

An Outlook over Electrical Energy Generation and Mixing Policies of Bangladesh to Achieve Sustainable Energy Targets - Vision 2041

Md. Kamrul Hasan

Dept. of Electrical and Electronic Engineering
Chittagong University of Engineering and Technology
Chittagong 4349, Bangladesh

kamrul21cuet@gmail.com

Nur Mohammad

Dept. of Electrical and Electronic Engineering
Chittagong University of Engineering and Technology
Chittagong 4349, Bangladesh

nur.mohammad@cuet.ac.bd

Abstract— This paper presents an outlook on the power generation and mixing policies taken by the Government of Bangladesh (GOB) to remove energy crisis and ensure energy access. Electricity generation and fulfilling people's demand with limited energy resources is very challenging for a developing country like Bangladesh. Over the last two decades, energy consumption in Bangladesh has been rising rapidly for the acceleration of economic growth and sustainable development. Conventional energy sources like natural gas, oil, coal, and some non-conventional energy sources are trying to fulfil the present energy demand. As development of the economy directly depends on the energy, a commitment of the current government to ensure the affordability of electricity for all citizens by 2041. The goal of this study is to analyze and compare the present and past energy consumption and reserve energy resources of Bangladesh, problems, and policies to meet present demand as well as future power demands.

Keywords— Power generation, installed capacity, natural resources, power mix, energy security, policies and strategies.

I. INTRODUCTION

Electrical energy generation and its proper distribution while reducing the losses are one of the important elements of modern civilization. Energy access for all is considered as a building block for economic and sustainable development and industrialization over the world.

The demand of energy in developing countries has been increasing at a significantly high rate. To meet the energy security and sustainable development, the growth rate is expected to continue in future. The current population of Bangladesh is around 167 million which is equivalent to 2.18% of the total world population. Population density is 1278 per square kilometre where around 36.5% of people lives in urban areas [1]. In Bangladesh, electricity demand is growing due to the widespread use of electricity in the rapid increase of urbanization. Demand is rising but electricity generation is not increasing at the same of demand. Lack of private investment due to different policies is a vital factor to increase the energy crisis since independence. Due to the energy crisis, a huge gap between demand and supply has been created, especially in the poorly managed area of the power system. It is so important to analysis the reserve of

present energy sources to make the suitable policies for vision 2041 which will make Bangladesh a developed country and in a developed country there is a assurance of energy access for all class of people. As a developing country, power sector may not be self-sufficient to fulfil the demand. However, it has been predicted that in the near future, the total demands will be fulfilled by exploiting the existing natural resources which are still untapped and backing up by the policies for the proper management of generated power.

Electricity generation in Bangladesh is mainly depends on natural gas and coal. Is it said that Bangladesh is floating on natural gas. Sometimes energy is needed to import from other country. As generation is lower than demand so load shedding is the common and frequent term for the people.

In a majority of the cases, in our best of knowledge, few paper addressed outlook over energy mixing. Authors in reference [7] are trying to explain the structure of energy sector of Bangladesh and gives some possibilities to reform it. Reference [5,13,15] presented the present and prospect of renewable energy in future in Bangladesh. Renewable energy may an alternative solution of energy crisis. In [18] discusses about the power system master plan for achieving vision 2041 focusing development in energy sectors by importing energy but disregard about the importance of establishing renewable sector.

To bridge this gap, this paper explicitly review on the present installed and generation capacity, reserve of energy, reason behind the energy crisis and future emerging energy sources and possible solutions for energy security.

The rest of the paper is organized as follows: The Section II, explain existing energy scenario in Bangladesh. Energy sector reformation and restricting in market is also discussed. Section III describe energy mixing profile. Section IV describe the policy for sustainable development, followed by conclusions at the end.

II. PRESENT ENERGY SENERIO IN BANGLADESH

Natural resources in Bangladesh basically are coal and gas. Between them, natural gas is the cheapest form of

energy. For this reason, almost 75% of the energy supplied for commercial purpose comes from natural gas which may arise a situation of shortage by the year 2020 [2].

In that case, Bangladesh needs to look forward to some new source of energy like renewable energy which may help to fulfil future demand. Renewable energy is the source of endless energy mainly comes from natural resources like sunlight, wind, biomass, tides and waves, geothermal heat, biofuel etc.

In 1990 only a 8.5% of people had access to electricity whereas in 2016 around 76% of people have access to electricity [3]. Presently almost 90% of the total population has access to electricity, and per capita, a generation has increased to 464 KWh [4].

Empowering end-user's energy consumption choice and demand flexibility in energy markets are unbundled throughout the world. In a restructured market, electricity is purchased from the supplier companies and sold to the retailer under a certain degree of coordination by the market operator. Energy sector in Bangladesh is being experienced such market restructuring. Power Division of Bangladesh (PDB) is divided into three sectors namely generation, transmission, and distribution. Bangladesh Power Development Board (BPDB), Electricity Generation Company of Bangladesh (EGCB), Ashuganj Power Station Company Ltd. (APSC), North West Power Generation Company Ltd. (NWPGCL) and Independent Power Producers (IPPs) are the main power generation companies in Bangladesh. Among all these companies the state owned BPDB generates around 60% of the country's total electricity.

BPDB is the only buyer in the power market of Bangladesh. It purchase electricity from independent power producer (IPPs), small independent power producer (SIPPs), rental plants, EGCB, NWZPGCL, and APSC and selling the energy to different distribution companies to deliver end-user customers. The BPDB is now working for exploring and researching alternative fuel for power generation. In the fiscal year, 2016-17 power sector witnessed remarkable progress in power generation. Table I shows listed power capacities newly added to power sector raising the total capacity to 13,375 MW [4]. In that year, load shedding came down at a moderate level, which indicates gradual improvement and development in the power sector.

Existing total installed generation capacity of Bangladesh is about 17685 MW [5], but due to lack of sufficient supply of fuel some of the power plants are in operation for few months and keep stand-still without any operation for rest of the year. For this problem, the present electricity demand may not be fulfilled. The power sector has the capacity to fulfil the demand, but there are too many system losses to run the system in full swing.

Table II shows the data about the present electricity installed capacity as on December, 2018. As seen, a 51% of our total energy comes from the public sectors and rest 49% of the energy comes from the private and some quick rental sectors [6].

TABLE I. NEW INSTALLED CAPACITY IN THE YEAR 2016-17 [4]

Installation Company	Newly Installation Capacity (MW)
BPDB	450
APSC	360
NWPGCL	450
Total	1260

TABLE II. EXISTING INSTALLED ELECTRICITY GENERATION CAPACITY [6]

Sectors	Sub-Sectors	Installed Generation Capacity (MW)
Public	BPDB	5266
	APSC	1444
	EGCB	839
	NWZPGCL	1211
	RPCL	77
	BPDB-RPCL	149
Public	Sub Total	8986 (51%)
Private	IPP	5549
	SIPP(BPDB)	99
	SIPP(REB)	251
	15 YEARS RENTAL	169
	3/5 YEARS RENTAL	1471
	Power Import	1160
Private	Sub Total	8699 (49%)
Public and Private	Total	17685
Captive Power Plant & Renewable energy	Generation	3090
Total Installed Capacity		20,775

For the accessibility to electricity, Government of Bangladesh (GOB) gives subsidy in energy sector from time to time to reduce the tariff charge on people. This kind of subsidy is divides into two types. The first type is to lower the production cost through subsidized fuel like natural gas, coal, furnace oil etc. used in electricity production. The second type offers electricity tariffs lower than production costs for groups of consumers. As a result BPDB sales energy at lower price than the break-even point. These losses are adjusted mainly through budgetary transfers by the government in every year [7].

III. ENERGY MIX IN BANGLADESH

The main problem between supply and demand is that the energy demand is expected to continue increasing rapidly whereas main generation fuel is natural gas only. The average energy use in the economy should be increased by about 11.0% per year.

A. Status of Natural Gas

Natural gas plays an emergent part in the economic sector. Its burning is odourless and clean that's why it is called as environment-friendly fuel. In Bangladesh, natural gas is the main fuel for domestic purpose like cooking and heating and in industry for metallurgical, glass, ceramic, power stations, factory process, steam boilers, , cement works etc. purpose. Moreover, Liquefied Natural Gas (LNG), liquefied petroleum gas (LPG), and compressed natural gas (CNG) are a different form of natural gas and used as fuels in different sectors.

The demand for natural gas to be used in power generation is increasing estimated at over than 5%. As a result, the probability of exhaustion of gas finishes within a decade [8].

Table III shows the summary of natural gas reserve in Bangladesh. According to Bangladesh Oil, Gas & Mineral Corporation (PETROBANGLA), 27 gas fields have been discovered in the country, and a total reserve of gas is around 11.91 trillion cubic feet (TFC) [9].

Fig. 1 shows the amount of consumption of natural gas in power generation for the past recent year. From the year 2011-12 needed amount of natural gas had been increasing till the 2016-17. But in the year 2017-18 dependency of natural gas has been reduced by adding another resource in the power sector [10]. In Fig. 2 it can easily be seen the contribution of natural gas in the power sector. Almost 58% of total power comes from only natural gas [11].

B. Status of Coal

Coal is the second energy resource now in Bangladesh. As seen in the year 2009-10, for electricity generation the share of gas, oil, and coal was 89%, 5% and 3.5% respectively [12]. Coal might be a good alternative fuel in the power generation sector. Only coal alone provides 28% needs of primary energy in Bangladesh [13]. There are five coal fields have already been discovered and it is assumed that nowadays total coal reserves in five fields are estimated at 3.0 billion tones.

Although this amount of reserve can ensure our energy security for the next 20 years but lack of technical knowledge and mismanagement Bangladesh cannot be able to elevate all its resource. Fig. 3 shows the statistical data for the past recent years about how much coal Bangladesh had used in power plant [14]. Again from Fig. 2, it is clear that around 3% of total energy comes using coal as fuel [11]

TABLE III. NATURAL GAS RESERVE IN BANGLADESH [9]

No of Gas Field	Proved amount (TFC)	Proved and Possible amount (TFC)	Cumulative Production (June, 2018) (TFC)	Remaining Reserve (July, 2018) (TFC)
27	20.9	30.82	15.94	11.92

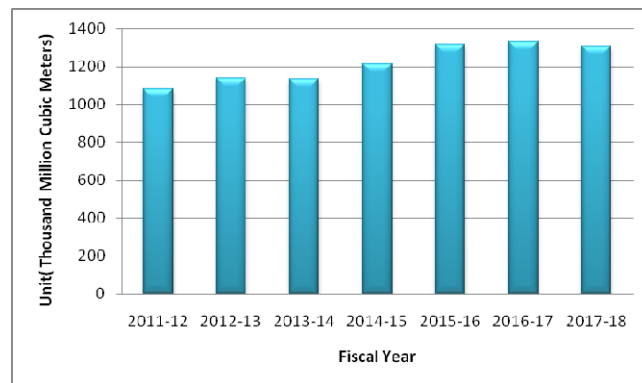


Fig. 1. Natural gas consumption in power generation [10].

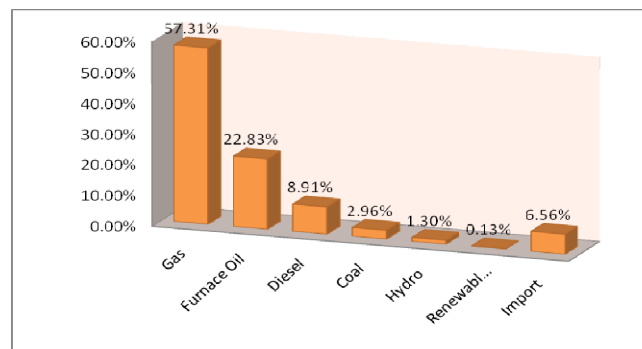


Fig. 2. Presently installed capacity based on fuel in 2018 [11].

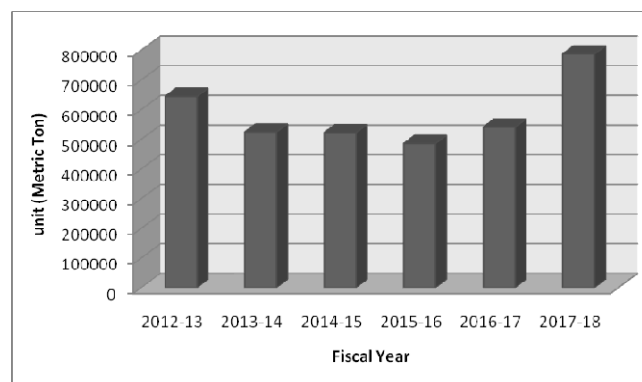


Fig. 3. Distribution of coal in power plant [14]

C. Status of Furnace Oil

Almost 21% of the total power in Bangladesh generate from furnace oil and 10% from diesel [11]. But it is a matter of great sorrow that, each year Bangladesh needs to import that amount of petroleum oil because there is no oil reserve except at Haripur, north-west zone of Sylhet district discovered in 1989.

But after exploiting 0.84 Mton out of 1.4Mton from Haripur reserve, exploitation was stopped as the quality of oil was poor [15]. According to Bangladesh Petroleum Corporation (BPC), present annual demand in the country for petroleum products is 3,300,000 tons, where the total storage capacity of petroleum products is only 687,500 tons. The furnace oil consumption in public power plants (PPP) was 205 million liter in the Fiscal year (FY) 2005-06, which increased to 513 million liters in FY 2016-17 shown in Fig. 4.

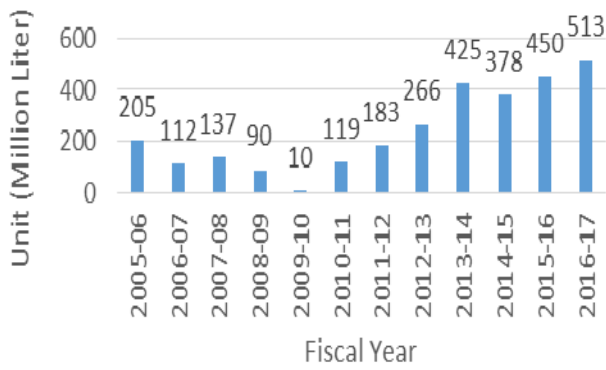


Fig. 4. Furnace oil consumption by public power plants [16].

Bangladesh has a hydro-electric power plant which contributes almost 1.35% of total power. It has installed capacity of 230 MW and the only hydroelectric power plant of the country.

Moreover, there is a very good chance for renewable energy generation from solar, wind, biomass, biogas, micro/mini-hydro plant in Bangladesh. BPDB has already taken some steps for developing project on renewable resource to achieve the target of the Renewable Energy Policy 2008. From Fig. 2 in has been seen that renewable energy has not very significant share to the total generation. Table IV represents the power generation from different renewable source.

IV. POLICIES FOR SUSTAINABLE DEVELOPMENT

Currently, Bangladesh has the installed capacity of producing 17043MW but it has produced maximum 11623MW power on 19 Sep 2018 [4].

Natural gas is the only dependable energy source but due to the mass use of natural gas there will be a risk of depletion which questions to sustainable development. The GOB had made the Power System Master Plan 2010 (PSMP2010) targeting a long term energy security due to decrease rate in the production volume of Natural Gas.

Subsidy from Government in energy sector is one of the challenging issues because there is uncertainty about the price of fuel which may cause negative effect on the national economy. In this situation, a pathway is needed to find which will ensure the energy security and energy for sustainable development with economic growth.

TABLE IV. ACHIEVEMENT IN RENEWABLE ENERGY [17].

Technology	Off-Grid (MW)	On-Grid (MW)	Total (MW)
Solar	268.29	17.35	285.64
Wind	2	0.90	2.90
Hydro	-	230	230
Biogas to Electricity	0.68	-	0.68
Biomass to Electricity	0.40	-	0.40
Total	271.37	248.25	519.62

In the year 2016, with the help of Japan International Cooperation Agency (JICA), the GOB has formulated “Power System Master Plan (PSMP) 2016” for balancing energy, power and tariff strategies. The main goal for Bangladesh is to be a middle income county by 2021 and be a developed country by 2041. For achieving the goal to make Bangladesh developed country, power sector needs to improve. For this vision a target has already been set that Bangladesh will produce 24000MW, 40000MW and 60000MW by the year 2021, 2030 and 2041 respectively [4].

For producing this mass amount of power already five plans has been set in the PSMP 2016 [18].

- Enhancement of imported energy infrastructure and its flexible operation.
- Efficient development and utilization of domestic resources.
- Construction of robust, high-quality network.
- Maximization of green energy and promotion of its introduction.
- Improvement of human resources and mechanism related to the stable supply of Energy.

Demand for energy is increasing day by day and to meet this demand Bangladesh needs to change dependency from natural gas to other source. Moreover, existing power system lead to an enormous amount of economic loss. So, for efficient use of energy, development and improvement of policies, system and infrastructure will be essential. By developing an efficient structure Bangladesh has to ensure maximize utilization of her limited resource.

Since domestically produced coal is of a high quality, development of an economical domestic coal development structure is important. Some coal based mega power plants jointly by BPDB and Singapore, Korea, Malaysia, and China at Rampal, Matarbari, Moheshkhali and Payra have already been approved by the Government which will give around 8500MW power [4]. Importing power from neighboring countries may be another policy for minimizing power crisis.

Bangladesh can accelerate access to gas through importing LNG, LPG and gas from neighboring country like North-East India and Myanmar for ensuring energy security.

In the same way, nuclear power generation may be introduced. Nuclear power plant at Rooppur in the North-West zone of the country is now under construction and expected to go under operation in 2023. Rooppur nuclear power plant is the country’s first nuclear fuel based power plant and will generate around 2400 MW power [19]. Renewable energy diversification is needed for energy accessing to rural people. Bangladesh is in a good geographical position for harnessing solar energy but it is not possible to capture large amount of power because of land problem [20], [21] and [22]. To recover this problem Government should give subsidy to use other renewable energy by building windmill in the offshore area of Cox’s

Bazar, biogas plant, micro hydro plant which is quiet possible.

V. CONCLUSION

Energy crisis is a common phenomenon in developing country like Bangladesh. But this problem can be minimize by building robust power network and taking proper policies for energy security and sustainable development. Though improving power sector is much more challenging and costly in a developing country which may leads an increase in power tariff rates. So, necessary steps must be taken for analyzing cost optimization in power generation, supply, and distribution sectors.

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