

## AN OVERVIEW OF ENERGY PROFILE FOR BANGLADESH: PAST, PRESENT AND FUTURE USES

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### ABSTRACT

Bangladesh is a relatively poor country. Although its infrastructure level is relatively low, with few paved roads and poor telephone or electricity access, the potential for growth is quite high and entails a large future increase in energy demand. And although it is the most densely populated agricultural country in the world, it also falls among the lowest per capita energy users in the world. However, Bangladesh was recently discovered to contain large reserves of natural gas, a major attraction to foreign investors. Natural gas is also a good source of relatively clean energy for the future, especially in a country where energy demand is growing at a rate of about 10% per year. This survey will first look at the past trends of energy use in Bangladesh, the current energy profile of the country's production, imports, exports and usage of fossil fuels and/or biomass. It will then address the predicted energy increases over the next twenty years, and conclude with an estimation of what the energy mix may look like by the year 2020.

### 1. INTRODUCTION

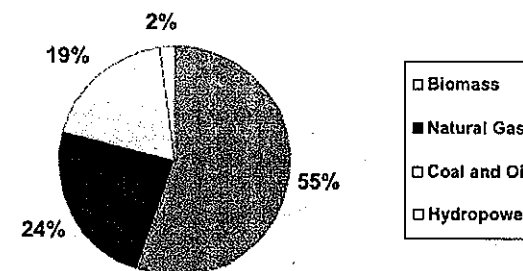
Bangladesh is a predominantly agricultural nation. Agriculture dominates around two thirds of the labor force and a little over a third (35%) of the Gross Domestic Product [1]. Bangladesh, with its low-lying land and ubiquitous river networks, has an abundance of fertile, arable land. The country produces enough domestic rice for its 133 million-person population, which is growing at a rate of 1.9 % annually, through its unique potential for three rice crops each year, but also relies heavily on wheat production, fish and lentils in the typical national diet [2]. However, the ready-made garment, and cotton textile industry is quickly expanding and already employing over 1.5 million people and contributing about 80 % to Bangladesh's export earnings. Exports are increasing by 8 % annually, and GDP has been growing by about 5.7 % annually for the past several years [3]. Since Bangladesh's independence from Pakistan in 1971, the economy continues to liberalize and orient itself toward a free-market system, despite the fact that many major enterprises still remain nationalized.

Bangladesh, principally composed of Bengali Muslims, is a relatively poor country. In 2001 the World Bank recorded its Gross National Income per capita at 370 US dollars annually [4]. Although its infrastructure level is relatively low, with few paved roads and poor telephone or electricity access, the potential for growth is quite high and entails a large future increase in energy demand. Although Bangladesh is the most densely populated agricultural country in the world, it also falls among the lowest per capita energy users in the world. However, Bangladesh was recently discovered to contain large reserves of natural gas, a major attraction to foreign investors. Natural gas is also a good source of relatively clean energy for the future, especially in a country where energy demand is growing at a rate of about 10% per year [2].

### 2. ENERGY USE IN THE PAST AND PRESENT TIME

As a poor and mostly rural country, Bangladesh uses relatively small amounts of energy compared to other developing or developed nations. In 1997, Bangladesh's energy consumption per capita was 198 kilograms of oil equivalent while the world consumption stood at approximately 1,671 kilograms per capita [3]. About 55% of the nation's total energy supply comes from traditional fuels, such as fuel wood, crop residuals and animal biomass, 24% from natural gas, 19% from imported oil and coal and about 2% from hydro-power (referring Chart 1). The majority of fuel wood is used for domestic cooking, and the remaining in industrial or commercial sectors [5]. Additionally, Bangladesh utilizes renewable energy forms such as solar and wind energy usually in their natural, un-harnessed forms, for example, in drying fish or sailing boats [6]. Non-renewable sources of energy such as natural gas, coal and oil are now, and have been in the past, used for the production of electricity, to which only about 18 % of the population has access. These fuels are also used in the commercial and industrial sectors.

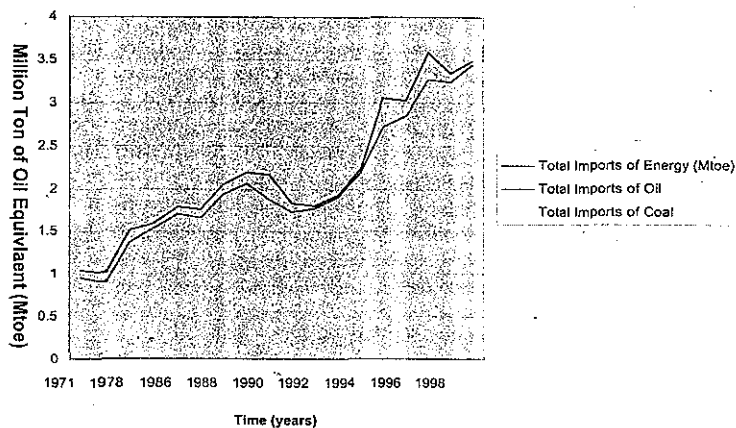
Chart 1: Energy Sources in Bangladesh, 2001 [6]



#### 2.1 Imports and Exports of Energy

Bangladesh does not export any energy source, but has import expenditures on oil and coal. Chart 2 shows Bangladesh's total oil and coal imports since 1971. However, exportation is a source of great contention in the future of the nation's large natural gas reserves. Exporting natural gas could bring substantial government revenue into the country, while using the gas domestically could help meet the needs of a population struggling with energy shortages and energy related health problems, such as the dangers of indoor domestic cooking. Petrobangla, the state owned gas, oil, and Minerals Corporation, is responsible for exploration, production and distribution of Bangladesh's formal energy sector, but has involved many private companies, including Cairn Energy and Occidental Exploration of Bangladesh Ltd. in the future development of its natural gas reserves [1].

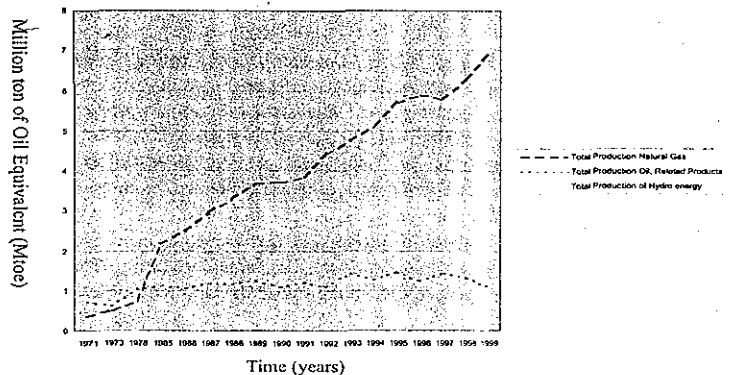
Chart 2: Energy Imports, 1971-1999 [7]



2.2 Natural Gas

Bangladesh has 32.1 trillion cubic feet of proved natural gas reserves. This is one of the largest proven reserves in the world, and the country's only meaningful source of commercial energy. Currently, a bit more than 80% of Bangladesh's produced natural gas is used for the power sector and the production of fertilizer and just below 20% is used by the industrial and residential sectors. The present production, of natural gas, is 319.6 billion cubic feet [1]. Charts 3 and 4 show the present and past production and consumption of natural gas.

Chart 3: Total Energy Consumption (excluding biomass), 1971-1999 [7]



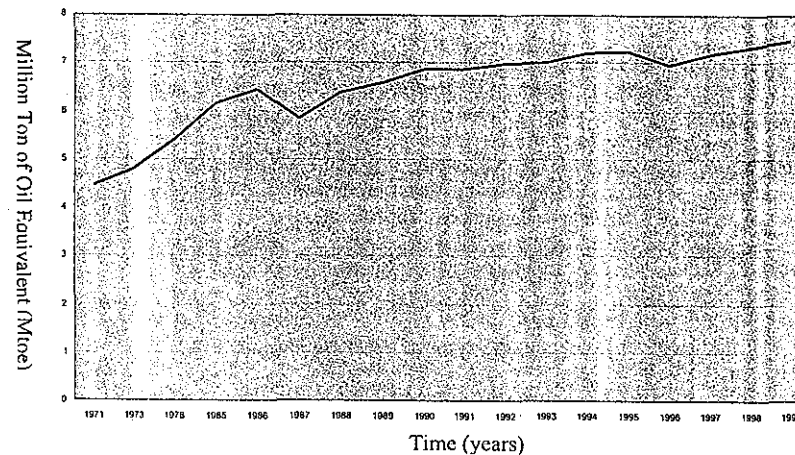
2.3 Coal and Oil

Bangladesh has minor reserves of coal and it's main reserve is located near Barapukria and in 1999 imported 0.05 million tons of oil equivalent of coal for domestic consumption [7]. There are small reserves of oil however, of which 56.9 million barrels are proven. Present oil production (2002) is 4,581 billion barrels per day, of which 3,381 is crude oil, and the consumption, due to oil imports, is greater, at 62,000 billion barrels per day [1]. Production and consumption of oil has greatly increased over the past three decades, whereas the use of coal has remained minor and constant in comparison (referring Charts 3 and 4).

2.4 Biomass Fuels

Biomass fuels are a critical part of Bangladesh's energy supplies. In a country where nearly 75% of the population is rural, and lacking dependable access to electricity, biomass fuels are dominantly used for cooking, lighting, par boiling and irrigation. The typical biomass fuels include cow dung, jute stick, rice straw, rice hulls, bagasse, twigs, leaves, wood and plant waste [8]. The dependency on fuel wood creates a tremendous strain on the nation's limited forests, but there are ways in which Bangladesh is seeking to use biomass in a sustainable manner through biogas digesters and biomass briquetting [1]. Chart 5 represents the past and present production of biomass fuels.

Chart 4: Biomass Fuel Production, 1971-1999 [7]



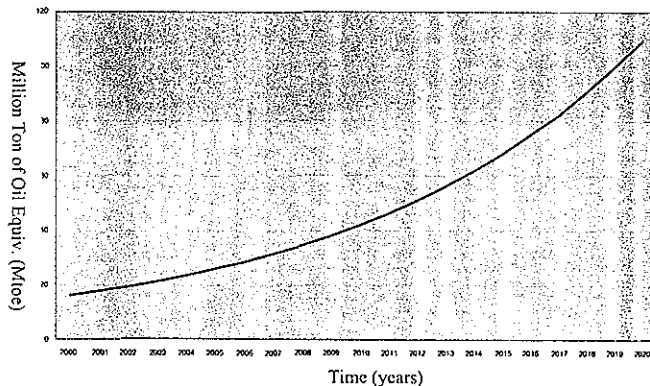
## 2.5 Renewable Energy Sources

Bangladesh has used renewable energy such as wind and solar power in the past, and continues to in the present, including transmission towers in Kaptai, Aricha, Karnaphuli and Chittagong, where photovoltaic cells provide lighting to areas that are not connected to the electricity grid. Hydropower, about 2% of the country's energy supply is utilized through various small-scale dams and projects, to also provide electricity [6]. As stated previously, certain forms of biomass are currently used in a renewable manner in biogas digesters and biomass briquetting. Bio-digesters can generate methane for cooking, and briquettes have many uses including fuel for urban hotels, melting bitumen (bitumen is used for paving roads), and in the brick manufacturing industry. The main impediment to these biomass uses is high capital costs, but nevertheless, there are plans in place to build infrastructure that is fueled by renewable energy sources in the future [1].

## 3. ENERGY USE IN THE FUTURE TIME

The future of energy use in Bangladesh depends on several key factors. These include the population growth rate, economic growth, the technology and capital available within the country, and actions of the Bangladeshi government. Currently, the annual population growth rate is around 1.9%, and depending on the future fertility and mortality rates, will likely increase, due to the fact that over 40% of the current population is fifteen years old or younger [3]. Economic growth, measured in terms of GDP, is growing by 5-7 % annually. Demand for energy is already growing at a rate of 10 % annually and how this demand will be met is influenced by government policies that may attract foreign direct investment (FDI), provide important research and development funding, or how the country's large natural gas reserves will be utilized [2]. Without a doubt, future energy use in Bangladesh will increase. The country's gas reserves will likely attract FDI, and with FDI often comes new, more efficient technologies. Providing the growing population with electrical power and basic infrastructure will require a huge energy investment, as will the transition from an agrarian nation to an industrialized one [9]. Based on Bangladesh's total consumption of energy in 1999, the US Aid estimate that demand for energy will increase 10% annually, and the assumption that Bangladesh, as one of the least developed countries in the world, will maintain this high level of increase for at least the next twenty years, the country's energy use in 2020 may necessitate approximately 109 million tons of oil equivalent. Chart 5 shows the increase in energy use over the next twenty years. Chart 6 is an aggregate forecast of total energy use in Bangladesh.

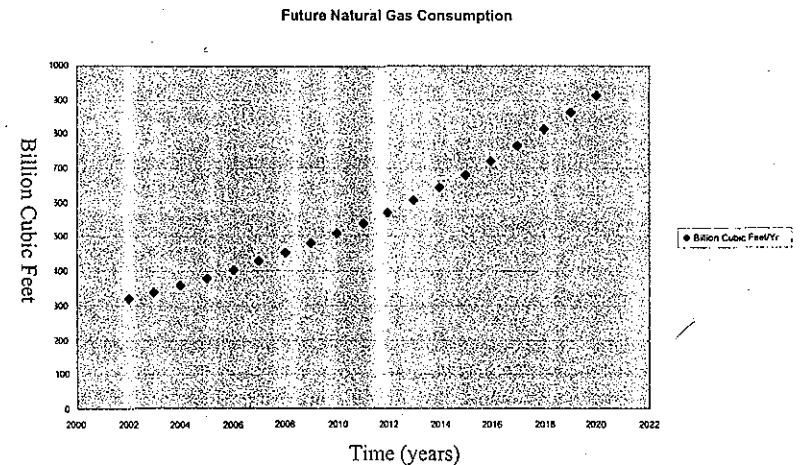
Chart 5: Total Energy Use, 2000-2020 [2]



## 3.1 Natural Gas

Natural gas use will most likely continue to increase in the next 20 years, due to Bangladesh's large proven reserves. The natural gas sources could be used to produce electricity and would be cleaner than oil or wood and therefore adhering to the principles of sustainability in a feasible manner. When methods of gas conversion into liquid fuels become readily available in the future, Bangladesh will be able to rely on its own gas to meet most of the energy needs. The total reserve of gas will last about 27 years when all other sectors of gas usage (fertilizer, industry, domestic, etc.) are considered. As mentioned earlier, only an insignificant fraction of population in Bangladesh currently uses gas for domestic needs. In addition, the amount of gas consumption will increase drastically, should Bangladesh decide to produce more electricity to meet increased demands in the power and fertilizer sectors. Experts predict that gas use will grow at about 6% annually over the next two decades [1]. By 2020 the consumption of natural gas could be up to 912 billion cubic feet (Refer to Chart 7).

Chart 6: Future natural gas consumption at the predicted 6% increase [1]



## 3.2 Coal and Oil

No new discoveries have been made as to new sources of coal or oil in Bangladesh. In fact, the cost of petroleum products increased by 20% in December 2001, making oil even less popular due to capital constraints [10]. Despite scarce domestic reserves, it is likely that Bangladesh will continue to import petroleum in the future, as capital-intensive infrastructure is built, cars per capita increase from the current value of 3 cars per 1000 people, and the liquid natural gas technology remains uncompetitive [3].

### 3.3 Renewable and Alternative Energy Sources

The alternative sources of energy discussed are all more costly compared with the energy produced by conventional methods. However, with an increase in energy demands and with the innovation and diffusion of more efficient technologies in the future, the production costs and price will decline. The two most likely forms of energy that Bangladesh will turn to are wind power and solar power. Both of these sources are being explored. Biomass, although a renewable energy, is being used in a non-sustainable way due to deforestation and related health hazards, and thus use will probably decrease from its present level [10]. However, other biomass fuels, such as animal dung, will be used as they traditionally have been and will increase in the future.

### 3.4 Biomass Fuels

From an energy use and environmental perspective, Bangladesh needs to look for other sources of energy besides biomass fuel from agricultural resources, tree residues, fuel wood and dung. At the current rate of biomass consumption (about 2/3 of total consumption) all of the forests would disappear very rapidly if this country continued to use wood as its main energy source until 2020. The use of biomass is also extremely detrimental to the environment and the forest cover has been reduced from 15.6% to 13.4% between 1973 and 1987 [9]. This in turn causes damage to soil fertility. From 1983 to 1994, fuel wood consumption had an annual growth rate of about 1.3%, which compares to conventional energy increasing at an average of 9% [11]. This shows that while energy use increases, Bangladesh is beginning to rely more on other energy sources besides fuel wood. Looking at past trends, such as those displayed in Chart 5 regarding past and current biomass use, we see that the trend has been going toward using less biomass fuels. Extrapolating on this trend, the use of biomass for fuel will slowly stop growing and level off.

### 3.5 Wind and Solar Energy

Wind energy has a lot of potential to be harnessed for power generation in Bangladesh. Bangladesh Center for Advanced Studies (BCAS) completed a wind speed study from 1996-97, in collaboration with Local Government and Engineering Department, which showed high potential for use of wind power on the coast of Bangladesh, despite the fact that the strength of the wind varies seasonally. Several small wind generators have been installed and several pilot programs are underway [9]. Although wind energy has not been fully explored, it has the potential to be a source of decentralized energy for Bangladesh.

At present, less than 20% of Bangladesh's population has access to electricity, and only an additional 20% could have access to the major grid, due to high percentages of the population dwelling in rural areas. There is immense potential for the use of photovoltaic (PV) technology in Bangladesh. Solar energy can be used in these rural areas and although it is expensive, it would be efficient for cost-effective application [10].

Although there are good prospects for solar PV systems, potential market development has rather limited it in practice. The government, private sectors, and non-governmental organizations are taking steps toward initiating development of solar energy utilization [9].

### 4. CONCLUSION

- (1) By 2020 the energy mix will have changed considerably from what it is today. An increase in alternative and renewable energy will be likely, coupled with increased natural gas use and imported petroleum.
- (2) The possibilities of using both wind and solar power are already being tested and will mostly increase due to successes of the current studies.
- (3) Hydro-power, although already existing in Bangladesh will probably not see much of an increase. There are very limited locations to install hydroelectric dams and the water flows are very seasonal.
- (4) The use of fuel wood must decrease in the future due to massive amounts of deforestation and other related environmental problems.
- (5) Decentralized locations in Bangladesh may turn to solar power for their energy uses if technology continues to advance as it is, and other countries continue to be interested in aiding Bangladesh with its energy development, such as the US Aid energy development program.
- (6) Since Bangladesh is largely rural and agricultural, other sources of biomass use will remain steady, such as animal dung.
- (7) As with most least-developed countries (LDCs), it is likely that Bangladesh will continue to use oil and for the construction of infrastructure, increase in transportation equipment, and increase in the manufacturing industries and as long as its use remains competitive, although they country must depend on future imports unless an undiscovered reserve is found.
- (8) The future utilization of natural gas is imperative for Bangladesh, whether the government decides upon a high or low level of exportation.
- (9) Bangladesh is a nation that has nowhere to go but up and up in energy use, in population, and hopefully, in the standard of living. Energy use, as a basic human need, must therefore greatly increase. Refer to charts 8 & 9 for predictions on the future energy mix. Chart 8 and 9 are personal predictions, which are based on the comprehensive reading material that was used in this survey.

Chart 7: Energy Mix in 2003 versus 2020

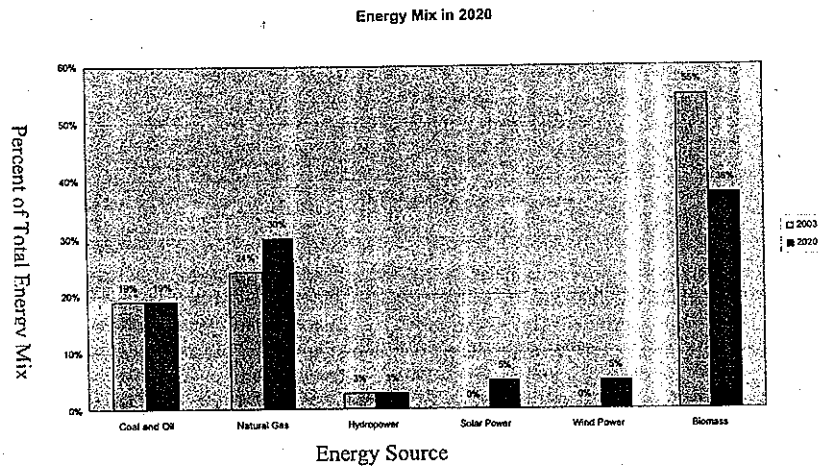
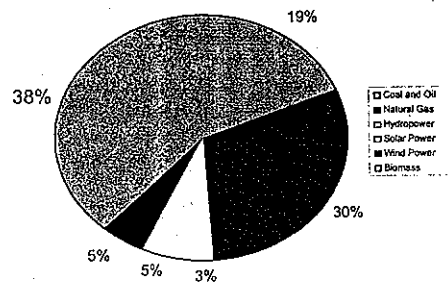


Chart 8: Energy mix in 2020



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