HYDROCARBON UNIT
Energy & Mineral Resources Division

Energy Scenario

Bangladesh

2017-18



Hydrocarbon Unit
Energy and Mineral Resources Division
Ministry of Power, Energy and Mineral Resources

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Preface

Report on Energy Scenario, Bangladesh was prepared and published by Hydrocarbon Unit for the first time in October 2009. The present one is the issue of Energy Scenario, Bangladesh for the period of July 2017 to June 2018. In this report, Energy Scenario of Bangladesh has been reflected. Daily average gas production rate have been included in the report as well. Moreover, Share of Primary and Commercial energy, Sector-wise Liquid fuel consumption, Historical Gas production and Net Energy Generation along with the graphical presentation have been depicted.

This report has been prepared based on the data available from the Monthly Reserve and Gas Production Report of HCU and Monthly Information System (MIS) of Petrobangla. Bangladesh Petroleum Corporation (BPC), Bangladesh Power Development Board (BPDB).

It is expected that the report will be helpful as reference book and elements of interest for the concerned.

The report will also be available at HCU's website: www.hcu.org.bd.

Date: 15 January, 2019

Md. Harun-Or-Rashid Khan
Director General

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1.0 Introduction

Bangladesh is a mid-income country. Her GDP growth rate is one of the world's largest. For any country, development is the precondition for continued growth of GDP. And the main driving force of the country's development is energy. Proper use of energy is essential to meet the country's growing energy demands as well as to lift up from a mid-income country to a developed country. Energy is playing a vital role in implementing Vision-2121, Vision-2041 and achieving Sustainable Development Goals.

In Bangladesh, about 70 percent of energy demand is met from natural gas. Among other fuels- oil, coal, biomass etc. are vital. There is a huge reserve of coal in our country, but coal is less produced as well as less used here. On the other hand, natural gas reserve is not that substantial, but its production and consumption are the highest among the available resources. Besides those, energy demand is being met through imported oil and LPG. Moreover, the government has already started importing LNG to meet increasing gas demand. Biomass is being used as a lion's share of energy. The energy demand is also being met by importing electricity from India.

The use of renewable energy instead of gas, coal and oil has been started in the whole world and is essential for sustainable development and keeping up with the environment by preventing carbon emissions. Many countries in the world like Sweden, Germany, China and USA are currently using renewable energy as a significant part of their energy demand. Bangladesh is also using renewable energy, but it's very less than necessity. The government has taken various steps to increase the use of renewable energy in the future, including solar home system, solar irrigation system, Rooppur nuclear project, etc.

Development of energy sector is the key factor for continued development of the country. Bangladesh needs to emphasize on the new exploration activities using latest techniques to explore new mines. Apart from reducing dependence on natural gas, it needs to be coordinated with the imported LNG and enhance the percentage of usage oil and LPG; thereby Bangladesh will succeed in reaching its desired goal of development.

2.0 Current Position of Energy Resources

Known commercial energy resources in Bangladesh include indigenous natural gas, coal, imported oil, LPG, imported LNG, imported electricity and hydro-electricity. Biomass accounts for about 29% of the primary energy and the rest 71% is being met by commercial energy. Natural gas accounts for about 68% of the commercial energy. Imported oil accounts for the lion's share of the rest. Every year Bangladesh imports about 6.6 million metric ton of crude and refined Petroleum Products. Apart from natural gas and crude oil, coal is mainly used as fuel in the brick-fields and Thermal Power Plant.

Moreover, power is also being generated by using Solar Home System (SHS) in on-grid and off grid areas. The amount of power generation using solar system is currently about 325 MW. In addition there are some poultry and dairy farms in which bio-gas plants are being set up and this bio-gas is used for cooking and power generation. The amount of power generation from such plants is currently about 1 MW. Steps have been taken to generate electricity by Bio-Mass Gasification Method in the country.

Estimated final consumption of total energy is around 47 MTOE. Average increase of energy consumption is about 6% per annum. Per capita consumption of energy in Bangladesh is on an average 293 kgoe (Kilogram Oil Equivalent) and per capita generation of electricity is 464 kWh with an access to electricity 90%, which is lower than those of South Asian neighboring countries.

Table 1: Energy calculation for 2017-18. (MTOE)

Name of Fuel	Unit	MTOE
Oil (Crude + Refined + LPG) in K ton	6948	6.9
LPG	554	0.5
Natural Gas in Bcf	961	22.3
Coal (Imported) in K ton	3395	2.1
Coal (Local) in K ton	923	0.6
RE (Hydro) in MW	230	0.2
RE (Solar) in MW	350	0.3
Electricity (Imported) in MW	625	0.5
Sub- total		33.4
Biomass		13.6
TOTAL		47.0

Figure 1: Share of Primary Energy (2017-18)

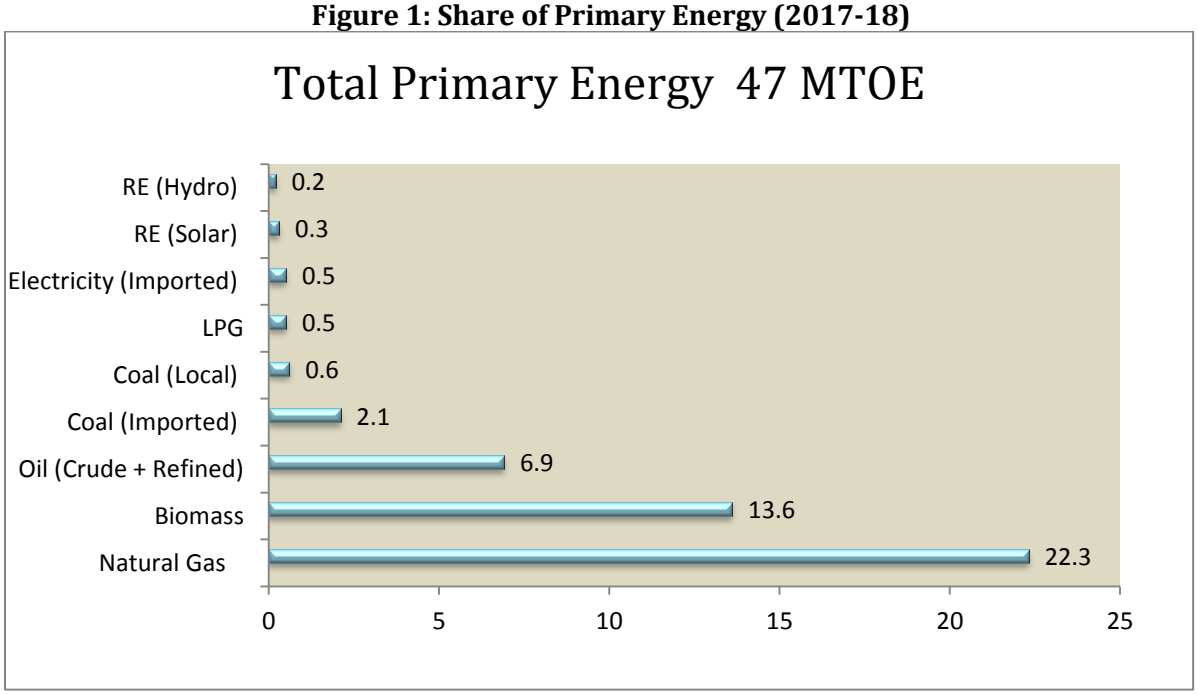
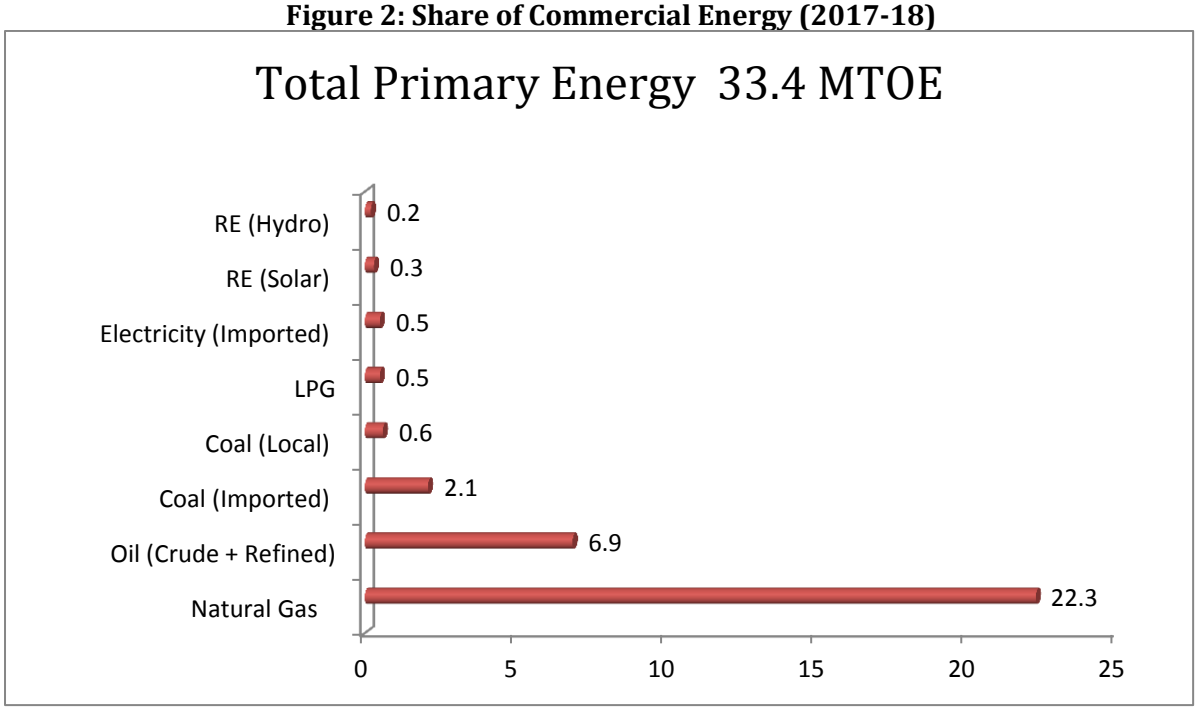


Figure 2: Share of Commercial Energy (2017-18)



Bangladesh also has a bright potential to produce electricity from wind and mini-hydro. Recently, solar power based irrigation pump has been used in a number of areas of the country. Its wide use will lessen the pressure on diesel and electricity.

3.0 Natural Gas

3.1 Organizational Structure

Bangladesh Oil, Gas, and Mineral Corporation, short named Petrobangla, under the Energy and Mineral Resources Division of the Ministry of Power, Energy and Mineral Resources is entrusted with the responsibility of exploration of oil and gas, and production, transmission and marketing of natural gas in the country.

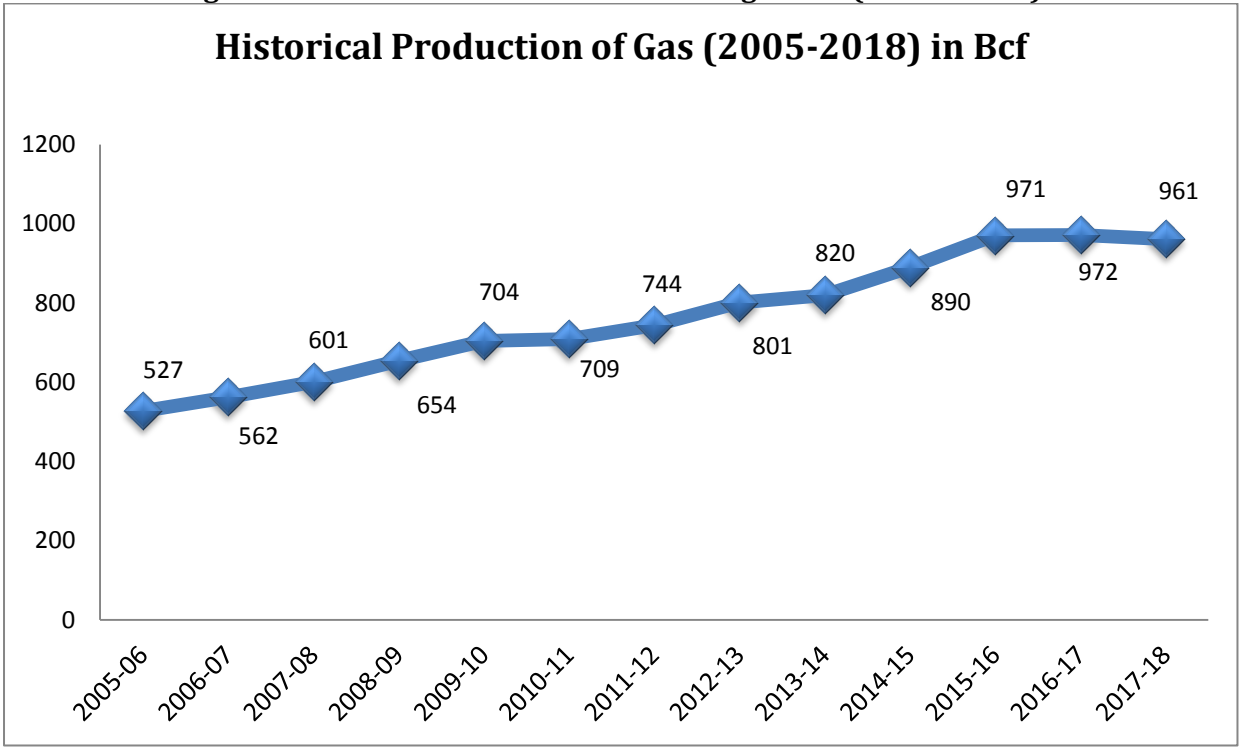
3.2 Natural Gas Reserve

Since first discovery in 1955 as of today 26 gas fields, 24 in the onshore and 2 in the offshore have been discovered in the country. Of them 19 gas fields are in production, one offshore gas field have depilated after 14 years of production while other offshore field has not been viable for production due to small reserve. The estimated proven plus probable recoverable reserve was 28.69 Tcf. As of June 2018, a total of 15.96 Tcf gas has already been produced leaving only 12.72 TCF recoverable reserve in proven plus probable category. Some key information about the natural gas sector is presented in the Table 2.

Table 2: Gas Sector at a Glance

Total number of gas fields	26
Number of gas fields in production	19
Number of producing wells	110
Present gas production capacity	2750 MMcfd
Avg. gas production rate	2633 MMcfd
Highest Production (6th May, 2015)	2785.80 MMcfd
Total recoverable (Proven + Probabale) reserve	28.69 Tcf
Cumulative Production (June,2018)	15.96 Tcf
Annual Production by NOC	385.34 Bcf (40 %)
Annual Production by IOC	575.43 Bcf (60 %)
Remaining Resurve (Proven + Probabale)	12.72 Tcf
Present Demand	3649 MMcfd
Present Deficit	1016.75 MMcfd
Number of Customer	41.80 Lakh (Appx.)

Figure 3: Historical Gas Production in Bangladesh (2005 – 2018)



Although natural gas was introduced as commercial fuel in early 1960s, its consumption got real momentum in eighties marking the beginning of the industrialization in the country.

Table 3: Field-wise Projection of Gas production

	Total 2P Reserve	Cumulative Production	Field-wise Projection of Gas production									
			2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2025-26	2030-31	2035-36	2041-42
Titas	7582	4556.6	191.13	195.42	195.42	195.42	195.42	195.42	195.42	195.42	0	0
Habiganj	2787	2386.8	81.17	79.9	79.9	79.9	79.9	79.9				
kamta	50	21.1	0	0		0	0	0	0	0	0	0
Bakhrabad	1387	806.9	14.26	12.02	12.02	12.02	12.02	12.02	12.02	12.02	12.02	12.02
Narshingdi	345	195	10.32	10.02	10.02	10.02	10.02	10.02	10.02	10.02		
Meghna	101	66.7	4.43	4.62	4.62	4.62	4.62	4.62	1.96			
Feni	130	63	0	0	0	0	0	0	0	0	0	0
Kailas Tila	2880	715	23.72	22.96	22.96	22.96	22.96	22.96	22.96	22.96	22.96	22.96
Sylhet	408	213.5	2.8	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.79
Rashidpur	3134	618.1	20.61	19.51	19.51	19.51	19.51	19.51	19.51	19.51	19.51	19.51
Chattak	474	25.8	0	0	0							
Beani Bazar	137	93.6	4.19	3.5	3.5	3.5	3.5	3.5	3.5	1.4		
Shahbazpur	261	47.5	9.78	15.26	15.26	15.26	15.26	15.26	15.26	15.26		
Semutang	318	12.9	0.78	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46
Fenchuganj	329	156.1	8.77	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Saldanadi	275	90.3	1.89	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06
Sundalpur	50.2	10.7	0	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Srikail	161	75.1	14.99	12.93	12.93	12.93	12.93	12.93	0			
Jalalabad	1346	1233.3	96.81	92.09	20.61	20.61						

	Total 2P Reserve	Cumulative Production	Field-wise Projection of Gas production									
			2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2025-26	2030-31	2035-36	2041-42
Moulavi Bazar	494	317.3	13.71	12.34	12.34	12.34	12.34	12.34	12.34	12.34		
Bibiyana	4532	3357.7	437.17	437.33	437.33	437.33	299.33					
Bangura	621	409.4	35.09	33.67	33.67	33.67	33.67	33.67				
Sangu	771	489.5	0	0	0	0	0	0				
Begumganj	33	0.9	0.006	0	0	0	0	0				
Rupganj	33.6	0.7	0.43	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Kutubdia	46	0	0	0	0							
	28685.8	15963.5	972.056	960.77	889.29	889.29	730.68	431.35	302.19	298.13	63.69	63.69
			Already consumed		will be produced and depleted at the current rate of Production							

Figure 4: Projection of Gas production

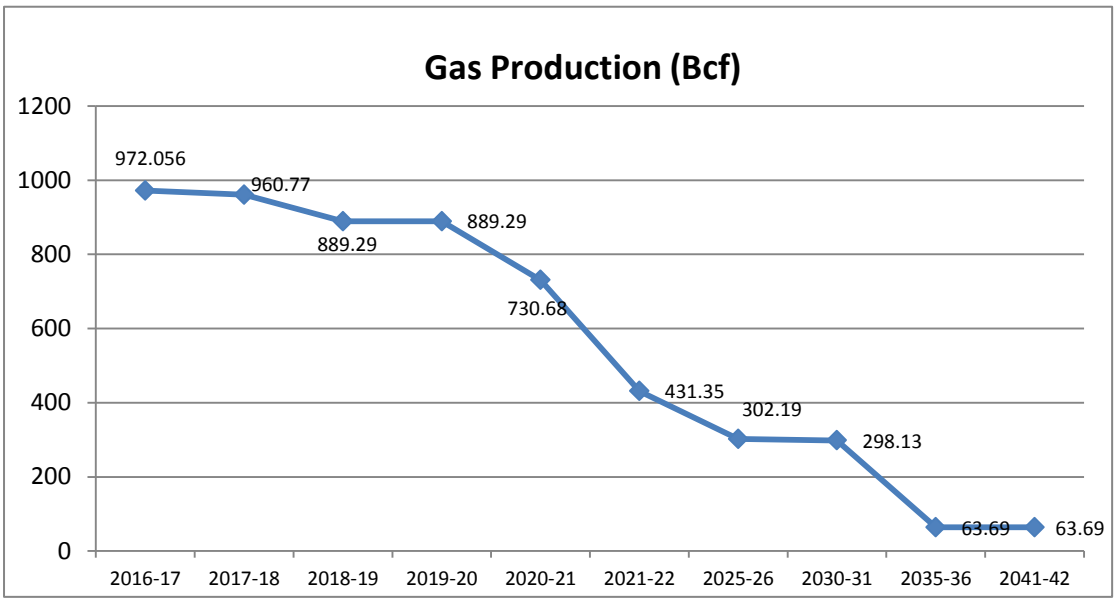


Table 4: Production per well and Production-Reserve Ratio

	No of well	Total 2P-Recoverable	2017-18 production	Production per well mmcf	Production reserve ratio
Titas	26	7582	195.42	7516.15	0.026
Habiganj	7	2787	79.9	11414.29	0.029
Kamta	0	50	0	0.00	0.000
Bakhrabad	6	1387	12.02	2003.33	0.009
Narshingdi	2	345	10.02	5010.00	0.029
Meghna	1	101	4.62	4620.00	0.046
Feni	0	130	0	0.00	0.000
Kailas Tila	4	2880	22.96	5740.00	0.008
Sylhet	1	408	1.79	1790.00	0.004
Rashidpur	5	3134	19.51	3902.00	0.006
Chattak	0	474	0	0.00	0.000
Beani Bazar	2	137	3.5	1750.00	0.026
Shahbazpur	3	261	15.26	5086.67	0.058
Semutang	2	318	0.46	230.00	0.001
Fenchuganj	2	329	4.7	2350.00	0.014
Saldanadi	1	275	1.06	1060.00	0.004
Sundalpur	1	50.2	0.94	940.00	0.019
Srikail	3	161	12.93	4310.00	0.080
Jalalabad	7	1346	92.09	13155.71	0.068
Moulavi Bazar	6	494	12.34	2056.67	0.025
Bibiyana	26	4532	437.33	16820.38	0.096
Bangura	5	621	33.67	6734.00	0.054
Sangu	0	771	0	0.00	0.000
Begumganj	0	33	0	0.00	0.000
Rupganj	1	33.6	0.25	250.00	0.007
Kuutubdia	0	46	0	0.00	0.000
Total	111	28685.8	960.77	8655.59	0.033

Figure 5: Production per well

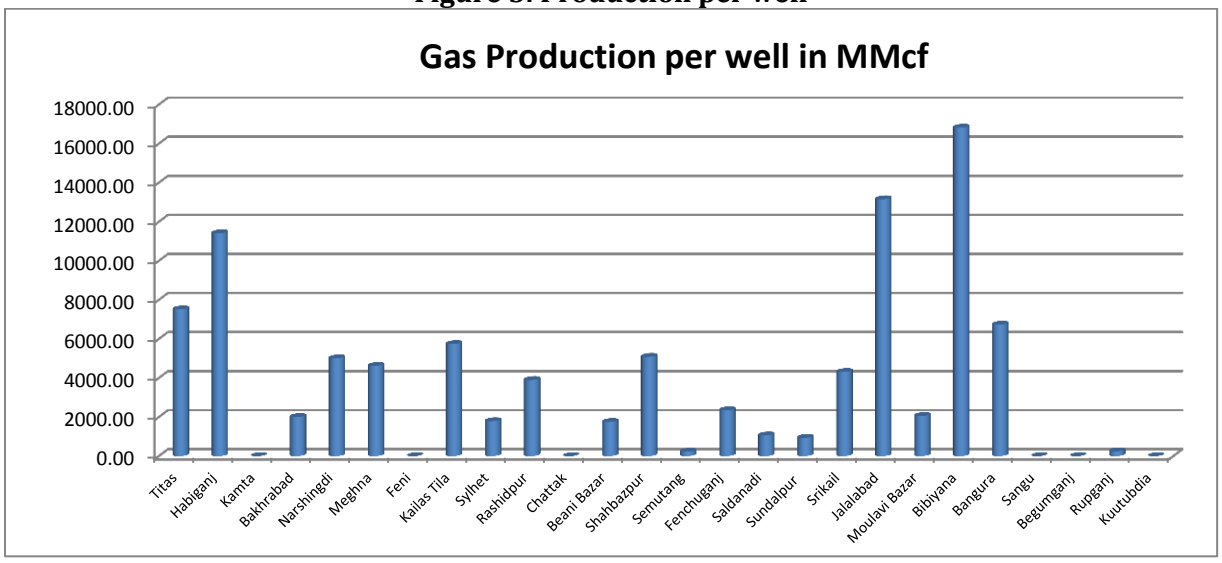


Figure 6: Well-wise gas production in 2017

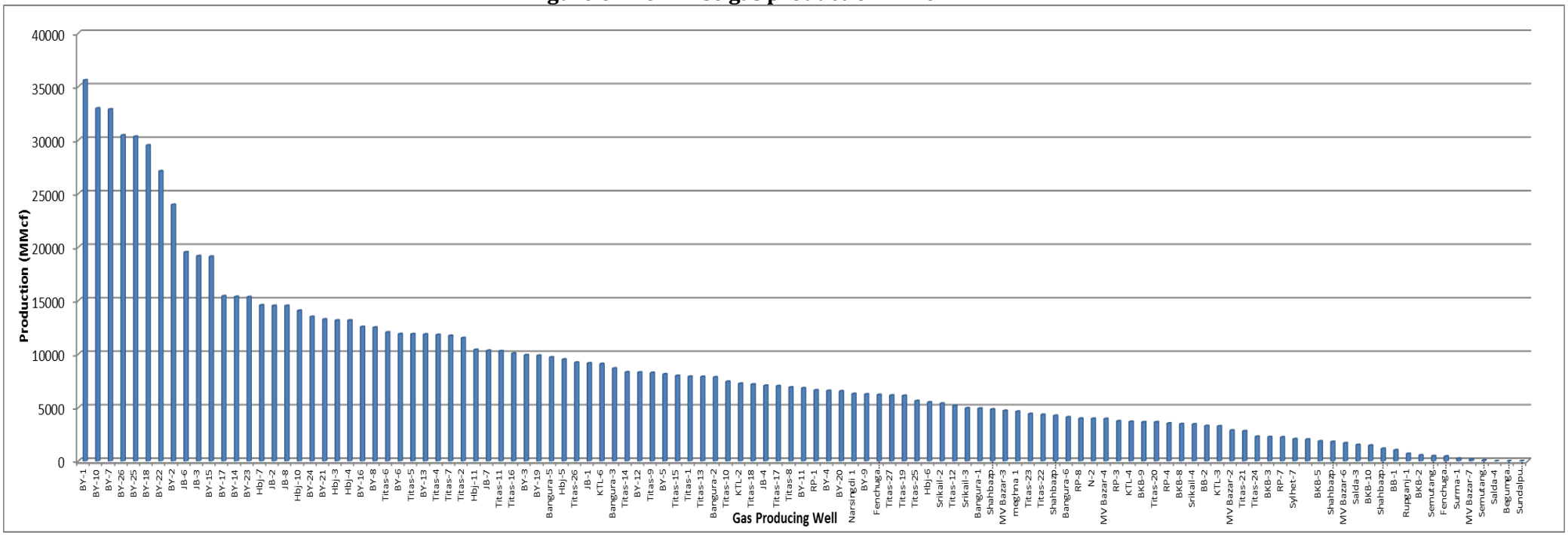


Figure 7: Produced vs remaining gas reserve for all fields

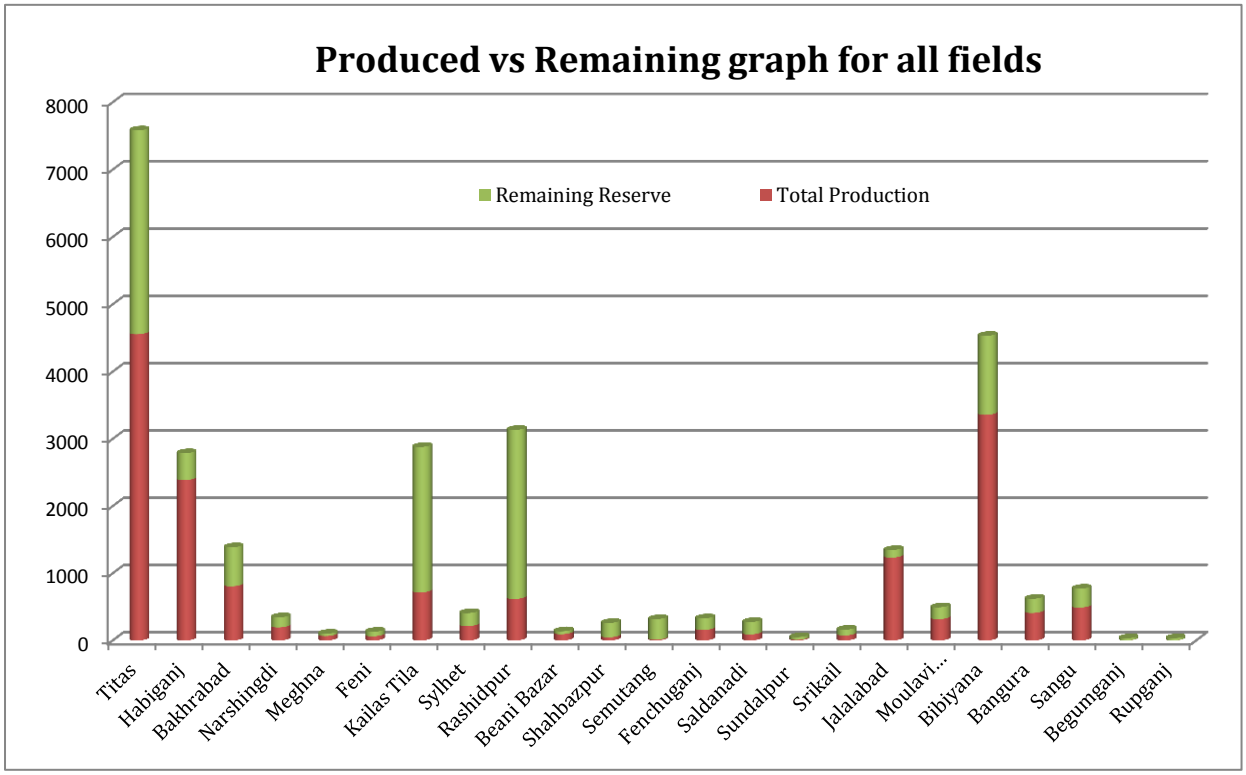
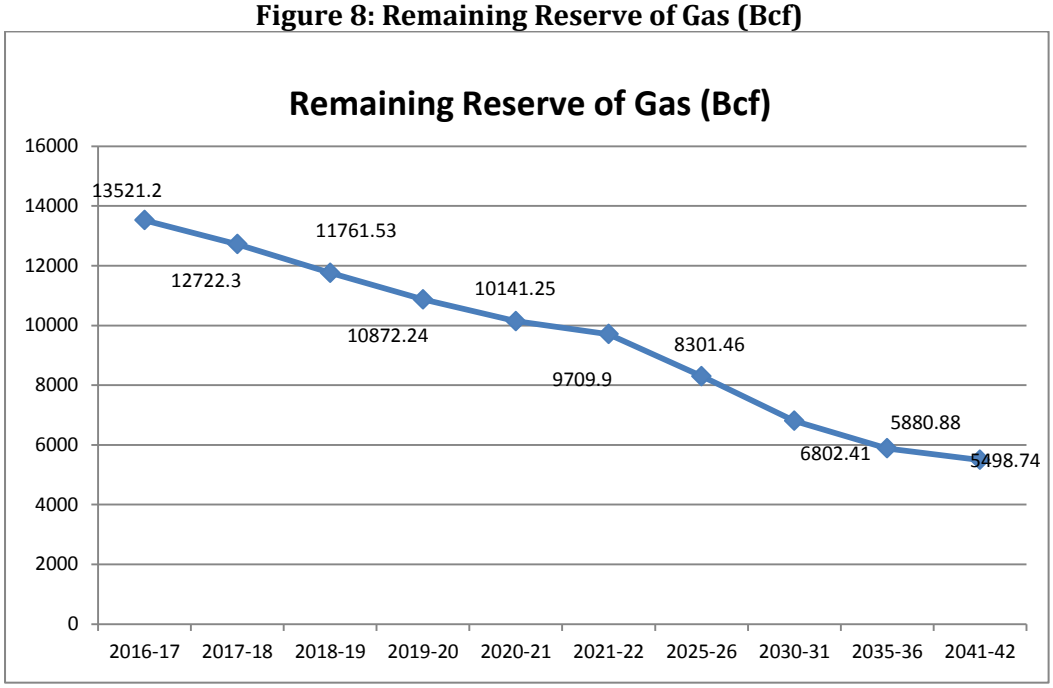


Table 5: Projection of Gas Reserve (remaining)

Gas Field	Total 2p Re-serve	Cumu-lative produc-tion	Projection of Gas Reserve (Remaining)									
			2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2025-26	2030-31	2035-36	2041-42
Titas	7582	4556.6	3220.8	3025.4	2829.98	2634.56	2439.14	2243.72	1462.04	484.94		
Habiganj	2787	2386.8	480.1	400.2	320.3	240.4	160.5	80.6				
kamta	50	21.1	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9	28.9
Bakhrabad	1387	806.9	592.1	580.1	568.08	556.06	544.04	532.02	483.94	423.84	363.74	291.62
Narshingdi	345	195	160	150	139.98	129.96	119.94	109.92	69.84	19.74		
Meghna	101	66.7	38.9	34.3	29.68	25.06	20.44	15.82	0	0		
Feni	130	63	67	67	67	67	67	67	67	67		
Kailas Tila	2880	715	2188	2165	2142.04	2119.08	2096.12	2073.16	1981.32	1866.52	1751.72	1613.96
Sylhet	408	213.5	196.3	194.5	192.71	190.92	189.13	187.34	180.18	171.23	162.28	151.54
Rashidpur	3134	618.1	2535.4	2515.9	2496.39	2476.88	2457.37	2437.86	2359.82	2262.27	2164.72	2047.66
Chattak	474	25.8	448.2	448.2	448.2	448.2	448.2	448.2	448.2	448.2	448.2	448.2
Beani Bazar	137	93.6	46.9	43.4	39.9	36.4	32.9	29.4	15.4	0		
Shahbazpur	261	47.5	228.8	213.5	198.24	182.98	167.72	152.46	91.42	15.12		
Semutang	318	12.9	305.6	305.1	304.64	304.18	303.72	303.26	301.42	299.12	296.82	294.06
Fenchuganj	329	156.1	177.6	172.9	168.2	163.5	158.8	154.1	135.3	111.8	88.3	60.1
Saldanadi	275	90.3	185.7	184.7	183.64	182.58	181.52	180.46	176.22	170.92	165.62	159.26
Sundalpur	50.2	10.7	40.4	39.5	38.56	37.62	36.68	35.74	31.98	27.28	22.58	16.94
Srikail	161	75.1	98.9	85.9	72.97	60.04	47.11	34.18	0			
Jalalabad	1346	1233.3	42.8	112.7	20.61	0	0		0			
Moulavi Bazar	494	317.3	189.1	176.7	164.36	152.02	139.68	127.34	77.98	16.28		
Bibiyana	4532	3357.7	1611.7	1174.3	736.97	299.64	0		0			
Bangura	621	409.4	245.2	211.6	177.93	144.26	110.59	76.92	0			
Sangu	771	489.5	281.5	281.5	281.5	281.5	281.5	281.5	281.5	281.5	281.5	281.5
Begumganj	33	0.9	32.1	32.1	32.1	32.1	32.1	32.1	32.1	32.1	32.1	32.1
Rupganj	33.6	0.7	33.2	32.9	32.65	32.4	32.15	31.9	30.9	29.65	28.4	26.9
Kutubdia	46	0	46	46	46	46	46	46	46	46	46	46
Total	28685.8	15963.5	13521.2	12722.3	11761.53	10872.24	10141.25	9709.9	8301.46	6802.41	5880.88	5498.74
			Already consumed		**will be produced and depleted at the current rate of Production**							

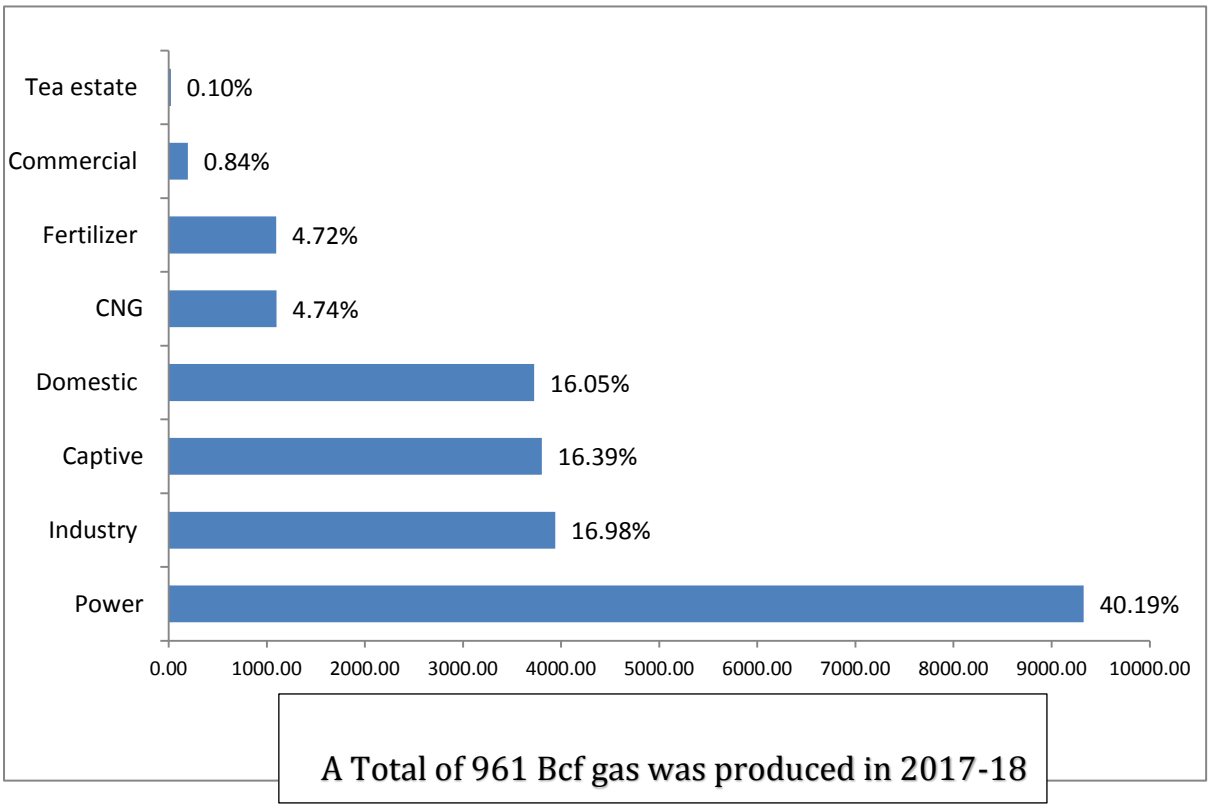
Figure 8: Remaining Reserve of Gas (Bcf)



3.3 Natural Gas Consumption

The current average production of natural gas is about 2633 MMcfd. A total 961 billion cubic feet (BCF) of natural gas was produced in 2017-18 which was used by power- 40%, fertilizer-5%, captive power-16%, industry-17%, domestic-16%, CNG - 5% and others very small amount. Natural gas accounts for the 66% grid electricity generation while all the 7 urea fertilizer factories are dependent on natural gas for feedstock. Natural gas has made tremendous contribution towards industrial growth in the country as fuel for heating and captive power generation at very favorable price. While the whole nation has been benefitted by this resource, about 7% of the populations have directly been benefitted by using piped natural gas for household purposes. Compressed National Gas is being used as automobile fuel by about 250,000 motor vehicles in the country. Expansion of CNG facilities early last decade dramatically improved air quality in large cities especially in the capital Dhaka as well as lot amount of foreign exchange has been saved due to less amount of oil import.

Figure 9: Sector wise Gas Consumption in Bangladesh (2017-18)



3.4 Natural Gas Demand

Being almost single indigenous sources of commercial energy demand for natural gas experienced vary fast growth over the last three decades often outstripping the supply. Present demand for gas in the country is about 3649 MMscfd whereas supply is 2650-2750 MMscfd indicating a shortage of about 1000 MMscfd. It is estimated that demand for natural gas will rise to about 8000 MMscfd by the 2030. Natural gas demand projection in the country is shown in the figure below:

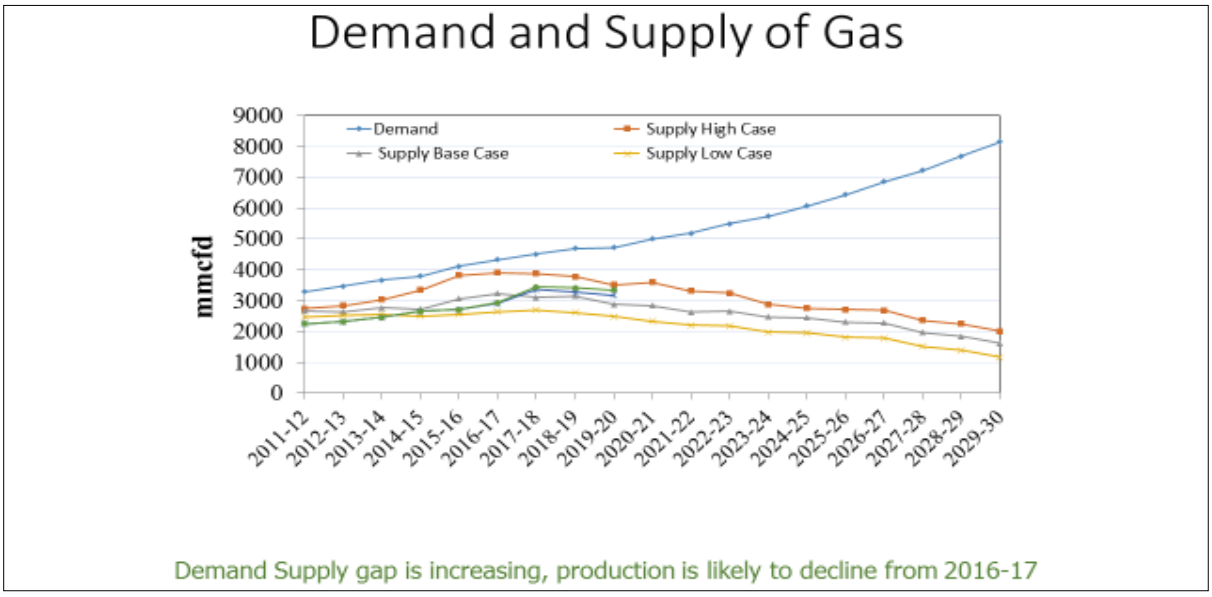


Figure 10: Demand and Supply of Gas in Bangladesh (2011 – 2030) ***source: PSMP 2016***

3.5 LNG import to Supplement Indigenous Supply

- Currently, daily 500 mmcf re-gasified LNG is added to the national grid through installing floating LNG terminal by Excelerate Energy, Singapore at Maheshkhali in Cox's Bazar district.
- SUMMIT LNG Terminal Co. (Pvt) Ltd. has signed the Agreement (BOOT) to set up FSRU at Maheshkhali in Cox's Bazar district with a capacity of supplying daily 500 mmcf re-gasified LNG. More 500 mmcfd re-gasified LNG will be added to the national grid by January 2019.
- The agreement (G to G basis) to buy LNG from Qatar has been signed with RasGas, a state-owned company for a contract period of 15 years.

- 30 organizations have been shortlisted for the purchase of LNG from Spot Market. It is expected that the final Master Sales Purchase Agreement (MSPA) will be signed with these companies soon.
- 2 Land Based LNG Terminal installation projects are underway at Maheshkhali and Kutubdia, each with a capacity of 1000 mmcfd.

3.6 Exploration Activities

The exploration activities in Bangladesh are mostly limited to eastern folded belt and surrounding areas. On the basis of previous geo-scientific study, it seems that the middle part of the country geologically know as Bengal Fore deep and Eocene shelfal region popularly known as Hinge Zone also have high Potential for hydrocarbon exploration. The objective of 2D seismic survey is to explore remaining potential of the Bengal Foredeep hydrocarbon- geological province in the least explored part of the country. In this regard, two projects on 2D seismic survey being financed by the Gas Development Fund have been approved by the Govt. Besides, with a view to identify new locations for drilling well in the exploration gas fields of structures for mitigating the ever- growing crisis of gas , 3D seismic data were gathered during 2017-2018 field-season over Fenchuganj and Rupganj gas fields. Moreover a joint study with mitsui Oil Exploration Company Ltd. (MOECO), Japan and BAPEX for interpretation of 20 possible leads and prospects in block 8 & 11.

2D seismic Survey Activities: The work programs for carrying out 3600 Line Km of 2D seismic survey have been approved the authority. Areas to over are Khulna and Bagerhat as well as Dhaka, Manikganj, Kishorganj, Narayanganj, Comilla, Faridpur, Gopalganj, Shariatpur, Madaripur, Narail, Netrakona, Kishorganj, Tangail, Gazipur, Jamalpur, Sherpur, Mymensingh and Bagura, of the exploration blocks 2B, 3B, Feni, Chittagong and Khagrachari of exploration

blocks 10, 12, 13, 14 and 15. Seismic data already been collected from the target 3600 Km. About 8-9 prospective leads/prospects have been identified and well proposals have been recommended.

Under the 2D Seismic Survey over Exploration Block 3B, 6B & 7 Project of BAPEX, a total of about 2226 LKm 2D seismic data have been acquired by hired international seismic survey contractor during the field season 2017-2018 in Dhaka, Gazipur, Narayangonj, Munshigonj, Tangail, Rajbari, Faridpur, Shariatpur, Madaripur, Gopalganj, Barisal, Pirojpur, Jhalokhati, Patuakhali, Barguna, Bhola and Bagerhat areas under exploration block 3B, 6B & 7. After thorough investigation 20 potential seismic lead have been identified which demands extensive exploration activities to keep up the growing demand of natural gas for the last growing economic development of the country.

Under the 'Vision 2021' BAPEX has proposed 19 exploratory wells to be drilled under exploration Block-B & Block- 11. In order to accelerate oil and gas exploration activities, BAPEX is expected to find new resource in these areas by conducting highest quality 2D seismic exploration. From the fiscal year 2017-18, a project tilted "Rupkalpa-9: 2D Seismic Project" has been approved by the Energy & Mineral Resources Division in the period of April, 2017 to June, 2019 to conduct 3000 LKm 2D seismic survey financed by gas development Fund (GDF) under Petrobangla. This project has been designed to finalize the Proposed exploratory well location under vision 2021 by conducting regional to semi detail/close gird 2D seismic survey. The Project area includes Kishoreganj, Narsingdi, Gazipur, Tangail, Jamalpur, Sherpur, Mymensingh, Netrakona and Sunamganj districts. During FY 2017-2018, 810 LKm seismic survey has been completed. Processing of acquired data is going on.

3D Seismic Survey: With a view to meeting the growing gas demand of the country and demarcate new well locations in the discovered gas fields or hydrocarbon prolific structures, a project titles "3D Seismic Project of BAPEX" has been approved by the Energy & Mineral Resources Division for the duration of December, 2012 to November, 2019 with an estimated cost of 247.70 crore BDT financed from the Gas Development Fund (GDF). A work plan has been undertaken to acquire 3D seismic data over 2700 sq. km. area of Sunetra, Srikail, Sundalpur-Begumganj, Shahabazpur, Narsingdi, Mubarakpur, Rupganj, Fenchuganj and Semutang gas fields or structures. Data from a total of 500 sq. km. area gas been collected during 2017-2018 field season that includes 300 sq. km. area has been accomplished under this project so far. 3D seismic data interpretation of fenchuganj Gas Field and data processing of Rupganj gas field area is in progress.

As per the Government directives during this fiscal, two wells were drilled by Gazprom and two wells were drilled as five workover by BAPEX using its own rigs and crew.

Drilling Activities

Shahbazpur East-1 Exploratory Well: Under Rupkalpa-4 Drilling Project and a drilling contractor agreement concluded between BAPEX and Gazprom, the drilling operation of Shahbazpur East-1 well was started on 21 August 2017 and was completed on 18 October 2017. The well has been drilled as per the location and design given by BAPEX. About 25 mmcfd gas is ready to be supplied.

Bhola North-1 Exploratory Well: Under Rupkalpa-4 Drilling Project and a drilling contractor agreement concluded between BAPEX and Gazprom, the drilling operation of Bhola North-1 well was started on 9 December 2017 and was completed on 23 January 2018. The well has been drilled as per the location and design given by BAPEX. About 25-30 mmcfd gas is ready to be produced.

Salda North Exploratory well: Under the Rupkalpa-1 Drilling Project, the drilling operation of Salda North-1 well was started 11 May 2018 using Bijoy-10 (ZJ70DBS) Rig. The drilling ended up at 2815 metre depth.

Kasba-1 Exploratory Well: Under the Rupkalpa-3 Drilling Project, the drilling operation of kasba-1 well started 27 April 2018 using ZJ50DBS Rig. The drilling was terminated at 2975 metre depth.

Workover Activities

Shahbazpur-1 Workover: Under the Rupkalpa-4 Drilling Project, the workover operation of Shahbazpur-1 well started was on 10 January 2018 IPS Card Garder Denver rig and was complete on 26 May 2018. About 25 mmcfd gas produced here to ass to the national grid.

Begumganj-3 Workover: Under the Rupkalpa-5 Project, the workover operation of Begumganj-3 well was started on 13 March using IDECO rig and was completed on 23 June 2018. About 14 mmcfd gas produced here to add to the national grid.

Habiganj-1 Workover: Under the agreement concluded between BAPEX & BGFCL, the workover operation of Habiganj-1 was started on 7 May 2018 using Bijoy-11 (ZJ40DBT) rig and was completed on 31 June 2018. About 15 mmcfd gas produced her to add to the national grid.

Titas-15 Workover: Under the agreement concluded between BAPEX & BGFCL, the workover operation of Titas-15 started 19 November 2017 using IDECO Rig and completed on

6 December 2017 on completing the well. About 15 mmcfd gas produced has been added to the national grid.

Kailashtila-1 Workover: After commissioning of the newly procured 650 HP (XJ650T) workover rig under Rupkalpa-10 Project, workover operation of Kailashtila-1 has been successfully carried out.

3.7 Exploration of Unconventional form of energy

Exploration of different form of Unconventional energy like Coal Bed Methane (CBM), Shale gas, Underground Coal Gasification (UCG) is going on in search of alternate energy.

Petrobangla has undertaken a project to assess the potentiality of coal bed methane in Jamalganj coal deposit, the largest and deepest coal deposit in the country.

A Preliminary Study on Shale Gas Potentiality in Bangladesh has been prepared by the Hydrocarbon Unit. Hydrocarbon Unit has prepared another report titled "Action Plan and Guide lines for CBM, UCG and Hard Rock Development in Bangladesh".

4.0 Oil (Petroleum) Sector

4.1 Organizational Structure

Bangladesh Petroleum Corporation under the Energy & Mineral Resources Division of the government is the nodal organization in the petroleum sectors which deals with import of crude oil and products, oil refining and marketing finished petroleum products. One refining company with lone crude oil refinery in Chittagong is engaged in refining of crude oil while four oil marketing companies are responsible for marketing of finished products across the country. Oil business used to be government monopoly until 1997 when one private company entered in fractionation of gas condensate extracted from gas fields. Presently, gas condensates, are fractionated by small scale fractionation plants of Petrobangla, BPC and private entrepreneurs. Besides, there two petrochemical plants in the private sector that imported condensate as feed.

4.2 Supply and Consumption of Oil

Petroleum products viz. diesel, petrol, octane furnace oil etc., account for about 22% commercial energy supply in the country. Liquid fuel used in Bangladesh is mostly imported. Locally produced gas condensate shares only 6% of total liquid fuel consumption. Bangladesh imports about 1.2 million metric tons of crude oil along with 5.5 million metric tons (approx.) of refined petroleum products per annum. About 4319 thousand BBL per year locally produced gas condensate, which is fractionated mainly into petrol, diesel and kerosene, is the only domes-

tic source of liquid fuel. Major consumer of liquid fuel is transport followed by power, agriculture, industry and commercial sectors. Sector-wise consumption of petroleum products are: transport-49.40%, power-26.94%, agriculture 15.70%, industry4.86%, domestic-2.26% and others 0.85% .

Table 6: Petroleum Sector at a Glance (2017-18)

Total Consumption of POL	69.48 Lac MT.
Import of Refined Oil	55.42 Lac MT.
Import of Crude Oil	11.73 Lac MT.
Import of Furnace Oil	13.99 Lac MT
Export of Naphtha	18,584 MT.
Total Storage Capacity	12.21 Lac MT
Domestic Production of LPG	15,936 MT
Production of LPG Under Private	5,37,686 MT
Demand of POL in FY 2018-19	76 Lac MT

Table 7: Sale of Petroleum Products during last 7 Year

Quantity in MT

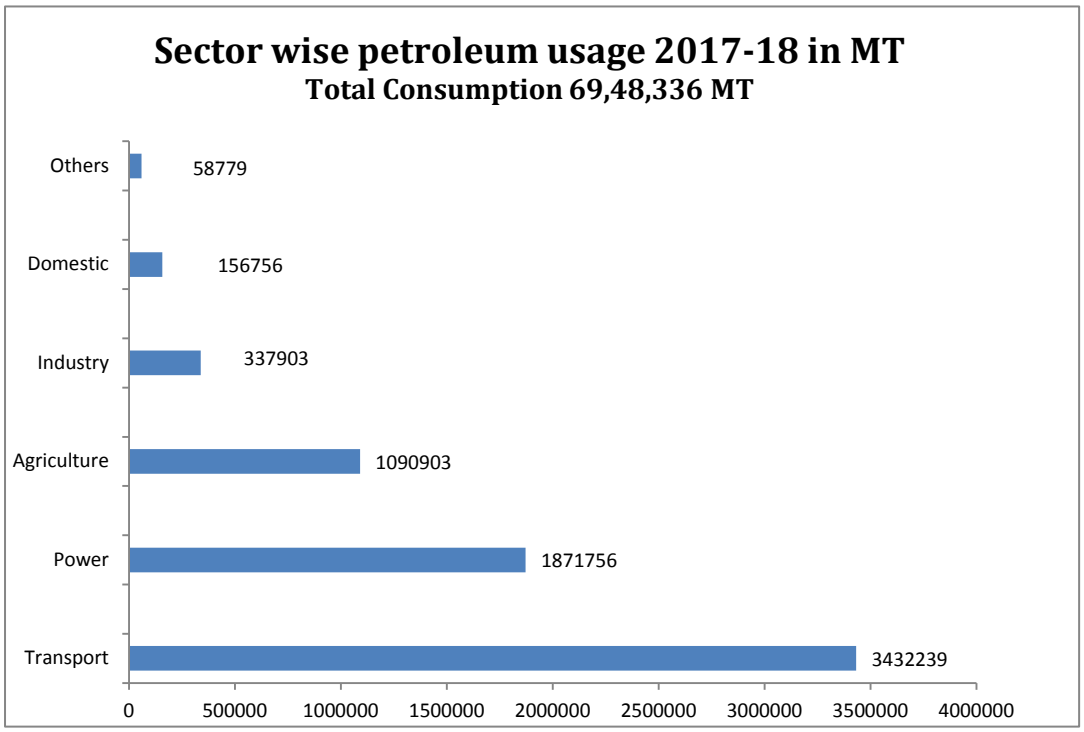
Products	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2017-18	2017-18
Octane	97264	107150	110850	117452	126114	147557	186911	230280
Petrol	141491	158707	169710	178674	166823	137360	232359	284668
Diesel	3239279	3240349	2962872	3242554	3396061	3606404	4000044	4835712
Kerosene	397209	358436	314450	289871	263029	213685	170993	138403
Furnace Oil	544617	883735	1070096	1202505	906771	711889	806440	925150
Jet A-1	335732	311890	318423	323327	338829	347323	376700	408272
Others	112432	153379	131591	130583	123796	91802	115283	125851
Total	**48868024**	**5213646**	**5077992**	**5484966**	**5321423**	**5256020**	**5888730**	**6948336**

Diesel is the dominant liquid fuel used in the country. Petroleum products used during last seven years are shown in the above table.

Table 8: Sector wise petroleum consumption 2017-18

Sector	Uses amount in M.T.	%
Transport	3432239	49.40%
Power	1871756	26.94%
Agriculture	1090903	15.70%
Industry	337903	4.86%
Domestic	156756	2.26%
Others	58779	0.85%
Total	**6948336**	**100%**

Figure 11: Sector wise Liquid Fuel Consumption in Bangladesh (2017-18)



4.3 Capacity Enactment Projects

Eastern Refinery Limited (ERL) installed in 1968 at Chittagong with the processing capacity of 1.5 million tons annually, now dated to around 1.3 million tons per year. A Project has taken for installation of 2nd unit of the existing refinery with annual refining capacity of 3 (three) million tons. Besides the state initiative, government allowed private entrepreneurs to establish Condensate Fractionation Plants to split Natural Gas Condensate (NGC) received from various gas fields in Bangladesh as well as imported NGC.

Total storage capacity of different grades of petroleum is around 1.08 million metric tons across the country. It may be mentioned that, according to the national energy policy, 60 days stock of petroleum products to be maintained for energy security of the country. But at present BPC is able to maintain 35 to 40 days stock of petroleum products due to lack of storage capacity as well as involvement of huge amount money for procuring petroleum. BPC has taken a project for construction of **Mongla Oil Installation** as 2nd main installation to enhance 0.10 million metric tons with 14 oil storage tanks.

Single Point Mooring (SPM) project is now in progress which will enable BPC to receive Crude Oil and Diesel from large size vessels of 120,000 metric tons carrying capacity through subsea pipeline, from near Kutubdia of the Bay of Bengal, within 48 hours instead of present required time of 9/10 days. Storage facility will be constructed of 0.24 million metric tons, for crude oil 0.15 million metric tons and for diesel 0.09 million tons, at Maheshkhali under SPM

Project for smoothing receiving of petroleum. Operational flexibility will improve amazingly after completion of the SPM project.

4.4 Demand for Petroleum Products

Demand for petroleum products is growing at the rate of 2 to 4% per year. If this trend continues demand for oil will increase to about 10 million tons by the year 2030. Government of Bangladesh has decided to make road connectivity with the neighboring countries like India, Nepal, Bhutan etc. Transport movement will increase remarkably in Bangladesh territory to avail port facilities Chittagong and Mongla ports by our neighbors. However, future demand will depend upon the future energy mix in the country and availability of other fuels.

4.5 Source Countries for Imported Oils

ADNOC Of UAE and Saudi Aramco of Saudi Arabia are suppliers for crude that BPC imports while finished products are imported from 13 National Oil Companies (NOC) of different countries. A project is in active consideration by the government to import diesel, produced in Numaligarh Refinery Limited (NRL) in Assam, from its marketing terminal at Shiliguri through pipeline to Parbatipur depot at Dinajpur district of Bangladesh.

5.0 Liquefied Petroleum Gas (LPG)

Demand of Liquefied Petroleum Gas (LPG) in Bangladesh is very high. In the public sector 15,936 MT of LPG are bottling every year, out of which 10000 MT is obtained as byproduct from processing of crude oil in Eastern Refinery and 6000 MT from is extracted from natural gas in Kailashtila gas field. LPG is imported by only private sector. Around 537,686 MT of LPG is imported and marketed by private sector entrepreneurs every year. So public and private sector combining do the marketing of 553,622 MT of LPG every year, which is meeting a certain portion of LPG demand of the country. Considering the rising demand for LPG, government has decided to enhance LPG bottling facilities for marketing more imported LPG. For this purpose, two LPG bottling plants, each having capacity of 100 thousands MT per annum, will be set up in the coastal area. Of them, one plant will be installed by Bangladesh Petroleum Corporation (BPC) and the in public private partnership with BPC.

Table 9: LPG scenario of last 4 year

Year	Public Sector Production MT	Import (Private) MT	Total MT
2014-15	17,574	110,000	127,574
2015-16	14,000	172,792	186,792
2017-18	16,382	307,000	323,382
2017-18	15,936	537,686	553,622

6.0 Coal

In Bangladesh, the reserve of coal (Bituminous Coal) is about 31,00 million tones which is equivalent to 85 Tcf gas in 5 coal fields so far discovered, namely Barapukuria, Khalaspir, Phulbari, Jamalganj and Dighipara. If initiatives are taken for exploration all over the country, there are enough possibilities to discover more coal mines. Out of the discovered mines, coal from 4 deposits (118-509 meters) is extractable at present. Production from Jamalganj may not be viable with present day's technology due to the depth of the deposits.

Table 10: Coal Fields of Bangladesh

Place/Field (Discovery Year)	**Depth (Meter)**	**Area (Sq.Km)**	**Reserve (Million Ton)**	**Depth (Meter)**	**Calorific Value (BTU/lb)**
Barapukuria, Dinajpur (1985)	119-506	6.68	390	119-506	11,040
Khalaspir, Rangpur (1995)	257-483	12.00	523	257-483	12,700
Phulbari, Dinajpur (1997)	150-240	30.00	572	150-240	11,900
Jamalganj, Jaipurhat (1965)	900-1000	16.00	1,054	900-1000	11,000
Dighipara, Dinajpur (1995)	327	15.00	600	327	13,090
			Total = 3139		

Coal resources can be alternative source of fuel to natural gas. These coals can conveniently serve the energy needs of Bangladesh for 50 years. It is notable that the coal of Bangladesh is considered to be high quality in terms of its high level of heat generation capacity as well as low sulphur content.

Table 11: Coal scenario of last 4 year

Year	Public Sector Production	Import (Private)	Total
2014-15	675,775.50	1,812,030	2,487,806
2015-16	1,021,638	3,812,060	4,833,698
2017-18	1,160,657.81	2,801,407	3,962,065
2017-18	923,276.00	3,394,534.24	4,317,810

Commercial production of Barapukuria Coal Mine commenced from 10 September 2005 using underground mining method with the targeted capacity of one million metric ton per year. Almost 65% of the production is being used by 250 MW (2x 125 MW) Coal fired power station operated by Power Development Board of Bangladesh near Barapukuria coal mine. Remaining 35% coal is being used in brick fields and other domestic purposes which have an impact of reducing deforestation. A total of 67.50 lakh metric ton of coal has been extracted from its inception up to June 2018. At present Barapukuria Coal Mine is producing at an average – 2500-3000 MT coal per day.

7.0 Peat

The peat deposits of Bangladesh are located in the low lying areas of the alluvial plain which are generally submerged under water for a large period each year. Peat occurs in Baghia-Chanda beel under Madaripur and Gopalganj district, Kola Mouza of Khulna district, Chatal beel area of Moulavibazar district, Pagla, Dirai and Shalla area of Sunamganj district, Chorkai area of Sylhet district, Brahmanbaria Sadar upazila of Brahmanbaria district and Mukundapur area of Habiganj district. It has a carbon content of 50-60% and has a calorific value between 5500 Btu/lb and 7000 Btu/lb. The peat occurs at the surface or at shallow depths below the surface. The total peat reserve (dry peat) discovered in Bangladesh is 146.36 million ton. There is no commercial utilization of peat in Bangladesh at present. Peat can be conveniently used in the form of briquette, ovoid and compressed tablets as an alternative fuel to household work, in brick and lime industries and in small capacity thermal power plant (10 MW) in rural areas. Three exploration licenses of peat is granted in Rajoir Upazila of Madaripur and Kotalipara Upazila of Gopalganj district.

8.0 Condensate and Natural Gas Liquids (NGL)

Some of the gas fields located in north - eastern part of Bangladesh contains high percentage of liquid hydrocarbon. Extraction of this liquid, especially value added by-products, is becoming a growing activity. Apart from the condensate fractionation plant installed in different gas fields, Rashidpur Condensate Fractionation Plant with a capacity of 3750 bbl/day is

producing petrol, diesel and kerosene by fractioning the condensate received from Bibiyana Gas Field. During 2017-18, a total of 514,046 barrels of condensate was produced by SGFL, BGFCL and BAPEX and 3,805,245 barrels by IOCs as a by-product of gas. During the same period, SGFL extracted 24,720,000 liter or 155,484 barrels of NGL from the gas processed at its Mole-Sieve Turbo Expander plant at Kailashtila. On the other hand, a total of 860,742 barrels of petrol, 353,104 barrels of diesel and 79,799 barrels of kerosene was produced by fractionating the condensate at the fractionation plants located at different fields of SGFL, BGFCL and RPGCL.

9.0 Power Sub-Sector

9.1 Primary Energy Mix for Power Generation

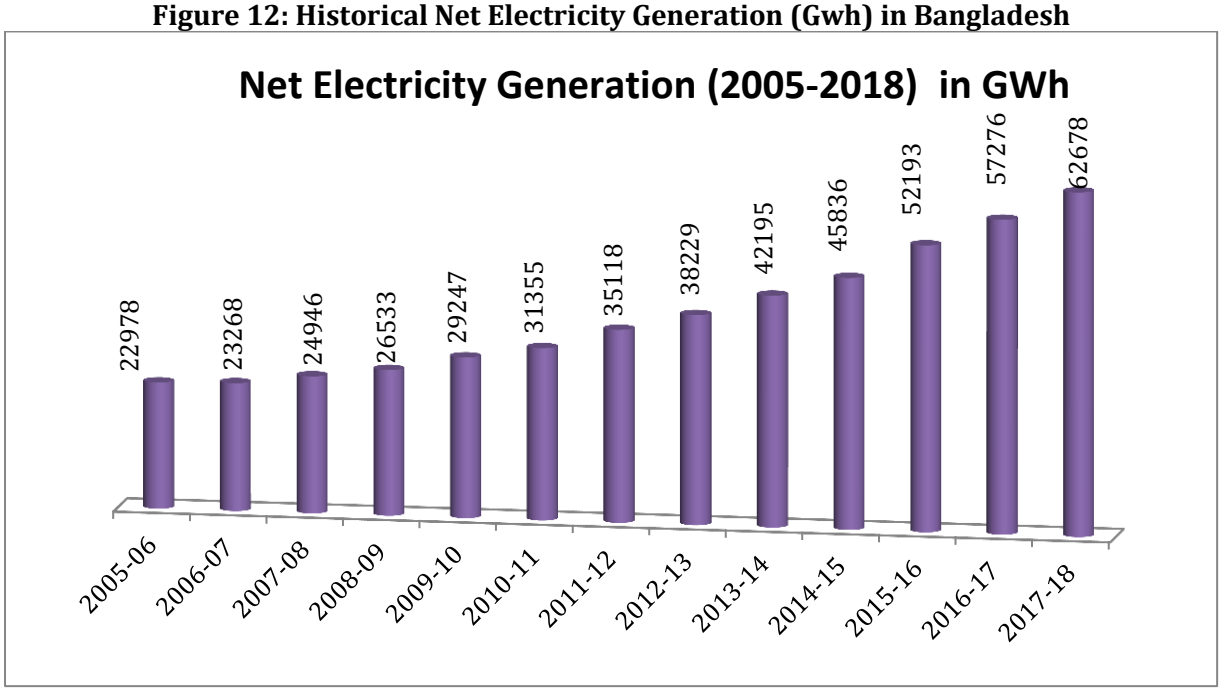
As of June 2018 the total power generation capacity combining public and private sector was 18753 MW, leaving 20% capacity for maintenance and forced outage, available generation capacity should be about 15000 MW without fuel constraint. Maximum generation actually obtained till 30 June 2018 was 10958 MW, which was less than 15000 MW. It might have occurred due to fuel supply constraint. Of the total generation capacity, distribution between public sector and private sector entities are 52% and 43% respectively and from import 5%. Bangladesh has started importing 500MW electricity from India (started in October 2013) additional 100 MW from March'16 which contributed 7% of total power generation.

Table 12: Bangladesh's Power Sector: At a Glance (2017-18)

Electricity Growth	19.02%
Installed Capacity (MW)	18753
Maximum Generation (MW)	10958 (28th May 2018)
Total Consumers (in Millions)	30.30
Transmission Lines (km)	11122
Distribution Lines (km)	457000
Per Capita Generation (including Captive)	464 Kwh
Access to Electricity (including Off-Grid Renewable)	90%

The composition of primary energy mix for power generation in FY 17-18 is shown in Figure 8. Of the total electricity generated in 2017-18, 68% was generated from domestic fuels (natural gas, coal & hydro) and 24% from imported petroleum fuels (diesel and furnace oil) and 8% was electricity Import from India as cross border energy trade.

Figure 12: Historical Net Electricity Generation (Gwh) in Bangladesh



Total Net Electricity Generation (2017-18): 62678 Gwh

Figure 13: Power Generation by Fuel Type (2017-18)

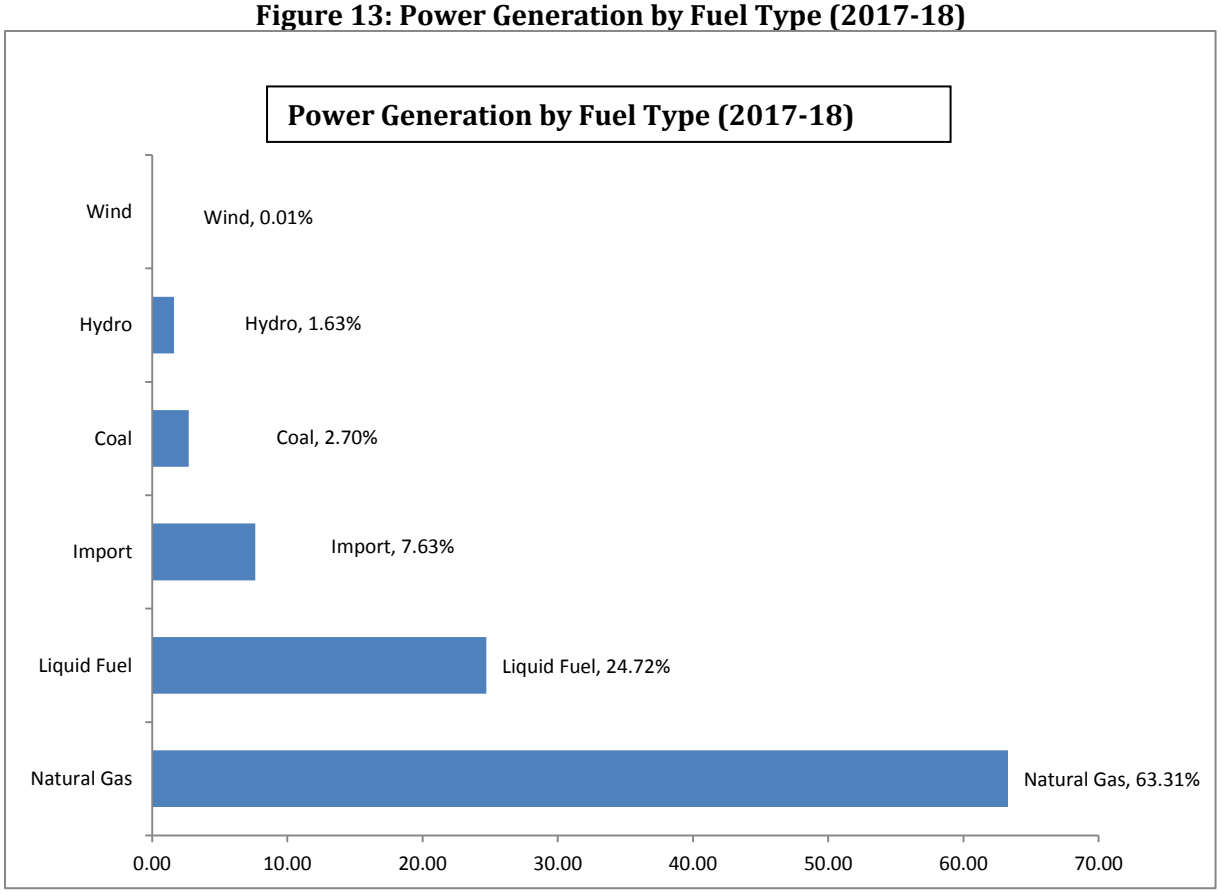
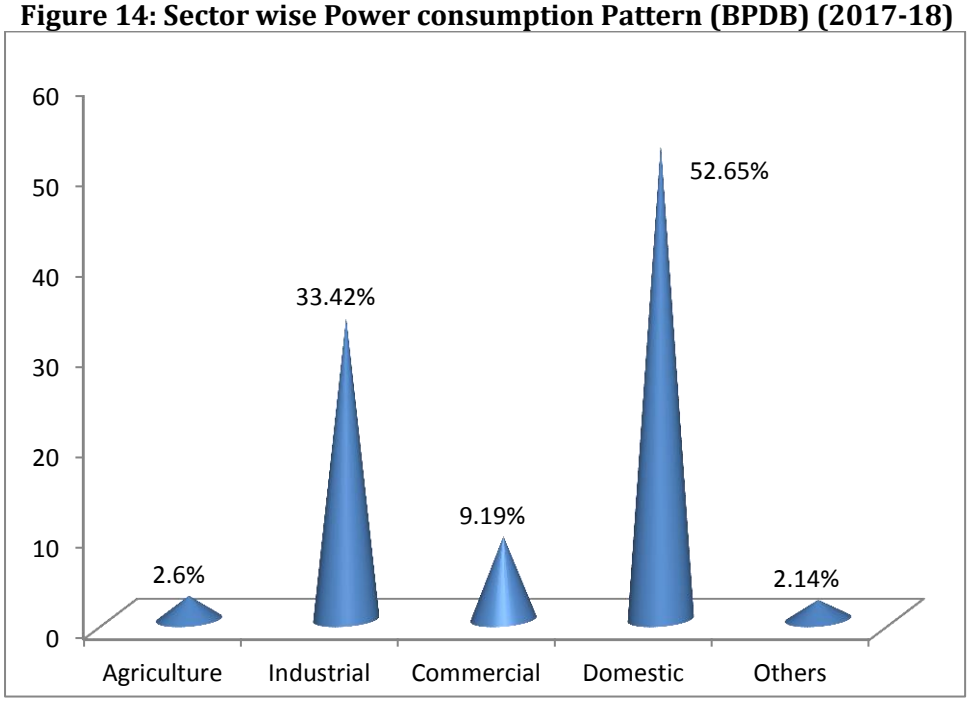


Figure 14: Sector wise Power consumption Pattern (BPDB) (2017-18)



9.2 Electricity Import

Bangladesh has entered into the era of cross border energy trade in October 2013 by importing electricity from India. Additional 100 MW from March 2016 from Tripura At present 600 MW electricity is being importing from India and in near future it will increase considerably.

10.0 Renewable Energy Resources

Renewable energy resources could assist in the energy security of Bangladesh and could help reduce the natural gas demand. Regions of the country without supply or access to natural gas or the electric grid use biomass for cooking and solar power and wind for drying different grains and clothes. Biomass is currently the largest renewable energy resource in use due to its extensive noncommercial use, mainly for cooking and heating. Biomass comprises 29 percent of the total primary energy use in Bangladesh. The country has a huge potential for generating solar power. Moreover the use of renewable energy has become popular worldwide in view of the depleting reserves of non-renewable fossil fuels. Renewable energy is environmentally friendly.

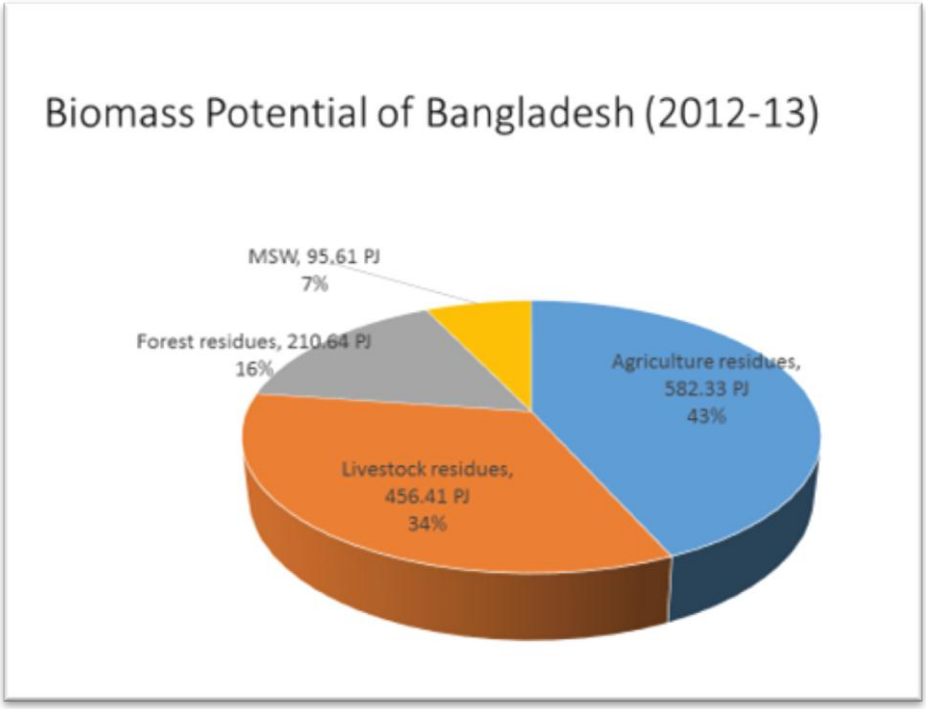
Renewable energy resources used in Bangladesh may be classified into three major types- (i) traditional biomass fuels, (ii) conventional hydropower, (iii) new-renewable resources (e.g. solar PV, wind, biogas etc.) of energy.

10.1 Traditional Biomass fuels

In Bangladesh, three major types of biomass fuel resources are in use: wood fuels, agricultural residues and animal dung. Wood fuels are obtained from different types of forests and tree resources grown in rural areas. Agricultural residues and animal dung contribute a substantial portion of biomass fuel in Bangladesh. A part of the total agricultural residues available during harvesting of crops and a part of total animal dung produced by animal resources are used as fuel. Availability of these resources (agricultural residues, animal dung) as fuel depends on local situation and socio-economic condition of the owners.

Converting biomass into more energy efficient fuel is a means of upgrading the rural energy consumption pattern. Biogas is very suitable for cooking and lighting (Mantel/Hazak) and for running a small generator to produce electricity. Throughout Bangladesh, there are currently about 80,000 households and village-level biogas plants in place. Around 50,000 domestic biogas plants already installed by IDCOL. There is a real potential for harnessing basic biogas technology through rural electrification, village-level biogas production, and internal combustion (or even micro turbine) power generation.

Figure 15: Biomass Potential of Bangladesh (2012 – 13)



The power generation of the country largely depends on the non-renewable (fossil fuel) energy sources, mainly on the natural gas. This trend causes rapid depletion of non-renewable energy sources. Thus, it is necessary to trim down the dependency on non-renewable energy sources and utilize the available renewable resources to meet the huge energy demand facing

the country. Most of the people living in rural, remote, coastal and isolated areas in Bangladesh have no electricity access yet. However, renewable energy resources, especially biomass can play a pivotal role to electrify those rural, remote, coastal and isolated areas in the country. Humankind has been using biomass as an energy source for thousands of years. In a study (Paul & Others) assesses the bio-energy potential, utilization and related Renewable Energy Technologies (RETs) practice in Bangladesh. Improved cooking stove, biogas plant and biomass briquetting are the major RETs commonly practiced in Bangladesh. The assessment includes the potential of agricultural residue, forest residue, animal manure and municipal solid waste. The estimated total amount of biomass resource available for energy in Bangladesh in 2012–2013 is 90.21 million tons with the annual energy potential of 45.91 million tons of coal equivalent. The recoverable amount of biomass (90.21 million tons) in 2012–2013 has an energy potential of 1344.99 PJ which is equivalent to 373.71 TWh of electricity.

10.2 Conventional Hydropower

Total hydropower potential of the country was reported as 1500 MkWh/year at Kaptai (1000MkWh/year). Matamuhury (300MkWh/year) and Sangu (200MkWh/year) (GOB 1996). In 2017-18, total generation capacity of 5 hydropower units installed at Kaptai was 230MW and electricity generated was 8934 MkWh. Depending upon rainfall, yearly electricity generation capacity of hydro plants varies between 700 MkWh to 1000 MkWh.

It was reported that a feasibility study was undertaken in 1998 to establish additional hydropower units (Nos. 6 & 7) at Kaptai with generation capacity of 100MW. There is potential to install hydropower plant at the Sangu and the Matamuhury rivers in the Chittagong Hill Tracts and possibility of constructing a second dam, six kilometers downstream of existing Kaptai dam to generate hydropower. Though in Chittagong Hill Tracts local population are already conscious about the negative impacts of existing hydropower plants at Kaptai proper rehabilitation programed should be under taken. Considering the energy scarcity of the country, the feasibility of harnessing additional electricity through conventional hydropower technologies and mini & micro hydropower technologies should be explored to meet a part of future energy needs.

10.3 New-Renewable Energy Resources

It was mentioned in the Renewable Energy Policy 2008 that 5% and 10% of total electricity would be generated using renewable energy by 2015 and 2020 respectively (GOB 2008). SREDA Act 2012 was enacted for the establishment of Sustainable & Renewable Energy Development Authority (SREDA) for promotion of efficient energy and renewable energy technology. The authority (SREDA) is in the process of institutionalization. Total generation of electricity from new-renewable energy sources (e.g. solar PV, biomass, biogas etc.) up to June 2018 was

339.80 MW. Total generation from RE including hydropower (230MW) was 569.80MW, which was 3% of total electricity generation capacity (18,753 MW) of the country including off grid, RE and Captive.

In line with the policy, government has already taken different initiatives in renewable energy development, in which some projects/programs have been completed and some are under implementation.

i. Solar Energy

Bangladesh is geographically located in a favorable position (within $20^0 34'$ to $26^0 38'$ north latitude) for harnessing sunlight, available abundantly for most of the year except for the three months June-August when it rains excessively. The amount of Solar Energy available in Bangladesh is high about 4 to 7 kWh/m2/day, enough to meet the demand of the country. There is a fast-growing acceptance of rural people to solar photovoltaic (PV) systems to provide electricity to households and small businesses in rural off grid areas. The Rural Electrification Board (REB), a government agency has been engaged in commercializing solar power electrification of domestic, commercial, irrigation in rural area. IDCOL, a government-owned entity has disseminated some SHS through its partners NGOs. Due to higher cost of its production it has to go a long way to become commercially competitive. However, in remote areas of Bangladesh it is gradually becoming popular and government has undertaken a lot of scheme to subsidize on it. Government has planned to setup solar panel with capacity of 5~10 MW.

[Solar Home System (SHS)]

Solar Home System (SHS) provides reliable power for lighting and operating low powered appliances such as radio, television, small electric fans. The electricity provided by a SHS can also be used to run Direct Current (DC) driven equipment such as DC shouldering irons, drilling machines etc. and to charge the battery of mobile phones. Larger systems can run computers, refrigerators, pumps etc. IDCOL and BREB are distributing Solar Home System (SHS) to the people living in the off-grid areas. IDCOL through different partner organization has already distributed about 55 lakh (installed capacity 250 MW) SHS and BREB distributed about 30 thousand SHS throughout the country.

[Solar Irrigation System]

Solar powered irrigation is the breakthrough technology for energy stricken agro-based economy. Solar powered irrigation is the innovative and environment friendly solution for the irrigation system, which currently depends on hugely inefficient electric and diesel pumps. Gradually replacing the electric and diesel pumps for irrigation with solar water pumps could save significant capacity of electricity and huge investment cost. Up to June'18, a 1158 nos solar irrigation pump has been installed by IDCOL.

ii. Bio fuel

Bio fuels can be produced from a variety of plants like rapeseed, mustard, corn, sunflower, canola algae, soybean, pulses, sugarcane, wheat, maize, and palm. The most popular option for producing bio-fuels is from non-edible oilseed bearing trees. The two most suitable species are:

Jamal gota (Jatropha curcas) and Verenda (RicinusCommunis). Both of these trees can grow virtually anywhere in any soil and geo- climatic condition.

Bio-fuel use is not new in Bangladesh. In the early 20th century, bio-fuel was used for lighting lamps or lanterns. In an agriculturally based country like Bangladesh, bio-fuel can be a better alternative because a 30 percent blend of bio-fuel can be used along with our diesel or petrol. This can also be an excellent fuel to kindle lamps in rural Bangladesh.

The use of bio-fuel is increasing in most European countries. Germany has thousands of filling stations supplying bio-fuel and it is cheaper than petrol or diesel. The German government declared that 5 percent of every liter of fuel must be bio-fuel by 2010.

iii. Wind Energy

Bangladesh is exploring the potential of wind power. In the coastal area of Bangladesh, windmills with a capacity of 2.9 MW are in operation. Bangladesh has had to wait for a breakthrough in wind power technology to be competitive against other conventional commercial energy sources. A pilot project to install windmills along the seashore with a capacity of 20 MW has been planned by the government. Based on the results of the pilot project, another 200 MW of power could be harnessed from wind power.

Rising fossil fuel and CO_2 prices, technological advances and economies of scale with wider deployment are expected to make renewable-based systems increasingly cost-competitive in coming decades (IEA 2011).

iv. Tidal Energy

The tides at Chittagong, south east of Bangladesh are predominantly semidiurnal with a large variation in range corresponding to the seasons, the maximum occurring during the south-west monsoon. A strong diurnal influence on the tides results in the day time tides being smaller than the night time.

In the year 1984, an attempt was made from the EEE department of BUET, Dhaka to access the possibility of tidal energy in the coastal region of Bangladesh, especially at Cox's Bazar and at the islands of Maheshkhali and Kutubdia. The average tidal range was found to be within

4-5 meter and the amplitude of the spring tide exceeds even 6 meter. From different calculation it is anticipated that there are a number of suitable sites at Cox's Bazar, Maheshkhali, Kutubdia and other places, where a permanent basin with pumping arrangements might be constructed which would be a double operation scheme. Tidal energy might be a good alternative source for Kutubdia Island where about 500 kw power could be obtained. At present there are only 2x73kVA diesel generator sets to supply electricity for 5-6 hours/day for 72,000 people and there is practically no possibility of main grid supply in the future.

v. Wave Energy

Until to now no attempt has been made by Government of Bangladesh to assess the prospects for harnessing energy from sea waves in the Bay of Bengal. Wave power could be a significant alternative source of energy in Bangladesh with favorable wave conditions especially during the period beginning from late March to early October. Waves are generally prominent and show a distinct relation with the wind. Waves generated in the Bay of Bengal and a result of the south-western wind is significant. Wave heights have been recorded by a wave rider buoy and correlated with wind data. Maximum wave heights of over 2 m, with an absolute maximum of 2.4 m, on the 29 July were recorded. The wave period varies between 3 to 4 sec for waves of about 0.5 m, and about 6 sec for waves of 2 m.

In Bangladesh wind speeds of up to 650 kmph (400mph), 221 kmph (138 mph) and 416 kmph (260 mph) have been recorded in the years 1969, 1970 and 1989 respectively. Severe cyclonic storms and storm surge of up to 15 m have been reported. Plant must also be able to survive the exceptional occurrence of very high waves in storm conditions.

vi. River Current

A network of rivers, canals, streams etc. numbering about 230 with a total length of 24140 km covers the whole of Bangladesh flowing down to the Bay of Bengal. Different sizes of boats are the main carriers of people and goods for one place to another. Boatmen usually use the water-sails to run their boasts against the wind direction. But until now no research has been reported to utilize the energy of river current properly.

vii. Waste to Electrical Energy

Dhaka City has been suffering for a long time from a tremendous environmental pollution caused by municipal solid waste, medical waste and various industrial wastes. In order to save the city from environmental pollution the waste management as well as electricity generation from the solid wastes program is being taken by the Government.

11.0 Nuclear Power

Nuclear powers is characterized by very large up-front investments, technical complexity, and significant technical, market and regulatory risks, but have very low operating costs and can deliver large amount of based load electricity while producing almost no CO_2 emissions. Typical construction times are between five and eight years from first concrete poured. Government of Bangladesh has signed a general contract with Russia on December 25, 2015 for the construction and commissioning of the country's first nuclear power plant (2*1200 MW) at Rooppur in Pabna at the cost of $12.65 billion.

Table 13: Planned Nuclear Power Reactors:

Unit	Type	Capacity	Construction start	Commercial Operation
Rooppur 1	VVER-1200/V-523	1200 MWe	Oct 2017	*2023 or 2024*
Rooppur 2	VVER-1200/V-523	1200 MWe	2018	*2024 or 2025*

All fuel for Rooppur is being provided by Rosatom, and all used fuel is to be repatriated to Russia, in line with standard Russian practice for such countries. A draft agreement on used fuel was signed in March 2017, totaling about 22.5 ton/yr from each reactor (42 fuel assemblies, each with 534 kg of fuel). A further agreement for repatriation of used fuel for reprocessing was signed in August 2017.

The Bangladesh Atomic Energy Commission (BAEC) has taken an initiative to conduct a survey in eight char areas of southern region to select one or two suitable sites to set up the country's second nuclear power plant, aiming to meet the future demand of huge electricity. The study will cover a demographic survey over a 5-km diameter, seismic stability, geological location, and power infrastructure and communication system.

12.0 Conclusion

Bangladesh is facing scarcity of energy. There is huge gap between demand and supply of energy. The gap is increasing day by day. Different initiatives have been taken to increase supply of energy. ERL expansion in underway and SPM project have been initiated. Cross boarder energy trade will get momentum, land based LNG terminal to import LNG has been commenced. New horizon has been exposed in sea after settlement of maritime boundary with Myanmar and India. Discovered Coal Fields will be developed. Coal based power production will get momentum. Successful implementation of all these activities will meet up the energy demand of the country that will help to achieve the Vision 2021, SDG's and Vision 2041 of the government.