

# **Impact of PESTLE Factors on Power Generation Projects of Bangladesh**

Submitted by

**Farhan Hussain**  
MPSM, Batch-2  
Student ID: 13182003

This Thesis Submitted in Partial Fulfillment of the Requirements  
For the Degree of  
Masters in Procurement and Supply Management

Supervised by

Professor & Dean Dr. Nazrul Islam  
Faculty of Business Administration  
Eastern University

April, 2013



Institute of Governance Studies  
BRAC University, Dhaka, Bangladesh



## **Declaration**

I hereby declare that I am the sole author of this thesis.

I authorize the Institute of Governance Studies (IGS) and BRAC University to lend this thesis to other Institutions or individuals for the purpose of scholarly research only.

I further authorize the IGS and BRAC University to reproduce this thesis by photocopying or by other means, in total or in part, at the request of other institutions for the purpose of scholarly research.

**Farhan Hussain**

Student ID: 13182003

Institute of Governance Studies (IGS),

BRAC University, Dhaka

## **Acknowledgement**

I am very grateful to the well known Dr.Nazrul Islam, Professor and Dean, Faculty of Business Administration, Eastern University, Dhaka for reviewing my manuscript in spite of his very busy schedule. He made several important suggestions which enhanced my study. I am also indebted to the Director, the faculty and staff members of Institute of Governance Studies, BRAC University, Dhaka for providing me with crucial study materials on research methodology and dissertation template. They allowed me to use the Computer Lab and the Library facilities of IGS, BRAC University from where I have obtained some important papers and articles which contributed immensely to the success of my study.

I am also thankful to my dearest colleagues and classmates of Cohort-2. They have been very helpful and encouraging, which allowed me to achieve my goals regarding this study. I also place on record, my sense of gratitude to one and all who, directly or indirectly have lent their helping hand in this venture.

**Farhan Hussain**

Student ID: 13182003

## **Abstract**

Generation of electricity in Bangladesh has been in prolonged crisis. To overcome this hindrance the government according to the road map has taken up several power production projects. However this journey to achieve a load shedding free Bangladesh has been very rocky. Some of the projects have faced criticism from pressure groups whereas other projects have become uncertain due to lack of funding or technical knowhow. The main reason for this failure has been lack of analysis and planning. PESTLE is one of the project management analysis tools that can be used as a solution to this problem. The rationale for this study is (1) To examine how these PESTLE factors or changes to these factors affect the power production projects. (2) To determine best possible solutions when these factor changes or remains unchanged so that projects can still attain their objectives.

In this study Literature review has been used to collect both primary and secondary information using the website, obtaining articles from newspapers and the library. Qualitative research is useful during the early stages of a study when the researcher may be unsure of exactly what will be studied or what to focus on and gives the researcher freedom to let the study unfold more naturally. In this study it has been observed that there are some PESTLE factors that have major impact on the outcome of the projects and these major factors vary from one project to another. So it is crucial to examine which factors are major and which are minor. Once the major factors related to a particular project have been determined the next step would be to choose the best possible solution to those factors so that they could be made favorable to accomplish the objectives of the project.

## TABLE OF CONTENT

Acknowledgement.....	i
Abstract.....	ii
Table of Content .....	iii
Acronyms.....	v
List of Tables.....	vii
List of Figures .....	viii
1 Introduction.....	1
1.1 Background.....	2
1.2 Statement of the problem.....	8
1.3 Objective of the study .....	10
1.4 Limitation of this study .....	13
1.5 Chapter Outline.....	14
2 Research Methodology .....	16
2.1 Introduction .....	17
2.2 Objectives and importance of research.....	17
2.3 Classification of Research models .....	19
2.4 Methods of collecting data .....	20
2.5 Population and population size .....	21
2.6 Place of study, duration and analysis tools used .....	22
3 Scenario of Power Sector.....	23
3.1 Introduction .....	24
3.2 Renewable Energy .....	25
3.2.1 Solar Energy .....	26
3.2.2 Micro Hydro .....	26
3.2.3 Biogas.....	26
3.2.4 Wind Energy .....	27
3.2.5 Biodiesel.....	28
3.2.6 Ocean wave energy and Tidal power.....	29
3.3 Rental power plants.....	29
3.4 Import of electricity and Regional co-operation .....	34
3.5 Rental power plants.....	36

3.6	The 1320 MW Rampal power project .....	40
3.7	Cobined Cycle power plants .....	43
3.8	Public Private Partnership energy projects .....	45
4	PESTLE Analysis of Power Generation Projects .....	47
4.1	Introduction .....	48
4.2	PESTLE analysis method .....	50
4.3	PESTLE analysis template .....	54
4.4	Impact of political factors on power generation projects .....	57
4.5	Impact of economical factors on power generation projects .....	63
4.6	Impact of socio-cultural factors on power generation projects .....	70
4.7	Impact of technological factors on power generation projects .....	78
4.8	Impact of legal factors on power generation projects .....	86
4.9	Impact of environmental factors on power generation projects .....	91
5	Conclusions and Recommendations .....	98
5.1	Conclusions .....	99
5.2	Reasons for failure and success of power generation projects.....	99
5.3	Recommendations .....	103
5.3.1	Suggestions to remedy failure of power generation projects .....	103
5.3.2	Adequate planning by writing a good PEST analysis .....	106
5.3.3	Facilities for Training and Education .....	108
5.3.4	Establishing Good Governance.....	109
5.3.5	Update PESTLE analysis regularly .....	109
5.3.6	Alternative business analysis tools.....	110
5.4	Concluding Remarks .....	112
	Appendix A : Definition of key technical terms .....	114
	Appendix B : Questionnaire.....	118
	References.....	120

## Acronyms

ADB	: Asian Development Bank
ADFD	: Abu Dhabi Fund for Development
APSCL	: Ashuganj Power Station Company Limited
B2B	: Business to Business
BAEC	: Bangladesh Atomic Energy Commission
BAPA	: Bangladesh Poribesh Andolon
BELA	: Bangladesh Environmental Lawyers Association
BERC	: Bangladesh Energy Regulatory Commission
BPC	: Bangladesh Petroleum Corporation
BPDB	: Bangladesh Power Development Board
BOI	: Board of Investment
BOOT	: Build-Own-Operate-Transfer
BUET	: Bangladesh University of Engineering and Technology
CEGIS	: Center for Environmental and Graphical Information Service
CHT	: Chittagong Hill Tracks
DOE	: Department of Environment
DSM	: Demand Side Management
EIA	: Environment Impact Assessment
EIB	: European Investment Bank
ECA	: Export Credit Agency
ERD	: Economic Relations Division
FDA	: Food and Drug Administration
FDI	: Foreign Direct Investment
FPI	: Foreign Portfolio Investment
GCM	: Global Coal Management
GDP	: Gross Domestic Product
GoB	: Government of Bangladesh
HVDC	: High Voltage Direct Current
IAEA	: International Atomic Energy Agency

ICS	: Improved Cooking Stove
ICT	: Information and Communication Technology
IDCOL	: Infrastructure Development Company Limited
INES	: International Nuclear Event Scale
IMF	: International Monetary Fund
IPFF	: Investment Promotion and Financing Facility
IPP	: Independent Power Producers
JV	: Joint Venture
LGED	: Local Government Engineering Department
MDG	: Millennium Development Goal
MoU	: Memorandum of Understanding
NGO	: Non Government Organization
NPP	: Nuclear Power Plant
NTPC	: National Thermal Power Corporation
PESTLE	: Political Economical Socio-cultural Technological Legal Environmental
PPA	: Power Purchase Agreement
PPA	: Public Procurement Act
PPP	: Public Private Partnership
PPR	: Public Procurement Rules
PSMP	: Power System Master Plan
QRPP	: Quick Rental Power Plant
RET	: Renewable Energy Target
SFD	: Saudi Fund for Development
SHS	: Solar Home System
SRE	: Sustainable Rural Energy
SWOT	: Strength Weakness Opportunities Threat
TEC	: Tender Evaluation Committee
TIB	: Transparency International Bangladesh
TOC	: Tender Opening Committee
UNDP	: United Nations Development Programme
USAID	: US Agency for International Development



## LIST OF TABLES

Table	Page
Table 1: Electricity Demand Forecast.....	4
Table 2: Lists Year-wise Projected Power Demand and Supply .....	24
Table 3: Solutions to Rooppur NPP crisis .....	39
Table 4: Subject of PEST analysis .....	55
Table 5: Calendar Year Wise Projects Completion (From 2012 to 2016) in MW .....	67
Table 6: Actual Efficiency of Gas fired Power Plant.....	80
Table 7: Coal based Power Plant Additions .....	84
Table 8: Electricity Production in Private and Public sector.....	100

## LIST OF FIGURES

Figure	Page
Figure 1: Power Generation Plan till 2030 by Fuel Type .....	4
Figure 2: PESTLE analysis of an organization.....	7
Figure 3: Different forms of Renewable Energy .....	25
Figure 4: Fuel Mix for Rental Projects set up in 2010-2011 .....	31
Figure 5: Taka per unit in consecutive Fiscal year .....	33
Figure 6: PESTLE factors in a geographical presentation .....	50
Figure 7: Impact on business due to changes in PESTLE factors .....	53
Figure 8: Power Development Plan by FY 2030.....	65
Figure 9: Power Generation (FY 2011): 4500 MW .....	72
Figure 10: The Elements of SWOT Analysis .....	111

# **Chapter 1**

---

## **Introduction**

## 1.1 Background

Bangladesh is one of the most densely populated countries in the world with about 161 million people living in 147,570 sq kilometers of land. It is also mostly agrarian, about 79% of its population live in rural areas. It is generally recognized that energy is the most essential factor for economic growth and human development in the modern world. There is a very strong correlation between economic development and energy utilization which are directly proportional to each other. The per capita annual consumption of 272 kW makes Bangladesh one of the lowest energy consuming countries in the world.

Bangladesh's economy is growing rapidly over the past decades and has been at an average of 6% annually since 2008 despite the global financial crisis and severe recession in the global economy in the last 3-4 years. Yet it remains an LDC. Bangladesh is striving to achieve a Middle Income Country (MIC) status by 2020. It can do so if it is able to push the economic growth to an average of 7%. In that case the energy growth needs to double. The country has made significant strides in the MDG goals and is set to exceed the targets in many areas of the social well-being by more than half. It has already made significant improvements in reducing infant and maternal mortality rates, improving school drop-out rates, attendance and enrollment of girl child, etc.

However the country needs to invest in energy significantly and improve its power generation capacity in order to achieve all the goals under social, economic and environmental aspects of sustainable development including achievement of the MDG goals. To attain a sustainable GDP growth of 6% and above by 2020 and beyond, it is deemed necessary to meet the essential energy needs of the people. In this regard, the GoB needs, at the very least, to increase its primary energy supply by 3-4 (2200 million cft/day) times and its electricity generation capacity by approximately 6 times (30,000MW/day).

The demand for energy is increasing day by day due to accelerated industrialization, rapid urbanization, infrastructure development and an emerging consumer society. The nation as a whole is trying to catch up with ICT. The "Digital Bangladesh" agenda of the government is focused on fast-forwarding ICT capacities at all levels –grassroots, sub-national and national - to leap-frog the country into the 21<sup>st</sup> Century. The prime mover of this agenda and the demands

mentioned above will be power supply. Therefore, the government has a declared vision of “Electricity for all by 2021”.

In the conventional power generation sector, the country has been able to somewhat reduce the gap between the current demand and supply, through the setting up some plants in public and private sectors that have produced the additional power. However, as the population grows and the economic activities gear up with rapid urbanization and industrialization, the demand for energy will far outstrip the production as it is expected. Subsidy provided to the entire power sector has become unsustainable over the years and the government has initiated phase-wise withdrawal of subsidy by increasing the price of electricity, which is unpopular but necessary. A direct impact on the common people of such action is the rise in living cost as cost of transport fares go up and as a result the prices of essentials and other food and non-food items rises. Till date, gas has remained the major source of primary energy in the country. Coal would be a much cheaper source of energy for the country with new reserves found recently which are promising. The government is also considering having electricity from a nuclear power plant, as well as exploring other options like regional power sharing.

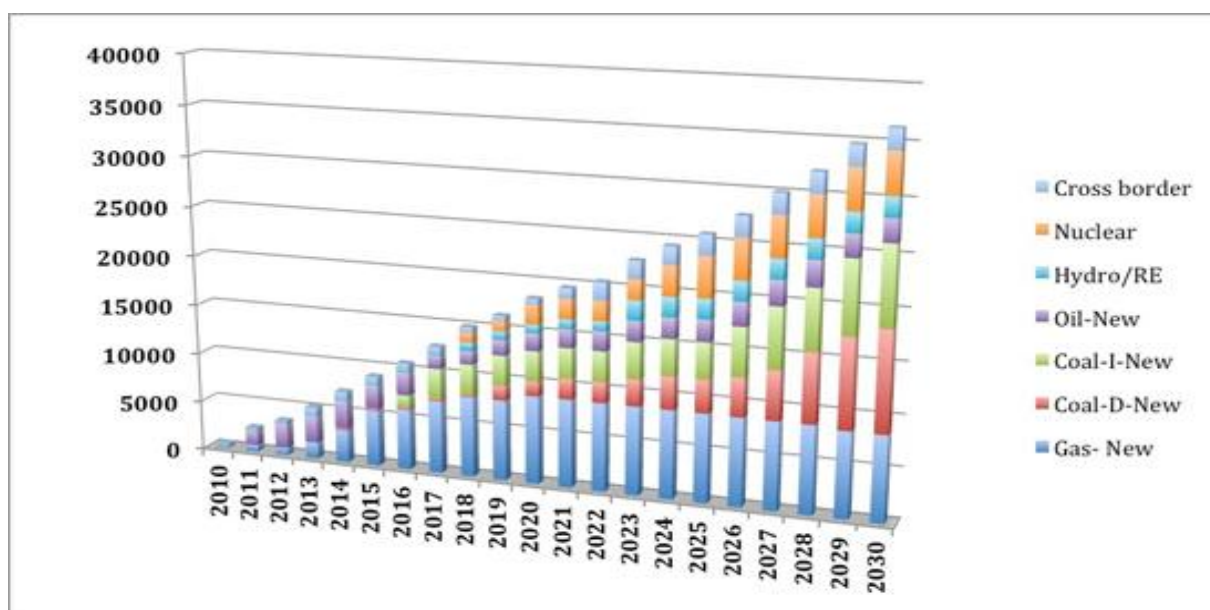
In recognition of the need to promote sustainable energy in the country, encompassing renewable energy, energy efficiency and energy conservation, the government is in the process of instituting the Sustainable & Renewable Energy Authority (SREDA) as a national nodal organization for promoting such energies in the country. With a view to promoting sustainable energy in the country, the government plans to generate 5% electricity from renewable resources by 2015 and increase it to 10% by 2020. The focus of renewable energies will be on off-grid and remote areas to provide energy services to the poor as well as urban areas where street lights can be solar powered and high rise buildings are already mandated to include 15% solar energy.

The Power System Master Plan 2010 (PSMP) forecasted year wise demands for electricity in Bangladesh up to 2030. The power demand forecast shows that the demand for electricity will be growing at around 10 percent over the next decade. The growth will slow down after that and will stabilize at a rate of 7 percent from the year 2028 onwards. Given such a GDP growth scenario, the demand for electricity both grid and captive is expected to be as shown in the following Table 1

Year	Demand in MW
2015	12000
2021	20000
2030	36000

**Table 1.1 Electricity Demand Forecast (Source: Powercell)**

To meet the demand with reasonable reliability, installed capacity must be increased to 23,000MW and 37,000 MW by 2021 and 2030. In line with this master plan, government has already taken short, mid and long term generation, distribution and transmission programs, which are at various stages of planning and implementation level. According to the existing generation expansion program, total 13,000 MW of new generation will be added to the national grid within FY 2015 (<https://docs.google.com/>). Indigenous natural gas, coal, LPG, LNG, nuclear, and hydro resources are mainly considered as fuel for the additional generation plan. It also includes cross-border trade. Other factors such as availability of fuel, cooling water, transportation of heavy equipment, proximately to grid network and load center etc. are also considered for plant placement. The generation plan up to 2030 segmented by fuel type is illustrated by the following Figure 1



**Figure 1.1 Power Generation Plan till 2030 by Fuel Type (Source: Powercell)**

As part of its sustainable energy agenda, the government is actively striving to promote Energy Efficiency (EE) and Energy Conservation (EC). These are two areas, which are mutually complementary, where significant amount of power/energy can be saved and redirected for economic use in the country. Outdated boilers, inefficient motors and use of old technologies are costing heavily through inefficient energy use. Bangladesh needs to opt for low consumption and low cost smart technologies by bringing policy changes in its import and production of technologies that use energy. At the same time leakage, pilferage and waste of energy at all levels needs to be brought under control through effective means.

Some initiatives have already been taken by the government in this regard, but more needs to be done. Some initiatives have already been taken by the government in this regard, but more needs to be done. For example, use of gas meters in households in some areas has yielded positive results. It needs to be extended to other commercial consumers like hotels, restaurants, shops using gas burners, etc and expanded in all areas for households. That will bring about a good reduction in the wastage in gas by the domestic and commercial users. Efficient energy use at every level including generation, transmission, distribution in the supply side and in demand side introduction of energy efficient household appliances; energy efficient equipment in the industries; CFL bulbs and energy efficient electric fans in households, offices and industries; etc can bring about a significant saving in energy through increased efficiency. Introduction of green building technology, energy efficient bricks, smart technologies that cut or reduce power supply when equipment are not in use or rooms are not occupied can save energy through conservation.

PESTEL analysis stands for "Political, Economic, Social, and Technological, Environmental and Legal analysis". It is a part of the external analysis when conducting a strategic analysis or doing market research and gives a certain overview of the different macro environmental factors that the project team has to take into consideration. Political factors include how and to what degree a government intervenes in the economy. This can include government policy, political stability or instability in overseas markets, foreign trade policy, tax policy, labour law, environmental law, trade restrictions and so on. Economic factors have a significant impact on how an organization does business and also how profitable they are. Factors include – economic growth, interest rates, exchange rates, inflation, disposable income of consumers and businesses and so on. These factors can further be broken down into macro-economical and micro-economical factors.

Macro-economical factors deal with the management of demand in any given economy. Governments use interest rate control, taxation policy and government expenditure as their main mechanisms they use for this.( <http://www.professionalacademy.com/.....>)

Socio-cultural factors are the areas that involve the shared belief and attitudes of the population. These factors include – population growth, age distribution, health consciousness, and career attitudes and so on. These factors are of particular interest as they have a direct effect on how marketers understand customers and what drives them. Environmental factors have only really come to the forefront in the last fifteen years or so. They have become important due to the increasing scarcity of raw materials, pollution targets, doing business as an ethical and sustainable company, carbon footprint targets set by governments (this is a good example where one factor could be classified as political and environmental at the same time). These are just some of the issues marketers are facing within this factor. More and more consumers are demanding that the products they buy are sourced ethically and if possible from a sustainable source.

We all know how fast the technological landscape changes and how this impacts the way we market our products. Technological factors affect marketing and the management thereof in three distinct ways:

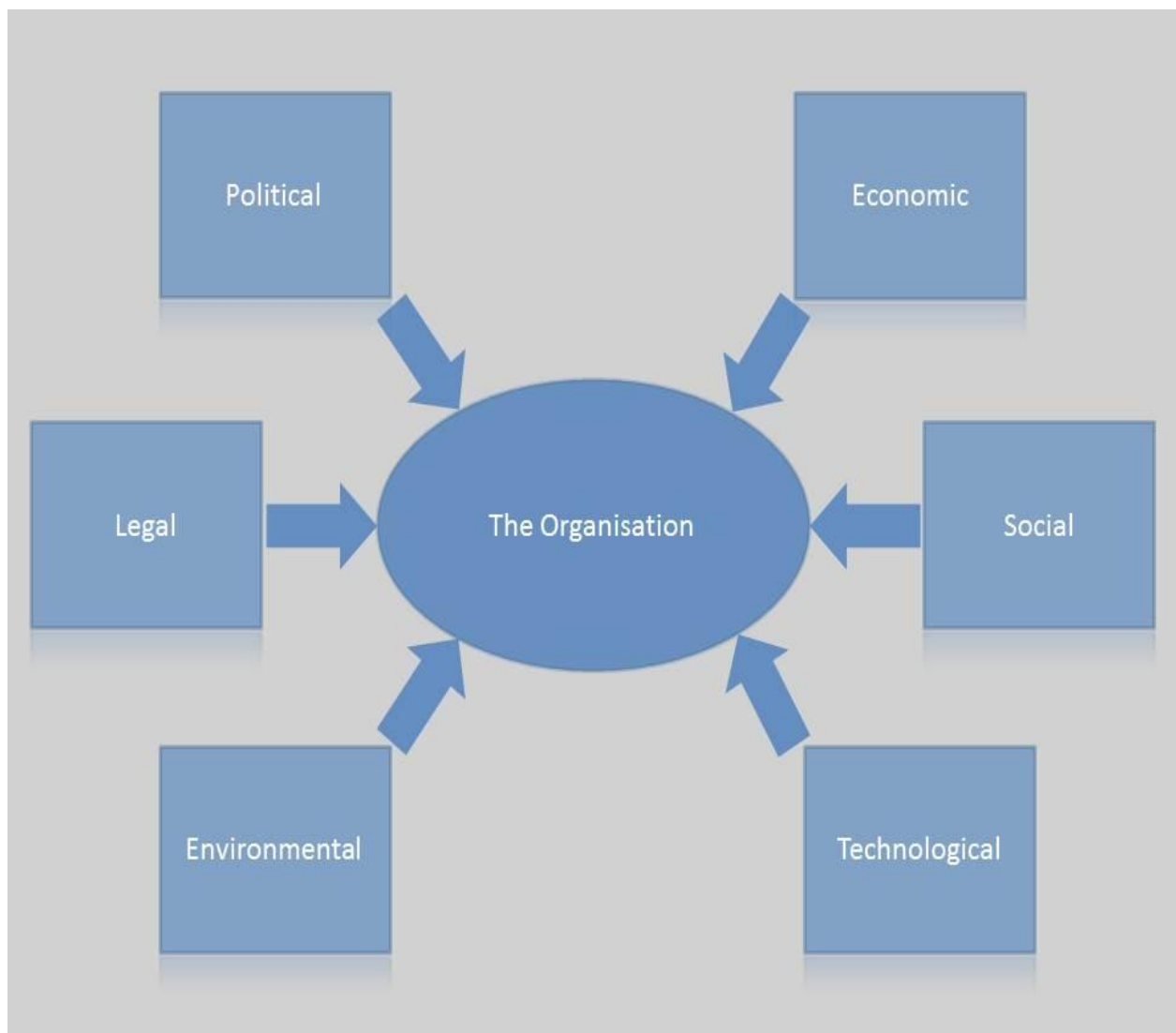
- New ways of producing goods and services
- New ways of distributing goods and services
- New ways of communicating with target markets

Legal factors include - health and safety, equal opportunities, advertising standards, consumer rights and laws, product labeling and product safety. It is clear that companies need to know what is and what is not legal in order to trade successfully. If an organization trades globally this becomes a very tricky area to get right as each country has its own set of rules and regulations.

Bangladesh Government in order to mitigate the energy crisis will be engaged in several projects for the next decade or so. These projects are taken up by both private and public sector entity. During the planning stage of these projects they need to take into consideration the PESTEL analysis. The projects vary in different ways such as PESTEL factors related to coal based power plants may not be same to that of combined cycle power plant. Example: In a coal based power



plant emphasis should be given more on environmental factors where as gas based power plant consideration should be given more on political factors. So for each project the organization need to use PESTEL tool and set up corresponding PESTEL template for each of those projects. Successful implementation of these power projects requires consideration of almost all major factors regarding politics, economic, social, technological, legal and ecological during the planning stage. Each public/private entity conducting the project needs to make up a spider web of the PESTEL factors according to the following Figure 1.2



**Figure 1.2 PESTLE analysis of an organization.**

## **1.2 Statement of the problem:**

All the energy projects have factors which are major and others which are minor. The major factors are those that has significant influence on the project where as the minor factors are those that do not have much power on the project. As mentioned earlier factors which are major and factors which are minor depend solely on the power project in question. It is essential to consider the major factors in the PESTEL analysis as it will impact on the outcome and the objective of the energy project on hand. In case of nuclear power plant project technology, economy and environmental factors are crucial whereas for import of power from neighboring factor such as political have significant authority.

It is very important for the Government and the private entity initiating the project to consider the major factors in the PESTLE template. So first of all one has to understand which factors are major and which are not. There have been many incidents where project has failed due to inappropriate selection of these factors. Secondly once proper factors has been considered it is crucial to take the best possible action regarding the major factors affecting the project objectives. One example where Bangladesh Government has failed to take the best possible action on the environmental factor of the Rampal power plant project.

The National Thermal Power Company of India and the Power Development Board of Bangladesh were to set up the Bagerhat coal-based power plant at Rampal. It was initially proposed that Indian coal would be used for the plant. However, the proposal was dropped because of the poor quality of Indian coal. Now, there are talks about importing high-quality coal from either Indonesia or Australia. This environmentally devastating project is to be financed with costly buyer's credit and India will own half of it with almost no direct investment. A joint venture, styled the Bangladesh-India Friendship Power Company Limited, is likely to start the project on Bangladesh soil, apparently in India's interest. Local people began agitation to save their agricultural land as soon as the government stepped into acquiring 1,834 acres of land. The project area lies only 10 kilometres away from the environmentally critical area of Sundarban; so, very soon the environmentalists from all over the country got concerned and stepped in to oppose it. The Bangladesh government fixed the project area without any economical benefit, technical feasibility, social and environmental impact study. Later, an eyewash study in the name

of initial environmental examination was done by the Centre for Environmental and Geographical Information Services, to get environmental clearance. The executive summary of the study stated:

- Firstly Local Clearance Certificate and thereafter Environmental Clearance Certificate shall be obtained from DOE for industrial unit falling under Red Category. In general local people are supportive except the project affected land owners. However, proper resettlement plan, adequate compensation and employment opportunity will make them cooperative towards the project.
- Impacts at the construction phase will include visual intrusion, local air pollution due to generation of dust particles and emissions from engine vehicles, noise from machinery and engine vehicles....Good housekeeping...noise control devices and waste management might mitigate the impacts. The possibility of deterioration of groundwater quality due to leakage and spillage of oils and chemicals might be controlled by proper maintenance of the storage.
- Provision of rainwater harvesting and retention ponds may mitigate the groundwater draw-downing. Sediment runoff from the construction site that might affect the aquatic habitat should be controlled. The fisheries and wildlife habitat might be protected by creating minimum disturbance during the construction phase. Disturbance to the dolphin colony might be reduced by limiting the construction activities.
- During operation period, air pollution might occur due to emission of SO<sub>x</sub>, NO<sub>x</sub> and SPM. Stack of 275m height and maintaining DOE standard of emission by using advance technologies of pollution control might reduce the air pollution. The most likely impacts from the thermal power plants are deterioration of surface water quality due to sediment runoff, runoff from coal yard, and discharge from thermal flume. Provision of runoff control and treatment of thermal flume might reduce the impacts.
- Excess mining of the groundwater may drawdown the groundwater level so that provision of groundwater infiltration should be considered. Apart from potential negative impacts, the proposed project will bring infrastructural development, economic development and as well as regional development. (<http://www.newagebd.com/detail.php.....>)

Thus, the executive summary mentioned many impacts (may, might) and suggested many solutions (should be, might be) that might reduce the environmental impacts. But the study finally states: ‘however, the present electricity crisis demands the project for national development. At the end, it can be said that the potential benefits may outweigh the negative impacts.’ Well, the CEGIS’s EIA report measures the potential environmental impacts, but, instead of commenting on whether the project should be acceptable or not, it suggests (with several times ‘should be’ and ‘might be’) measures to mitigate those impacts. Whether those measures are being practised in or outside the country, are not mentioned. It says a good number of people are to be evicted, valuable croplands to be vanished and negative impacts shall be there on the environment, but mitigation measures are suggested. Those suggestions are such that, if the Rampal project creates hell in the area, appropriate measures can turn it to heaven again. The EIA report does not mention the wind direction from October to May when it flows from north to south, when the toxic gas and materials to be emitted from the plant are to overlay and devastate Sundarban areas.

It is now clear that the IEE and EIA studies of CEGIS were aimed only to support the anti-people and environmentally disastrous project. The EIA advocates that the project is taken following the Environment Conservation Rules of 1997. The workshops and consultations with the local people were staged and imposed. It states lots of job shall be created but not how many people will lose their livelihood with the change. It does not compare the disastrous effects on animal and environment with the proposed benefits.

So from the above article it can be understood that any private/public entity engaged in the energy projects fails to properly conduct PESTLE analysis will result in negative impact on the project.

### **1.3 Objective of the study:**

The rationale of this study is to have a clear understanding of the PESTLE factors for different energy projects. The importance of different PESTLE factors vary according to the energy projects to be implemented. Environmental factors are crucial for nuclear power plants, coal power plants whereas political factors are important for import of power from neighboring

countries and combined cycle power plants. To understand more in details the following article will provide which factors are crucial in case of Rooppur power plant project.

Nuclear power plant (NPP) offers the prospect of environmentally clean power supply at low operating costs over the long term. The estimated \$1.5 to \$2 billion construction cost of the Rooppur NPP does not seem expensive for such a plant. However, more details are needed about the modernity and sophistication of the NPP technology to be installed -- the components of the construction cost that will not be covered by the cited cost figure, and the proportion of the construction cost that will be local (in Bangladesh taka). Information is needed about the contracted operating fees, servicing fees, uranium costs, used fuel and waste management cost, decommissioning cost, and the cost of supporting facilities.

The various cost components are duly factored in, it needs to be evaluated whether the Russian collaboration is the most cost effective choice for Bangladesh. Prior to 2009, China offered to build and fund the Rooppur plant; South Korea also offered financial and technical help. It is thus unclear as to what comparative evaluations led to the agreements with Russia. According to the 2011 agreements with Rosatom (Russian atomic agency), Russia will supply the enriched uranium fuel and repatriate the used fuel back to Russia, and the Russian firm Atomstroyexport will build the NPP. Given the physical distance between Russia and Bangladesh, and the transportation and navigation arteries to Rooppur, the plan for long distance ferrying of the radioactive materials needs to be known and carefully evaluated. The plan for a repository of the radioactive waste is not quite known either, although low level wastes might be concealed beneath the NPP structures. Any radioactive waste repository in Bangladesh, however, exposes the connected water and marine system to grave risks of contamination due to seepage. These issues are more pertinent in Bangladesh than in Russia or elsewhere, given Bangladesh's topography, population density, and population proximity to any corridor.

International Nuclear Event Scale (0 to 7, each increment is roughly ten times more severe) measures the severity of NPP events. By any estimation, the hazardous effects of a higher level event on health, water and food chain, and in general on the riverine ecological system of Bangladesh will be many times greater than those the world has hitherto witnessed. Bangladesh is a very small country and any radioactive material released into the open is likely

to spread quickly to much of the country and the neighboring regions of India, exposing possibly more than hundred million people to nuclear contamination. While the government of Bangladesh is expected to have conducted in-depth study of the potential impacts of INES higher scale events, the information needs to be more widely circulated, examined and debated.

Before constructing and operating the Rooppur or any other NPP, it is essential that not only the risks be measured/estimated, but also an efficient and well-resourced risk control and disaster management system is designed, put in place and well-rehearsed ahead of time. This is of paramount importance because NPP will be a novel venture for Bangladesh, but the country is not reputed for its governance effectiveness, safety and disaster management record and preparedness. Moreover, the infrastructure, from transportation to medical, is grossly inadequate even under normal circumstances. It is unfathomable how Bangladesh can quickly evacuate and relocate say just a few hundred thousand people from the Rooppur area, not to speak of the expected millions.

Once we have had thorough understanding of which PESTLE factors are important to a particular power plant project, the next step would be take proper steps and action against those crucial factors. The public/private entity needs to choose the best possible solution to the major factors of that particular project. Regarding Rooppur plant the Government has taken the following best possible options:

Proposed nuclear power plant at Rooppur is likely to be set up on the basis of build-own-operate-transfer (BOOT) system. A final deal with Russia concerning the plant is expected to be signed within this year with the aim of commissioning it by 2017. During the last three years, the government has made considerable progress in meeting the requirements specified by the International Atomic Energy Agency (IAEA) for building the long-sought-after nuclear power plant to resolve the country's energy crisis. A number of deals, framework agreements and MoUs have already been signed with Russia for peaceful use of nuclear power, technology transfer, creating human resources to run a nuclear power plant, supply of required fuel and taking spent fuel back. IAEA has a set of general guidelines regarding a nuclear power plant. Recently, it gave Dhaka 20 specific suggestions concerning the financier and ownership of the proposed plant, its safety measures and legal framework. Safety is Bangladesh's number one priority.

Officials of Russian State Atomic Energy Corporation and IAEA, who had visited Bangladesh and the Rooppur site, are genuinely impressed to see the infrastructures.

On safety measure, one more crucial deal - nuclear radiation safety control has been signed with Russia. Under the deal, Russia will fully cooperate with Bangladesh in radiation leakage control. The cabinet recently approved a draft of the deal. The proposed nuclear plant is expected to be built with modern technology to preclude the chance of radiation leakage as in Japan's Fukushima. The nuclear reactor will automatically be shut down in case of any leakage. Bangladesh is going to frame a law and form an independent regulatory body to carry out IAEA's suggestion of forming a legal structure for implementing a nuclear project. The cabinet in the recent past approved in principle a draft Bangladesh Atomic Energy Regulatory Act, which is now being vetted by the law ministry. The draft will be placed at the parliament session soon. A five-member independent regulatory body comprising experts will be formed after it is enacted. The proposed regulatory body will be the supreme authority regarding the nuclear plant, its operation and use. Russia has also agreed to train Bangladeshi engineers and other technical persons for creating necessary workforce to operate the plant. The trainees will work in Russian plants for two years before starting their assignments in Bangladesh. As suggested by IAEA, Bangladesh government has to involve various stakeholders and conduct a nationwide campaign so that people are well aware of the project and its risk factors.(<http://www.thefinancialexpress..>)

So it is very important that the best possible option should be selected so that the project achieves its main objectives and the desired outcome. At the end of this study suggestions and recommendations will be provided on the options that can be chosen for the major factors of different energy projects.

#### **1.4 Limitation of this study:**

The development of any sector is a continuous, dynamic and multi-dimensional process. It is necessary to change required plans and strategies to adjust with this process. Therefore, a number of addition, revision, and extension have been made in the roadmap. Moreover, a range of new initiatives to generate power have been taken up. As many new independent power producers have shown their interest in electricity production, a revised target of additional 12,473 MW (instead of 9,426 MW) by 2015 has been fixed together with adoption of different new

programme. Installation of quick rental power plants, repairing and restructuring existing power plants and improvement of electricity demand management aimed at rapid enhancement of electricity generation capacity. As demand and capacity management is dynamic the prioritization of PESTLE factors for different energy projects will also change with time. Such as for coal based power plant political factor was not considered to be that important in the past but now due to increase of coal based power plant projects in recent years has put political factor on top of the priority list. It is because coal will be required to be imported from abroad countries which will in turn require closer diplomatic relations with them. So as it is dynamic, PESTLE analysis will be required to be updated regularly which can be difficult and cumbersome.

The limitation of this study is also caused by the limitations of PESTLE factors. The drawback of the PESTLE analysis is that it can become too focused on the historical or current instead of future environment. It can become long and time consuming and it may be hard to predict the impact of the significant factors. The constant and unpredictable changes make the environment uncertain and organizations need to adapt faster. It also fails to mention potentially significant contextual factors such as demographic trends and issues relating to globalization. Collecting large amounts of information may make it difficult to see the wood for the trees and lead to "paralysis by analysis." PEST analysis only covers the external environment and the results need to be considered with other factors, such as the organization itself, competitors and the industry in which it is working. The analysis may be based on assumptions that prove to be unfounded.

### **1.5 Chapter Outline:**

This study has been represented in 5 different chapters. The first chapter provides the background of the study upon which the study was conducted. It also provides the guideline on the rationale of this research, its limitation and the objectives. The second chapter is based on the methodology used to carry out this study. It also provides information on how survey was conducted, the size of the population and the place where it was conducted.

The third chapter shows the current scenario of the power sector and what measures the government has taken to accelerate this sector. It also provides some exclusive information of the road map of energy and power sector developed by the government.



The fourth chapter is the backbone of this study. It resembles how PESTLE factors impact on the power sector. What are the major factors and the minor factors related to any particular energy project. How changes in these factors affect the balance of the power sector has also been explained.

The last chapter is the conclusions and recommendations. It draws out the findings and the important points of this study. At the end some recommendations and suggestion have been provided which will definitely help any government/ private entity to achieve their mission on power generation projects.

## **Chapter 2**

---

### **Research Methodology**

## **2.1 Introduction:**

Research is a scientific inquiry aimed at learning new facts, testing ideas, etc. It is the systematic collection, analysis and interpretation of data to generate new knowledge and answer a certain question or solve a problem. Research is a systematic search for information and new knowledge. It covers topics in every field of science and perceptions of its scope and activities are unlimited. A basic research method is a more formal way of going about asking questions. We usually begin with something very specific we want to know. Then we ask the question or questions in a structured way. This structure is called a methodology. In research, there are a lot of different kinds of methodologies, and some of them are very complicated. However there are some basic ones that have been tried and tested, and which can be easily learned.

Research is a logical and systematic search for new and useful information on a particular topic. It is an investigation of finding solutions to scientific and social problems through objective and systematic analysis. It is a search for knowledge, that is, a discovery of hidden truths. Here knowledge means information about matters. The information might be collected from different sources like experience, human beings, books, journals, nature, etc. A research can lead to new contributions to the existing knowledge. Only through research is it possible to make progress in a field. Research is done with the help of study, experiment, observation, analysis, comparison and reasoning. Research is in fact ubiquitous. For example, we know that cigarette smoking is injurious to health; heroine is addictive; cow dung is a useful source of biogas; malaria is due to the virus protozoan plasmodium. (<http://arxiv.org/pdf/physics/0601009.pdf> )

## **2.2 Objectives and Importance of Research:**

The prime objectives of research are:

- (1) To discover new facts
- (2) To verify and test important facts
- (3) To analyse an event or process or phenomenon to identify the cause and effect relationship
- (4) To develop new scientific tools, concepts and theories to solve and understand scientific and nonscientific problems

- (5) To find solutions to scientific, nonscientific and social problems and
- (6) To overcome or solve the problems occurring in our everyday life.

Research is important both in scientific and nonscientific fields. In our life new problems, events, phenomena and processes occur every day. Practically implementable solutions and suggestions are required for tackling new problems that arise. Scientists have to undertake research on them and find their causes, solutions, explanations and applications. Precisely, research assists us to understand nature and natural phenomena. Some important avenues for research are:

- (1) A research problem refers to a difficulty which a researcher or a scientific community or an industry or a government organization or a society experiences. It may be a theoretical or a practical situation. It calls for a thorough understanding and possible solution.
- (2) Research on existing theories and concepts help us identify the range and applications of them.
- (3) It is the fountain of knowledge and provides guidelines for solving problems.
- (4) Research provides basis for many government policies. For example, research on the needs and desires of the people and on the availability of revenues to meet the needs helps a government to prepare a budget.
- (5) It is important in industry and business for higher gain and productivity and to improve the quality of products.
- (6) Mathematical and logical research on business and industry optimizes the problems in them.
- (7) It leads to the identification and characterization of new materials, new living things, new stars, etc.
- (8) Only through research can inventions be made; for example, new and novel phenomena and processes such as superconductivity and cloning have been discovered only through research.
- 9) Social research helps find answers to social problems. They explain social phenomena and seek solution to social problems.

(10) Research leads to a new style of life and makes it delightful and glorious.

### **2.3 Classification of Research models:**

Broadly speaking there are two major types of research models: quantitative research and qualitative research. Qualitative Research is collecting, analyzing, and interpreting data by observing what people do and say. Qualitative research is much more subjective than quantitative research and uses very different methods of collecting information, mainly individual, in-depth interviews and focus groups. The nature of this type of research is exploratory and open-ended. Small numbers of people are interviewed in-depth and/or a relatively small number of focus groups are conducted. Participants are asked to respond to general questions and the interviewer or group moderator probes and explores their responses to identify and define people's perceptions, opinions and feelings about the topic or idea being discussed and to determine the degree of agreement that exists in the group. The quality of the finding from qualitative research is directly dependent upon the skills, experience and sensitive of the interviewer or group moderator.

The three most common qualitative methods are participant observation, in-depth interviews, and focus groups. Each method is particularly suited for obtaining a specific type of data.

- Participant observation is appropriate for collecting data on naturally occurring behaviors in their usual contexts.
- In-depth interviews are optimal for collecting data on individuals' personal histories, perspectives, and experiences, particularly when sensitive topics are being explored.
- Focus groups are effective in eliciting data on the cultural norms of a group and in generating broad overviews of issues of concern to the cultural groups or subgroups represented.

Quantitative Research options have been predetermined and a large number of respondents are involved. By definition, measurement must be objective, quantitative and statistically valid. Simply put, it's about numbers, objective hard data. The sample size for a survey is calculated by statisticians using formulas to determine how large a sample size will be needed from a given population in order to achieve findings with an acceptable degree of accuracy. Generally, researchers seek sample sizes which yield findings with at least a 95% confidence interval

(which means that if you repeat the survey 100 times, 95 times out of a hundred, you would get the same response), plus/minus a margin error of 5 percentage points. Many surveys are designed to produce a smaller margin of error. Three general types of quantitative methods:

1. Experiments- True experiments are characterized by random assignment of subjects to experimental conditions and the use of experimental controls.
2. Quasi-Experiments- Quasi-experimental studies share almost all the features of experimental designs except that they involve non-randomized assignment of subjects to experimental conditions.
3. Surveys- Surveys include cross-sectional and longitudinal studies using questionnaires or interviews for data collection with the intent of estimating the characteristics of a large population of interest based on a smaller sample from that population.

## **2.4 Methods of collecting data:**

The objective of this study is to understand the PESTLE factors related to different energy projects, analyze them and to determine the best possible solution to these factors in question. To reach the mentioned objectives, the study intends to use qualitative research model for collecting both primary and secondary information. Qualitative research is useful during the early stages of a study when the researcher may be unsure of exactly what will be studied or what to focus on. This type of research does not need a strict design plan before it begins. This gives the researcher freedom to let the study unfold more naturally. Another advantage to qualitative research is the researcher gains more detailed and rich data in the form of comprehensive written descriptions or visual evidence, such as photographs. This type of research looks at context and social meaning and how it affects individuals, which is advantageous particularly in the social sciences.

In this regard both Literature review and experience survey has been used to collect primary as well as secondary information. The experience survey is comprised of interviews of people who are experienced in the area that is being researched. These types of interviews are generally informal and unstructured, but researchers often develop a set of questions to use as a guide. It is to one's advantage to keep the interviews unstructured in order to allow the expert to elaborate their ideas and opinions. It's likely that this type of interview will generate more questions than answers. A literature review is a text written by someone to consider the critical points of

current knowledge including substantive findings as well as theoretical and methodological contributions to a particular topic. Literature reviews are secondary sources, and as such, do not report any new or original experimental work. Also, a literature review can be interpreted as a review of an abstract accomplishment. Most often associated with academic-oriented literature, such as a thesis, a literature review usually precedes a research proposal and results section. Its main goals are to situate the current study within the body of literature and to provide context for the particular reader. The combination of the stated methods has been used to take advantages of their respective strengths. The secondary information's have been obtained from articles, books and library work's to support both conclusions and recommendations. ([http://wiki.answers.com/Q/What\\_is\\_the.....](http://wiki.answers.com/Q/What_is_the.....))

## **2.5 Population and Population size:**

By population we mean the entire set of people who we want to understand (the sample is going to be the people from this population who end up actually taking the survey). So, for example, if someone wants' to understand how to market a toothpaste in France, the population would be residents of France. (<http://www.surveymonkey.com/mp.....>). Similarly the experience survey was conducted with individuals that had long term experience in handing power generation projects. BPDB is a semi-government entity that has been engaged in energy projects for many years. So there are a number of experience officers that could provide valuable assistance and knowledge to this study. As a result BPDB officers were interviewed for suggestions and improvements. A total of 12 senior and mid-level officers were interviewed who were highly experienced and skilled regarding project management.

The interview mainly covered issues such as (i) Whether PESTLE analysis was conducted in the project. (ii) What are the negative issues that the project bumped into inline with the PESTLE factors (iii) What suggestions were made and necessary actions taken to tackle the issues. (Appendix-B)

The sample size of this study was determined to be 4 as the scope and the time frame of this study was limited. Among the officers who are at the senior managerial positions such as the

Project Director's and the Project Manager's were considered, as they are the key personnel for project management.

## **2.6 Place of study, duration and analysis tools used:**

The project offices are situated both at the site of project and also at the BPDB's Head office Biddut Bhaban 1, Abdul Gani Road, Dhaka. As there were two project offices and on top of that the senior management officers were so busy, it was really very difficult for me to make an appointment with them. Luckily I managed to contact, make the required appointment and came in touch with them either at the site office or the Head office. Since the experience survey is unstructured and informal, the duration of the interview varied from person to person. Collected data have been cleaned, edited and re-arranged for analysis and drawing to a conclusion. No statistical analysis has been used as 100% of the sample is covered under the questionnaire survey. Microsoft word has been used to prepare this study. Eventually, a written report has been prepared as per instruction provided by the Institute of Governance Studies, BRAC University under the guidance of the supervisor.



## **Chapter 3**

---

### **Scenario of Power Sector**

### 3.1 Introduction:

Power is one of the most important factors for a developing country like Bangladesh. Like the rest of the countries of the world, the demand for power is increasing day by day in our country. At present, power failure has become an acute problem for this country. It has become hard to solve the power crisis. There are several reasons behind this problem such as limitation of resources, low generation capacity, high demand, derated capacity of power station machineries etc. To become a developed country, Bangladesh needs to overcome the problem of power crisis soon. At present, 53% of the total electricity generation of Bangladesh is from the power plants under public sector and 47% of the net generation of the country is from private sector. Even though many extra units both from public and private sector have been added to the national grid, the power crisis is still a big issue in the country. Table 3.1 shows the government's long term plan to meet the increasing demand of power by introducing additional supply up to 2016.

Topic	2011	2012	2013	2014	2015	2016
Maximum Demand for Electricity (Including DSM) (MW)	6500	7518	8349	9268	10283	11405
Generation Capacity (MW)	8042	10116	12629	13660	15882	17649
Capacity Retired (MW)	88	83	161	1292	128	1033
New Additional Supply (Both Govt and Private sector) (MW)	2194	2157	2674	2323	2350	2800
Reliable Production Capacity (MW)	5945	7575	9578	10491	12197	13554

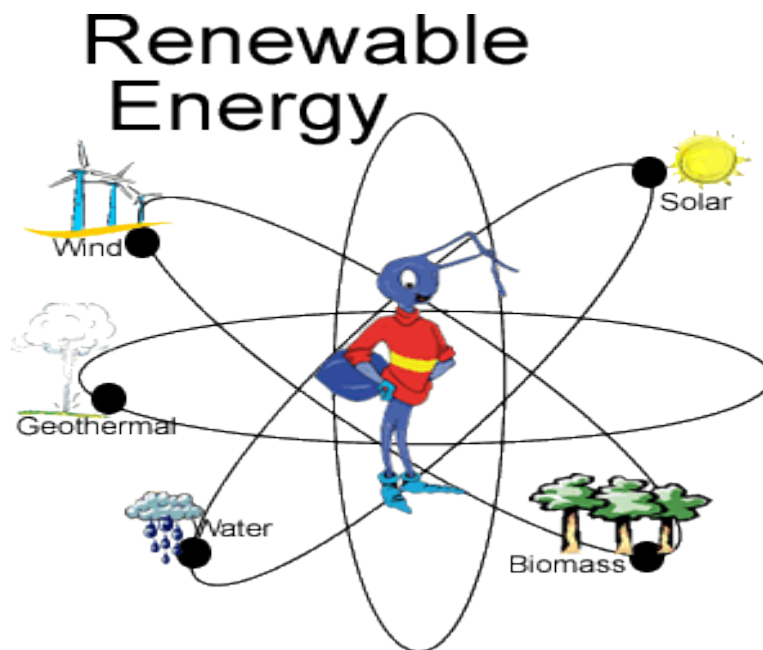
**Table 3.1 Lists Year-wise Projected Power Demand and Supply (Source: Powercell)**

Renewable energy can be a great source to solve the power crisis problem at a great extent. Different forms of renewable energy that we can use to meet the increasing power demand of Bangladesh. The demand of electricity cannot not be met due to the insufficient production of electricity around the country and as most of our power stations depend primarily on natural gas as fuel, because of the shortage of gas supply some power plants are unable to produce power of their rated generation capacity. Beside natural gas based power plants, other power plants are Hydro Electric Plant at Kaptai, the coal based plant at Barapukuria and several other power

plants around the country. But the insufficient gas supply has decreased the power generation capacity in the whole country. In most cases, we have failed to use our national resources to get maximum power output. Industrial production and house hold life are regularly hampered due to regular load shedding problem which is hampering our economy as well as making us lag behind.

### 3.2 Renewable Energy:

As a result of the power crisis, degradation of the fossil fuel resource, deforestation, environmental pollution is going on which is causing natural disasters. If this situation continues, industries will face loss due to power crisis; production will become low and eventually economy of the country will fall behind which will cause the major industries to shut down resulting into poverty and unemployment. We can get rid of this situation through renewable energy. Renewable energy can help us improve the condition of power crisis and help us move forward economically and environmentally. Moreover, the environmental drawbacks of renewable energy sources are minimum. Renewable energy is also called “Green Energy”. Renewable energy can be obtained in various ways. Figure 3.1 shows renewable energy is obtained from various sources.



**Figure 3.1 Different forms of Renewable Energy**

### **3.2.1 Solar Energy:**

Solar Energy can be a great source for solving power crisis in Bangladesh. Bangladesh is situated between 20.30 and 26.38 degrees north latitude and 88.04 and 92.44 degrees east which is an ideal location for solar energy utilization. In the rural areas where there is no electricity connection, photovoltaic technology can be a blessing. Although, the installment cost of solar systems in the house is very much costly, but once installed it can give service up to 20-25 years with proper maintenance. Moreover, in the northern territories of Bangladesh where the solar intensity is very high, solar thermal power plant can be installed. For both photovoltaic technology and solar thermal technology, Bangladesh is at a perfect location. In fact, Bangladesh Government has recently taken many steps to encourage people to use photovoltaic energy. Almost every newly built apartment building is now using solar panels along with the grid connection to get support during the load shedding period. Even in the rural areas, some NGO's have been working to provide solar panels to the villagers in a cheap price.

### **3.2.2 Micro Hydro:**

Because of the geographic position, Bangladesh is a riverine country which is a huge advantage for the country. This huge amount of river currents and sources of low head of waterfalls can be used for generating micro-hydro power. Micro hydro means generating up to 5-300 KW of electricity through hydroelectric power. It is a simple technology that converts hydropower to mechanical power. Micro-Hydro technology is very much suitable for a developing country like Bangladesh because it is an special source of energy which can generate energy without of fuel and the technology is very cheap. Because of the presence of many canals and tributaries of main river Karnafuli, Shangu, Matamuhuri which have very good potentials for setting up micro hydropower unit in Chittagong Hill Tracts region, recently Sustainable Rural Energy (SRE) under LGED has successfully demonstrated first micro-hydro power unit at Bamerchara, Chittagong. Although the installed capacity of the unit was 10kW but due to insufficient water head only 4kW power was generated.

### **3.2.3 Biogas:**

Natural resources in the form of fossil fuels are the raw materials from which electrical energy is generated and the day to day life of the people of today's world is solely dependent on the

electrical energy in this present world. Scientists around the world have already indicated that our natural reserve of gas is decreasing day by day and the time is not too far when we will have no natural gas resource. Although previously it was believed that Bangladesh has plenty amount of gas, but recent study has shown that natural gas reserve of Bangladesh is not sufficient to meet the daily cooking purpose of the people for next few decades, let alone generation of electricity. However, waste materials produced from natural day to day life usage and also from animal wastes, can be good sources of energy in this purpose and can help to meet the electricity demand by generating electricity through biogas. Many countries around the world are now paying their attention to biogas because of its environment friendly technology and as a supplement for the gradually decreasing fossil fuel reserves. Many countries now-a-days are producing electricity from biogas. Some of them are using biogas technology in mass production of electricity rather than using it in a distributed ways around the country.

In Bangladesh biogas is still a relatively new technology. In most of the places it is used to generate electricity to meet the household demands. But an agro-based country like Bangladesh produces huge amount of waste materials. Converting these waste materials into energy is economically advantageous as well as helpful to solve the issue of power crisis. In Bangladesh, recycling industry wastes raises a total of 436 t/d of material recovery. Moreover, 3,054 t/d of wastes is expected to be collected in 2015 and cumulative disposal volume is estimated at about 9 million tones by the end of 2015. This huge amount of waste, most of which are compostable and have very good fermentation property can be easily used to produce electricity as well as the generated gas can be used for the cooking purpose. Waste to energy technology can be a huge asset for a developing country like Bangladesh. Although some small farms and houses in the rural areas are using wastes produced from their livestock to produce electricity for daily purposes, it should be used commercially to produce electricity in the areas where there is still no electricity from the national grid. It will help the people of these areas to meet their demand of electricity and the government and the companies related to this technology can earn money which is also beneficial.

#### **3.2.4 Wind Energy:**

There are many hilly and coastal areas in Bangladesh which have huge potential for wind energy generation. Wind energy is a technique which converts the air flow into mechanical energy

which is eventually converted into electricity without generating pollutants. Bangladesh has a 724 km long coast line and many small islands in the Bay of Bengal, where strong south-westerly trade wind and sea-breeze blow in the summer months and there is gentle north-easterly trade wind and land breeze in winter months. Along the coastal area of Bangladesh, the annual average wind speed at 30m height is more than 5 m/s. Wind speed in northeastern parts in Bangladesh is above 4.5 m/s while for the other parts of the country wind speed is around 3.5 m/s. Coastal locations of Bangladesh such as Chittagong, Kutubdia and Cox's Bazar have immense potential to produce electricity from wind energy. By using one year data of Bangladesh Centre for Advanced Studies, it has been found that at 50 meter height in these areas the wind speed varies from 4.1 to 5.8 meter/second with a power density of 100-250 w/m<sup>2</sup>. An analysis of wind energy measurement done by RISOE shows locations with power density above 200 w/m<sup>2</sup> over 2000 km<sup>2</sup> which is very good to set up wind turbines and expand wind energy in Bangladesh. To check whether wind energy can be a potential renewable source of electricity, small-scale wind turbines can be installed in areas in Bangladesh such as St. Martins Island, Patenga, Bhola, Barguna, Dinajpur, Thakurgaon and Panchagar. So from the above discussion we see that there is a huge possibility of extracting electrical or mechanical energy from the wind in Bangladesh.

### **3.2.5 Biodiesel:**

In recent years fossil fuel depletion and global warming issues are the point of concern around the world. To reduce Carbon emissions and decreasing reserves of fossil fuels, Biofuel can be an attractive source of energy. In comparison to fossil fuels, biofuel can reduce the emission of CO<sub>2</sub>. Next generation bio-fuels can be a great solution to the global warming and the crying need of fossil fuels. Biofuel or Biodiesel is clean burning oil produced by Transesterification of oils with short chain alcohols. Now-a-days, researchers are turning their attention into the production of biodiesel from algae because of their higher productivity, abundance in the nature, high Triacylglycerides and they can be a major source for biodiesel production. Production of biodiesel from algae is less time consuming and cheaper than the petroleum diesel.

So rather using petroleum diesel in the diesel generators in the power plants, we can use biodiesel which will both save our money and reduce our dependence on the diminishing fossil fuel reserves. This biodiesel can be used in the diesel generator to produce electricity. This will

be cost efficient and as well as environment friendly. Algae grow in abundant in Bangladesh. So we can produce biodiesel from algae which we can use in the power plants to generate electricity. Biodiesel can be a great source of power generation for Bangladesh. Microalgae can take waste from CO<sub>2</sub> and convert it into natural oil.

### **3.2.6 Ocean wave energy and Tidal power:**

Ocean wave energy is generated directly from the waves of the oceans. It is another special type of renewable energy which helps to decrease the harmful emissions of greenhouse gases associated with the generation of power. It can be potentially a significant source of electricity for Bangladesh. Though the main purpose of ocean wave energy is electricity generation, it can also be used for the pumping of water, water desalination etc. “The Oscillating Water Column method is technically feasible and becoming economically attractive in this purpose. This type of wave energy harnessing device is being commissioned by several countries such as the United Kingdom (500 kW), Ireland (3.5 MW), Norway (100 kW), India (150 kW), etc. Bangladesh has potential for harnessing ocean wave energy from the Bay of Bengal.

Tidal power or tidal energy is a form of hydropower that converts the energy of tides into electrical power. As tides are more predictable than wind and sunlight, tidal energy can easily be generated from the changing sea levels. The coastal area of Bangladesh has a tidal rise and fall of between 2 to 5 meters. Among these coastal areas, with 5 meter tides experienced, Sandwip has the best prospect to generate tidal energy. Moreover, Bangladesh can generate tidal power from these coastal tidal resources by applying Low head tidal movements and Medium head tidal movements, low head tidal movements which uses tides of height within 2m to 5m can be used in areas like Khulna, Barisal, Bagerhat, Satkhira and Cox's Bazar regions and the height tidal movements which use more than 5m of tides can be mainly used in Sandwip. So we can say that with suitable tidal height available, this can be a great source of energy for Bangladesh. (<http://www.cyberjournals.com/Papers/.....>)

### **3.3 Rental power plants:**

In order to meet the growing demand for electricity, 15,000 MW of new generation capacity has been planned. The plan involves commissioning a number of quick rental and rental power plants as immediate measures to meet the demand in the short run. Once the generation scenario

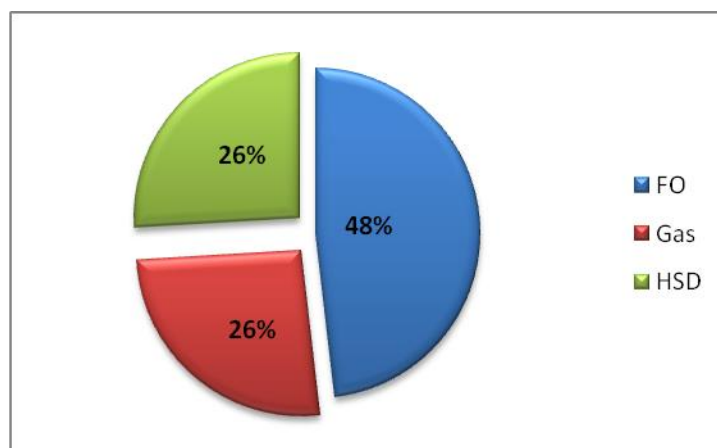
is strengthened after the completion of large power projects, small generation units will be gradually uninstalled. The generation expansion program of GoB is planned to be implemented in the following phases:

- Immediate: 6 -12 Months
  - Rental and Quick Rental Plants (liquid fuel)
- Short term: 18 - 24 Months
  - Peaking Plants (liquid fuel)
- Medium term: 3 - 5 years
  - Combined Cycle Plants (Gas or dual fuel)
  - Peaking Plant (Gas or dual fuel)
  - Coal fired steam plants
- Long term: beyond 5 years
  - LNG based Combined Cycle Plants
  - Domestic/Imported Coal Power Plant
  - Gas/Oil based Peaking Plant
  - Nuclear Power Plant
  - Renewable Energy

Commercial arrangement of contracts in case of Independent Power Producers (IPP) is guided by the Private Sector Power Generation Policy of Bangladesh (IPP) whose tenure could be anything from 7 to 22 years. IPPs are characterized by three contracts. The Power Purchase Agreement (PPA) is a contract between BPDB and the IPP where BPDB is bound to purchase the power produced by the IPP. The Fuel Supply Agreement is between the IPP and the Fuel Supplier (namely PetroBangla) where the IPP is guaranteed uninterrupted fuel supply.

The Implementation Agreement (IA) is a direct contract between the IPP and the Government backstops BPDB's payment commitment, provides fiscal incentives to facilitate the project. No new rental or quick rental projects are in the pipeline. Figure 3.2 shows the fuel mix for rental projects that were recently commissioned i.e. in 2010 to 2011. It provides information that most of these rental power plant operates on furnace oil.





**Figure 3.2: Fuel Mix for Rental Projects set-up in 2010-2011 (Source: Power Division)**

Rental Power Plants again follow PPR or a competitive bidding process whereas contracts for quick rentals are awarded based on negotiation. Price determination in such cases either requires the single buyer to supply fuel where the vendor only gets the capacity payment or the vendor is allowed to import the necessary fuel directly, provided the fuel is a pass through item. Payment is made by the single buyer on a monthly basis in Bangladeshi taka, unless otherwise specified in the contract. The duration of the contract may vary from a minimum of three years up to twelve years. However, contracts have extended beyond twelve years in the past. Rental power plants have a ‘must dispatch’ obligation under the contract up to the declared capacity with an acceptable level of variance. A default results in penalty. But if directed by the load dispatch authorities to produce a lower amount of electricity or go for a complete shutdown, the vendor is entitled to receive capacity payment only.

According to the power generation expansion plan, the GoB intends to phase out rental power plants shortly with the commissioning of gas or coal-based large scale steam turbine or combined cycle power plants. Any delay in execution of the plan will compel the government to extend the rental contracts resulting in the government either choosing to continue providing high subsidies or seek alternatives measures e.g. tariff inflation, extensive load shedding, etc. (<http://fkk.weebly.com..>)

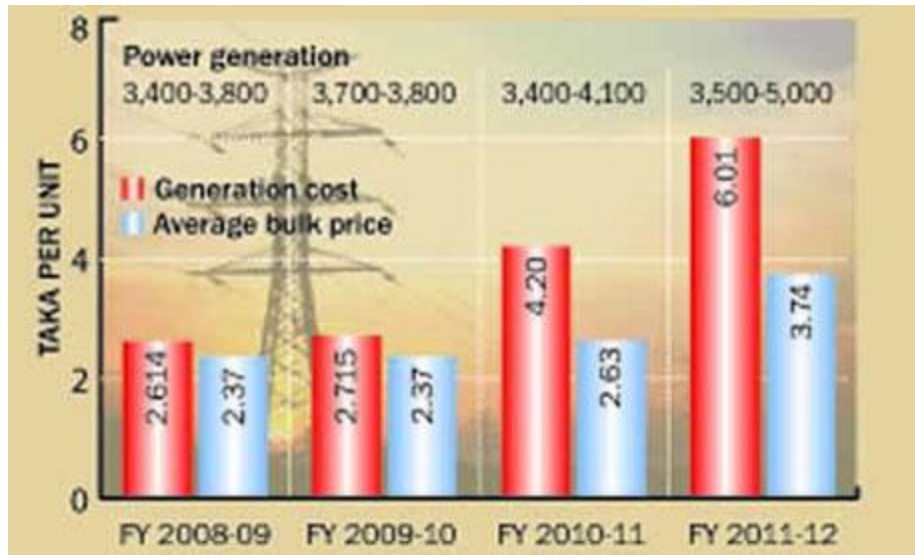
The government has extended the contract period for seven quick rental power plants by a year despite criticism by energy experts and opposition parties. This extension would cost the

government Tk 12 billion. Dr Akbar Ali Khan, a former adviser to caretaker government, said the government could solve the problem by repairing the existing plants and solving the gas crisis instead of opting for rental power plants again. He also said that not a single country in the world succeeded in solving the electricity crisis through rental power plants.(<http://www.thefinancialexpressbd.com/.....>)

There is no justification why the people would pay excessive electricity bills resulting from system loss, mismanagement, corruption and quick rental power plants. The government stopped coal development and gas exploration despite clear advantages and decided to go for short-term and expensive oil-based rental power plants. The economy cannot sustain the burden of importing expensive fuel. It would have been possible to produce additional 2,400 mw of power from the existing structure if the government reopened and repaired all the closed plants. The total subsidy of the government in the energy sector stands at about 4.0 per cent of the country's gross domestic product (GDP), an amount higher than what it spends on health and social welfare programmes. The government is saying that energy subsidies are investment.

The Bangladesh Power Development Board (BPDB) is in difficulty in managing the burden of the quick rental power plants. The PDB is losing Tk 6.0 billion per month on account of these power plants. PDB officials say that the amount will increase during the boro irrigation season. The total loss per year is Tk 72 billion crores. The PDB is receiving subsidy from the government as loan thereby further increasing their liability. The PDB has requested the government time and again to release fund as subsidy (grant) and not as loan but the government is not giving any clear directive.

The government is rather planning to phase out subsidy on the advice of the IMF and the World Bank. By raising power tariff several times the government is shifting the burden to the consumers. It is learnt from distribution companies that they are selling power to the consumers at a lower price than what they are paying to the producers. The loss of distribution companies is, therefore, going up. Figure 3.3 shows how rental power plant has contributed to the increase in per unit generation price for the last few financial years. During the FY 2008-2009 the per unit generation price was around 2 Tk but in the FY 2011-2012 the per unit generation price jumped to 6 Tk which has put substantial pressure on the power sector subsidy.



**Figure 3.3: Displays Taka per unit in consecutive Fiscal year (Source: BPDB)**

In order to get out of this situation, power tariff is to be increased at the level of consumers or the wholesale price is to be lowered. Lowering wholesale price would mean increase in the loss of the PDB. The PDB's cost of production is still below Tk 3.0 per unit. But PDB has to pay Tk 22 per unit in some cases to quick rentals. The PDB has to add the cost of buying power from rentals to its own cost of production and then fix the average price. That is why PDB's price of supplying power goes up. Pressure on the government for raising power tariff was building up soon after awarding contracts to quick rental companies without tender under cover of an indemnity law. PDB officials informed that power tariff was raised because the owners of quick rentals pressurised the government/PDB for doing so. The Bangladesh Energy Regulatory Commission (BERC) has again recommended for further increase in the price of power.

It is pointed out that fuel price has not increased recently. Therefore, there is no reason for raising the price of electricity. Cost of producing power varies between Tk 2.0 to Tk 2.50 per unit by burning gas or coal. But the cost may go up to Tk 20 per unit if power is produced by burning fuel oil. Oil-based power production was a short-term measure but the inability to implement medium to long term projects has compelled the government to continue depending on the short-term quick rentals. This is resulting in the rise in subsidy. Coal-based power production has to be increased. This will bring down the average cost of production. The scheme for making Bangladesh free from load-shedding has been delayed. 2011 was the target for

making Bangladesh free from load-shedding. The target was shifted to 2012. This has also not materialised. Load-shedding is still continuing.

The immediate past BERC chairman had promised not to hike power rates within the next one year unless the oil price increased significantly in the international market. But moves are now on to effect yet another hike in power tariff although oil price is not showing sign of volatility. The proposed hike may be due to IMF pressure. The Bangladesh Petroleum Corporation (BPC) incurred losses exceeding Tk120 billion last year for importing fuel oil at a high price and selling it at a lower price. BPC imported about 4.0 million tons of fuel oil. Foreign suppliers of oil have demanded more premiums from BPC. Because of this BPC may lose more money in the current year. One litre of diesel is imported at Tk 81.83 and it is sold at Tk 61 thereby losing Tk 20.22 per litre. Furnace oil is imported at TK 65/67 and selling price is Tk 60. The import price of kerosene is Tk 82/84 and selling price is Tk 61.

Any fresh hike in fuel oil prices may necessitate yet another hike in power rates because of increased dependence on liquid fuel-guzzling rental power plants. The people are unlikely to get any respite from intermittent power tariff hike. The government has again increased prices of diesel and kerosene by Tk 7.0 a litre and octane and petrol by Tk 5.0 per litre. The ground is now prepared for one more hike in power tariff. Too much dependence on fuel-based quick rentals is the main reason for increasing prices of electricity and fuel.

### **3.4 Import of electricity and Regional co-operation:**

According to the bilateral decisions taken at the Prime Ministers' level meeting between India and Bangladesh, the Government has begun implementation of 'Regional Grid Interconnection' by installing 400 KV transmission line and HVDC (High Voltage Direct Current) Power sub-station to import 500 MW of electricity from India. Bangladesh will import 250 megawatt-hours (MWh) a day of electricity from India starting in August 2013, the two countries said in a joint statement, to help meet demand. A grid interconnection between Bheramara in Bangladesh and Baharampur in India will be completed by the end of July 2013. When that work is finished, Bangladesh will buy 250 MWh of electricity from the Indian market, and it is also in the final stage of negotiation the purchase of an additional 250 MWh.

Bangladesh is desperately trying to augment electricity generation to achieve 8.0 percent economic growth to become a middle income country by the year of 2022. The Bangladesh government will import 250-megawatt electricity from India by July, 2013 which will cost Tk 4 per unit excluding transmission expense. There is a plan to import 500 MW of hydro-electricity from a hydro power plant located at Lemro river of Rakhain state, Myanmar. For this purpose, a MoU has been signed between the governments of Bangladesh and Myanmar. It is expected that by 2018 the proposed 500MW of electricity would be imported through successful regional cooperation.

Bangladesh will seek support from India to import electricity from Nepal and Bhutan using Indian corridor or power grid line, an official concerned said. The government will seek the support from its Indian counterpart during a two-day power sector cooperation dialogue between Dhaka and Delhi on January 30-31, 2013 in the city. Bangladesh Power Secretary Monwar Islam and Indian power secretary P Uma Sankar will lead their respective delegations in the dialogue. “Bangladesh and Nepal are working for bilateral cooperation in the field of hydro power development in Nepal,” an official of the Power Division said. Earlier, a delegation of the Power Division led by Joint Secretary Md Mofazzel Hossain visited Nepal in July, 2012 to discuss various aspects of the proposed power sector cooperation. During a meeting with the Nepalese counterpart, the power division delegation discussed constructing a dedicated power transmission line between the two countries through Indian Territory, a power division official said.

The official also said both sides were interested to have power connectivity through Indian power grid line via Duhabi-Purnia-Barapukuria or Anarmani-Siliguri-Barapukuria. The meeting also discussed to exchange power through the under-construction Bheramara HVDC station using 400 KV Muzaffarpur-Dhalkebar cross-border line, subject to approval from the Indian authorities. “The Nepalese counterpart has already agreed to initiate a joint venture hydro electric project in Nepal,” the Power Division official said. Dhaka is also interested to import hydro power from Bhutan. The power import will require a dedicated power transmission line from Tala of Bhutan to Thakurgaon through Siliguri of the North East India, an official said. Additional Power Division Secretary Md Mofazzel Hossain said the construction of an Indo-Bangla grid station, activities of Bangladesh-India Friendship Power Company, exchange of

electricity between Bangladesh and India through interconnectivity, import of electricity from neighboring countries and development of joint venture power projects will top the agenda during the Indo-Bangla dialogue on power sector cooperation. ([http://www.daily-sun.com/details\\_yes\\_29-01-201.....](http://www.daily-sun.com/details_yes_29-01-201.....))

### **3.5 Rooppur Nuclear power plant:**

Prime Minister Sheikh Hasina said she was hopeful that the work to set up the 1,000MW nuclear power plant at Rooppur will begin by October, 2013. She called a press conference at her office to brief the media about her recent trip to Russia and its outcome, where she expressed the optimism. The deal to install the power plant was signed during the visit. The Prime Minister said State Atomic Energy Corporation ROSATOM Director General Sergey Kirienko called on her on Jan 16, 2013 in Moscow to discuss possibilities of starting work on the Rooppur project this year. Bangladesh will get \$0.5 billion loan from Russia for setting up the plant at Pabna's Rooppur.

In her written speech, Hasina said, "The ROSATOM has expressed keen interest in starting construction work of the nuclear power plant." She said Bangladesh will only have to set up a legal organization to this end. "The design will have to be completed within May, 2013. The construction area prepared within August, 2013 and we will be able to start the main construction work within September-October, 2013." The Prime Minister said a top level inter-ministerial coordination committee will be formed soon to handle the plant's construction work quickly and efficiently. When her attention was drawn to rumours that the \$1 billion deal to purchase weapons from Russia was part of a deal to set up the nuclear plant, Hasina said, "There is no condition attached with the Rooppur nuclear power plant, it's a separate deal." She said talks had been taking place for long for setting up the power plant and added that Bangladeshis will be trained up on maintenance of the plant. "We are prioritising the safety issue," the Prime Minister said and added that once this plant went into production, the dream of the nation of producing nuclear power will be fulfilled. She recognized that a 'fear factor' also worked among the people over safety issues. "Every aspect of the nuclear reactor's safety has been taken into consideration. A five-layered security arrangement has been ensured," Hasina said. She added Russia will take back the radioactive fuel waste of the reactor. She said one of the agreements entitles Bangladesh to \$0.5 billion loan from Russia for research and developing technical

abilities for the power plant. The other one aims at establishing an information centre at the Bangabandhu Novothreatre on nuclear power. The centre will work on making people aware of the nuclear power plant and assure them of safety “Those concerned will be trained. Both countries (Bangladesh and Russia) will exchange information on nuclear power,” she added.

The Prime Minister said the power plant hosts two 1,000MW capacity reactors. The next two years will be spent on technical evaluation to determine the actual cost of the plant. The government plans to make use of Russia’s third-generation technology for setting up the power plant. The plant is designed to have two units. Each of the units is estimated to cost from \$1.5 billion to \$2 billion. Bangladesh had signed a contract with ROSATOM in November 2011 for assistance in the project. The Russian government will provide fuel for the plant under the agreement. The plant is expected to be in operation for 60 years which, according to the State Minister for Science and Technology Yeafesh Osman, may be extended for a further 20 years. (<http://bdnews24.com/bangladesh.....>)

Few critical questions have been raised so far by Bangladesh’s intellectual community regarding the deal towards construction of two nuclear power plants in Rooppur. Yet, questions do need to be posed. On November 2, 2012, Russia and Bangladesh signed the long-awaited nuclear power agreement on the supply of two 1,000-megawatt reactors. The first critical point to be noted is the fact that few details regarding the contents of the nuclear agreement have been revealed to Bangladesh’s public. From the ‘self-evaluation report’ submitted by Bangladesh to the International Atomic Energy Agency in the middle of 2012, however, it appears that the two nuclear reactors to be supplied by Russia to Bangladesh will be of VVER-1000 design. This is a water-cooled and water-moderated reactor reportedly devised in the late 1970s. Towards the cooling of the nuclear fuel rods, water is pumped into the primary circuit of the reactor and kept under constant pressure to prevent it from reaching boiling point. And after its use in the reactor complex, the (polluted) water needs to be released, i.e. dumped back onto the environment. This immediately raises the question as to the consequences of Rooppur for the fisher-folk in Ishwardi, the sub-district of Pabna where Rooppur is located. Will biodiversity in the reactor’s surrounding water bodies be affected? Further pertinent questions arise once we try to envision how Rooppur’s nuclear fuel rods will be supplied and disposed of. To some extent, the

arrangements chosen imply that Bangladesh's own population will not itself be burdened with the damaging consequences of the nuclear waste that is generated in the nuclear production chain. Neither will massive amounts of low-level waste be dumped in the country in consequence of uranium mining. Nor will the country's landscape or subsoil be disfigured due to the presence of storage tanks containing long-lasting, high-level fluid waste from nuclear reprocessing. These consequences will be borne by people elsewhere (!). Yet, will these facts suffice to allay the public's fears? Under the agreement signed between Russia and Bangladesh, Bangladesh will not itself enrich uranium. Russia will both supply the fuel elements for the reactors, and will take back the highly radioactive rods once they have completed their 'lifecycle'. However, this does not mean that the people of Ishwardi and Pabna can rest reassured.

Central issues to be looked into here are the temporary storage of the radioactive fuel rods after the end of their usage and the transportation of the fuel rods to and from the Rooppur nuclear complex. In Europe the transportation by road of used fuel elements has for many years aroused fierce resistance by anti-nuclear activists. Thirdly, there is the question of reactor safety from a nuclear catastrophe. Russian officials will surely argue that the VVER-1000 design has proven to be more secure than the design of the granite-moderated reactor in Chernobyl, Ukraine, where the world's most catastrophic nuclear accident ever took place in 1986. Surely, it is the last-mentioned RBMK-design which has burdened the Russian state and people with nightmarish problems of hundreds of thousands of cancer deaths, of a vast contaminated region where agricultural production had to be suspended, and of a huge financial burden for the construction and re-building of a reactor-sarcophage. Yet the so-called 'stress tests' undertaken in Russia in 2011, subsequent to the Fukushima disaster in Japan, have laid bare numerous basic defects that Russian reactors share with those in Japan. A joint report brought out by Rosatom and other Russian state institutions in the middle of 2011, for instance, questioned the capability of the country's reactors to remain safe if cooling systems collapse, and there reportedly is no guarantee that power backup systems will be effective in case of a cooling system failure. The official report also described how spent fuel is simply allowed to accrue in onsite storage sites because of lack of space. One wonders whether scientists belonging to Bangladesh's nuclear



establishment have reviewed this report by Russia's state agencies. And whether their own worries have been dispelled.

What then is the best way forward? How can the risks deriving from Rooppur for Bangladesh's population best be assessed? Scientists and economists who are concerned about solving Bangladesh's energy needs will undoubtedly argue that we need a dispassionate debate on the issue, and that it would be wrong to oppose Rooppur merely on the basis of fear. In neighboring India, for instance, there has emerged an informed debate, which is of immediate relevance for Bangladesh. Coincidentally, the strongest opposition against nuclear construction has been built in the area surrounding Koodankulam, in Tamil Nadu, precisely in opposition against a VVER-reactor supplied by the Russian Federation. Being densely populated and subject to Annual River flooding, Bangladesh can ill afford to take risks. Hence, whatever construction works in Rooppur, if any, should be preceded by an informed public debate, a debate in which both the country's progressive intellectuals, the new generation of urban activists, and Pabna's peasants and fisher folk take part. (<http://newagebd.com/detail.php?date=2013-01-.....>). Table 3.2 shows that some experts have suggested other alternatives to the problem raised by NPP.

<b>Nuclear Highlights</b>	
<b>Problem</b>	<b>Solution</b>
Nuclear fuel is available only from a small club of suppliers who are driven by geopolitics as well as cost	Bangladesh should organize multi-country consortium of nuclear power plant operators to buy and reprocess fuel
To have a single 1000 MW plant, the grid capacity needs to be at least 10000 MW to avoid national grid failure	Bangladesh can interconnect power grid with India or Myanmar to make the grid capacity even higher
Dumping nuclear waste is risky and complicated	The waste can be sent back to the nuclear fuel supplier or dumped by packing the waste in glass material down to subsoil hard rock layer in designated parts of the country

**Table 3.2 Solutions to Rooppur NPP crisis (Source: <http://phulbarinews.wordpress.com>)**

### **3.6 The 1320 MW Rampal power project:**

Following the issuance of the Joint Communiqué on the occasion of the Prime Minister Sheikh Hasina's visit to India in January 2010, Bangladesh Power Development Board (BPDB) and National Thermal Power Corporation (NTPC) of India signed a Contract on 29 January 2012 to build under Joint venture the 1320 MW Rampal Coal Fired Power Plant at Bagerhat. Rampal power plant is considered as Bangladesh-India Friendship Power project and it promises to be the largest power plant in Bangladesh to be built on 1,834 acres of land, located 14-km north of the Sundarbans, the world's largest mangrove forest.

The Rampal Power Project was estimated to involve USD 1.5 billion capital cost 70% of which was planned to arrange through costly 'buyer's credit' and the balance was planned to equally shared by the JV partners. Under the 50:50 Joint Venture deal a JV Company was floated to install and operate the plant within the framework of BPDB and NTPC. BPDB Chairman and his counterpart at NTPC were very optimistic to deliver power from the Rampal power plant within 2015. India's Power Secretary Uma Shankar stated that the deal opened up a 'great platform' for better cooperation between the two neighbors. There are differences of opinions on the project's proposed financing and operation modalities. Buyer's credit financing system will involve the selected contractor to arrange required external finance for the project. It is apprehended that the 'buyer's credit' option for Rampal project implementation was accepted hastily by powerful officials who sensed lack of interest of international development partners to finance the project. On the contrary, BPDB and NTPC decision makers are less encouraged by the traditional development partner's interests for financing and buyer's credit was opted as an alternative. But present revised date (authorities concerned in Bangladesh expects now the Rampal Power plant project be completed in 2016) gave some space for sourcing and negotiations with multilateral development partners for softer term loans for better protecting the interest of the country and electricity consumers. Rapid growth of electricity tariff within a very short spell of time has already shaken the consumers in Bangladesh. Buyer's credit based rigid term loan for a major power plant like Rampal plant will push the electricity cost further and might affect the viability of the project. The proposed Rampal coal fired power plant project was initiated with only conceptual study basis and the issues of coal supply and cost of power production, investment realities, and environmental issues came later.

In the meantime, land development works on the bank of Moidara canal in Rampal Upazila of Bagerhat district near the mangrove forest Sundarban was initiated by BPDB as part of the project implementation. Local and national level environmental activist groups raised voices against the project and a public interest writ petition was filed by the organization called ‘Save the Sundarban’. The environmental groups have started campaign against the proposed power plant project, fearing that it would be a serious blow to the ecology and environment for the world heritage site, the Sundarbans. The main opposition BNP expressed its solidarity with the environmental activists against the JV for Rampal coal fired power plant project. BPDB is still to carry out credible studies on the environmental and social impacts and their management strategies. So far BPDB claims that it plans to install super critical highly efficient boilers with necessary scrubbers to prevent pollution within acceptable limits. The advanced technology will keep the adverse environmental impacts controlled. But BPDB’s generic statement failed to neutralize the concerns of the environment groups.

The environment activists claim that the Rampal Power Plant authority did not bother to obtain Environmental Clearance from the Department of Environment as per prevailing regulations so far. The Honorable High Court bench asked the government to explain why filling up of lands on the bank of Moidara canal in Rampal Upazila for the project for setting up of the coal fired power plant would not be declared illegal. Media further reports that there has been very little physical progress for the Rampal Power Plant project in real term and power sector specialists fear that the project might not be completed within next five years. Already the 2015 dateline is revised as the fundamental issues including project financing, source and supply of coal and Power purchase agreement for developing the 1320 MW coal fired power plant at Rampal, Bagerhat remain open so far.

With the time passing the project costs will increase further. BPDB and NTPC need to agree on many other important issues for project implementation. As reported, Power Grid Company of Bangladesh (PGCB) is expected to install the transmission lines for facilitating power evacuation from the proposed power plant at Rampal. BPDB wanted that PGCB to become partner to the project, but NTPC disagreed with the proposal. BPDB is in favour of 25 year power purchase agreement and wishes to set a formula for power tariff setting. But NTPC favours power tariff fixing every year. BPDB Chairman had no definite information about power generation cost per

unit while asked after signing the Contract with NTPC. He preferred to say that the variables including plant cost, contractors cost for building the plant, interest rates and cost of financing, coal import costs will determine the per unit power generation costs. Various sources indicated that BPDB expected BDT 5.90 per unit power cost if the coal is supplied at USD 105/tonne; In case the coal will cost USD 145 per tonne the power generation cost will increase to BDT 8.85 per unit. It may be mentioned that Barapukuria coal fired power plant generates power at a cost of BDT 5.00 per unit (Barapukuria coal fired power plant receives coal supply from the adjacent Barapukuria Coal Mine at a rate of USD 105/tonne). BPDB signed a contract with Orion Group with a power tariff of BDT 3.88 per unit of power with import based coal fired power plants to be build at Khulna. Prime Minister's Energy Adviser suggests for getting people ready to pay the cost for electricity. He believes that wastage of electricity will be reduced if electricity is purchased at a higher rate.

The proposed Rampal coal fired power plant will require annually approximately 4.5 million tonne of coal to generate 1320 MW electric energy. There is no required infrastructure for importing the necessary volume of coal at the plant site at present. BPDB intends to build a dedicated jetty for coal handling near the plant site. But the Moidara canal and its connecting rivers lack necessary draft for all season river transportation facilities. The Mongla port channel has a maximum 4 meter draft which restricts the large size barges to navigate. Bangladesh government appointed consultant CEGIS, a trust under Water Resources Ministry indicated the need for capital dredging from Akram Point of the confluence of the Bay of Bengal to the Rampal project site as well as for regular maintenance dredging of the rivers and canals connecting the Rampal Power Plant site to take advantage of coal transportation using ocean going vessels and to keep the coal transportation costs feasible. The primary estimate of CEGIS suggests that USD 105 million would be required for the capital dredging for facilitating the coal transportation for the proposed Rampal Power plant. In addition the route will have to be maintained with regular maintenance dredging annually with an estimated cost of USD 30 million per year. CEGIS further suggested that long term coal purchase and supply arrangements would be required for uninterrupted operation of the power plant. In that case the potential coal supply source could be Australia, South Africa or Indonesia. The quality coal import will be costly as the primary estimate indicates minimum cost for coal per tonne USD 145 plus USD 27

freight charges to apply for importing coal from the nearest Indonesian sources. This means the fuel cost per unit of power generation will be almost BDT 6 per unit. In case coal is to be imported from South Africa, the per tonne cost of coal will be USD 160 plus transportation cost of USD 39 per tonne. Australian coal will be costlier. The operation and maintenance cost of power generation at BPDB's Barapukuria coal fired power plant is BDT 1.3 per unit. Therefore, Rampal Power Plant will hardly be able to deliver power at a price less than BDT 7 per unit.

It is obvious that the proposed Rampal coal fired power plant has several issues to address before the plant construction starts. BPDB and the Power Division officials made several visits to India to discuss further the ways for speedy implementation of the project as BPDB put a lot of hope for commissioning of the base load power plant project to help ease the acute power shortages in Bangladesh. But there are skeptics who consider the project is not viable. The authorities concerned so far ignore such skepticism and show determination to go ahead with the project. Energy and Power sector decision makers are less concerned about the environmental activists' move. The physical development concerning the Rampal Power Plant works indicate that the power plant project will unlikely be implemented within the revised time schedule; rather it will be delayed further.

That implies unmet promises for replacing costly oil based power generated mainly from the rental and quick rental power plants with cheaper baseload power. Delays in implementing a major baseload power plant like the Rampal coal fired 1320 MW power plant show unprepared moves from the BPDB end and its limitation to understand coal supply chain, infrastructure requirements for coal import and their costs. Such an assessment is echoed by Prime Minister Sheikh Hasina's Energy and Mineral Resources adviser Dr. Tawfiq E Elahi Chowdhury. He informed, 'we have not taken any project like this. So it is taking some time. This is normal!' (<http://www.fairbd.net/Details.php?Id=518...>)

### **3.7 Combined Cycle power plants:**

Combined cycle power plants are among the world's safest fossil-fired plants for the environment and climate. They combine a gas-powered turbine with a steam turbine to make twice the use of the fuel they consume: The exhaust heat from the gas turbine is exploited to

power the steam turbine, greatly improving overall power-plant efficiency. Today's combined cycle plants already achieve an efficiency of around 58 percent, but raising the combustion temperature could boost this even further. Another advantage of these power plants is that the natural gas they run on is less carbon dioxide-intense than other fossil fuels. This means that the generators in combined-cycle plants are one of the key power generating technologies in the battle against climate change.

The Asian Development Bank (ADB) will provide US\$ 185 million to Bangladesh as loan aimed at boosting the country's power supply system. The Government and ADB on April 3 signed a loan agreement in this regard. Saifuddin Ahmed, Joint Secretary of Economic Relations Division (ERD) and Stefan Ekelund, Deputy Country Director and Officer-in-Charge of ADB's Bangladesh Resident Mission, put pen on the paper at a ceremony at NEC-II conference room in city's Sher-e-Bangla Nagar. The assistance is the first tranche of ADB financing under an overall multi-donor- supported project entitled Power System Expansion and Efficiency Improvement Investment Programme of US\$ 1.6 billion, with ADB contributing US\$700 million. The other co-financiers supporting the programme include Agence Francaise de Developpement, the European Investment Bank (EIB), and the Islamic Development Bank.

The investments are part of a broader government plan to reform and strengthen the power sector, tapping private sector financing. The goal is to raise generating capacity to more than 12,500 megawatts and the rate of electrification to 68 percent by 2015. The assistance under the first tranche will help convert four open cycle power plants to combined cycle plants, raising both their power generation capacity and operational efficiency up to 50 percent.

It will also construct three transmission lines and associated substations, further strengthen the high voltage network and power dispatch capacity, improve reliability of the transmission system, and reduce transmission losses. The overall programme will connect 450,000 households to the power grid and reduce carbon emissions by almost 2.5 million tons per year when the project is completed in 2018. Power system and financial management training will be given to staff in sector institutions, and a pilot project with around 200 solar energy-driven irrigation pumps will be established, benefiting around 4,000 poor farming families.

### **3.8 Public Private Partnership energy projects:**

Reassuring her government's determination to provide all necessary cooperation to the Public-Private-Partnership (PPP) initiatives in the country, Prime Minister Sheikh Hasina said a process is underway to enact the PPP law with provisions for selecting private partners transparently for PPP projects. This (PPP) is a new beginning, a new form of partnership, whereby the government stands ready to share the risks along with the private sector, especially those who will be able to manage best. For this, we're ready to commit all necessary material and human resources," she said. (<http://www.bangladeshchronicle.net/index.php>.....)

Noting that one of the key conditions for achieving goal of becoming a middle-income country by 2021 is to boost investments in infrastructure from only 2 percent to 6 percent of GDP, Hasina said her government has identified and prioritised PPP as one of the key initiatives to meet this investment gap. "PPP will enable us to deliver public services at an affordable price, reducing the pressure on the national budget." Hasina said the development partners have been working in partnership with the PPP Office in ensuring the establishment of a robust, transparent and comprehensive framework for accelerating the implementation of PPP projects in Bangladesh. She said in her previous term from 1996 to 2001, the two most successful PPP projects in Bangladesh — Meghnaghat 450 MW Power Plant and Haripur 360 MW Power plants were contracted. The premier said through these two projects Bangladesh had been able to secure the lowest electricity tariff in the region, and these projects received 'Euro Money' award as examples of successful project finance transactions.

Facilitating Private-Public Partnership is an important step in reducing investment gap for infrastructure in Bangladesh, the World Bank said in a statement. The international money lender said it was supporting the government for infrastructure development and diversification by private sector participation through the Investment Promotion and Financing Facility Project. The project also helps build the capacity of the local financial sector for longer-term financing to the much-needed private-public partnership ventures in infrastructure. According to the statement, the participating financial institutions have submitted two loan applications to IPFF Cell at Bangladesh Bank for consideration. The ongoing IPFF project had also earlier financed a water treatment plant, first of this kind in Bangladesh. The World Bank is also reviewing the

other proposal of a 50 MW power plant at Patenga, Chittagong. The bank said with the support from IPFF, the PPP office, in collaboration with the Board of Investment and Bangladesh Bank had organized a high-level international conference to attract foreign investors. IPFF will provide technical assistance from the start of the ventures to ensure quality and efficiency - in terms of technical standards and pricing at the beneficiary stage - in the delivery of important public good and public service. (<http://newagebd.com/.....>)



## **Chapter 4**

---

### **PESTLE Analysis of Power Generation Projects**

## 4.1 Introduction

The PESTLE Analysis is a tool that is used to identify and analyze the key drivers of change in the strategic or business environment. The tool allows the assessing of the current environment and potential changes. The idea is, if the project is better placed than its competitors, it would be able to respond to changes more effectively. The term has been widely used and the earliest reference can date back to a book by Aguilar in 1967 who discussed ETPS (Economic, Technical, Political, and Social) in his book *Scanning the Business Environment*. After this publication, came the work of Brown who modified the theory and named it STEP (Strategic Trend Evaluation Process). This was further modified and became known as the STEPE analysis (Social, Economic, Political, and Ecological factors). Post 1980, the word PESTLE originated along with its variations like PEST, STEEPLE (includes Ethical factors), PESTLIED (includes Demographic and International factors), STEEPLED (includes Demographic and Education factors), etc.

PESTLE analysis, which is sometimes referred as PEST analysis is a concept in marketing principles. Moreover, this concept is used as a tool by companies the world over to track the environment they're operating in or are planning to launch a new project/product/service etc. A PESTLE analysis is a method for reviewing the macro environment (external forces that impact a company's ability to plan). It stands for: (<http://en.wikipedia.org/wiki/.....>)

- a) Political
- b) Economic
- c) Sociological
- d) Technological
- e) Legal
- f) Environmental

PESTLE analysis is very important that an organization considers its environment before beginning the marketing process. In fact, environmental analysis should be continuous and feed

all aspects of planning. The organization's marketing environment is made up from:

1. The internal environment e.g. staff (or internal customers), office technology, wages and finance, etc.
2. The micro-environment e.g. our external customers, agents and distributors, suppliers, our competitors, etc.
3. The macro-environment e.g. Political (and legal) forces, Economic forces, Socio-cultural forces, Technological forces, Legal and Environmental forces. These are known as PESTLE factors.

These forces, although out of the company's control, may have an impact on the success of any future plans. By considering them, a company can change direction, build contingencies, identify new opportunities or do nothing at all: it is an important part in the strategic decision making. Managers have used a combination of the factors to suit their needs including:

- PEST
- STEP
- ETPS

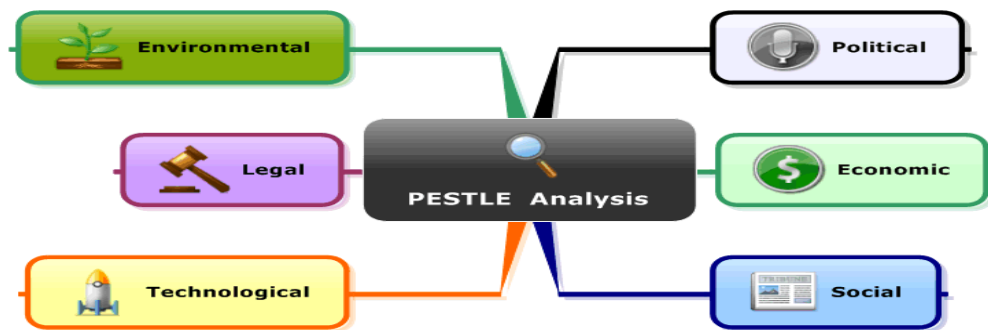
There are certain questions that one needs to ask while conducting this analysis, which give them an idea of what things to keep in mind. They are:

1. What is the political situation of the country and how can it affect the industry?
2. What are the prevalent economic factors?
3. How much importance does culture has in the market and what are its determinants?
4. What technological innovations are likely to pop up and affect the market structure?
5. Are there any current legislations that regulate the industry or can there be any change in the legislations for the industry?
6. What are the environmental concerns for the industry?

All the aspects of this technique are crucial for any industry a business might be in. More than just understanding the market, this framework represents one of the vertebrae of the backbone of strategic management that not only defines what a company should do, but also accounts for an

organization's goals and the strategies stringed to them. It may be so, that the importance of each of the factors may be different to different kinds of industries, but it is imperative to any strategy a company wants to develop that they conduct the PESTLE analysis as it forms a much more comprehensive version of the SWOT analysis. ([http://pestleanalysis.com/...](http://pestleanalysis.com/))

It is very critical for one to understand the complete depth of each of the letters of the PESTLE. Figure 4.1 shows the all the six factors in a graphical presentation and below it a detailed description of them is provided:



**Figure 4.1 PESTLE factors in a graphical presentation. (Collected: [www.biggerplate.com](http://www.biggerplate.com))**

#### **4.2 PESTLE analysis method:**

The PEST analysis is a useful tool for understanding market growth or decline, and as such the position, potential and direction for a business. A PEST analysis is a business measurement tool. PEST is an acronym for Political, Economic, Social and Technological factors, which are used to assess the market for a business or organizational unit. The PEST analysis headings are a framework for reviewing a situation, and can also, like SWOT analysis, and Porter's Five Forces model, be used to review a strategy or position, direction of a company, a marketing proposition, or idea. Completing a PEST analysis is very simple, and is a good subject for workshop sessions. PEST analysis also works well in brainstorming meetings. Use PEST analysis for business and strategic planning, marketing planning, business and product development and research reports.

You can also use PEST analysis exercises for team building games. PEST analysis is similar to SWOT analysis- it's simple, quick, and uses four key perspectives. As PEST factors are essentially external, completing a PEST analysis is helpful prior to completing a SWOT analysis (a SWOT analysis- Strengths, Weaknesses, Opportunities, Threats - is based broadly on half internal and half external factors).

A PEST analysis measures a market; a SWOT analysis measures a business unit, a proposition or idea. The PEST model is sometimes extended (some would say unnecessarily) to seven factors, by adding Ecological (or Environmental), Legislative (or Legal), and Industry Analysis (the model is then known as PESTELI). Arguably if completed properly, the basic PEST analysis should naturally cover these 'additional' factors: Ecological factors are found under the four main PEST headings; Legislative factors would normally be covered under the Political heading; Industry Analysis is effectively covered under the Economic heading. If you prefer to keep things simple, perhaps use PESTELI only if you are worried about missing something within the three extra headings. (<http://www.gilbertsilvius.nl/Handout%20PEST%20Analysis.pdf>....)

A SWOT analysis measures a business unit or proposition, a PEST analysis measures the market potential and situation, particularly indicating growth or decline, and thereby market attractiveness, business potential, and suitability of access - market potential and 'fit' in other words. PEST analysis uses four perspectives, which give a logical structure, in this case organized by the PEST format, which helps understanding, presentation, discussion and decision-making. The four dimensions are an extension of a basic two heading list of pro's and con's.

PEST analysis can be used for marketing and business development assessment and decision-making, and the PEST template encourages proactive thinking, rather than relying on habitual or instinctive reactions. Here the PEST analysis template is presented as a grid, comprising four sections, one for each of the PEST headings: Political, Economic, Social and Technological. The free PEST template below includes sample questions or prompts, whose answers are can be inserted into the relevant section of the PEST grid. The questions are examples of discussion points, and obviously can be altered depending on the subject of the PEST analysis, and how you want to use it. Make up your own PEST questions and prompts to suit the issue being analyzed

and the situation (i.e. the people doing the work and the expectations of them). Like SWOT analysis, it is important to clearly identify the subject of a PEST analysis, because a PEST analysis is four-way perspective in relation to a particular business unit or proposition - if you blur the focus you will produce a blurred picture - so be clear about the market that you use PEST to analyze.

A market is defined by what is addressing it, be it a product, company, brand, business unit, proposition, idea, etc, so be clear about how you define the market being analyzed, particularly if you use PEST analysis in workshops, team exercises or as a delegated task. The PEST subject should be a clear definition of the market being addressed, which might be from any of the following standpoints:

- A company looking at its market
- A product looking at its market
- A brand in relation to its market
- A local business unit
- A strategic option, such as entering a new market or launching a new product
- A potential acquisition
- A potential partnership
- An investment opportunity

Be sure to describe the subject for the PEST analysis clearly so that people contribute to the analysis, and those seeing the finished PEST analysis, properly understand the purpose of the PEST assessment and implications. Figure 4.2 shows how changes in Pestle have an influence on the business. When the Pestle factors changes the organization should take proper measures in such a way that these changes are made favorable to the organization.

The traditional use of PESTLE in organizational change management is as follows:

List external PESTLE factors for the organization – you may need to brainstorm and have expert knowledge of the organization and/or the world outside the organization for this. Identify the implications of each PESTLE factor for the organization.

Issue	Impact on Business
<b>Political</b>	
<ul style="list-style-type: none"> <li>• Growing political focus and pressure on Healthcare</li> <li>• Global governments looking for healthcare savings.</li> <li>• Harmonization of healthcare across Europe.</li> </ul>	<ul style="list-style-type: none"> <li>• Cut backs (loss of business) more pressure on pricing.</li> <li>• Increase pressure on pricing.</li> <li>• Reference pricing, exposing prices across borders.</li> </ul>
<b>Economic</b>	
<ul style="list-style-type: none"> <li>• Global economic crisis.</li> <li>• Reduction in individual disposable income.</li> <li>• Increasing number of buying groups putting pressure on pricing.</li> <li>• Reduction in Pharma Growth.</li> </ul>	<ul style="list-style-type: none"> <li>• Reluctance of consumers to spend on healthcare.</li> <li>• Again, an increased pressure on pricing, however market is likely to grow due to aging population.</li> <li>• Need to introduce value adding processes.</li> <li>• Increased pressure from shareholders.</li> </ul>
<b>Social / Culture</b>	
<ul style="list-style-type: none"> <li>• Patient awareness, changing expectations.</li> <li>• Patient /public activism is also increasing (e.g. harnessing new social networking technologies).</li> <li>• Increasing age of population &amp; growth in obesity.</li> </ul>	<ul style="list-style-type: none"> <li>• More pressure on customer service, increased need for education and more price transparency.</li> <li>• Better intelligence gathering requires.</li> <li>• Market likely to grow with increasing health concerns.</li> </ul>
<b>Technological</b>	
<ul style="list-style-type: none"> <li>• New info and Comms technologies (Social Media).</li> <li>• Customized Treatments.</li> <li>• Direct to Patient Advertising.</li> </ul>	<ul style="list-style-type: none"> <li>• New digital opportunities: creating new "e-models".</li> <li>• Direct to patient communications.</li> <li>• More responsive service facilities required.</li> </ul>
<b>Legislation</b>	
<ul style="list-style-type: none"> <li>• Changes to advertising laws.</li> <li>• Increased litigation.</li> <li>• Global inconsistencies.</li> </ul>	<ul style="list-style-type: none"> <li>• Need to focus on Education.</li> <li>• Quality becomes key.</li> <li>• Unable to rationalize (US and European markets require different formulas).</li> </ul>
<b>Environmental</b>	
<ul style="list-style-type: none"> <li>• Growing environmental agenda and community awareness.</li> </ul>	<ul style="list-style-type: none"> <li>• Identify eco opportunities to market.</li> </ul>

**Figure 4.2 Impact on business due to changes in PESTLE factors.**

Then decide the importance of the implications of the external factors – ranks or rate them. Normally this involves assessing their: impact over time (short-, medium and long-term), impact by type (positive or negative affects) and impact by dynamics i.e. is the significance/importance of the implication increasing, decreasing or remaining unchanged. Rate the potential impact to

the organization e.g. high – low, and the likelihood of it happening e.g. low – high. One can then undertake further analysis in the form of a SWOT Analysis or Scenario building. Developing ‘what if’ scenarios enables you to visualize different alternative futures for the organization, focusing on high frequency, high impact combinations of influences.

#### **4.3 PESTLE analysis template:**

Other than the four main headings, the questions and issues in the template below are examples and not exhaustive - add your own and amend these prompts to suit your situation, the experience and skill level of whoever is completing the analysis, and what you aim to produce from the analysis. If Environmental is a more relevant heading than Economic, then substitute it. Ensure you consider the three additional 'PESTELI' headings: Ecological (or Environmental), Legislative (or Legal), and Industry Analysis. The analysis can be converted into a more scientific measurement by scoring the items in each of the sections. There are established good or bad reference points - these are for you to decide. Scoring is particularly beneficial if more than one market is being analyzed, for the purpose of comparing which market or opportunity holds most potential and/or obstacles. This is useful when considering business development and investment options, i.e., whether to develop market A or B; whether to concentrate on local distribution or export; whether to acquire company X or company Y., etc. If helpful when comparing more than one different market analysis, scoring can also be weighted according to the more or less significant factors. Table 4.1 provides a standard PEST template which can be used for any purpose. PEST analysis looks at the external business environment and is an appropriate strategic tool for understanding the "big picture" of the environment in which business operates, enabling the company to take advantage of the opportunities and minimize the threats faced by their business activities. When strategic planning is done correctly, it provides a solid plan for a company to grow into the future. (<http://www.iseindia.com/ResearchPDF....>). With a PEST analysis, the company can see a longer horizon of time, and be able to clarify strategic opportunities and threats that the organization faces. By looking to the outside environment to see the potential forces of change looming on the horizon, firms can take the strategic planning process out of the arena of today and into the horizon of tomorrow. PEST is not a set of rigid compartments into which ideas need to be sorted. It is better thought of as a set



<p><b><u>Political</u></b></p> <ul style="list-style-type: none"> <li>•ecological/environmental issues</li> <li>•current legislation home market</li> <li>•future legislation</li> <li>•European/international legislation</li> <li>•regulatory bodies and processes</li> <li>•government policies</li> <li>•government term and change</li> <li>•trading policies</li> <li>•funding, grants and initiatives</li> <li>•home market lobbying/pressure groups</li> <li>•international pressure groups</li> </ul>	<p><b><u>Economic</u></b></p> <ul style="list-style-type: none"> <li>•home economy situation</li> <li>•home economy trends</li> <li>•overseas economies and trends</li> <li>•general taxation issues</li> <li>•taxation specific to product/services</li> <li>•seasonality/weather issues</li> <li>•market and trade cycles</li> <li>•specific industry factors</li> <li>•market routes and distribution trends</li> <li>•customer/end-user drivers</li> </ul>
<p><b><u>Social</u></b></p> <ul style="list-style-type: none"> <li>•lifestyle trends</li> <li>•demographics</li> <li>•consumer attitudes and opinions</li> <li>•media views</li> <li>•law changes affecting social factors</li> <li>•brand, company, technology image</li> <li>•consumer buying patterns</li> <li>•fashion and role models</li> <li>•major events and influences</li> <li>•buying access and trends</li> <li>•ethnic/religious factors</li> <li>•advertising and publicity</li> </ul>	<p><b><u>Technological</u></b></p> <ul style="list-style-type: none"> <li>•competing technology development</li> <li>•research funding</li> <li>•associated/dependent technologies</li> <li>•replacement technology/solutions</li> <li>•maturity of technology</li> <li>•manufacturing maturity and capacity</li> <li>•information and communications</li> <li>•consumer buying mechanisms/technology</li> <li>•technology legislation</li> </ul>

**Table 4.1 Subject of PEST analysis (defines the standpoint and market here)**

of hooks that can be used to fish for important facts. Once the factors have been "fished out", it does not matter which hook they were attached to. When it comes to writing up the analysis, there is no need to mention the PEST labels at all. By using the PESTEL framework we can analyze the many different factors in a firm's macro environment. In some cases particular issues may fit in several categories. For example, the creation of the Monetary Policy Committee by the Labour government in 1997 as a body that was independent of government but had the ability to set interest rates was a political decision but has economic consequences; meanwhile government economic policy can influence investment in technology via taxes and tax credits. If a factor can appear in several categories managers simply make a decision of where they think it best belongs.

However, it is important not to just list PESTEL factors because this does not in itself tell managers very much. What managers need to do is to think about which factors are most likely to change and which ones will have the greatest impact on them i.e. each firm must identify the key factors in their own environment. For some such as pharmaceutical company's government regulation may be critical; for others, perhaps firms that have borrowed heavily, interest rate changes may be a huge issue. Managers must decide on the relative importance of various factors and one way of doing this is to rank or score the likelihood of a change occurring and also rate the impact if it did. The higher the likelihood of a change occurring and the greater the impact of any change the more significant this factor will be to the firm's planning.

It is also important when using PESTEL analysis to consider the level at which it is applied. When analysing companies such as Sony, Chrysler, Coca Cola, BP and Disney it is important to remember that they have many different parts to their overall business - they include many different divisions and in some cases many different brands. Whilst it may be useful to consider the whole business when using PESTEL in that it may highlight some important factors, managers may want to narrow it down to a particular part of the business (e.g. a specific division of Sony); this may be more useful because it will focus on the factors relevant to that part of the business. They may also want to differentiate between factors which are very local, other which are national and those which are global.

#### **4.4 Impact of Political factors on power generation projects:**

These factors determine the extent to which a government may influence the economy or a certain industry. For example a government may impose a new tax or duty due to which entire revenue generating structures of organizations might change. Political factors include tax policies, Fiscal policy, trade tariffs etc. that a government may levy around the fiscal year and it may affect the business environment (economic environment) to a great extent. Political factors may also include goods and services which the government wants to provide or be provided (merit goods) and those that the government does not want to be provided (demerit goods). Furthermore, governments have great influence on the health, education, and infrastructure of a nation. Political factors relate to the pressures and opportunities brought by political institutions and to what degree the government policies impact the business. (<https://processpolicy.com/.....>)

- Government policies
- Government term and change
- Trading policies
- Funding, grants and initiatives
- Lobbying and pressure groups
- Wars, terrorism and conflicts
- Elections and political trends
- Internal political issues
- Inter-country relationships
- Local commissioning processes
- Corruption
- Bureaucracy

Every project has both internal politics and external politics. The internal politics like team jealousies, cohesive projects, and personal interests occur in all projects and must be considered and managed by stakeholders. The external politics refer to those which the stakeholders do not control. These events include all political events like employment laws, tax policies, trade restrictions, trade reforms, environmental regulations, political stability, tariffs, etc.

Government has taken short, medium and long term plan. Under the short term plan, Quick Rental Power Plants will be installed using liquid fuels/gas and capable to produce electricity

within 12-24 months. Nearly 1753 MW is planned to be generated from rental and quick rental power plants. Under the medium term plan, initiatives have been taken to set up power plants with a total generation capacity of 7919 MW that is implementable within 3 to 5 years time. The plants are mainly coal based, some are gas and oil based. In the long term plan, some big coal fired plants will be set up, one will be in Khulna South and other will be in Chittagong, each of having the capacity of 1300 MW. Some 300-450 MW plants will be set up in Bibiana, Meghnaghat, Ashugonj, Sirangonj and in Ghorashal. If the implementation of the plan goes smoothly, it will be possible to minimize the demand-supply gap at the end of 2012.

Bangladesh has undertaken an ambitious plan to augment the energy starved nation through import of 4500 megawatt of electricity by 2030, subject to setting up of interconnectivity regional power grid. Bangladesh oil and natural gas fields are quickly depleting for power hungry export industries. The government is under immense political pressure from the investors and entrepreneurs' apex body to augment power transmission or provide compensation package for their export losses. The government is contemplating to import power from neighboring India and Burma. The prime minister's representative held parleys with the two neighboring governments in the last two years.

The government is planning to import 500 MW of electricity from India by 2013. Another 500 MW of electricity would be imported through north-west route by 2018. Other imports of 250 MW, 750 MW, and 1000 MW would be made possible from north-east Indian states. A memorandum of understanding (MoU) was signed between India and Bangladesh for cooperation in power sector during Prime Minister Sheikh Hasina's visit to New Delhi in Jan 2010. Bangladesh would also hold talks with Nepal and Bhutan for import of power from the two Himalayan countries, and if fruitful, it would help set up a trilateral or quadrilateral sub-regional architecture for cooperation in the energy sector.

Bangladesh launched a simultaneous move to import electricity from its two neighbors' India and Myanmar in 2009. Myanmar had initially expressed its interest export electricity from it two planned hydropower plants having total capacity 575 megawatts (mw) in Rakhaine state, which is very close to Bangladesh border. A high-level delegation was supposed to come to Bangladesh from Myanmar to discuss the issue and sign a memorandum of understanding (MoU). But without showing any reason, Myanmar suspended the tour. Analyst's link Myanmar's losing

interest to the recent changes in Myanmar's politico-economic policies. They said that the withdrawal of US and European economic embargo opened opportunities for foreign investment in Myanmar. In that case Myanmar will need huge electricity to run its industries.

Professor of Bangladesh University of Engineering and Technology (BUET) Professor M. Tamim, also former energy adviser to an interim government, said the import of electricity depends not only on good regional relationships, but for budget crunch for establishment of infrastructure for import of electricity from other side of the border. (<http://www.nl-aid.org/continent/south-asia/....>).

Another political hurdle that the government is facing relates to Rampal coal power plant. A joint venture company as per the deal signed by Bangladesh and India is going to construct a 1,320 MW coal based power plant at Rampal in Bagerhat district near the Sundarbans. Environmentalists and experts expressed their concern over the planned coal-based power plant adjacent to the Sundarbans, a world heritage site. They urged the government to make public its environmental impact assessment (EIA) study on the planned coal-based power plant near the world's largest mangrove forests. The government will talk to the lawyers of the Bangladesh Environmental Lawyers Association (BELA) and other experts and environmental activists over the implementation of the proposed 1,320-megawatt coal-fired power plant at Rampal. Admitting the harmful effects of the coal-based power plant, Muhith emphasized that the government was taking preventive measures: "It's true that coal-fired power plant isn't environment-friendly. But pollution control technologies have been set up at Rampal coal power plant to make it environment-friendly." (<http://www.bdnews24.com/details.php....>)

Before independence, most of the power plants in the country were coal-fired, though the first one was hydro-electric power plant. Till 1968, coal-based power plants were the key tool in the power sector. Even, the USA, Australia, China and India are continuing the operations of coal-fired power plants still now. The coal-fired power is the best option for Bangladesh as its production cost is cheaper than the liquid fuel-fired power. The Cabinet body has approved it in principle as part of the government's future plan of power generation for the next 20 years of which 50 percent will come from coal-fired power plants. Half of the coal-fired power plants would be run by imported coal while rest will be operated by the locally produced coal.

Establishment and timely commencing production of the major segments of the power plant, contracted to be established on “Quick Rental” basis in Bangladesh is failing gradually, thus not only causing huge amount of financial loss to national exchequer but also increased sufferings of the citizen of the country. The policy of letting private companies establish QRPP (Quick Rental power Plant) was greatly criticized by experts in the country. Many said, this was a mere “money-making” project of some of the influential figures in the government and the ruling party. Awami League government adopted a “Crash Program” in October 2009 to set up power generation plants in next five years having total capacity of 7,000 MW. Opposing the idea of QRPP, experts said that mostly second-hand equipments and machinery are used in such plants, which will be less efficient and the tariff will ultimately rise. They argue that the government would be better off spending money on upgrading the existing power stations.

Energy ministry sources in Bangladesh claimed that, QRPP are considered to be quickest method of meeting the growing demands of electricity in the country, and end consumers will pay the same or a bit less for their electricity. The finance minister has also insisted that rental power plants are needed immediately to ease power shortage, scotching criticism that fuelling these plants had led to depletion foreign currency reserves. A.M.A Muhith claims "We had no other option, many are saying that fuel prices are rising due to the use of diesel and octane to run the plants. Their claims are baseless as there was no other option to address the power crisis” ([http://bdnews24.com/details.php?...\)](http://bdnews24.com/details.php?...)

Bangladesh’s energy infrastructure is quite small, insufficient and poorly managed. The per capita energy consumption in Bangladesh is one of the lowest in the world. Noncommercial energy sources, such as wood, animal wastes, and crop residues, are estimated to account for over half of the country’s energy consumption. Bangladesh has small reserves of oil and coal, but very large natural gas resources. Commercial energy consumption is mostly natural gas, followed by oil, hydropower and coal. Problems in the Bangladesh’s electric power sector include corruption in administration, high system losses, and delays in completion of new plants, low plant efficiencies, erratic power supply, electricity theft, blackouts, and shortages of funds for power plant maintenance. Overall, the country’s generation plants have been unable to meet system demand over the past decade.

Bangladesh government aspires to complete the first 1000MW nuclear based power station at Rooppur by 2015 while another plant is planned to be established at the same site with same production capacity by 2018. Russians though have submitted proposal for the establishment of nuclear based power station in Bangladesh, it has not yet submitted the details on how Bangladesh would dispose off the nuclear waste that would be released from the plant. Bangladesh government was also negotiating with Iran for their assistance in establishing both or at least one of the nuclear based power plants in the country. Delegation from Iran has already made a number of trips to Bangladesh to discuss and negotiate the project with the ruling party tops.

Blasts at three reactors of a power plant in Japan's Fukushima following an 8.9-magnitude quake and a 10-feet tsunami have triggered debates over nuclear power generation. The blasts released radiation into the environment, making people around the world anxious about the safety of such power plants. China, a country pursuing the world's most ambitious N-power expansion plan, has suspended approval for new nuclear power stations following the accident at Japan's Fukushima Daiichi plant. Responding to about the safety of establishing the Rooppur plant, the government claims that all these countries were operating second-generation plants, whereas the one to be set up in Bangladesh is a third-generation one provisioned with updated technology to withstand such disasters. The International Atomic Energy Agency (IAEA) will scrutinize the security of the plant thus allaying fears about the plant. Bangladesh Atomic Energy Commission (BAEC) also assured that the reactors that exploded in Japan are all more than 40 years old. The ones established recently were unaffected. Russia will also be providing support for nuclear waste disposal.

Bangladesh is strategically located as a potential hub of regional trade. Roads, bridges, and ports are being developed for facilitating transit routes for regional trade through Bangladesh. Regional energy grid is being developed for enhancing energy security. Bangladesh offers excellent opportunities and facilities for foreign investment. No prior permission is required for investment in industrial sector (except for four reserve sectors including defense equipment, reserve forestry, atomic energy, currency printing and minting). Investment proposals need only to be registered with the Board of Investment (BOI). There is no ceiling on percentage of foreign ownership; both wholly foreign owned and joint ventures are permissible.

The capital market is open for foreign portfolio investment (FPI) by individual and institutional investors. The Foreign Private Investment (Promotion and Protection) Act, 1980 and a number of bilateral intergovernmental agreements protect foreign investments fully, with assurance of no expropriation or nationalization without fair compensation. Profits/dividends on FDI and FPI are freely repatriable, so are disinvestment proceeds (at market value for listed companies, at net asset value for unlisted entities) and capital gains. Capital gains are free of income tax. External trade has been liberalised in line with WTO rules, and Taka is fully convertible for current external transactions. Potential sectors for foreign investment include conventional power generation and renewable energy. Qatar wants to invest in the country's power sector through setting up a gas-based power plant of 450-500MW. According to officials at Power Division, the Gulf nation placed the investment proposal during the visit of a delegation, led by Assistant Minister for International Cooperation Affairs of Qatar Sheikh Ahmed Bin Mohammed Bin Jabr Al Thani. Saudi multi-billionaire Prince Al-Waleed Bin Talal has shown interest to invest in Bangladesh's power and tourism.

Kaptai dam is the one and only dam of Bangladesh that is used to generate hydro-electric power. The only hydropower plant in the country is located at kaptai, about 50 km from the port city of Chittagong. This plant was constructed in 1962 as part of the 'Karnafuli Multipurpose Project', and is one of the biggest water resources development projects of Bangladesh. The water storage capacity of the Kaptai dam is 11000 km<sup>2</sup>.

The government sought assistance from the USA in power sector for building another Kaptai dam for doubling hydropower generation from the lake waters in Rangamati hill district. At present Kaptai Lake is suffering from many problems. Fertilizers and pesticides used in lake adjacent crop fields polluting lake water. Again, water level reduces much more than previous years. People living adjacent to the lake depends on the lake water for drinking, cooking, washing and breathing. Local fishermen also catch fish in this lake. To get more and sustainable production, proper and scientific management systems need to be introduced for this lake. Also government and associated authorities should take immediate steps to make a good solution of existing problems of the lake.



#### **4.5 Impact of Economical factors on power plant projects:**

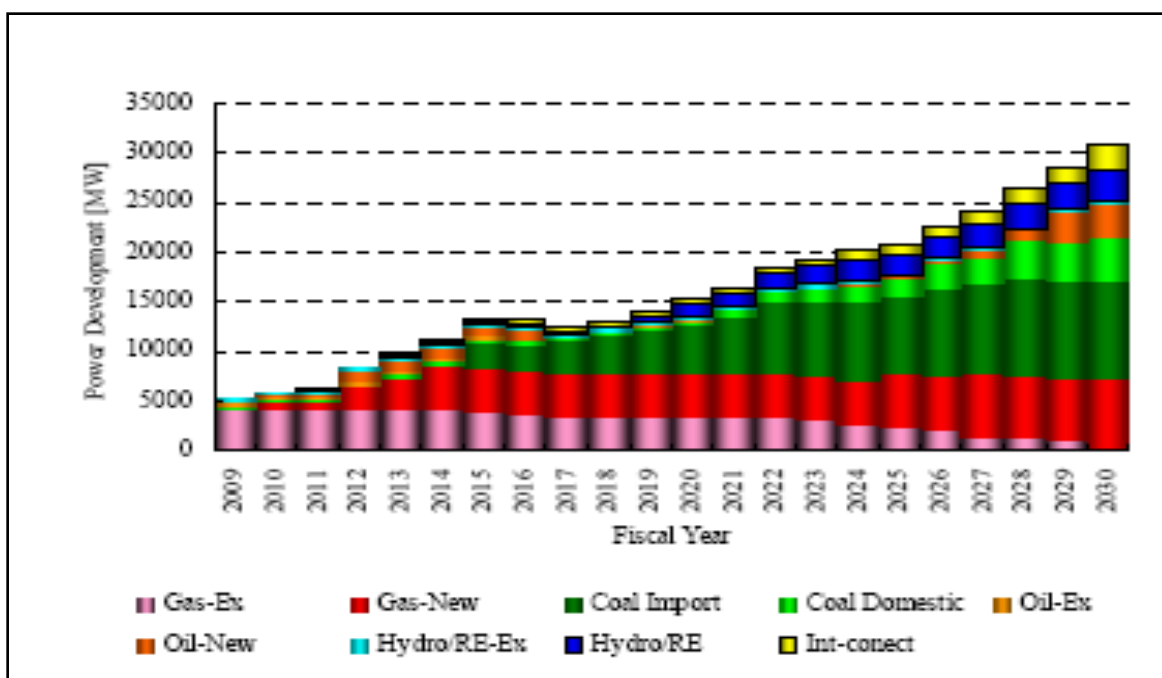
These factors are determinants of an economy's performance that directly impacts a company and have resonating long term effects. For example a rise in the inflation rate of any economy would affect the way companies' price their products and services. Adding to that, it would affect the purchasing power of a consumer and change demand/supply models for that economy. Economic factors include inflation rate, interest rates, foreign exchange rates, economic growth patterns etc. It also accounts for the FDI (foreign direct investment) depending on certain specific industries who're undergoing this analysis. Interest rates affect a firm's cost of capital and therefore to what extent a business grows and expands. Exchange rates affect the costs of exporting goods and the supply and price of imported goods in an economy. Economic factors relates to economic policies, economic structures and to what degree the economy impacts the business.

- Local economy
- Taxation
- Inflation
- Interest
- Economy trends
- Seasonality issues
- Industry growth
- Import/export ratios
- International trade
- International exchange rates

This factor takes into consideration all events that affect the internal and external economic environment. The internal or micro-economic events relate to the project viability and internal soundness of the project. Financial models and accounting techniques need to be used during the evaluation phase to ensue the viability. The external or macro-economic events include interstate taxes, embargoes, interest rates, economic growth, recession, inflation rate, exchange rate, minimum wage, wage rates, unemployment, cost of living, working hours, credit availability, financing availability, etc.

The government has engaged in dialogue with neighboring countries to import power to reduce energy crisis in Bangladesh. Dhaka has signed an agreement with New Delhi that day to import 250MW power at tariff of Rs 2.40 per KW hour. The price is equivalent to Tk 4 per KW hour. This price is feasible compared to that of quick rental power plants. Similarly electricity from the planned plants in Myanmar will be commercially viable business for both Bangladesh and Myanmar. Although the price per KW hour is reasonable the main drawback that the government will face is the construction of the 400KV transmission line and also the substation. It is estimated that the construction of the grid and the substation will be substantially high. Some experts even mentioned that the 4500 MW electricity import is possible through regional power exchange agreement by 2030 but the purchase of electricity would be expensive from neighboring countries, as it would be costly for construction and maintenance of the grid.

The government is contemplating signing the power purchase agreement (PPA) and the installation agreement (IA) with India to set up the Bangladesh-India Friendship Power Company (Pvt) Limited by the end of November 2012. The coal-fired power plant, which would be the biggest in Bangladesh, would help meet the ever-increasing demand for power. In order for it to happen, Bangladesh Power Development Board has signed an initial agreement with the NTPC (National Power Thermal Corporation) for installing the 1,320 MW coal-fired power plant in Rampal in the southern part of the country. The proposed 1,320 MW coal-fired power plant would be able to supply 1,234.20 MW of electricity for the next 30 years. According to power division the joint venture company will enjoy a 15-year tax holiday. The NTPC and the BPDB are yet to complete the registration process. Bangladesh and India will equally share up to 30 per cent equity of this mega project. The remaining equity, which may be equivalent to USD 1.2 billion, will be taken as bank loan with help from the NTPC. Although Bangladesh wanted to count the entire funds raised as capital cost, the NTPC had disagreed to it. Now, it will go on the loan account or will be counted as an investment by the NTPC. The NTPC will provide liability damage if the plants fail to run at 85 per cent load factor, while the Bangladesh-India Friendship Power Company (Pvt) Limited will provide 50 per cent “incentive” to the NTPC if the plant runs at, or above, 85 per cent load factor. Figure 4.3 shows that government has taken steps to produce bulk of the energy through coal based power plant in the coming years, so this nature of coal based power plant deal is just the beginning.



**Figure 4.3: Power Development Plan by FY 2030 (MW) (Source: Powercell)**

Bangladesh has planned to add 13,154 MW power by 2016 to its current available production capacity of about 6,000 MW. But fund crunch has been the biggest challenge in this regard. To overcome this problem, the government has made vigorous multiple moves, including lending from multiple donor agencies, supplier's credit, buyer's credit and ECA funding. The Power Division is waiting for the clearance from the Ministries of Law and Finance to receive about US\$ 630 million ECA (export credit agency) fund for implementing two power plant projects having capacity of about 675 MW. Upon receiving the clearance from the two ministries, the Power Division will move ahead to complete its negotiation with two leading international banks the HSBC and the Standard Chartered to receive the fund.

These two international banks will arrange the ECA fund for the two projects where they will themselves also participate as lenders. The state-owned Ashuganj Power Station Company Limited (APSCL) will set up the projects 225 MW combined cycle and 450 MW combined cycle plants within three years. The APSCL signed a contract in October 5, 2012 with its EPC contractor South Korean Hyundai Engineering Company and Daewoo International Corporation to build the 225 MW combined cycle power plant at Ashuganj station. The APSCL signed

another contract with a consortium of Inelectra International AB of Sweden and TSK Electronica y electricidad SA of Spain to build a 450 MW power plant at the same power station.

The two power plants need a total foreign funding of US\$ 630 million for their implementation. Following the contracts, the APSCL has been pursuing the two international leading banks HSBC and Standard Chartered to receive the ECA fund. The 225 MW project will need about US\$ 202 million of which the Standard Chartered will alone contribute 80 percent while its other ECA partners will provide the rest of the required fund. On the other hand, the HSBC 's Hong Kong branch will finance the project as coordinating arranger of fund under the ECA facilities while the HERMES of Germany, ONDD of Belgium, CESCE of Spain will provide the ECA facilities to implement the project.

Severe power crisis compelled the government to enter into contractual agreements for high-cost temporary solution, such as rental power and small IPPs, on an emergency basis, much of it diesel or liquid-fuel based. This has imposed tremendous fiscal pressure. With a power sector which is almost dependent on natural-gas fired generation (89.22%), the country is confronting a simultaneous shortage of natural gas and electricity. In spite of the major deterrents energy crisis and gas supply shortage, government has taken several initiatives to generate 6000 MW by 2011, 10,000 MW by 2013 and 15,000 MW by 2016. According to the Master Plan the forecasted demand would be 19,000 MW in 2021 and 34,000 MW in 2030. To meet this demand the generation capacity should be 39,000 MW in 2030. The plan suggests going for fuel-mixed option, which should be domestic coal 30%, imported coal 20 %, natural gas (including LNG) 25%, liquid fuel 5%, nuclear, renewable energy and power import 20%.

Now in order to fulfill the required demand according to the master plan both public and private sector investment is required. Government has already started implementation of the plan. Total 31,355 Million-kilowatt hour (MkWh) net energy was generated during 2010-11. Public sector power plant generated 47% while private sector generated 53% of total net generation. In line with the Power system Master Plan 2010, an interim generation plan up to 2016 has been prepared, which is as follows in Table 4.2

Year	2012	2013	2014	2015	2016	Total
Public	632	1467	1660	1410	750	5919
Private	1354	1372	1637	772	1600	6735
Power import		500				500
Total	1986	3339	3297	2182	2350	13,000

**Table 4 .2 Calendar Year Wise Projects Completion (From 2012 to 2016) in MW**

In generating and distributing electricity, the failure to adequately manage the load leads to extensive load shedding which results in severe disruption in the industrial production and other economic activities. A recent survey reveals that power outages result in a loss of industrial output worth US\$1 billion a year which reduces the GDP growth by about half a percentage point in Bangladesh. A major hurdle in efficiently delivering power is caused by the inefficient distribution system. It is estimated that the total transmission and distribution losses in Bangladesh amount to one-third of the total generation, the value of which is equal to US\$ 247 million per year. Top ministers, business leaders and economists have all cried out seeking extraordinary attention from the government to steer the country out of the current energy crunch for the greater interest of industrialization.

The government is continuing power generation through rental power plants despite having its huge negative consequence. In 2009, the average electricity production cost was below Tk.3/kWh. The energy mix for power production was roughly 82% gas, 10% oil, 4% hydro and 4% coal. Within a span of three years the oil contribution of power production has shot up to 30%; reducing gas component to 67% and the average production cost has more than doubled to Tk. 6.5/kWh. As a result the government was forced to raise the electricity tariff several times recently. Besides this the government is counting losses worth billions of taka in 'capacity

payments' to oil-fired rental and quick rental power plants for its failure to purchase electricity. Dr Akbar Ali Khan, former adviser to a caretaker government said "Not a single country in the world succeeded in solving their electricity crisis through rental power plants," He said the government could solve the power problem by repairing the existing power plants and solving the gas crisis instead of opting rental power plants (<http://www.thedailystar.net/newDesign/.....>). Experts also say that the government could easily make 2,400MW of power only spending Tk 12-15 billion by improving the efficiency of the existing plants instead they spent nearly Tk 320 billion to generate 900MW from rental or quick rental powers.

The Power Division has estimated that the state-run Power Development Board will need Tk 6,479 in subsidy for the 2012–13 financial year to buy 20 per cent more electricity from fuel-oil-run rental plants. In the 2011–12 financial year, the government gave the power board Tk 6,100 crore in subsidy to buy electricity from the rental plants. According to the latest Power Division assessment, the board will count Tk 1.45 in losses a kilowatt-hour (unit) as it would be spending Tk 6.15 on the generation of a unit of power against the sales price of Tk 4.7. The amount of losses was Tk 0.72 a unit in the 2011-12 financial year.

On the contrary the government opposed by saying that quick rental power plants have saved the economy. Had there been no quick rental power plants, the country's GDP (gross domestic product) would have suffered a loss of around Tk 160,000 crore. Due to the additional electricity, garment exports rose by \$6.5 billion, a study of the Saarc (South Asian Association for Regional Cooperation) Chamber suggests. Businesses would have to buy thousands of generators if there was no electricity from such plants. Generators are run by diesel but quick rental power plants are run by furnace oil where diesel is costlier than furnace oil. If there had been no additional production of power, the country would have to spend Tk 10,000 crore more on import of these products.

The government is also encouraging investment from foreign countries. Bangladesh government and Saudi Fund for Development (SFD) on November 22, 2012 signed a 200 million Saudi Arabian Riyals (US\$ 53.33 million) loan deal under which the Saudi government that will provide US\$ 53.33 million in loan for implementing the proposed Shikalbaha 225-megawatt power plant in Chittagong. Three other financiers – Kuwait, UAE government and the OPEC

fund will also provide \$114.40 million worth of credit for the power station. Kuwait has already confirmed US\$ 53 million loan for the power station. The UAE's Abu Dhabi Fund for Development (ADFD) will provide \$31.4 million while the OPEC Fund for Development \$30 million for the plant. The government will provide \$71.40 million and the rest \$31.62 million will come from the state-owned Bangladesh Power Development Board (BPDB). The \$270.75 million Shikalbaha power plant is expected to meet the growing electricity demand in Chittagong port area. The private sector is also receiving financial aid from foreign donors. Summit Group, the country's leading company on energy sector, has recently signed an agreement with China Energy Group, the largest government-owned Chinese company, to develop Bangladesh's energy sector.

Nuclear power is desirable in Bangladesh, due to its underdeveloped and mismanaged energy infrastructure. But the Bangladesh government needs assistance from foreign country to setup a nuclear power plant. Under these circumstance countries such as Russia, China put forward proposals to set up the nuclear facility in Rooppur. But the Bangladeshi government decided to make an agreement with the Russians. It is reported that Russia agreed "to provide as credit 85% of the estimated Tk.12,000-15,000 crore needed for setting up the first-ever nuclear power plant in Bangladesh." Initially \$ 500 million will be provided for conducting necessary studies and preparation of the design for the 1,000 MW nuclear power plant. The estimated cost of Tk. 12,000-15,000/ crore (\$1.47-1.84 billion, roughly) for a 1,000 MW plant corresponds to \$1,470-1,840 per kW. Russia signed a contract with Belarus in July 2012 for the supply of two 1,200 MW nuclear reactors with a price tag of \$4,166 per kW and is due to sign another contract with Turkey for four similar reactors at the same per kW cost. Taking this price as a bench mark, a 1,000 MW reactor at Rooppur should cost more than Tk. 34,000 crore.

Renewable energy represents 1.5 per cent of the country's total power consumption at present with 1.3 million solar home systems and 45,000 bio-gas plants. Considering global warming and excessive dependence on non-renewable energy resources, the government wants to increase the use of renewable energy and promote energy efficiency. The United Nations has announced that it would help Bangladesh build up a common platform to develop renewable energy in the country. The UN would assess the needs of Bangladesh in achieving its target to increase the share of renewable energy in the total electricity production. This is a great opportunity for

Bangladesh to scale up investment in energy sector and speed up poverty alleviation with the help of UN, while a large section of the people does not have access to energy. The government has recently set a target to increase the country's share of renewable energy to 5.0 per cent by 2015 and 10 per cent by 2020. To implement the plan, Bangladesh needs \$3-4 billion for which the country is making approach to donor agencies like the World Bank, the Asian Development Bank and other agencies and international investors. The government has to create an environment so that donor agencies and private investors take interest to mobilize their funds and invest in renewable energy sector.

Recently, the Power Division has sent a revised and updated country paper on the country's position about sustainable renewable energy to the United Nations Development Programme (UNDP) in response to a request from the UN Secretary General's Sustainable Energy for All programme. This programme is a special initiative taken up by the UN Secretary General to promote development of sustainable renewable energy across the world. In the revised and updated paper, power generation from renewable energy in Bangladesh is targeted to be at 800 megawatt (MW) instead of 500MW by 2015 and 2000MW instead of 1500MW by 2020. The total fund requirement for generation of renewable energy has been set at \$2.0 billion. At present, about 77MW power is being generated in the country from solar system, which is the main component of renewable energy.

#### **4.6 Impact of Socio-cultural factors on power plant projects:**

These factors scrutinize the social environment of the market, and gauge determinants like cultural trends, demographics, population analytics etc. An example for this can be buying trends for Western countries like the US where there is high demand during the Holiday season. It includes the cultural aspects and includes health consciousness, population growth rate, age distribution, career attitudes and emphasis on safety. Trends in social factors affect the demand for a company's products and how that company operates. For example, an aging population may imply a smaller and less-willing workforce (thus increasing the cost of labor). Furthermore, companies may change various management strategies to adapt to these social trends (such as recruiting older workers). Social factors relates to the cultural aspects, attitudes, beliefs, that will affect the demand for a company's products and how the business operates.

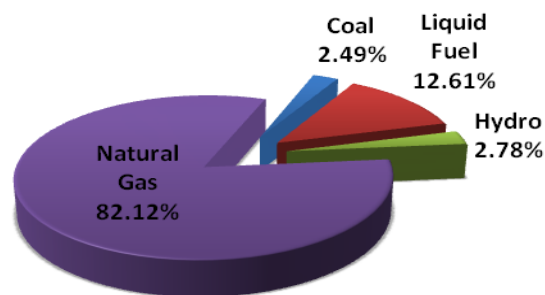


- Demographics
- Media views of the industry
- Work ethic
- Brand, company, technology image
- Lifestyle trends
- Cultural Taboos
- Consumer attitudes and opinions
- Consumer buying patterns
- Ethical issues
- Consumer role models
- Major events and influences
- Buying access and trends
- Advertising and publicity

The sociological factor takes into consideration all events that affect the market and community socially. Thus, the advantages and disadvantages to the people of the area in which the project is taking place also need to be considered. These events include cultural expectations, norms, population dynamics, healthy consciousness, career altitudes, global warming, etc.

Bangladesh has major problems with energy crisis, persisting poverty and environmental degradation. With only 49% of Bangladeshis having access to electricity, the per capita energy use is only 180 kWh. Moreover, the people who are connected with the national grid are experiencing frequent load shedding. At present, the country can generate about 4500 MW electricity which has been represented in Figure 4.4, while peak demand is about 6000 MW (USAID, 2011).

Therefore, the supply is unreliable. Most of the supply is limited to urban areas; access to electricity in rural areas is less than 10%. RET can solve this problem by harnessing energy from country's free flowing renewable such as sunshine, wind, tidal waves, waterfalls or river current, sea waves or biomass. Use of renewable energy, increased energy efficiency and enhancement of energy security constitute a sustainable energy strategy approach.



**Figure 4.4: Power Generation (FY 2011): 4500 MW (Source: Powercell)**

It was evident that adequate supply of natural gas has been at stake due to depleting existing gas reserves and non-exploration of new gas reserves. The uncertainty has been constraining development of further gas based power generation expansion program. Taking this into cognizance the government has diversified the fuel mix and under the new generation expansion plan substantial proportion is from liquid, coal based and renewable energy. Development of renewable energy is one of the important strategies adopted as part of Fuel Diversification Program. Under the existing generation scenario renewable energy has a very small share to the total generation. However, under the changed perspective renewable energy would have a significant contribution given the global climate change scenario and carbon trading prospect.

Renewable forms of energy emit far smaller amounts of greenhouse gases compared with fossil fuels and increased energy conservation facilitates the reduction of primary fossil fuel use, thus mitigating climate change impacts while contributing to the provision of energy services and enhancing security of energy supply. Usable biomass including cow dung, human excreta, poultry litter, kitchen organic waste, aquatic plants and weeds of a village in Bangladesh can produce the amount of biogas that villagers require for cooking. The fermented slurry from biogas digester is enriched with nitrogen, potassium and other nutrients. It is, therefore, best for soil, environmental health and agricultural productivity management.

Bangladesh is hoped to have enormous potentiality in renewable energy development. More than 70% of total populations of the country live in rural areas. At present major portion of total energy needs for cooking is met by locally available biomass fuels. The rural electrification program meets a small portion of total energy needs. For overall national development there is a need to pay special attention so that the energy needs of rural areas for subsistence and productive requirements (e.g. agriculture, industries, and transport) are met on a sustainable basis. Different types of renewable energy technologies such as Solar Home System (SHS), Biogas, and Improved Cooking Stoves (ICS) are suitable for Bangladesh.

SHS has been a successful story in Bangladesh. Our rural people have accepted SHS on a mass scale. Once it was thought that solar energy was not affordable for the rural people. This myth has been broken. Along with thirty partner organizations in the country, as of August 2011, over one million SHS have been installed in Bangladesh, benefiting over 6 million rural people (IDCOL, 2011). On average, more than 35,000 systems are installed every month and within the next 1 to 3 years, this rate is likely to be triple. A powerful economic model has been created to make solar energy a part of rural life, integrating one of most sophisticated technologies with the aspirations, toils and successes of the rural people. A rural family can have bright light, watch TV and power their mobile phones at the same cost as kerosene, while escaping from dim light, foul smelling smoke including health and fire hazards. Rural businesses can increase their productivity and income through extended working hours and attracting more customers.

This sector has been creating green jobs and linkage businesses especially in the rural areas. Hundreds of local youths are working in the rural areas as solar technicians. Rural women are assembling solar accessories in village based Technology Centre's. Solar engineers are increasingly employed in designing SHS, working in battery factories, and other accessory related businesses. Bangladesh is on the verge of a Solar Revolution. Increased aspirations, failure of grid electricity, growing machination and disposable income have created huge potential for solar energy in rural areas.

The role of energy and the cost of energy services should be factored into overall national economic and social development policies, including poverty reduction strategies and our

donors' programs in order to reach millennium development goal (MDG), get carbon credits from international organizations, and fulfill long-term sustainability requirements. Energy planning must be linked to goals and priorities in other sectors. If we take the continuous rise of price and supply disruption of oil due to geopolitical conflicts and other events in consideration, it is clear that oil and gas based electricity production cannot be the only option for Bangladesh. Adoption of diversified and environmental friendly power generation technologies will benefit the people of Bangladesh in the long-term. In this section some of the expected socio-economic benefits of adopting green power in Bangladesh are highlighted:

**Improved and reliable power distribution:** Many countries are adopting distributed power generation scheme as opposed to centralized power generation and reliance on national grid to deliver the power to remote areas. In case of any failure in the national grid larger area or the entire country would be affected if the power generation is centralized. The distribution costs and losses will also be much higher in such scheme. Hundreds of interwoven rivers, low lands and periodic floods and cyclones make it much more difficult for Bangladesh to maintain a centralized power distribution system with only a handful of generation sites connected by a national grid. BPDB has moved towards a policy of localized power plants distributed all over the country. Local solar plants of 1 to 10 MW capacities will be a great addition to this distributed power generation scheme.

**Institutional and sector productivity:** Power generated by small solar plants in areas beyond the reach of the national grid will create limitless possibilities of productive and economic activities. Factories, industries, commercial organizations, health and education institutions, and many other entities can be set up all across the country. Equal distribution of facilities and opportunities across the country is a long-cherished goal for Bangladesh. Solar power industry can be a very effective vehicle to fulfill this goal. Some of the benefits that can be harvested from solar power in various sectors are illustrated below:

**Agricultural productivity:** One of our recurring problems is the interruption of power to the irrigation pumps during the cultivation seasons. Small and distributed solar plants can be the solution to this problem. Another serious problem of our agriculture sector is the manual handling, harvesting and processing of crops. People cannot afford expensive oil run machines to

speed up the process. Solar plants in rural areas can open the door for many rechargeable agricultural machineries and equipments, which will dramatically increase the productivity and the efficiency of the whole cultivation, harvesting and processing chain.

Fisheries industry: Except few export oriented fisheries firms, most of the fishermen across the country do not have any means to preserve their catch for extended period due to the lack of cold storage facility, particularly in the coastal and river bank areas. As a result, if the fishermen cannot sell their catch by the end of the day, they have to suffer huge financial loss. Greedy middlemen are taking unfair advantage of these poor fishermen. Most of the coastal and river bank areas are still beyond the reach of our national grid. Small and distributed solar plants in these areas can revolutionize the fisheries industry.

Spreading Information Technology: The most remarkable achievements of human race in the 21st century is the wide spread use of information technology, which changed the way we live our life and the way we do things. Mankind achieved unimaginable productivity, connectivity and facilities through the use of information technology. Unfortunately, the vast majority of Bangladesh is still unable to enjoy the fruits of this sector. In this digital age spreading the information technology and related facilities across the country from urban to rural areas is an utmost necessity. Our government has very clear plans, and we have all the experts to implement this program, but materializing it requires uninterrupted electricity supply. A solar solution to this issue seems very feasible for Bangladesh.

Other industries: In Bangladesh, still the major industries are concentrated in few districts mainly due to availability of electricity in these areas. For equal distribution of development and economic opportunities we need to set up industries all over the Bangladesh. This can only be done through supply of electricity.

Administrative decentralization: Since the birth of Bangladesh, a long-cherished dream is to decentralize the administration, public service entities, judiciary and other government agencies. Lack of electricity is one of the primary obstacles in fulfilling this dream.

Women empowerment: 1 to 10 MW capacity power plants can satisfy demands for vast rural territories of Bangladesh. Electricity generated by these plants would become the backbone of

rural economy. The power can be used in women oriented cottage industries. This will not only solve the power crisis to a great extent, it will also open the door for economic empowerment of women and gender equality in Bangladesh.

Environmental protection and ecological balance: The sustainability of energy supply and consumption depend on the reduction of ecological and health hazards. This requires measures that increase energy efficiency of tools and machines used by human race, substitute cleaner fuels for polluting fuels, and introduce green and renewable energy technology. Protecting our nature and environment by reducing carbon foot print is one of the most important ethical and scientific goals of our time. For Bangladesh, being a low-lying coastal area, it is also a question of survival. One of the most disastrous impacts of current change in ecological balance is the increase of sea water level. Bangladesh is expected to be one of the worst sufferers of this disaster considering its geographical location and population density.

Carbon credit: International organizations, multinational corporations and industrially developed countries are expected to compete to trade carbon credits with the developing countries. By adopting solar solution to cover a significant portion of our electricity shortage Bangladesh can serve its own need, and at the same time get economic benefit by selling carbon credits to interested parties. (<http://newagebd.com/newspaper1/archive....>)

In the course of energy production, coal-fired power plants directly emit particulate matter (PM, sometimes called “soot”) as well as gases that undergo chemical reactions to form fine particles in the atmosphere, such as SO<sub>2</sub> and NO<sub>x</sub>. These emissions of PM, SO<sub>2</sub> and NO<sub>x</sub> increase the ambient concentration of PM less than 2.5 microns in diameter (PM<sub>2.5</sub>) over hundreds to thousands of kilometers downwind of the plants. Exposure to PM<sub>2.5</sub> has been consistently linked with increased mortality from cardiopulmonary diseases, lung cancer, and numerous other respiratory illnesses and associated morbidity. While most new power plants in both developed and less-developed countries have some modern pollution controls, such as electrostatic precipitators (ESPs), use of flue-gas desulfurization (FGD) is relatively rare in the less-developed countries, like Bangladesh. Greater awareness of health impacts from coal-fired power plants is needed to assure that energy policy decisions taken by the government take these external costs into account.

In Phulbari, 350 kilometers northwest of the Bangladesh capital Dhaka, local communities have come together to raise their voices against the proposed Phulbari open pit coal mining project. On November 23, 2012 the authorities had imposed Section 144 banning gatherings of more than four people indefinitely in effort to stop the demonstrations. Bangladesh is sitting on a considerable amount of coal and gas reserve and in 1997, when the Phulbari coal reserve (572 mill tonne) was discovered, it caught everybody's attention. The licensee of the mining project is GCM Resources Plc, formally Asia Energy PLC from UK chose the open pit method, a polluting method of surface mining, which promises 80% extraction. The project, if implement fully, will acquire more than 100 villages within a 59 sq. km radius. GCM has taken up a plan to resettle some 16,000 people at Phulbari town, out of some 40,000 people enumerated to be affected in the process of open-pit mine development at the coalmine.

An influential group of land owners at the proposed Phulbari coalmine have agreed to vacate their lands against adequate compensation for commercial exploration of the mineral resource for the greater interest of the nation. It was the first expression of intention of local people to give their lands as they had been convinced that commercial exploration of coal is urgently needed to generate electricity for the country, which lacks adequate natural gas and also cannot easily afford costly oil-fired power plants. The group demanded adequate compensation to be disbursed and the affected people should be resettled by the GCM Resources Plc, instead of government officials and administrative procedures.

Kaptai Lake is a manmade lake in south-eastern Bangladesh. It is located in the Kaptai Upazila under Rangamati District of Chittagong Division. The lake was created as a result of building the Kaptai Dam on the Karnaphuli River, as part of the Karnaphuli Hydro-electric project. The Kaptai Lake's average depth is 100 feet (30 m) and maximum depth is 490 feet (150 m).

In the early 1960's, the USAID-funded Kaptai hydroelectric dam flooded 40% of the arable land in the Chittagong Hill Tracts in Bangladesh and forced relocation of a fourth of the indigenous population. The palace of the Chakma Raja (King) disappeared into the lake. After Bangladeshi independence from Pakistan in 1971, indigenous leaders' appeals to the new government for autonomy and constitutional recognition were rejected. Subsequent governments opted for a military escalation of the area that triggered a protracted armed conflict. The

government resettled more than 400,000 landless Bengalis into the region to outnumber the indigenous population and overwhelm the resistance. This changed the demographics completely. In a series of massacres and other human rights violations thousands of indigenous people were killed and women raped and vast lands were grabbed by settlers and vested interests. In the December 2008 elections, the Awami League won a landslide victory and pledged to fully implement the CHT Peace Accord that was signed in 1997. But settlers have challenged the constitutionality of the accord in the courts, and vested interests are fighting to preserve the status quo. The government's remaining four year tenure will likely determine the fate of the accord. The dams developed across the rivers disturbed the aquatic life and lead to their large scale destruction. There is a chance that fish and other water animals may enter the penstock and ultimately the power generation turbines where they will be killed. These Dams can also disturb the mating seasons and mating areas of the water animals. In some cases water animals have to swim against the water stream during breeding seasons. If a dam is built in the path of migrating fish they could be stuck there and killed, never reaching their destination. This could have a devastate effect on the population of fish. Most of the inhabitants around the lake depend on the fish population.

#### **4.7 Impact of Technological factors on power plant projects:**

These factors pertain to innovations in technology that may affect the operations of the industry and the market favorably or unfavorably. This refers to automation, research and development and the amount of technological awareness that a market possesses. It also includes technological aspects such as R&D activity, automation, technology incentives and the rate of technological change. They can determine barriers to entry, minimum efficient production level and influence outsourcing decisions. Furthermore, technological shifts can affect costs, quality, and lead to innovation. Technological factors relates to the technological aspects, innovations, barriers and incentives, and to what degree these impact the business.

- Emerging technologies
- Maturity of technology
- Technology legislation
- Research and Innovation



- Information and communications
- Competitor technology development
- Intellectual property issues

This factor takes into consideration all events that affect technology. Since technology often becomes outdated within a few months after it is launched, it is important to consider this. This factor could also take into consideration all barriers to entry in certain markets and changes to financial decisions.

A fossil-fuel power station is a type of power station that burns fossil fuels such as coal, natural gas or petroleum (oil) to produce electricity. Central station fossil-fuel power plants are designed on a large scale for continuous operation. In many countries, such plants provide most of the electrical energy used. Fossil fuel power stations have rotating machinery to convert the heat energy of combustion into mechanical energy, which then operates an electrical generator. The prime mover may be a steam turbine, a gas turbine or, in small plants, a reciprocating internal combustion engine. All plants use the energy extracted from expanding gas - steam or combustion gases. Fossil fueled power stations are major emitters of CO<sub>2</sub>, a greenhouse gas (GHG) which according to a consensus opinion of scientific organizations is a contributor to global warming as it has been observed over the last 100 years. Brown coal emits about 3 times as much CO<sub>2</sub> as natural gas, and black coal emits about twice as much CO<sub>2</sub> per unit of electric energy.

Bangladesh currently has 6463 MW installed capacity of fossil-fuel power station. These power stations comprise of public sector, private sector and quick rental power plants. Among them QRPP(3yrs), RPP(15yrs) and RPP(3yrs) have derated capacity of 1043MW, BPDB has 3459MW. High prices of petroleum products in international market has increased electricity generation costs in oil-fired power plants substantially resulting in halting of generation in oil-fired power plants. The government has kept shut most of the oil fired rental and quick rental power plants set up in the past three years under a cost-cutting measure aggravating public woes due to frequent power outages. The government costs in purchasing electricity fell 78.89 per cent to Tk 44.47 million from Tk 210.75 million during the past one month from March 17, 2012 to April 17, 2012.

One fourth of the generation plants of the power system are more than 20 years old causing higher maintenance costs and plant outage. Lack of inspection, funds and regular maintenance leads to “break down maintenance” and lower efficiency. Moreover, the reduced efficiency of the steam turbine facilities was caused by steam leakage from turbine, absence of a high-pressure heater, difficulty to maintain a vacuum in the condenser, and leakage from thin pipes in the condenser. Some gas turbines reduced in efficiency with age. To improve the efficiency BPDB prepares retirement plans for the existing power generation plants. Higher efficiency may be achieved through re-powering of the existing power stations, construction of higher efficient gas combined power stations and allocation of gas to more efficient power stations. Table 4.3 shows the efficiency of different forms of gas fired power plants in Bangladesh.

Serial No	Type	Capacity	Number	Ave. Heat Efficiency
(A)	Mid Capacity Steam Turbine Conventional Type	150 to 210 MW	10	31.1%
(B)	Small Capacity Steam Turbine Conventional Type	55 to 64 MW	5	25.6%
(C)	Simple Gas Turbine	15 to 100 MW	15	24.1%
(D)	Combined Cycle	97 to 146 MW	2	29.5%

**Table 4.3: Actual Efficiency of Gas fired Power Plant (Collected: Power division)**

Power is an essential factor for developing the socio-economic conditions of our country. Demand for power is increasing day by day. Moving towards energy sustainability will require modifications not only in the way energy is supplied. The government has decided to setup combined cycle gas power plants which has higher efficiency compared to previous gas power stations. In electric power generation a combined cycle is an assembly of heat engines that work in tandem off the same source of heat, converting it into mechanical energy, which in turn usually drives electrical generators. The principle is that the exhaust of one heat engine is used as

the heat source for another, thus extracting more useful energy from the heat, increasing the system's overall efficiency. This works because heat engines are only able to use a portion of the energy their fuel generates (usually less than 50%). In an ordinary (non combined cycle) heat engine the remaining heat (e.g., hot exhaust fumes) from combustion is generally wasted.

The relationship between energy and economic development is crucial; the process of economic growth requires the substitution of energy mix in the performance of agriculture, industrial and domestic tasks. The lack of adequate energy in rural Bangladesh has economic costs not just at the individual and household level but at the national level as well. Development in Bangladesh without corresponding increase in per capita electricity and gas consumption is, therefore, not feasible. Everyone needs energy in one form or another, for day-to-day life, for cooking, lighting, heating and so on. Consequently, energy is to be considered as a basic need along with food, water, shelter and others.

Renewable energy is energy that comes from natural resources such as sunlight, wind, rain, tides, waves and geothermal heat, which are renewable because they are naturally replenished at a constant rate. About 16% of global final energy consumption comes from renewables, with 10% coming from traditional biomass, which is mainly used for heating, and 3.4% from hydroelectricity. New renewables (small hydro, modern biomass, wind, solar, geothermal, and biofuels) accounted for another 3% and are growing very rapidly. The share of renewables in electricity generation is around 19%, with 16% of global electricity coming from hydroelectricity and 3% from new renewables.

Biogas is a proven and widely used source of energy in the country. There is now yet another wave of renewed interest in biogas due to the increasing concerns of climate change, indoor air pollution and increasing oil prices. Such concerns, particularly for climate change, open opportunities for the use of the CDM benefits in the promotion of biogas. In spite of being insignificant in volume, the availability of biogas to very large number of rural people and to very remote areas makes the technology very suitable and effective. True, commercially produced pipeline natural gas plays and will continue to play vital role in the industrialization and urbanization of the country, but this gas will not reach the remote village households any time soon, if at all! In that respect there is no alternative to biogas for the millions of villagers.

The above situation leaves the rural population to rely on the traditional biomass sources for household supply of energy. Over the last few decades there have been renewed interests and initiatives by many organizations to innovate new and improved biomass energy technologies whereby the biomass energy sources can be used more efficiently and cost effectively for the rural people. The most popular and widely used of these technologies has been the biogas technology in which biomass (cow dung, poultry dropping, agricultural residue etc) is converted into biogas. The biogas is supplied to households for use in cooking in a similar way natural gas is used. In addition, biogas may be use to light houses. Biogas can also be used to run small generator to produce electricity for running electrical household appliances like TV, electric light, fridge etc. Biogas technology is the most ideal technology for rural Bangladesh. Biogas plant is built with simple technology and uses raw material easily available with the rural households -- mostly cow dung. Biogas is a kind of gas generated when biomass i.e. cow dung or other animal dung or biodegradable organic masses are stored in underground chamber in an anaerobic condition (absence of oxygen). It is a kind of anaerobic bacteria that produces the biogas from the organic debris. The composition of biogas is mainly methane (60 to 70%) with lesser amount of carbon dioxide (30 to 40%) and traces of hydrogen and nitrogen. It is a colorless gas and burns in similar way as natural gas (it actually burns at 800 °C compared to natural gas which burns at 1000 °C, both suitable for cooking and any other household application). A biogas plant consists of a brick made underground chamber about 10 feet in height connected to a smaller surface feeding chamber on one side and a debris outlet chamber on the other side. Cow dung or other biomass material with water (in 1:1 ratio) are fed once a day into the underground chamber from the surface and biogas is generated and accumulated at the top part of the chamber. The gas is tapped by inserting a rubber pipe and supplied to kitchen or other places in the house. After producing gas, the residue is moved to the outlet chamber under the gas pressure and incoming new biomass materials and is deposited in a pit as a very good quality fertilizer ready to use in the field.

In Bangladesh about 44 million tons of fuel wood is used in rural areas as cooking fuel each year (Islam and Islam, 2011). These destroy our forest and have negative impact on weather, land and environment. Also, as other biomasses like leaves, cow dung and agricultural residues are burnt as cooking fuel, these can no more help as a natural fertilizer as part of the cycle that keeps the

balance in the ecosystem. In all the above counts, use of biogas technology will bring about benefits to the environment and the people. It certainly upgrades an age old inefficient and poor energy use practice into a more efficient and scientific one.

ICS (Improved Cooking Stove) are those traditional stoves upon which some modifications have been made to give higher thermal efficiencies. The efficiencies are defined as a fraction of heat content of the fuel fruitfully utilized. Improved stove save 50-60% traditional fuel as compared with traditional ones. Total amount of traditional fuel consumption in the country is about 39 million tons annually. If improved stoves popularized in the country and if it saves 50% traditional fuel, then annually about 19.5 million tons of traditional fuel will be saved. The reductions of traditional fuels by improved stoves, therefore, have lower emission of green house gases in the atmosphere. It also helps conserve the forest resources of the country. In Bangladesh it will be difficult to supply natural gas for cooking purpose to the every households of the country. Therefore, improved stoves have bright future in the country. Large scale dissemination of improved stoves in the country can conserve the local forest and change the social life to a great extent.

Lack of proper coordination among the concerned departments of the government, improper use of technology and continuation of opposition by some quarters have muddled up things for a prospective explorer over the proposed commercial exploration of the country's largest coalmine. Coal reserves lying untapped for decades in the country could be the cheapest fuel for generation of electricity, which also could be distributed at the lowest price among the consumers in Bangladesh. The coal to be explored from local fields, especially at Phulbari which has the largest deposit of some 572 million tonnes out of the country's total reserves of some 3.0 billion tonnes, would be much cheaper than the imported coal. The government has cancelled the tenders submitted for five coal-fired power plants, planned to generate up to 2,500 megawatts (MW) of electricity, at pre-qualification stage, which is seen as a major setback to generating low-cost electricity from base-load power plants. The coal-fired power plant projects are Dhaka 600-800-MW plant, Dhaka 100-300-MW plant, Chittagong 600-800-MW plant, Chittagong 100-300-MW plant and Barisal 100-300 MW plant. All these power plants were planned to be run by imported coal. However, local coal was also planned to be utilized once the country starts extracting coal significantly from mine. BPDB Chairman A S M Alamgir Kabir had said that the

country currently has five discovered coalmines, having the reserve of around 3.0 billion metric tonnes. But coal production is limited to only one coalmine, having the extraction capacity of around 1.0 million tonne per year. (<http://openblogbd.wordpress.com/201>). The following Table 4.4 summarizes the PSMP projections for Coal based power plant additions with respect to the total demand between the years 2017 to 2030. In order to fulfill this target the government desperately needs to utilize the best technology to extract coal from all the discovered coal mines as soon as possible.

FY		Unit Addition, Number of Units		
	Peak load	Domestic coal 600 MW	Domestic coal 1000 MW	Import coal 600 MW
2017	12644			3
2018	14014			1
2019	15527	2		
2020	17304	1		
2021	18838			
2022	20443	1		
2023	21993	1		1
2024	23581	2		
2025	25199			
2026	26838	1		2
2027	28487		1	2
2028	30134		2	
2029	31873		2	2
2030	33708		1	1
Total		8	6	12
Total MW		4800	6000	7200

**Table 4.4: Coal based Power Plant Additions (Source: PSPM Study)**

Notwithstanding the confused state of the current situation over the proposed exploration activities, the London-based Global Coal Management (GCM) Resources Plc is determined to go

ahead for mining in joint venture with the government of Bangladesh. The GCM will conduct the Phulbari project in partnership with the (Bangladesh) government so that the country and its people can reap the enormous benefits and realize an unprecedented phase of industrial development, employment and wealth creation. Amid controversies over the coal mine in Dinajpur's Phulbari, a government formed expert panel has suggested extracting coals from the mine using open-pit system. Open-pit mining is good to extract coals where it is near the surface of the land. There is coal 175 metres under the ground at Phulbari and north side of the Barhapukuria mine. At least 90-95 percent of the total reserve can be extracted by open-pit mining while only 65-70 percent can be extracted through underground mining. Open-pit mining is being used around the world to extract coal.

Russia has assured Bangladesh of providing both financial and technical assistance for setting up its first-ever nuclear power plant at Rooppur in Pabna. Proposed nuclear power plant at Rooppur is likely to be set up on the basis of build-own-operate-transfer (BOOT) system. A number of deals, framework agreements and MoUs have already been signed with Russia for peaceful use of nuclear power, technology transfer, creating human resources to run a nuclear power plant, supply of required fuel and taking spent fuel back. On safety measure, one more crucial deal - nuclear radiation safety control - is expected to be signed with Russia. Under the deal, Russia will fully cooperate with Bangladesh in radiation leakage control. The proposed nuclear plant is expected to be built with modern technology to preclude the chance of radiation leakage as in Japan's Fukushima. The nuclear reactor will automatically be shut down in case of any leakage.

To dispel fears in public mind, Russia made it clear that that the proposed Rooppur power plants would be based on generation 111 pressurised water reactors with dual containment now being undertaken in the US and Europe. The plants will include hydrogen to ensure recombiners and passive heat removal system. That will make the containment structures strong enough to prevent leakage or spread of radioactivity into the atmosphere. According to a director of Rosatom, the state owned nuclear organization of Russia, the plants would be strong enough to withstand a massive earthquake and tsunami. Russia has also agreed to train Bangladeshi engineers and other technical persons for creating necessary workforce to operate the plant. The trainees will work in Russian plants for two years before starting their assignments in Bangladesh. (<http://216.70.80.40/newDesign/.....>)

#### **4.8 Impact of Legal factors on power plant projects:**

These factors have both external and internal sides. There are certain laws that affect the business environment in a certain country while there are certain policies that companies maintain for themselves. Legal analysis takes into account both of these angles and then charts out the strategies in light of these legislations. For example, consumer laws, safety standards, labor laws etc. Factors include discrimination law, consumer law, antitrust law, employment law, and health and safety law which can affect how a company operates, its costs, and the demand for its products. Legal factors relates to the laws, regulation and legislation that will affect the way the business operates. This factor takes into consideration all legal aspects like employment, quotas, taxation, resources, imports and exports, etc.

- Current legislation
- Future legislation
- International legislation
- Regulatory bodies and processes
- Employment law
- Consumer protection
- Health and safety regulations
- Money laundering regulations
- Tax regulations
- Competitive regulations
- Industry-specific regulations

The government agency, Bangladesh Power Development Board conducts most of the power plant projects. The power plant projects include the Quick rental power plant project, the IPP projects and also the public power plant projects. The BPDB floats in tender regarding these power plant projects comprising both local and international biddings. The tenders which are floated in strictly follow the Public Procurement Act, 2006 and the corresponding Public Procurement Rules, 2008 and their amendments.

Public procurement involves acquisition through contracts of goods, works, or services required by governments. In such a public activity therefore transparency on the part of the given



government is a higher value which public law tends to promote. In Bangladesh, public procurement contracts have been a major source of corruption in the administration. Bangladesh's recent public procurement law, the Public Procurement Act, 2006 has thus sought to ensure transparency and accountability in public contracts and 'fairness' to the participants in government or public purchases. Despite the procurement rules that have by and large followed international standards, the accountability-goal of the Bangladeshi procurement regime has not become optimally successful.

Two principal legal instruments to deal with public procurement are the Public Procurement Act, 2006 and Public Procurement Rules, 2008 (*hereinafter* PPR). Until the enactment of the PPA in 2006, the legal regime of public procurement in Bangladesh was based on procedures and practices that date back to the British era. Interestingly, these regulations were greatly influenced by international development agencies and banks such as the World Bank, partly because Bangladeshi public procurements tended to rely mostly on external aid. In the context of escalating concerns for streamlining the country's public procurement system, the government undertook an array of reforms in order to strengthen the public procurement regime. The reform process ultimately led to the making and issuance of Public Procurement Regulations in 2003, providing a unified procurement processing system. The PPR, 2003 was supplemented by Public Procurement Processing and Approval Procedures (PPPA), a revised Delegation of Financial Powers (DOFP) and several Standard Tender Documents (STDs) and Standard Request for Proposal Documents for the procurement of goods, works and services. Further later, in order to intensify the improvement measures in the public procurement system, the House of the Nation enacted the much desired law, the PPA, 2006. Under the Act of 2006, the PPR, 2008 was framed and issued, which replaced the Public Procurement Regulations, 2003 which until then continued to have effect.

Public procurements in Bangladesh, to be brief, are processed mainly through a four-tier process: (i) advertising the invitations for tenders/quotations, (ii) evaluation, (iii) approval, and (iv) awarding of contract. The first step for a procuring entity to take is to advertise for Invitations for Pre-Qualification (IFPQ), Invitations for Enlistment (IFE), Invitations for Tender (IFT) and Request for Expressions of Interest (REI) concerning the procurement of goods, services, works and intellectual services. The advertisements, following prescribed formats and maintaining the

timeframe, are to be published in at least two widely circulating daily newspapers, in choosing which the entity should apply ‘sound judgment’. It is important to note that all invitations shall also be advertised in the procuring entity’s website, if any. It means that having a website is still not mandatory. Secondly, the procuring entity may opt for inviting only pre-qualified applicants in which case there is a list of such applicants drawn through the prescribed rule. A procuring entity may undertake pre-qualification for a number of large and complex procurements such as construction works, maintenance works, design and build infrastructure, and so on. However, a procuring entity has a duty to carefully consider the merits and demerits of pre-qualification before initiating the pre-qualification process for procurement of goods or works. PQ applications are opened by Tender Opening Committee (TOC), which shall then be evaluated by the tender evaluation committee (TEC) that may be supported by a Technical Sub-committee constituted by the Head of the procuring entity.

The next step is the opening of tenders. There is a tender/proposal opening committee in each procuring entity. Following the deadline of submitting tenders, the procuring entity convenes the meeting for tenders-opening. Tenders are required to be opened promptly and publicly at the time and place specified in the IFT. Thereafter, the evaluation committee of the procuring entity evaluates the tenders on the basis of pre-disclosed criteria and technical specificities and by following the rules and principles of procurement. The members of evaluation committee, which need to be constituted fairly/transparently, have to sign a declaration of impartiality, and the committee is to certify that evaluation has been made in accordance with the rules of the Act. The TEC sends its report along with recommendations to the Approving Authority and, the Approving Authority shall make its decision as to whom to award the contract. As a matter of rule, the lowest evaluated tender being the ‘responsive tender’, that is the one which does not meaningfully alter or depart from the technical specifications, characteristics and commercial terms and conditions of the Tender Document, becomes the successful tender. A notification of award is then issued to the successful tendered within one week of the approval of the award by the Approving Authority, attaching therewith the contract with detailed terms and conditions.

Public-Private Partnership plays an important role in the power plant projects. A PPP is an arrangement between the public and private sectors (consistent with a broad range of possible partnership structures) with clear agreement on shared objectives for the delivery of public

infrastructure and/or public services by the private sector that would otherwise have been provided through traditional public sector procurement. A particular arrangement or project may constitute a PPP where the following key objectives have been met:

- (i) Better value for money and optimal allocation of risk, for example, by exploiting private sector competencies (managerial, technical, financial and innovation) over the project's lifetime and by promoting the cross-transfer of skills between the public and private partners;
- (ii) Shared responsibility for the provision of the infrastructure or services with a significant level of risk being taken by the private sector, for example, in infrastructure projects linking design and construction with one or all of the finance, operate and maintain elements; and
- (iii) Encourage and promote resource owners participation in infrastructure development.

The Bangladesh government recent years have taken steps to setup a PPP agreement with private sector companies to implement QRPP and IPP projects. Most of these projects are implemented on the basis of BOO (Build Own Operate). In a BOO project ownership of the project remains usually with the project company for example a mobile phone network. Therefore the private company gets the benefits of any residual value of the project. This framework is used when the physical life of the project coincides with the concession period. A BOO scheme involves large amounts of finance and long payback period. Some examples of BOO projects come from the water treatment plants. This facilities run by private companies process raw water, provided by the public sector entity, into filtered water, which is after returned to the public sector utility to deliver to the customers.

Standards regarding health and safety must comply with by all persons working at power station, including Principal Contractors, sub-contractors, staff and visitors to site. If any of the Standards set out below are breached by any individual and/or Contractor, then the authority reserve the sole right to remove the individual and/or Contractor from the site with immediate effect:

- i. Confined Spaces - All confined spaces work must be done under a permit for work.

ii. Working at Heights – All work above ground level must be carried out wearing an approved harness, securely attached to a suitable anchorage unless working on a solid platform with handrails, or the work has been approved by the Technical Officer.

iii. Recklessness – All staff and visitors must behave in a responsible and professional manner whilst on site. Any reckless behavior or horseplay likely to cause injury will be deemed a breach of the Standards.

iv. Working with Electricity – All electrical work must be carried out with the permission of a Safety Controller.

v. Working on Plant – All work on plant must be safety assessed by a Safety Controller, and any specified instructions must be followed.

vi. Working on Chemical Systems – All work on chemical systems must be carried out with the permission of a Safety Controller, the correct PPE must be worn, and any specified instructions must be followed.

vii. Further Precautions – Any further precautions specified in a permit to work must be followed.

viii. Trips and Interlocks – Locks, interlocks or safety trips must not be interfered with.

ix. Environmental – Any substance with the potential for environmental harm must be correctly used and disposed of.

x. Waste – All staff and contractors must follow instructions from the site Waste Officer on correct disposal procedure.

xi. Substance Abuse – No work may be carried out on site by persons believed by their Supervisor or Technical Officer to be under the influence of drugs or alcohol.

Fires in electric power generating plants can have costly and even fatal consequences. Yet, the owners and operators of many plants have paid little if any attention to fire suppression systems

since they were installed 10 or even 20 years ago. In about one-third of the cases in which fire suppression systems fail to operate as expected, the cause is inadequate inspection, testing and maintenance. Incidents can be prevented with a good documented inspection, testing and maintenance program, which will result in achieving maximum reliability of the fire suppression equipment. A wide range of fire protection systems are found at the power plants. Below is a list of systems typically found at electric generating stations:

- I. Fire pumps
- II. Hydrants
- III. Sprinkler/water spray systems
- IV. Hose houses
- V. Halon systems
- VI. Dry chemical systems
- VII. Halon-alternative systems
- VIII. Carbon dioxide systems
- IX. Detection/alarm systems
- X. Portable fire extinguishers

Standards regarding fire-protection must comply with at the power station, failure to do so may result in a catastrophic disaster.

#### **4.9 Impact of Environmental factors on power plant projects:**

These factors include all those that influence or are determined by the surrounding environment. This aspect of the PESTLE is crucial for certain industries particularly for example tourism, farming, agriculture etc. Factors of a business environmental analysis include but are not limited to climate, weather, geographical location, global changes in climate, environmental offsets etc. Furthermore, growing awareness of the potential impacts of climate change is affecting how companies operate and the products they offer, both creating new markets and diminishing or destroying existing ones. Environmental factors relate to the ecological and environmental aspects that will affect the demand for a company's products and how that business operates.

- Environmental regulations
- Ecological regulations
- Reduction of carbon footprint
- Sustainability
- Impact of adverse weather

This factor takes into consideration ecological and environmental aspects that could be either economic or social in nature. These include temperature, monsoons, natural calamities, access by rail, air, and road, ground conditions, ground contamination, nearby water sources, and so forth.

Speakers at a press conference on 20<sup>th</sup> October, 2012 demanded that the government to stop the project of setting up a coal-based thermal power plant at Rampal upazila of Bagerhat, adjacent to the Sundarbans. They emphasized conducting an international Environmental Impact Assessment (EIA) and make public the details of the project to assess its positive and negative aspects. An agreement was signed on January 29, 2012 with India's state-run National Thermal Power Corporation to set up the 1,300-megawatt plant at Rampal, 14 km from the world's largest mangrove forest. The press conference, “Rampal thermal power plant's possible impacts on the Sundarbans and adjacent areas”, was organized by eight NGOs at Jatiya Press Club. The NGOs are Bangladesh Poribesh Andolon (Bapa), Transparency International Bangladesh (TIB), Bangladesh Environmental Lawyers Association (Bela), Center for Human Rights Movement, Save the Sundarbans Foundation, Krishijami Rakkha Committee, Bagerhat Unnayan Commission, and Green Voice. Bela Chief Executive Advocate Syeda Rizwana Hasan alleged that the government started acquiring land before completing the EIA and without giving due consideration to environment clearance certificates. The government's activities prove it is more concerned to ensure India's interests, said Prof Asif Nazrul of Dhaka University. (<http://www.thedailystar.net/newDesign/.....>)

Experts say that if the power plant is established, the ecosystem, environment and wildlife of the Sundarbans will be badly affected and it will be impossible to bring back the natural state of the forest. The coal-based power plant will also damage the surface water and agriculture of the surrounding areas and affect the livelihood of local people. The research findings shows that climate, topography, land use pattern, air and water quality, wetlands, floral and faunal diversity

and captive fisheries will be affected permanently due to proposed power plant. It says increasing water logging condition, air pollution, health hazards and destruction of agriculture will happen due to the plant. A typical coal power plant uses only 33-35 percent of the coal's heat and majority of the heat is released into the atmosphere or absorbed by the cooling water.

The government will talk to the lawyers of the Bangladesh Environmental Lawyers Association (BELA) and other experts and environmental activists over the implementation of the proposed 1,320-megawatt coal-fired power plant at Rampal. It has approved the draft of Power Purchase Agreement (PPA) to be signed between Bangladesh and India on buying electricity from the planned coal-fired power plant. The approval to the proposed PPA came as a big jolt to the country's environmentalists who have been protesting against the initiative to set up the coal-fired power project fearing that it would be disastrous for the flora and fauna of the world's longest mangrove forest. But the go-ahead has now paved the way for the implementation of the project although the Department of Environment (DoE) is yet to clear the project. The Environmental Impact Assessment (EIA) report is pending with the DoE. Admitting the harmful effects of the coal-based power plant, Muhith emphasised that the government was taking preventive measures: "It's true that coal-fired power plant isn't environment-friendly. But pollution control technologies have been set up at Rampal coal power plant to make it environment-friendly."(<http://www.bdnews24.com/details.php?>)

The decision to revive the Rooppur nuclear power project after about 50 years raises some questions in the public mind. Power generation by nuclear reactor in a country lacking enough fossil fuels is definitely a viable option. But whether it is a boon or a bane has to be studied dispassionately in the light of nuclear catastrophes that have struck some places with horrifying consequences. Almost in all countries, people are having second thoughts in opting for a nuclear reactor for power generation. After the Chernobyl nuclear disaster, voters in Italy, a country that lacks fossil fuels, decided to go without nuclear energy. Almost everywhere, nuclear construction is winding up after the Chernobyl reactor meltdown. In the popular imagination, nuclear reactors are so many ticking nuclear time bombs -- even if they do not explode they go on piling up waste that will ultimately cause a depopulated globe to glow in the dark. As a result, an energy source once hailed as a fuel for the future is in wide disrepute.

There are two types of dangers involving nuclear energy. The first is an accident resulting from loss of control over the fission chain reaction occurring in the reactor by the bombardment of fast neutrons on the fissile atomic nucleus of uranium-235 or plutonium-239. The danger here is that the heat produced could outstrip the ability of the reactor coolant to cope, causing uncontrolled nuclear chain reaction. This could cause system failures which would release radioactivity into the environment. In the case of an extreme failure, the result would be a nuclear meltdown like the ones in Chernobyl and Fukushima. In such situations, the reacting nuclear material burns or melts away through its containment vessel, into the ground and then into the water table. This would throw a huge cloud of radioactive steam and debris into the atmosphere. Accidents of this type have the potential to release radioactivity over an immense area.

Unlike natural disasters, where death and destruction are immediate, nuclear disasters continue to take human lives and contaminate the environment for years. There is hardly any way to mitigate or get rid of the adverse effects even by the best possible scientific advances so far achieved. The accident raised concerns about the safety of nuclear power plants, slowing their expansion for a number of years, and has definitely hurt the nuclear power industry's credibility. Nuclear energy generation in a densely populated country like Bangladesh raises alarming prospects. In the event of an accidental meltdown, we have hardly any space to evacuate people to safety. Even a vast country like USSR found it difficult to evacuate its people after the Chernobyl disaster. Soviet officials ordered permanent evacuation of villages within 30 km of the power plant, but heavy nuclear fallout covered a much wider area.

The second danger stems from the disposal of waste from the reactor. Spent fuels from a nuclear power plant are radioactive and highly toxic. Coming back to Rooppur nuclear plant, even though Russia has agreed to take away the spent fuels, there will still be some dangers in the transfer mechanism that must be taken care of well in advance. Our opting for nuclear power must be geared with technical means that can guarantee its absolute safety. The best means for that, as Russian nuclear physicist Sakharov points out, is international legislation requiring all new nuclear reactors to be built deep enough underground so that they do not discharge radioactive material into the atmosphere even in the worst-case scenario. After the Chernobyl and Fukushima disasters, most countries having nuclear power plants in operation are reviewing their safety features and making necessary modifications. (<http://216.70.80.40/newDesign/.....>)



Bangladesh government is planning to build another dam six km downstream of the Kaptai Hydroelectric Dam with the assistance of the USA in power sector for doubling hydropower generation from the lake waters in Rangamati hill district. However many experts are contemplating on the adverse effect of the dam on the environment which are described below:

1) Disruption in the surrounding areas: Plant and animal life around rivers thrive due to continuous fresh flowing water in the river. Due to construction of the dam lots of areas have to be cleared that disrupt the plant and animal life. In many cases even a number of trees have to be cut that destroys not only the plant life but also the animals dependent on them. Even changing the course of flow of water in the river due to the construction of the dam disrupts the plants and animals life.

2) Requires large areas: In order to build a dam, power generation unit and transformers, and connect them to the national grid, a huge amount of land is needed. This requires forests to be cleared disrupting many local, natural ecosystems.

3) Large scale human displacement: Because this dam takes up such a large area, it is often necessary for humans to relocate. It is not easy to convince people to uproot their lives and businesses. Often they are not compensated fairly for their land and the inconvenience. This creates large scale opposition and revolts against construction of the dams.

4) Affects on environment: Though the hydroelectric power plants do not require any fuel, don't produce greenhouse gases and don't create pollution directly, it does have a number of detrimental effects on the environment. The construction activity of the dam itself disturbs the environment to a great scale. When the course of water is changed the surrounding areas may get flooded disturbing natural flora and fauna. Human beings living in these areas also get displaced. The large quantities of water collected due to the floods also emit a lot of greenhouses gases like carbon dioxide. Thus though the hydroelectric power plants don't generate greenhouse gases directly, they generate it indirectly. Over several years, a number of vehicles coming to the construction site for loading and unloading materials also emit greenhouse gases that directly affect the sensitive plants and animal life found in forests.

It is hard to imagine an energy source more benign to the environment than wind power; it produces no air or water pollution, involves no toxic or hazardous substances (other than those commonly found in large machines), and poses no threat to public safety. And yet a serious obstacle facing the wind industry is public opposition reflecting concern over the visibility and noise of wind turbines, and their impacts on wilderness areas. One of the most misunderstood aspects of wind power is its use of land. Most studies assume that wind turbines will be spaced a certain distance apart and that all of the land in between should be regarded as occupied. This leads to some quite disturbing estimates of the land area required to produce substantial quantities of wind power. In reality, however, the wind turbines themselves occupy only a small fraction of this land area, and the rest can be used for other purposes or left in its natural state. For this reason, wind power development is ideally suited to farming areas.

The large amount of land required for utility-scale solar power plants—approximately one square kilometer for every 20-60 megawatts (MW) generated—poses an additional problem, especially where wildlife protection is a concern. But this problem is not unique to solar power plants. Generating electricity from coal actually requires as much or more land per unit of energy delivered if the land used in strip mining is taken into account. Solar-thermal plants (like most conventional power plants) also require cooling water, which may be costly or scarce in desert areas. Large central power plants are not the only option for generating energy from sunlight, however, and are probably among the least promising. Because sunlight is dispersed, small-scale, dispersed applications are a better match to the resource. They can take advantage of unused space on the roofs of homes and buildings and in urban and industrial lots. And, in solar building designs, the structure itself acts as the collector, so there is no need for any additional space at all. Materials used in some solar systems can create health and safety hazards for workers and anyone else coming into contact with them. In particular, the manufacturing of photovoltaic cells often requires hazardous materials such as arsenic and cadmium. Even relatively inert silicon, a major material used in solar cells, can be hazardous to workers if it is breathed in as dust. Workers involved in manufacturing photovoltaic modules and components must consequently be protected from exposure to these materials. There is an additional—probably very small—danger that hazardous fumes released from photovoltaic modules attached to burning homes or buildings could injure fire fighters.

Inevitably, the combustion of biomass produces air pollutants, including carbon monoxide, nitrogen oxides, and particulates such as soot and ash. The amount of pollution emitted per unit of energy generated varies widely by technology, with wood-burning stoves and fireplaces generally the worst offenders. Modern, enclosed fireplaces and wood stoves pollute much less than traditional, open fireplaces for the simple reason that they are more efficient. Specialized pollution control devices such as electrostatic precipitators (to remove particulates) are available, but without specific regulation to enforce their use it is doubtful they will catch on. Emissions from conventional biomass-fueled power plants are generally similar to emissions from coal-fired power plants, with the notable difference that biomass facilities produce very little sulfur dioxide or toxic metals (cadmium, mercury, and others). The most serious problem is their particulate emissions, which must be controlled with special devices. More advanced technologies, such as the whole-tree burner (which has three successive combustion stages) and the gasifier/combustion turbine combination, should generate much lower emissions, perhaps comparable to those of power plants fueled by natural gas.

Natural gas is the cleanest of all the fossil fuels. Composed primarily of methane, the main products of the combustion of natural gas are carbon dioxide and water vapor, the same compounds we exhale when we breathe. Coal and oil are composed of much more complex molecules, with a higher carbon ratio and higher nitrogen and sulfur contents. This means that when combusted, coal and oil release higher levels of harmful emissions, including a higher ratio of carbon emissions, nitrogen oxides (NO<sub>x</sub>), and sulfur dioxide (SO<sub>2</sub>). Coal and fuel oil also release ash particles into the environment, substances that do not burn but instead are carried into the atmosphere and contribute to pollution.

The combustion of natural gas, on the other hand, releases very small amounts of sulfur dioxide and nitrogen oxides, virtually no ash or particulate matter, and lower levels of carbon dioxide, carbon monoxide, and other reactive hydrocarbons. Natural gas, as the cleanest of the fossil fuels, can be used in many ways to help reduce the emissions of pollutants into the atmosphere. Burning natural gas in the place of other fossil fuels emits fewer harmful pollutants, and an increased reliance on natural gas can potentially reduce the emission of many of these most harmful pollutants.

## **Chapter 5**

---

### **Conclusions and Recommendations**

## **5.1 Conclusions:**

A conclusion is the last part of something, its end or result. When you write a paper, you always end by summing up your arguments and drawing a conclusion about what you've been writing about. In this study we have so far discussed about our power sector situation and its future planning. We have also gained knowledge on PESTLE analysis and what are its factors. In this study the most important part was how these PESTLE factors affected the energy projects. So some of the important points that could be drawn out from this research is discussed below.

## **5.2 Reasons for failure and success of power generation projects:**

It has been observed that PESTLE analysis plays an important role in project management. Similarly successful implementation of the objectives of power projects is highly dependent on the PESTLE analysis.

### **(a) Political Factors:**

The political factor is one of the most crucial elements of the PESTLE analysis. The policies, rules and regulations laid down by the government controls this factor of the PESTLE analysis. In recent years the government has put a lot of emphasis on the rental power plant projects. But in doing so it has faced criticism from the economists who believes that it has had an adverse effect on the economy of Bangladesh. In order to meet the electricity demand the government is working closely with the neighboring countries to import power from them. This has resulted in establishing closer and stronger diplomatic relations with India, Myanmar, Nepal and Bhutan. Due to the crisis of natural gas, coal based power plant is now high on the agenda. To meet the fuel demand of these power plants coal will be imported from abroad which will require strong friendship tie with those countries. The government in recent days has faced problems regarding Phulbari open pit mining project. It has faced resistance from the local community regarding reallocation of the people who will be affected by this project.

### **(b) Economical Factors:**

Economical and Political factors are related closely with each other. Economical factors are dependent on the policy drawn up by the government. To meet the increasing crisis of the power sector the government is looking to boost up foreign direct investment. But recent analysis

showed that FDI in power sector is below par. It is really very difficult for the government alone to make available the amount of resources required for the development of power and energy sector. For this purpose, private sector participation and the flow of foreign investments are required. The participation of private sector is satisfactory in this sector but the flow of foreign investment is inadequate and the participation of development partners is also not sufficient. Table 5.1 shows how private sector contribution is increasing in electricity production but way below the expectation.

Year	Public Sector	Private Sector
April 2010	60%	40%
April 2011	56%	44%
April 2016	42%	58%

**Table 5.1 Electricity Production in Private and Public sector (Source: Powercell)**

From the power and energy sector road map it can be observed that by 2020 the private sector will produce bulk of the power compared to that of the public sector. But in order to achieve this aim the government requires financial contribution from the private sector entities. Different private entities such as the Orion group, Summit Group etc have contributed significantly in the power sector. As of now, 49 percent of the population is within the coverage of electricity. The demand for electricity will substantially increase in future if the rest of the population is brought under the electricity coverage and the agenda for high growth through industrialization and investment to realize the Vision is pursued. The new concept of Public Private Partnership has been very popular as both the public and the private entity are jointly working together to set up power plants in the country. The government has recently signed a MoU with the Russian government to setup the country's first nuclear power plant solely by the Russia's financial assistance. Similarly many European countries have shown interest in investing in the renewable energy projects. The Bangladesh government will sign the MoU with them very soon.

#### **(c) Socio-cultural Factors:**

Socio-cultural factors contribute to the economic development of the country. Renewable energy has been the back bone of rural community's economy advancement. Solar panels are being

installed in villages where people are deprived of power from the grid. This has resulted in employment, creation of small enterprise in the rural areas. There are some energy projects which will have an adverse effect on the local community. The prime example has been the Kaptai Hydro power plant project. The building of Kaptai dam has resulted in inhabitants losing their land, they were also dependent on the fish population which was also lost. As there is a dark side there is also a bright side of power plant projects. It creates employment opportunity which in turn improves the social status of the local people. Another positive aspect is that more semi-skilled and skilled workers, Engineers are being developed which can be utilized both in the local and foreign market.

**(d) Technological Factors:**

Technology factors contribute immensely to the energy projects as it is highly technical and requires robust engineering. Shortage of gas has been a problem which has hampered production of electricity. To maximize the usage of natural gas combined cycle power plant is being built to increase its efficiency. To minimize the greenhouse effect most of the countries are turning to renewable energy. Technology has made “Green Energy” a realistic. Solar panel has changed the face of rural inhabitants, new techniques and engineering such as bio-gas, tidal power has given light on energy production. Coal based power plant has been a top priority. The government has opted for the latest method of mining which is ‘Open pit mining’. Open pit mining increases the amount of extraction of Coal which would help to overcome shortage of coal in this country. The safety concern related to nuclear power plant has been a debatable issue for many years. But the advancement in science and technology has made nuclear power plant safer than before.

It is not possible to address the shortage of power by increasing the electricity production alone. This indeed requires effective demand management. A range of efforts need to be carried out to produce electricity from renewable energy like solar power and biogas by reducing the dependency on natural gas for electricity generation and to ensure diversification of the energy resources as well. At the same time, import and lifting up coal from mine, LPG and LNG import should be expedited. Successful implementation of these initiatives calls for improvement in related infrastructure and creation of skilled manpower. In tandem with this, the technical and technological skills have to be improved as well.

**(e) Legal Factors:**

There have been many incidents in the past where the government has faced many allegations regarding partiality and corruption. This has resulted in dissatisfaction of the donor agencies which led to cancelation of many projects. To ensure transparency the government has set up legal framework within which the power plant project is initiated, progressed and then completed. The Bangladesh government uses Public Procurement Rules, 2008 and Public Procurement Act, 2006 to initiate any power plant project, select the entity that will set-up the plant, the selected entity then builds and operate the plant according to the contract which follows the PPR regulations. This procedure is used to setup Rental power plant, QRPP and IPP. Another legal structure that has been under the spotlight is the Public Private Partnership. The government has written down set of rules which allows both the public and private entity to work together to meet the ever increasing demand of electricity. Another legal issue that has been a hot topic in recent days is health and safety issues. Safety and health issues of both the workers and inhabitants surrounding the power plant falls into the jurisdiction of safety and health act.

**(f) Environmental Factors:**

The concern for environment has been a sensitive issue in modern days. Developed countries are working with the developing nations to minimize the carbon emission from the power plants. This has lead to increased emphasis on renewable energy. Similarly in Bangladesh environmentalist and pressure groups are protesting against the Rampal coal based power plant. This power plant is situated near the Sundarbans and experts suggest that if this power plant is built then it will have a disastrous effect on the nature. Similarly questions have been raised against the Rooppur Nuclear power plant. The radioactive wastes and leakages from the power plant will have a negative effect on the surrounding atmosphere. Though Hydro electric projects don't create pollution in the environment but still it has some detrimental effects. The surrounding area near the dam will get flooded disturbing natural flora and fauna. Questions have also risen as the long term planning shows that bulk of the power will be produced from coal based power plant which will result in emission in CO<sub>2</sub>. So the government might face the curse of greenhouse effect if they do not take this issue seriously.



### **5.3 Recommendations:**

A recommendation means a suggestion that someone or something is especially suitable or useful for a particular situation. In this study we have so far pointed out the major factors that influence the outcome of the energy projects. If these macro-environmental factors change it surely could have an adverse affect on the organization if they are not prepared for it proactively or if they do not take proper actions reactively. Some suggestions have been provided below which if followed will help any entity to attain its objectives even if these factor changes.

#### **5.3.1 Suggestions to remedy failure of power generation projects:**

To overcome the challenges in power sector the government needs to follow the right path. They need to take the best possible decisions to fulfill the objectives of energy projects.

##### **(a) Political Factors:**

One key political factor is the funding and grants. Recent analysis showed that the Foreign Direct investment in the power sector is far less than expected. So policies and procedures should be changed to favor more investment in this sector. Import from neighboring countries could play an important role in the future. So the government should focus on inter-country relationship which will be beneficial for this sector. There have been recent allegations that there has been corruption in the Rental Power Plant projects. The government should ensure transparency and sustainability in the energy projects. There have been many protests from the pressure groups regarding Phulbari coal project, Rooppur nuclear power plant and the Rampal coal based power plant project. The government should focus on these issues in a more delicate way so that both the demand of these lobbying groups and the objectives of these projects are being met. The government should also amend policies on tax, interest and VAT in such a way that it would encourage private entities to invest more in the power sector.

##### **(b) Economical Factors:**

Due to depletion of fossil fuels, Renewable energy is being seen as the savior. According to the road map of power and energy more and more power will be produced from renewable energy in the coming years. The government in order to fulfill this mission should allow tax and VAT exemption on the goods, equipments and products related to renewable energy projects which

encourage more investment. The government is going to take a hard-term loan from an export credit agency (ECA) that entails a rate of interest of about eight per cent and a repayment period of ten years, in order to set up a 331 megawatt (mw) power plant at Shahjibazar. Similarly more investment should be drawn out from different banks and investment firms. There are many private companies or groups which have already invested handsomely in power sector. The government could arrange tax or VAT exemption for these companies as a gesture which would encourage them more to invest. The government should encourage private entities to work with them in a public private partnership arrangement to overcome financial barriers.

**(c) Socio-cultural Factors:**

Energy sector has a role to play in Bangladesh's remarkable progress in achieving a number of the Millennium Development Goals (MDGs), including the reduction of poverty, primary school enrolment and maternal health. The Bangladesh government should take a long term plan to expand energy in rural areas through 'Green energy' where Grid power is not feasible. This sector will create green jobs and linkage businesses especially in the rural areas. Hundreds of local youths will work in the rural areas as solar technicians. Rural women will assemble solar accessories in village based Technology Centre's. Solar engineers will increasingly be employed in designing SHS, working in battery factories, and other accessory related businesses. The government should ensure employment from local community, safe reallocation of inhabitants affected by different projects that will be implemented. It will allow local people to gain more social status and security. By creating more job facilities, the number of semi-skilled and skilled workers will also increase which will have a positive impact on both local and foreign labor market.

**(d) Technological Factors:**

The Bangladesh government should encourage more Research and Development in the power sector to improve the quality and to make the cost more feasible. The electrical equipments of different power plants are costly and bulky in size. Example: The solar panel of solar housing system is costly which sometimes become hard for rural people to afford it. Inventions in this sector have led to production of energy from wastes, the concept of bio-gas and biomass has also provided electricity in rural areas which has contributed significantly to the development of the

economy. The government should also improve the intellectual property rights and patent laws related to scientific and engineering inventions. This will in turn encourage foreign firms to invest in research and development activities related to energy sector. In the past nuclear energy was a debatable issue. The concern for radiation and nuclear wastes was high on the agenda. But development in science and technology has made nuclear power much safer than before. So the government should ensure that the Rooppur power plant gets the best possible technology to ensure safety from earthquake and radiation leakage.

**(e) Legal Factors:**

Legal issues are closely related to political factors because it is the political government that will enact the laws. The Bangladesh government should follow the international legislation if it purchases power from the neighboring countries or setup nuclear power plant. So conditions on tax, VAT, interest, arbitration and protection act etc should be according to the international legislation. Another prime concern for the government is the health and the safety issues. It should ensure safety and good health of both the workers and the local people associated with any of the power plant project. The government should strictly monitor money laundering issues. There have been many allegations that millions of dollars have been laundered during the rental power plant projects. The government should also set up regulatory bodies and process. It should ensure that no harm is done to the environment or to the economy of the country. Such as in the case of Phulbari coal project where it must ensure that the rights of the local people are respected. The government should also make the Public Private Partnership policy much more attractive to ensure that both the government and private entity work together so that they can complement each other.

**(e) Environmental Factors:**

In recent years the lobbying and the pressure groups have raised their voice against any steps that will harm the environment. So the government should make sure that all the energy projects should strictly follow environment regulations if it wants to attain its objectives. Ecological regulations could be breached if Rampal coal based power plant is built. It could have an adverse effect on the Sundarban forest. So the government should be concern about the safety of the forest. Solution to this matter can be achieved if the power plant is shifted to another location

safe distance from the Sundarbans. Reduction of carbon is crucial to minimizing the “Greenhouse effect”. For this reason the government is looking forward to produce clean energy through renewable projects. Sustainability is the capacity to endure. Sustainability is the potential for long-term maintenance of well being, which has ecological dimensions. There have been debates that the Phulbari coal project will result in a reduction of water level in the surrounding area which will have a negative impact in the environment. So the government should ensure that such things do not happen and the beauty of the nature should stay unchanged.

### **5.3.2 Adequate planning by writing a good PEST analysis:**

PEST analysis incorporates four perspectives, which give a logical structure, providing clear presentation for further discussions and proactive decision-making. In writing a good PEST, subject should be a clear definition of the market being addressed, which might include the following issues of:

- A company looking at its market
- A product looking at its market
- A brand in relation to its market
- A local business unit
- A strategic option, such as entering a new market or launching a new product
- A potential acquisition
- A potential partnership
- An investment opportunity

It is crucial to describe the subject for the PEST analysis clearly so that people, contributing to the analysis, and those interpreting the results from PEST analysis, could understand the purpose of the PEST assessment and its implications. Before producing a good PEST analysis, it is of primary importance to, firstly, brainstorm the relevant factors that apply to the company or to its business environment.

Second requirement is to identify the information that applies to these factors; and thirdly, to draw conclusions from this information. It is, however, necessary not only to describe factors, but to think through what they mean and how they impact the business. PEST analysis is only a

strategic starting point, and has its own limitations, emphasizing the need to test the conclusions and findings against the reality.

In conducting PEST analysis, it is required to consider each PEST factor as they all play a part in determining the overall business environment. Some examples of topics include the following:

Political: (includes legal and regulatory): elections, employment law, consumer protection, environmental regulations, industry-specific regulations, competitive regulations, inter-country relationships/attitudes, war, terrorism, political trends, governmental leadership, taxes, and government structures.

Economic: economic growth trends (various countries), taxation, government spending levels, disposable income, job growth/unemployment, exchange rates, tariffs, inflation, consumer confidence index, import/export ratios, and production levels.

Social: demographics (age, gender, race, family size, etc.), lifestyle changes, population shifts, education, trends, fads, diversity, immigration/emigration, health, living standards, housing trends, fashion, attitudes to work, leisure activities, occupations, and earning capacity.

Technological: inventions, new discoveries, research, energy uses/sources/fuels, communications, rates of obsolescence, health (pharmaceutical, equipment, etc.), manufacturing advances, information technology, internet, transportation, bio-tech, genetics, agri-tech, waste removal/recycling, and so on.

After the key trends have been identified, the next step is to analyze the potential each trend has to disrupt the way the company does business. The company is able to determine the changes needed to exploit the opportunities, and blunt the threats. When carrying out a PEST analysis it is important to show how and how much the factors that the firm picks out influence the nature of competition. It is this appraisal of the impact of each factor that distinguishes an analysis from a mere list. A common error is to try and devise a single analysis to try and cover the entire history of a firm and an industry.

Therefore, the company must keep the analysis of past developments separate from that of the present situation and future trends. When analyzing PEST factors in the present, it is required to

make it plain why the present is different from the past, and how the industry may need to change. There is no need to agonize too long over whether a particular item is political, economic, social and technological in nature. Many important factors transcend the simple PEST categories. The advent of the microprocessor is a technological event that has had a broad economic and social impact. The "green" movement may have started as a social-cultural phenomenon, but it has been translated into legislation and has stimulated technological change. It is perfectly legitimate when using a checklist like PEST to leave some categories empty. If there are no important political/legal influences on a particular industry, those conducting PEST analysis do not need to waste time trying to find factors that do not exist. There should be a limit to relevant factors. (<http://www.iseindia.com/ResearchPDF..>)

### **5.3.3 Facilities for Training and Education:**

Training is the acquisition of knowledge, skills, and competencies as a result of the teaching of vocational or practical skills and knowledge that relate to specific useful competencies. Training has specific goals of improving one's capability, capacity, and performance. Training may be provided in two ways: On-job training and Off-job training. Whether it is public or private entity emphasis should be put on human resource development. Any entity should have the provisions to train their employees. By giving them sufficient training, employees will have a better understanding on business analysis tools including PESTLE analysis. It increases the possibility for the organization to achieve its target on energy projects.

There are also educational institutes which provide courses on business studies. Such as Chartered Institute of Purchasing and Supply which provides professional degree on supply chain management. The government of Bangladesh should put more importance on providing their employees with the opportunity to study on supply chain management. Not only government institutes but also private companies should educate their employees on business studies. There are many advantages for training its employees. First of all it creates job enrichment and job satisfaction. Drop outs from the company will decrease which will be very beneficial for the company. Also it creates a pool of experts which can be tapped into both the local and foreign job market. When a company creates more opportunity to develop their employees skills the more attractive the company becomes for the job-seekers. It allows the

company to attract more talented employees. It is obvious that a company which has more trained and educated employees, the more successful the company becomes.

Training and education will provide the foundation for success for the company. Skilled and satisfied employees will provide more knowledge, skills and experience to meet the objectives of the energy projects.

#### **5.3.4 Establishing Good Governance**

Whether public or private entity, good governance plays a vital part. Good governance ensures transparency within the organization, appliance of the rules and regulations. In the past years there have been many allegations that power generation projects have failed due to corruption. There have been many incidents where the Donar agencies have cancelled their funding due to severe corruptions. So this has led to shortcomings in achieving the goals. As a result it is very important for any entity to lay down policies that will ensure transparency and impartiality.

Another issue that comes into mind is proper application of those rules. Policies and regulations are there but it is of no relevance as nobody obeys those rules. So the authority must ensure that PESTLE factors have been conducted at the planning stage of the projects. To make it happen, chain of command must be followed and the top management should be briefed about the progress.

Bureaucracy has been a prolonged problem in the government organizations. The main problems of bureaucracy is that it is time consuming and lengthy. The longer the project continues the higher is the chance for increase in cost of the projects. So this is another cause of failure of projects. There should be provisions to cut the red tape so that prompt decisions are made regarding PESTLE factors. The quicker the response the higher is the possibility to overcome the problem swiftly.

#### **5.3.5 Update PESTLE analysis regularly:**

PESTLE analysis is a dynamic process. As the project progress, the influence of the PESTLE factors also changes. Such as for a particular project, at the initial stage political factor may be crucial whereas the economical factor might be not that important. However at the midpoint of the project the situation may change. The economical factor might become more important than

the political factor. Hence if this change in circumstances is not monitored properly the project will face problems as it progresses. So it is very important to update the PESTLE regularly. PESTLE analysis may be conducted in various ways. The project team may update it at check points of the project or they can review it at every 3 months or 6 months or even yearly.

Updated PESTLE analysis also provides some important facts. These information's may also be used for management purposes. Updated PESTLE analysis has the advantage of keeping the management team always in an alert state. Under these circumstances if any hindrance occurs the entity is in a better state to tackle the problem. It also allows the entity take proactive actions so that any changes of these factors in the future could be converted into a favorable one.

### **5.3.6 Alternative business analysis tools:**

Besides PESTLE analysis there are other analysis tools which can also be used to achieve the goals of the energy projects. These tools use both the internal environment of the entity and also the external environment in which the entity operates. For a particular project the entity can use all the tools or they can select anyone of these tools. (<http://home.kku.ac.th/petmas/.....>). The SWOT analysis is one of the very useful tool for understanding and decision-making for all sorts of situations in business and organizations. SWOT is an acronym for Strengths, Weaknesses, Opportunities, and Threats. A scan of the internal and external environment is a crucial part of the strategic planning process, which is being covered by SWOT analysis. It is used to evaluate the Strengths, Weaknesses, Opportunities, and Threats involved in a project or in a business venture. Strengths, Weaknesses are considered to be internal to the corporation or organization where as Opportunities, and Threats are part of the external environment.

The analysis involves identifying the purpose of the business venture or project and recognizing the internal and external factors that are favorable and unfavorable to achieve that goal. Strengths are uniqueness of the business or department that gives it an advantage over others in the industry. Weaknesses are these are characteristics that place the firm at a disadvantage relative to its peers. Opportunities are the external factors that will boost the sales or profitability of the organization Threats: These external elements in the environment could cause trouble for the business. These fundamentals of SWOT analysis is also shown in Figure 5.1



# SWOT ANALYSIS



**Figure 5.1 Displays the Elements of SWOT analysis (Source: <http://nathanlunn.com>)**

The internal factors may be viewed as strengths or weaknesses depending upon their impact on the organization's objectives. What may represent strengths with respect to one objective may be weaknesses for another objective. Identification of SWOTs is essential because subsequent steps in the process of planning for achievement of the selected objective may be derived from the SWOTs. SWOT analysis is a tool for auditing an organization and its environment. It is the first stage of planning and helps to focus on key issues.

Michael Porter's Five Forces of Competitive Position model provides a simple perspective for assessing and analyzing the competitive strength and position of a corporation or business organization. In 1990's American Michael Porter had established a reputation as a strategy guru. Apart from his novel thinking, Porter has a unique talent to represent complex concepts in relatively easy to handle formats, notably his Five Forces model, in which market factors can be analyzed so as to make a strategic assessment of the competitive position of a given supplier in a given market. The model originated from Michael E. Porter's 1980 book "Competitive Strategy: Techniques for Analyzing Industries and Competitors."

The Porter's 5 Forces tool is a simple but powerful tool for understanding where power lies in a business situation. It helps to understand both the strength of present competitive position and the strength of a position one is willing to aspire. With a clear understanding of where power lies, one can take a fair advantage of the situation by improving a situation of weakness and avoid taking wrong steps. Conventionally, the tool is used to identify whether new products, services or businesses have the potential to be profitable.

**Supplier Power:** Here we need to assess how easy it is for suppliers to drive up the prices. This is to determine how much pressure suppliers can place on a business. If one supplier has a large enough impact to affect a company's margins and volumes, then it holds substantial power.

**Buyer Power:** In this factor we need to analyze how easy it is for buyers to drive prices down. This is to determine how much pressure customers can place on a business. If one customer has a large enough impact to affect a company's margins and volumes, then the customer holds a substantial power.

**Competitive Rivalry:** What is important here is the number and capability of competitors. If business we are operating in has many competitors, and they offer equally attractive products and services, then we most likely have little power in the situation, because suppliers and buyers will go elsewhere if they don't get a good deal. On the other hand, if no-one else can do what we do, then we can often have tremendous strength. Highly competitive industries generally earn low returns because the cost of competition is high.

**Threat of Substitution:** What is the likelihood that someone will switch to a competitive product or service? If the cost of switching is low, then this poses a serious threat. If substitution is easy and substitution is viable, then this weakens your power.

**Threat of New Entry:** Power is also affected by the ability of people to enter the market. The easier it is for new companies to enter the industry, the more cutthroat competition there will be. Factors that can limit the threat of new entrants are known as barriers to entry.

#### **5.4 Concluding Remarks:**

Power sector is one of the major components for the development of this country. So the government has allocated substantial amount of budget for the next few years as a part of their

long term. However it has been witnessed that many projects that has been undertaken in this sector has faced many hindrance. Some of them have resulted in cancellation of the projects. The reasons for these failures have been lack of analysis, planning, monitoring and feedback. Under these circumstances PESTLE analysis can be the savior. PESTLE factors are some way the other is related to all the power generation projects. Some of these factors are crucial while some of them might be trivial for a particular project. Hence it is every important at the initial stage of the projects to conduct a PESTLE analysis in order to find out the significance of various factors. When the relationship of these factors with the project has been found out, it would be easy to identify the main reasons for the failure of the project. So PESTLE analysis provides the basis to recognize the causes of hindrance to the project. Once the source of the problem has been found, the next step would be to remedy the cause of the problem and PESTLE analysis under this situation also provides guidance to solution. It is then imperative for the organization to take the best possible measures to convert these factors in favor of the project. So from this study it has been observed that PESTLE analysis is the ladder to the success of a project. If PESTLE analysis is conducted thoroughly at planning stage of the project than there is no doubt that the objectives will be attained. However if the analysis is not conducted then there is a high possibility that the project will fail.

## **Appendix A: Definition of key technical terms**

Definition of key technical terms used in this study:

(1) ‘Base Load’ is the minimum amount of power that a utility or distribution company must make available to its customers, or the amount of power required to meet minimum demands based on reasonable expectations of customer requirements. Base load values typically vary from hour to hour in most commercial and industrial areas.

(2) ‘Capacity Retired’ means power generation unit coming to cease. There are some power station units that are dismantled due to end of their life or the contract with the government to produce electricity comes to an end.

(3) ‘Derated capacity’ means the capacity at which the power plant unit practically runs. Any electrical equipment depreciates as it becomes old. As a result the unit runs lower than its rated capacity as time goes by.

(4) ‘Distribution Companies’ are the government entity or state owned companies that deliver electricity to the end users at the final stage. DESCO, DPDC, BPDB etc are some of the examples of distribution companies.

(5) ‘DSM’ means Demand Side Management. DSM programs involve using energy-saving equipment and machinery, holiday staggering programs in the industrial segment, and avoiding wastage of electricity.

(6) ‘Electrical Grid’ is an interconnected network for delivering electricity from suppliers to consumers. It consists of generating stations that produce electrical power, high-voltage transmission lines that carry power from distant sources to demand centers, and distribution lines that connect individual customers.

(7) ‘Electric-power transmission’ is the bulk transfer of electrical energy, from generating power plants to electrical substations located near demand centers.

(8) ‘Energy Efficiency’ means to increase power by improving the effectiveness of the electrical equipments. There are many power station units that have not been overhauled for many years

which have resulted in decrease of its usefulness. Outdated boilers, inefficient motors and use of old technologies are costing heavily through inefficient energy use. So it is important to take steps to increase the value of these outdated equipments by using low consumption and low cost smart technologies.

(9) ‘Generation Units’ may be referred to as the individual components that produce electricity.

(10) ‘Grid Station’ means a substation is a part of an electrical generation, transmission, and distribution system. Substations transform voltage from high to low, or the reverse, or perform any of several other important functions. Between the generating station and consumer, electric power may flow through several substations at different voltage levels.

(11) ‘Installed capacity’ means the rated capacity at which the power plant unit is expected to operate.

(12) ‘IPP’ refers to Independent Power Producers which is an entity, not a public utility, but which owns facilities to generate electric power for sale to utilities and end users.

(13) ‘Load Center’ means the surrounding area at which the demand of power is high. Normally load center usually refers to a densely populated area.

(14) ‘Load Dispatch’ means depending on the demand from the grid, generation is controlled. The power generated has many characteristics such as voltage, frequency, load etc. The load on the grid varies with time and human activity. The generation has to be controlled to meet the demand of load and frequency.

(15) ‘Load shedding’ means s an intentionally engineered electrical power shutdown where electricity delivery is stopped for non-overlapping periods of time over different parts of the distribution region. Load Shedding generally result from two causes: insufficient generation capacity or inadequate transmission infrastructure to deliver sufficient power to the area where it is needed.

(16) ‘Net generation’ is the amount of electricity generated by a power plant that is transmitted and distributed for consumer use. Net generation is less than the total gross power generation as

some power produced is consumed within the plant itself to power auxiliary equipment such as pumps, motors and pollution control devices.

(17) ‘Peaking Plants’ also known as peaker plants, and occasionally just "peakers," are power plants that generally run only when there is a high demand, known as peak demand, for electricity. Because they supply power only occasionally, the power supplied commands a much higher price per kilowatt hour than base load power.

(18) ‘Power Tariff’ means Electricity pricing. The price of power generation depends largely on the type and market price of the fuel used, government subsidies, government and industry regulation, and even local weather patterns.

(19) ‘PSMP’ means Power System Master Plan. The PSMP 2010 includes an optimum power development plan and identification of the potential power plant sites based on the fuel diversification study. It has been developed with fundamental conditions of the development e.g. demand forecast, procurement of primary energy resources, optimum power development plan, future optimum power supply structure including the positioning of gas-fired power plants, and so on.

(20) ‘Subsidy’ is assistance to a business or economic sector for producers. Most subsidies are set in place by the government for producers or are distributed as subventions in an industry to prevent the decline of that industry (e.g., as a result of continuous unprofitable operations) or an increase in the prices of its products or simply to encourage it to hire more labor (as in the case of a wage subsidy).

(21) ‘System Loss’ are losses can be defined as the difference between the amount of electricity entering the system (by generation of power plants or import from neighboring transmission grids) and the electricity leaving the grid (by consumption of end-users, export to other transmission grids or delivery to lower voltage levels). Primarily we should differentiate between technical losses (TL) and non-technical losses (NTL). Technical losses are losses on power lines (such as Joule losses and losses by corona effect) and losses in transformers (such as losses in magnetic cores). These losses are the result of the inherent resistance of electrical conductors. Non-technical losses include more or less all energy, which gets lost because of energy theft, errors in metering, billing und data processing as well as differences between real

consumption of customers with annual meter reading within a year and the estimated consumption within an accurately defined period.

(22) Units: Mw and Kw measure the rate of energy conversion or transfer.  $1\text{Mw} = 10^6$  watt and  $1\text{Kw} = 10^3$  watt. Kilowatt hour is a unit of energy equal to 1000 watt hours or 3.6 mega joules.

## Appendix-B: Questionnaire

**Institute of Governance Studies (IGS)  
BRAC University**

### Survey Questionnaire

#### **Research Topic: Impact of PESTLE Factors on Power Generation Projects of Bangladesh**

This is a survey questionnaire for conducting a study to find out to what extent PESTLE is being practiced in BPDB's ongoing selected projects. The objective of this research is to determine which PESTLE factors have more significant influence on a particular project and what measure have been taken to make the factors favorable to the project. It is a part of academic necessity for the Masters Program on 'Procurement and Supply Management' in the Institute of Governance Studies (IGS), BRAC University. Your honest response is valuable for the researcher. The researcher assures you that the information given by you will be kept confidential & will be used only for the academic purpose.

##### **Part A: Demographic information**

1. Name of the respondent :
2. Designation :
3. Job Experience (years) :
4. Name of the project :
5. Location :
6. Project cost (*Tk. in crore*) : Total: GoB: PA:

##### **Part B: Opinion about PESTLE factors influence on projects. Please provide your candid opinion regarding the following questions.**

1. To what extent PESTLE analysis is conducted in your project you think?
2. What are the main hindrances you faced in line with PESTLE factors in your project?
  - i)
  - ii)



iii)

iv)

v)

vi)

3. Please mention your proposal to tackle the hindrances stated above.

4. What improvements/amendments you think needed to make to attain the objectives of your project?

## References

Power Division Website, <http://www.powerdivision.gov.bd/>

Bangladesh Power Development Board Website, <http://www.bpdb.gov.bd/bpdb/>

Blog and news agency (May, 2011), Import of Power, Retrieved on November 28<sup>th</sup>, 2012, <http://www.nl-aid.org/continent/south-asia/bangladesh-envisage-regional-power-trade-with-india-burma-to-ease-electricity-crisis/>

Bdnews24, Rampal Coal Power Plant, Retrieved on November 27<sup>th</sup>, 2012, from <http://www.bdnews24.com/details.php?id=235667&cid=2>

Bdnews24, Quick Rental Power Plant, Retrieved on November 27<sup>th</sup>, 2012, <http://bdnews24.com/details.php?id=213133&cid=2>

Dailystar, Stop Rental power plants, Retrieved on November 28<sup>th</sup>, 2012, <http://www.thedailystar.net/newDesign/news-details.php?nid=252653>

Newagebd (October 22<sup>nd</sup>, 2011), Renewable Energy, Retrieved on November 29<sup>th</sup>, 2012, [http://newagebd.com/newspaper1/archive\\_details.php?date=2011-10-22&nid=37769](http://newagebd.com/newspaper1/archive_details.php?date=2011-10-22&nid=37769)

Openblogbd (July 28<sup>th</sup>, 2012), Bangladesh cancels five coal power plant, Retrieved on November 29<sup>th</sup>, 2012, <http://openblogbd.wordpress.com/2012/07/28/bangladesh-cancels-five-coal-power-plant-projects/>

Nuclear power plant in Bangladesh, Retrieved on November 29<sup>th</sup>, 2012, <http://216.70.80.40/newDesign/news-details.php?nid=230155>

The Dailystar (October 21<sup>st</sup>, 2012), Stop to Rampal power plant project demanded, Retrieved on December 1st, 2012, <http://www.thedailystar.net/newDesign/news-details.php?nid=254704>

Bdnews24, Rampal power plant, Retrieved on December 1st, 2012, <http://www.bdnews24.com/details.php?id=235667&cid=2>

Union of concerned scientist, Clean energy, Retrieved on December 2nd, 2012 , [http://www.ucsusa.org/clean\\_energy/our-energy-choices/renewable-energy/environmental-impacts-of.html](http://www.ucsusa.org/clean_energy/our-energy-choices/renewable-energy/environmental-impacts-of.html)

Natural gas, Environment, Retrieved on December 2nd, 2012, <http://www.naturalgas.org/environment/naturalgas.asp>

Arxiv (January 25<sup>th</sup>, 2006), Research Methodology, Retrieved on April 20th, 2013, <http://arxiv.org/pdf/physics/0601009.pdf>

Answers, What is the definition of Quantitative and Qualitative, Retrieved on April 20th, 2013, [http://wiki.answers.com/Q/What\\_is\\_the\\_definition\\_of\\_quantitative\\_and\\_qualitative](http://wiki.answers.com/Q/What_is_the_definition_of_quantitative_and_qualitative)

Survey monkey, Survey Sample Size, Retrieved on April 20th, 2013, <http://www.surveymonkey.com/mp/sample-size/>

Processpolicy, What is PEST analysis, Retrieved on April 12th, 2013, <https://processpolicy.com/pestle-analysis.htm>

Wikipedia, Pestle analysis, Retrieved on April 12th, 2013 [http://en.wikipedia.org/wiki/PEST\\_analysis](http://en.wikipedia.org/wiki/PEST_analysis)

Pestle analysis, PESTLE analysis, Retrieved on April 12th, 2013 <http://pestleanalysis.com/>

Pestle analysis, Examples of Pestle analysis, Retrieved on April 12th, 2013 , <http://pestleanalysis.com/examples-of-pestle-analysis/>

Gilbert Silvius, Pestle Analysis, Retrieved on April 12th, 2013 <http://www.gilbertsilvius.nl/Handout%20PEST%20Analysis.pdf>

Bright hub pm, Limitations of Pestle analysis, Retrieved on April 12th, 2013 , <http://www.brighthubpm.com/project-planning/100700-limitations-of-a-pest-analysis/>

Cyber journals (September, 2011), power crisis and its solution through Renewable energy in Bangladesh, Retrieved on April 12th, 2013 , <http://www.cyberjournals.com/Papers/ Sep2011 /02.pdf>

The Financial Express (January 7<sup>th</sup>, 2013), The viability of rental power plant, Retrieved on April 12th, 2013, <http://www.thefinancialexpressbd.com/index.php?ref=MjBfMDFfMDdfMTNfMV85MI8xNTU4Njg=>

The Daily Sun (January 17<sup>th</sup>, 2008) , Dhaka eyes import from Bhutan and Nepal through India Retrieved on April 13th, 2013,[http://www.daily-sun.com/details\\_yes\\_29-01-2013\\_Dhaka-eyes-power-import--from-Nepal,-Bhutan-thru-India\\_393\\_1\\_3\\_1\\_1.html](http://www.daily-sun.com/details_yes_29-01-2013_Dhaka-eyes-power-import--from-Nepal,-Bhutan-thru-India_393_1_3_1_1.html)

Bdnews24 (January 23<sup>rd</sup>, 2013) N-Plant work from Oct, Retrieved on April 13th, 2013, <http://bdnews24.com/bangladesh/2013/01/23/n-plant-work-from-oct-pm>

Newagebd (January 30<sup>th</sup>, 2013), Questions on Rooppur Nuclear power plant, Retrieved on April 13th, 2013, <http://newagebd.com/detail.php?date=2013-01-30&nid=38377#.UWISokq84iw>

Fair, 1320 MW Rampal Power Project, Retrieved on April 13th, 2013, <http://www.fairbd.net/Details.php?Id=518>

The Bangladesh Chronicle (December 7<sup>th</sup>, 2012), PPP law in the offing, Retrieved on April 13th, 2013,<http://www.bangladeshchronicle.net/index.php/2012/12/ppp-law-in-the-offing-pm/>

Newagebd (April 2<sup>nd</sup>, 2013), PPP for water, ETP and power generation, Retrieved on April 13th, 2013, <http://newagebd.com/detail.php?date=2013-04-02&nid=44813#.UWljTUq84iw>

Professional Academy, Marketing theories-Pestle analysis, Retrieved on April 14th, 2013,<http://www.professionalacademy.com/news/marketing-theories-pestel-analysis>

Newagebd (March 6<sup>th</sup>, 2013), EIA study Rampal power plant is deceitful, Retrieved on April 14th, 2013,<http://www.newagebd.com/detail.php?date=2013-03-06&nid=41989#.UWp7mEq84ix>

The Financial Express (March 18<sup>th</sup>, 2012), Rooppur power plant can't wait any longer, Retrieved on April 14th, 2013,[http://www.thefinancialexpress-bd.com/more.php?date=2012-03-18&news\\_id=123766](http://www.thefinancialexpress-bd.com/more.php?date=2012-03-18&news_id=123766)

ISE India (April 2011), BCG Matrix, SWOT and Porter Model, Retrieved on April 14th, 2013, [http://www.iseindia.com/ResearchPDF/BCG\\_Matrix\\_SWOT\\_and\\_Porter\\_Model-April\\_2011.pdf](http://www.iseindia.com/ResearchPDF/BCG_Matrix_SWOT_and_Porter_Model-April_2011.pdf)

KKU, What is a PEST analysis, Retrieved on April 14th, 2013, <http://home.kku.ac.th/petmas/What%20is%20a%20PEST%20analysis.pdf>