption often results in buyer's dissatisfaction and as well as delayed production schedules. These shortcomings certainly decrease competitiveness and very costly.

5.9 Wasted Energy and Cost of Alternative Power Generation

The interruption to manufacturing process results in a waste of energy in the restart process. This adds to the increase in production cost of RMG sector. Generation by stand-by diesel generators is about four times as costly as average cost of utility power supply.

5.10 Damage of Equipment / Decreased Equipment Life

The load shedding in the garment factories affect some life of the equipment. This is attributed by switching on and off several times during load shedding. However, this is negligible.

5.11 Mitigation of Power Supply Crisis due to Load Shedding

The present crisis in power supply is primarily attributed to generation shortage. This resulted in inevitable load shedding which affect all consumer groups including RMG industries. This situation will continue to worsen further beyond 2008. Therefore, for immediate mitigation of the power supply the following measures may be taken up.

5.11.1 Load Management

Load management is a tool to control the load demand and thus meeting the demand without new investment. Some measures that have been taken by the utilities were discussed in **Chapter-2 (Section-2.1.5)**.

The replacement of Incandescent Lamps by Compact Fluorescent Lamps (CFL) is very important. It will substantially reduce the total lighting demand of the country considering about 80 lac domestic consumers nationwide and reduction of 100W for each consumer, a total of about 320MW lighting load may be reduced with diversity factor of 40%. Vigorous campaign may be taken up to aware the consumers about this. However, to increase the affordability to purchase the CFL by consumers particularly rural ones, CFLs may be given to them either free or on loan.

In an RMG factory a series of standard tube lights with magnetic ballasts are used. These are appropriate for using in production lines of RMG industries. However, it is recommended to use electronic ballasts in place of magnetic ballasts to reduce power loss by about 12 watts per unit. It will reduce the power demand on account of lighting by 20 percent without sacrificing illumination. This may be perused nationally also which will reduce about 100MW of total national demand.

Further, if one tube light from each fixture is replaced by a 7 watt CFL fitted on the body of each machine, this will reduce the lighting load demand of RMG industries by about 56%. As a result the power demand for lighting load of 2509 RMG factories will come down from 75MW to about 33MW.

Other measures like, shifting irrigation load from peak hour to off peak hour, switching off the non-essential loads, e.g. iron, air-conditioners, welding machines etc. during peak hour, holiday staggering, operating industries having two shifts during off peak hour, operating large commercial establishment using own generation should be pursued vigorously.

The present measure of closing the commercial establishment at 8 P.M will not result the desired goal. It should be effected from the starting time of the peak load i.e. 5 P.M in the evening during winter period and 7 P.M in the summer period. This will help reduce the peak load substantially which may be used for the RMG sector and other consumers.

Chapter-6

Recommended Strategies and Action Plans for Improving the Power & Energy Supply Situation in RMG Sector

6.1 Current Difficulties and Prospects

The study identified the problems of power supply; the actions necessary for improving power supply; and to this end employed consultant to do the needful. As per the terms of reference of the service, the consultants took up study to identify the difficulties presently faced by RMG industries under BGMEA in respect of power supply, and recommend strategies and action plans for improvement. Sample survey was taken up on the basis of which data and information were collected, difficulties identified and losses quantified.

The power crisis in Bangladesh is looming large in view of widening gap between emerging demands and generation. With a per capita generation of 170kWh, the demand base is still very low and as such, possibility of growth of power market is reeling under a variety of institutional and policy constraints.

As part of divulging into multi-faceted ramification of consistent power outage on growing RMG industries of Bangladesh, an investigation was carried out in order to reveal the ground realities of generation, distribution and demands.

Also an attempt was made to examine the policy issues, shaping up and regulating the power generation and distribution markets of Bangladesh. The expansion of market is constrained by a number of factors including existing regulatory framework and susceptible to interference and failure to attract IPP investments.

The fragile power supply situation will continue to worsen further beyond 2008 even if pragmatic steps are not taken now for increasing generation capacity. As yet, there is no immediate solution with regard to making up deficits. This would continue to affect the industrial growth and the economic development of the country.

Power supply in Bangladesh is passing through a critical phase. In particular, since reforms initiated in 1996, government investment has been drastically cut on one hand, and on the other hand, share private investment in power generation was insignificant.

As against the projected demand increase from 1997 to 2007 of (5367-2419) = 2948 MW, a capacity of only 2294 MW has been added during the same period causing a short fall of 654 MW. Shortfall of capacity has been further increased due to aging of generators, total estimated to about.700 MW. Gas supply shortage has caused another shortfall of 440 MW in daily availability of generation capacity. All these add to about 1700 MW.

Despite a lot of barriers in private investments as IPP and for captive power generation, the possibility of investment can be explored in areas where there is higher concentration of garment factories. The government has produced a 3-Year Road Map for Power Sector Reform (2008 - 2010), which may create an ambience in attracting investors. However, acute gas shortage is a major impediment for such investments to take place. Pertinent to mention that, “Private Sector Power Generation Policy of Bangladesh” was adopted in 1996. The Government approved “Policy Guidelines for Small Power Plants (SPP) in Private Sector” in 1998. Government should be persuaded strongly implement the above mentioned policies.

In view of this situation following recommendations have been drawn from the analysis of study findings

6.2 Recommendations

On the basis of the above findings the following recommendations are proposed

6.2.1 Short Term (Fast-track) Actions

There is no magic to combat the crisis of power supply in a short time. However, some mitigation measures can be taken up to partly remove the difficulties in the short term as proposed below:

1) Load Management programme now in hand nationwide should continue

In addition, following are recommended:

2) <u>Garment Sector</u>

a) Replace the magnetic ballasts of florescent lamps with electronic ballasts

RMG Industries use standard 4-ft. fluorescent tube lights, two per fixture with magnetic ballasts.

The ballasts consume power @15 to 21 each. These may be replaced with electronic ballasts thereby reducing power loss by about 12 watts per unit, which means it will reduce the power demand by 20% of lighting load i.e. about 15 MW. As a result, energy bill will also be reduced by Tk.222 million. This may cost about Tk 125 per lamp.

Alternatively, retrofit the sewing machine with integral lamps of low wattage (say, 7 watts) eliminating one of the two standard tubes from the ceiling fixtures.

This would save about 50% of lighting load. As a result, demand will come down to 37 MW and energy consumption reduced by 152 MkWh which will reduce the energy bill by Tk. 562 million. This needs an investment of Tk. 150 per machine.

However, this will house very little effect on load shedding problem.

3) <u>Utilities</u>

a) Shut down all shopping malls at 5 p.m in winter and 7 p.m in summer.

The on going measure of closing the commercial establishment at 8 P.M will not result the desired goal. It should be effected from the starting time of the peak load i.e. 5 P.M in the evening during winter period and 7 P.M in the summer period. This will help reduce the peak hour load substantially.

b) Replace all incandescent light bulbs with CFL in residential lighting.

Replacement of incandescent lamps by compact fluorescent lamps (CFL), is an important measure to take for reducing the load demand on account of lighting load. It is estimated to reduce about 320MW lighting load from the system. However, to increase the affordability of the consumers to purchase the CFL particularly by rural ones, these may be given to them on loan at a subsidized price. Loan may be recovered with electric bills within a year.

6.2.2 Medium Term Actions

Some energy conservation and Efficiency improvement measure may be taken up under mid-term programme such as.

a) Co-generation
b) Heat recovery boiler for hot water supply
c) Replace existing diesel engines with gas engines for standby generation

Item (a) and (b) are same thing (symbiotic). Prospect of co-generation is discussed below:

(a) Co-generation / (b) Heat Recovery Boiler for Hot Water Supply

Cogeneration is the use of a heat engine such as diesel engine, gas turbine etc. simultaneously generating electricity and heat. The heat of exhaust hot gas raising steam or hot water for steam turbine in combined cycle, district heating, and for process heat in textile mills, chemical industries etc. Garment factories co-generates process steam or hot water for calendaring of fabrics, sweaters and woven products. Use of co-generation is worth considering. However, it may be recommended only for the large factories, which have large diesel generators so that their exhaust gas may be passed through a heat recovery boiler to raise steam or hot water for various use in the factories. This would reduce the consumption of fuel and thus the production cost would reduce.

In the RMG factories having captive power generation in the range of 2000 to 3000 kW, with heat recovery boiler, generation of hot water utilizing the waste heat is a possibility.

For installation of such additional facilities, sufficient space shall be earmarked. But while surveying the RMG factories it is observed that there is space constraints which will be a general problem. However, it will need separate survey for specific industries having large captive generation.

- Therefore, the possibility of co-generation may be examined in depth by the owners of the large factories as to its technical and economic feasibility and may be implemented accordingly.

(b) Replacement of Existing Diesel Engines by Gas Engines

Diesel engine operation using diesel oil as fuel to generate electricity is costly as fuel is costly.

At current (during survey) price of Tk. 55/litres of diesel oil entails fuel cost of about Tk.11/kWh generated. Even at reduced price of Tk. 48/lit, fuel cost comes to about Tk.9.6/kWh. Compared to this, use of natural gas at Tk. 150/MCF will cost about Tk. 1.5/kWh.

In view of less cost of fuel, the existing diesel engines may be replaced by new gas engines. This will save about Tk.10.00 per kWh generated by standby generating.

If a 500KW diesel generator is replaced by same capacity of gas generator the capital cost (Tk. 12.5 million), shall be recovered within 3 (Three) years, considering energy generation per year (500kW x 900 hrs) 450,000 kWh, and savings per year shall be about Tk. 4.5 million.

- Therefore, it is recommended to replace the old diesel generators with new gas engine generators. Owners may examine the option to select the least cost solution for their respective factories.

- GOB should consider unrestricted supply of gas to these factories at the same price as for BPDB.

6.2.3 Long Term Actions

6.2.3.1 Strategy

Following strategy is proposed for improvement of power supply to garment industry.

Assumption: Power plant to be developed on IPP basis anywhere.

Case-1: Power plants to be developed on distributed basis sponsored by Garment Manufacturers Co-operative (GAMCO) to be organized and incorporated (See Option-1 Action Plans).

Power plants of appropriate capacities would be developed in Savar, Mirpur, Kaliakoir, Gazipur, Sonargoan, Kantchpur areas. Output of these power plant would be delivered to 33kV system of REB.

The sending end switches at 33kV substations and receiving end switches at garment factories will be kept "ON" all the time. Any surplus capacity whenever available will be absorbed by REB.

The Commercial arrangement may be as follows:

- GAMCO will sell power to PBSs at a tariff based on power purchase agreement (PPA) between PBS and GAMCO. The PBSs will sell power to RMG industries at existing tariff.

Case-2: A central power station of appropriate capacity may be developed by a IPP anywhere exclusively for an industry located at Dhaka or elsewhere (See Option-2 Action Plans).

- Power plants dedicated to the garment industry, rated adequately to the requirement.
- Generated power will be evacuated to national grid system existing in the country.
- Contracted power will be delivered to the industry at a nominal wheeling charge.
- To ensure delivery of contracted power all is required is to keep the receiving end switch "ON".
- In case where the industries are scattered, all is required is to keep the supply feeders to these industries "ON" all the time.

Thus, supply of power from a dedicated power plant located anywhere in the system to the beneficiary/client is ensured.

The commercial arrangement may be as follows:

All the generated power is to be purchased by the single buyer BPDB. It will buy all power from the power producer at a tariff based on power purchase agreement (PPA) between BPDB and IPP. BPDB will sell net power to the PBSs/Regional distribution companies, and pay wheeling charges to grid company. In their turn, PBSs/Regional distribution companies will sell power to the garment factories at existing tariff.

The power plant may be sponsored/ developed by a co-operative of the garment industry owners with equity arrangement with a foreign development partner. In this case GoB may provide all support to the developer.

The above are oversimplified description of strategies. If it is agreed in principle, detailed plans on the agreed option can be worked out for implementation. GOB has to adopt a new policy where required.

6.2.3.2 Action Plans

Recommended action plans are as follows:

A. Installation of Generating Stations Exclusively for Garment Industries

Option-1

Steps may be taken to install gas turbine generating stations in areas where garment industries are concentrated, under BOO (Built-Own-Operate) arrangement. Entrepreneurs may be the garment manufacturers cooperative(s) to be formed, or others may be interested to install these power plants under the existing IPP policy of the country. Output of these power plants would be catered to the garment factories through existing networks isolated from the grid.

2x20MW power plant each at Savar, Mirpur, Kaliakoir, Gazipur, Sonargaon, Kanchpur may be considered. Total estimated cost shall be about US$ 96 million and time required shall be 18 months.

Option-2

In case gas is not available the following option may be considered.

Build an imported coal based power plant of 300MW capacity at Chittagong on the east side of river Karnafully expressly for garment industries. This may take about 4 to 5 years. A policy intervention is required for this, because no such project is included in the plant documents. The estimated cost for this shall be about US$ 360 million.

The output of these power plants shall be used by the RMG industries at usual rate through the existing distribution system of BPDB / REB at agreed wheeling charge. Appropriate policy may be developed in this respect.

B Installation of Generating Stations as Planned by the Govt.

A pragmatic and whole-hearted effort should be made to implement the generating projects as planned, which have been discussed in Chapter-4, so that those are commissioned at scheduled times.

C Improving Power Supply Situation through Load Management

Investigate whether power supply to garment industries can be improved by reducing load shedding to the feeders supplying RMG factories. Our observations are that the locations of the RMG industries are such that the feeders supplying RMG industries cannot be separated from other consumers and hence cannot be relived from load shedding. However, if shopping malls are closed before the peak time occurs during a day some load shedding may be avoided.

D Exemption of Levies and Taxes for Installation of Own Generation by RMG Factories

To overcome the crisis of load shedding most of the RMG Industries have installed their own generation either, standby or captive. For standby generators imported Diesel oil is used as fuel, whereas the captive generators use indigenous gas. This may be persuaded during the coming years until the national generation capability improves. To encourage the RMG industries to this effect, Govt. should render all-out support by withdrawing all taxes & levies on the import of generators, by supplying gas at a rate earmarked for BPDB and by providing loans at lower interest rates.

Annexure-3.10:
Lighting Load of a Large Size, Medium Size and Small Size Factory

Table - 3.1: Lighting load of a Large Size Factory

Type of Light	Rated watt of light	Type of ballasts (if tube light)	Rated watt of ballast	Total watt/ lamp	Qty	Total connected load (kW)	Running hour in a day	Diversity factor	Total power demand (kW)
TL	40	M	20	60	1450	87	8	0.9	78

Table - 3.2: Lighting load of a Medium Size Factory

Type of Light	Rated watt of light	Type of ballasts (if tube light)	Rated watt of ballast	Total watt/ lamp	Qty	Total connected load (kW)	Running hour in a day	Diversity factor	Total power demand (kW)
TL	40	M	20	60	885	53.1	10	0.9	48

Table - 3.3 Lighting Load of a Small Size Factory

Type of Light	Rated watt of light	Type of ballasts (if tube light)	Rated watt of ballast	Total watt/ lamp	Qty	Total connected load (kW)	Running hour in a day	Diversity factor	Total power demand (kW)
TL	40	M	20	60	200	12	10	0.9	11

Annexure- 3.11:
Mechanical Load of a Large Factory, Medium Factory and Small Factory

Table - 3.4: Machine Load of a Large Factory

Machine Type	Built in PFI (Yes/ No)	Rated power hp/ watt	Quantity	Total connected Load kW	Running hour in a day hrs	Diversity factor	Total power demand (kW)
Cutting Section	-	1600	3	4.8	10	0.9	4.32
Sewing Section	-	250	1200	300	10	0.9	270
Total							**274**

Table - 3.5: Machine Load of a Medium Factory

Machine Type	Built in PFI (Yes/ No)	Rated power hp/ watt	Quantity	Total connected Load kW	Running hour in a day hrs	Diversity factor	Total power demand (kW)
Cutting Section	-	1600	4	6.4	8	0.9	5.76
Sewing Section	-	250	355	88.75	8	0.9	78.88
Total	(Including two other cutting & sewing sections)						**86**

Table - 3.6: Machine Load of a Small Factory

Machine Type	Built in PFI (Yes/ No)	Rated power hp/ watt	Quantity	Total connected Load kW	Running hour in a day hrs	Diversity factor	Total power demand (kW)
Cutting Section	-	746	4	2.98	4	0.9	2.68
Sewing Section	-	250	230	57.50	7	0.9	51.75
Total							**54**