

# Energy Sector Development and Energy Security in Bangladesh

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## Abstract

Energy security has always been a concern for all the countries in the world, as with modernization, the use of energy has been increasing rapidly and people's life and national economy becoming dependent on the usage of energy. So to maintain a secured future different initiatives are being taken in the energy sector all over the world. It is therefore essential to take steps to ensure necessary energy supplies and their proper distribution in Bangladesh to support steady socio-economic development. The main objective of this paper is to illustrate the forthcoming steps and activities for the effective development in the energy sector of Bangladesh. The policy planners and decision makers of the country often make statements desiring to increase the economic level of the country to that of the middle-income countries by 2020,[3] without mentioning increasing needs of energy, whereas growing size of the economy and rising energy demand go hand in hand. So attention towards the energy sector has to be a top-notch in order to get the best out of this sector. Along with energy development the concern of energy security comes with modernization, as the use of energy is increasing day by day, people's life and economy are becoming dependent on the usage of energy. Energy security indices reveal that necessary emphasis should be given in the energy security i Shortage of fuel, Shortage of fund, Short of experts in managing large projects, lack of adroit manpower has led to insecurities in energy sector. This paper presents a broad overview of energy scenario and energy security in Bangladesh perspective providing insights into the present status and guidelines for future action.

**Keywords:** Energy security, Strategy, Energy consumption, Renewable Energy

**1.Introduction:** The primary concern of energy production in Bangladesh is the protracted effects of energy demand and this requirement of energy will be more than double by 2020. With commercial energy increasing by 400% , 53% of the present supply of energy comes from traditional fuels and the remaining from commercial sources. Therefore traditional energy supplies have been transferred away towards commercial energy which has been the characteristic of Bangladesh's energy development since 1980's [3]. If supply of energy is not proliferated accordingly there will be a serious adverse implications for the nation's economic and social development. Relations between energy consumption and Human Development Index, energy consumption and economic growth, biomass fuels consumption and economic growth on the one hand and different energy sources that are trapped to meet the World Energy Demand has been presented. For a Developing country like Bangladesh , energy development program should be so conceived as would ensure energy security under long term perspective not only to meet the demand according to the present requirement but also to ensure energy security for future generation. A conceptual framework for national energy policy has been outlined .Energy consumption of the country in 2000 and projected demands of commercial energy estimated by Gas Demand and Reserve Committee for business as usual GDP growth rate (4.55) and cumulative natural gas demand for different GDP growth scenarios (3%, 4.55%,6% & 7%) up to 2050 have been presented[2]. Availability of indigenous commercial ,non-commercial and non-renewable energy sources have been assessed.To hold a good operational command and proficient managerial activities , some issues have been illustrated.

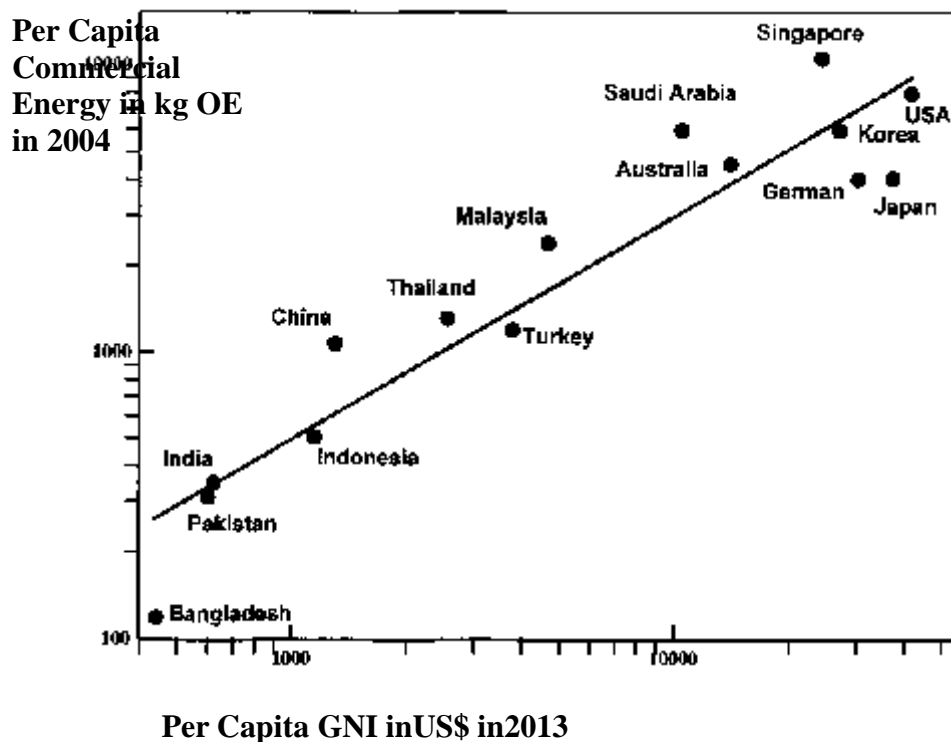
## 2. Energy Development Strategies:

For a developing country like Bangladesh the energy development strategies are dependent on the sustaining relations between energy consumption and economic growth, energy consumption and Human Development index, biomass fuels consumption and economic growth and different energy sources providing world energy demand. A long term comprehensive and integrated energy policy along with appropriate strategies should be formulated to ensure energy security over short, medium and long terms for the country. The policy should ensure tapping of all possible sources of energy, adequate supply of energy to its various uses and equitable access of renewable energy to all segments of society [1]. Due emphasis must be given on the usage of the renewable energy sources and extensive research and development programs should be conducted to for the further development of renewable technologies. As the domestic energy sources of Bangladesh are extremely limited the option for importing hydropower from Nepal, perhaps also from Bhutan and India , should be pursued by promoting mutually beneficial GBM regional co-operation on energy .The co-operation regime may include the establishment of a Regional Electricity Grid. Energy sector must be made sufficient through the improvement of management and operational aspects relating to generation, transmission and distribution. In this context , it is essential to curb the system loss, improve transparency and accountability, remove financial constraints and introduce proper billing system and collection procedures[7].

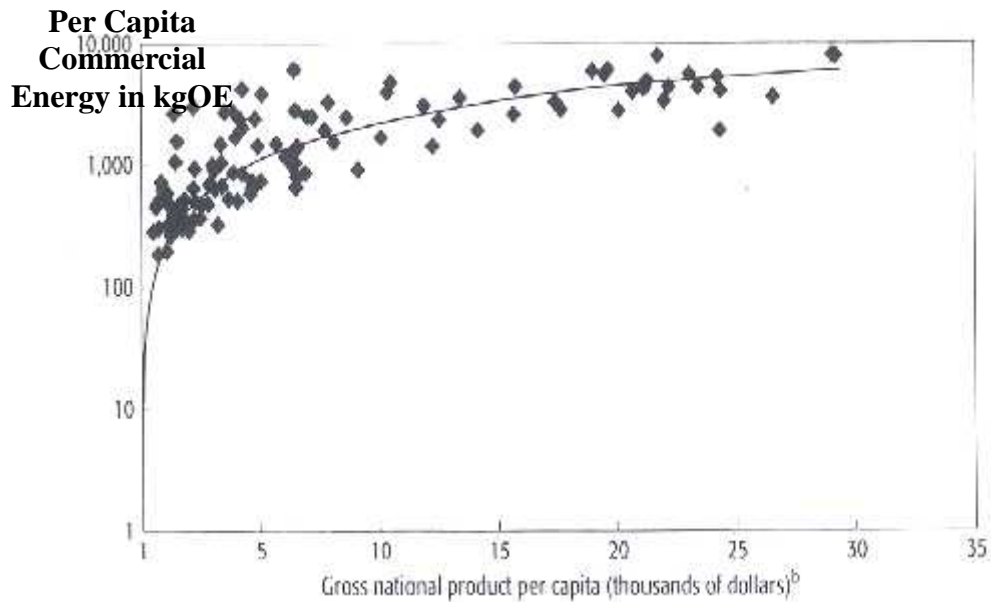
### a) Energy Consumption and Economic Growth:

Per capita energy consumption of Bangladesh is one of the lowest in the world. Major portion of Energy is consumed for Subsistence (e.g. cooking, lighting, heating etc.)& small portion for economic growth for instance agriculture, industry, transport and commerce etc. In developed countries higher proportion of energy is consumed for economic growth and smaller proportion for subsistence.[5]

### Per Capita Commercial Energy and Per Capita GNI



## Per Capita Commercial Energy Consumption & Per Capita GNP

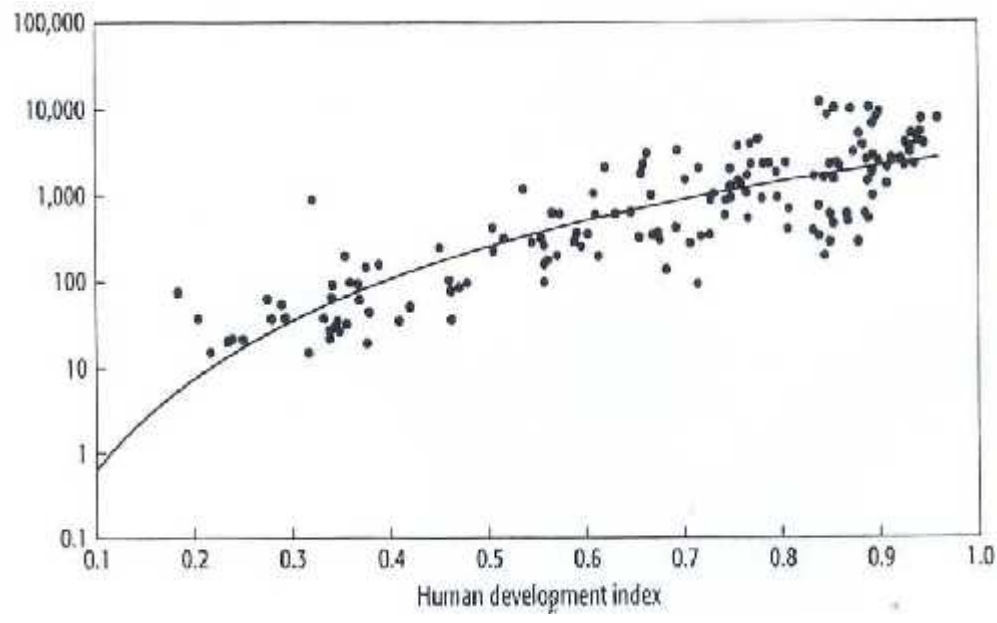


Source: Saghir & O'Sullivan  
2012

### b) Energy Consumption and Human Development Index:

Nowadays human development index is considered as a better indicator of development than per capita GNP. Energy has determinant influence on HDI (Human Development Index). [8] In the early stage of development where the most of the developing countries exist, per capita consumption of total energy of Bangladesh in 2013 was only 217.5 kg OE and per capita commercial energy consumption of 1000 kg OE is necessary to sustain a reasonable level of development [9]. In Bangladesh national planners will have to decide about the time when the country would attain a reasonable level of HDI from .502 in 2010 to .75-.8 (at a future year). [7] Future energy needs of the country may then be estimated accordingly. It may be stressed that it may not be possible to increase HDI without providing adequate energy input in national economic development. Per capita energy needed to reach a particular level of HDI may vary from country to country which relies on the energy intensity of the chosen development path.

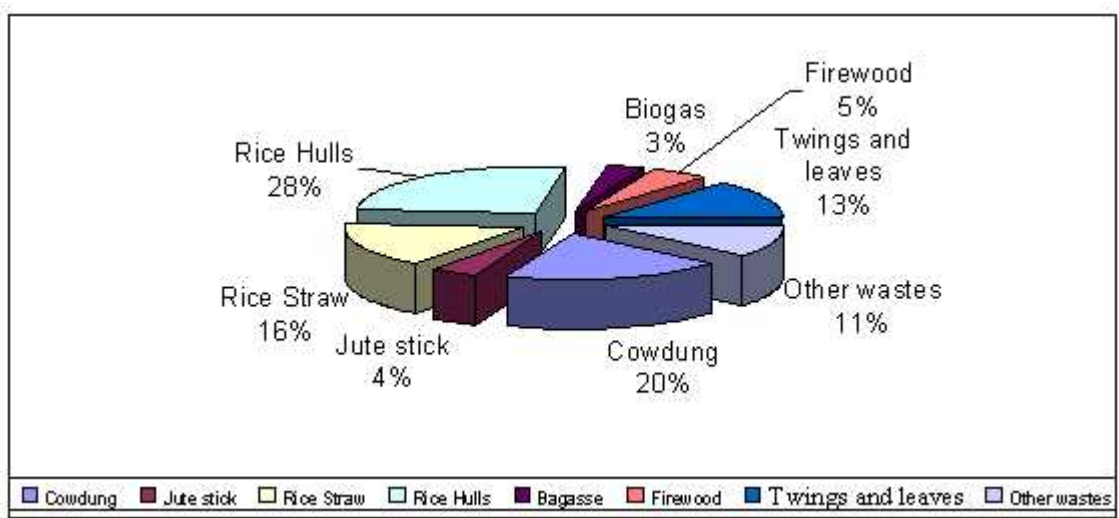
**Per Capita Commercial Energy Consumption & Human Development Index (HDI)**  
**Energy in kg OE**



**Source: Saghir & O'Sullivan 2012**

**c) Biomass fuels Consumption and Economic Growth:**

One of the important sources of energy in many countries as well as in our country is the Biomass energy which is the oldest type of fuel which has been used for centuries after discovery of fire itself. The increase in numbers of rural poor to use forests unsustainably for fuel-wood, bamboo, fodder, game meat, medicine, herbs and roof materials. Deforestation will deteriorate the natural cycling system as well as increase the cost of fuel wood required, both in time and money, creating a vicious circle and further deforestation. Forest in many developing countries are disappearing at a high rate.[11] Major problems are facing Bangladesh are food and fuel. In Bangladesh commonly known Bio-mass fuels are; fuel wood, agricultural residues and animal dung. The country has naturally high potential rate of production of Biomass resources but because of high growth rate of population forest cover is being reduced in an alarming proportion. In Bangladesh while looking at over all energy consumption over the past 15 years, Bio-mass energy contributed 83% in 1980-81, 73% in 1989-90 and 67% in 1994-95.[3,4] With the growth of GDP, consumption of commercial fuel increased more rapidly than that of Biomass fuel.



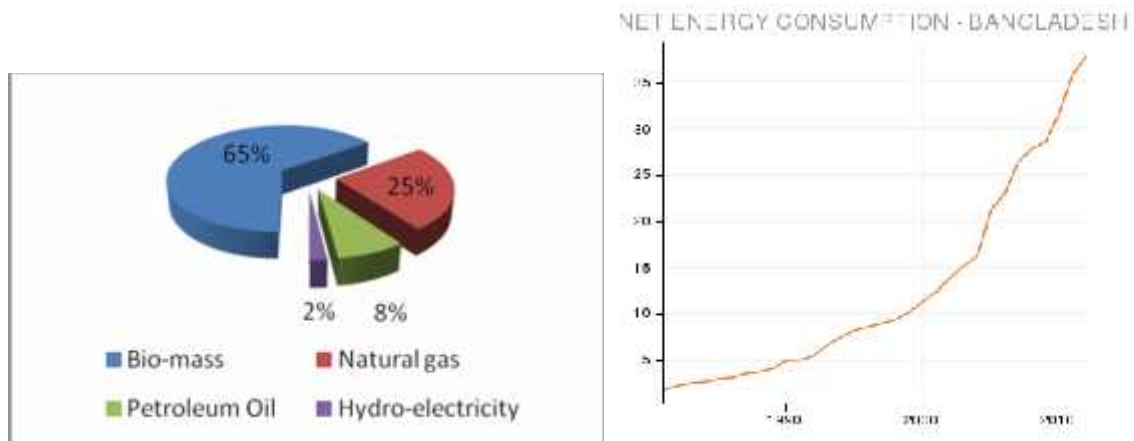
**Source: World Tables, World Bank, (2011) and BBS (2010)**

#### d) **Energy for Sustainable Development:**

Energy is a strategic input for socio-economic development. Energy has direct linkages with economic security, food security and environmental sustainability. For a developing country like Bangladesh, the energy security issue needs to be considered in the context of sustainable human development. In order to ensure energy security for sustainable development it would be necessary to consider the energy needs of the country under long term perspectives

### **3. Energy consumption in Bangladesh:**

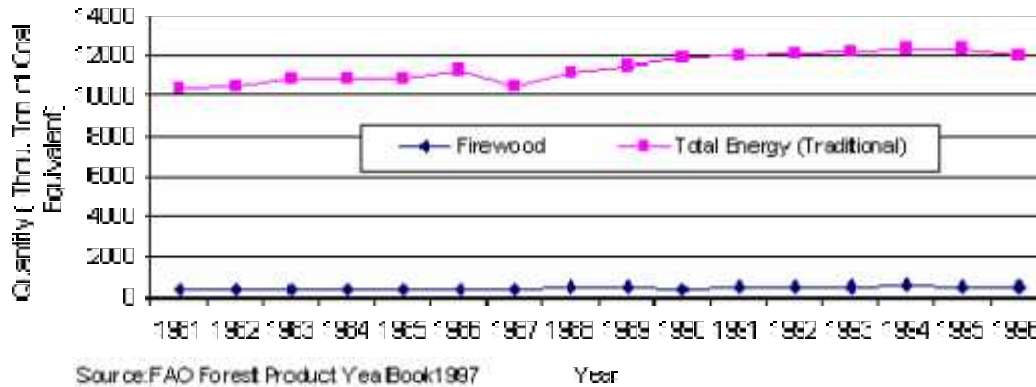
In Bangladesh the sources of energy consumption are Bio-mass (wood, animal and agricultural residues, municipal waste etc.) which contributes about 65% of the total energy consumption and the remaining 35% stands for commercial sources which are natural gas, oil, coal and hydroelectricity [1]. The estimated consumption of Biomass and commercial fuels in 2000 are shown in Table: 1 and Fig: 1. Distributions of commercial energy consumption in 2000 were: Natural gas 67.8%, petroleum fuels 28.6%, coal 2.8% and hydropower 1%. According to the World Bank, the consumption of energy in Bangladesh was 204.72 kg OE (kg of oil equivalent per capita) in 2011. <sup>[1]</sup>. Consumption of energy in Bangladesh from 1991 to 2011 is shown in Fig: 2.



**Fig: 1. Distribution of energy Consumption in Bangladesh**

Though there is a huge demand of energy for about 130 million people, statistical data shows that, the per capita commercial energy consumption in Bangladesh is extremely low comparing to other south Asian countries. Approximately three-fourths of the total population of Bangladesh is rural and a substantial proportion of the urban population is poor and slum dwellers; [2] whose are mostly outside of commercial energy system. In order to support a reasonable level of development, per capita commercial energy consumption 1000 kgOE is necessary (Suarez 1995), but our per capita consumption is almost 5 times far back from that. The traditional source of energy supply in Bangladesh consist of fuelwood, agriculture residues such as cow-dung, jute stick, rice straw that dominates the primary energy production and supply in Bangladesh. Figure 1. demonstrated that the total energy supply from traditional source increased from 10,357 for the year 1981 to 12034 in 1996 thousand ton of coal equivalent with an exception of decreasing trend in 1987. [3] During this period the share of fuelwood supply has also increased from 3.6 to 4.5 percent for the same period. In Bangladesh, biomass fuels, including dung, accounted for around 73 per cent of total energy consumption in 1989/90, one of the largest percentages in the Regional Wood Energy Development Programming (RWEDP) countries. [12] Of the estimated 39 million tons this represents, around 20 per cent came in the form of fuel wood, tree residues.

Figure 1: Total Energy Supply from Traditional Sources



#### 4. New Renewable Energy resources:

- **Solar PV:** The Renewable Energy Research Centre (RERC) at Dhaka University shows that average irradiation rate in Dhaka is (4.7 kW.hr/m<sup>2</sup>/day). Bangladesh being a compact,[12] flat country with little geographic variation this data can be taken as reasonably representative for the whole country. The period February to June gives excellent insolation over Bangladesh. Although the rainy season is long, the overall condition for solar energy in Bangladesh is quiet good throughout the year which is suitable for generation of electricity using PV cells.
- **Solar thermal technologies:**
  - a) **Solar power tower:** For the production of solar power concentrated sunlight is focused on a solar production unit. The system uses hundreds to thousands of sun-tracking mirrors called heliostats to reflect the incident sunlight onto the receiver. These plants are best suited for utility-scale applications in the 30 to 400 MW range.[3]
  - b) **Solar Parabolic trough:** Parabolic trough technology is currently the most proven solar thermal electric technology. This is primarily due to nine large commercial-scale solar power plants, the first of which has been operating in the California Mojave Desert since 1984.[4] These plants, which continue to operate on a daily basis, range in size from 14 to 80 MW and represent a total of 354 MW of installed electric generating capacity. Large fields of parabolic trough collectors supply the thermal energy used to produce steam for a Rankine steam turbine/generator cycle.
  - c) **Solar dish engine:** Dish/engine systems convert the thermal energy in solar radiation to mechanical energy and then to electrical energy in much the same way that conventional power plants convert thermal energy from combustion of a fossil fuel to electricity.[5] This systems use a mirror array to reflect and concentrate incoming direct normal insolation to a receiver, in order to achieve the temperatures required to efficiently convert heat to work. This requires that the dish track the sun in two axes. The concentrated solar radiation is absorbed by the receiver and transferred to an engine.[7]

- **Biomass fuels:**

- a) Gasification based biomass:
- b) Direct-fired biomass:
- c) Biomass co-firing:

**Wind Energy:**Total wind power generation units installed in Bangladesh was reported as .05 MW and it was .00125% of the total installed power plants of Bangladesh (4000MW).[10] Because of high cost there is limited prospect of wind power towards meeting the total energy need of Bangladesh. Micro and mini hydro-power, which is one of the most important branches of renewable energy sources, is a cheap and clean method of power generation. Unfortunately, the scope is very limited in Bangladesh by the country's topography. Because the country is flat, hydroelectricity is not abundant. At present 230 MW is being harnessed from the Kaptai Dam. Two potential sites for feasibility studies are Bandarban and Madhabkundu.[11]

## **5. Strategies for Energy sector development:**

In Bangladesh's perspective the probable strategies for the development of energy sector are presented below:

### **a) Political Consensus on energy policy**

Long term energy policy is necessary for the development of energy sector. For that reason political consensus of opinion is necessary among the political parties, so that with the change of political government the decisions are not frequently changed. In the political manifesto the parties should declare their policy on energy with reference to short-marginal financial gain that must fit the national contexts. Political consensus should also be reached on issues related to energy sector reforms and equitable distribution of energy among different geographical areas and socio-economic groups.[4]

### **b) Energy conservation**

“Energy Conservation” means reduction in energy consumption by any deliberate action, including improved technology, fuel switching, maintenance and operation of existing technology and other change in behavior of end users. Although there is Energy conservation law and also good potential to compensate energy demand through energy conservation, no success has been achieved in the past due to the lack of serious actions.[5] Energy monitoring and Conservation center (EMCC) should be established providing adequate fund to carry out necessary enforcement for the enactment of National Energy Conservation law.

### **c) Emphasis on indigenous Energy Supplies:**

Energy supply from the indigenous sources should be given priority during the energy development plan. Different energy sources considered for this purpose are presented below:

- Bangladesh has moderate reserves and resources of natural gas. With the latest gas field found in Narayanganj, now there are 26 discovered gas fields in Bangladesh<sup>[2]</sup>. By ensuring local demand export of natural gas from reserved gas fields may facilitate medium to long term energy security.
- Traditional energy sources (e.g. coal, LPG) should be substituted with commercial energy. Coal as a cooking fuel can be popularized both in urban and rural areas for domestic, commercial and

institutional cooking. Use of biomass fuels in urban and household and commercial units can be substituted by LPG.

- Popularization of biogas technology is necessary for the efficient use of animal residues. Biogas plants can be installed in poultry and dairy farms so that sufficient supply of animal residues is ensured.
- Biomass (e.g. wheat husk, rice husk, sawdust) should be briquetted to obtain better efficiency as a fuel.
- Gasification of biomass fuel (e.g. wood, rice husk, bamboo roots) through controlled burning in limited air can produce a higher quality fuel that can be capable of running a dual fuel engine. Addition of generator to the engine can enable the system as a means of electricity generation by biomass.

#### **d) Development of renewable energy technologies:**

Technological development must be ensured to use the potential of renewable energy resources in meeting future energy needs. A Renewable Energy Development Agency should be established to provide funding and policy support for the promotion of all types of renewable energy technologies.[8]

#### **e) Implementation Strategies:**

- For the assurance of sustainable operation of different energy enterprises Independent Energy Regulatory Commission should be institutionalized.[7,8]
- In order to implement and manage energy sector development programs both national and international private sectors should be encouraged.
- To ensure sustainable commercial operations of energy enterprises rational energy pricing policy should be considered.
- Consideration of corporatization and commercialization of public utilities is necessary for their efficient operation and management.[10]

#### **f) Capability development programs:**

- Strengthening national capabilities in the planning and managements of energy sector programs, initiation of appropriate educational programs should be given priority.
- Universities, research organization and private companies should give emphasis on undertaking research about energy technology issues.
- Training programs should be carried on as a continuous process for the management of energy sector programs.

## **6. Energy security and regional co-operation**

In this chapter, we shall have an overview of the need of regional co-operation for Bangladesh to sustain in Energy sector. Undoubtedly Energy is an imperative factor to economic and social welfare of a country. But to cope with the increasing security concern regarding Energy, regional co-operation is a must. Bangladesh is strategically located in between two great geo-economic areas, namely South and South-East Asia, bordering India to the north, west and north-east, Myanmar to the east and the Bay of Bengal to the south .So exchanging energy with these neighboring countries makes very much sense. Here we shall discuss the following factors on Energy security from Bangladesh's perspective :



a)

### Key features of Bangladesh's commercial

#### Energyaccess regime :

- Gas is a key factor in the Bangladesh's electricity generation. The gas market is highly concentrated in production, transmission and distribution and the government lacks a regional perspective on the development of the gas sector.
- Nuclear power is a unique source of energy in power production. Nuclear power is desirable in Bangladesh due to its underdeveloped and mismanages energy infrastructure.
- Hydropower is the most widely used form of renewable energy. Kaptai dam is the only source of hydro power in this country, which is not adequate.
- Bangladesh has a very little source of oil energy. Oil demands are assembled by importation at huge amount of cost.
- Wind and solar power are again two sources of energy which Bangladesh lack and needs to taken under consideration.

All of these energy resources needs serious attention from regional countries.

Without the help of other countries, it will be a tough job to sustain in these energy sectors for Bangladesh.

#### b)The GBM regional co-operation in Hydro power development and exchange :

Hydropower is the production of power is the production of power through use of the gravitational force of falling/flowing water, which is a great source of power. A study has revealed that there is an immense prospective for water based GBM(Ganges,Brahmaputra,Meghna) regional co-operation.the study shows the following data :

#### Hydropower prospects in the GBM countries

Country	Installed generation capacity(MW)	Hydropower developed(MW)	Hydropower potential(MW)
Bangladesh	4,120	218	755
Bhutan	481	469	23,670/30,000
India	1,24,287	32,300	84,000/150,000
Nepal	684	627	43,000/83,000

So from the chart, it can be seen that Bangladesh and India can act as buyers and Bhutan and Nepal can act as sellers. India has already made agreement with Bhutan and Nepal regarding power development. Bangladesh is also in progress with Nepal in this regard which we shall see in the next point.[4,5]

#### c)Effective demand for electricity :

Though Bangladesh has doubled its power generation in the last 5 years, it is also struggling to meet its electricity demand.Nepal is ready to sign an agreement with Bangladesh to spur power trade between the two countries.Nepal has 83,000-megawatt hydro-power potential, but the country suffers from a severe power crisis as it is able to generate barely 800MW and imports electricity from India during winter.[7] The country is expected to become power surplus by 2016, and signing of the power trade agreements will allow Nepal to export electricity to India and other countries like Bangladesh. The north-west part of Bangladesh is most conveniently located near Nepal. So,

electricity can be imported to this part of the country from Nepal and when necessary, can be transferred to other regions. Bangladesh operates at 132 KV and 230 KV ,whereas Nepal operates at 132 KV and 66 KV. So power can only be transferred through 132 KV line, which is a big concern. So the regional transmission issue is to be resolved among Bangladesh, India and Nepal for the proper power transfer of power.[11] In fact, A regional agreement can be reached regarding electricity grid among the concerned countries, which will be beneficial for all the countries in the days to come.

## **7. Summary and Recommendations:**

Energy is fundamental to the quality of our lives. Nowadays, every aspects of life is totally dependent on an abundant and uninterrupted supply of energy for living and working. It is a key ingredient to all sectors of modern economical and social development. Bangladesh, with a population of about 1170 million,[1] is greatly challenged for providing energy for its people. Limited electrification, energy shortage, poor management and heavy reliance of a single primary energy resources( i.e. natural gas that fuels 85% of country's power generation) all contribute to low access of energy. Demand of energy will be double of today's level within 2050.[11] Bangladesh's situation is typical of most developing countries i.e. additional funds to pursue sustainable development are not available even though decision makers may be well aware of the current situation. Often policy makers do not understand the implication of development path they are pursuing.

Energy security of a country means, according to IEA, "The uninterrupted availability of energy sources at an affordable price".[3] In this context, both the energy resources and its implementation both has to be taken into account. For Bangladesh, given the energy resources are meager, it has to depend on other countries to some extent. Bangladesh has a great opportunity to import hydropower from the GBM countries like Bhutan and Nepal, specially from the latter in this regard as we mentioned earlier. Bangladesh should advance towards this agreement earnestly as demand for electricity is increasing by lips and bounds. We can also give attention to sources like nuclear power ,which will be a great source of energy.

There are at least three main objectives in energy policy :

- Provide energy for sustainable economic growth
- Meet the energy demands of different geographical zones in the country
- Ensure sustainable operation of energy utilities and a rational use of total energy resources.

Bangladesh government should take well thought-out development schemes to ensure that these basic needs are fulfilled as early as possible.

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