Report

On

Energy Economics

Hydrocarbon Unit

Energy And Mineral Resources Division

Ministry of Power, Energy And Mineral Resources

Karwan Bazar, Dhaka.

November, 2015

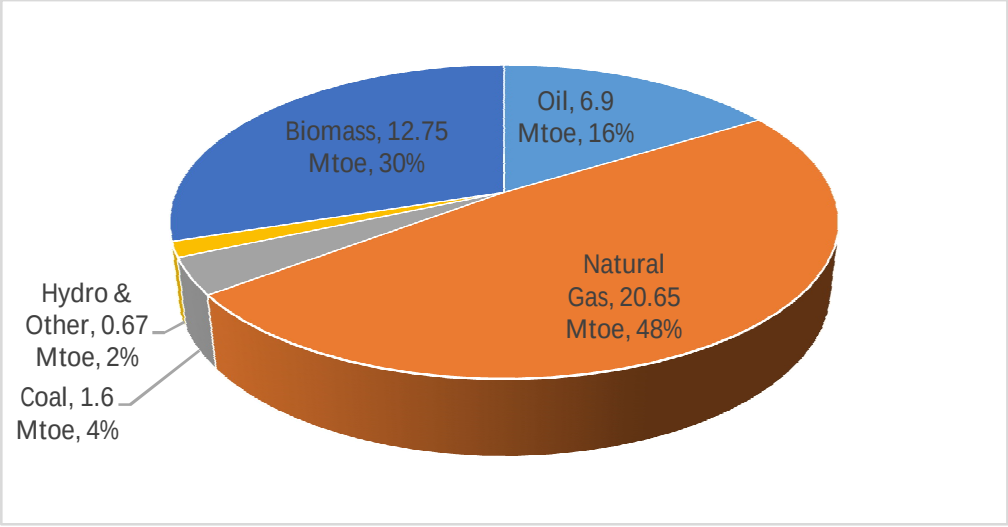
Executive Summary

The committee formed by the Energy and Mineral Resources Division has gone through the energy scenario of Bangladesh and has been compared it's situation with the energy of regional and global context. The demand and supply of energy of the country have been analyzed to realize vision 2021 turning Bangladesh into a middle income country. Recommendation on different measure to be adopted for energy conservation and efficiency have been also made.

Bangladesh is coping with a serious energy crisis which is the result of sluggish growth in energy supplies while the demand for energy has grown up reasonably toattain higher economic growth.

To realize Government vision 2021 , Planning Commission has prepared a Perspective Plan of Bangladesh (2010 – 2021) : Making Vision 2021 a Reality". As per theperspective plan by 2021 per capita income would be 2000 US$. In that respect energy assessment has been made.

Natural gas is presently the principal source of primary energy supply followed by the biomass. A share of primary energy by different fuel sources in Bangladesh is presented in the Figure 1.



Fiqure : 1 Bangladesh Energy Mix (2014 -15)

As known commercial energy resources in Bangladesh include indigenous natural gas, coal, imported oil, Imported electricity and renewable energy hydro& solar electricity. Biomass

accounts for about 30% of the primary energy and the rest 70% is being met by commercial energy.Natural gas accounts for about 69%,petroleum product contribute 23%, coal 6% and renewable energy 1% of the commercial energy.In the 2014-15 total primary energy supplied was 42.53Mtoe. The energy mix (Figure 1 &Figure 2.) is heavily dependent on domestic resource, natural gas. The reserve of which is diminishing quickly. Then petroleum product mostly of which is being imported. Contribution of coal is very less (6% only),which is the most significant to explore.

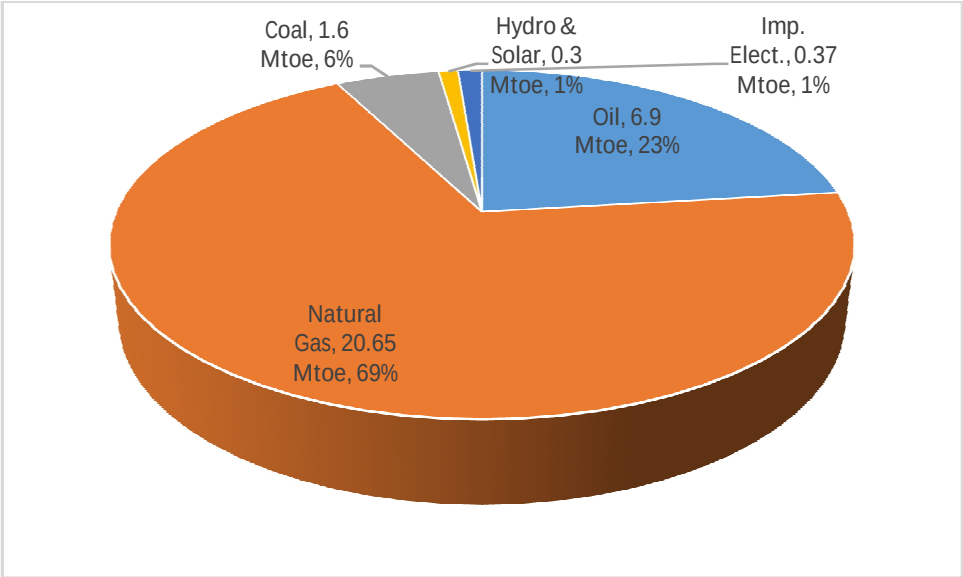


Figure 2 : Share of Commercial Energy in Bangladesh (2014 – 15)

Comparison with other country

Bangladesh is one of the less consuming primary energy country. Primary energy potential is not bad, but that should be explore. The country is facing a huge energy crisis. There is no alternative to increase primary energy supply. As per global and regional context we are far behind of energy supply vis a vis energy consumption. As per EIA data of 2012 our country's total primary energy supplied was poor (33.17 Mtoe) compare to World (13371 Mtoe), China (2909Mtoe), Australia (128.27Mtoe), India (788.13Mtoe) , Korea (263.44Mtoe), Malaysia (81.23Mtoe), Russia (756.59Mtoe), USA (2140.62Mtoe). The energy mix of those countries were analyzed. It was clear from the data of different countries coal (imported& local) played a vital roll (15% to 69%) in the fuel mix of those countries compare to 6% in our country. There

should be a comprehensive plan to utilize coal (Local& Imported) as primary fuel in our country to meet the energy need of vision 2021.

World Energy mix

World energy consumption refers to the total energy used by all of human civilization. Typically measured per year, it involves all energy harnessed from every energy source applied towards humanity's endeavors across every industrial and technological sector, across every country.

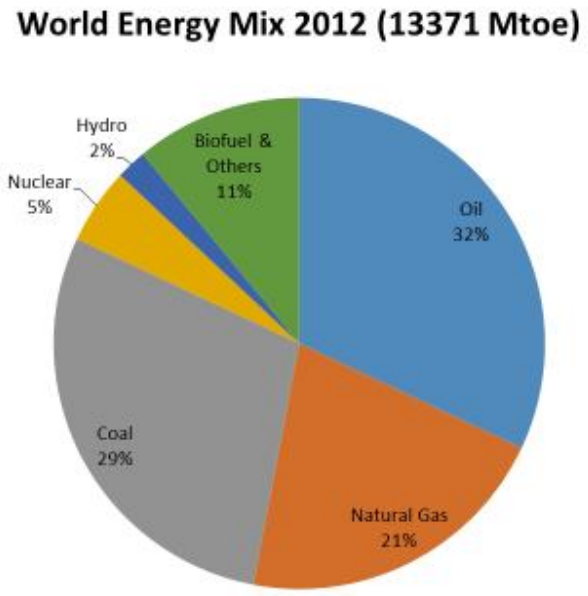


Figure 3 :Energy Mix of World

As per iea 2012 the total primary energy supply was 13371 Mtoe and per capita energy cosumption was 1880 Kgoe. Highest supplier of primary energy was petrolieum oil 32%, second highest coal 29 %, then natural gas 21 %, nuclear 5% , hydro 2% and biofuel & others 11%.

Projection of World Energy

Total global energy consumption in 2035 is projected as 18,301mtoe and the projected energy mix is: fossil fuels 80%, nuclear 6% and renewable 14% (Figure 4). It indicates that during 2012-2035, the share of fossil fuels in total energy will decrease from 82% to 80% and the shares of nuclear will increase from 5% to 6% and renewable will increase from 13% to 14%.

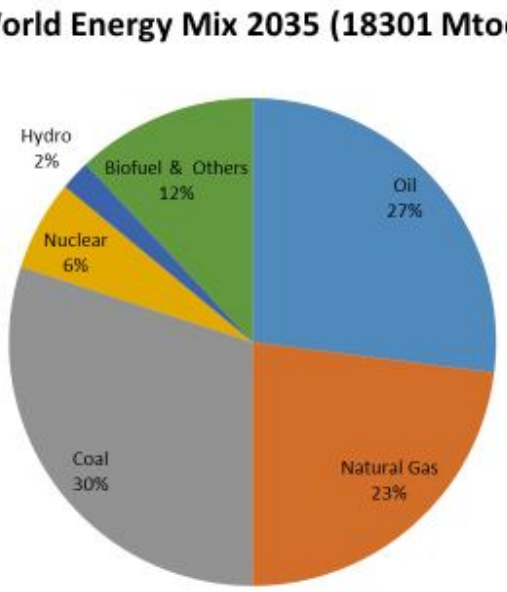


Figure 4 :World Energy Mix 2035

It is generally opined that the reserves of non-renewable fossil fuels are finite in quantity; future energy demand of the country should be met by nuclear and renewable sources of energy. Above analyses indicate that in 2035 major portion (80%) of world energy will be met by fossil fuels. In 2012, reserves to production ratio (R/P) of coal, oil, natural gas in the world were 109 years, 53 years and 56 years respectively (BP 2013). It may be inferred that in future fossil fuels will continue to play more important role in meeting the total energy need of Bangladesh, compared to nuclear and renewable energy.

Economic Status of Countries.

World bank classify the member states every year for the purpose of lending issue as in the category of Low Income, Lower Middle Income , Upper Middle Income and High Income countries on the basis of per capita GNI of the countries and the ranges for 2015 is<US$ 1045, US$ 1,046 – 4,125, and US$ 4,126 – 12745 respectively. As per BBS our GNI per cap was 1314 US$ in 2014-15(as per WB 1080 US$) , we are now on the level of lower middle income. As a result World Bank has categorized our country as a Lower Middle Income country.

Energy Economic Relationship

Energy is an essential commodity for most human activities, directly (as fuel) or Indirectly (to provide power, light, mobility). In traditional societies, populations rely on their own physical

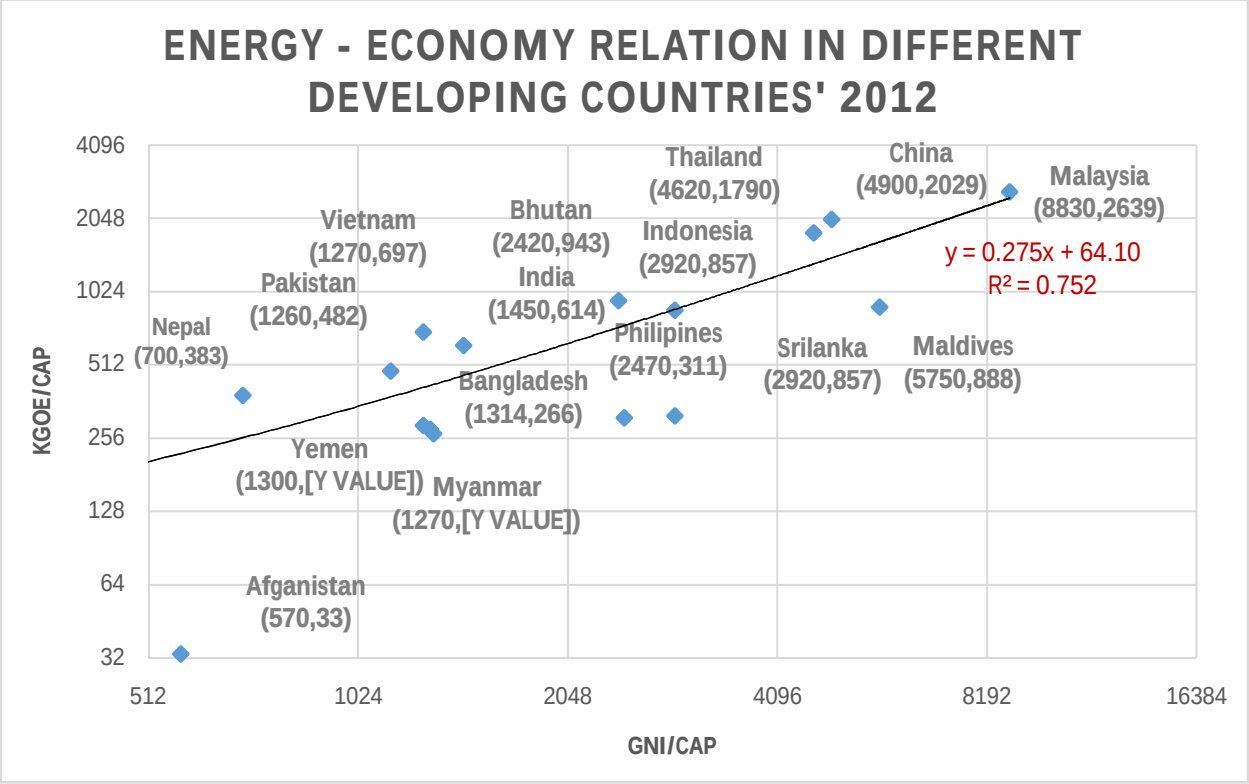


Figure : 5 Energy Economic Relationship

strength for labor, then on the power of domesticated animals, such as horses and oxen, then on water and wind, steam engines, hydrocarbons (fuel motors for land, sea and air vehicles) and finally - electricity. Energy combined with technology multiplies human force (e.g. motor fuel for cars, electricity for Household appliances), thereby playing a crucial role in pre- and post-industrial and then IT societies. For other essential needs such as space heating and cooking, the transition has been from local biomass (e.g. firewood, agriculture waste) to industrialized fuels (e.g. LPG, natural gas) and also electricity. Poor access to reliable and affordable modern energy services therefore acts as a barrier to economic and social development. So energy and development has a positive correlation in developing countries.

Total energy consumption of our country in 2014-15 was 42.53Mtoe, with a per capita consumption of about 270 Kgoe(World Bank data 205 Kgoe in 2012) which is less compare to

India (614 Kgoe), Pakistan(482 Kgoe), Srilanka (499 Kgoe), Nepal (383 kgoe) ,China (2029 Kgoe), Vietnam (697 Kgoe) Indonesia (857 Kgoe), Malaysia (2639 Kgoe), Brazil (1371 Kgoe) . We are far behind of Asia Standard (890 Kgoe) and Global Standard (1880 Kgoe).

It may be very difficult for Bangladesh to attain upper middle-income level (US$ 4,126 – 12,745) within 2021. However, it may be possible to attain lower-middle income level (US$ 1,046 - 4,125). In 2021, total population of Bangladesh is projected as 171.4 million. In that case, total energy consumption of the country will have to be increased from 42.53 mtoe in 2015 to a reasonable value in 2021. Policy planners and decision makers need to recognize increasing need of energy to achieve higher per capita GNI level. It will be challenging tasks to increase projected consumption of energy on sustainable basis.

Energy Requirement

To achieve the vision 2021 turning the country to a middle income country with a per capita income of 2000 US$ there should be a drastic increase in energy consumption consequently the energy supply should increase. From Figure 5, energy economic relation of some developing countries it is seen that there is a linear relation between them and the relation may be represent by the equation y = 0.275x + 64.10 with R square of 0.752 . From the figure for a per capita GNI of 2000 US $ of a country the per capita assessed energy consumption should be around 614Kgoei,e. Total assessed consumption should be 105.5 Mtoe for a population of 171.4 Million.

Projected Energy Supply (2015 – 2021)

In the back drop of huge energy demand, our energy resources are limited. Government has initiated programmed to produce electricity by coal (local & Domestic) and LNG based power plant is also going to be set up as per power sector master plan. The renewable energy sector is also growing rapidly. Import of electricity through cross border boundary is going on and which will improve further in near future. Nuclear power will also available by 2021. Biomass is also very promising to explore. Considering all form of energy sources in our country the energy supply scenario is shown in Table 1. Total forecasted energy supply would be 87.64 Mtoei,e 511.32 Kgoe per cap in 2021 for a population of 171.4 Million.

Table 1: Energy Supply of Bangladesh (2015 – 2021)

Year	Natural Gas & LNG (Bcf)	Liquid Fuel (Kton)	Coal Imported& Local (Kton)	Imp. Elect. & Nuclear (MW)	Renewable Energy (MW)	Total Commercial Energy Supply (Mtoe)	Biomass (Mtoe)	Total Energy Consumed (Mtoe)	Population (Million)	Per Capita Energy Consumed (Kgoe)
2015	955	6680	2500	500	580	31.2	12.74	43.94	157.1	279.72
2016	1029	7940	3000	600	730	34.42	13.39	47.81	157.5	303.56
2017	1380.5	8550	3200	1200	930	39.65	14.66	54.32	158.2	343.48
2018	1357	8824	7900	1200	1130	47.01	16.51	63.51	158.7	400.23
2019	1385	9000	14800	1200	1230	52.16	17.38	69.55	162.5	428.01
2020	1619	9000	19350	2200	1330	61.47	18.36	79.84	167.5	476.67
2021	1600	9300	30350	3200	1430	69.24	18.40	87.64	171.4	511.32

There will be a deficit of energy by 18 Mtoe(105.5 – 87.5) to attain per capita income of 2000 US$ by 2021.This low level of energy supply situation calls for an urgent but well-crafted sustainable long-term strategy to address the energy crisis and increase the energy supply. Energy options from domestic sources needs to be complemented with possible options for energy trade. The strategy will also explore alternative solution such as increased electricity imports from neighboring countries and LNG trade and promoting use of LPG for domestic & transportation sector. Further more exploration of domestically available resources, such as coal and oil and gas from offshore drilling will be intensified. The supply side options will be balanced with policies for demand management that conserve energy and discourage inefficient use of energy.

Report of the committee formed by Energy and Mineral Resources Division on Energy Economics.

1. Formation of Committee

Energy and Mineral Resources Division under Ministry of Power and Energy & Mineral Resources formed a 7 (Seven) member committee vide memo no. 28.00.0000.016.99.002.15 – 120 dated 10.02.2015 to expedite and completion of Energy Economics related work.

i.	Mr. Md. Harun- Or - Rashid Khan, Director General, Hydrocarbon Unit	Convener
ii.	Mr. Shirajun Noor Chowdhury, Deputy Secretary, Finance Division	Member
iii.	Mr. Lutfar Rahman, General Manager, Petrobangla	Member
iv.	Mr. Mustafa Qudrat - I - Elahi, General Manager, BPC	Member
v.	Mr. Md. Shazibul Hoque, Deputy Director, Power Cell	Member
vi.	Mrs. Tahrin Tahrim , Research Associate, BIDS	Member
vii.	Mr. A S M Manzurul Quader, Director, Hydrocarbon Unit	Member Secretary

2. Term Of Reference Of the Committee

a. Analysis of Global / Regional energy situation and determination of position of Bangladesh in that respect;
b. Analysis of Demand and Supply of Energy of the country to realize vision 2021 turning Bangladesh into a middle income country.
c. Analyzing the energy situation to identify the different measure to be adopted for energy conservation and efficiency.
d. Committee will submit the report within 3 (Three) month.

3. Methodology

Methodology is of very important in any methodical inquiry as the validity and reliability of the facts primarily depend upon the system of investigation. The committee sat in series of meeting formally after the formation of the committee to discuss the issues. Besides that so many informal discussion also held with the eminent personalities in this sector and sought their suggestion.

For this study work information were collected as secondary source of information from different related agencies and report like Planning Commission, Perspective Plan Of Bangladesh (2010-2021),Power Division, EMRD, BBS, Petrobangla and its subordinated companies, BPC and its subordinated companies, PDB, Power Cell ,concerned study report, annual report etc. By surfing internet Global/Regional energy & economy related data of different developed, under developed and developing countries were used and analyzed. World Bank data were used as reference. Beside that EIA, IEA data also used for analysis..

4. Limitation of the work

This report has been prepared on the basis of information and data obtained from EMRD, Petrobangla, BPC, PDB, Power Cell, HCU and other agencies like World Bank, IEA & EIA. This is just an exercise on the basis of data provided by the agencies and surfing internet. Assurance or warranty cannot be given, that any of the future results or achievements, expressed or implied, contained will be realized.

5. Introduction

A. Background

Energy has a key function in economic growth of a country. It improves the efficiency and productivity of the country and also has a very important role for individual and house hold. The role of energy in economic development is well recognized in the energy economics literature. It is one of the driving forces for development. It is consumed to meet energy requirement for subsistence (e.g. cooking, lighting, room heating etc. at household level) needs and for productive activities (e.g. agriculture, industries, transport, commercial etc.)

Bangladesh is coping with a serious energy crisis which is the result of sluggish growth in energy supplies while the demand for energy has grown up reasonably to attain higher economic growth.
To realize Government vision 2021 , Planning Commission has prepared a Perspective Plan of Bangladesh (2010 – 2021) : Making Vision 2021 a Reality" is a strategic articulation of the development vision, mission, and goals of the Government in achieving a prosperous Bangladesh grounded in political and economic freedoms a reality turning it a middle income country by 2021.

Energy security will be one of the critical element for realizing the vision. The Plan aims to develop an integrated and developed energy sector with a diversified fuel mix that will be the key driver of a sustainable local and national economy, while attaining global competitiveness in all sectors by 2021. The Plan will ensure prompt and timely decisions to steadily encourage greater private sector role in the energy sector; ensure transparent governance of energy-related public sector institutions; enhance the development of human capital; support development of the energy sector through physical and systemic structures; and contribute to the protection and enhancement of the natural environment. It will also promote renewable energy, such as solar and biogas; and ensure access to power and energy to all.

Economic Development depends on reliable energy supply. Bangladesh continues to face a number of major challenges, including poverty, political instability, overpopulation and vulnerability to climate change. However, it has been praised by the international community for its significant progress on the Human Development Index. Through various government pragmatic program and NGO-led social programs, the country is improving living standards and life expectancy, promoting education and women empowerment, stemming population growth, achieving self sufficiency in food production and building healthcare infrastructure. The country is also undergoing rapid industrialization, with globally competitive industries in textiles, shipbuilding and pharmaceuticals. Bangladesh has been identified as a next emerging economy. Behind all energy is playing the vital role in all economical activities.

B. Energy scenario of Bangladesh

Bangladesh is located in the most energy deficit region (Asia Pacific) of the world. Almighty Allah has blessed this small populous country with significant potential of primary energy resources. Out of which explored traditional indigenous fossil fuel like natural gas, coal and small amount of oil and significant potential of unexplored hydrocarbon in off shore and on shore. There is also potential of unconventional

form of energy like CBM, Shale gas and synthetic gas as UCG. As renewable energy there is huge prospect of solar energy, hydro and wind.

At present energy crisis has taken an acute shape due to the lack of proper initiatives in the energy sector during the regime of past government. As a result, acquiring overall growth of the industry and other production sectors including power generation has been hampered. To overcome the stagnant situation of the country the government is working to ensure energy supply to expedite the motion of economic development and to achieve this goal mid-term and long-term plan has been undertaken for exploration, development and production of domestic primary fuel such as gas and coal..

Considering the shortage of domestic commercial energy, multi-dimensional approach has been taken to import different commercial energy: (i) Electricity, (ii) Coal, (iii) Petroleum via pipeline (iv) Natural Gas via pipeline, (v) Natural gas as LNG, vi) Liquefied Petroleum Gas (LPG).

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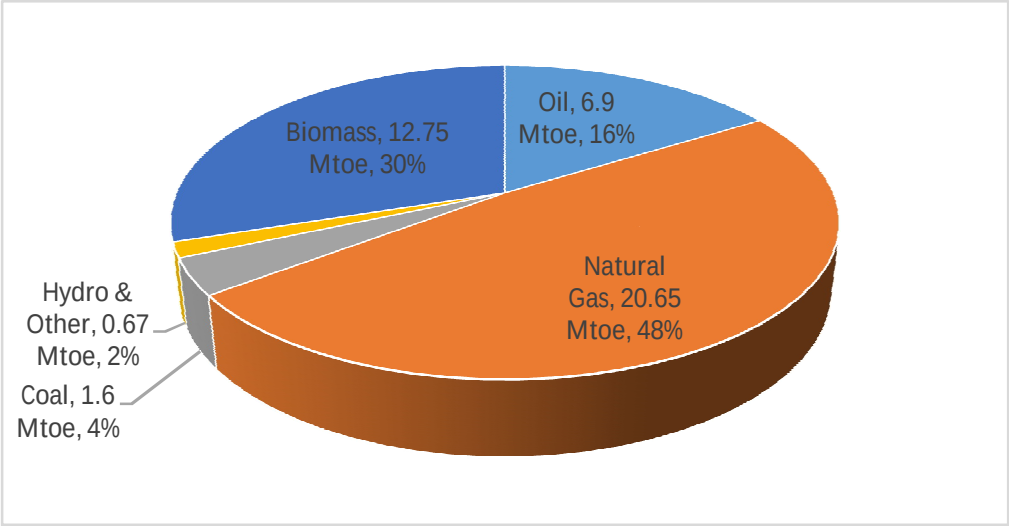

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primary energy and the rest 71% is being met by commercial energy. Natural gas accounts for about 69%, petroleum product contribute 23%, coal 6% and renewable energy 1% of the commercial energy. In the 2014-15 total primary energy supplied was 42.53Mtoe. The energy mix (Figure 1 & Fiqure 2.) is heavily dependent on domestic resource, natural gas. The reserve of which is diminishing quickly. Then petroleum product mostly of which is imported. Contribution of coal is very less (6% only), which is the most significant to explore.

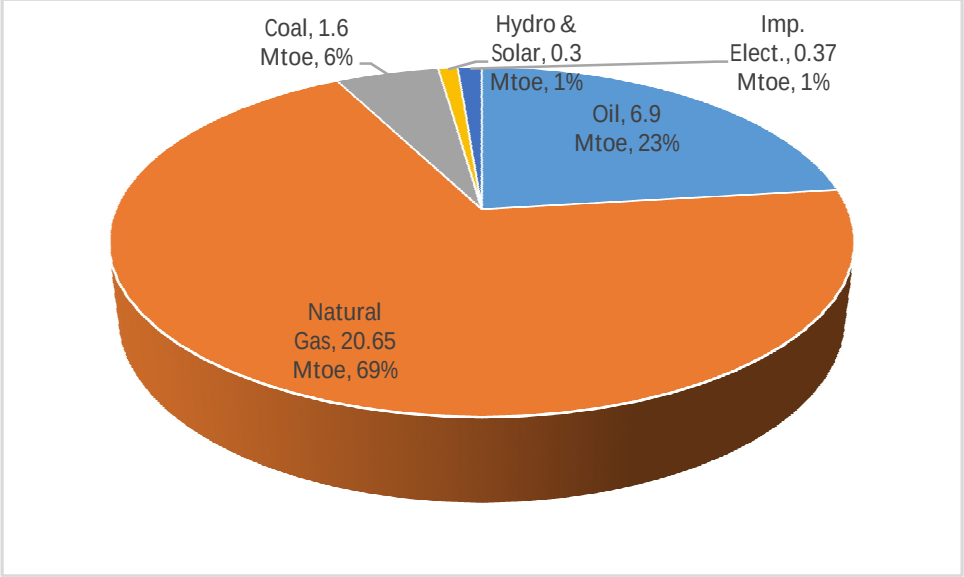

Figure 2 : Share of Commercial Energy in Bangladesh (2014 – 15)

1. Natural Gas Sector

1.1 Organizational Structure

Bangladesh Oil, Gas, and Mineral Corporation, short named Petrobangla, under the Energy and Mineral Resources Division of the Ministry of Power the 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.

1.2 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 27.07 TCF. As of June 2014, a total of 12.*14*TCF gas has already been produced leaving only 14.94 TCF recoverable reserve in proven plus probable category. Some key information about the natural gas sector is presented in the Table – 1 ..

Table – 1 :Gas Sector at a Glance

Total number of gas fields	26
Number of gas fields in production	20
Number of producing wells	97
Present gas production rate	2700+ MMCFD
Highest Production (06 May, 2015)	2785.8 MMCFD
Total recoverable (Proven + Probabale) reserve	27.12 TCF
Cumulative Production (June,2015)	13.032 TCF
Remaining Resurve (Proven + Probabale)	14.088 TCF
Present Demand	3200 MMCFD
Present Deficit	500 MMCFD
Number of Customer	30 Lakh (Appx.)

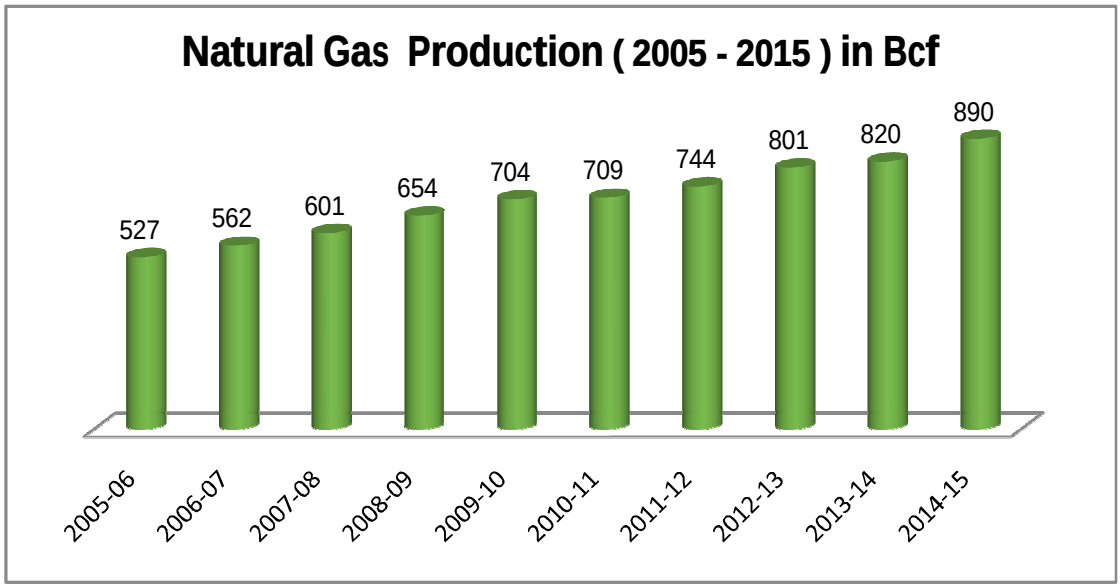

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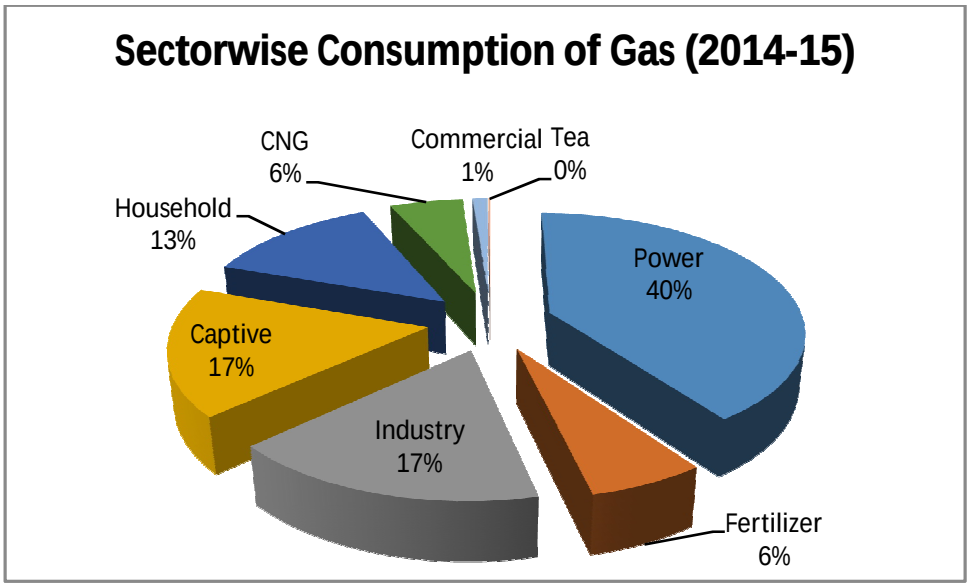
Figure 3 : Historical Gas Production in Bangladesh (2005 – 2015)

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

1.3 Natural Gas Consumption

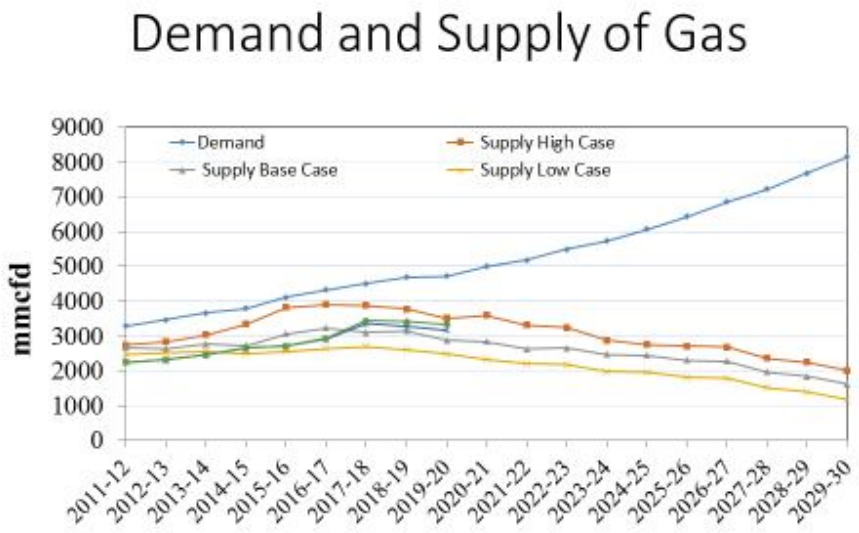
The current average production of natural gas is about 2,700 MMscfd. A total 890 billion cubic feet (BCF) of natural gas was produced in 2014 – 15which was used by power- 40%, fertilizer-6%, captive power-17%, industry-17%, domestic-13%, CNG- 6% and others very small amount. Natural gas accounts for the 75%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 population 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.



A Total 890.6 Bcf gas was produced in 2014 – 15.

1.4 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 3,050 MMscfd whereas supply is 2450-2500 indicating a shortage of about 500 MMscfd. It estimated that demand for natural gas will rise to about 8000MMscfd by the 2030. Natural gas demand projection in the country is shown in the figure below:



Demand Supply gap is increasing, production is likely to decline from 2016-17

1.5 LNG import to Supplement Indigenous Supply

As seen from the figure above, existing demand supply gap will widen with time, if large reserves cannot discovered shortly. Foreseeing the uncertainty in new discovery, government has undertaken a project to import LNG equivalent to 500MMscfd in the first phase to offset demand supply gap. It is expected that re-gasified LNG will be fed to the network in early 2017 after installation of a floating storage re-gasification unit (FSRU) at Maheshkali in Cox's Bazar district by a private entrepreneur on build, own, operate and transfer (BOOT) basis, and construction of a 30 inches dia 91 km transmission pipeline from re-gasification facilities to Chittagong ring-main by the national gas transmission company, GTCL.

1.6 Exploration Activities

Exploration for oil and gas in his country in the early last century while first success came in with discovery of gas filed in Sylhet. So far 97 exploration wells have been drilled in the country with 26 discovery of gas fields. Government has attached utmost importance to the exploration for oil gas in the country both in the onshore and in the offshore. It is the government priority sector. National exploration company BAPEX is engaged in the exploration in the offshore while international oil companies are carrying out in offshore.

Two PSCs, signed in February 2014, are currently active in the shallow offshore, one with ONGC Videsh Limited and Oil India Limited while another with the consortium of Santo and Kriss Energy (Asia) limited. Bid for three deep sea blocks received in the last bidding round held in January 2014, has been evaluated and placed for the approval of the government.

It has been decided in the back drop of maritime boundary settlement with Myanmar and India to conduct " Non-Exclusive Multi-Client Seismic Survey" on the offshore to get seismic data of deep sea which is a internationally recognized practice followed by many countries.

1.7 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 .

2. Oil (Petroleum) Sector

2.1 Organizational Structure

Bangladesh Petroleum Corporation under the 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.

2.2 Supply and Consumption of Oil

Petroleum products viz. diesel, petrol, octane furnace oil etc, account for about 20% primary the commercial energy supply in the country. Liquid fuel is used Bangladesh is mostly imported. Locally produced gas condensate shares

only 6% of total liquid fuel consumption. Only. Bangladesh imports about 1.2 million metric tons of crude oil along with 4.3 million metric tons (approx) of refined petroleum products per annum. About 350 thousand tons per year locally produced gas condensate, which is fractionated mainly into petrol, diesel and kerosene, is the only domestic 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-47%, power-26%, agriculture 17%, industry- 4% and others including domestic-6%.

Table – 2 :BPC at a Glance (2014 – 15)

Total Consumption of POL	53.21 Lac MT.
Import of Refined Oil	40.92 Lac MT.
Import of Crude Oil	13.03 Lac MT.
Export of Naphtha	0.75 Lac MT.
Total Storage Capacity	11.63 Lac MT
Supply of POL in Power Plant	13.64 Lac MT.
Production of LPG Under BPC	17,574 MT
Production of LPG Under Private	1,10,000 MT
Import of Furnace Oil Under Private	14.54 Lac MT
Demand of POL in FY 2015 - 16	54.00 Lac MT.

Import of Furnace oil under private sector has increased remarkably in 2014-15. As per NBR it was 1,454,060.20 MT.

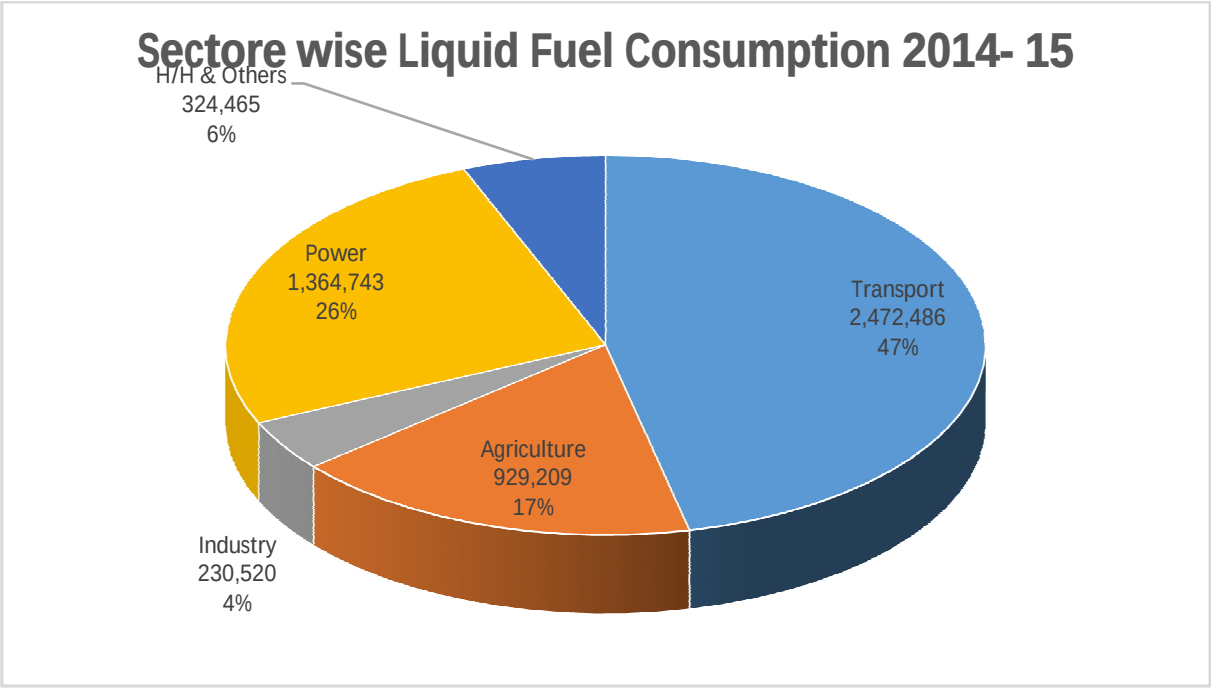
Table – 3 :Petroleum Sector at a Glance

SALE OF PETROLEUM PRODUCTS DURING LAST 5 YEAR & CURRENT YEAR PROJECTION

Quantity in MT

Products	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Octane	85541	97264	107150	110850	117452	126114	130000
Petrol	127247	141491	158707	169710	178674	166823	170000
Diesel	2568208	3239279	3240349	2962872	3242554	3396061	3600000
Kerosine	376645	397209	358436	314450	289871	263029	260000
Furnace Oil	194165	544617	883735	1070096	1202505	906771	700000
Jet A-1	286938	335732	311890	318423	323327	338829	350000
Others	118546	112432	153379	131591	130583	123796	190000
Total	**3757290**	**48868024**	**5213646**	**5077992**	**5484966**	**5321423**	**5400000**

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



Total Consumption 5,321,423 MT

Figure 4 : Sector wise Liquid Fuel Consumption in Bangladesh (2013 -14)

Table 4: Financial Performance of BPC from 2002-2013 to 2014-2015

(Taka in Crore)

Financial Year	Profit/(Loss)	Contribution to Exchequer
2001-2002	(780.16)	3,033.00
2002-2003	(7.61)	2,766.00
2003-2004	(958.93)	3,087.27
2004-2005	(2,317.88)	2458.95
2005-2006	(3,337.78)	2,620.26
2006-2007	(2,914.63)	2,756.55
2007-2008	(7,750.30)	3,003.61
2008-2009	(1,022.63)	1,908.99
2009-2010	(2,571.22)	2,324.25
2010-2011	(9,799.91)	3,508.50
2011-12	(10,548.09)	4,548.06
2012-13 (Provisional)	(5,368.70)	5,022.31
2013-14 (Provisional)	(2,477.69)	4,854.06
2014-15 (Provisional)	5268.08	5448.61
Total	**(44,587.45)**	**47,340.42**

Source: BPC

2.3 Capacity Enactment Projects

Eastern Refinery Limited (ERL) installed in 1968 at Chittagong with the processing capacity of 1.5 million tons annually, now derated 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 Moheshkhali under SPM Project

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

2.4 Demand

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 8 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.

2.5 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 Parbotipur depot at Dinajpur district of Bangladesh.

3. Liquefied Petroleum Gas (LPG)

Demand of Liquefied Petroleum Gas (LPG) in Bangladesh is very high. In the public sector 22,500 MT of LPG are bottling every year, out of which 15000 MT is obtained as byproduct from processing of crude oil

in Eastern Refinery and 7500 MT from is extracted from natural gas in Kailashtila gas field. LPG is imported by only private sector. Around 75000 MT of LPG is imported and marketed by

private sector entrepreneurs every year. So public and private sector combining do the marketing of 95,000 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.

4. Coal Sector

4.1 Coal

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 sulpher content.

In Bangladesh, the reserve of coal (Bituminous Coal) is about 33,000 million tones which is equivalent to 85 tcf gas in 5 coal fields so far discovered, namely Barapukuria, Khalashpir, Phulbari, Jamalgonj 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.

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.

Total in-situ coal resource in rest 4 coal fields is 2247 million tonnes. Barapukuria coal deposit is 303 million tonne. Underground coalmine is in operation with design capacity of 1 million tonne per year. During 2005-2012, total extracted coal from Barapukuria coalmine was 5.2 million tonnes. Estimated coal

reserve in Phulbari basin is 572 million tonnes, of which 475 million tonnes is extractable by open cut mining method. Khalaspir coal deposit is 143 million tonnes. A consortium of Chinese and Bangladeshi company proposed to develop coalfield by underground mining method @ 2 million tonnes per year. Dighipara coal basin deposit is 150 million tonnes. Petrobangla got the Exploration License in 2008 for development of Dighipara coal basin.

Following the experience of development of hydrocarbon under Production Sharing Contract, development of coalmines should also be considered under Production Sharing Contract of coal (PSC-Coal).

The Mines & Mineral Resources Act 1992 and the Mines & Mineral Rules 2012 are the legal framework for the development of all mines (including coal mines). It is not legally obligatory to have an approved coal policy for the development of coalmines. Even then, Energy and Mineral Resources Division (EMRD) have been trying to get a coal policy approved by the cabinet.

4.2 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-Chandabeel under Madaripur and Gopalganj district, Kola Mouza of Khulna district, Chatalbeel area of Moulavibazar district, Pagla, Dirai and Shalla area of Sunamganj district, Chorkai area of Sylhet district, Brahmanbaria Sadarupazila 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.

5. Power Sub-Sector

5.1 Primary Energy Mix for Power Generation

As of June 2015 the total power generation capacity combining public and private sector is 11,534 MW, leaving 20% capacity for maintenance and forced outage, available generation capacity should be about 9225MW without fuel constraint. Maximum generation actually obtained on 13August 2015 was 8177MW, which was less than 9225 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 48% respectively. Bangladesh has started importing 500MW electricity from India (started in October 2013), which contributed 7% of total power generation.

Table 5 :Bangladesh's Power Sector: At a Glance (2015)

Electricity Growth	9.00%
Installed Capacity (MW)	11,534
Maximum Generation (MW)	8,177 (13 August, 2015)
Total Consumers (in Million)	17.70
Transmission Lines (ckm)	9,695
Distribution Lines (km)	3,35,000
Per Capita Generation (including Captive)	371 Kwh
Access to Electricity (including Off-Grid Renewable)	74%

Table 6 :Present Installed Generation Capacity (June, 2015)

Public Sector		
SL.		**Installed Generation Capacity**
1.	**BPDB**	**4126**
2.	**APSCL**	**829**
3.	**EGCB**	**622**
4.	**NWPGCL**	**368**
5.	**RPCL**	**77**

	Subtotal	***6,022 (52%)***
Private Sector		
1.	**IPPs**	**2536**
2.	**SIPPs (BPDB)**	**99**
3.	**SIPPs/ Merchant Plant**	**251**
4.	**15 YR. Rental**	**167**
5.	**3/5 YR. Rental**	**1959**
6.	**Power Import**	**500**
	Subtotal	***5,512 (48%)***
Total		**11,534**

The composition of primary energy mix for power generation in FY 2014 - 15is shown in Figure 5. Of the total electricity generated in 2014 -15, 73% was generated from domestic fuels (natural gas, coal & hydro) and 20% from imported petroleum fuels (diesel and furnace oil) and 7% was imported from India as cross border energy trade.

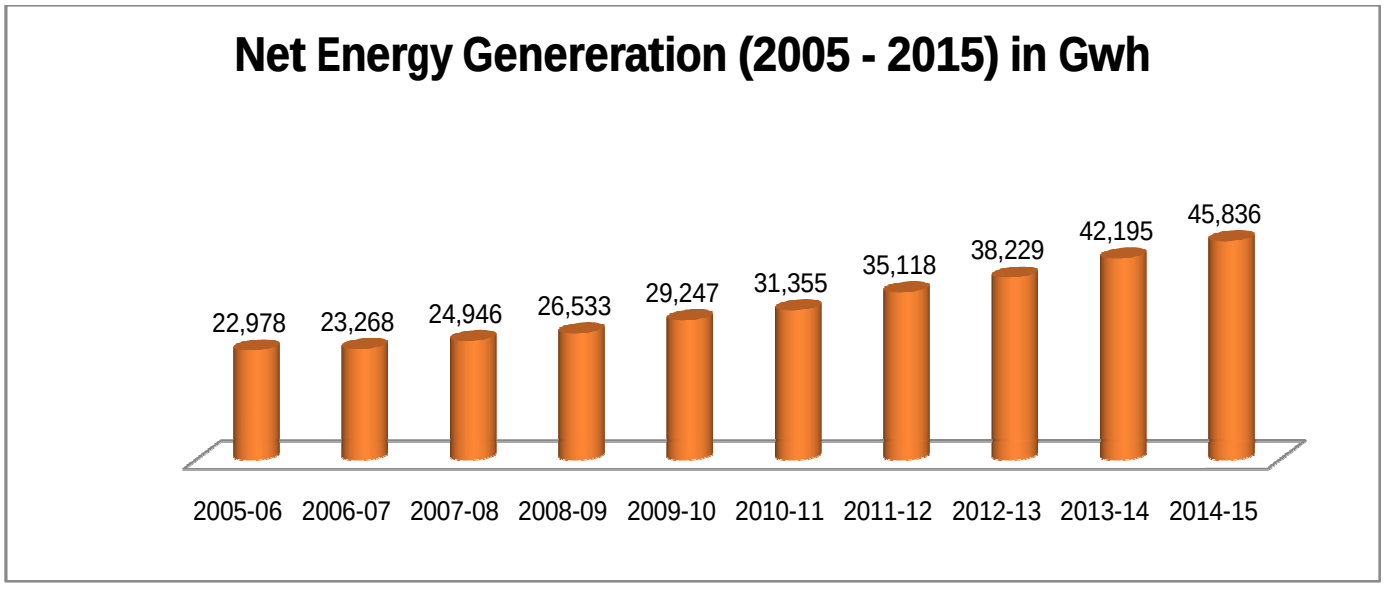
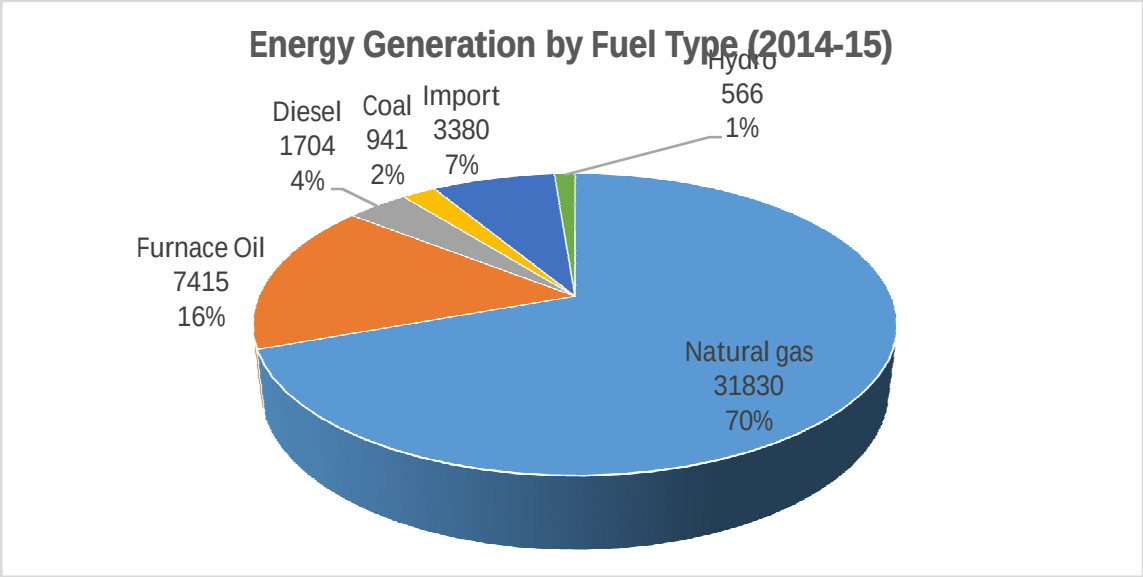


Figure 4: Historical Net Energy Generation (Gwh) in Bangladesh



Total Net Energy Generation (2014 – 15) : 45,836 Gwh

Figure – 5 : Energy Generation by Fuel Type (2014 – 15)

5.2 Electricity Import

Bangladesh has entered into the era of cross border energy trade in October 2013 by importing electricity from India. At present 500 MW electricity is being importing from India and in near future it will increase considerably.

6 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.

(a) 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 50,000 households and village-level biogas plants in place. Around 38,000 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.

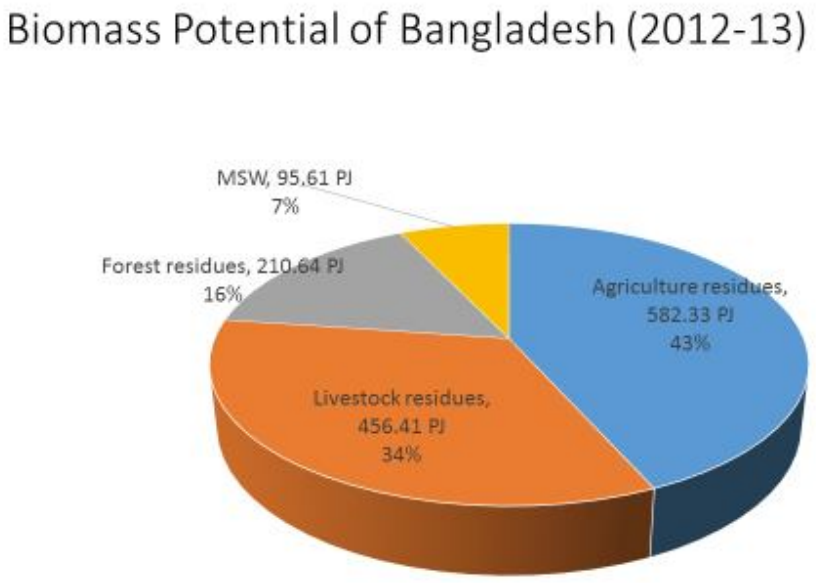


Figure 6 : Biomass Potential of Bangladesh (2012 – 13)

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 to373.71 TWh of electricity.

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(b) 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 2013, 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. Total electricity generated in 2013 was 36,482MkWh, of which the share of hydro power (primary electricity) was only 2.5 percent.

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.

(c) 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 2015 was 175 MW. Total generation from RE including hydropower (230MW) was 405MW, which was 3.5% of total electricity generation capacity (11,534 MW) of the country.

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

i. <u>Solar Energy</u>

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 equipments 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 37.7 lakh (installed capacity 150 MW) SHS and BREB distributed about 15 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 ’15 262 nos (installed capacity 1.5 MW) solar irrigation pumps has been installed by IDCOL.

ii. Bio fuel

Biofuels 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:
the 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 and 10 percent of every liter of fuel must be bio-fuel by 2015.

iii. Wind Energy

Bangladesh is exploring the potential of wind power. In the coastal area of Bangladesh, windmills with a capacity of 2 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 renewables-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, specially at Cox's Bazar and at the islands of Moheshkhali 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, Moheshkhali, 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 is land where about 500 kw power could be obtained. At present there are only 2x73 kva 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 specially 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 height 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 programme is being taken by the Government.

7 Nuclear Power

Nuclear power 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. Fukushima Daiichi, Japan Nuclear Power Accident on 11 March 2011 has resulted a setback for the promotion of nuclear technology in the world. Japan announced a review of the existing plan for nuclear power to account for 53% of electricity output by 2030. Germany decided to close down all the nuclear power plants by 2022, Switzerland announced to close five nuclear reactor by 2034, a referendum in June 2011 in Italy proposed a permanent ban on the reintroduction of a nuclear power program. Some countries decided to continue their nuclear power program. Indonesia and Thailand delayed their first nuclear power projects until 2020 (IEA 2011). In this context, government of Bangladesh has decided to establish 2x1000MW NP at Rooppur with assistance of Russia. For obvious reason, there is general concern in Bangladesh about the safety issues of nuclear power plant; because of long-term (100 years) implications of the decision.

C.Comparison with other country

Bangladesh is one of the less consuming primary energy country. Primary energy potential is not bad, but that should be explore. The country is facing a huge energy crisis. There is no alternative to increase primary energy supply. As per global and regional context we are far behind of energy supply vis a vis energy consumption. As per EIA data of 2012 our country total primary energy supplied is poor (33.17 Mtoe) compare to World (13371 Mtoe), China (2909Mtoe), Australia (128.27Mtoe), India (788.13Mtoe) , Korea (263.44Mtoe), Malaysia (81.23Mtoe), Russia (756.59Mtoe), USA (2140.62Mtoe). The energy mix of those countries are shown in different figure. It is clear from the data of different countries coal (imported & local) played a vital roll (15% to 69%) in the fuel mix of those countries. There should be a comprehensive plan to utilize coal (Local & Imported) as primary fuel in our country to meet the energy need of vision 2021.

i. Energy mix of India

India was the fourth-largest energy consumer in the world after China, the United States, and Russia in 2011, and despite having notable fossil fuel resources, the country has become increasingly dependent on energy imports.

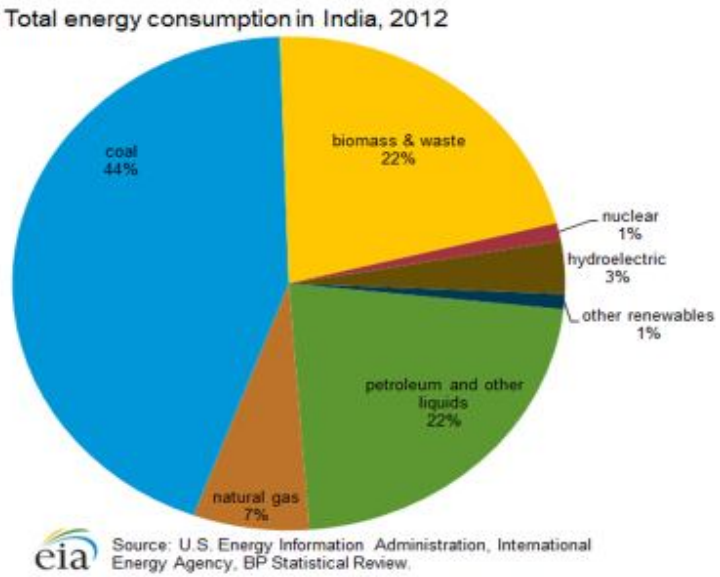

Figure 7 :Energy Mix of India

Total energy consumption in 2012 was 788.13Mtoe with a per capita of 614 Kgoe. Highest percentage came from coal 44%, petroleum product contributed 22%, biomass 22% natural gas 7%, hydroelectric 3%, nuclear 1% and other renewal 1%. Heavily dependent on fossil fuel (73% of total consumption).

Despite having large coal reserves and a healthy growth in natural gas production over the past two decades, India is increasingly dependent on imported fossil fuels. Primary energy consumption in India has more than doubled between 1990 and 2012.

ii. Energy mix of China

China is the world's most populous country with a fast-growing economy that has led it to be the largest energy consumer and producer in the world. Rapidly increasing energy demand, especially for liquid fuels, has made China extremely influential in world energy markets.

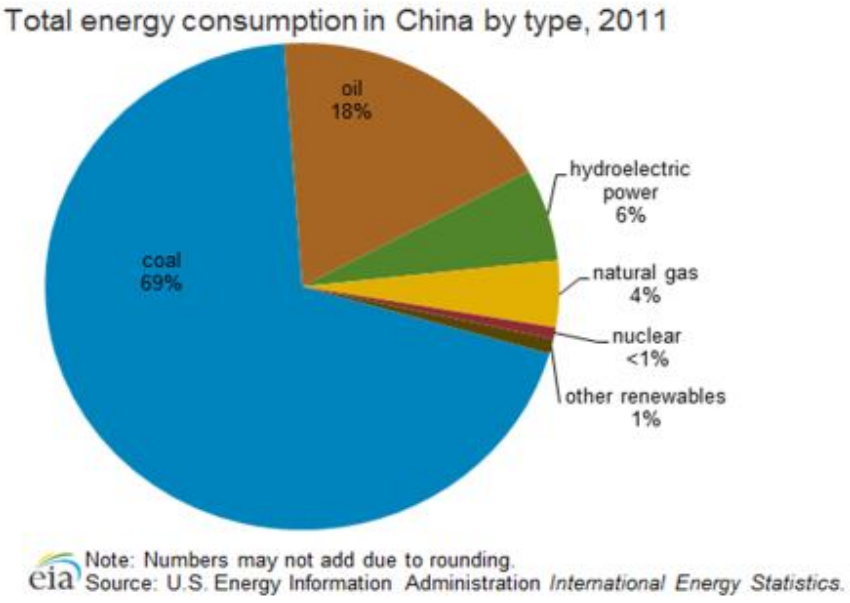

Figure 8 :Energy Mix of China

Coal supplied the vast majority (69%) of China's total energy consumption in 2011. Oil was the second-largest source, accounting for 18% of the country's total energy consumption. While China has made an effort to diversify its energy supplies, hydroelectric sources (6%), natural gas (4%), nuclear power (nearly 1%), and other renewables (1%) accounted for relatively small shares of China's energy consumption.

iii. Energy mix of Korea, South

South Korea relies on imports to meet about 97% of its energy demand as a result of insufficient domestic resources, and the country is one of the world's leading energy importers.The U.S. Energy Information Administration (EIA) estimates that South Korea was the world's ninth-largest energy consumer in 2011. Korea is one of the top energy importers in the world and relies on fuel imports for about 97% of its primary energy demand because the country lacks domestic energy reserves.

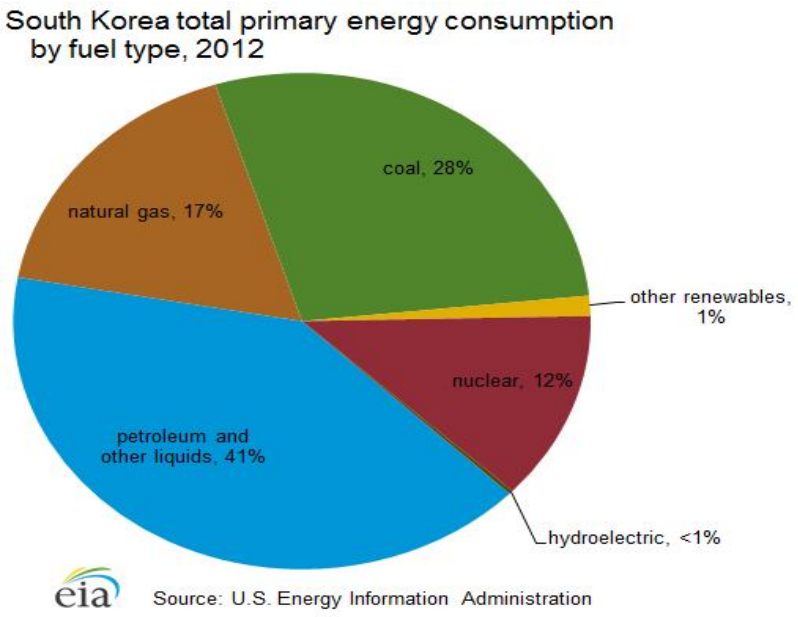

Figure 9 : Energy Mix of South Korea

In 2012 the total consumption of energy was 266.88 Mtoe with a per capita consumption of Kgoe. Out of total consumption of energy petroleum product contribute highest 41%, then coal 28% , natural gas 17%, nuclear 12% and other renewables 1%.

South Korea's highly developed economy drives its energy consumption, and economic growth is fueled by exports, most notably exports of electronics and semiconductors. The country also contains one of the world's top shipbuilding industries. Gross domestic product (GDP) grew by 2.8% in 2013, up from 2% in 2012. The government anticipates even higher GDP growth in 2014 of 3.8% on the back of rising exports and recovering economic growth in other developed countries. South Korea's economic growth following the 2008 global financial crisis remained relatively resilient compared to other developed country economies.

iv. Energy mix of Malaysia

Malaysia is the world's second-largest exporter of liquefied natural gas and the second-largest oil and natural gas producer in Southeast Asia, and is strategically located amid important routes for seaborne energy trade.

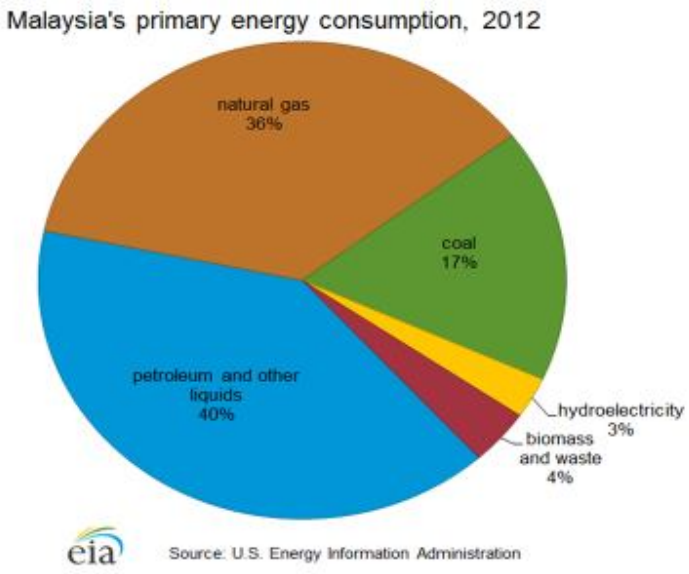

Figure 10 : Energy Mix of Malaysia

As Malaysia targets economic development and increased manufacturing, the country is focused on securing energy through cost-effective means and diversifying its fuel supply portfolio. Petroleum and other liquids and natural gas are the main primary energy sources consumed in Malaysia, with estimated shares of 40% and 36%, respectively in 2012. About 17% of the country's energy consumption is met by coal. Biomass and waste make up another 4%, and hydropower contributes 3% to total consumption. Malaysia's heavy reliance on oil and natural gas to sustain its economic growth is causing the government to emphasize fuel diversification through coal imports and to promote investments in renewable energy.

v. Energy mix of Russia

Russia is the second-largest producer of dry natural gas and third-largest liquid fuels producer in the world. Despite its significant reserves of coal, it produces only modest amount of coal. Russia's economy is highly dependent on its hydrocarbons, and oil and gas revenues account for more than 50% of the federal budget revenues.

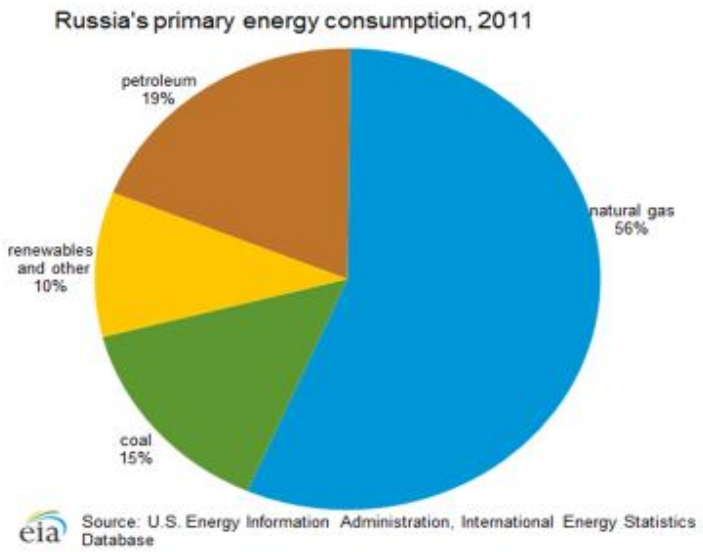

Figure 11: Energy Mix of Russia

Russia is a major producer and exporter of oil and natural gas, and its economy largely depends on energy exports. Russia's economic growth continues to be driven by energy exports, given its high oil and gas production and the elevated prices for those commodities. Oil and gas revenues accounted for 52% of federal budget revenues and over 70% of total exports in 2012. Russia was the world's third-largest producer of oil (after Saudi Arabia and the United States) Preliminary data for 2013 show that Russia still is the third-ranked producer of total liquids, with average production at 10.5 million barrels per day (bbl/d) through September 2013. Russia was the second-largest producer of natural gas in 2012 (second to the United States).

Russia is the third-largest generator of nuclear power in the world and fourth-largest in terms of installed capacity. With ten nuclear reactors currently under construction, Russia is the second country in the world in terms of number of reactors under construction in 2012, according to the International Atomic Energy Agency.

Russia consumed 756.59 Mtoe of total energy with per capita consumption Kgoe in 2011, the majority of which was in the form of natural gas (56%). Petroleum and coal accounted for 19% and 14%, respectively.

vi. Energy mix of Australia

Australia, rich in hydrocarbons and uranium, was the world's second-largest coal exporter in 2012 and the third-largest liquefied natural gas (LNG) exporter in 2013. Australia has experienced limited energy demand growth because of lower levels of energy intensity compared to a few decades ago. Energy efficiency measures in many end-use sectors, technological advances, and a shift from heavy industries to a more service-sector oriented economy have resulted in a decrease in Australia's energy intensity.

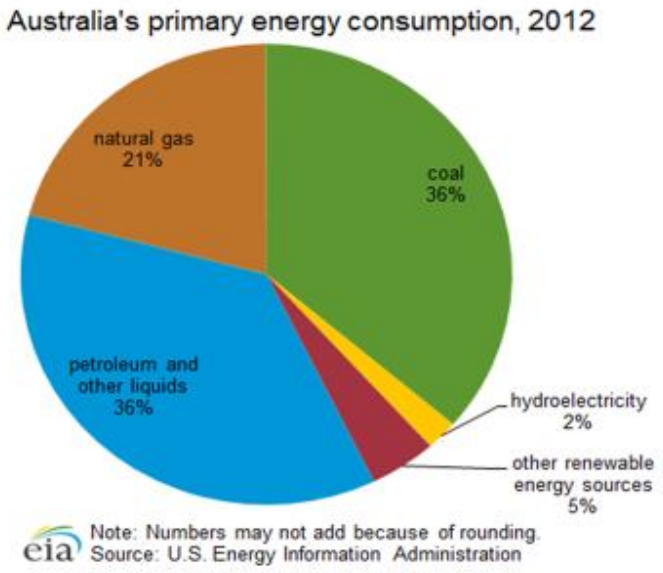

Figure 12 : Energy Mix of Australia

Australia is heavily dependent on fossil fuels for its primary energy consumption. In 2012, petroleum and other liquids accounted for an estimated 36% of the country's total energy used. The share of oil consumption has risen in the past few years as it supports the country's commodity production growth, mining, and petrochemical industry as well as the transportation sector.

Coal and natural gas account for 36% and 21% of the energy demand portfolio, respectively. Renewable sources, including hydroelectricity, wind, solar, and biomass accounted for more than 6% of total consumption. Although the country is rich in uranium, Australia has no nuclear-powered electricity generation capacity and exports all of its uranium production.

vii. Energy mix of USA

The United States is the 2nd largest energy consumer in terms of total use. The majority of this energy is derived from fossil fuels: in 2014, data showed 35% of the nation's energy came from petroleum, 18% from coal, and 28% from natural gas. Nuclear power supplied 8% and renewable energy supplied 10%, which was mainly from hydroelectric dams and biomass but also included other renewable sources such as wind power, geothermal and solar energy.

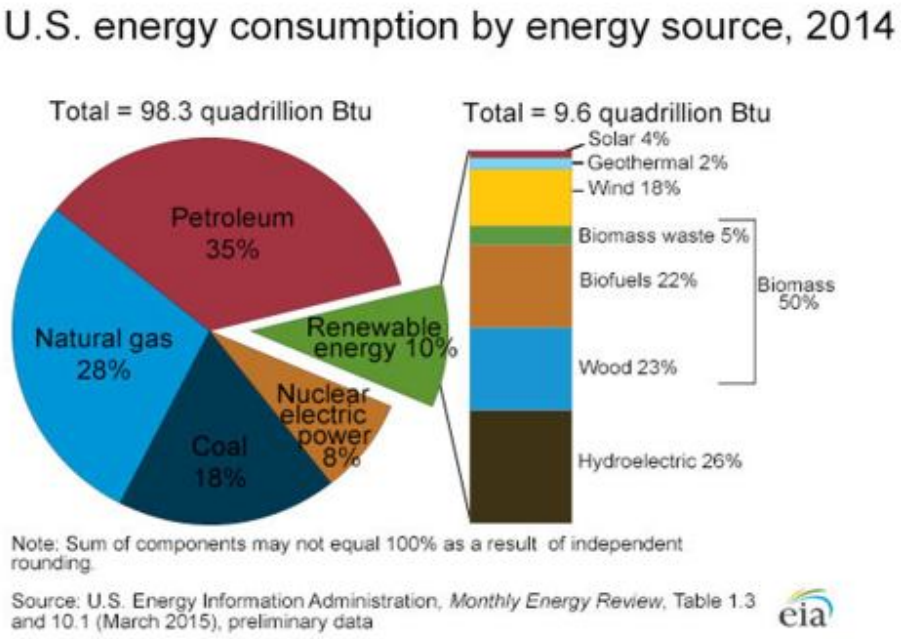

Figure 13 : Energy Mix of USA

viii. World Energy mix

World energy consumption refers to the total energy used by all of human civilization. Typically measured per year, it involves all energy harnessed from every energy source applied towards humanity's endeavors across every industrial and technological sector, across every country.

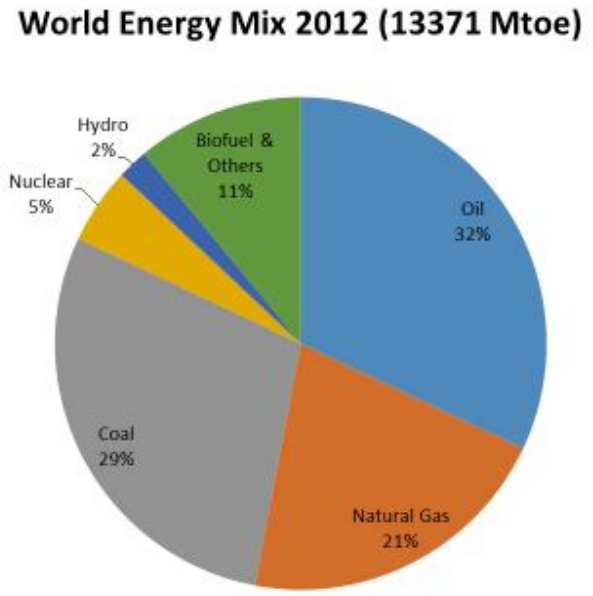

Figure 14 :Energy Mix of World

As per iea 2012 the total primary energy supply was 13371 Mtoe and per capita energy cosumption was 1880 Kgoe. Highest supplier of primary energy was petrolieum oil 32%, second highest coal 29 %, then natural gas 21 %, nuclear 5% , hydro 2% and biofuel & others 11%.

A comparision of fuel shares of world total primary energy supplies between 1973 and 2012 as per IEA 2014 is shown in figure 15 and world total primary energy supply by fuel from 1972 to 2012 is shown in figure 16.

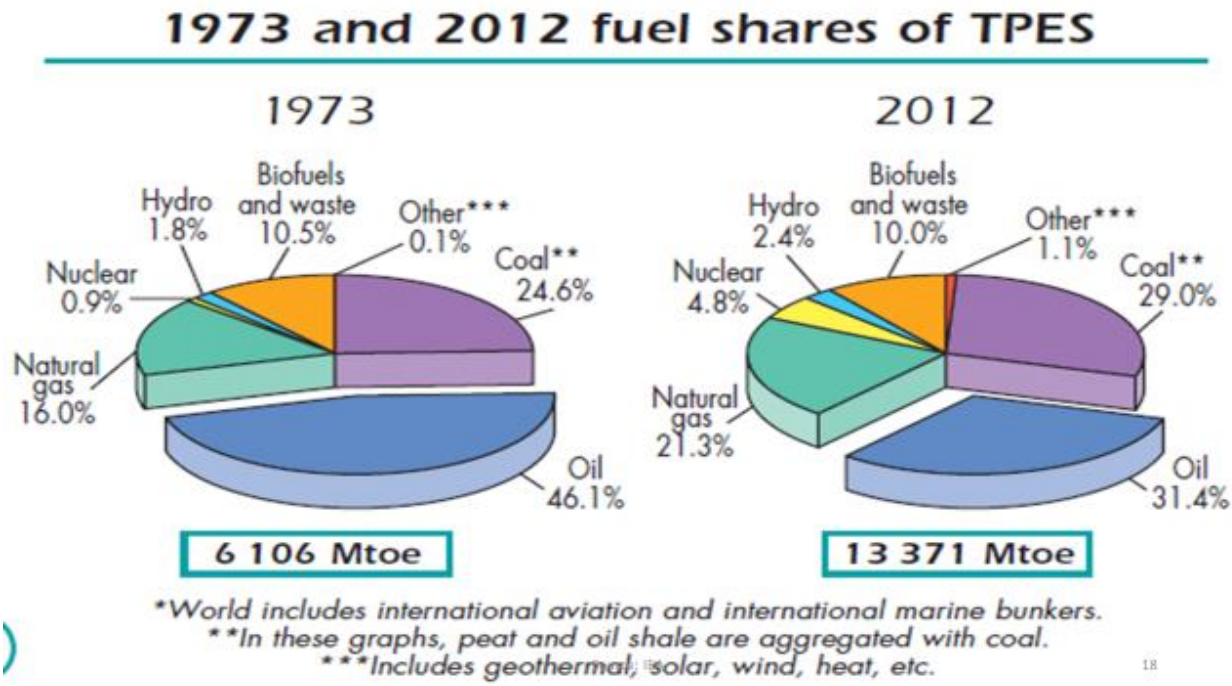

Figure 15 : Fuel Shares of TPES (1973 & 2012)

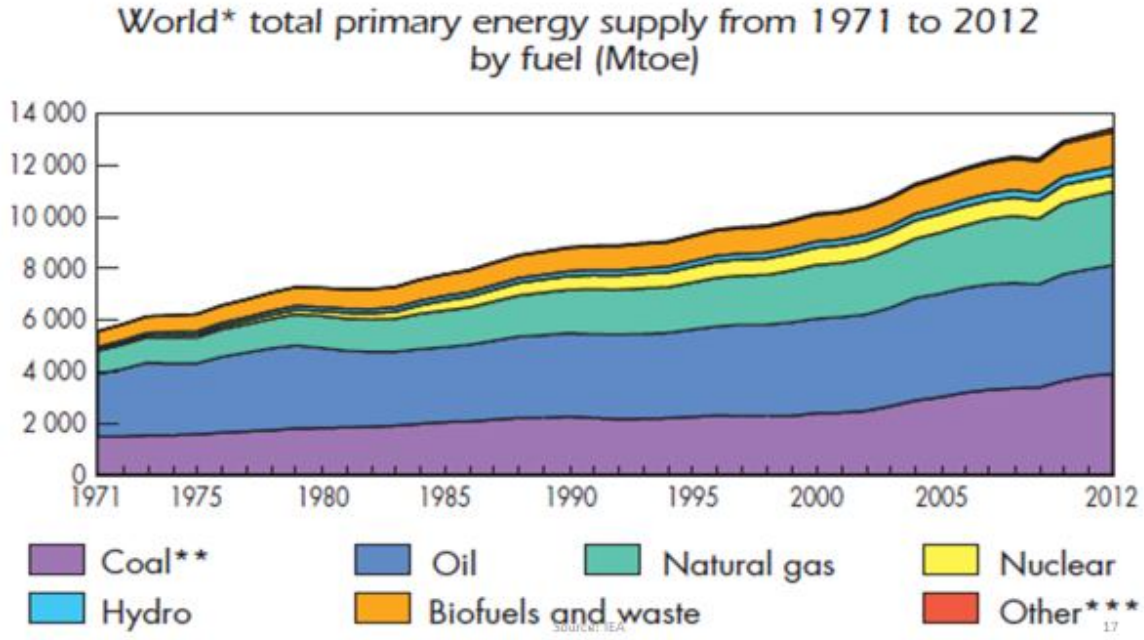

Figure 16 :World total primary energy supply (1973 – 2012)

ix. Projection of World Energy

Total global energy consumption in 2035 is projected as 18,301mtoe and the projected energy mix is: fossil fuels 80%, nuclear 6% and renewable 14% (Figure 17). It indicates that during 2012-2035, the share of fossil fuels in total energy will decrease from 82% to 80% and the shares of nuclear will increase from 5% to 6% and renewable will increase from 13% to 14%.

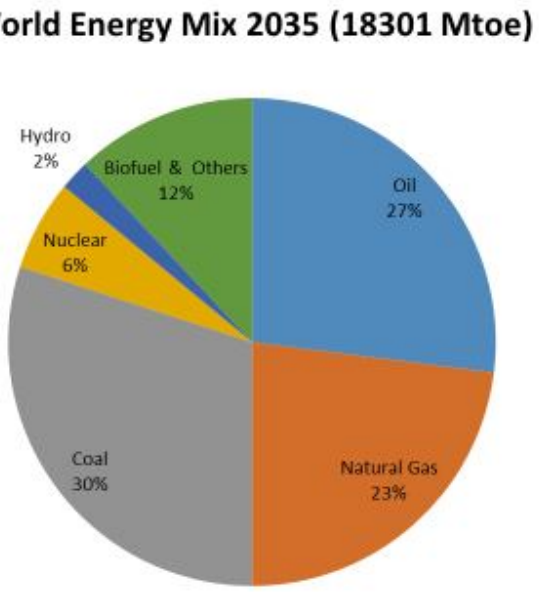

Figure 17 :World Energy Mix 2035

It is generally opined that the reserves of non-renewable fossil fuels are finite in quantity; future energy demand of the country should be met by nuclear and renewable sources of energy. Above analyses indicate that in 2035 major portion (80%) of world energy will be met by fossil fuels. In 2012, reserves to production ratio (R/P) of coal, oil, natural gas in the world were 109 years, 53 years and 56 years respectively (BP 2013). It may be inferred that in future fossil fuels will continue to play more important role in meeting the total energy need of Bangladesh, compared to nuclear and renewable energy.

D. **Energy Economic Relationship.**

i. **Energy and Social Development**

Energy is an essential commodity for most human activities, directly (as fuel) or Indirectly (to provide power, light, mobility). In traditional societies, populations rely on their own physical strength for labour, then on the power of domesticated animals, such as horses and oxen, then on water and wind, steam engines, hydrocarbons (fuel motors for land, sea and air vehicles) and finally - electricity. Energy combined with technology multiplies human force (e.g. motor fuel for cars, electricity for Household appliances), thereby playing a crucial role in pre- and post-industrial and then IT societies. For other essential needs such as space heating and cooking, the transition has been from local biomass (e.g. firewood, agriculture waste) to industrialized fuels (e.g. LPG, natural gas) and also electricity . Poor access to reliable and affordable modern energy services therefore acts as a barrier to economic and social development.

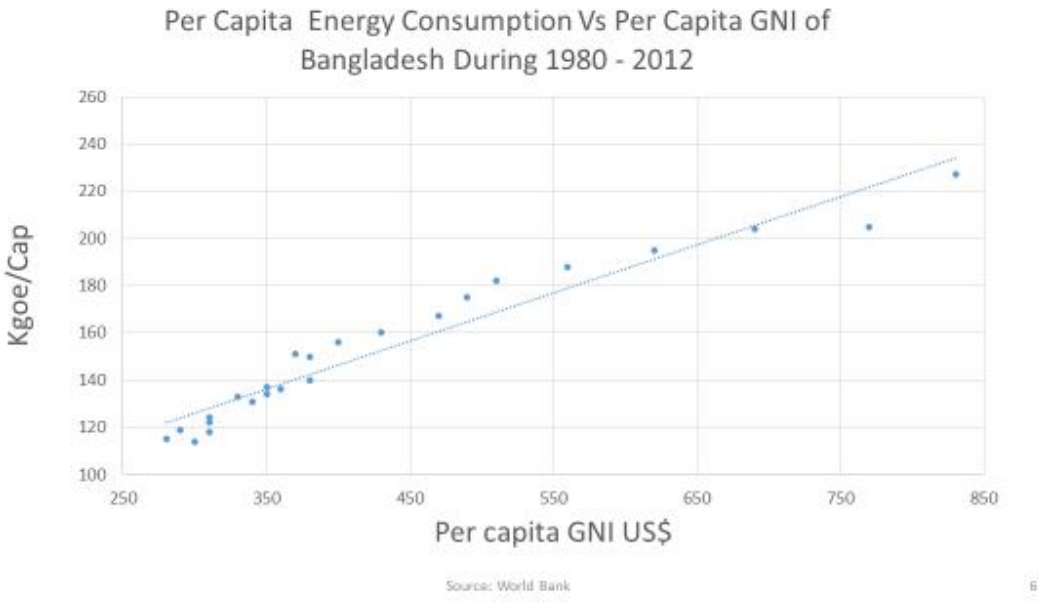

Figure 18 :Per capita Energy consumption VS Per capita GNI of Bangladesh (1980 – 2012)

ii. **Energy-Economy Nexus**

Energy is a critical input for socio-economic development. It is consumed to meet energy requirement for subsistence (e.g. cooking, lighting, room heating etc. at household level) needs and for productive activities (e.g. agriculture, industries, transport, commercial etc.). In the Least Developed Countries (LDCs)[1] major portion of total energy is consumed to meet subsistence need and the demands are met mainly by traditional energy sources including biomass fuels; and smaller portion is consumed in productive sectors by using commercial energy resources (e.g. coal, oil, natural gas and hydropower). When a country moves upward in the economic ladder, simultaneously it also move up in the energy ladder (inferior energy to superior energy). With the increase of per capita commercial energy consumption, proportion of energy used for subsistence needs decreases and productive needs increases. In industrialized countries major portion of energy is consumed to meet productive needs and smaller portion to meet subsistence needs.

Economic growths of a country mostly depend on it. Energy consumption, Economic growth, Capital, Manpower are co integrated. In the Fig. 1 Per Capita Energy Consumption is shown against Per Capita GNI of Bangladesh during 1980 – 2012. The linear curve indicate a direct relation between them.

As in fig. it is seen that there is positive correlation between per capita commercial energy consumption and per capita GNI; it means that increase in per capita consumption of commercial energy is necessary to increase per capita GNI. This correlation is different among the developing, under developed and developed countries.

viii. Energy Economic relation in Bangladesh

Historical data of per capita commercial energy consumption versus per capita GNI of Bangladesh during 1980 to 2013 is shown in Figure 1.

In Bangladesh, the policy planners and decision makers often make statements desiring to increase the economic level of the country to that of the middle-income countries by 2021, without mentioning

increasing needs of energy. According to World Development Indicator 2015 (WB 2015) in 2015, per capita GNI of Bangladesh, low-income, lower-middle-income and upper middle-income countries were US$ 870, <US$ 1045, US$ 1,046 – 4,125, and US$ 4,126 – 12745 respectively. A plot of per capita energy consumption versus per capita GNI of some selected Asian Countries in 2012 is shown in Figure 2. Per capita energy consumption of Bangladesh was one of the lowest among all the countries and in 2012 it was 270 kgoe and corresponding total energy consumption was 42.53 mtoe. It may be very difficult for Bangladesh to attain upper middle-income level (US$ 4,126 – 12,745) within 2021. However, it may be possible to attain lower-middle income level (US$ 1,046 - 4,125). In 2021, total population of Bangladesh is projected as 171.4 million. In that case, total energy consumption of the country will have to be increased from 42.53 mtoe in 2015 to 105.5 mtoe in 2021. Policy planners and decision makers need to recognize increasing need of energy to achieve higher per capita GNI level. It will be challenging tasks to increase projected consumption of energy on sustainable basis.

ix. Energy Economic Relation in others Countries

Advanced industrialized societies use more energy per unit of economic output and far more energy per capita than poorer societies, especially those remaining in a pre-industrial state. Energy use per unit of output does seem to decline over time in the more advanced stages of industrialization, reflecting the adoption of increasingly more efficient technologies for energy production and utilization as well as changes in the composition of economic activity. And energy intensity in today's developing countries probably peaks sooner and at a lower level along the development path than was the case during the industrialization of today's developed world. But even with trends toward greater energy efficiency and other dampening factors, total energy use and energy use per capita continue to grow in the advanced industrialized countries and even more rapid growth can be expected in the developing countries as their incomes advance. Development involves a number of other steps besides those associated with energy, notably including the evolution of education and labor markets, industrialization, employment generation, financial institutions to support capital investment, modernization of agriculture, and provision of infrastructure for water, sanitation, and communications. Nevertheless, it is hard to imagine overall economic development succeeding without energy development being an integral part of the evolution.

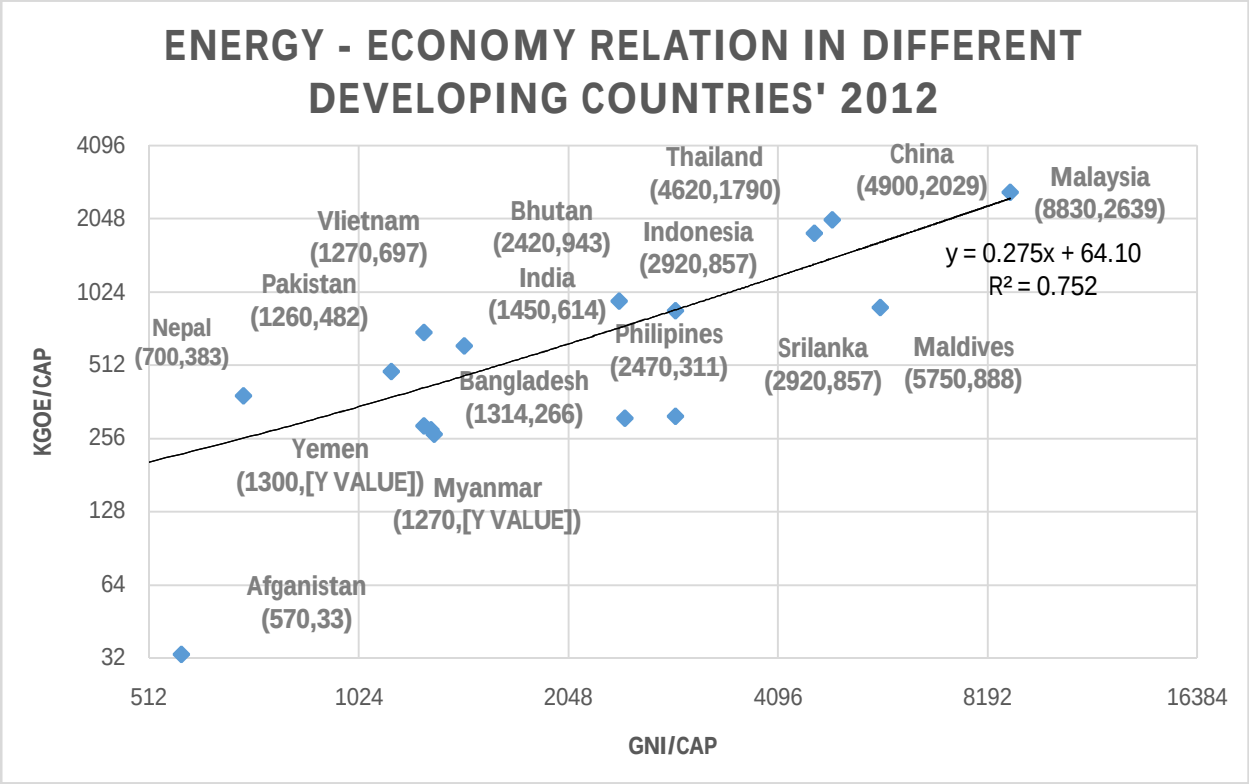

Figure 19 :Energy – Economy Relation in Different Developed & Developing Countries'2012

Table 7 : Year wise Per Capita Energy (Kgoe) of Selected Countries (1980 - 2012)

	1980	1981	1982	1983	1984	1985	1986	1987
Bangladesh	102	101	104	104	102	106	110	105
Australia	4737	4695	4817	4561	4652	4621	4620	4765
Brazil	935	877	871	872	908	950	974	992
China	610	598	607	622	651	658	671	695
India	294	302	307	310	317	326	331	336
Malaysia	860	898	886	1001	1002	983	1060	1046
Thailand	464	460	457	412	447	475	490	532
Singapore	2126	2125	1987	2196	2456	2473	2626	2754
Indonesia	383	394	395	393	400	405	438	444
Vietnam	268	266	271	275	273	271	278	287

1988	1989	1990	1991	1992	1993	1994	1995	1996
113	115	119	114	118	112	124	133	131
4771	4998	5053	4927	4958	5161	5111	5122	5404
987	989	937	939	934	942	977	995	1032

721	724	767	737	753	788	816	867	882
347	357	365	372	379	380	388	402	408
1067	1135	1183	1408	1514	1600	1553	1635	1760
596	656	741	797	842	882	968	1050	1163
2977	2893	3779	4157	4578	5477	6451	5337	5412
447	464	552	569	583	630	621	674	688
282	270	271	269	276	294	290	304	316

1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
134	137	136	140	150	151	156	160	167
5470	5555	5611	5665	5447	5570	5570	5599	5565
1068	1077	1085	1074	1078	1091	1095	1141	1157
872	870	879	920	933	979	1108	1285	1362
416	419	437	439	438	444	448	467	479
1788	1839	1812	2011	2059	2089	2194	2314	2457
1171	1086	1146	1159	1179	1289	1382	1479	1513
5894	5074	4564	4641	5130	5030	6230	7403	5145
700	675	698	741	750	767	778	796	799
335	352	357	376	390	420	436	478	503

2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
175	182	188	195	204	205	
5557	5297	5766	5629	5561	5501	5883
1154	1239	1296	1243	1362	1371	
1479	1551	1601	1717	1881	2029	
496	522	539	587	600	614	
2420	2609	2674	2514	2569	2639	
1534	1587	1627	1619	1768	1790	
5341	4755	5199	5667	6752	6452	
807	792	797	841	878	857	
510	544	575	621	678	697	

Table 8 : Year wise Per capita GNI (US$) of Selected Countries (1980 - 2013)

	1980	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**
Bangladesh	220	250	230	210	210	220	240	260
Australia	10840	11880	12090	11600	12040	12020	12300	12540
Brazil	2180	2080	2000	1710	1620	1590	1790	2040
China	220	230	220	220	240	280	320	320
India	270	300	290	290	290	300	320	360
Malaysia	1820	1860	1890	1820	1970	1930	1880	1960
Thailand	710	760	760	760	790	790	830	950

Singapore	4930	5510	5710	6790	6900	7030	7260	8120
Indonesia	510	580	600	580	560	530	530	520
Vietnam								

1988	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
270	280	290	300	316	310	310	330	340
14100	15590	17460	18340	18560	18920	18890	19280	20500
2250	2710	2700	2800	2780	2740	3040	3730	4460
330	330	330	340	370	410	470	540	660
400	400	390	350	350	330	350	380	410
2130	2240	2370	2530	2850	3200	3560	4010	4450
1160	1320	1490	1660	1890	2130	1960	1960	1900
8590	10690	12040	13450	15720	17760	20980	23610	25640
540	560	620	620	680	810	890	1000	1110
	220	130	110	130	170	200	260	310

1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
350	350	360	380	380	370	400	430	470
21970	21780	21440	21120	20120	19970	20120	25510	30340
5050	4870	4130	3860	3290	3050	2950	3310	3360
750	800	850	920	1000	1100	1260	1450	1740
420	420	450	460	470	470	530	630	740
4570	3600	3350	3420	3510	3760	4130	4700	5240
1900	2060	1960	1960	1900	1900	2060	2370	2600
27750	24010	23420	23670	21550	21760	23110	25650	28370
1110	670	980	570	680	730	910	1090	1230
350	360	370	400	430	460	510	590	680

2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
480	510	560	620	690	770	850	900
34170	37350	42390	44020	46510	50130	59790	65520
4800	6100	7480	8140	8520	10700	11640	11690
2040	2470	3050	3610	4240	4900	5720	6560
820	960	1050	1170	1290	1450	1550	1570
5810	6600	7500	7590	8150	8830	9820	10400
2890	3280	3750	3860	4320	4620	5250	5370
32080	35660	36680	37080	44790	48630	51090	

Total energy consumption of the country in 2014-15 was 42.53Mtoe, with a per capita consumption of 270 Kgoe (World Bank data 205 Kgoe in 2012) which is less compare to India (614 Kgoe), Pakistan(482 Kgoe), Srilanka (499 Kgoe), Nepal (383 kgoe) ,China (2029 Kgoe), Vietnam (697 Kgoe) Indonesia (857 Kgoe), Malaysia (2639 Kgoe), Brazil (1371 Kgoe) . In Figure19 & 20 Energy Economy Relation in different developing countries for 2012 is shown. We are far behind of Asia Standard (890 Kgoe) and Global Standard (1880 Kgoe).

Table 9 : Energy consumption and GNI per cap of some countries on income level

Country	**GNI per cap**	**Energy Consumption per cap**
a. Low income country (GNI per cap < 1045 US $)		
Afghanistan	570	33
Benin	810	390
Ethiopia	550	493
Nepal	700	383
b. Lower Middle income country (GNI per cap 1046 – 4125 US $)		
Bangladesh	1314	266
India	1450	614
Srilanka	2920	857
Bhutan	2180	943
Pakistan	1140	482
Vietnam	1270	697
c. Upper Middle income country (GNI per cap 4126 - 12745 US $)		
Maldives	5750	888
China	4900	2029
Malaysia	8830	2639
Thailand	4620	1790

d. High income country (GNI per cap > 12746 US $)

Korea Rep.	25870	5268
Japan	46330	3546
Singapore	48630	4716
Australia	50130	5644

On the top of this low level of consumption, there is already a serious energy crisis which is the result of sluggish growth in energy supplies while the demand for energy has grown by leaps and bound attendant with higher economic growth Clearly, the situation calls for an urgent but well-crafted sustainable long-term strategy to address the energy crisis and increase the energy supply to support Bangladesh's development. Energy options from domestic sources needs to be complemented with possible options for energy trade. Specifically, the strategy will address what the government can do about gas and power, and will look at options for diversification of fuels for generation. The strategy will also explore alternative solution such as increased electricity imports from neighboring countries and LNG trade. Furthermore exploration of domestically available resources, such as coal and oil and gas from offshore drilling will be intensified. The supply side options will be balanced with policies for demand management that conserve energy and discourage inefficient use of energy.

To determine energy – economy relation of 42 developed, underdeveloped and developing countries are shown in figure20. From the figure it is clear that though the relation is not linear, per capita GNI of a country is depend on consumption of energy per capita.

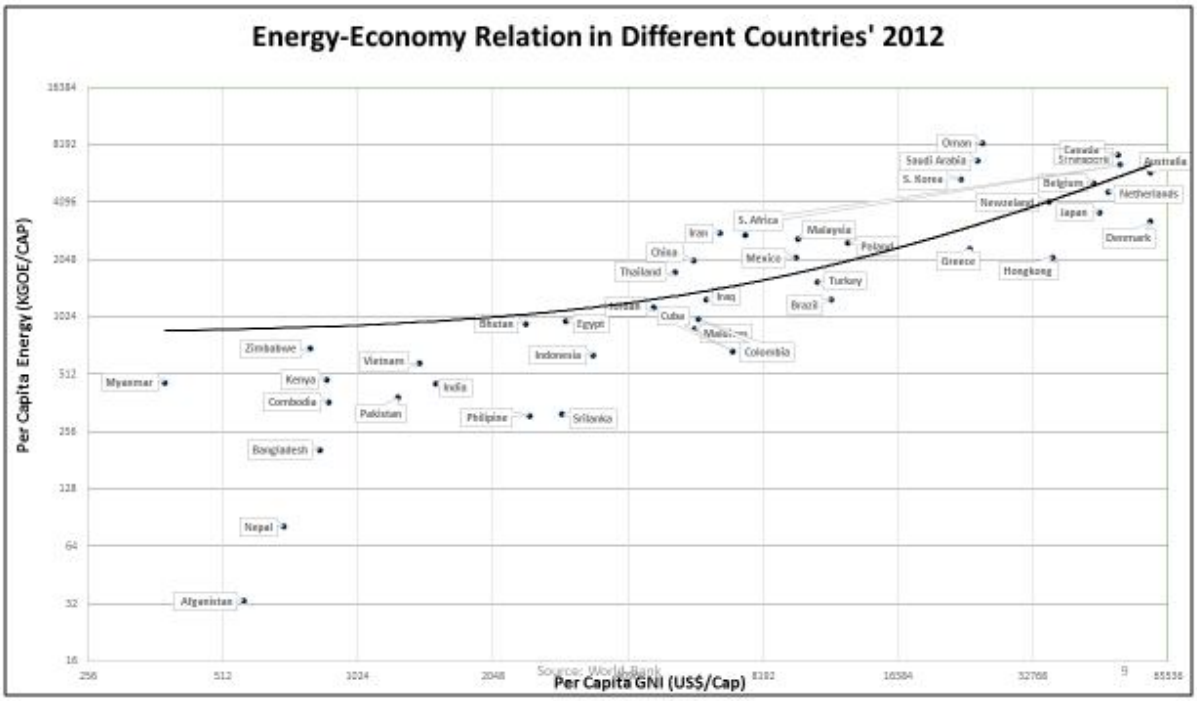

Figure 20 : Energy – Economy Relation in Different Developed & Developing Countries'2012

To realize vision 2021 of Government of Bangladesh **Energy security** will be one of the critical element. The Plan aims to develop an integrated and developed energy sector with a diversified fuel mix that will be the key driver of a sustainable local and national economy, while attaining global competitiveness in all sectors by 2021. The Plan will ensure prompt and timely decisions to steadily encourage greater private sector role in the energy sector; ensure transparent governance of energy-related public sector institutions; enhance the development of human capital; support development of the energy sector through physical and systemic structures; and contribute to the protection and enhancement of the natural environment. It will also promote renewable energy, such as solar and biogas; and ensure access to power and energy to all.

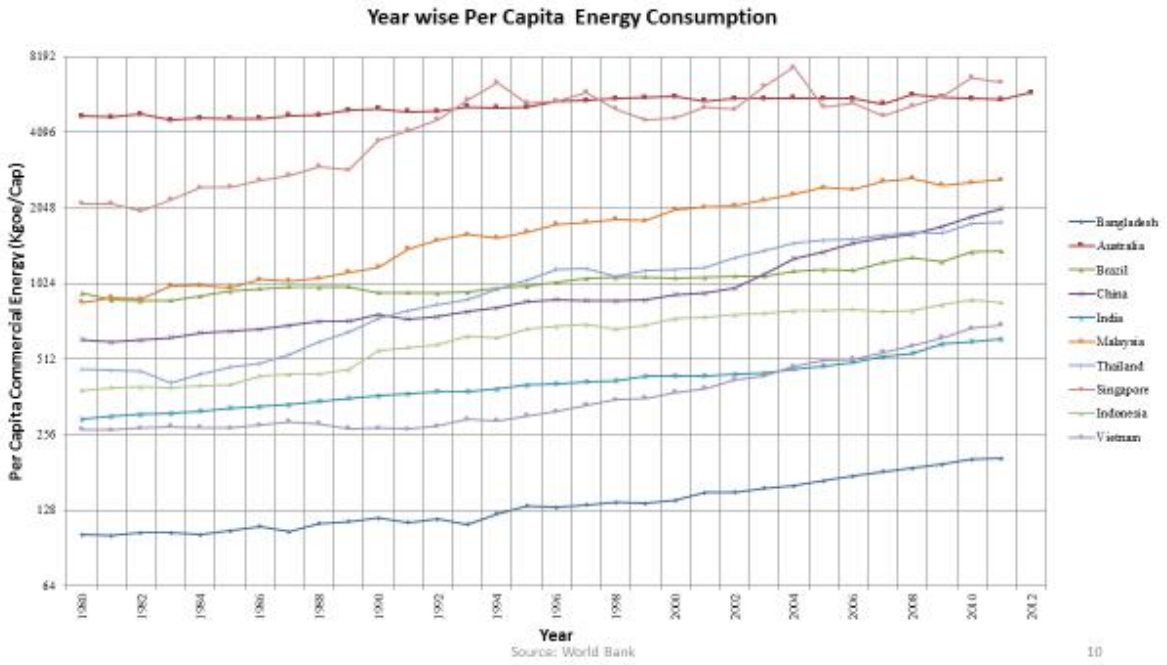

Figure 21 : Year wise per capita Energy consumption in Different Developed & Developing Countries'2012

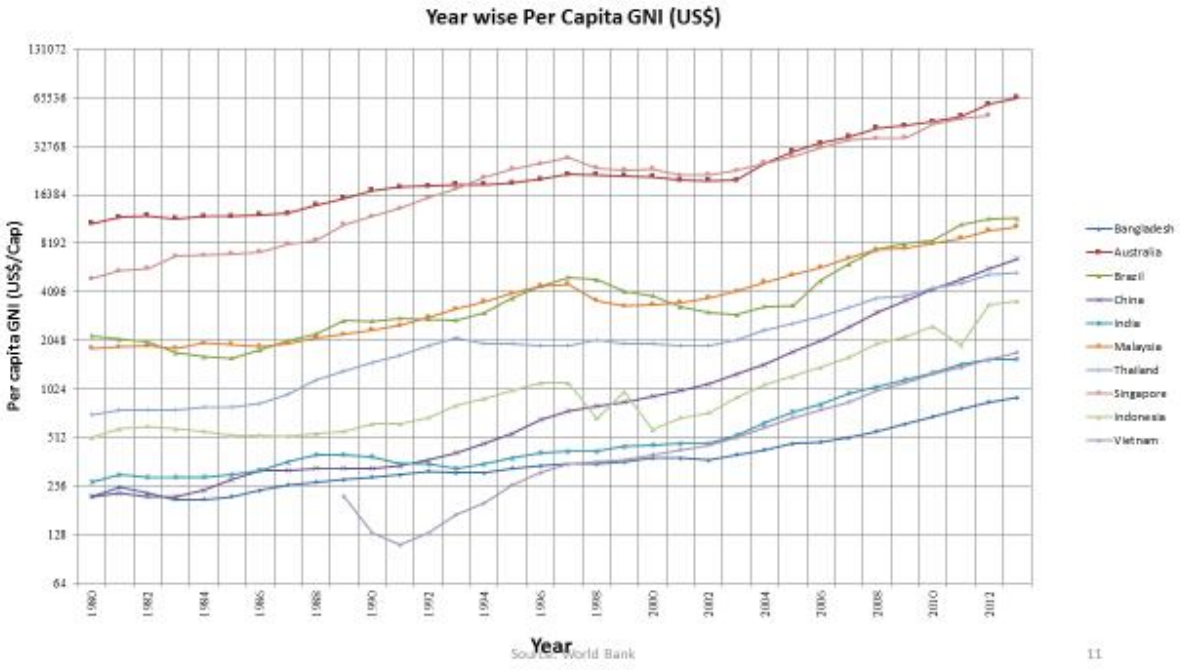

Figure 22 : Year wise per capita GNI in Different Developed & Developing Countries'2012

x. Efficient Energy Use

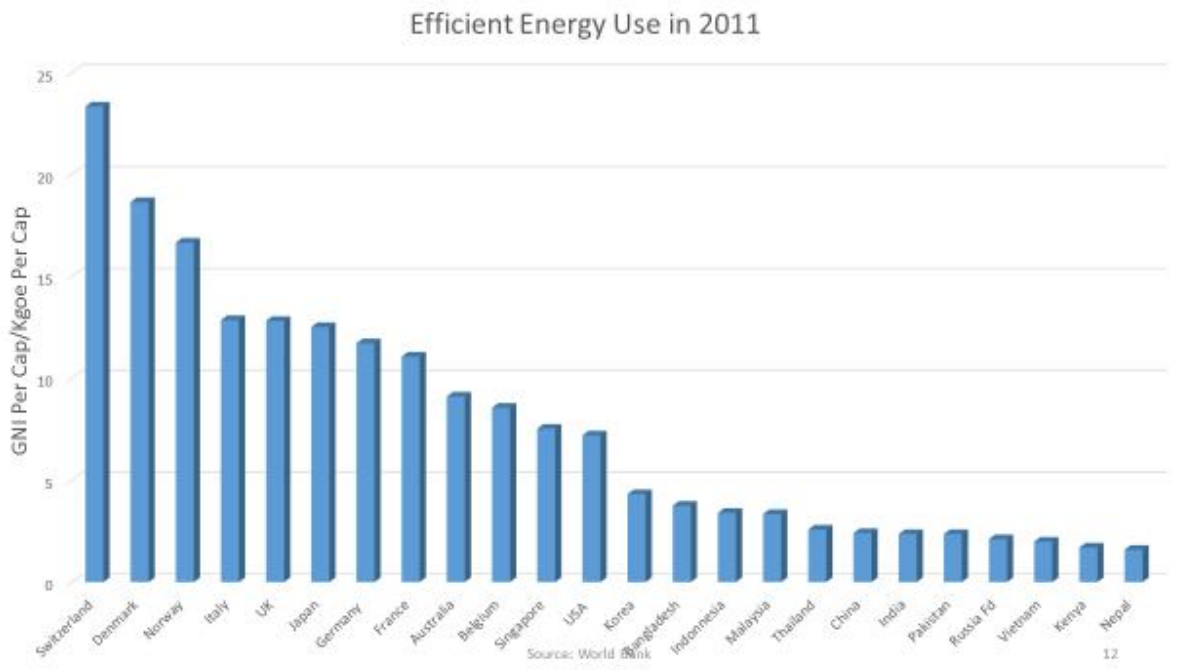

Figure 23 : Efficient Energy Use in Different Developed & Developing Countries'2012

E. Economic status of Countries

World bank classify the member states every year for the purpose of lending issue on the basis of income level in the category of Low Income, Lower Middle Income , Upper Middle Income and High Income. In Table 10 the classification criteria is shown. In table 9 list of some countries on different income level are shown. As per BBS our GNI per cap is 1314 US$ in 2014-15, we are now on the level of lower middle income. Though as per World Bank our GNI I is 1080 US$. As a result World Bank has categorized our country as a Lower Middle Income country.

Table 10 : World Bank Classification of Countries

World Bank Classification Of Countries

GNI Per Capita In US$

Economic Status	FY 13	FY 14	FY 15
Low Income	< 975	< 1035	< 1045
Lower Middle Income	976 - 3855	1036 - 4085	1046 – 4125
Upper Middle Income	3856 - 11905	4086 - 12615	4126 - 12745
High Income	> 11906	> 12616	> 12746

Source: World Bank 16

F. Energy Requirement

To achieve the vision 2021 turning the country to a middle income country with a per capita income of 2000 US$ there should be a drastic increase in energy consumption consequently the energy supply should increase. In Fig. from energy economic relation of some developing countries it is seen that there is a linear relation between them and the relation may be represent by the equation y = 0.275x + 64.10 with R square of 0.752 . From the diagram for a per capita GNI of 2000 US $ of a country the per capita energy consumption should be around 614 Kgoe.

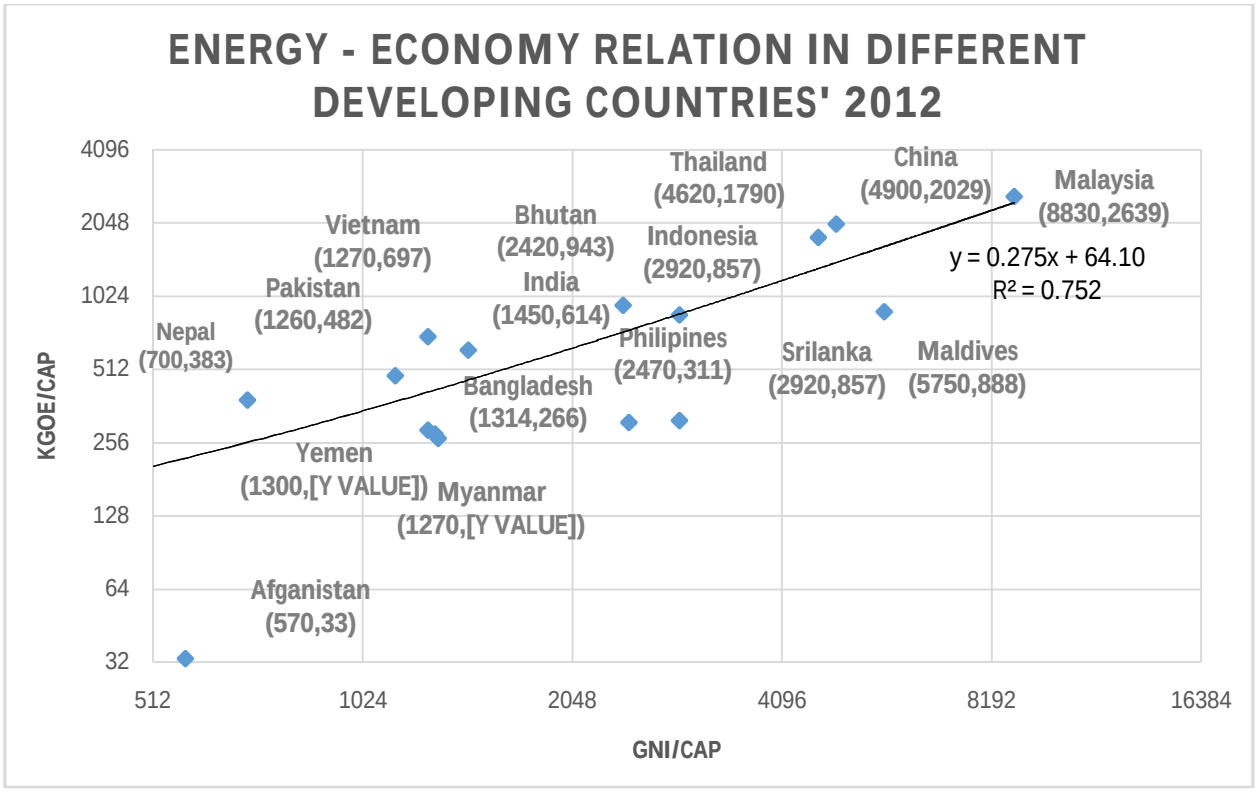

Figure 24 :Energy – Economy Relation in Different Developed & Developing Countries'2012

ii**. Demand Forecast (2015 – 2021)**

a. Natural Gas

Present demand for natural gas is 3200 mmcfd where supply is 2700 mmcfd with a deficit of 500 mmcfd. The demand will grow further in future. The Demand and Supply scenario is shown in Figure 25. The production forecast is shown in Table 12.To turn the country middle income country by 2021 the demand for natural gas will have to meet not only by limited natural gas reserve also through importing LNG. In that case Bangladesh will enter in the new world of energy and to face a new challenge to cope with the high cost of energy. But the scenario will be different if there is some discovery in the offshore (though it will take minimum 7 – 8 years to develop), which is very prospective in the settlement of maritime boundary with Myanmar and India. Interim period LNG is the alternative.

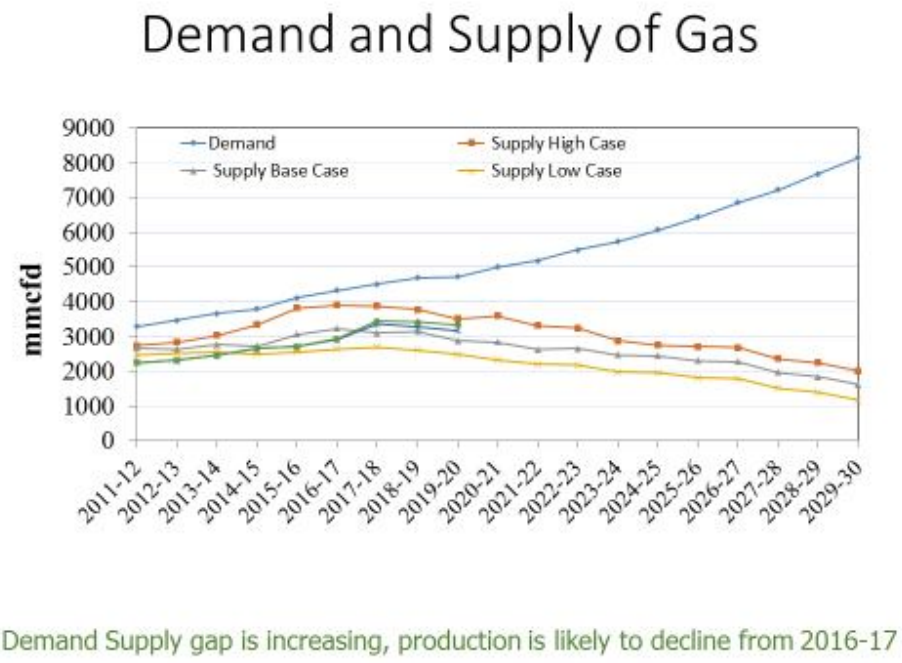

Figure 25 : Demand and Supply of Gas up to 2029 - 30

Table 11: Production Forcast of Natural Gas

Production Forecast of Gas (2015 - 2021)

Year	2015	2016	2017	2018	2019	2020	2021
Production (MMcfd)	2617	2818	2780	2717	2632	2546	2358

Source: PB 36

Table 12: Forcast of LNG Import

Forecast of LNG Import (2015 – 2021)

Year	2015	2016	2017	2018	2019	2020	2021
LNG (MMcfd)	-	-	500	1000	1165	1885	1885

Source: PB,PDB 37

b. Power sector.

The installed capacity for power generation will get huge boom during 2015 – 2021 to ensure electricity for all by 2021. Demand forecast of electricity is given in table 12. The projection of increasing installed generation capacity by 2021 is shown in figure 26. To meet the energy requirement for this purpose the energy mix should be change with great contribution from coal based power generation. Focusing coal as main primary source of energy. Power generation by liquid fuel will continue. Private sector will play important role in this respect.

Table 13 : Demand Forecast of Electricity

Table 3-1 Result of demand forecast (3 scenario)

FY	Government Policy Scenario		Comparison GDP7% Scenario		Comparison GDP6% Scenario	
	Peak Demand [MW]	Generation [GWH]	Peak Demand [MW]	Generation [GWH]	Peak Demand [MW]	Generation [GWH]
2010	6,454	33,922	6,454	33,922	6,454	33,922
2011	6,765	35,557	6,869	36,103	6,756	35,510
2012	7,518	39,515	7,329	38,521	7,083	37,228
2013	8,349	43,882	7,837	41,191	7,436	39,084
2014	9,268	48,713	8,398	44,140	7,819	41,097
2015	10,283	54,047	9,019	47,404	8,232	43,267
2016	11,405	59,945	9,705	51,009	8,680	45,622
2017	12,644	66,457	10,463	54,994	9,165	48,171
2018	14,014	73,658	11,300	59,393	9,689	50,925
2019	15,527	81,610	12,224	64,249	10,255	53,900
2020	17,304	90,950	13,244	69,610	10,868	57,122
2021	18,838	99,838	14,249	75,517	11,442	60,640
2022	20,443	109,239	15,344	81,992	12,056	64,422
2023	21,993	118,485	16,539	89,102	12,713	68,490
2024	23,581	128,073	17,840	96,893	13,416	72,865
2025	25,199	137,965	19,257	105,432	14,167	77,564
2026	26,838	148,114	20,814	114,868	14,979	82,666
2027	28,487	158,462	22,509	125,209	15,848	88,156
2028	30,134	168,943	24,353	136,533	16,776	94,053
2029	31,873	180,089	26,358	148,928	17,768	100,393
2030	33,708	191,933	28,537	162,490	18,828	107,207

Source: PSMP Study Team

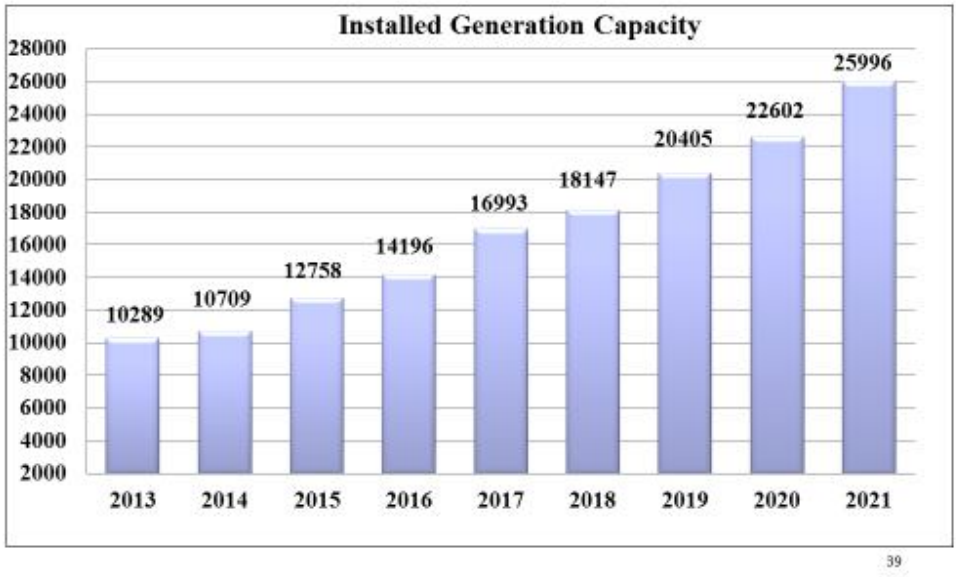

Figure 26 : Projection of Increasing Installed Generation Capacity by 2021

iii. Projected Energy Supply (2015 – 2021)

In the back drop of huge energy demand, our energy resources are limited. Government has initiated programmed to produce electricity by coal (local & Domestic) and LNG based power plant is also going to be set up as per power sector master plan. LNG is the alternative to meet the natural gas demand considering this LNG terminal is going to be set up. Initiative has been taken to set up more LNG terminal both land based and floating type. Through fuel diversification programed different initiative has been taken. The renewable energy sector is also growing rapidly. Import of electricity through cross border boundary is going on and which will improve further in near future. Nuclear power will also available by 2021.Biomass is also very promising to explore.

Considering all form of energy sources in our country the energy supply scenario is shown in Table 13.

Table 14: Energy Supply of Bangladesh (2015 – 2021)

Year	Natural Gas & LNG (Bcf)	Liquid Fuel (Kton)	Coal (Kton)	Imp. Elect. & Nuclear (MW)	Renewable Energy (MW)	Total Commercial Energy Supply (Mtoe)	Biomass (Mtoe)	Total Energy Consumed (Mtoe)	Population (Million)	Per Capita Energy Consumed (Kgoe)
2015	955	6680	2500	500	580	31.2	12.74	43.94	157.1	279.72
2016	1029	7940	3000	600	730	34.42	13.39	47.81	157.5	303.56
2017	1380.5	8550	3200	1200	930	39.65	14.66	54.32	158.2	343.48
2018	1357	8824	7900	1200	1130	47.01	16.51	63.51	158.7	400.23
2019	1385	9000	14800	1200	1230	52.16	17.38	69.55	162.5	428.01
2020	1619	9000	19350	2200	1330	61.47	18.36	79.84	167.5	476.67
2021	1600	9300	30350	3200	1430	69.24	18.40	87.64	171.4	511.32

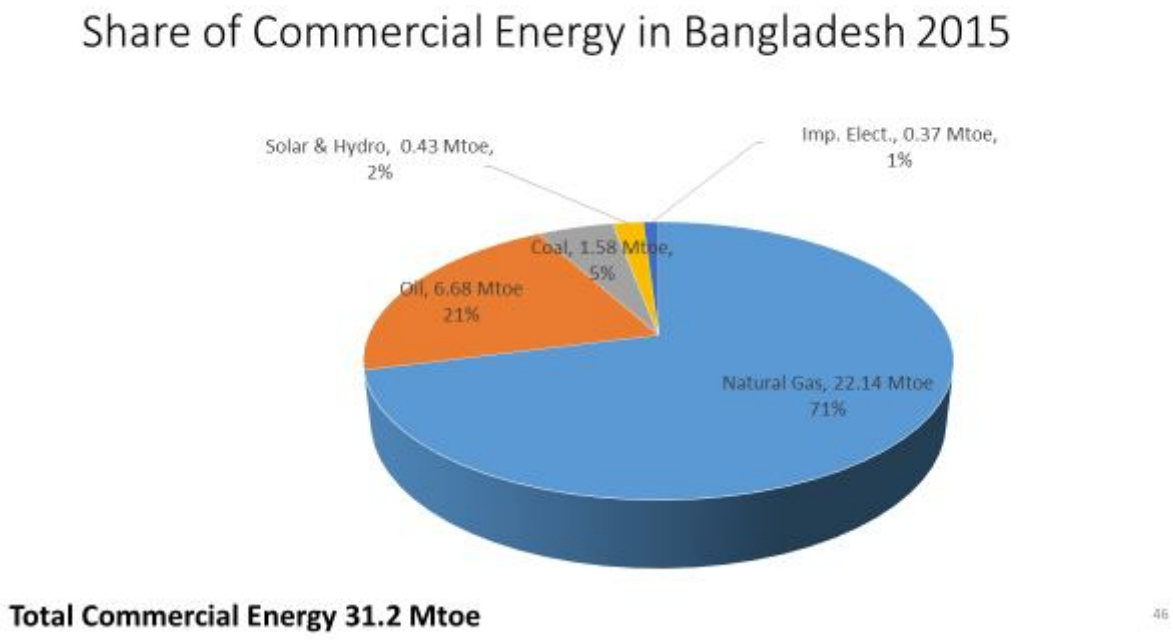

Figure 27 : Share of commercial energy in Bangladesh 2015

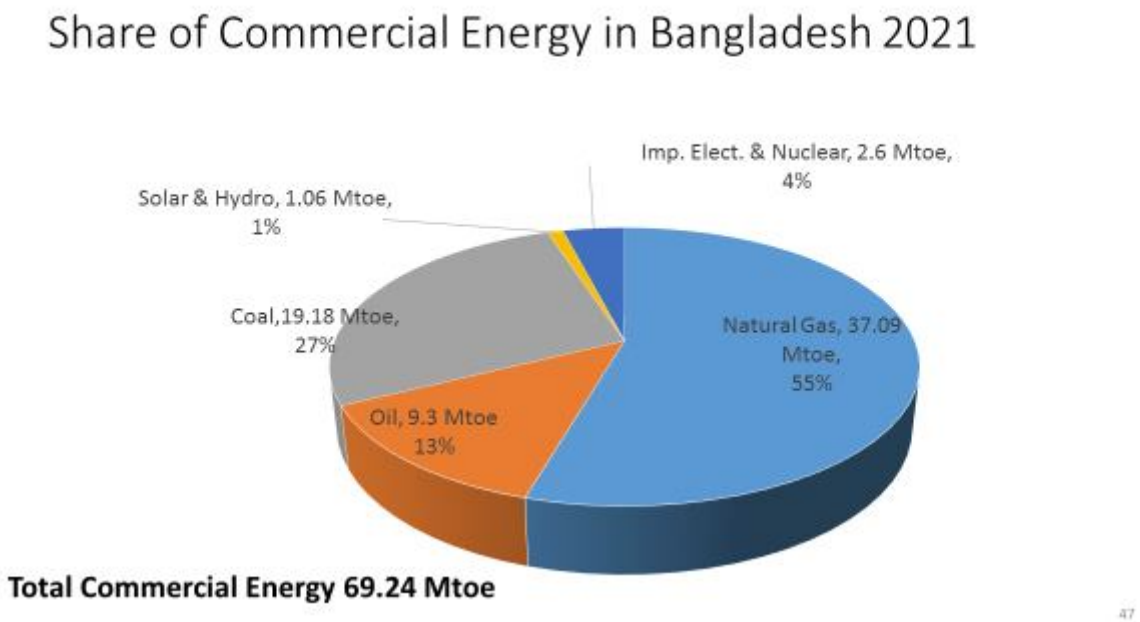

Figure 28 : Share of commercial energy in Bangladesh by 2015

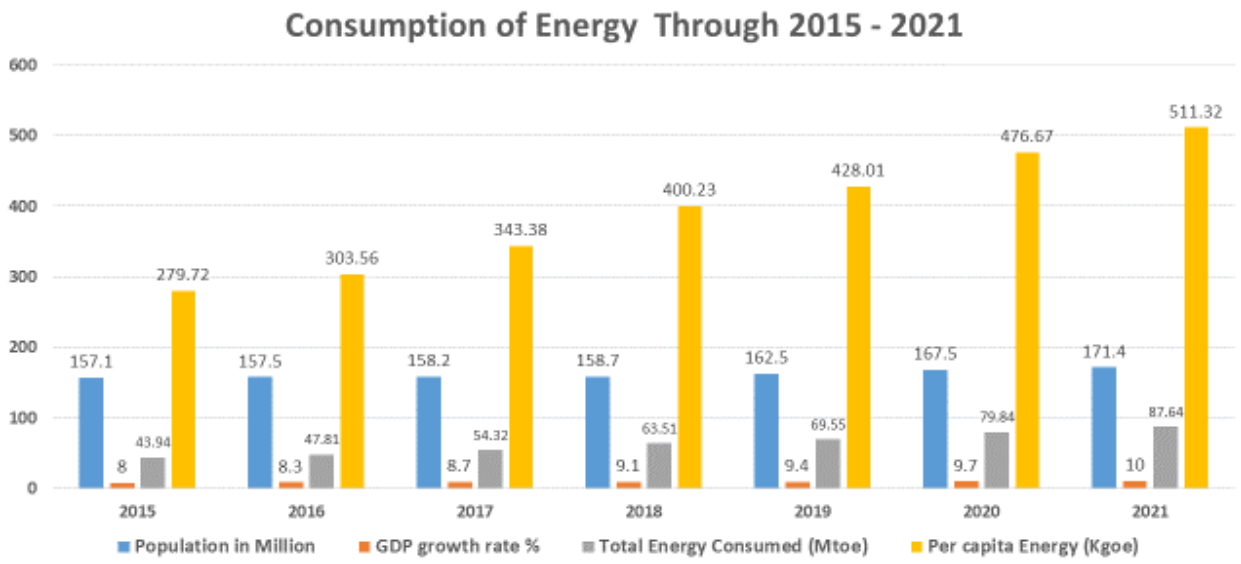

Figure 29 : Consumption of Energy Through 2015 - 2021

Energy conservation and energy efficiency

"Energy conservation" and "energy efficiency" are often used interchangeably, but there are some differences. At the most basic level, energy conservation means using less energy and is usually a behavioral change, like turning your lights off or setting your thermostat lower. Energy efficiency, however, means *using energy more effectively*, and is often a technological change. Energy efficiency measures the difference between how much energy is used to provide the same level of comfort, performance or convenience by the same type of product, building or vehicle.

Conservation certainly reduces energy use, but it's not always the best solution because it may impact comfort or safety as well. Efficiency, on the other hand, maintains the same level of output (e.g. light level, temperature) but uses less energy to achieve it.

A combination of both energy conservation and energy efficiency measures yields an ideal solution.

The following measures should be taken for energy efficiency and conservation of energy:

1. Energy conservation act should be enacted and that should be strictly implemented.
2. Energy Audit should be performed in energy intensive industries like Power, Fertilizer and manufacturing and process industries.
3. Adaption of latest generation energy efficient technology in all energy intensive industries.
4. Replacement and Rehabilitation of inefficient, aged installations should be phase out by modern latest generation energy efficient plant and appliances.
5. Action program me should be taken to standardize modern latest generation technology based plants and appliances in different energy consuming sector.
6. Energy efficient green building technology should be encouraged and include in National Building Code.
7. Promotion of energy efficient vehicle like hybrid car.
8. Optimal utilization of natural gas in all sectors should be ensured..
9. Domestic use of natural gas should be gradually phase out instead of LPG should be encouraged.

10. Natural gas in captive power sector should be restricted and phase out gradually.

11. Energy price should be made rational and target group may get the privilege of subsidy but not common to all.

12. Energy taxes may be introduce for conservation of energy.

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