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Natural Gas Scenarios in Bangladesh and Its Future

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ABSTRACT
Natural gas is the most important indigenous source of energy that has been continuously produced and consumed in significant quantities since 1970. Bangladesh is the nineteenth-largest producer of natural gas in Asia. Gas supply meet 56% of domestic energy demand. About 75% of the commercial energy of the country comes from the natural gas. So far 27 gas fields have been discovered of which two of the gas fields are located in offshore area. The paper shows the present scenario of natural gas in Bangladesh and its future. Though Bangladesh has considerable amount of gas yet it is not enough for 50 more years at current demand and extraction rate. The analysis suggests to reduce dependency on natural gas by introducing alternative energy sources. Moreover, a comprehensive energy policy should be developed with a proper regulatory body that has oversight responsibilities. Efficient gas marketing is the key to derive numerous benefits from the gas reserves of Bangladesh. Lastly, Bangladesh government need to explore ocean area that has been acquired from India & Myanmar in 2014.

Keywords: *Bangladesh, natural gas, production, consumption and utilization, reserve.*

1. Introduction
Natural gas is the most important fuel for Bangladesh, both in terms of energy and diversity of use. Natural gas burns more cleanly than other fuels, such as oil and coal, and produces less carbon dioxide per unit of energy released.

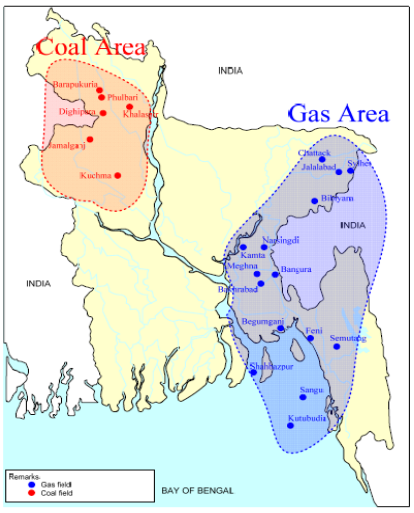

Figure 1: Discovered Coal and natural-gas fields in Bangladesh [7].

Bangladesh Oil, Gas and Mineral Resources Corporation, Petrobangla, is entrusted with the responsibilities of the gas and coal sectors of Bangladesh. Subsidiaries under Petrobangla are responsible for exploration, production, transmission, distribution and marketing of natural gas to the end users. In 1993, there were 17 gas fields in the country with an estimated total initial gas reserve of 12.43 TCF and remaining reserves of 10.55 TCF. In 2003, the number of gas fields was 22 as shown in figure 1 and the total initial gas reserve was estimated at 20.51 TCF and a remaining reserve of 15.4 TCF. In 2014, the number of gas fields grew to 26 with an estimated initial gas reserve of 26.84 TCF and a remaining reserve of 16.74 TCF. In 2016, remaining gas reserve is 12.88 TCF [1]. Bangladesh also has good amount of coal along with natural gas as its main resources reserved in its territory. But the extensive portion of the demand is met by gas alone and it is about 75% of the total consumptions.

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2. Objectives
The objectives of this paper are:
(i) To analysis the existing reserve and production of natural gas in Bangladesh and (iii) To find out the reasons behind natural gas crisis in Bangladesh and the way to reduce dependencies on natural gas.

3. Present Scenarios of Natural Gas Production in Bangladesh
The production of gas till December 2016 was 14.243 trillion cubic foot and 12.87 trillion cubic foot of gas was in reserve for production. The reserve of natural gas as per December,2016 is shown in the table 1(a), 1(b) and 1(c):

Table 1(a): Gas field in production (in BCF) [1].

Sl. No.	Field	Cumulative Production (Dec,16)	Remaining Reserve (Jan,17)
1	Titas	4221.34	2145.66
2	Habiganj	2273.03	359.97
3	Bakhrabad	803.87	427.65

4	Kailashtilla	647.07	2112.93
5	Rashidpur	585.81	1847.19
6	Sylhet/Haripur	211.27	107.63
7	Meghna	61.32	8.58
8	Narshingdi	180.92	95.88
9	Beani Bazar	94.66	108.34
10	Fenchuganj	148.34	232.66
11	Shaldanadi	87.70	191.30
12	Shahbazpur	26.86	363.14
13	Semutang	12.10	305.60
14	Sundalpur Shahzadpur	9.98	25.12
15	Srikail	54.84	106.16
16	Begumganj	0.88	69.12
17	Jalalabad	1046.70	137.30
18	Moulavi Bazar	289.54	138.46
19	Bibiyana	2530.04	3223.96
20	Bangura	359.05	162.95
	Sub-Total a:	13645.32	12169.60

Table 1(b): Non-production gas field (in BCF) [1].

Sl. No.	Field	Cumulative Production	Remaining Reserve
21	Kutubdia	0	45.5
22	Rupganj	0	33.6
	Sub-Total b:	**0**	**79.1**

Table 1(c): Suspended production gas field (in BCF) [1].

Sl. No.	Field	Cumulative Production	Remaining Reserve
23	Chattak	26.46	447.54
24	Kamta	21.1	29.2
25	Feni	62.4	62.6
26	Sangu	487.91	89.85
	Sub-Total c:	**597.87**	**629.19**

Grand Total (a + b + c) in BCF	14243.19	12877.89

Figure 2 shows the historical production of gas from 1993 to 2016. It shows that gas production was significantly increasing from 1993 to 2016. But in recent years, the gas production rate has started to decline.

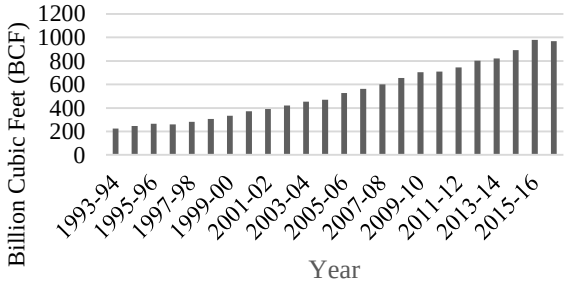

Figure 2: Historical production of gas [5].

Three national companies; Bangladesh Gas Fields Company Limited (BGFCL), Bangladesh Petroleum Exploration & Production Company Limited (BAPEX), Sylhet Gas Fields Limited (SGFL) and four international oil companies; Chevron, Cairn, Tullow and Niko are in charge of exploration and production of gas in Bangladesh. Three national companies are operating with a production capacity of 1137 MMCFD while the international oil companies are operating with a production capacity of 1160 MMCFD [3].

4. Consumption of Natural Gas

Bangladesh being one of the world's most densely populated countries has been facing supply to demand gap of natural gas for a long time. Among all the countries which use natural gas, Bangladesh ranks at 34th position [4]. The table 2 shows the consumption of natural gas by different sectors in the year 2016-2017.

Table 2: Sector wise gas consumption in 2016-17 [5].

Sector	Consumption Percentage
Commercial	0.88%
Domestic	15.64 %
Tea State	0.1 %
Industry	16.52%
Electricity	40.88%
Fertilizer	4.97%
Captive	16.26%
CNG	4.76%

Power generation as expected is the dominant sector and industrial sector, together with fertilizer and captive power uses about 40% of the total gas which is the second largest share. CNG sector had modest beginning with only 1.3% during 2005-06, but rapidly increased to the current level of 5%. Domestic consumption of gas also takes a large share of total consumed gas and this is a sector which has hardly an alternative source to gas. With increasing population and urbanization, the use of domestic use of gas is expected to increase [6].

Table 3: Sector wise demand of natural gas in Bangladesh (Billion Cubic Feet) [9].

Sector	2013-14	2014-15	2015-16	2016-17
Electricity	337	416	458	504
Captive power	143.5	234	258	284
Fertilizer	53.8	94	94	94
Industry	53.8	259	280	307
Brick field	0	0	0	0
Household	101.5	148	168	185
Tea Garden	0.51	1	1	1
CNG	40.1	121	153	168
Commercial	8.9	8.9	14	14
Total	827.8	1,276.5	1,424	1,557

Table 3 shows sector wise demand of Natural Gas in Bangladesh (billion cubic foot). Historical consumption of natural gas by different sectors has been shown in figure 3 below. Separate data for the consumption of natural gas is 1315.88 MMCM for the year 2015-16 and 1329.67 MMCM for the year 2016-17.

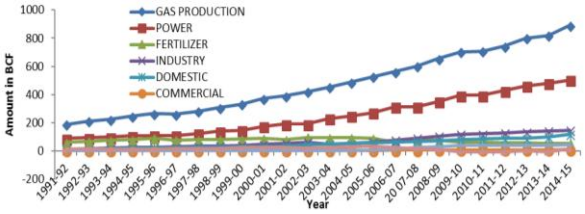

Figure 3: Historical Consumption of Gas in Different Sectors [9].

4.1. Electricity Generation

Bangladesh's power sector is mostly dependent on supply of natural gas. Almost 86% power plants use natural gas as their fuel. As a result, almost 40% of gas produced is used in this sector. In 2017, total installed capacity was 13,555 MW. The maximum peak generation was 9,479 MW which was 4.90% higher than that in the previous year [10]. Only 62% of the population has access to electricity with a per capital availability of 321 kWh per year [7]. Electricity production from natural gas sources in Bangladesh was 91.5% as of 2011. Its highest value over the past 42 years from 2011 was 91.5% in 2011, while its lowest value was 34.69% in1973. Electricity production from natural gas sources (kWh) in Bangladesh was last measured at 40308000000 in 2011, according to the World Bank. As the power sector is dangerously dependent on natural gas, decentralization strategies are under research.

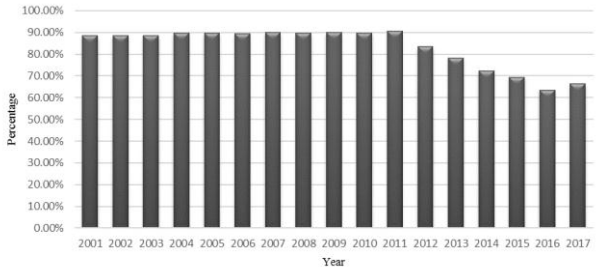

Figure 4: Electricity production from natural gas (percentage of total) [10].

4.2. Industrial Sector

The major industries of Bangladesh which consume natural gas are textile and leather, iron & steel, food processing, beverages & tobacco, nonmetallic minerals, chemicals, pulp, paper & print non-ferrous metal, machinery and some non-specified industry. But newer industries are emerging, some existing ones are flourishing and some are diminishing. So, the industrial sector is hard to define in terms of energy consumption. Relatively small increase in the number of these industries can have a significant impact on the overall scenario. As of 2017 about 17% of produced natural gas was consumed by this sector.

4.3. Captive Power

Captive Power Plant (CPP) is a plant which produces electricity for its owner's own uses or for a group for their own use. The gas demand for power generation at present has reached nearly 1,200 MMCFD and Petrobangla can supply maximum 900 MMCFD for the power plants

4.4. Fertilizer Productions

Bangladesh has a large agrarian base with 76 percent of total population living in the rural areas and 90 percent of the rural population directly related with agriculture. Fertilizer is considered to be one of the main inputs for increasing crop yields and farm profit for any country. Fertilizer consumption (% of fertilizer production) in Bangladesh was last measured at 231.51 in 2009, according to the World Bank. Fertilizer consumption measures the quantity of plant nutrients used per unit of arable land [11].

4.5. Household Sector

Domestic sector is incurred by the greatest number of customers and it consumes about 11% of the total natural gas produced. The Bangladesh government's priority is to increase gas supply to power plants to be followed by industries and fertilizer factories. Fresh household gas connection does not feature in the Government's priority agenda. The domestic sector slowed down as piped gas connections to household was suspended from July 2010 to 2013. Some 15 MMCFD of gas has been earmarked for new household gas connections. Still the country is facing huge gap in supply and demand of natural gas in household sector and the government is planning to import LPG to cope with gas supply shortfall.

4.6. Compressed Natural Gas

CNG as a vehicle fuels were first introduced to Bangladesh in 1982 through a World Bank pilot project. CNG was promoted by the government in 2005 to address the severe air pollution in Dhaka during the 90's. It had a modest beginning with only 1.3% natural gas consumption in the initial year, but quickly became popular and increased to the current level of 4.76% rapidly.

5. Prediction of Remaining Natural Gas Reserve

At present, the amount of remaining gas reserve in Bangladesh is 12.88 TCF. This reserve is forecasted by using moving average technique taking the data from the year 2014 to 2017 which is shown in figure 5. From figure 5 it has been depicted that if the gas consumption rate remains same, this reserve can be consumed until 2032. After 2032, demand of natural gas will need to be met by another energy sources or by importing energy. Although this forecast shows that, the gas reserve will sustain till 2032, but the real scenario is different. According to table 3 sector wise demand of natural gas

is increasing significantly. So, there is a possibility that the remaining gas reserve will barely sustain till 2032. So, for an uninterrupted gas supply an intensive search should be conducted specially in the southeast part in the country by the relevant authorities.

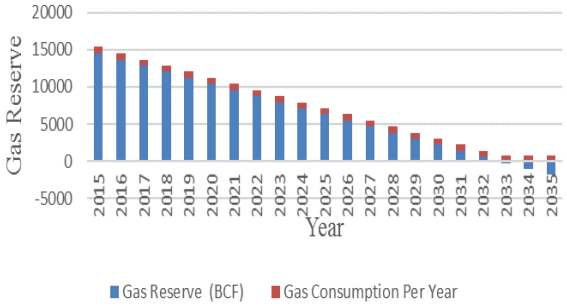

Figure 5: Prediction of remaining natural gas.

6. Recommendations

Some recommendations that need to be quickly set in motion in order to provide consistent supply and utilization of energy are given below.

a. Dependency on natural gas should be reduced for power generation.
b. Alternative sources of energy such as LNG, nuclear energy and other renewable energy sources like solar, wind, biomass etc. should be implemented and developed.
c. Development and focus on renewable sources such as solar, wind, small hydro is also necessary to reduce the pressure on natural gas.
d. Government should prepare an action plan to ensure energy efficiency &conservation both at supply and demand side, where number of interventions will be identified for implementation within a time-frame work.

It is important to inform mass consumers of natural gas about the crisis of gas. They should know that if they waste gas and other energy sources, they will completely run out of gas in no time. Government can create campaigns and use media to enlighten people.

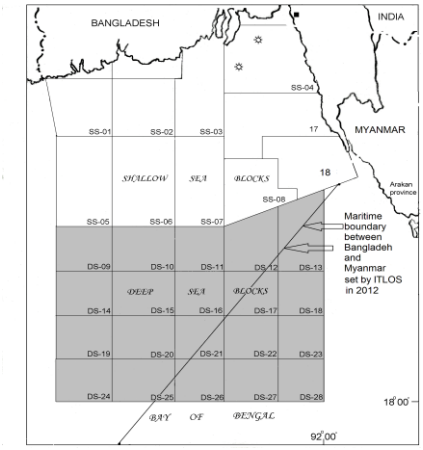

Figure 6: Possible availability of Natural Gas in Bay of Bengal [9].

Figure 6 shows possible availability of natural gas in Bay of Bengal. Bangladesh has the scope to explore the area boarding Myanmar and India in the Bay of Bengal. Myanmar already explored and found available of gas in their side of boarder in sea.

At present the government of Bangladesh is importing LNG. It is a part of the government's efforts to eliminate gas shortages and power outages and unlock the potential of the economy.

7. Reasons behind natural gas crisis in Bangladesh and steps taken by the present Government to supply natural gas as per priority need.

Bangladesh is facing gas crisis of 500 million cubic feet a day (mmcfd), which is one fifth of the demand. The government is bound to monitor the utilization of gas in important sectors like power generation, fertilizer factory, household consumption and CNG sector. Gas is used in the industries primarily as a source of power, heating in the boilers and in some cases as a raw material. Transportation sector has recently been experiencing a rapid growth in gas connection. At present due to shortage of natural gas reserve, supply of natural gas is supplied limitedly to fertilizer factories in Bangladesh. Frequently Shahjalal fertilizer factory remains close for sometime. Similarly CNG Gas stations remain close from 5:00 pm to 8:00 pm every day throughout the country. Also gas supply has been shorten in Savar industrial area and some industries in and around Chittagong city. Those industries uses long cylinder filled with natural gas during shortage of natural gas supply through pipes. Nowadays no permission is given for connecting gas lines to residential houses and industries. Industries are using long gas cylinders for gas supply to industries. A major hurdle in efficiency delivering power is caused by the inefficient distribution system. It is estimated that the total transmission and distribussion losses in Bangladesh is about one-third of the total generation. Old and inefficient plants need to be replaced soon to minimize loss of gas distribution system. Bangladesh needs to explore other energy source like LNG. New power plants must be run by coal. Also the government of Bangladesh need to take decision to explore sea area bordering Myanmar at sea where several gas reserves have been discovered on the Myanmar side since 2014.

8. Findings

This study depicted that natural gas is the main source of energy in Bangladesh. But at present reserve of natural gas is at stake. This study predicted that the remaining gas reserve can serve the energy demand until 2032. After 2032, Bangladesh needs to depend on other energy sources. But according to increasing demand of natural gas, this gas reserve will barely sustain till 2032. It is possible that the remaining reserve will be consumed before 2030, if the demand of natural gas increase at this rate. So, there is no other way to go for new energy

sources for Bangladesh to meet the future demand of energy in Bangladesh.

9. Conclusion

This study has analyzed present scenarios of natural gas and forecasted the remaining gas reserve in Bangladesh. It is clearly depicted here that Bangladesh will face gas crisis in very near future which is very concerning. So, Bangladesh needs to start searching for new energy source immediately which will fulfill the demand of natural gas.

References

[1] Petrobangla annual report, 2016.

[2] World bank.

[3] Rahman, M., & Tamim, M. (2012). Analysis of Natural Gas Consumption by the Industrial Sector of. Journal of Chemical Engineering, IEB , Vol. ChE. 27, No. 1.

[4] United nations data, 2010.

[5] https://petrobangla.org.bd/?params=en/gasproductiondistributionpipeline/distribution/

[6] Amin, A.S.M Tareq, Md. Rakibul Hassan, and Md. Shadekul Islam. "Feasibility & Comparison of available alternatives of gas as captive power generation source for Textile Industries."Bangladesh Textile Today, May-June 2010.

[7] Wikipedia

[8] Choudhury, Z. (2010). Natural Gas Reserve Estimate. Dhaka: Petrobangla.

[9] Mohammad Iqbal, ABM Abdul Maalek, Salma Akhter, Mohammad Farhad Howladar And AHM Samsuzzoha. "SCENARIO OF ENERGY UTILIZATION IN BANGLADESH." 10th International Conference on Thermal Engineering: Theory and Applications February 26-28, 2017, Muscat, Oman.

[10] Power development board annual report 2016-17.

[11] Quader, A. K. M. Abdul. "STRATEGY FOR DEVELOPING THE FERTILIZER SECTOR IN BANGLADESH FOR SUSTAINABLE AGRICULTURE."Chemical Engineering Research Bulletin, 2009: 39-46.