# ENERGY SECURITY IN BANGLADESH

*Dissertation submitted to Jawaharlal Nehru University*
*in partial fulfillment of the requirements*
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## MASTER OF PHILOSOPHY

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# CERTIFICATE

Certified that the dissertation entitled **"ENERGY SECURITY IN BANGLADESH"**, submitted by me in partial fulfillment of the requirements for the award of the degree of **MASTER OF PHILOSOPHY**, has not been previously submitted for any other degree of this or any other university and is my own work.

**(Naresh Kumar B.K.)**

We recommend that this dissertation may be placed before the examiners for evaluation.

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**DEDICATED TO**

**PAPA AND AMMA**

**Whose Sacrifice Is Not Less Than Everything**

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# CHAPTER I

# INTRODUCTION

# *Chapter I*

# INTRODUCTION

Energy is a major component of economic growth. It has become the most elements for the survival of security and as such in the absence of appropriate supply of energy the aspirations of the human beings cannot be met with. Global energy has entered a very crucial phase now due to the realization of the depletion of the oil reserves and the ever-increasing need for energy. Although various sources of energy are utilized, the massive demand cannot be met with.

Energy is a strategic input necessary for socio-economic development. Future economic growth crucially depends on the long-term availability of energy in increasing quantities from the sources that are accessible, easily available, and socially acceptable and environment friendly. Energy impinges on poverty, social services, gender disparities, population, agricultural production and food security, health, land degradation, climate change and environmental quality and economic and security issues.[1] It is often considered as a key factor in industrialization and modernization. Energy helps in meeting basic human needs and it contributes to economic growth. The main sources of energy may include natural gas, water, sun, crop residue, cow-dung, coal, atom, oil, etc.

Energy is vital for economic growth of the country. There are two way links between energy and economy. Energy is needed to meet both subsistence as well as productive requirements. It is a productive process that contributes to economic growth. On the other hand exploration, extraction, processing and delivery of energy resources require capital investment. When the supply of energy cannot be met from indigenous sources, it is imported and energy import consumes money that is earned by exporting different commodities. Because of the importance of energy in the national economy, development of the energy sector gets priority attention in national development.[2] To meet the growing

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[1] Som Dutt Gupta etc, "Energy and Energy Resource Management", in V. S. Mahajan, (et al), *Energy and Energy Resource Management*, (New Delhi: Deep and Deep Publications, 1999), p 13.

[2] M. Nurul Islam, "Energy and Mineral Resources Management", in A. Atiq Rahman, (et al), *Environment and Development in Bangladesh, Vol.II*, (Dhaka: The University Press Limited, 1994), p 272.

demand for an increasing population, commercial energy input in agriculture for irrigation, tillage and chemical fertilizer (indirect energy) has become very important for sustainable development.[3]

Security is one of the few concepts perpetually related to the situations of threats or perceptions of insecurity. Security is amongst the prime concerns of nation states. But security maintenance, in view of rapid changes in the politico-economic and strategic fields at the national, regional and global level, becomes difficult task. Even states with high national capabilities, well-conceived and well-formulated security doctrine, and identified threats and foes may find it difficult to respond to new changes in consistent manner.[4] The problem is more complicated for the states which have the least national capabilities, no security doctrine— conceived or formulated, no identified sources of threats.[5]

Security is a universal yet nebulous concept which, despite lying at the heart of contemporary political theory, has generally been under theorized.[6] The word comes from the Latin *securitas*, meaning 'lack of care'. Historically, then the concept of security has been concerned with safety, certainty and by implication, maintenance of the *status-quo*. Security is something intuitively desirable. It can be characterized in two ways. First, it can be subject specific, entailing stability in the face of particular risk. The particular risk can be referred to as *'the what'* of security.

Secondly, security can be more generically understood as an entity in kits own right, i.e. as a state of low risk and (relative) stability of all things to a given person or community. In both cases there is an object to be secured. The particular entity to be secured can be referred as *'the who'*, or referent of security. Further, in as much as contemporary understandings of security talk in terms of threats and dangers, it is often revealing to ask,

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[3] Ibid, p 279.
[4] Md. Nuruzzaman, "National Security of Bangladesh: Challenges and Options", *BIISS Journal*, Vol.12, No.3, 1991, p 367.
[5] Ibid.
[6] Barry Buzan, *People, State and Fear: An Agenda for International Security Studies in the Post-Cold War Era*, (London: Harvester Wheatsheaf, 1991), p 8.

'*where* ' is the threat perceived come from and *how* ? Other questions that might be asked in order to clarify on account of security is: *how much security* ? *By what means* ? *At what cost* ? *And in what time period* ? [7] Thus the concept of security is inherently about risk and vulnerability.

In the circumstances, the whole notion of security as traditionally understood in terms of economics, political and military threats to national sovereignty as posed by other states is rapidly changing. In the changed context, while the state-centric security concerns did not disappear, the new security agenda came to include issues as diverse as intra-state conflict, ethno-religious violence, landmine, terrorism, democracy, health hazards, and human development, economic security, market, water, energy, emigration, environmental degradation and so on.[8] Along with traditional aspects – economic social, military and political – now international security invariably encompasses various other issues.

Since the end of the Cold War there has been substantial change in the threat perceptions. The changes affected international society, regional structures, nation-states and the individuals who constituted them. The traditional security concerns, however, had been state centric, but these concerns have changed in terms of dimensions and levels.

Any discourse on national security immediately raises the question: what constitutes a nation's insecurity, and how a nation can feel secure? Put differently, what contributes to a sense of insecurity, and conversely, what makes one secure? The concept of security has undergone a major transformation in recent years, and hence it is rightly viewed that the discourse on security has to be moved from the level of abstraction to the contextual level of "a temporal framework".[9] To this end, analytical approach has been concentrated

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[7] Jon Barnet, *The Meaning of Environmental Security: Ecological Politics and Policy in the New Security Era*, (London: Zed Book Limited, 2001), p 24.
[8] A. K. M. Abdus Sabur, "Degradation of Environment as a Threat to the Security of Bangladesh: Sources and Challenges", *BIISS Journal*, Vol.22, No.1, 2001, p 90.
[9] C. Uday Bhaskar, "Post-Cold War Security", *Strategic Analysis*, November 1997, p 1135.

on ensuring that a 'decoupling in the military sphere goes hand in hand with multiplying and intensifying positive relations in other spheres.[10]

End of the Cold War marked by a sudden collapse and disintegration of the USSR, also raised questions about the utility and relevance of conventional security, based on military preparedness or power. Multiple threats that defy military solutions have caused some neo-realists and even some of their critics in the field of peace studies and conflict resolution to search for a border definition of security that encompasses both freedom from physical violence as well as ensuring material well-being of the people and the environmental health of the entire planet.

Thus security has come to be viewed as more inclusive, encompassing the political, economic, military and non-military strands, with greater emphasis on the economic performance of the nation-state in an increasingly interdependent, free-market, export oriented international community. This means that the primacy of the state as an actor has become diluted and the state per se has become less effective and relevant with eth emergence of a variety of transnational forces and multinational entities.[11]
Earlier security was viewed only from statist perspective. But with globalization and its allies the security perception also changed. The states started to submerge their identities in the name of development. The increasing role of supra-national institutions like UN and active role of multi-lateral and multinational organizations resulted diversification of security threat perceptions. They started concentrating more on economic security rather than military security.

A three-tier post Cold War security has thus been posited. First is traditional security, which continues to be statist, the armed forces retaining the strength of major punctuation. Second is the macro-security debate that concerns transboundary military capabilities in terms of both fire power and surveillance, covering arms control mechanisms and regulation of the weapons of mass destruction. The third-tier or micro-

[10] Abdul Kalam, "Multilevel Security Debate and the National Security of Bangladesh in a Regional Frame", *BIISS Journal*, Vol.6, No.3, p 97.
[11] C. Uday Bhaskar, n 9, p 1136.

security notion involves a complex mix of national, international and transnational forces, the prevailing focus being on economic gain/fiscal profiteering, environmental and feminine or gender concerns and such other issues reflecting increasing levels of disorder, dynamism and complexity, with a combination of emerging political, economic, technological, social, ethnic and cultural undercurrents.[12]

It is increasingly observed that priority has changed from security of unit actors to the perception of insecurity of not only of state as unit actor but also of its constituting components, i.e. of land and nature, life and living extended along the lines of "levels of analysis" to an understandings of security at all different levels which cause insecurity of states as well as of the planet earth and its surroundings.[13]

Buzan's influential study of the security concept revolves around two questions:
What is the referent object for security ? What are the necessary conditions for security ? Security as a concept clearly requires a referent object, for without an answer to the question, 'The Security of What ?', the idea makes no sense.[14] He identifies five major sectors or components of national security: military security, political security, societal security, economic security and ecological security.

For Buzan, political security is primarily about the organizational stability of states, systems of government and the ideologies that give them legitimacy. In the same way he identifies societal security with sustainability, within acceptable conditions for evolution, of traditional patterns of language, culture and religious national identity and custom.[15] For him environmental degradation is significant risk to the welfare of the people.

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[12] Dr. Abdul Kalam, n 10, p 99.
[13] Chetan Kumar, "Environmental Degradation and Security in South Asia", in Marvin G. Weinbaum, Chetan Kumar, (eds), *South Asia Approaches the Millennium: Re-examining National Security*, (Boulder: Westview Press, 1995), pp 148-149.
[14] Eric K. Stern, "Bringing the Environment In: The Case for Comprehensive Security", in Michael Sheenan, (ed), *National and International Security*, (Aldershot: Dartmouth Publishing Company Limited, 1996), p 217.
[15] Jon Barnet, n 7, p 24.

Barry Buzan, as he stated, "the concept of national security has an enormous power as an instrument of social and political mobilization, (and therefore) the obvious reason for putting environmental issues into the security agenda is the possible magnitude of the of the threats posed, and the need to mobilize urgent and unprecedented responses to them. The security label is a useful way both of signaling danger and setting priority and for this reason alone it is likely to persist in the environment debates".[16]

The 1997's People's Conference on Alternative Security System states that, "security must be fundamentally redefined, democratized and reclaimed by people. It must replace narrow state, military or market interests with comprehensive human security which includes the social, cultural, gender, economic and environmental aspects of security. It must also recognize the need for peace-building and the prevention of violent conflict. This requires both a transformation of existing structures and relationships and the creation of new structures and relationships which include groups previously marginalized. Real security is based on establishing democratic relations among men and women, within societies, between people and the state and between states themselves, and within international institutions. Establishing substantive democracy is fundamental".[17]

Jessica Tuchman-Mathews, describing an incremental widening of the scope of the security notion in the US context, suggests that the ebbs and flows of international context and US position in the world have stimulated successive reformulation of the security concept. In the 1970's the concept was expanded to include international economics as it became clear that the US economy was no longer the independent force it had once been, but was powerfully affected by economic policies in dozens of other countries. Global developments now suggest the need for another analogous, broadening definition of national security to include resource, environmental and demographic issues.[18]

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[16] Narottam Gaan, *Environment and National Security: The Case of South Asia*, (New Delhi: South Asian Publishers Private Limited, 2000), p 15.
[17] Jon Barnet, n 7, p 126.
[18] Jessica Tuchman-Mathews, "Redef ning Security", *Foreign Affairs*, Vol.68, No.2, 1989, p 163.

The 1980 Brandt Commission (The Independent Commission on Development Issues) called for a broadening of the scope of the security concept: 'Our survival depends not only on the military balance but on global cooperation to ensure a sustainable biological environment and sustainable prosperity based on equitably shared resources'.[19]

The Brundtland Commission (World Commission on International Development) couched its findings in the language of comprehensive security in its report *Our Common Future*. Environmental threats to security are now beginning to emerge on a global scale. The most worrisome of these stem from the possible consequences of global warming caused by the atmospheric build-up of carbon dioxide and other gases.[20]

*Human Development Report 1994* also introduced the concept of human security – a different from the commonly known security of a country's borders from external aggression. The various dimensions of human security are: economic security (assured basic income), food security (physical and economic access to food), health security (assured health care and sanitation), environmental security (sustainable physical environment), personal security (security from the state, war crime, street violence, gender violence, drugs, etc.), community security (within family, race, ethno-religious groups etc.), and political security (basic human rights). It has been opined in the United Nations Development Programme (UNDP) report (UNDP, 1994) that in the 21st century the real threat to human security will arise from unchecked population growth; disparities in economic opportunities; excessive international migration; environmental degradation; drug production and trafficking; international terrorism.[21]

Different types of risks to national security have been identified under a common understanding that 'new threats are emerging, threats with which security forces cannot cope'. This identification of new security issues received further impetus with the fall of

[19] N. Brown, "Climate, Ecology, and International Security", *Survival*, Vol.31, No.6, 1989, p 521.
[20] Ibid, p 522.
[21] M. Nurul Islam, "Energy Security in Bangladesh", in Asit K. Biswas, (et al), *Contemporary Issues in Development*, (Dhaka: Academic Press and Publishers, 2002), p 50.

the Berlin Wall in 1989. A suite of pre-existing dangers (mostly to US interest) were reemphasized, such as the strength of the Japanese and German economies (economic security), global environmental change (environmental security), an array of difficulties associated with third world countries and energy availability (energy security).[22]

## ENERGY SECURITY

Energy security is the most critical issue for sustainable development. It indicates the availability of energy in different forms at all time to the users according to their needs at reasonable and affordable prices. As energy is considered essential for economic development its production, supply, transfer, transmission and sustainable use is very crucial for the nation. Now-a-days the national security question seems more dependent on country's energy security.

Energy use has increased massively since the onset of the industrial revolution, and particularly in the post-Second World War period. Energy security is a widely used term but is much less precise. Coined in the 1950s to mean safeguarding adequate supplies in the event of war, it has moved beyond the military aspect to include among other energy security issues, long-term economic safeguards against the effect of oil price shocks as well.

Energy security became a concern in the United States and other industrialized nations with the 'oil shocks' and oil product shortages of 1973-74 and 1979.[23] Enhancing energy security has been a major mission of the United States Department of Energy and the International Energy Agency of the Organization for Economic Cooperation and Development ever since the troubled 1970s.[24]

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[22] Jon Barnet, n 7, p 33.
[23] John R. Moroney, (ed), *Advances in the Economics of Energy and Resources vol.11 1999: Fuels for the Future*, (Connecticut: Jai Press Inc., 1999), p 67.
[24] Ibid, p 67.

The relation between energy import dependence and energy security has been a persistent theme in the international energy debate. On the one hand, it has been argued that there is no direct link between energy import dependence and energy security. While on the other, however, arguments that increased dependence on imported energy is a threat to security have driven the for energy policies and strategies in the past. Thus the debate has a specific context – the global energy dependence on the Middle East.

The definition of "energy security" has been subject to wide range of interpretations. Free market advocates saw energy security as a matter of reducing the national economy's vulnerability to oil market disruptions and price shocks. Environmentalists saw it as reduced consumption of oil. Producers saw it as higher domestic production of fossil fuels. The US Energy Policy during 1970s reveals it as reduced reliance on Persian Gulf oil suppliers. Some came to understand energy security as lower intensity of oil use in the economy and reduced reliance on oil imports.[25]

Energy security is the theory and practice of securing energy for the nation-state. According to a report by the Trilateral Commission (North America, Western Europe and Japan), energy security is maintained by utilizing national power to secure a steady supply of affordable energy for the purposes of economic growth.[26]

For European Union energy security is, as it defined as an adequate and secure availability of energy on a satisfactory basis.[27] Energy security has two aspects: (a) mitigation of the consequences of temporary shortages due to supply disruptions, and (b) development of long-term policies to avoid shortages due to medium or high price rice.[28]

Energy security is a state in which consumers and their governments believe, and have reasons to believe, that there are adequate reserves and production and distribution

[25] Vito Stagliano, *A Policy of Discontent: The Making of a National Security Strategy*, (Oklahoma: Penn Well Corporation, 2001), p 160.
[26] Ibid, n 7, pp 34 – 35.
[27] Robert Belgrave, (et al), *Energy Security to 2000*, (Aldershot: Gower Publishing Company Limited, 1987), p 186.
[28] Gulshan Dietl, "The Security of Supply Issue: The Growing Dependence on the Middle East", in Pierre Audinet, (et al), *India's Energy: Essays on Sustainable Development*, (New Delhi: 2000), p 218.

facilities available to meet their requirements in the future, from sources at home or abroad, at costs which do not put them at a co npetitive disadvantage or otherwise threaten their well-being.[29] Insecurity arises when the welfare of the citizens or the ability of governments to pursue their other normal objectives is threatened, either as a result of physical failure of supplies of sudden or major price changes.

**Threats to energy security**

Energy security emphatically related to two basic questions i.e. how energy security is threatened and how energy security is managed and maintained. Energy security is threatened when the resources from which energy is produced will be exhausted. Increase in population also threatens energy security when the required energy supply is not sufficient to meet the increasing demand. Insecurity may also arise due to the poor management of energy and energy resources. Environmental degradation also impinges on energy security. Energy security becomes vulnerable when there is a weak institutional capability at the planning and implementation level, lack of financial capability, lack of technological capability, political insensitivity to long term energy planning and lack of rational energy pricing policy and also lack of good governance.

Resource exhaustation is the cause for energy insecurity. Most of the energy resources which are used worldwide are commercial and non-renewable in nature. Most of the energy resources are in the process of depletion for long period of time. The gestation period they take to recover is very higher compared to the fostering growth of consumption and resources depletion.

Rapid increase in population has become a global trend now. Population tends to increase at very faster rate, leading to increase in demand for supply. Thus conventional view of energy population nexus is that population is an external factor influencing energy consumption. Thus increasing population and consumption of energy results in an insecure energy position.

[29] Robert Belgrave, n 27, p 2.

Energy security position is threatened, if energy use not made more compatible with the aims of sustainable development through better containment of emissions. The patterns of energy consumption in rich industrial and poor developing countries, and the rich and the poor within developing countries are such that industrialized countries and the rich within the developing countries – because of their energy intensive consumption patterns – for greater per capita impact on the global atmosphere.

Poor management of energy and energy resources may have an adverse impact on energy security. In many countries the power sector is facing the challenge of reducing the system loss. This is mainly due to poor management. Poor management also results in power theft, irresponsible use of energy, poor collection of revenue etc.

In most of the developing countries the energy sector is under the exclusive domain of government. Most of the public sector energy industries are the most inefficient one, resulting in inefficient use of energy. A weak technological capability is another problem. In most of the developing countries the technologies which are used in energy production, distribution, conservation, etc are outdated and inefficient. They are not going for modern technologies which tend to save energy.

The basic goal of any country's energy policy is to achieve long-term energy security. If the government in power pursues a long term energy policy which according to experts is the most effective may tend to change when the next government comes to power for mere political reasons. Thus problems of governance may also become hindrance to energy security.

Ordinarily energy security may simply mean matching supply of energy to its demand.[30] Important issues related to energy security are *security of supply, availability at an acceptable price over the long term, environmental impact*, etc. The risks to energy

[30] M. Asaduzzaman, "Energy Security of Bangladesh: Issues, Perspectives and Prospects", in Mohd. Humayun Kabir, (ed), *National Security of Bangladesh in 21st Century*, (Dhaka: Academic Press and Publishers Limited, 2000), p 126.

security also include *large-scale market failure, price volatility* and *supply disruptions*. If the source of supply is basically imported one, then the vulnerability of national security is the most critical problem. The question of legal rights here implies the authority to the government or to the international energy companies to extract, export energy. Demand and supply side includes assessment of feasibility for future demand and plans secure energy for the long term. Energy security can be ensured if the pricing is more reasonable and should bring benefits.

It may be stressed that energy security is not only an important issue affecting human security within a country, but it can also cause problems at the global level. Energy security concerns problems such as source of supply, questions of legal rights, demand and supply side and pricing. It also addresses the crisis arising from demand, exploration and supply of gas, oil and power, management and pricing of energy.

The problem of energy security is not only the need to alleviate scarcity, however, but also concerns the ecological impact of burning fossil fuels. In the medium and long term, energy security is a question of energy efficiency, diversification and the maintenance of flexibility in the provision of energy services.[31]

Energy security can also be defined in terms of the physical availability of the supplies to satisfy demand at a given price. The security problem therefore involves a supply risk and a price risk governed by internal and external consequences. Long term supply security requires a delicate balance between indigenous and external energy sources along with technologies in order to minimize risks.

In a particular situation, if the supply of energy is less than the demand, an insecure situation arises. Energy insecurity may also take place due to lack of purchasing power. An imbalance between demand and supply of energy may occur at different levels: individual, household, community, district, division, and country, regional and global.[32]

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[31] OECD, *Towards a Sustainable Energy Future*, (Paris: OECD, 2001), p 75.
[32] Asaduzzaman, n 30, p 127.

An individual citizen's concern for energy security may arise from all the different levels mentioned above. Energy insecurity may take place at a time of the day, during certain period of a year or for some years. Energy insecurity is multi-dimensional problem. The basic principle of energy security is to ensure supply from appropriate sources of energy to meet the demands of different end use sectors.

For a household energy security refers to availability of energy at affordable prices over the long period of time. For rural community which is more dependent on biomass energy sources, energy security refers to availability of biomass fuels at cheap prices, within a short distance. For the urban community it means availability of commercial energy sources like natural gas, power etc. at affordable prices and for long period of time. For energy industries energy security is availability of power, or sources of energy at lower and more subsidized price. Thus energy security varies people to people and from one locality to the other.

Energy security is determined by anticipated danger (the degree of which depends on its scale, how often it occurs and how long it lasts) and counter measures to deal with it (two types of measures, one before and the other after the danger takes place). If the anticipated danger contains too large factor of probability, countermeasures will have widen on scope to deal with every possible situation. Energy security is to a large extent a subjective perception. It is a, "matter of degree" in other words what constitutes 'security' is relative concept depending on countries, societies and communities.

In general an energy security policy can best be described as long term measures to adequately maintain the required supplies of energy resources, both domestic and imported, for a country at all times and at minimum costs. This would primarily involve the production, import and consumption of commercial energy fuels such as coal, crude oil, natural gas and hydro and nuclear power. In essence this would entail the avoidance of a situation which could lead to the disruption of supply (along with its consequent implications), as well as migration of such consequences, should any such disruption occur.

**Measures to Ensure Energy Security**

Energy security is basically managed and maintained through policies, systematic planning, etc. It can also be managed through substitution, which can be either energy trade or feasibility of using resources like nuclear energy. Promoting fiscal measures like reduction of taxes and royalties on domestic production, minimum import price, etc. Energy security can be improved through promotion of research and development work into new technologies and renewable energy sources. Developing capacity in crisis management and reserving stocks also desirable for energy security.

Energy security can be managed through imports, if the country has enough foreign exchange reserves. A minimum import price on imported crude oil and products could be effective in protecting indigenous energy from disastrously low international prices.[33]

Developing indigenous energy to meet the requirement. Developing renewable energy technologies. Energy security can be enhanced through research and development activities. Short term commercial considerations threaten to prevent further research in important areas such as renewables, gasification, transport technologies all of which could assist in reducing the dependence on oil.[34]

Energy security can also be enhanced through energy conservation and efficiency measures. Reducing energy intensity will reduce the dependence of the economy on energy consumption and imports. To achieve energy security requires first of all ensuring global energy adequacy- the existence of enough energy resources, or other prospects to meet long-term energy needs.

[33] Robert Belgrave, n 27, p 23.
[34] Ibid, p 26.

**Energy Security and Other Security Paradigms: Interfaces**

The term security has different connotations in different fields of human activity. So far it has been used mainly in connection with the maintenance of political sovereignty and territorial integrity of a state. In the present day world, however, other types of security have also gained prominence. Food security issues have long been debated and acted upon. Increasingly, those related to energy and environments are also becoming important.

It must, however, be admitted that the concept of security has always been a contested domain. In fact, the lack of an agreed definition and varied theoretical approaches to examining security raises the question of how one defines security.[35] Earlier security issues were mainly state-centric and related to military. But now it is understood that a fixation with military security cannot address the problem of non-military threat to national security that are rapidly gaining significance. Nor can it address threats national and regional, like the struggle for resources embedded in the pursuit of energy security, food security and, more lately, environmental security.

The UN Conference on the Relationship between Disarmament and Development, held in 1987, adopted a final document which states that: "recently, non-military threats to security have moved to forefront of global concerns.... The world can hardly be regarded as secure so long as there is polarization of wealth and poverty at the national and international levels.... Mass poverty, illiteracy, disease, squalor and malnutrition afflicting large proportions of world's population often become the cause of social strain, tension and strife".[36]

Thus a national security policy, in a wider sense, encompasses the economic, industrial and technological base; the cohesiveness of the socio-cultural structure; the resilience and stability of the political system and the efficacy of diplomacy. There is a fair agreement

[35] P. R. Chari, Sonika Gupta, "Introduction", in P. R. Chari, Sonika Gupta, (eds), *Human Security in South Asia: Energy Gender, Migration and Globalization*, (New Delhi: Social Science Press, 2003), p 1.
[36] Sunil Kumar, "Rethinking Security in South Asia", *International Studies*, Vol.36, No.2, 1999, p 106.

now that the national security directly incorporates in it, political, social, economic and environmental concerns. This provides a more radical approach being pursued towards the underlying issues like conventional defense, reviewing force structures, weapons acquisition options, and reducing defense budgets. Redeploying resources for development would address the neglected aspect of human security to which attention would now be turned.

Indubitably, the end of the Cold War heralded the necessity to undertake a paradigm shift in the security discourse by privileging the well-being of citizens alongside ensuring the security of the state. This required a broadening of the traditional security agenda to include socio-economic and politico-cultural rights, and to recognizing the role of non-state and informal actors, civil society, Non-Governmental Organizations (NGOs) and political parties to enable a more syncretic understanding of the reasons for conflict between and within states.[37]

Security thus is defined from a multi-dimensional, multi-level perspective, with denomination such as gender perspective, mutual/cooperative security, individual/population security, common security, global or neighbourhood security, economic and environmental security and comprehensive security. They include freedom from military, political, societal, economic and environmental threats, demographic or gender concerns and prevention of natural disasters, ensuring quality of life and fulfilling basic human needs on an equitable basis.

Such a reconceptualization of security also includes both positive (the ability to maintain relationships that are viewed as essential to survival such as access to food, oil, water and credit) and negative security (the ability to defend against threats viewed as harmful).[38] They stand together on one basic point, namely, their rejection of hegemonic or military-centered notions of security as the sole criteria of security, which it is felt, are

[37] P. R. Chari, Sonika Gupta, n 35, p 7.
[38] Abdul Kalam, n 10, p 99.

fundamentally flawed in a highly interdependent world facing multiple security threats that are not amenable to statist solutions.[39]

Given the multi-dimensional, multi-level situation of insecurity in the post-Cold War era, many analysts shifted their interest from state-centric models that focus on military conflict to broader definitions of security. To them insecurity in the comprehensive sense may result in various types of violence: direct (or physical), structural (or social), and, more recently, violence against nature, endangering ecological or environmental vulnerabilities.

Peace, economics and environmental security are perceived inseparable, as there cannot be any peace or stability without development and without an assured environmental security development cannot be sustained. Common security, by emphasizing common dangers, bases its appeal for cooperative behaviour not on altruism but on a larger sense of collective self interest. The extended security concerns at the individual or grassroots level, conveying the sense that people must be regarded as equally important as the security of states. The notion of comprehensive security includes ensuring access to food, energy, and other resources and recognizes the utility of development aid and other economic methods in pursuit of security.

The process of paradigm shift in the security arena has already begun in the last quarter of the century. Since the Stockholm Conference in 1972 and the founding of the United Nations Environmental Programme (UNEP), there has been a major shift in emphasis on both environment and development. The Conference on Security and Cooperation in Europe (CSCE), convened since the early 1970s by the states of the North Atlantic Treaty Organization (NATO) and Warsaw Pact, and the Helsinki Final Act (1975), including its baskets of accords guaranteeing East-West border security, trade and human rights and subsequent initiation of "Confidence and Security Building Measures" (CSBMs) aimed at reducing East-West tensions – all served as useful references and provide framework for similar cooperation in other regions of the world for common well-being.

[39] Ibid, p 99.

The report of World Commission on Environment and Development (WECD) or the Brundtland Commission of 1987, the Earth Summit in 1992 (including the Rio Declaration on Environment and Development (chapter 8) presents 27 principles of environment and development as well as Agenda 21 for ensuring sustainable development), followed by Earth Summit II (1997) and the World Conference on Climate Change (Kyoto 1997) in essence projected the emergence of a paradigm of global environmental change and a sense of global crisis. A sustainable development paradigm also emerged with an emphasis for ensuring interna. social development, children, gender and human rights – with a great deal of importance attached to civil society and governance – displacing the exclusionist, externalize – statist traditional paradigm.[40]

The WECD was especially dealt with environment and need for its protection. While the Earth Summit of 1992 was even though was related to environment and sustainable development, the principle 7 and 23 had energy related components. The 7th principle says, state shall co-operate in a spirit of global partnership to conserve, protect and restore the health and integrity of the earth's eco-system.[41] Whereas the 23rd principle enumerated the environment and natural resources of people under oppression, domination and occupation shall be protected.[42]

But the Earth summit of 1997 dealt elaborately with energy and related issues. The Summit essentially that energy is necessary to economic and social development. However the focus should be on sustainable patterns of production, distribution and use of energy. It also stated in order to reduce the environmental impact and to reduce local health hazards and environmental pollution enhanced international co-operation, notably in the provision of concessional finance for capacity development and transfer of the

[40] Michael Grubb etc, *The Earth Summit Agreements: A Guide and Assessment*, (London: The Royal Institute of International Affairs, 1993), p 6.
[41] Digumarti Bhaskara Rao, (ed), *Earth Summit – Part I*, (New Delhi: Discovery Publishing House, 1998), p 4.
[42] Ibid, p 7.

relevant technology and national action are stated.[43] It also emphasized on the need for ensuring international co-operation for promoting energy conservation and improvement of energy efficiency, the use of renewable energy and research, and the development and dissemination of innovative energy-related-technology.[44]

The various interfaces between energy security and other security paradigms can be seen as follows,

**Energy Security and National Security**

Energy shortages and insecurity affect countries in two ways: they handicap productive activities, and they undermine consumer welfare. Energy insecurity discourages investors by threatening production and increasing costs. Thus it halts foreign exchanges which is necessary for economic security. There are several national security issues related to energy trade. On a regional scale, conflicts potentially could arise from the harnessing of rivers for hydroelectric power in watersheds covering several countries. Energy security concerns are raised when natural gas pipelines that cross national borders are built or proposed. But oil trade has raised the greatest concerns about national security.

Too Much dependence on imported energy would imply increasingly vulnerable national security situation. Resource security is an integral part of national security. Among other considerations, security is determined by the interactions of two principal factors that can be affected directly by the interruption in energy supplies – economic security and military security. Imported petroleum is vital both to the operation of the economies and to the functions of military defense in many countries. For the remainder of the century, international petroleum trade will remain under the control of groups of countries who have shown a willingness to use this control as a political and economic weapon.

Energy and national security are linked in another way, political, economic and environmental policy conflicts over the relative priority given to energy, development,

[43] Digumarti Bhaskara Rao, (ed), *Earth Summit – Part II*, (New Delhi: Discovery Publishing House, 1998), p 632.
[44] Ibid.

conservation and government sponsored energy research and development engender uncertainties over the future economic conditions and the supply and cost of energy, thus constraining investment and the prospects for enhancing industrial productivity.[45] Thus this necessitates energy security for a country.

**Energy Security and Human Security**

Human security is linked to human rights, human development and humane governance. It has various dimensions like, economic security, food security, political security, environmental security, personal security, communal security, political security and energy security.

The primary concerns of human security are the individual and the people and secure their safety, freedom and opportunity for them. Human security is threatened by the state, non-state and global actors and indirect threats from nature. The main human security ensuring agencies are state, non-state actors, civil society, Non governmental Organizations, United Nations International/multilateral organizations and cooperation among actors. Basically security achieved through non-military means.

The basic human security issues are, personal security which is ensured by the state through legal and physical protection. Economic security fro which development policies and activities which aims at creation of employment and conditions of self employment. The basic goal of ensuring food security is to increase the production of food, improving distribution mechanism, poverty alleviation, income generation for vulnerable groups. Ensuring human development and providing health and education is another basic purpose of human security. In order to ensure human security there is a need for good governance which can protect human rights and bring normative and attitudinal change. Ensuring energy for growth, environmental protection, prevention of misuse and overuse of natural resources are other important aspects. Thus to ensure human security it is very pertinent to secure energy security for rural areas, poor households over a long period.

[45] Robert Belgrave, n 27, p 284.

**Energy Security and Economic Security**

There is a historical relation between energy and economic growth. The central feature of industrial revolution was the massive expansion in the amount of energy that became subject to human control in the productive process. The essential growth was a shift both in the sources of energy use and in the transformations that the energy sources went through before they were converted into purposeful productive activities.[46] It was through energy that major sectoral changes took place, new inventions were made resulting in industries, and transport, communication network etc. lead to economic growth.

Energy has come to be considered as a basic factor in economic production. Depending on the structure of production and the relative prices of all factors energy has been used in varying proportions. Considerable attention is now focused on achieving an economically optimum energy path in each country, as well as on understanding the energy implications of alternative economic development paths. Energy is required for all the sectors of the economy – primary, secondary and tertiary. The energy sector, as an integral part of the national economy, can be expected to be managed only as well as the rest of the economy. The experience of countries in the Asia-Pacific region bears this out. Well-run economies such as Japan's tend to have vigorous and effective energy policies and programmes.



Unquestionably, the process of economic development has nearly always been accompanied by increased mechanization in the primary sector (such as agriculture), growth in the secondary (manufacturing), which is more capital intensive, and the concomitant growth in the tertiary sector (trade and services), spawned by the increasing specialization accompanying the secondary sector growth.[47] These changes imply increased use of commercial fuels to complement human and animal power and traditional fuels. The structure of country's energy demand is therefore highly dependent

[46] Nathan Rosenberg, "Historical relations between Energy and Economic Growth", in Paul Stevens, (ed), *Economics of Energy – Volume I*, (Glos: Edward Elgar Publishing Limited, 2000), p 55.
[47] Kirk R. Smith etc, "Energy in Asia and the Pacific: The Important Questions", in Fereidun Fesharaki, (et al), *Critical Energy Issues in Asia and Pacific – The Next Twenty Years*, (Boulder/Colorado: Westview Press Inc., 1982), p 226.

on the combinations of activities in these sectors, on the energy intensity of these activities, and on the form of energy used in each.

A sustainable energy future is compatible with strong economic growth. Moreover pursuit of a sustainable energy path facilitates the realization of sustainable socio-economic growth over the long-term. Meeting energy sector investment needs in particularly a problem in developing countries, where the capacity to finance investments is a major factor limiting growth. While future capital requirements for energy are huge and are expected to continue to increase, the challenge of meeting capital needs for energy is not inherently so daunting as was thought to be the case just a few years ago.[48]

Major challenges for developing countries and for the economies in transition are to establish strong domestic capital markets and to attract more private capital to the energy sector, especially the power sector. The other challenge is the burden of foreign exchange required to import fossil fuels were very heavy and had adverse impact on country's balance of trade positions. So many countries started pursuing sustainable energy development strategy to meet the future requirements. Thus for an effective economic security energy policy is vital.

**Energy Security and Environmental Security**

In recent years, the areas of energy, environment and sustainable development has drawn considerable attention of the national and global policy makers. While the importance of energy planning has long been accepted, the oil crisis in the 1970s gave impetus to the process of formulation and implementation national energy planning and policy responses. But the apparent linkage between the emissions from the fossil energy use and the green-house effect made the environmental concerns a critical component of energy planning. The global warming phenomenon and the consequent climate change have now emerged as a major item on the global environmental agenda.[49]

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[48] Amulya K. N. Reddy etc, *Energy After Rio: Prospects and Challenges*, (New York: UNDP, 1997), p 122.

[49] Richard Loulou etc, *Energy and Environment Policies for a Sustainable Future*, (New Delhi: Allied Publishers Limited, 1997), p 2.

This is evident from the signing of the Framework Convention on Climate Change (FCCC) by 154 countries at the Earth Summit in Rio de Janeiro in 1992. The convention provided the legal, institutional, procedural and normative framework for the international community to consider responses to the threat of climate change and its impacts. The central objective of the FCCC is to achieve stabilization of atmospheric greenhouse gas concentrations at a level that would prevent dangerous anthropogenic interference with the climate system.[50]

Lothar Brock defines environmental security as "the avoidance of negative linkages between the environment and human activities which includes the avoidance of warfare, war over natural resources and also environmental degradation, which is a form of war".[51] Environment security today stands as a national security concern. Barry Buzan, a critic who wants to see environmental security a part of the economic field is of the view that the concept 'national security' has been tacked on to environmental debates, because of the latter's mobilization potential.[52]

Today most of the countries' energy and environment policies linked with the economic development. At the meeting in June 1991, International Energy Agency Ministers reaffirmed their governments' commitment to develop integrated policies with the objectives of energy security, environmental protection and economic growth.[53] The essence of this idea is that development should be such as to meet the needs of the present generation without compromising the ability future generations to meet their needs. For energy it means that, energy should be available at prices moderate enough to ensure that economic growth is accomplished with acceptable environmental impacts.

The mining, processing, transport, conversion and use of fuels are responsible for a large portion of the direct disruption to ecosystems, through deforestation for fuel woods and

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[50] Ibid, p 3.
[51] Lothar Brock, "Peace through Parks: The Environment on the Peace Research Agenda" *Journal of Peace Research*, Vol.28, No.40, 1991, p 407.
[52] Narottam Gaan, n 16, p 14.
[53] IEA, *Global Energy: The Chaning Outlook*, (Paris: International Energy Agency/OECD, 1992), p 28.

mining of coal. The impacts on ecosystem and human health are the other critical aspects. As with the relationship between energy use and economic activity, the connection between energy and environmental impact is not necessarily direct. There are substantial differences among the environmental impacts of different fuels as well as possible modifications of technology to decrease the impacts from any particular fuel cycle. Since the absorptive capacity of the environment is essentially constant, a growing energy use implies an increasing amount of pollution control expense, or a shift in the types of energy used, if continuing environmental degradation is to be avoided.

The amount and type of energy use is itself a general indicator of the potential for a number of important environmental risks. Although energy's potential for enhancing human well-being is unquestionable, conventional energy production and consumption are closely linked to environmental degradation. This degradation threatens human health and quality of life, and affects ecological balance and biological diversity.[54]

At every level, the environmental consequences of current patterns of energy generation and use make up a significant fraction of human impacts on the environment. At the household level, solid fuel use for cooking and heat has significant health impacts. Poor air quality at the household, local and regional levels is associated with increased sickness and premature deaths in many developing countries.[55]

Sustainable energy systems must support both human and ecosystem health over the long term. They should also take into account the public's tendency to demand more health and environmental protection as prosperity increases. Although the scope of environmental problems related to energy may seem overwhelming, numerous strategies could simultaneously benefit the environment, the economy and the human well-being. So energy security must not be at the cost of environment.

[54] UNDP, *World Energy Assessment: Energy and the Challenge of Sustainability*, (New York: UNDP, 2000), p 9.
[55] Ibid, p 11.

**Energy Security and Social Security**

Energy is closely linked to a range of issues, including poverty alleviation, population growth, urbanization, and a lack of opportunities for women. Although these issues affect energy demand, the relationship is two way: the quality and quantity of energy services and how they are achieved, have an effect on social issues as well.[56] There is probably no country that does not use its energy system as a tool to achieve social goals. Most obviously, this is done through differential pricing of fuels and electricity. To some extent in nearly every country, each fuel is taxed or subsidized to a different extent, that is, relative prices are not determined entirely on the basis of the cost of production, the market, or energy content. One of the principle reasons usually given for creating such price differential is to assist poor or otherwise disadvantaged groups.

Poverty is the overriding social consideration for developing countries. The energy consumption patterns of poor people especially their reliance on traditional fuels in rural areas tend to keep them impoverished. There are number of people who have no access to electricity and many of them use traditional solid fuels for cooking. In addition hundreds of millions of people mainly women and children spend several hours a day in the drudgery of gathering firewood and carrying water, often from considerable distances, for household needs.[57] Because of these demands on their time and energy, women and children often miss out on opportunities for education and other productive activities.

Although population growth tends to increase energy demand, it is less widely understood that the availability of adequate energy services can lower the birth rates. But energy can play a key role in accelerating the demographic transition, particularly by achieving dramatic reductions in fertility to stabilize global population as quickly as possible and at as low a level as possible.[58]

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[56] UNDP, n 54, p 7.
[57] Ibid.
[58] Amulya K. N. Reddy, "Energy and Social Issues", in *World Energy Assessment: Energy and the Challenge of Sustainability*, (New York: UNDP, 2000), p 52

The growing concentration of people in urban centres is another key demographic issue linked to energy. Rapid urbanization is associated with a rise in energy demand which potentially threatens the sustainability of human settlements and the natural environment. Although the negative externalities associated with energy use in urban areas can be severe, various strategies can mitigate their effects and promote energy conservation.

In recent years a number of critics have pointed out that energy systems can effect social equity in ways other than through pricing of fuels. They argue that some classes of energy technologies may lead to economic development patterns that consolidate economic and consequently political power in the hands of a few people. Other types of energy developments in contrast may tend to lead societies into less centralized and more participatory modes. Thus for societal security energy is necessity and for meet the energy needs energy security is pertinent.

**Energy Situation in Bangladesh**

The known energy resources of Bangladesh are natural gas, oil, coal, peat, hydropower, and animal power and biomass fuels. All the known natural gas reserves are located in East Zone of the country. During the last thirty years, the government has made consistent efforts in expanding the use of natural gas to different parts of the East Zone. It has also been possible to assess the total deposits of all the known gas fields on a reliable basis. So far, the government policy on the expansion of natural gas has been mainly addressed to the substitution for imported petroleum. Considering the acute scarcity of biomass fuel: deliberate attempt should also be made to substitute the use of natural gas for biomass fuel to support sustainable supply of the other.

In Bangladesh, the per capita energy consumption is relatively low. It is one of the country's formidable development challenges. The present rate of consumption has been constraining Bangladesh's efforts towards attracting sizable foreign direct investment, accelerating development and improving the quality of life of Bangladeshis, to mention a few. The factors involved in the country's energy equation have both intra and inter-

generational implications. Bangladesh, in one hand, is required to create and meet energy demand at the level that could facilitate a speedier economic growth and human development, among others. It is required, on the other hand, to establish initial condition for the future generation to meet their energy requirement a continuing basis.

Presently known primary commercial energy resources of Bangladesh include natural gas, oil, coal, peat and hydroelectricity. According to World Bank estimates, per capita consumption of energy and per capita Gross National Production of Bangladesh were 197 KgOE (Kilogram of Oil Equivalent) and US $350 respectively. Natural gas is the major indigenous commercial energy source in the country. The total in-place reserve of natural gas in 20 gas fields was 23.198 Trillion Cubic Feet (TCF).[59] The total reserves of coal in three locations (Jamalganj, Barapukuria and Khalaspir) are about 1,750 million tons.[60] The total hydro-power potential of the country in three locations (Kaptai, Sangu and Matamuhuri) is 1,500 Giga Watts per year (GWh/year), of which 1,000 GWh/year have been harnessed at Kaptai.[61]

It may not be possible to harness the additional hydro-power potential of the country without inundation of human settlements and agricultural lands. The total peat deposit of the country is 170 million tons. It has not yet been possible extract peat due to techno-economic reasons (possible negative effects on agricultural land). In Bangladesh traditional energy sources (i.e. biomass fuels) supply a major share of the total energy consumed in the country. Limited tree covered lands (reserve forests and village woods lots), agricultural lands and cattle population are the major source of biomass fuels. Over exploitation of biomass fuels is environmental degradation. There is a need to substitute biomass fuels with commercial energy to maintain their supply within sustainable limits.

Existing known reserves of primary commercial energy sources (e.g. natural gas, coal, and hydro-power) of Bangladesh are very modest in comparison to the development

[59] Atiur Rahman, (et al), *People's Report on Bangladesh Environment 2001*, Vol.I Main Report, (Dhaka: The University Press Limited, 2001), p 169.
[60] Ibid, p 169.
[61] Ibid, p 171.

needs of the country. Among these natural gas is the most important indigenous commercial energy source. Different claims made about additional reserves of natural gas in Bangladesh presented below:

(a) 9.3 TCF (National Energy Policy, Government of Bangladesh 1996).

(b) 25 TCF (Shell Bangladesh, The Bhorer Kagoj, October 7, 1999).

(c) 55 TCF (US International Oil Companies, 1999).

(d) 100 TCF (Sobhan, ibid, March 10, 2000).

(e) 50 TCF-60 TCF (Cookson, The Independent, March 31, 2000).[62]

Table 1.1

**The Consumption Pattern of Different Types of Primary Fuels in Bangladesh during 1994-95 and 2000-01.**

| | |
|---|---|
| Petroleum Products | 10.6% |
| Natural Gas | 25.3% |
| Hydro-power | 0.13% |
| Coal | 1.8% |
| Commercial Energy | 37.8% |
| Biomass Fuels (Non-Commercial Energy) | 62.2% |
| Total Energy | 100% |

Source: *People's Report on Bangladesh Environment 20001*, Vol.I Main Report, p.173.

Considering the importance of energy in supporting sustainable development the government of Bangladesh approved the National Energy Policy in 1995 to ensure long term energy security for the country. During the formulation of the National Energy Policy the energy demand for the country has been projected for two economic growth scenarios for the period from 1995-2020. Then energy demands were balanced with possible supply of indigenous sources of energy (e.g. natural gas, hydro-power and coal). At that time it was estimated that it would not possible to increase the supply of indigenous natural gas beyond the projected level of supply for the year 2000. It means that the projected level of energy supply (in 2000) is to be maintained for the already

[62] Atiur Rahman, n 59, p 172.

connected large energy consuming industries up to the end of their life cycle. In other words if the consumption level increased, available resources will be exhausted before the end of the life cycle of the installed energy consuming facilities. So the exploration and development of new gas fields took place. Thus it is envisaged that if resources are directly used to meet the future needs of the country, energy security can be provided at least up to the year 2020.

The main objectives of National Energy Policy 1995 were:

(i) To provide energy for sustainable economic growth so that the economic development activities of different sectors are not constrained due to shortage of energy.

(ii) To meet the energy needs of different zones of the country and socio-economic groups.

(iii) To ensure optimum development of all the indigenous energy sources (e.g. commercial fuels, biomass fuels, and other renewable energy sources).

(iv) To ensure sustainable operation of energy utilities.

(v) To ensure rational use of total energy sources.

(vi) To ensure environmentally sound sustainable energy development programmes causing minimum damage to the environment.

(vii) To encourage public and private sector participation in the development and management of the energy sector.[63]

Despite all-out efforts, it has not been possible to ensure sustainable supply of electricity to the consumers. As a consequence it has affected the economic activities. In order to meet the problem of power interruption, government has allowed duty free import of small generators and fixed lower price of gas for captive power generation in comparison to the price fixed for usage in industries. Bangladesh Petroleum Corporation (BPC) and different organizations under its supervision have maintained reliable supply of different types of petroleum fuels. They have taken special care to ensure supply of diesel oil during the irrigation season. Supply of biomass fuels has been continuing in an

[63] Ati Ur Rahman, n 59, p 173.

unorganized manner. Over exploitation of biomass fuels and its effect on the environment is a case of great concern.

In Bangladesh there are debates on many issues relating to the energy security. Many scholars think that there is a need to consider long term energy development programmes. The other issue related to energy security which is gaining importance day by day is environment. Combustion of inferior bio-fuels creating highly polluted environment. Gas export is another hot issue in discussion with regard to energy security in Bangladesh. There are pressure groups who maintain that the huge gas reserves of Bangladesh can be best utilized by exporting to India. However, there are serious political problems in doing so. The debate of late has become enlivening. Most of the analysts believe that there is no surplus gas to export. But different studies reveal different levels of gas reserves in Bangladesh. Thus there are so many issues.

The main challenge before Bangladesh is ensuring energy security for the poor. Because low income households spend a major portion of their limited income to meet their daily energy needs. It is said that energy pricing policy itself has led to the significant inefficient use of energy resources. Thus some scholars point out the need for exploring a regional approach to the energy security with potentially energy rich Nepal and Bhutan.

Thus with regard to energy security of Bangladesh many issues are left unaddressed. Since most of the people in Bangladesh are from rural areas, there is a need to formulate policies which can provide them energy security at affordable prices. It is also necessary to scientifically analyze the energy reserves that Bangladesh requires to ensure energy security. Another aspect which needs examination is, how energy security and effective use of energy can be done and how it could be used in enhancing economic growth. All these issues will be discussed in the subsequent chapters.

The second chapter will discuss the historical and the present situation in energy management in Bangladesh. Management issues like meeting the demand and supply

gap, pricing will also be focused. This would also assess the major policy changes over the years.

The third chapter will throw light upon the natural gas sector in Bangladesh. Here an analysis of major developments and policy changes in the natural gas sector will be made. This would also include an inquiry into the original available gas reserves in Bangladesh.

The fourth chapter will discuss the issues related to energy security in Bangladesh. This would analyze broad range of issues which have geographical, socio-economic, temporal, environmental dimension.

The fifth chapter will examine the energy security implications for Bangladesh. The external dimension of energy security implications will also be looked into.

The concluding chapter will include the main findings of the study.

# CHAPTER II

## ENERGY MANAGEMENT IN BANGLADESH

# *Chapter II*

# ENERGY MANAGEMENT IN BANGLADESH

Energy, irrespective of the type, is the basic input for all developmental activities so that a strong correlation prevails between per capita energy consumption and the economic development of a country. The conventional energy sources are coal, oil and natural gases, which are also known as fossil fuels. The energy crisis in the 1970s has brought into focus the realization that the fossil fuel resources are limited and at the present rate of consumption these would not last forever. Coal might last for several centuries, but oil and gas, the preferred fuels of the twentieth century, will probably be used up in a few decades. Apart from the need to conserve the energy for future generations and to give time for the development of more permanent sources (such as solar, wind, wave, etc) shortages will progressively produce much higher costs. Cost has already increased dramatically, so that every effort is made to use energy as economically as possible. Hence the need for energy management arises.

Among the major questions that arise in connection with present and projected patterns of energy use are those concerning the adequacy of the supply of energy resources. Which resources are scarce and which are abundant ? What does it mean to run out, and how accurately can such eventualities be predicted ? What is the potential for harnessing inexhaustible sources ? The stock-limited or non-renewable resources, which the earth is endowed with fixed stocks; once the stocks are depleted, no more will be available on any time scale for practical interest. Flow-limited or renewable resources, by contrast, are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time.[1]

The phrase energy management means different things to different people. Energy management is the judicious and effective use of energy to maximize profits and enhance

[1] S.K. Shukla and P.R. Srivastava, (eds), *Environmental Energy Impact Analysis*, (New Delhi: Commonwealth Publishers, 1992), p 11.

competitive positions.[2] Therefore, any management activity that affects the use of energy falls under this definition. The rapid increase in costs of all forms of energy and the general shortage of energy supplies call for a rational energy utilization policy for each and every segment of the industrial sector. Thus, in order to tackle the energy problem from all sides an effective energy management function is required.

**Aspects of Energy Management**

Proper planning and management in respect of energy are necessary for proper and effective uses of energy and to ease the burden on the conventional energy sources. This is also essential for giving more stress on renewable sources of energy and to prevent wastage or misuse of energy. This exercise also includes proper production and distribution and keeping ecosystem and environment free of pollution.[3] Policies governing energy resources and management are closely related to the national economic and social development policies. Being recognized as a critical input into the development process, adequate, affordable and reliable supply of energy has always been the policy concern of the governments. Although since mid-1980s the international price of oil remained low and stable, other factors, including the sustainability and environmental pollution concerns of major commercial sources of energy, have made the choice of fuel an even more difficult policy and management issue. The issue is therefore, that of the sustainable development and management of energy resources with minimum adverse impact on the environment.

Although the per capita energy consumption in developing economies is very low, indicating more energy needs to be used to fuel the economic growth, in many cases energy is used inefficiently for various reasons. There is a huge potential for energy efficiency improvements, through better use of production and end-use equipments and appliances. By applying the concept of demand-side management in energy, including electrical energy, at the consumer end, a part of the demand can be met with little or no

[2] P.R. Trivedi and BR Julka, *Energy Management*, (New Delhi: Commonwealth Publishers, 1997), p 45.
[3] Shukla, n 1, p 23.

investment.[4] It may help defer some capacity addition for a later date. Financing energy infrastructure, along with the associated pricing issue, is another, but related, major issue.[5] Thus for all these an efficient energy management system and managers are pertinent.

P. R. Trivedi and B. R. Julka identified some desirable objectives of energy management programmes.[6] They include:

i) Conserving energy, thereby reducing costs.

ii) Cultivating good communications on energy matters.

iii) Developing and maintaining effective monitoring, reporting and management strategies for wise energy usage.

iv) Finding new and better ways to increase returns from energy investments through research and developments.

v) Developing interest in and dedication to the energy management programme from all employees.

vi) Reducing the impacts of curtailments, brownouts, or any interruption in energy supplies.

The primary purpose of energy management is to develop policy and action programmes to increase energy efficiency. Major activities of the energy manager include organizing, developing, budgeting, selling and promoting, coordinating, technical solutions, record keeping, follow-ups and analysis. To achieve this goal the energy manager must save energy, save money, should decide on what will be the prime technical resource for energy questions, identify energy conservation opportunities, develop energy conservation projects, coordinate energy actions and decisions, ensure future energy

[4] UN, *Energy Environment and Sustainable Development III: Energy Infrastructure Policies and Issues*, (New York: UN, 1999), p 18.
[5] Ibid.
[6] Trivedi, n 2, p 46.

supplies and the economics of the possibility of the introduction of the new energy source, etc.[7]

Any new economic activity can be justified only if it is cost effective; that is, the net result must show a profit improvement or cost reduction greater than the cost of the activity. Energy management has proven and again that it is cost effective. In fact, for most manufacturing and other commercial organizations energy management is one of the most promising profits improvement-cost reduction programmes available today.[8] One of the most important features is that energy management helps the nation in successfully facing some of its biggest problems like operating efficiency, inadequacies of production and distribution, losses, inadequate investment etc.

In many cases energy management has shown that it can substantially reduce energy costs and consumption. In fact, energy available from energy management activities has almost always proven to be the most economical source of "new" energy.[9] Furthermore, energy management activities are gentler to the environment that large-scale energy production and they certainly lead to less consumption of scarce and valuable resources. Thus, although energy management cannot solve all nations's problems, perhaps at least one among them is, it can ease the strain on our environment and buy enough time so that we can develop new energy sources.

An energy manager must be familiar with all energy terminologies and units. Knowing the terminology of energy use and the units of measure is essential to developing a strong energy management background. The most important single ingredient for successful energy management programme is commitment to the programme by the top management. Here, the role of the energy manager is crucial in ensuring that management is committed to the programme. As with any other form of management, the first requirement is to know the present position. An audit must be conducted to find out

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[7] Dhulasi Birundha Varadarajan, P Vijayan, "Energy Management: A Vital Issue of the Industry", in V.S. Mahajan , (ed), *Studies in Energy and Economic Development*, (New Delhi: Deep and Deep Publications Private Limited, 1991), p 122.
[8] P.R. Trivedi, n 2, p 48.
[9] Shukla, n 1, p 13.

exactly what energy being used, where it is used and from which fuel it is derived.[10] Energy accounting is a system used to keep track of energy consumption and costs. A basic energy accounting system has three parts: energy use monitoring, an energy use record, and a performance measure. All these are necessary for effective energy management.

In order to reduce energy costs in the most economic manner, it is necessary to start the energy conservation project with an energy audit. The way in which energy utilization is divided among the different users, etc. it is possible to make energy cost calculations for all energy saving measures on the basis of the energy balance. A priority listing of measures, based on the profitability, can be made. It is important that all types of measures which reduce energy costs are evaluated, from every simple measures aimed at cutting down on wastefulness to recovery measures, process changes and changeover to cheaper energy sources.[11] Thus the name 'energy management' implies as an energy manager or energy technologist the steps he or she has to undertake in order to manage an energy system in the most efficient way possible.[12]

Demand and supply management of energy supplies requires a thorough understanding of both economic and technical factors. Too often, micro-economic, technical and macro-economic aspects. In the same way, one should not ignore the implications of using each type of technology or the responses of various economic sectors and industrial decision makers to macroeconomic policies that deal with the demand and supply of energy.[13] Management of energy demand is not as easy as that of other commodities as energy consumption is not an objective by itself. It is derived demand that is several layers deeper than the surface demand equation. Nevertheless it is an important input in any productive activity.

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[10] Trivedi, n 2, p 3.
[11] P.C. Sinha, (ed), *International Encyclopaedia of Sustainable Development Vol.18: Energy Crisis*, (New Delhi: Anmol Publications Private Limited, 1998), p 219.
[12] B. Majumdar, *A Text Book for Energy Technology: Both Conventional and Renewable Sources of Energy*, (New Delhi: A. P. H. Publishing Corporation, 1999), p 141.
[13] Fereiden Fesharaki etc., *Critical Energy Issues in Asia and Pacific-The Next Twenty Years*, (Boulder and Colorado: Westview Press Inc., 1982), p 277.

The energy management programme includes:

i) Preparation of Energy Report, which contains energy situation, energy conservation action, energy promotion, energy goal, and energy saving potential etc.
ii) Energy Audits: it aims at assessing current energy usage and efficiency of usage. Sufficient data should be collected to determine the functional efficiency of end users and provide basis for energy conservation plan.
iii) Energy Budgeting: The various innovative schemes must be budgeted through.
iv) Effective implementation of all plans.

With the advent of new technologies for alternative or renewable energies and with the gradual facing out of the conventional energy resources it has become necessary to take the following steps for effective energy management:

i) It is necessary to have a bank of accurate data on all available energies that may affect a site in any location,
ii) Development of these data into tools or easily understood version for public to assist in the problem solving process,
iii) Provide easy access to the data to any group or person,
iv) Management training, organization and implementation,
v) Energy education to school children through texts and to all other classes of society through seminars, TV, radio, newspapers, workshops, etc, and
vi) Legislations and regulations.[14]

**Risk Assessment**

Thus the primary purpose of the energy management is to develop policy and action programme to increase energy efficiency. A key element in energy management programme is flexibility. Every energy management programme should have a contingency and back-up plan. Risk assessment can help the energy manager determine

[14] A. Rahman, "Energy and Energy Resource Management", in V.S. Mahajan, (et al), *Energy and Energy Resource Management*, (New Delhi: Deep and Deep Publications Private Limited, 1999), pp 126-127.

the resources required to meet various emerging scenarios. Above all periodic energy audits are essential to determine how much energy is needed and how much of it is wasted is helpful to identify process changes required and scope for adopting less energy consumption technique.[15]

The main objective of the energy policy in most of the countries has been to ensure adequate, reliable and affordable energy supply to stimulate economic growth and a decent life-style. While most countries have a policy in place towards energy efficiency, the Central Asian Republics are gradually introducing energy conservation measures as part of their reform policy. Most have argued for an efficient energy pricing policy to have a cost-plus tariff. Developing countries in the South Asian region are currently facing very acute energy infrastructure and management constraints. The gap between the demand and the supply of power is ever widening, leading to a slowdown in agro-industrial growth and exports with frequent brownouts, load shedding and voltage fluctuation.[16]

It may be useful to have a common understanding of the term "energy infrastructure". The word 'infrastructure' is normally associated with the physical plants and /or structures and buildings. In the energy sector, these are more commonly held to lay within the supply side, that is, those physical facilities and plants associated with the three stages of production or mining, the transformation or refining and the transport and distribution or transmission of energy commodities.[17] Thus they include coal mines, offshore oil platforms, refineries, all sorts of power plants (thermal, hydro and nuclear), transmission lines and pipelines, oil tankers and coal barges, etc. It is also normal to include the transport infrastructure, such as roads, trucks, ships and ports, and fuel shortage sites.

[15] Dhulasi Birundha Varadarajan, n 7, p 128.
[16] UN, n 4, p 49.
[17] Ibid, p 67.

**Demand Side Management**

More recently the demand side has come into the picture, as demand side management has been found to be a potentially powerful management tool. The demand side is where the users and energy consumers lie, and they are usually categorized into a number of sectors: the industrial, transport, commercial and household sectors.[18] Other sectors are the government sector, sometimes combined with the commercial sector, and the agricultural sector, sometimes included in the ir dustrial sector. Within each of these sectors the energy users have to use various kinds of equipment which have variable efficiency and which require capital expenditure. Thus it makes sense to include the capital expenditure in the consideration for overall energy sector management.

Energy infrastructure in the developing countries faces acute problems of operational efficiency and management, heavy transmission and distribution losses, ecology concerns, financial resource scarcity owing to sub optional pricing and absence of an integrated energy policy framework.[19] Prices charged to consumers are often in conflict with the pricing objectives of average costs, and there are no set norms of energy efficiency pertaining to pricing decisions. The industrial sector in the region has become acutely conscious of the need for improved energy efficiency and conservation to meet the international competition. Demand for oil and gas is likely to grow in the developing countries, with their young and growing populations, in the short and medium terms, and will necessitate increasing crude oil and gas imports over the years.[20] The focus in the developing countries is to target and achieve maximum returns from the existing assets in the energy sector, reducing technical losses in production, transportation and distribution of power, initiating action to reduce energy intensity and maximizing satisfaction of energy demand.

In the energy starved growing economies, emphasis on demand side management is essential. Various steps are already being taken by developing countries towards demand side management. These include, shifting the system load from peak to off peak hours,

[18] Ibid, p 67.
[19] Ibid, p 21.
[20] Ibid, p 22.

including staggering of the weekly holidays and working hours of industrial and commercial establishments and staggering of agricultural load. Incentives in terms of concessional tariffs for rescheduling loads have been introduced by installing time-of-the-day metering.[21] Energy conservation measures in the agro-industrial sectors through energy audits, awareness campaigns, the training of personnel, and the conduct of research studies are being introduced in the region.

There are very considerable gaps in energy demand/supply in the region even at the base level scenario -business as usual-. These are more pronounced at moderate and high rates of growth. The supply gap is bigger for hydro-electricity projects in the region owing to their longer gestation period and other environmental factors. The gap is intensified by heavy transmission and distribution losses in the region owing to weak and inadequate sub-transmission systems, large rural electrification projects in the South Asian region, in proper load management, lower power factor of operations, poor quality of equipment maintenance and widespread pilferage/theft of power.[22]

Emerging trends in energy consumption reflect energy demand rising to the extent that it is constrained by supply shortages. Supply of electricity to the agriculture in the developing countries of the region entails high transmission and distribution losses, leading higher generation requirements for each unit usefully consumed. The power industry has been unable to fulfill the primary obligation of ensuring adequate power supply and the quality has also been poor and inconsistent. Energy should be inexpensive (priced low enough to stimulate industry) and affordable, if necessary through cross-subsidies (so that the poor can obtain access); but it should not be cheaper otherwise it would lead to wasteful use and energy supplies would be less commercially viable.[23] Thus energy management addresses all these issues, increasing energy efficiency, minimizing cost, maximizing profit as primary objective. Bangladesh is not an exception to this.

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[21] N.N. Bhattacharya, "Energy Resource Management", in V.S. Mahajan, (et al), *Energy and Energy Resource Management*, (New Delhi: Deep and Deep Publications Private Limited, 1999), p 29.
[22] UN, n 4, p 23.
[23] Ibid, p 70.

## Energy Deposits in Bangladesh

### Natural Gas

Bangladesh is no doubt fortunate to have been blessed with a substantial reserve of natural gas distributed over its 22 gas fields including an offshore one. The Petrobangla study reveals the natural gas deposits, the gas initially in place and initial recoverable reserve as 24.745 and 15.51 TCF respectively.[24] But in Bangladesh there are many disagreements on the reserve estimates. For optimum utilization and long term planning of this valuable national resource, it is considered necessary that efforts should be made to continuously update and make the best possible estimates with most updated information of the gas fields. An USGS-Petrobangla Gas Reserve Assessment, made in 2001 to assess the country's undiscovered gas resources is indicative that the Monte Carlo Simulation mean is 32.12 TCF.[25]

### Coal and Peat

Coal is a recent discovery in Bangladesh. Until recently Bangladesh had to be content only with peat (i.e. first stage in the process of forming coal). The reserves of coal found are not much either. In the North-Western part of Bangladesh, the 'Gondwana Fault' has been the rich geologic 'kitchem', which, in course of million of years of its geologic history, generated both relatively shallow (500 feet) and deep (1500 to > 3000 feet) deposits of coal in large quantities.[26] The coal deposits (in place) of these areas are estimated to be over one billion ton at Jamalganj, 350 million tons in Barapukuria and about 650 million tons in Pirganj, i.e. a total of about two billion tons.[27]

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[24] http://www.nbr.org/regional_studies/Bangladesh/bangladesh_initial-study_VIII.html

[25] Atiq Rahman etc., *Development and Climate Change: Bangladesh Country Case Study—Phase* I, in http://www.developmentfirst.org/studies/BangladeshCountryStudies.pdf

Note: Monte Carlo Method is a technique for estimating probabilities. The method involves the construction of a model and the simulation of the outcome of an activity a large number of times. Probabilities are then estimated from an analysis of the range of outcomes from the model.

[26] Ibid.

[27] Ibid.

Peat found in Madaripur, Gopalganj, Khulna, Bagerhat, Sylhet, Barihal and Mymensingh meets part of fuel demand in the rural areas.[28] The peat deposits are estimated to be about 170 million tons at Faridpur, Khulna.[29] Peat is still not being exploited in any commercial quantities, except for use by local people for domestic cooking, molasses boiling. Environmental consequences on agricultural production due to local exploitation of peat have not been assessed in the country. At strategic point of view it should rather be considered a national reserve for future considerations.

**Biomass**

Biomass is the traditional primary energy source for Bangladesh and provides the major share of the total energy need. In fact on an average basis about 55% of the country's current energy supply is based on biomass as traditional fuels in rural areas.[30] The various sources of biomass energy sources for Bangladesh are rice hulls, cow dung, rice straw, twigs and leaves, bagasse, firewood, jute stick and other wastes. In the year 2000, the total fuel supplied from the biomass sources mounted to about 293 trillion British Thermal Unit (BTU).[31] Crop residues like rice hulls occupies the largest share, about 26% of the total biomass fuel used, following cow dung 19% of the biomass fuels.[32] Since the major primary energy supply for cooking fuel in rural areas of Bangladesh comes from biomass, the overexploitation of tree as one of the major biomass sources has led to an alarmingly fast rate of forest depletion.

**Solar Photovoltaic and Thermal**

Of all the non-traditional energy resources, sun light is the most pollution free source of energy. Solar energy can be best utilized in the regions between 40 degree north to 45 degree south latitude with little rain. Since Bangladesh is between 20.43 degree north and 26.33 degree south use of solar energy quite prospective here.[33] The annual direct solar

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[28] Philip Gain, (ed), *Bangladesh Environment Facing the 21st Century*, (Dhaka: Society for Environment and Human Development, 2002), p 175.
[29] Atiur Rahman, (et al), *People's Report on Bangladesh Environment 2001—Vol.I: Main Report*, (Dhaka: The University Press Limited, 2001), p 169.
[30] Rahman, n 25.
[31] Ibid.
[32] Ibid.
[33] Gain, n 28, p 177.

radiation available in Bangladesh is estimated to be equivalent to about 25,610 million tons of coal equivalent with the sunshine hours are available almost throughout the year except during about 3 months of the peak monsoon season.[34]

**Wind energy**

The wind energy country is adequately mapped and the process has been started only within the last few years. There has not been any serious attempt to exploit wind energy for power. The average economic wind speeds (4-5 meters per second on the average) are not available throughout the year, excepting in a few places like Kuatka, Barisal coasts, Cox's Bazar,m St. Martin's Island, and off shore islands Swandeep, Kutubdia and others.[35]

**Biogas**

Biogas is the fuel produced following the microbial decomposition of organic matter in the absence of oxygen.[36] Biogas offers an alternative fuel source to wood and so can ease the fuel wood scarcity in many developing countries, lessening the need for. firewood energy which in turn reduces the possibility of deforestation and soil erosion. With appropriate planning approach dissemination of biogas plants on a larger scale is possible in rural and rural-urban fringe areas of Bangladesh (e.g. integrated with over 25,000mini/medium-scale dairy units, its potential will remain less than 5% of the traditional biomass fuel).[37]

**Energy Demand and Supply Scenario In Bangladesh**

**Demand Scenarios**

Two economic growth scenarios (Low Scenario and Reference Scenario) were considered to forecast future energy demand, as presented in table 2.1. Projected

[34] Rahman, n 25.
[35] Ibid.
[36] Gain, n 28, p 166.
[37] Rahman, n 25.

demands for commercial energy and electricity up to the year 2020 under both the scenarios are also presented in tables 2.2 and 2.3 respectively.

Table 2.1

**Economic Growth Rates Used in the National Energy Policy (in Pre cent)**

| Scenario definition | Time Frame | | | | | |
|---|---|---|---|---|---|---|
| | 1990-1995 | 1995-2000 | 2000-2005 | 2005-2010 | 2010-2015 | 2015-2020 |
| Low | 4.44 | 5.25 | 5.24 | 5.24 | 6.65 | 6.65 |
| Reference | 5.0 | 6.0 | 6.7 | 7.2 | 7.5 | 8.0 |

Source: Ahsan Uddin Ahmed, *Energy and Sustainable Development in Bangladesh*, (Dhaka: Bangladesh Unnayan Parishad, 2002), p. 8.
Note : Taken from NEP (GOB, 1996). Values are expressed in percents.

The table indicates growth rates of from 4.44% and 5.0% in 1990-1995 to 6.65% and 8.0% in 2015-2020 under low and reference scenario respectively over the span of 30 years. The main attribute for increase is population which is growing at very fast rate. The increasing migration of rural population to urban areas where they tend to depend on commercial sources of energy is another reason. The other reason is the rapid industrialization and modernization process which necessitates the demand for more energy.

Table 2.2

**Projected Demand for Energy (Commercial and Electricity) Under Low Economic Growth Scenario.**

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|---|---|
| **Commercial energy** | | | | | | | |
| Population (million) | 107 | 118 | 130 | 141 | 153 | 165 | 177 |
| GNP Growth Rate (%) | 4.44 | 5.25 | 5.24 | 5.24 | 5.24 | 6.65 | 6.65 |
| Per capita GNP ($) | 190 | 214 | 242 | 276 | 317 | 366 | 424 |
| Energy Coefficient | 1.62 | 1.37 | 1.37 | 1.37 | 1.08 | 1.08 | 1.08 |
| Energy Growth Rate (%) | 7.13 | 7.19 | 7.18 | 7.18 | 7.18 | 7.18 | 7.18 |
| Per Capita use (kgOE) | 56 | 68 | 92 | 127 | 157 | 219 | 272 |
| Total Energy (MTOE) | 6 | 8 | 12 | 18 | 24 | 36 | 48 |
| Total Energy (pj) | 256 | 342 | 512 | 769 | 1025 | 1537 | 2050 |
| Energy Productivity | 12.59 | 13.54 | 16.27 | 19.76 | 21.13 | 25.45 | 27.32 |
| **Electricity** | | | | | | | |
| Status in energy mix (%) | 35 | 37 | 39 | 37 | 33 | 33 | 33 |
| Total GWh | 8207 | 11584 | 18315 | 26063 | 30994 | 46491 | 61988 |
| Per capita KWh | 77 | 98 | 141 | 185 | 203 | 282 | 351 |
| Load factor (%) | 55 | 57 | 57 | 57 | 58 | 59 | 60 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Peak Load (MW) | 1703 | 2320 | 3668 | 5220 | 6100 | 8995 | 11794 |

Source: Ahsan Uddin Ahmed, *Energy and Sustainable Development in Bangladesh*, (Dhaka: Bangladesh Unnayan Parishad, 2002), p 9.

Table 2.3

**Projected Demand for Energy (Commercial and Electricity) under Reference Economic Scenario.**

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|---|---|
| **Commercial energy** | | | | | | | |
| Population (million) | 107 | 118 | 130 | 141 | 153 | 165 | 177 |
| GNP Growth Rate (%) | 4.5 | 5.4 | 6.4 | 7.2 | 7.7 | 8.2 | 8.7 |
| Per capita GNP ($) | 190 | 214 | 254 | 318 | 416 | 560 | 774 |
| Energy Coefficient | 1.62 | 1.37 | 1.37 | 1.37 | 1.08 | 1.08 | 1.08 |
| Energy Growth Rate (%) | 7.34 | 7.4 | 8.77 | 9.86 | 8.32 | 8.86 | 9.40 |
| Per capita use (kgOE) | 56 | 72 | 94 | 131 | 194 | 269 | 384 |
| Total energy (MTOE) | 6 | 8 | 12 | 19 | 31 | 46 | 72 |
| Total energy (pj) | 256 | 362 | 531 | 827 | 1314 | 1979 | 3055 |
| Energy intensity (MJ/$ GNP) | 13 | 14 | 16 | 18 | 20 | 20 | 21 |
| **Electricity** | | | | | | | |
| Status in energy mix (%) | 35 | 37 | 39 | 37 | 33 | 33 | 33 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Total GWh | 8207 | 12280 | 18971 | 28060 | 39750 | 59858 | 92402 |
| Per capita KWh | 77 | 104 | 146 | 199 | 260 | 363 | 522 |
| Load factor (%) | 55 | 57 | 57 | 57 | 58 | 59 | 60 |
| Peak load (MW) | 1703 | 2459 | 3799 | 5620 | 7823 | 11581 | 17580 |

Source: Ahsan Uddin Ahmed, *Energy and Sustainable Development in Bangladesh*, (Dhaka: Bangladesh Unnayan Parishad, 2002), p 9.

The tables 2.2 and 2.3 represent the demand for energy (commercial and electricity) low economic growth and reference economic scenario. These tables indicate growth in demand corresponding to the growth in population. But sooner or later Bangladesh has to face the energy problem since the demand is increasing at a faster rate whereas the resources to meet the demand are rapidly depleting.

**Supply Scenarios/Options**

Keeping a common set of strategies two supply options (Current Option considering business-as-usual practices to continue, while the Reference Option considering few issues which are additional to the Current Option) were considered to meet the projected energy demand in the future. The salient features of the two supply options which are given by Ahsan Uddin Ahmad are presented below.

The basic principle of Current Option, as presented in the NEP, was that the then existing practices of energy development programme would continue in the future. The conditions under this option are as the following:[38]

i) Development of known indigenous natural gas will continue.
ii) Development of indigenous coal at Barapukuria will continue.
iii) Development of known oil deposits and use of natural gas liquid will continue.
iv) Development of peat will continue.

[38] Ahsan Uddin Ahmad, *Energy and Sustainable Development in Bangladesh*, (Dhaka: Bangladesh Unnayan Parishad, 2002), p 10.

v) Imported oil will meet the major energy needs of liquid fuels.

vi) Indigenous natural gas, coal, hydropower and imported petroleum fuels will be used for power generation.

vii) There will be no effective programme on energy conservation.

viii) Imported coal will meet part of the energy need main for brick industries.

ix) Development and management of biomass fuels will be considered without having any linkages with commercial energy development programmes.

Specific assumptions under the reference option are as the following:[39]

i) Exploration and appraisal of oil and natural gas will be continued.

ii) Development of natural gas will continue.

iii) Development of coal will be continued.

iv) Development of oil and natural gas liquid will continue.

v) Development of peat resources will be enhanced.

vi) Harnessing of new-renewable sources of energy will be undertaken.

vii) Imported oil will meet the major energy demand of liquid fuels.

viii) Imported coal and gas will meet part of total energy needs.

ix) Indigenous natural gas, coal, hydropower and imported coal, petroleum fuels and nuclear power will be used for electricity generation.

x) Effective programme will be undertaken for conservation of commercial energy and biomass fuels.

xi) Development of biomass fuels will be considered along with the development of commercial energy sources.

[39] Ibid, pp 10-11.

Table 2.4

**Known Major Exploitable (Indigenous) Commercial Primary Energy Resources**

| Resource | Location | Reserve | | Production/Supply | | Comments |
|---|---|---|---|---|---|---|
| | | In Situ | Recoverable | 2001 | Projected 2020 | |
| Coal (West Zone) | Barapukuria, | 300 mln. Tons | 70 million tons | 0 | 1 mln tons per year from 2003 | About seventy years production envisaged. |
| | Jamalganj | | | | | Mining from 1000 meters difficult. |
| | Khalaspir | | | | | Feasibility study needed. |
| Natural Gas (West Zone) | Sylhet, Brahmanbaria, Comilla, Dhaka and Bhola (22 discovered fields, 12 producing) | 26.24 TCF | 16.20 TCF | 370 BCF (annual) | 1.14 TCF (annual) | Present recoverable reserve 11.90 TCF expected to exhaust by 2020. |
| Natural Gas Liquid (NGL) (East Zone) | Sylhet, Brahmanbaria, Comilla, and Dhaka. | Not fully estimated. | 53.5 million barrels (not recoverable) | 150 tons per day | 480 tons per day | After commissioning of Kailasthila and Beani Bazar fields |

| | | | | | | |
|---|---|---|---|---|---|---|
| Hydro-power (East Zone) | Chittagong Hill Tracts | - | - | 1000 GWh per year | 1000 GWh per year | Only Kaptai is being exploited. |
| Peat | Faridpur | 170 million tons | Not known | - | - | Demonstration project at Madaripur |

Source: Government of Bangladesh, *Committee Report on Utilization of Natural Gas in Bangladesh*, (Dhaka: Ministry of Energy and Mineral Resources, August 2002) as in http://www.emrd-gob.org/

**Energy Consumption and Patterns**

Bangladesh is marginal energy consuming, subsistence economy, whose energy use is dominated by non-commercial biomass fuels. Economic development of the country will entail changes in this pattern of use. Increased agricultural output will require the intensification of agricultural production because of land availability constraints. Economic growth and increased industrialization will lead to an increase in the energy intensity of the economy. This will reflect itself in higher energy demands, particularly for commercial fuels, which will be accounted by a lagging availability of biomass fuels. The bulk of the increase in demand can be expected to come from the productive as opposed to the domestic sectors of the economy.

Table 2.5

**Consumption of Energy by Sector and Type of Energy (in Peta Joules)**

| Consuming sector | 1983-84 | | | 1989-90 | | |
|---|---|---|---|---|---|---|
| | Commercial | Biomass | Total | Commercial | Biomass | Total |
| Domestic | 19.5 (3.2) | 391.8 (65.5) | 411.3 (68.7) | 37.8 (5.5) | 404.6 (59.2) | 442.4 (64.8) |
| Agriculture | 5.4 (0.9) | – | 5.4 (0.9) | 11.9 (1.7) | – | 11.9 (1.7) |
| Industry | 26.1 (4.4) | 95.4 (15.9) | 121.5 (20.3) | 40.5 (5.9) | 92.6 (13.6) | 133.1 (19.5) |

| | | | | | | |
|---|---|---|---|---|---|---|
| Commerce | 5.3 (0.9) | 1.8 (0.3) | 7.1 (1.2) | 7.1 (1.0) | 1.8 (0.3) | 8.9 (1.3) |
| Transport | 19.0 (3.2) | – | 19.0 (3.2) | 27.6 (4.0) | – | 27.0 (4.0) |
| Others | 33.0 (5.5) | – | 33.0 (5.5) | 59.0 (8.6) | – | 59.0 (8.6) |
| All | 109 (18.3) | 489.0 (81.7) | 598.3 (100) | 183.9 (26.9) | 499.1 (73.1) | 683.0 (100) |

Note: figures in the parentheses are percentages of total energy use by all sectors.
Source: as presented in Q. K. Ahmad, (et al), *Resources, Environment and Development in Bangladesh*, (Dhaka: Academic Publishers, 1994), p 89.

Table 2.6

**Energy Consumption in the year 1999-2000 (PJ)**

| Sector | Coal | Oil | Natural gas | Total fossil fuels | biomass |
|---|---|---|---|---|---|
| Power generation | – | 11.90 | 147.31 | 159.21 | – |
| Residential | – | 26.2 | 29.36 | 55.38 | 440 |
| Commercial | 1.35 | 1.27 | 3.81 | 6.43 | 2 |
| Industrial | 12.15 | 11.43 | 40.62 | 64.20 | 118 |
| Transport | – | 62.35 | – | 62.35 | – |
| Agriculture/others | – | 24.57 | – | 24.57 | – |
| Non-energy use (urea fertilizer production) | – | – | 84.0 | 84.0 | – |
| Losses and own use | | 1.86 | 23.91 | 25.77 | – |
| Total | 13.50 | 139.40 | 329.01 | 481.91 | 560 |

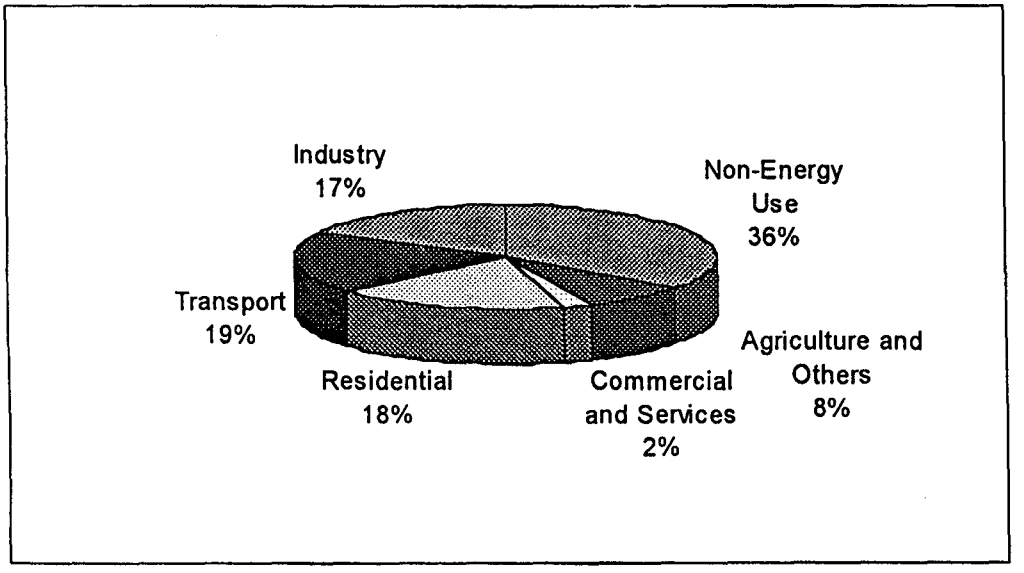
Source: M.A.R. Sarkar etc, *Energy for Sustainable Development*, Vol.VII, No. 2, June 2003, p. 79.

If we compare the two tables, it is evident that there is drastic change in consumption over the years. Table 2.2 shows energy consumption over for the year 1999-2000 (BUET

2002).[40] There is heavy reliance upon traditional biomass fuels but the share of commercial fuels, is gradually increasing, because of the increased use natural gas. Commercial energy accounts for 46% of the total energy consumed in the year 1999-2000, which was only 18.3% in 1983-84. Traditional fuels consisting of crop waste are the predominant fuels for rural cooking. Rural industries also consume a large amount of biomass. A rural activity that consumes a significant amount of biomass is paddy parboiling. Brick manufacturing also consumes a large amount of biomass fuels. There is very dim prospect for increasing supply of biomass fuels in the future. On the other hand it is not economically possible to substitute biomass fuels by any commercial energy source.

Figure 2.1

**Consumption of Commercial Fuels by Sectors.**




Source: Atiq Rahman etc., Development and Climate Change: Bangladesh Country Case Study—Phase I, in http://www.developmentfirst.org/studies/BangladeshCountryStudies.pdf

Traditionally Bangladesh depends heavily on biomass fuel. However, gas being an indigenous primary energy source the proportion of natural gas in commercial fuel mix is

[40] MAR Sarkar, M Ehsan, MA Islam, "Issues Relating to Energy Conservation and Renewable Energy in Bangladesh", *Energy for Sustainable Development*, Vol. VII, No. 2, June 2003, p. 78.

increasing rapidly, especially after 1984-85.[41] As per the current trends of commercial energy consumption by sectors, sharp rise has been observed in all sectors – transport (19%), residential (18%), and industry (17%), excepting in commercial and service sectors. Driven by rapid infrastructure development in the country, like development of national road network and use of multi-storied residential complexes, significant increase in commercial energy consumption have been observed in transport (19%) and residential (18%) sectors. The share of commercial energy use by industry has been 17%.

In 2000-2001, among the users of different commercial fuels, 35 per cent of total commercial fuels were used for non-energy use i.e. raw materials for fertilizer production. The residential sector consumed 18 per cent, industry used 17 per cent and transport accounted for 19 per cent. Commerce and service sectors accounted for 2 per cent and agriculture sectors used the remaining portion. Figure 2.1 presents consumption of commercial fuels by sectors.

**Energy Management in Bangladesh**

It is of interest to note that Bangladesh is divided geographically into two parts by a major river called Jamuna. Because of this physical separation, practically two separate energy demand management scenarios have developed in the country. In the short term, the government of Bangladesh has therefore, placed adequate emphasis on the transmission and distribution of gas in the Eastern Zone. In the Western Zone, on the other hand, fuel for generation of electricity and other commercial and industrial use comes from imported oil. It is expected that through careful demand management, under the overall primary commercial energy scene, the contribution of natural gas will rise substantially and the use of petroleum products will remain more or less stable.

The first oil crisis in November 1973, and to an even greater extent the second oil price hike of 1979/80, confronted the non-oil producing Bangladesh with a new and more

[41] Atiq Rahman etc., Development and Climate Change: Bangladesh Country Case Study—Phase I, in http://www.developmentfirst.org/studies/BangladeshCountryStudies.pdf

difficult energy scenario.[42] The problem for the government was to face uncertainties and make ad hoc adjustment plans for future unexpected increase in international oil prices. Although the country consumes an insignificant amount of petroleum products, dependence on the same could not be overcome, nor could conservation of energy in general be introduced. However substitution by other sources of energy for imported oil did take place, at least in the primary commercial energy sub-sector. Fuel switching has been achieved mainly by achieving indigenous natural gas.

Despite the low level of energy consumption in Bangladesh, the present energy supply situation to meet the growing needs of the country is less than satisfactory. The rural population is overwhelmingly dependent on the non-commercial sources. The demand for commercial energy has been growing very fast in recent years. Per capita energy consumption, which was recorded as 24 kilogram of oil equivalent (kgoe) in 1972, rose to 31 kgoe in 1983 and 42 kgoe in 1986, 197 kgoe in 1996 and 240 kgoe in 2000.[43] With the introduction of more energy intensive agricultural practices and technologies to increase food production and expansion of the small and cottage industries in the future, the rural electrification programme will continue to enjoy priority and further expand. As regards changes in energy and oil intensities, after 1973, the total energy intensities of Bangladesh have been declined. However, after the second crisis, the total energy intensity of the country rose moderately; the commercial energy intensity of the country rose, but because of the increased use of natural gas, its oil intensity declined.

The government of Bangladesh regulates oil, gas and electricity prices as part of general price control for achieving other economic and social objectives. The distribution of electricity, petroleum products, and natural gas is in the hands of government monopolies. Earlier the main consideration in setting energy prices was maintaining positive cash flows for the government owned energy companies. Price changes required government approval. The government of Bangladesh delayed adjustments in imported

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[42] United Nations, *Energy Issues and Prospects in the Asia and Pacific Region: Energy Resources Development Series-No 31*, (New York: United Nations, 1988), p 39.

[43] Ahm Mustain Billah, Md. Abdul Aziz Khan, "Gas Extraction and Its Implications for Economic Sustainaility of Bangladesh", *The Bangladesh Development Studies*, Vol.XXVII, September 2001, No.3, p 2.

oil prices during the early 1980s, causing serious financial problems for the oil company and the electric power company. From 1972/73 to 1982/83, the price of crude oil increased 9.71 times, but the index of real commercial energy prices increased only 3.82 times.[44] Domestic prices of oil and natural gas increased only 3.82 times and 3.23 times respectively.[45] The government also kept some energy prices lower than others. The prices of gasoline and high-speed diesel oil were raised less than the prices of other petroleum products.

**Energy Monitoring Unit**

The Energy Monitoring Unit (EMU), which originated from a joint concern by the government and the World Bank about inefficient energy use in Bangladesh, was established within the Ministry of Energy and Mineral Resources. This was primarily aimed to develop, initiate and carry out a national industrial energy conservation and diversification programme to improve energy use efficiency in the industry and power sector. Thus it was a main step towards energy maintenance and management in Bangladesh. The main responsibilities of EMU included policy consideration, planning, promotion and monitoring of energy conservation to establish an efficiency improvement programme focusing on energy audits of plants in major energy using industry sectors like fertilizer, power, pulp and paper, jute, textiles and steel.

Bangladesh is a low energy using country. At the same time Bangladesh is an inefficient user of energy resources. Bangladesh's system loss in power generation is one of the highest in the developing world.[46] The combined system loss of BPDB, DESA, REB, DESCO in 2000-01 was 35.42% of net production.[47] Bangladesh's energy conservation strategy to date seems to lack comprehensiveness and success seems have been limited due to the piecemeal nature of the energy planning, bordering on short term considerations resulting from lack of clear understanding of the intricate issues

[44] Ibid, p 2.
[45] United Nations, n 42, p 40.
[46] Mohammad Alauddin, Clement Allan Tisdel, *The Environment and Development in South Asia: An Overview Concentrating on Bangladesh*, (Hampshire: MacMillan Press Limited, 1998), p 179.
[47] Government of Bangladesh, *Bangladesh Economic Review 2002*, (Dhaka: Ministry of Finance, June 2002) p 77.

surrounding the balance between use of energy resources and sustainable development. To date, energy-planning efforts have been directed primarily to augmenting supply to meet increased demand. Inadequate attention has been paid to formulating a comprehensive energy conservation strategy incorporating efficient energy use and overall environmental management.

Population growth has a direct bearing on energy demand in the domestic sector. Also the rate of urbanization is an important factor in determining the amount and pattern of energy use in this sector. Any improvements in living standards would have significant consequences for energy demand. Thus to convert aggregate energy demand into fuel requirements, energy policy considerations shall have to be introduced. Since the rural energy development plans cover areas as yet not institutionalized, proper funding must be made available to support the phase of the envisaged rural and new and renewable energy programme. Increasing amounts of energy will be required in the rural areas, mainly for agricultural applications (irrigation, fertilizers, machinery and transport) but also in domestic household to cook food for the growing population.[48] Much of the future increase in the energy demand will have to be met by commercial fuels.

Reactions in Bangladesh towards energy demand management were more positive following the second oil crisis. The second Five Year Plan (1980-85) called for the substitution of the indigenous fuels for imported fuels, improvement of the electricity distribution system, expansion of the gas transmission and distribution system, increasing gas production, stepping up exploration for oil and gas, and developing renewable energy sources including community forests.[49] The target for the supply to petroleum products was sharply reduced. In addition to the Five Year Plans, energy policy has been articulated principally in the ADB/UNDP funded Bangladesh Energy Study of 1976, and the National Energy Policy, approved by the Council of Ministers in September 1980.[50] The study was a commendable pioneering effort, but it was based on weak data and made some erroneous assumptions. Although the National Energy was not based on the

[48] United Nations, n 42, p 41.
[49] Ibid, p 41.
[50] Ibid, p 41.

rigorous analyses, it contained useful prescriptions for managing the energy sector and also for diverting increases in demand from oil to gas. The recent National Energy Policy of 1995 (published in Bangladesh Gazette in 1996) also includes energy sector management particularly enumerating encouraging public and private sector participation in the development and management of energy sector.

In Bangladesh the process in the energy sector policy reform and implementation necessary to achieve its full potential are lagging. The energy sector remained publicly managed. Generation, transmission and distribution of both power and natural gas sub-sectors are dominated by integrated public sector utilities namely, Bangladesh Power Development (BPDB) for electricity and Petrobangla (Bangladesh Oil, Gas and Mineral Corporation) for oil and natural gas. Bangladesh Petroleum Corporation (BPC) is charged with the responsibility of import of oil, refining and marketing petroleum products throughout the country. Geological Survey of Bangladesh (GSB) is the principal organization responsible for survey, investigation and research for minerals and water etc. throughout the country. Ironically, the major reason why Bangladesh still could not make a "take-off" from low level of energy consumption (intensity) and poor energy access of people is typical of many other developing countries of the world. It is not actually the resource endowment, but more the lack of appropriate resource management, which needs to be planned, designed and implemented appropriately with a specific sense of national direction, targeted to achieve a sustainable development in the long term.

Commercial energy of the country comes from both indigenous and imported sources. Natural gas, hydropower and a little amount of petroleum product comes from indigenous source and the country import a significant amount of petroleum product. Over time, the share of oil in total energy mix has declined and conversely the use of natural gas has increased. In 1980-81, the share of oil in the total energy was about 56%, which reduced to 36% in 1994-95 and on the other hand, the share of natural gas increased from 32% to 54% over the same period.[51]

[51] Alauddin, n 46, p 183.

**Power Sector Management**

The power sector in Bangladesh is facing the pressure of increasing demand for infrastructure and related services and the government's financial capacity to meet this demand, has correspondingly weakened. During the past decade the sector suffered from a shortage of funds, inadequate policy options, poor management, low employee commitment, and high system loss and rampant corruption by the management and the workers trade union, etc. Despite increase in generation over the years, the development of transmission lines fell far short of demand. However, there are serious weaknesses in the existing arrangements and sector entities, as well as limitations on its ability to raise adequate resources to finance the expansion of the electricity infrastructure.

The present structure of the power sector is a large integrated generation, transmission and distribution business (BPDB); a large rapidly growing distribution business (DESA) and 45 rural electrification cooperatives (known as PBS) under REB, BPDB, and DESA are characterized by overstaffing, inefficiency, lack of accountability and frequent excess in trade unionism.[52] Although the situation in BPDB improved a little with the introduction of the Punishment and Reward Scheme, a sustained and appreciable improvement in efficiency has not been achieved up to now.

One of the major concerns of energy management is pricing of electricity. In Bangladesh it is based on political considerations than on economic viability. The present government controlled structure of the power sector has not been able to deliver in accordance with the country's growing needs.[53] It now faces a major challenge of improving low coverage, bad quality and poor reliability. The need for low cost distributed power systems to improve the quality of life in the rural areas is urgent, in part, to assure balanced economic development as well as to help stem the tide of migration from the villages into the emerging and increasingly unmanageable towns and cities.

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[52] *Changes and Challenges: A Review of Bangladesh's Development 2000*, (Dhaka: The University Press Limited, 2001), p 192.

[53] UN, n 4, p 73.

The availability of electricity is not only crucial for attracting domestic and foreign direct investment into the manufacturing sector and services; it significantly influences the quality of social and human development. At present the daily average electricity generation is insufficient to meet even the suppressed demand for electric energy in Bangladesh on a stable basis throughout the year.

However, the more critical issues include; high system loss (average 30%), low plant efficiencies (except the Independent Power Producers Plants), erratic power supply, shortages of funds for maintenance of power infrastructures, unwillingness of the customers to pay utility bills, illegal connections, faulty meters, the unholy alliance between the supplier and the consumer of electricity, and above all, serious management deficiencies within the BPDB and DESA.[54] At the available levels of power supply adequate and balanced development generation, transmission and distribution system have not been achieved mainly due to insufficient financial investment in and poor management of the distribution system.

The characteristic of demand of electricity in Bangladesh is such that evening peak is very sharp and for several hours the demand goes as high as 20 per cent in some seasons of the year. In order to improve the performance of the system, reduce investment and rationalize the energy use, there is a need to undertake some measures for load management and conservation of energy. These are known as Demand Side Management (DSM), which is an established and effective tool. The ultimate objective is to ensure optimum use of generation by load shifting, peak shaving and valley filling or the load curve.

**Energy Management Issues in Bangladesh**

In Bangladesh besides low plant availability and capacity constraints, the generation system also faces operating efficiency problems. That either they use outdated technology or have inefficient manpower. Besides they also suffer from poor collections, making them to depend upon the government or on donors assistance for the expansion and up

[54] *Changes and Challenge*, n.52, p. 192.

gradation of their assets. Furthermore, because of varied sources of supply, the productions systems of the BPDB generate tend to be different, which aggravates coordination problems. The Relay Coordination System is one of the weakest links in the high voltage transmission area. Thus increasing generation efficiency is the foremost challenge in management of energy sector in Bangladesh. It was expected that with the construction of new plans, the overall efficiency would increase. But, this has not happened and it appears to be a neglected area of policy action.

**Power Distribution**

Another notable management issue is power distribution. The distribution system continues to be the weakest link, which also affects the quality of supply to the consumers. However, any attempt to improve the distribution remains constrained by lack of availability of funds from external sources as well as insufficient inflow of private investment to this area.[55] Erratic power distribution has tended to increase the unwillingness of some customers to pay bills, which in turn aggravate the already shortage of fund for maintenance worsening the situation.

Managing system loss is a serious problem. During 1989-90, the system loss was 39 per cent, which rose to 41 per cent in the following year.[56] Now the state of the things in the power sector reveals that even the very conservative estimates put the system loss in the sector anywhere between 30 to 35 per cent. Added to this is that hardly 65 per cent of the electricity generated in the country is paid for. The degree to which theft and other corrupt practices pervade the power sector has created conditions where the power sector is in danger of falling apart unless political commitment towards a resolution of the problem is brought in. as much as US$ 100 million are lost annually.[57]

[55] CPD Task Force Report – *Policy Brief on Development and Governance of the Energy Sector*, (Dhaka: Centre for Policy Dialogue, 2001), p 29.
[56] Ibid, p 31.
[57] Ibid, p 14.

**Load Management**

Load management in the power sector has been a major issue because the daily pattern of electricity consumption is such that a heavy demand occurs during the evening hours, a demand which could not be met properly. To ameliorate the situation, the need for more reliable supply through commissioning of new plants has been emphasized.

There is a spatially uniform price structure of commercial energy in Bangladesh but the prices vary by type of consumer. In general, the present policy is to charge either economic or as close to economic prices as possible. However, other considerations such as promotion of growth, equity and social justice as well as encouragement of inter-fuel substitution may tamper the policy of charging economic prices.[58]

**Finance**

Financing problems have consistently plagued Bangladesh's energy infrastructure development. Public investment and state ownership had been the traditional means to meet power needs in this country.

BPDB's financial management systems are rudimentary. Although annual reports and statements of account are produced regularly, they do not comply fully with GAAS. BPDB is heavily subsidized, and if not for frequent government bailouts, it would probably become financially unavailable with about 24,500 employees most of whom desire to work in the highly controversial distribution component.[59] Its yearly losses have led to huge accumulated deficit. Collections average only around 80 per cent of billings. Accounts receivable are growing about US$ 100 million a year, and no apparent action is being taken to reserve the deteriorating trend. The net result of cascading inefficiency – from inefficient generation to high system and non-technical losses – lead to poor collections.

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[58] A Atiq Rahman, (et al), *Environment and Development in Bangladesh Vol. 2*, (Dhaka: The University Press Limited, 1994), p 270.

[59] Changes and Challenge, n 52, p 178.

**Biomass and Deforestation**

Majority of the population in rural areas are depending on wood fuels. Therefore the forest cover of the country has been on the verge of depletion. Only a few decades ago the forests covered about 16-18% of Bangladesh's land area. The alarming rate of deforestation (currently at 4.2 hectares per hour), unfortunately has brought down this coverage to a very critical 6-7% coverage (or 769,000 hectares).[60] In order to ensure energy security of the country there is a need to have a better forest and other biomass energy management.

**Depleting Natural Gas**

The most important commercial energy source of the country natural gas is also depleting at a faster rate. The increasing population and increasing migration to urban areas and increasing industrialization has increasing pressure on government to extract more natural gas. The unnecessary wastage of natural gas by household sector is adding fuel to the fire.

**Governance and Management**

The main hindrance to the development of both the power and natural gas sector is highly government controlled mechanism. For institutions in both power sector and gas sector which are controlled and regulated by government bodies resulting in lack of responsibility and accountability. So there is a need to separate policy making, regulation and operations, because the three functions involve different levels of responsibility and accountability.

There is a general apathy in the efficient management of public owned resources (e.g. power system, etc.). Whereas the same type of resources are managed in an efficient manner under private ownership. Lack of adequate information about the resource base, its consumption pattern, absence of proper resource accounting system is the major constraints for inefficient management of public resources. Necessary measures should be considered to improve the efficiency of resource management.

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[60] Atiq Rahman, n.25.

Once the facts are taken into account, the picture, which emerges, is one bad management going into the sector over the years and hitting below the belt of the goal of development. Compounding the problems of management has been the existence of powerful pressure groups in the sector. The failure of the management and the labour unions to work out a modus operandi towards a smooth operation of a power sector is yet another telling story. The fact that there has been an absence of incentives for good performance. To make a bad situation worse, a woeful lack of accountability has characterized the sector. Most important, the power sector, which in the industrial world is privy to autonomy, in Bangladesh has been constrained by its dependence on bureaucratic control leading to a terrible arbitrariness in billing and poor collection.[61]

In order to strengthen energy management the Energy Regulatory commission has to operate more efficiently. The main tasks before them are,

i) Framing of rules and codes of practices for operation and maintenance;

ii) Establishing performance standards and uniform system of accounting;

iii) Approving tariff and regulatory procedures for enforcing bill collection from both the public and private sector;

iv) Ensuring enforcement of industry standards, public safety, as well as demand management;

v) Issuing exclusive service franchises to the distribution companies, either public or private, and license to private generators; and

vi) Arbitrating and conducting inter-ministerial coordination regarding BPDB, REB, and DESA and other affiliated organs or the power sector and the private sector operators (equally applicable in case of gas sector).[62]

[61] Changes and Challenge, n 52, p 176.
[62] Ibid, p 186.

**Demand Side Management Options**

'Low Investment – Medium Management' (Energy efficiency improvement Options)

The demand-side options include planning and implementation of Energy Efficient Improvement Options (EEIOs), which are very cost-effective and immediately doable measures, being low on investment (primarily only changes in management approach) and an appropriate and detailed planning implementation programme of well-designed efficiency improvement options.

Medium Investment – High Management (System Loss Reduction) Measures

As it is well known, Bangladesh must reduce the system loss of natural gas, electricity and water, which are primarily the social losses (or electricity thefts and non-payment of electricity bills). The system losses require a medium scale investment but a higher-level management and monitoring.

Historically, the system losses, even a decade back, used to be in a range of 40 per cent – one of the highest in the world. The actual technical losses, by best professional estimates, should not exceed about 12 per cent. Launching of national efforts, with gradual reorganization and phase-out of Dhaka Electric Supply Authority (DESA) into private-structured Dhaka Electric Supply Company (DESCO), has already resulted in improvement of system losses to 30 per cent.[63] Many developed countries of the world have now achieved average system losses, not exceeding technical (actual transmission and distribution losses 12 per cent or even less (e.g. Singapore, China-7.5-10 per cent).[64]

With measures, like privatization of the 'downstream electricity' (distribution and sales), it is expected that the system losses can be brought down from its present 30 per cent to at least 15 per cent levels.[65] Intensive management and appropriate institutional and policy approaches of the government will be the key to this process, which can be

[63] Report No 7 – *Negotiating Strategies for the Development of Bangladesh's Energy Reserves*, (Dhaka: Centre for Policy Dialogue, 1999), p 11.
[64] Ibid, p 11.
[65] Ibid, p 13.

attained over the next 7-10 year horizon, i.e. by 2010. This demand side management will be equivalent to a corresponding generation-15 per cent of 2010 electricity production (6900 MW).[66]

**Generation/Supply Side Management Options**

The supply side management options for sustainable energy for Bangladesh should target at low-emission new and renewable energy technologies, appropriate in the context of Bangladesh. They can be classified into: (i) high investment-medium management options and (ii) high investment-high management options, based on the level and nature of the technologies being targeted-both in the conventional and renewable energy sectors.

High investment-Medium Management (Renewable Energy) Options

As has already been mentioned in the previous sectors on resource endowments, the major resource potential of Bangladesh in the renewable energy sector centers primarily on the already field-proven solar Photovoltaic (PV) technology. Although wind and biomass are yet to be intensively tried and disseminated on large scales in the field, their exploitation potentials are logical.

These technologies (e.g. PV) presently require relatively high investment costs and medium-level management supports (e.g. intensive maintenance/repair/customer service and monitoring networks) for their sustainability.[67] Their investment costs, however, are rapidly falling, based on the increasing scales of their global production (advantage of the 'economy of scales' and amortization of the initial research and development investments put in for developing these technologies.

Two major renewable technology options deserves special consideration for Bangladesh, as they are already locally proven and have potential to make significant dents in securing energy supply to rural and remote areas on long term. They are: further rapid

[66] Ibid, p 13.
[67] Atiq Rahman, n.25, p.58.

dissemination of rural PV home systems (SHSs), biomass gas based small rural power plants.

As already mentioned, about 25 per cent of 21 million rural households in Bangladesh (by 2030), when the urban-rural population-mix will be 40:60 will remain out of reach of conventional electricity grids, being remotely located, which means about 5 million rural households will be ideal cases for these options to start with.[68]

This would mean a 250 MW of SHS capacity, which would require an investment of US$ 2.2 billion at present cost of US$ 450 (global average) per 50 WP SHS.[69] However, in all probability, with rapidly decreasing costs of solar PV panels and system, the chances are strong that by 2030, the costs of solar PV will be only 25 per cent of their present-day costs, which would mean an investment in the range of US$ 500 million, when the market will also rapidly increase.[70]

Although the wind power sector is currently under more intensive evaluation and assessment a minimum 500 MW wind potential is quite probable in the costal belts of Bangladesh, which may come into renewable energy-mix by 2030.[71]

A renewable energy option needs to have a more serious look in the context of Bangladesh is in the biomass sector, in which country has already a historical and on-going involvement through the large contribution of this low emission (source+sink). Apart from 10 MW small conventional energy-based (natural gas) decentralized power plants, which are currently being implemented by the Rural Electrification Board, biomass gas (methane) based small rural power plants may be set up in typical capacity ranges of about 25 kW, 50 kW and 100kW, as decentralized power plants.[72]

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[68] Ibid, p.59.
[69] Ibid, p 59.
[70] Ibid, p 59.
[71] Ibid, p 63.
[72] Ibid, p 65.

If the above mentioned demand side and supply (Generation) side measures under broad heads are implemented, the existing primary energy and power gap of Bangladesh required for long term energy security can be resolved with a low emission approach.

Nonetheless, apparently unavoidable problems like corruption and inefficiency in all aspects of operations (production, distribution, filling and collection) have overshadowed the development mood in the energy sector in the past one-decade, in particular. Insufficient investments in new facilities, low levels of commercialization and financial indiscipline coupled with low tariffs, excessive bureaucratic intervention and inadequate expertise in the corporate level have aggravated the energy scenario.

In the foreseeable future because of shortage of land there are dim prospects of increasing the supply of biomass fuels. On the other hand it is not economically possible to substitute all the biomass fuels by commercial fuels. On environmental considerations there is a need to maintain the supply of biomass fuels within the regenerative limits, and commercial fuels should meet the demand for biomass fuels in excess of sustainable limits. All these point out towards a need for an efficient energy management system. Under a sector reform, energy shortages could be substantially reduced within a few years as systematic issues of inefficiency; corruption and mismanagement begin to be addressed in a modest way.

# CHAPTER III

# NATURAL GAS SECTOR IN BANGLADESH

# *Chapter III*

# NATURAL GAS SECTOR IN BANGLADESH

Natural gas is currently the only indigenous non-renewable primary energy resource Bangladesh, which is being produced and consumed in significant quantities. Gas, the main source of commercial energy plays an active role towards economic growth of the country. Natural gas is fast emerging as an attractive substitute for oil, and as an important future energy source. Natural gas is a more versatile product than oil. Apart from being used as a source of energy, it can also be used very profitably as feedstock, as in case of fertilizer.

It may be a coincidence that both the major actors in the field of energy i.e. hydrocarbon exploration and electricity entered Bangladesh, then British India, about ninety-six years back. For Bangladesh, natural gas has played a pivotal role in the country's economic development. There is no doubt whatever that without an ever increasing supply of natural gas from the very beginning, both fertilizer industry and the power sector (apart from other minor sectors) would have never reached the level of growth they have achieved today.[1] 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 higher rate of about 10 per cent per year.[2]

The search for petroleum started as far back as 1908 when the Indian Petroleum Prospecting Company started drilling in Sittakund, Chittagong. They conducted geographical survey and drilled several shallow wells, but no gas or oil was struck. The Burmah Oil Company (BOC) drilled two shallow wells in Patharia in 1922-23.[3] The

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[1] Azim Uddin Ahmad, *Changes and Challenges*, (Dhaka: University Press Limited, 2001), p 141.
[2] United States Agency for International Development (USAID) 2002 "Bangladesh" at www.usaid.gov/bd.html.
[3] Ahmad, n 1, p 142.

wells were abandoned, although there was some trace of crude oil in one well. Then after the war the Pakistan Petroleum Limited (PPL) undertook seismic survey in Sylhet and south of Chittagong and drilled wells in Sylhet, Patharia, Chatak, Fenchuganj, Patiza and Lalmai and made first discovery of natural gas in Sylhet structure at Haripur in 1955.[4] In 1959, they discovered another gas field at Chatak. The Pakistan Shell Oil Company (PSOC) was even more successful and discovered five gas fields in Titas, Habiganj, Rashidpur, Kailastila and Bakhrabad around this time. Natural gas found in Sylhet and Chatak was brought into production in 1960s and the supply was made to Chatak Cement Factory and fenchuganj fertilizer factory.[5]

On the other hand, after expiry of almost fifty years exploration efforts under private companies (with no discovery until 1954) in the early 1960s state corporation called Oil and Gas Development Corporation (OGDC) was created to conduct hydrocarbon exploration and development.[6] In 1974, the First Petroleum Act was enacted, and the first Production Sharing Contract (PSC) was also formulated for initiating oil exploration in the offshore (Bay of Bengal). Later, in 1981, 1987 and in 1999s PSCs were signed with the International Oil Companies (IOCs). In June and July 2001 two more PSCs were signed.

Currently, gas is being produced from 51 wells of 12 fields viz., Titas (13 wells), Bakhrabad (4 wells), Habiganj (10 wells), Rashidpur (7 wells), Kailastilla (4 wells), Sylhet (1 well), Narsinghdi (1 well), Meghna (1 well), Salda Nadi (1 well), Sangu (4 wells), Jalabad (4 wells), and Beani Bazar (1 well). The three gas fields at Kamta, Chatak and Feni having been productive for a long time, has been abandoned. In 1999-2000, actual gas production was 331.247 billion CFT and in the financial year 2000-2001 372.688 billion CFT.[7] The gas deposits, most of them are in eastern part of the country.

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[4] Report No.24, *Bangladesh Gas Sector Development: Status, Policy Options and Challenges*, (Dhaka: Centre for Policy Dialogue, May 2000), p 150.
[5] Ahmad, n.1, p.142.
[6] *Policy Brief on Development and Governance of the Energy Sector: CPD Task Force Report*, (Dhaka: Centre for Policy Dialogue, August 2001), p 15.

Until a few years ago Petrobangla, the state corporation was the sole player in the gas sector. Since 1994, however, after it entered into a new phase of production sharing contracts (first round bidding) with the IOCs and the production of gas from offshore Sangu (geological) structure and Jalalabad started, a new scenario evolved. Petrobangla supervises and monitors the activities of the companies, acing simultaneously as their partner, the sole purchaser of their potential output, and their regulator.

Petrobangla's parent organization the Bangladesh Oil, Gas and Mineral Corporation (BOGMC) was established in 1972. Petrobangla was however was created under the Petroleum Act, 1974 as a state corporation in charge of oil/gas exploration and production, marketing of gas. In 1977 the functions relating to petroleum liquids were unbundled from Petrobangla to the newly established Bangladesh Petroleum Corporation (BPC). BPC soon become a Holding Corporation under the company's law and holds the shares of oil marketing companies and the only refinery in Bangladesh.

Natural gas is the most vulnerable resource for Bangladesh. Its demand is increasing rapidly. The rapid rise in the demand for natural gas signifies its crucial role in the energy sector and also in the economic development of the country. Presently, 90 per cent of the total electricity is produced from the low cost natural gas.[8] In the composition of the gas of Bangladesh almost 97 per cent is the methane, 2 per cent ethane, 0.05 per cent propane and 0.14 per cent butane.[9] The main users of power and fertilizer share around 80 per cent of total consumption.

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[7] Pepole's Republic of Bangladesh, *Bangladesh Economic Review 2002*, (Dhaka: Ministry of Finance, June 2002), p 78.

[8] Philip Gain, (ed), *Bangladesh Environment Facing the 21st Century*, (Dhaka: Society for Environment and Development, 2002), p 167.

[9] Ahm Mustain Billah, Md. Abdul Aziz Khan, "Gas Extraction and Its Implications for Economic Sustainability of Bangladesh", *The Bangladesh Development Studies*, Vol.XXVII, No.3, Sep. 2001, p 2.

Table 3.1

**Production and Consumption of Natural Gas in Bangladesh 1972-2000**

| Fiscal Year | Gas Production | Consumption by Sector | | | | | | | Total Consumption |
|---|---|---|---|---|---|---|---|---|---|
| | | Power | Fertilizer | Industry | Domestic | Commercial | Tea Estates | B. Fields | |
| 1972 | 11511 | 5480 | 4978 | 610 | 36 | 33 | 0 | 0 | 11137 |
| 1973 | 23578 | 7960 | 14075 | 1295 | 87 | 66 | 0 | 0 | 23483 |
| 1974 | 28291 | 10136 | 15558 | 2054 | 146 | 115 | 0 | 0 | 28009 |
| 1975 | 18900 | 8446 | 7109 | 2742 | 277 | 181 | 0 | 0 | 18755 |
| 1976 | 28821 | 8704 | 15787 | 3523 | 489 | 266 | 0 | 0 | 28769 |
| 1977 | 32240 | 10785 | 15919 | 4261 | 766 | 370 | 0 | 0 | 32101 |
| 1978 | 34294 | 13181 | 13958 | 5288 | 1116 | 548 | 0 | 0 | 34091 |
| 1979 | 39289 | 14806 | 15444 | 6336 | 1809 | 805 | 0 | 0 | 39200 |
| 1980 | 45658 | 15855 | 18587 | 6972 | 2685 | 1021 | 0 | 0 | 45050 |
| 1981 | 49946 | 18515 | 17609 | 7747 | 3589 | 1289 | 0 | 0 | 48749 |
| 1982 | 64847 | 22246 | 26112 | 8682 | 4546 | 1591 | 0 | 0 | 63177 |
| 1983 | 72159 | 27706 | 25240 | 9426 | 5611 | 1816 | 0 | 0 | 69799 |
| 1984 | 83292 | 30164 | 31834 | 10053 | 5918 | 1965 | 0 | 0 | 79934 |
| 1985 | 94592 | 38293 | 30962 | 8643 | 6275 | 2271 | 0 | 1481 | 87925 |
| 1986 | 105082 | 39778 | 35401 | 11747 | 6797 | 2456 | 304 | 2295 | 98778 |
| 1987 | 120858 | 51912 | 31618 | 13527 | 6841 | 2731 | 576 | 2612 | 109817 |
| 1988 | 147379 | 62072 | 50979 | 13775 | 7588 | 2930 | 641 | 2500 | 140485 |
| 1989 | 162044 | 66106 | 53407 | 13500 | 9261 | 3127 | 628 | 0 | 146029 |
| 1990 | 167657 | 75558 | 55909 | 13310 | 10172 | 3098 | 677 | 0 | 158724 |
| 1991 | 172708 | 82556 | 54173 | 12651 | 10529 | 2931 | 750 | 3 | 163593 |
| 1992 | 188362 | 88105 | 61642 | 12670 | 11646 | 2939 | 678 | 604 | 178284 |
| 1993 | 210885 | 93212 | 69202 | 14228 | 13496 | 2395 | 660 | 740 | 193933 |
| 1994 | 223765 | 97491 | 74435 | 17975 | 15628 | 2710 | 689 | 1043 | 209971 |
| 1995 | 247191 | 107453 | 80456 | 22532 | 18918 | 2877 | 621 | 1139 | 233996 |
| 1996 | 265664 | 110976 | 90978 | 25583 | 20709 | 2996 | 727 | 994 | 252954 |
| 1997 | 260916 | 110864 | 77848 | 28827 | 22770 | 3287 | 712 | 91 | 244399 |
| 1998 | 281946 | 123451 | 80002 | 32475 | 25201 | 3462 | 743 | 30 | 265364 |
| 1999 | 307881 | 140837 | 82730 | 35779 | 27183 | 3652 | 710 | 347 | 291238 |
| 2000 | 331247 | 148865 | 84900 | 41978 | 28945 | 3827 | 671 | 347 | 309533 |

Note: Gas in Million Cubic Feet (MMCF)

Source: Government of Bangladesh, *Committee Report on Utilization of Natural Gas in Bangladesh*, (Dhaka: Ministry of Energy and Mineral Resources, August 2002) as in http://www.emrd-gob.org/

In order to clearly comprehend the natural gas situation in Bangladesh, it is important to know what has been achieved so far. This information is essential in order to critically examine the present policy and even, more importantly, to workout a strategy for future.

Bangladesh's consumption of natural gas in 1970 was only 46 Million Metric Cubic Feet per Day (MMCFD) and 75 barrels a day of condensate (liquid extracted from natural gas in a processing plant such as petrol and diesel) 29 exploratory wells had been drilled resulting in discovery in 8 wells success 1:3.6.[10]

In the second phase (from 1971-81), both PPL and Shell left Bangladesh and Petrobangla was established in 1972. Petrobangla conducted exploration through Soviet and FRG assistance Bangladesh Petroleum Act of 1974 was enacted and off shore oil exploration was awarded to six major international companies in 1974.[11] By 1978 all companies departed. Only Union Oil discovered 1 (one) Trillion Cubic Feet (TCF) of gas in Kutubdia, which they gifted to Bangladesh. In 1981 Shell were awarded blocks in the Chittagong Hill Tracks (CHT), but no oil was found. (It is interesting to note here that gas had already been discovered in Semutang in the CHT long ago.) However, Shell also left soon after.

In 1981, only 139 MMCFI of gas was being produced along with 186 barrels/day of condensate. Major consumers of natural gas (as is the case even now) were Power and Fertilizer. 13 exploratory wells were drilled during this period of which 4 turned out to be gas-rich, success 1:3.[12]

It is during the third phase (1982-90) that major thrust in the gas sector was made. With the assistance of donor countries/agencies extensive gas field development and expansion of network programmes were undertaken. Chittagong was connected with gas network (Dhaka had already been covered) and supply was extending to 59 upzilas in 19 districts. More gas based fertilizer and power plants were brought into operation. 10 exploratory

[10] Ahmad, n 1, p 143.
[11] Ibid, p 143.

wells drilled of which 5 were gas-rich and 1 had oil. Success 1:1.6. 23 gas development wells were drilled. Gas production rose to 490 MMCFD anti condensate 920 barrels/day by 1990.[13]By 1995 gas production reached 800 MMCFD. Petrobangla had achieved all this by its own efforts.[14]

**Institutional Arrangements**

Petrobangla, being a statutory body of the government, continued to be governed by a 1985 ordinance under the purview of the Ministry of Energy and Mineral Resources. However, Petrobangla is not active operationally. Instead, it conducts its activities through eight operating companies, which it controls on behalf of the government. The operating companies (OCs), some of which originated with the nationalization of foreign oil companies, are now incorporated under the Companies Act as public limited companies. In principle their boards of directors govern them. But both Petrobangla and the Ministry of Energy usurp the board's powers. The board's decisions are subject to ratification by Petrobangla's board, a major decisions relating to pricing, operating and development budgets, organizational setup and staffing, and the award of contracts exceeding Taka 10 crore subject to government approval.[15] The directors of the OCs are either also director of Petrobangla or government officials appointed by the MPEMR. The operations of BPC are subject to lesser torture.

For quick exploration and expansion entire country has been divided into 23 blocks. To this end, foreign investment has been allowed under production sharing arrangement on favorable terms and encouraging responses have been received from several international companies. Under production sharing contracts (PSCs) an International Oil Company makes an initial bid and if successful enters into negotiations with Petrobangla with respect to key elements of a PSC. The initial bid will propose critical features such as the maximum cost recovery by the IOC, the share of production between the IOC and

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[12] Ibid, p 143.
[13] Report No.24, n 4, p 150.
[14] Ahmad, n 1, p 143.
[15] CPD Task Force Report, n 6, p 15.

Petrobangla, the price at which the IOC share of gas production would be sold to Petrobangla.[16]

The PSCs are structured so that gas fields eventually revert to the Bangladesh government. Also, the area covered by a contract block reverts to the Bangladeshi government in the following sequence: 25 per cent of contract area at the end of third contract year, 25 per cent at the end of the fifth contract year, and all remaining, non-producing areas at the end of the seventh contract year.[17] Finally, IOCs are exempt from Bangladesh taxes.

Under the first and second round of production sharing contract, bidding has been concluded for 12 exploration blocks (given in the table).[18] Meanwhile one of these companies has discovered gas in the Bay of Bengal (Sangu) and production commenced in 1998 from Sangu gas field under production sharing agreement. One more company has been able to discover gas at two new places (Bibiana and Moulvibazar).

[16]Mark Jaccard etc., "Natural Gas Options for Bangladesh", *CPR Commentary*, No.1, Winter 2000, p 26.
[17] Ibid.

Table 3.2

**Contract for Gas Exploration under Production Sharing Contract (PSC)**

**(February 2002)**

| Oil Company | Exploration Block | Area |
|---|---|---|
| Occidental of Bangladesh Ltd./Unocal. | Block 13, 14 | Greater Sylhet District |
| Occidental Explorations of Bangladesh Ltd./Unocal | Block 12 | Greater Sylhet District |
| Cairn Energy and Holland Sea Search JV | Block 15, 16 | Bay of Bangal and greater Chttagong District. |
| Rexwood Okland JV | Block 17, 18 | Bay of Bengal |
| United Meridian Corporation | Block 22 | Greater Chittagong Hill District |
| Unocal/Bapex | Block 7 | Barishal and Patuakhali |
| Tullow/Chevron/Texaco/Bapex | Block 9 | Gazipur, Narshindi, Comilla, Chandpur |
| Shell Bangladesh Exploration and Development BD/Bapex | Block 5, 10 | Laximpur, Noakhali, Bhola, Shatkhira, and Bangherhat |

Source: Petrobangla as in Pepole's Republic of Bangladesh, *Bangladesh Economic Review 2002*, (Dhaka: Ministry of Finance, June 2002), p 81.

Since the late eighties, exploration for oil and gas in Bangladesh by the public entities has slowed down dramatically, as it was envisaged that this relatively risky business would mostly be conducted by IOCs under the PSC framework. This has not worked as anticipated due to low level of exploration undertaken by the IOCs and because such exploration has later been linked by one IOC to an ensured gas market.[19]

Transactions involving foreign oil companies are conducted through Petrobangla's Petroleum Concession Department (PCD), a specialized unit that also acts as the regulator and administrator of these transactions. But the department was kept weak and

[18] Peopele's Republic of Bangladesh, n 7, p 78.

as such could not perform adequately. Moreover, trained and efficient professionals suited for the purpose were not placed in the PCD for a long time, which jeopardized the activities of the IOCs during the 1990s. The Bangladesh Petroleum Exploration Company Limited (BAPEX), incorporated in 1989 is charged with the responsibility of various exploration phases, but Petrobangla has kept the company's financial position extremely vulnerable and it is not allowed to conduct its business as required. Besides, there are gas production and transmission companies, who act as franchised operating companies and hold exclusive right to development, production and transmission of gas respectively.[20] A national transmission company called Gas Transmission Company Limited (GTCL), incorporated in 1993, will eventually be responsible for the high-pressure national trunk system. The other three companies, namely, Wes Gas, Barapukuria coal mining and Maddapara hard rock mining has not into operation as yet.

As a state corporation holding its equity in the OCs on behalf of the state, Petrobangla is not required to produce consolidated accounts. In fact, it is has become customary to assess the financial condition of each of the OCs separately. But because of the web of transaction between OCs, this approach does not yield a full and accurate picture of the Petrobangla Groups condition. In a sense, Petrobangla does not maintain its account in accordance with Generally Accepted Accounting Principles (GAAP).[21]

The government, through the Ministry of Power, Energy and Mineral Resources (MPEMR), wholly owns and supervises the exploration for oil and gas as well as production, transmission and marketing of gas; import of crude oil, refining and distribution of POL products; and generation, transmission and distribution of electricity. The exclusive authority for policy formulation, key appointments (even transfer of officials), investment decisions, and above all regulatory aspects of the energy sector rests with the MPEMR. The present framework is institutionally complex. Its main feature is that all matters- whether policy, operational, or regulatory- are ultimately

[19] Nuruddin Mahmud Kamal, "Infrastructure Regulation and Reforms: A Case Study on the Gas Sector in Bangladesh", *SAFIR Newsletter*, Issue 10, November 2002, p 2.
[20] CPD Task Force Report, n 6, p 15.
[21] Ibid, p 15.

decided by the government, and the decisions are often delayed unnecessarily, leading to mismanagement, cost and time over run etc.

To explore new gas fields and develop those already discovered, the government has opened doors for the foreign companies to invest in the gas sector under the PSC. The government informs that some foreign companies have responded to Bangladesh's call for foreign investment. By mid-2001 the government signed 12 PSCs with foreign companies permitting them to explore and develop gas fields in 10 out of 23 blocks through the country.[22] Bangladesh Petroleum Exploration Company Limited is the only Bangladeshi oil and gas company, which is taking part in the exploration activities with the foreign companies.

**Gas Production, Consumption and Distribution Network in Bangladesh**

Natural gas is currently the only indigenous non-renewable primary energy resource of the country, which is being produced and consumed in significant quantities. Natural gas is today recognized as an important indigenous hydrocarbon resource in Bangladesh. Its use as a fuel in Chhatak Cement Factory in 1960 from the Chhatak Gas Field marked its first commercial exploitation.[23] It was fed to the first ammonia-urea grass-roots complex, NGFF at Fenchugonj in 1961.[24] Since then over the years the consumption of natural gas has been increasing and it has contributed to the national development significantly.

Natural gas is now the major fuel for power generation in Bangladesh. It is the feedstock and fuel for production of urea fertilizer and ammonia. It is the fuel for many industries and commercial establishments. It is an important cooking fuel in metropolitan areas like Dhaka, Chittagong, Sylhet, Comilla, Mymenshing, Tangail etc. replacing the usual fuel such as wood and kerosene.

[22] Gain, n 8, p 168.
[23] Report No.24, n 4, p 150.

**Gas Utilization in Various Sectors**

As already mentioned the current utilization pattern shows that the ammonia-urea fertilizer sector consumes approximately 35%, power 45% and other sectors (industry, domestic, commercial and seasonal) 20% of the gas consumption.[25] We examine here the utilization of gas in the future by these sectors one by one.

**Fertilizer Sector**

The growth of the ammonia-urea fertilizer sector in the future will be limited. A 500,000-ton/year capacity urea plant to be located at Fenchugonj to replace the existing 39-year-old NGFF is a likely possibility by 2005.[26] It would mean an additional demand of about 25 MMSCFD gas if NGFF is shut down.[27]

Nitrogen and phosphate are the main chemical fertilizers exported from the country. While animal /vegetable fertilizers, nitrogen, phosphate and potasseo are basic imports. During 1991-2000 gas consumption for fertilizer sector was 756 BCF out of total 2490 BCF. The natural gas for fertilizer production is being supplied at a price cheaper than its economic price. The revised NEP of 2004 suggested to limit the production of natural gas based fertilizer to meet domestic demand only.[28]

By 2005, another 500,000-ton per/year urea complex is likely to be built on the western bank of the river Jamuna. This will create an additional demand of 40 MMSCFD gas. With these two plants on-stream the country in 2010 will have a total urea production capacity close to 4 million ton per year including KAFCO against the current urea consumption of about 2.2 million ton per year.

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[24] http://www.nbr.org/regional_studies/Bangladesh/bangladesh_initial-study_I.html
[25] Jaccard, n 16, p 30.
[26] http://www.nbr.org/regional_studies/Bangladesh/bangladeh_initial-study_VIII.html.
[27] Ibid.
[28] Government of People's Republic of Bangladesh, *National Energy Policy*, (Dhaka: Ministry of Power, Energy and Mineral Resources, May 2004), p 16 as in http://www.petrobangla.org/

If the two proposed 800 ton/day DAP plants to be built nearby CUFL come on-stream by 2005, these would further augment urea availability by about 200,000 ton/year.[29] However, these two plants would create a demand for gas of 1.65 MMSCFD for steam and power generation. If the 500,000-ton/year ammonia-urea complex at Fenchugonj and two DAP plants come on-stream by 2005, the gas demand would be increased by about 27 MMSCFD.[30]

It is evident that demand or consumption of gas by this sector does not increase without the commissioning of new plants. For example, since 1994 (after the commissioning of JFCL) the connected load for this sector has remained stagnant at 289 MMSCFD.[31]

Table 3.3

**Consumption of Gas by Fertilizer Sector during 1991-2000**

**(Served by 3 Gas Companies)**

| YEAR | Gas Consumption Served by Companies, MMCM | | |
|---|---|---|---|
| | TGTDCL | BGSL | JGTDCL |
| 1990-91 | 904 | 454 | |
| 1991-92 | 1074 | 507 | |
| 1992-93 | 1341 | 461 | |
| 1993-94 | 1451 | 491 | |
| 1994-95 | 1370 | 745 | |
| 1995-96 | 1515 | 904 | 157 |
| 1996-97 | 1331 | 703 | 170 |
| 1997-98 | 1300 | 809 | 157 |
| 1998-99 | 1257 | 919 | 167 |
| 1999-2000 | | | 166 |

Source: http://www.nbr.org/regional_studies/Bangladesh/bangladesh_initial-study_VIII.html.

[29] Gain, n 8, p 176.
[30] Ibid, p 176.

**Power Sector**

The current development in the power sector suggests that Power Development Board (PDB) on its own will not build new power plants after the on-going plants, namely, 210 MW gas based Siddirgonj plant and 300 MW coal based Barapukuria plant.[32] It is likely that PDB will not build any more power plants beyond 2005.

PDB's role as a power plant builder is henceforth being replaced by Independent Power Producers (IPPs). The much talked about WRIP has been shelved. IPPs' plants are troubled by many ifs and buts including funds and concessions. IPPs have planned to produce 1260 Mega Whatt (MW) power by 2005 (Meghnaghat-1 and 2 of 450 MW each and Haripur 360 MW); and would require about 150 MMSCFD gas at the peak and 120 MMSCFD on the average.[33]

By 2005, if things proceed as planned; the gas based generation capacity would be increased by 1400 MW (PDB: 210 MW and IPPs: 1260 MW). 1700 MW would augment the total generation capacity if the Barapukuria plant comes on stream.[34] This will certainly improve the availability of power. Moreover, the installation of the captive and stand-by gas engine generators by the industries will further improve the power supply and its reliability.

It is evident that the demand or consumption of gas in the power sector does not also increase without the commissioning of new plants. During the plan period 1995-2000, the additional gas fuelled power generation capacity added was 580 MW against the envisaged projection of about 1800 MW.[35] In the 1990's the gas based generation capacity added was 1090 MW in spite of the participation by IPPs and Rural Power Company (RPC).

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[31] Ibid, p 168.
[32] Report No.24, n 4, p 154.
[33] Ibid.
[34] http://www.nbr.org/regional_studies/Bangladesh/bangladesh_initial-study_VIII.html

Table 3.4

**Consumption of Gas by Power Sector during 1991-2000**

**(Served by 3 Gas Companies)**

| Year | Gas Consumption Served by Companies, MMCM | | |
|---|---|---|---|
| | TGTDCL | BGSL | JGTDCL |
| 1990-91 | 2026 | 240 | |
| 1991-92 | 2220 | 220 | |
| 1992-93 | 2361 | 152 | |
| 1993-94 | 2125 | 479 | |
| 1994-95 | 2222 | 544 | |
| 1995-96 | 2367 | 450 | 321 |
| 1996-97 | 2507 | 242 | 390 |
| 1997-98 | 2500 | 550 | 445 |
| 1998-99 | 2916 | 720 | 353 |
| 1999-2000 | | | 289 |

Note: MMCM Million Metric Cubic Meter.

Source:http://www.nbr.org/regional_studies/Bangladesh/bangladesh_initial-study_VIII.html

**Domestic Sector (Cooking Fuel)**

The consumption of gas in the domestic sector as a cooking fuel will continue to rise. Basically domestic gas supplies are made through pipelines. However, the four transmission and distribution companies including the newly formed company the Pashchimanchal Gas Company Ltd. (WES GAS) would be able to provide gas connection to about 70,000-75,000 households per year provided the funds for the expansion of pipeline network are available. This additional connection means additional gas demand of about 6.4 MMSCFD based on daily consumption of 82 SCF per

[35] Ibid.

connection.[36] This will give rise to an annual increase of gas consumption by this sector by 2.33 BCF.[37] The trend is not going to change overnight just because the gas is available on the western bank of the river Jamuna. When the demand of the larger metropolitan areas like Dhaka and Chittagong will be fully served the sector will find the growth diminishing. The current growth has little bearing on the growth of economy or GDP. Because having a gas connection is an option for replacing the existing fuel type in use leading to convenience and comfort of cooking.

**Industry Sector**

The consumption of gas in the industry sector will continue to rise in the franchise areas of TGTDCL. The franchise areas under WES GAS will show some initial growth like that shown by BGSL and JGTDCL. Adding the system loss of 55 MMSCFD to this sector is a distortion. This has not led to additional sale revenue not to speak of proportional increase. The consumption in the franchise areas served by BGSL and JGTDCL has remained static during the decade 1991-2000.[38] No growth is noticeable; probably the potential industries were served as soon as the gas had become available.

**Gas Consumption by Industry in Titas Francise Area**

The franchise areas covered by TGTDCL have shown steady growth during 1991-2000 and it will continue for a few years. One of the reasons for the growth is the installation of gas engine driven generators as captive power or stand-by power supply by RMGs, Textile, Ceramics, Pharmaceuticals and other manufacturing plants. It is reported that one company alone supplied more than 300 gas engine generators in the range 125-2000 kW in past few years.[39] There are more such suppliers. 37.5 MMSCFD gas was consumed by the captive power generators out of total 112 MMSCFD.[40] A number of recycle paper mills and cement clinker grinding plants in the franchise areas with captive power generation have come on-stream in past few years.

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[36] Report No.24, n 4, p 153.
[37] Ibid, p 153.
[38] Ibid, p 153.
[39] http://www.nbr.org/regional_studies/Bangladesh/bangladesh_initial-study_VIII.html

Since the actual consumption in different franchise areas by the three older distribution companies are known, it would be useful to study the customers industry wise and uses of gas to understand the potential of this sector. This would provide a realistic basis for future planning of this sector.

The gas of Bangladesh contains more than 94% methane by volume.[41] Its suitability as a feedstock for petrochemicals is not promising. It does not have technological edge over other raw materials used for petrochemicals worldwide and it is not considered as a potential raw material for petrochemical industry.

**Commercial Sector and Seasonal Users**

In 1998, the commercial sector used about 1.62% of the total gas consumption.[42] The growth of this sector will remain slow. Similarly, the growths for the seasonal users will also remain slow. Then, at the prevailing extremely low average consumption level, there is glaring disparity in Bangladesh in access to energy. Piped natural gas and electricity are accessible only to four per cent and 20 per cent of the country's total households respectively; moreover, most of these households are located in urban areas. The disparity is thus both between rich and poor and between urban and rural population. Almost four/fifths of the total population of Bangladesh are rural and a substantial proportion of the urban population is slum dwellers. Poverty is pervasive in both rural and urban areas. In the urban areas, the disparity is much more visible.

The production of natural gas in Bangladesh commenced in 1961, when Chatak Field started production to supply Chatak Cement Factory. This was followed by similar gas production from Sylhet Field in 1962, supplying Fenchuganj Fertilizer Factory with natural gas. In 1968 Titas Field started production, supplying gas to the Siddhirganj Power Station.[43] During the period from 1961-70, only 67 BCF of gas were produced, but during the next ten years with an annual production increase of 18 per cent it reached a

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[40] Ibid.
[41] http://www.nbr.org/regional_studies/Bangladesh/bangladesh_initial-study_VII.html
[42] Ibid.

total of 279 BCF by 1980.[44] This again increased to 1088 BCF in the 1980s with an annual average growth of 14 per cent, and further to 2492 BCF by 1990 with an annual growth of 7 per cent. The total production of natural gas in Bangladesh during the last 40 years is 4.3 TCF by June 2001.[45]

The official information stated that during the 1950-70 only 63 BCF of gas was consumed. During the 70s and the 80s this increased 280 BCF and 1068 BCF, respectively. The gas consumption became about 2000 BCF in the 90s; only in 1998/99 fiscal year alone the total consumption was about 308 BCF.[46] The gas consumption in major industries like textile, dyeing, paper, pulp, cement etc. and in the commercial sector, including tea gardens is also increasing steadily. With the gradual coverage of major growth centers with gas distribution network, use of as domestic fuel is increasing manifold.

**Petrobangla's Exploration: Production and Distribution Network**

| | | |
|---|---|---|
| BAPEX | : | Bangladesh Petroleum Exploration Company |
| BGFCL | : | Bangladesh Gas Field Co. Ltd. |
| SGFL | : | Sylhet Gas Field Ltd. |
| BGSL | : | Bakhrabad Gas Systems Ltd. |
| TGTDSL | : | Titas Gas Transmission and Distribution Co. Ltd. |
| JGTDSL | : | Jalalabad Gas Transmission System Ltd. |
| [GTCL | : | Gas Transmission Co. Ltd. |
| RPGCL | : | Rupantarito Petroleum Gas Co. Ltd.] |

From the above, one can see that fairly elaborate structure had been established for Petrobangla's exploration, production and distribution. Petrobangla (Bangladesh Oil, Gas and Mineral Corporation), a state owned corporation, has the primary responsibility for

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[43] Atiq Rahman etc., *Development and Climate Change: Bangladesh Country Case Study—Phase I*, in http://www.developmentfirst.org/studies/BangladeshCountryStudies.pdf
[44] Ibid.
[45] Ibid.

the natural gas industry in Bangladesh. Petrobangla is under the direction of the Ministry of Energy and Mineral Resources; it comprises five groups of companies:

- An exploration company – Bangladesh Petroleum Exploration Company;
- Production companies – Bangladesh Gas Fields Company, Sylhet Gas Fields Company;
- Transmission and distribution companies – Titas Gas Transmission and Distribution Company, Bakhrabad Gas System, Jalalabad Gas Transmission and Distribution System, Western Zone Gas Supply Company (Poschim Anchal Gas Bitaran Company, WESGAS, a new company for distribution of gas in the western part Bangladesh);
- A compressed natural gas company – Rupantarito Prakritik Gas Company; and

Mining companies – Barapukuria Coal Mining Company, Maddhapara Hard Rock Company.[47]

Just as the gas fields in Bangladesh are in the eastern part of the company, so too are the transmission and distribution pipelines. There is no natural gas supply to the western part of the country, although the recently completed Bangabandhu bridge over the Jamuna river carries a pipeline that now opens the possibility of expansion to the west. Major cities in the eastern part of the country served by the gas network include Sherpur, Jamalpur, Sylhet, Tangail, Dhaka, Chandpur, Comilla, Noakhali and Chittagong. While Titas Gas, Bakhrabad Gas and Jalalabad Gas are focused on linking local gas fields to regional transmission and distribution, the recently created Gas Transmission Company is responsible for developing the national transmission grid.[48]

**Demand – Supply Scenarios**

Since the emergence of Bangladesh, there have been several projections of natural gas demand. These are reported in the planning documents of various 5-year plans and one 2-year plan, ADB study, Task Force Report, National Energy Policy Report and Petrobangla's own report/study. These documents while making projections have

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[46] Ahm Mustain Billah, Md. Abdul Aziz Khan, Gas Extraction and Its Implications for Economic Sustainability of Bangladesh, *The Bangladesh Institute of Development Studies*, Vol.XXVII, No.3, September 2001, p 2.
[47] Jaccard, n 16, p 29.

envisaged considerable annual growth of the power and fertilizer sectors continuously. All demand and supply estimates are based on certain assumptions and are likely to inaccurate if any of the components or variables constituting demand or supply does not perform as expected. Some of the important underlying assumptions include:

- 7 to 10% increase in gas demand for fertilizer yearly
- 10-13% growth of natural gas fuelled power generation yearly
- Industrial growth in excess of 7% requiring 7% rise in gas demand yearly growth of gas demand to exceed the growth in GDP.[49]

Petrobangla experts made projections of gas demand and supply up to the year 2005 and arrived at a surplus deficit figure. Some of them are as follows,

Table 3.5

**Daily Average Gas Demand by Sector (MMCFD)**

| | 1999-00 | 2000-01 | 2001-02 | 2002-03 | 2003-04 | 2004-05 |
|---|---|---|---|---|---|---|
| Power | 400 | 452 | 493 | 522 | 556 | 578 |
| Fertilizer | 260 | 260 | 287 | 353 | 392 | 471 |
| Non-bulk | 248 | 272 | 304 | 325 | 344 | 365 |
| Others* | 40 | 40 | 40 | 40 | 40 | 40 |
| Total | 948 | 1042 | 1124 | 1240 | 1332 | 1454 |

Note: *Others mean system loss and own use. MMCFD=Million Metric Cubic Feet per Day.
Source: Petrobangla, as in *Changes and Challenges: A Review of Bangladesh's Development 2000*, (Dhaka: University Press Limited, 2001), p 151.

[48] Ibid, p 29.
[49] Ibid.

Table 3.6

**Demand – Supply Balance 2000 – 2005 (MMCFD)**

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|
| Average System Demand | 948 | 1024 | 1124 | 1240 | 1332 | 1454 |
| Maximum Demand | 1112 | 1187 | 1307 | 1451 | 1571 | 1703 |
| Standby Capacity | 225 | 235 | 260 | 290 | 315 | 340 |
| Maximum Demand + Supply | 1337 | 1422 | 1567 | 1741 | 1886 | 2043 |
| Production | 1311 | 1303 | 1296 | 1296 | 1284 | 1284 |
| Balance with Standby | - 26 | - 119 | - 271 | - 445 | - 602 | - 759 |
| Balance without Standby | + 199 | + 116 | - 11 | - 155 | - 287 | - 419 |

Note: MMCFD=Million Metric Feet per Day

Source: Petrobangla, as in *Changes and Challenges: A Review of Bangladesh's Development 2000*, (Dhaka: University Press Limited, 2001), p 151.

The table shows a deficit balance from the year 1999 allowing for the standby factor, and a deficit balance even without the standby factor from the year 2001 onward.[50] It is being stated that Bangladesh has no option but to rapidly expand its gas production in order to meet its sharply rising demand. But to Mr. Azim Uddin Ahmad it's just an exaggeration. He writes:

> Demand of gas for power and fertilizer (in particular) will not rise as is being made out. There are two main reasons for this. Quite substantial increase in power availability is possible by long neglected rehabilitation of both gas and non-gas fed existing power generation. In addition, rise in demand for power depends on the country's overall economic growth, which is predictably going to be less encouraging than the optimistic would like us to believe. As for fertilizer, rise in demand would depend on the expansion of country's fertilizer production. There are perhaps no such immediate plans. Besides, the enterprise having a fairly long gestation period, a new plant is not expected to be in place earlier than 5-6 years from now even if there be ally thinking in that direction.[51]

Even the popular articles and reports related to gas demand and future need, which have appeared recently in newspapers etc. speak of 10% annual growth of gas demand in Bangladesh. Different projections of gas demand since 1973 by the five 5-year plans and different studies show an average and peak respectively plus the actual consumption of gas. The First 5-year plan (1973-78) assumed that the power sector by 2000 would consume about 700 MMCFD gas supporting 5000 MW gas fired steam generating power plants at 60% plant factor, and the proven gas reserves of 8.29-9.36 TCF would be exhausted by then.[52] In 1973, the generation capacity of gas-based power plants was just 317 MW. It is clear that the projected daily demands of gas either as peak or average have always been above the actual consumption by a wide margin. For example, the projected peak daily demands of 1999 according to the Fifth 5-year plan, National Energy

[50] Ahmad, n 1, p 151.
[51] Report No.24, n 4, p 155.
[52] http://www.nbr.org/regional_studies/Bangladesh/bangladesh_initial-study_VIII.html

Policy (NEP) and Petrobangla are 1470, 1350 and 1112 MMSCFD, respectively, while the actual peak production in March 2000 was 1015 MMSCFD.

The projected demands in the context of gas reserves have always predicted that the reserves would be exhausted by the end of a particular year. For example, the latest projection supported by Petrobangla predicts that the gas reserves of 10.46 (excluding Bibiyana and Moulavibazar) would be exhausted by 2015 if the demand grows as projected. This projection assumes that power generation in 2005 will reach 5,264 MW and 11,035 MW in 2015.[53] The same projection further assumes that, the fertilizer sector will require additional 234 MMSCFD gas in 2005 for five new urea complexes of CUFL's size and expansion of CUFL.[54]

**Current Status of the Gas Reserve**

Reserve estimation is very important for the proper planning of the energy sector of the country. However, it must be recognized that the reserve estimation is a dynamic process and the reserve of a field/country needs to be updated with the exploration, production and development activities. When it comes to reserve, one needs to have clear understanding of some technical terms to avoid confusion. When talking about the reserve, people often get confused by the interchanging use of the terms reserve and the gas initially in place (GIIP). GIIP is the total amount of gas found initially in a reservoir when the reservoir is discovered. Hsowever, GIIP needs to be updated with additional information as a result of production and development activities. Reserve is that portion of the GIIP that can be produced from the reservoir under the present technical and economic conditions. Another term that is quite frequently used now a day is reserve growth. Reserve growth is the additional reserve over that of the previous estimate of the discovered fields as a result of additional appraisal cum development activities and/or application of new technology. Finally, resource potential of a country means probability of finding new reserve in addition to that already discovered. Resource potential is a probabilistic estimate, and information like geological data, exploration history of the

[53] Ibid.
[54] Ibid.

region, exploration history of similar but mature basins of other region, etc., are used in this kind of study. In this section various studies on reserve and resource potential of the country has been summarized.

**IKM Study**

In 1992, Intercom-Kanata Management Ltd. (IKM), a Canadian petroleum consulting company, conducted a comprehensive geological and reservoir engineering study on eight gas fields of Bangladesh. In this study, IKM conducted geophysical/petrophysical evaluation of the gas fields and updated the subsurface maps of the fields. On reservoir engineering side they conducted well testing and fluid properties evaluation of the gas fields and estimated the gas initially in place (GIIP) and the reserve. The results of IKM study are summarized shows that the GIIP and the recoverable reserve of the eight fields considered are 15.651 TCF and 9.04 TCF, respectively. [55]

Table 3.7

**Summary of Gas in Place and Reserve Estimation by IKM (1992)**

| Field | GIIP, BCF (Proven + probable) | Initial recoverable reserve, BCF (Proven + probable) | Remaining recoverable reserve,[a] BCF |
|---|---|---|---|
| Bakhrabad | 1,432 | 867 | 614 |
| Beanibazar | 243 | 167 | 167 |
| Belabo | 111 | 79 | 79 |
| Habiganj | 3,669 | 1,895 | 1580 |
| Kailashlila | 3,657 | 2,529 | 2478 |
| Marichakandi | 159 | 83 | 83 |
| Rashidpur | 2,242 | 1,320 | 1320 |
| Titas | 4,138 | 2,100 | 1243 |
| Total | 15,651 | 9,040 | 7,564 |

a. Based on cumulative production up to December 31, 1991.

[55] http://www.nbr.org/regional_studies/Bangladesh/bangladesh_initial-study_VIII.html

Source: http://www.nbr.org/regional_studies/Bangladesh/bangladesh_initial-study_VIII.html

**Petrobangla Study**

Petrobangla engages consultants time to time to perform specific jobs and studies on its behalf for the development of different gas fields. On the exploration and production side, Petrobangla usually engages consultants to conduct and interpret seismic surveys, perform drilling, completion, workover, pressure survey, reserve estimation, etc.

Some of these consulting firms carried out studies to estimate and update the gas in place and reserves on behalf of Petrobangla. Welldrill (UK) Ltd., Hydrocarbon Habitat Study, IKM Study, and BCIF study conducted some of the important ones. Based on the findings of these studies, Reservoir Study Cell of Petrobangla has estimated/updated the gas initially in place (GIIP) and reserve of different gas fields. Summaries of gas initially in place (GIIP) and reserve estimates of different gas fields by Petrobangla are shown in Table 3.8. Table 3.8 shows that the total GIIP and initial recoverable reserve of Bangladesh are 24.745 TCF and 15.51 TCF, respectively. Out of this reserve, 4.07 TCF has been produced already (up to February 2001), and the remaining reserve is 11.42 TCF.

Table 3.8

**Gas in Place and Reserve of Different Gas Fields As Declared By Petrobangla**

| Sl. No | Fields | Year of Discovery | Reserve Estimated by | | GIIP (proven + probable) | Recoverable (proven + probable) | Cumulative Production (Dec. 2000) | Net Recoverable |
|---|---|---|---|---|---|---|---|---|
| | | | Company | Year | | | | |
| **A. Producing** | | | | | | | | |
| 1. | Bakhrabad | 1969 | IKM | 1992 | 1432 | 867 | 586.568 | 280.432 |
| 2. | Habiganj | 1963 | IKM | 1992 | 3669 | 1895 | 818.315 | 1076.685 |
| 3 | Kailashtilia | 1962 | KM | 1992 | 3657 | 2529 | 231.820 | 2297.180 |
| 4 | Rashidpur | 1960 | IKM | 1992 | 2242 | 1309 | 194.920 | 1114.080 |
| 5. | Sylhet | 1955 | HHS | 1986 | 444 | 266 | 166.084 | 99.916 |
| 6 | Titas | 1962 | IKM | 1992 | 4138 | 2100 | 1783.400 | 316.600 |
| 7. | Narsingdi | 1990 | IKM | 1992 | 194 | 126 | 29.205 | 96.795 |
| 8 | Meghna | 1990 | IKM | 1992 | 159 | 104 | 23.278 | 80.722 |
| 9 | Sangu | 1996 | Cairn/Shell | 1997 | 1031 | 848 | 91.026 | 756.974 |
| 10 | Saidanadi | 1996 | Bapex | 1996 | 200 | 140 | 14.816 | 125.184 |
| 11. | Jalalabad | 1989 | Unocal/PB | 2000 | 1195 | 815 | 52.298 | 762.702 |
| 12 | Beanibazar | 1981 | IKM | 1992 | 243 | 167 | 4.681 | 162.319 |
| | **Sub-total A** | | | | **18604** | **11166** | **3996.411** | **7169.589** |
| **B. Non-Producing** | | | | | | | | |
| 13. | Begumganj | 1977 | Welldrill | 1991 | 25 | 15 | 0 | 15 |
| 14. | Fenchuganj | 1988 | Bapex | 1988 | 350 | 210 | 0 | 210 |
| 15 | Kutubdia | 1977 | Welldrill | 1991 | 780 | 468 | 0 | 468 |
| 16 | Shahbazpur | 1995 | Bapex | 1995 | 514 | 333 | 0 | 333 |
| 17 | Semutang | 1969 | HHS | 1991 | 164 | 98 | 0 | 98 |
| 18 | Bibiyana | 1998 | Unocal | 2000 | 3150 | 2401 | 0 | 2401 |
| 19 | Moulavibgazar | 1999 | Unocal | 2000 | 500 | 400 | 0 | 400 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Sub-total B** | | | | **5483** | **3925** | **0** | **3925** |
| | **Sub-total (A+B)** | | | | **240087** | **15091** | **3996.4** | **11094.59** |
| **C. Production Suspended** | | | | | | | | |
| 20 | Chattak | 1959 | Niko/Bapex | 1998 | 447 | 268 | 27 | 241.5 |
| 21 | Kamta | 1981 | Niko/Bapex | 1998 | 33 | 23 | 21.1 | 1.9 |
| 22 | Feni | 1981 | Niko/Bapex | 1998 | 178 | 125 | 40 | 85.49 |
| | Subtotal C | | | | 658 | 416 | 87.11 | 328.89 |
| **Grand Total (A +B+ C) in BCF** | | | | | **24745** | **15507** | **4083.52** | **11423.48** |
| **Grand Total (A +B+ C) in Tcf** | | | | | **24.745** | **15.507** | **4.08** | **11.42** |

**Source:** Marketing and Production Division, Petrobangla (Revived on 15/02/2001) as in http://www.nbr.org/regional_studies/Bangladesh/bangladesh_initial-study_VIII.html

## BUET Study

Petroleum and Mineral Resources Engineering Department (PMRE) of Bangladesh University of Engineering and Technology (BUET) conducted a gas in place estimation study recently. In this study gas in place values of all the fields under Petrobangla have been estimated using flowing material balance and volumetric estimation methods. Since sufficient pressure survey data are not available for most of the fields operated by Petrobangla, flowing well material balance method in which flowing well pressure data instead of the static reservoir pressure data have been used in this study. The results have been compared with those of Petrobangla. The comparison shows that for a number of reservoirs estimation of this study is significantly higher than those of Petrobangla study. This happened because in this study some new information revealed by some recently drilled development wells have been used. Data from these recent development wells have showed that some of the reservoirs are much larger than previously thought, for example Titas field. If all the gas fields are systematically developed, it is highly likely that the natural gas reserve of the country would increase from the present value. Summary of BUET Study is provided in Table 4.3. Table 4.3 shows that the GIIP of the material balance and volumetric study are 28.49 TCF and 24.401 TCF, respectively. The

difference may be due to under estimation of the reservoir bulk volume or presence of water drive.

Table 3.9

**Estimated GIIP of Different Gas Fields by BUET Study (2001)**

| Field | No. of sand | No. of well | Estimated GIIP[a] (TCF) | | GIP Petrobangla, 1998 (TCF) |
|---|---|---|---|---|---|
| | | | MB | Vol. | |
| Producing | | | | | |
| Titas | 13 | 14 | 10.24 | 9.050 | 4.132 |
| Habiganj | 12 | 7 | 8.022[b] | 3.669 | 3.669 |
| Bakhrabad | 5 | 8 | 1.120 | 1.332 | 1.432 |
| Narshingdi | 2 | 1 | 0.402 | 0.194 | 0.194 |
| Meghna | 1 | 1 | 0.095 | 0.160 | 0.159 |
| Saldanadi | 2 | 2 | 0.227 | 0.351 | 0.200 |
| Sylhet | 2 | 2 | 0.84 | 0.444 | 0.444 |
| Rashidpur | 2 | 7 | 3.189 | 2.243 | 2.242 |
| Kailastila | 3 | 4 | 3.588 | 3.656 | 3.657 |
| Beanibazar | 2 | 2 | 0.108 | 0.243 | 0.243 |
| Non Producing | | | | | |
| Shahbazpur | 1 | 1 | | 0.514 | 0.514 |
| Fenchuganj | 3 | 2 | | 0.404 | 0.350 |
| Production Suspended | | | | | |
| Chhatak | 1 | 1 | 0.406 | 1.900 | 1.900 |
| Kamta | 1 | 1 | 0.137 | 0.109 | 0.325 |
| Fani | 2 | 2 | 0.117 | 0.132 | 0.132 |
| Total (TCF) | | | 28.49 | 24.401 | 19.593 |

[a] Proven GIIP only

[b] May be overestimated due to water drive

Source: http://www.nbr.org/regional_studies/Bangladesh/bangladesh_initial-study_VIII.html

**Study by Shell**

In 1998, Shell Bangladesh Exploration and Development B.V. carried out a study on the gas reserve base in all regions of Bangladesh.[56] In this study five categories of resource base have been considered. These are: Cumulative production, mature reserves (discovered and developed), and immature reserves (discovered but not developed), Identified potential, and Unidentified potential.[57]

In the study the undiscovered resource base has been assessed with the concept of 'chance of success'. The chance of success is based on a combination of the historical success rate and geological evaluation of the individual prospect. In this study, each prospect/field has been assigned a probabilistic volume range based on uncertainties in the input parameters. The risked volume is an assessment of the expected success volume, which is likely to be obtained from the undiscovered potential of a basin.

This study by Shell estimated the total resource base of the country as 38 TCF. This includes the total reserves of the discovered fields and undiscovered resource potential based on geological evaluation and exploration history of the country. Later in a presentation and in the light of the USGS-Petrobangla study Shell estimated the total resource base between 43 to 64 TCF, in which existing reserve 18.0 TCF, field growth 5-6 TCF, and the undiscovered resource potential 20-40 TCF.

**UNOCAL Study**

Unocal Bangladesh Ltd. conducted a study on Hydrocarbon Resource Base of Bangladesh. This study has estimated the existing recoverable reserve, field growth potential and further resource potential of six blocks considered in this study. In this study existing reserve has been taken as 16.1 TCF including Bibiyana but excepting Moulovibazar.

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[56] Report No.24, n.24, p.161.
[57] Ibid.

The second category of their reserve is the field growth, which includes additional probable reserve as a result of new technology and enhanced recovery technique applied to the existing fields. The field growth components considered in the study are: 1) 3-D Seismic surveys, 2) Petrophysical thin bed analysis, 3) Compression, and 4) Reservoir management.[58] This study estimated a probable reserve addition of 12.8 TCF of field growth (1.6 TCF from reservoir management, 3.2 TCF from 3-D seismic, 4.8 TCF from thin bed and 3.2 TCF from compression) from existing fields.[59]

The third category that the study considered for the resource base is the potential of new field discovery. The study considered 30 selected prospects from 6 PSC blocks of the country and estimated a mean probability of finding new discoveries to be 13.2 TCF (5.3 TCF for P90 and 22.6 TCF for P10). In the light of the USGS-Petrobangla study Unocal concluded the total hydrocarbon resource base of the country as 61 TCF, in which discovered reserve 16.1 TCF, field growth potential 12.8 TCF and undiscovered resource potential 32.1 TCF. [60]

**USGS- Petrobangla Joint Study on Natural Gas Resources of Bangladesh**

A joint team of the United States Geological Survey (USGS) and Petrobangla conducted a study on natural gas resource assessment of Bangladesh. This study, which was funded by the U.S. Agency for International Development (USAID), estimated the natural gas resource potential of the undiscovered gas fields of Bangladesh. The assessment team consisted of six geologists from the USGS's World Energy Resources Assessment Team and seven geologists, geophysicists, geochemists, and a petroleum engineer from Petrobangla. A regional assessment geologist presented the geological and geophysical data needed for the formal assessment. International oil companies, namely, Unocal Corporation, Shell Bangladesh, and Cairn Energy PLC, were invited to present geological background and assessment information and included. The objective of the study was to assess the technically recoverable undiscovered gas resource potential of Bangladesh that

[58] http://www.nbr.org/regional_studies/Bangladesh/bangladesh_initial-study_VIII.html
[59] Ibid.
[60] Ibid.

might be found in a 30-year period (2000-2030) through a properly conducted exploration program.

The USGS periodically conducts assessments of hydrocarbon resources of the United States and of the world. As a part of the process, regional geologists present descriptions of the petroleum geology and known hydrocarbon resources of the region to be assessed to the Assessment Team. This information is used to identify and describe Total Petroleum Systems (TPS) within the assessed region. Total Petroleum Systems encompass the natural process that begins with the generation of hydrocarbons from kerogen-rich source rocks, is followed by the migration of hydrocarbons from their source area, and ends with their entrapment within reservoir rocks beneath relatively impervious seals. The area (or country) in which that Total Petroleum System is active is then divided into Assessment Units (AU). Assessment Units are areas of specific geological terrain for hydrocarbon development within a given Total Petroleum System. Available historical oil and gas production data from existing wells and fields and information on discovered prospects and leads are then allocated to each AU. The AU is characterized as to type of hydrocarbon, in this case gas, the minimum field size to be assessed (in this case 42 BCF), the number of discovered fields exceeding the minimum size, and the median size of discovered gas fields. Geologic elements may be risked only when no fields of the minimum field size have been discovered within an AU.

In such a hypothetical AU, geologic risk probabilities are determined for adequate petroleum charge, reservoirs, traps, and seals, and the timing of geologic events. These probabilities are multiplied together to determine the geological risk for an accumulation of one deposit equal to or greater than the minimum field size. Accessibility is also risked to account for the possibility of adequate locations to allow for exploration for a field equal to or greater than the minimum field size to be found within a 30-year time frame. Utilizing these data, along with the historical knowledge of world petroleum resources and geology of hydrocarbon accumulations worldwide, the Assessment Team conducts an iterative analysis of each AU until they reach a consensus on the ranges of the numbers and sizes of undiscovered fields (minimum, median, maximum) in that unit.

These data are input into a computer simulation program that generates probabilistic forecasts on the undiscovered resources such as natural gas, oil and their co-products contained within the AU.

Previously, the USGS had conducted an assessment of the Ganges-Brahmaputra province, including parts of India and Myanmar and almost all of Bangladesh, as documented in the World Petroleum Assessment 2000 (U.S. Geological Survey World Energy Assessment Team, 2000).[61] The current assessment reflects new information for the time period 1995 to 2000 and utilizes considerable proprietary data.

The study divided the country into six Assessment Units based on their geological attributes. These are: Bang0101 Surma Basin Assessment Unit; Bang0102 Easternmost Extremely Folded Assessment Unit; Bang0103 High Amplitude Faulted Anticlines Assessment Unit; Bang0104 Moderately Folded Anticlines Assessment Unit; Bang0105 Western Slope Assessment Unit; and Bang0106 Western Platform Assessment Unit.[62] The study summary results for the onshore region, offshore region, and the grand total for all of Bangladesh. Table 3.8 shows that Bangladesh has a natural gas resource potential of 8.43 TCF with 95% probability, 65.7 TCF with 5% probability, with a mean potential of 32.12 TCF. The onshore area is more promising and has a potential of finding natural of 5.99 TCF with a 95% probability and of 48.33 TCF with 5% probability with a mean potential of 23.34TCF. The offshore has a potential of 2.44 TCF with a 95% probability and 17.37 TCF with 5% probability with a mean potential of 8.05 TCF.

The resource numbers calculated indicate the range of probable resources that may be discovered if Bangladesh were actively explored during a 30-year time frame. In places, where detailed geologic information is lacking in Bangladesh, the assessment team used geological play types that occur in similar geological provinces elsewhere in the world. In addition to the fairly well understood structural anticlines, which have thus far constituted the main play in Bangladesh, the assessment team recognized the potential offered by

[61] http://www.nbr.org/regional_studies/Bangladesh/bangladesh_initial-study_VIII.html
[62] Ahmad, n 1, p 156.

stratigraphic traps, plays at depth within the high-pressure zone and other possible plays. The study also considered the possible technological advances in the in the fields of exploration and production that may occur within the nest 30 year time frame.

Table 3.10

**Prediction of the Undiscovered Gas Resources of Bangladesh by USGS-Petrobangla Study**

| Area | Undiscovered gas resources, TCF | | | |
|---|---|---|---|---|
| | F95 | F50 | F5 | Mean[a] |
| Onshore | 5.99 | 21.11 | 48.33 | 23.34 |
| Offshore | 2.44 | 8.05 | 17.37 | 8.78 |
| Total | 8.43 | 29.17 | 65.7 | 32.12 |

a. From Monte Carlo Simulation

Source: http://www.nbr.org/regional_studies/Bangladesh/bangladesh_initial-study_VIII.html

**Hydrocarbon Unit and Norwegian Petroleum Directorate Joint Study**

A joint team of Hydrocarbon Unit (HCU) of Energy and Mineral Resources Division and Norwegian Petroleum Directorate (NPD) conducted the latest study to estimate the reserve of the discovered fields and undiscovered resource potential of the country. Experts of NPD on Norwegian side and those of Petrobangla, BAPEX, BGFCL, SGFL, and GSB conducted this joint study on HCU side.[63]

This study re-estimated the reserve of four major gas fields, namely, Titas, Habiganj, Rashidpur and Kailashtilla, by material balance and volumetric methods utilizing latest available data and reviewed the gas reserves of other discovered fields. For estimation of the resource potential, this study divided the country into two petroleum provinces comprising of six petroleum systems. This study identified the prospects, leads, plays,

[63] Ahmad, n 1, p 156.

and selected reservoir parameters utilizing latest information and available geological, exploration, reservoir and production data.

This study estimated the proven and probable gas initially in place (GIIP) of the discovered fields as 28.79 TCF and recoverable reserve as 20.44 TCF. Based on recent information, this study showed an increase in GIIP in Titas and Habiganj fields and a decrease in GIIP in Kailashtilla and Rashidpur fields. The study contended that using modern technologies and good reservoir management practices, it is possible to achieve a recovery factor of 70-75% in different gas fields compared to 52-70% used by Petrobangla.

**Major Findings of Committee Report on Utilization of Natural Gas in Bangladesh**

The Government of the People's Republic of Bangladesh appointed a committee to assess and analyze the utilization of natural gas in Bangladesh. Azimuddin Ahmad has been appointed as its chairman and Ijaz Hossain, M Tamim, KAS Murshid, SA Hafiz FCA, Debapriya Bhattacharya, Momtaz Uddin Ahmed, M Ismail as its members. The basic issues that confronted this committee are, (a) to assess the country's gas demand; (b) the most rewarding and economic utilization of gas resources, particularly, in the light of the production sharing contracts; (c) the foreign currency obligations under the PSCs; (d) assessment of the country's global foreign currency out-flows and in-flows; (e) the cross-border prospects of energy trade; and (f) socio-economic overview of the country's energy scenario.[64]

The report has incorporated some important considerations. They are, firstly, ever increasing part of gas shall come from IOC operated fields; secondly, these supplies shall have a bearing on Petrobangla's as well as the country's finances; and the third is their impact on the domestic gas price structure. It has also revealed that country's gas demand

[64] Government of Bangladesh, *Committee Report on Utilization of Natural Gas in Bangladesh*, (Dhaka: Ministry of Energy and Mineral Resources, August 2002), as in http://www.emrd-gob.org/

and supply henceforth shall be intrinsically interlinked with the issue of cash flow, both in dollar and taka terms.[65]

According to the report the country has large unmet demand in commercial energy as may be observed from the following stylized facts:
Electricity: About 5 million customers i.e., about 25 million customers (out of 130 million people) in the country (assuming on an average 5 members in each family). Thus access to electricity is only 19 per cent.
Gas: Approximately 96 per cent of the total population do not have direct access to indigenous natural gas as cooking fuel; and
Oil: Imported oil provides direct access to only 5 per cent rural people as customers of kerosene for cooking and lighting.[66]

The report signifies based on latest studies that, the current gas reserves are estimated at 16 TCF; but in this case also there are differences of opinion. In order to ensure the energy security of the country it has to assess the possibility of pursuing cross border energy trade. With regard to gas export the committee has taken a stand that PSCs were neither offered nor negotiated under export other than in LNG form. Therefore any departure from this contractual constraint must be on terms more favorable to the country. [67]

**Gas Sector Issues**

a) Governance and Management

For institutions in the gas sector to function effectively, there is a need to separate policymaking, regulation, and operations— because the three functions entail different levels of responsibility and accountability. Policymaking is best left to the government accountable to parliament and to voters. Regulation is best left to specialized entity operating independent of the industry, in accordance with the policy guidelines provided

[65] Ibid.
[66] Ibid.

by the government. Operations are best left to the management of companies accountable to the board of directors, and shareholders.

b) Institutional Aspects

Petrobangla is the sole player in the Bangladesh gas sector. The organization entered into its first production sharing contracts for the offshore blocks with foreign oil companies in1974. Petrobangla is a statutory body of the government, governed by a 1985 ordinance and operating under the purview of the Ministry of Energy. A 'member board' appointed by the government governs it. The operating companies are all corporatized under the Companies Act, while the mother organization Petrobangla is not. Transactions involving foreign oil companies are conducted through Petrobangla's Petroleum Concession Division (PCD).[68] Apparently, the present framework is institutionally complex. Its main feature is that all matters-whether policy, operational, or regulatory-are ultimately decided by the government (as desired by the Ministry of Energy). T5he decisions are often delayed, and it remains unclear whether they are guided by commercial or other considerations.

c) Legal and Regulatory Commission

Petrobangla acts as a regulator of the upstream through its Petroleum Concession Division or popularly known as PCD. Petrobangla is the sole buyer of gas from the International Oil Companies operating under the PSC policy of the government. In addition, it is also a partner of the IOCs under PSCs. The allegation that conflicts inherent in combining all these functions are not conducive to the healthy development of the industry does not stand out logically. This issue has cropped up recently in the 1990s although PSCs were initiated in 1974 and subsequently contracts were also signed in 1981 and 1987. In fact, reportedly, the IOCs are taking undue advantages in the operation of PSCs due lack of proper supervision and monitoring of contracts by Petrobangla. Joint

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[67] Ibid.

[68] http://www.businessweek.com/bwdaily/dnflash/may2001/nf2001056_893.htm

Review Committee of Petrobangla is very poorly structured and generally appears to be non-effective from the point of view of taking care about national interest.

d) Financial Management

Petrobangla operates through various operating companies (OCs), which transact with each other under a complex system of internal transfer price. Some OCs are profitable, other aren't—so consolidated accounts are required to assess the condition of the gas sub-sector. Gas production had declined in the late 1990s, mostly due to Bakhrabad gas field, a large producer now in declining phase resulting in collection of lesser revenue in some years. About 65 per cent of the gross revenue of Petrobangla Group is paid to the state to the state in taxes and compulsory dividends—making effective price received for gas at a very low rate (compared to international standard). As a result of low margins, the Petrobangla Group has not been investing enough in exploration, development and pipelines, or distribution. Nor have the expenditures on operation and maintenance been adequate for upkeep of the gas system.

e) Gas Reserves and Supply-Demand Balance

Although considerable anomaly exists in the reserve estimate, Gas-Initially-In-Place (GIIP) from 22 gas fields is assumed at 22.80 trillion cubic feet (TCF).[69] No proper comprehensive reserve estimate exercise has been conducted by Petrobangla as per international petroleum field practices since 1989. Even one IOC (Cairn/Shell) has started production of offshore Sangu field without carrying out a reserve study. The resource position would need to be firmed up through further investment in exploration, appraisal and evaluation to obtain a reserve figure in future. Gas consumption is growing at a very fast rate. The gas shortages have been caused by several factors. Reservoir management practices have been inadequate; gas wells have been overproducing, with little consideration of the reservoir characteristics and the petroleum industry practice of producing on a well's "maximum efficient rate".[70] The future supply demand balance for

[69] http://www.businessweek.com/bwdaily/dnflash/may2001/nf2001056_893.htm
[70] Ibid.

gas will depend on the ability of Bangladesh to mobilize the resources needed to develop the gas sector, whether from the public or the private sector.

f) The Gas Market

A relatively complex system of administered internal transfer prices is in place in the Petrobangla group, but for all practical purposes the single buyer model applies. The upstream segment of the natural gas industry in Bangladesh is governed by the Petroleum Act 1974, which gives the government the exclusive right to explore, produce, and market hydrocarbon. In the downstream gas sector there is no regulatory framework, as the transmission service is integrated in the operating companies' bundled price and GTCL's tariff is expected to be set by the government.

f) Distributive Inefficiency

Natural gas distribution system in Bangladesh is plagued by inefficiencies like leakages, lack of funds, insufficient distribution, corruption etc. Due to the leakages in pipelines, distribution and transmission of natural gas experiencing loss every year. Most of the officials in the institution are corrupted. All these have resulted in poor collection of revenues in some years. As a result the Petrobangla group has not been investing enough in distribution system development. The distribution of natural gas is only adequate in urban areas, whereas in rural remote areas it has to be fully established. Finally it is questionable to subsidize natural gas distribution systems in urban areas, considering that funds could instead be directed to electrification.

g) Accessibility to the Poor

In Bangladesh most of the rural people and poor depend largely on biomass fuels in order to meet their daily energy demand. They can't afford the natural gas due to the limited nature of their income. In most of the rural areas gas pipelines are not installed, thus alienating them from using the country's largest commercial energy source. Thus the major problem confronted by the natural gas sector is providing natural gas to the country's largest section of the population comprising rural and poor people.

h) Environmental Effects

The exploration process includes drilling which on the other hand affects in negative manner. Gas development and downstream uses of gas are not closely monitored resulting in serious blowouts. The blowouts not only waste large amount of gas but also endanger forests and biodiversity.[71]

[71] Micael Mastaller etc, *Bangladesh: Toward an Environment Strategy*, (Manila: Asian Development Bank, 2000), p 61.

# CHAPTER IV

# ENERGY SECURITY ISSUES IN BANGLADESH

# *Chapter IV*

# ENERGY SECURITY ISSUES IN BANGLADESH

Energy development appears to be a major constraint for continued development of a developing country like Bangladesh. The major stumbling block is lack in terms of capital investment since energy development programmes are highly capital intensive. Traditionally these programmes have been implemented with the support from the donors and/or multilateral banks. Since independence the government has given adequate priority and about 20% of the total public sector investment has been allotted for the development of the energy sector. Even then the achievements made in this sector have not been able to cope with the growing demand for energy services, in terms of both quality and quantity.

Apart from general mistrust about the political and financial system by the public, a genuine concern for everyone is the question of energy security. Being a country with a single commercial energy resource and heavily dependent on it, Bangladesh runs the risk of energy shortfall or insecurity far more than its neighbours. Energy development appears to be a major constraint for continued development of a less developed country like Bangladesh. It is pertinent to have a look at various energy sector issues that are creating hurdle in the development process in Bangladesh.

**Poverty and Energy Security**

Poverty has received scant attention from an energy perspective. This is remarkable given that energy is central to the satisfaction of basic nutrition and health needs, and that energy services constitute a sizeable share of total household expenditure in developing countries. Observations across countries reveal that low-income households tend to rely on a significantly different set of energy carriers than do the rich. People living in poverty primarily use wood, dung, and other biomass for their energy services, and tends to use less electricity and liquefied petroleum gas (LPG) than do those who are better off. Approximately two billion people continue to depend on traditional fuels, such as

biomass, for cooking.[1] This finding is significant in part because indoor air pollution is a major by-product of the traditional use of biomass, which diminishes the quality of life, especially for women and young children. Households use fuel for a variety of purposes including cooking, water heating, lighting and space heating. Firewood, dung, charcoal, coal, kerosene, electricity, and LPG can be used for cooking and kerosene and electricity for lighting.

Energy can play a critical role in helping to achieve the Millennium Development Goals (MDGs) and improving the lives of poor people across the world. The wide range of 'energy services'- cooking, lighting, heating, water pumping, transport, etc.- made possible by fuels and fuel technologies can have a major impact in facilitating sustainable livelihoods, improving health and education and significantly reducing poverty.[2] Conversely, energy poverty- energy poverty- the absence of sufficient choice in accessing adequate, affordable, reliable, safe and environmentally benign energy services- can be a severe constraint on economic and human development.

There are a number of misconceptions or myths about energy, which should be dispelled in order to encourage the development community to think more seriously about issues related to energy supply, energy access and energy use;

- Myth—poor people do not consider access to energy as a priority.

  Reality—the poor spend more time and effort obtaining energy services than the better off; and they spend a substantial proportion of their household income on energy just for basic human survival (cooking, lighting, etc.).

- Myth—access to grid electricity will solve all the energy services needs of the poor.

  Reality—people need access to other fuels for cooking and heating.

- Myth—the poor will not pay for energy services.

  Reality—poor people already pay more than the better off.

[1] http://www.undp.org/seed/energy/chapter2.html
[2] *Energy for the Poor: Consultation Document*, May 2002, p 1, in www.dfid.gov.uk

- Myth—new technology (such as solar photovoltaic and wind power) can massively improve poor people's access to energy services.

Reality—technology is rarely the constraint: addressing institutional, political and social problems is typically more important.

- Myth—only people in rural areas suffer from energy poverty.

Reality—poor people in urban areas also suffer from energy poverty: the number of people in energy poverty in urban areas looks likely to increase as it is predicted that 61% of the world's population will be living urban areas by 2025.[3]

Poverty reduction remains today the greatest development challenge to Bangladesh. In this country, a large segment of the people are poor and do not have sufficient income to meet their basic needs like food, shelter, clothing, education, and health. In 2000 there were around 33.7% of the population were below the lower poverty line constituting 37.4% rural and 19.1% urban population.[4] But the number and proportion of poor have both risen and fallen.

In Bangladesh majority of the people live in rural areas. Thus large number of poor, indeed majority live there. But the number of poor living in urban areas are also not negligible. In 2000 49.8% of the population were below the upper poverty line constituting 53.1% of rural population and 36.6% of urban population.[5] among the poor majority of them were wage labours. Apart from all these Bangladesh suffers from chronicle natural calamities and adverse physical environmental condition. Highest incidences of poverty are witnessed in flood prone areas followed by those in the drought prone areas.[6]

Next to food and water, poor rural people struggle for energy for cooking. Biomass fuel accounts for 73.6 of the total fuel in rural industries such as paddy parboiling, smithies,

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[3] *Energy for the Poor*, n 2, p 2, in www.dfid.gov.uk

[4] Government of the People's Republic of Bangladesh, *2000 Statistical Yearbook of Bangladesh*, (Dhaka: Bangladesh Bureau of Statistics, June 2002), p 611.

[5] Ibid.

[6] Begum Meherunnnessa Zaman, "Poverty Alleviation in Bangladesh: Past, Present and Future", *BIISS Journal*, Vol.16, No.2, 1995, p 146.

potteries, etc. and is the common fuel for the domestic rural sector.[7] Wood fuel has become scarce over the last few years through deforestation. As a result prices of wood fuels have also gone up steadily. Correspondingly increases in annual incomes of poor households have been relatively slow, and the rural household budget for this fuel-wood now account for about half of the annual income of 50 per cent of rural households.[8] Consequently, women of these households have to gather lower grade biomass fuels in the form of agricultural and animal residues. The usage of all these lower grade fuels could lead to following results:

- As the calorific value of these fuels is low, they require a higher quantity to meet the same energy demand. Therefore, time spent on gathering these fuels is very high, one to five hours per day.
- These fuels formerly supplied nutrients to the soil. Increased dependence on them results in an ecological imbalance.
- Due to lack of purchasing power, low income households can only meet a part of their total demand, whereas higher income households have the ability to meet their total demand.
- There is a range of health problems associated with this fuel cycle. Increased exposure to smoke during cooking can cause acute respiratory infection, chronic obstructive lung diseases, lower birth weights and lung cancer and eye problems. Adverse health effects can further increase poverty by increasing medical care expenditure and diminishing productivity. The whole family could be vulnerable to indirect health impacts from lack of fuel for proper cooking (i.e. malnutrition) and for boiling water (diarrhoea, parasites, etc).
- There are equity issues of both gender and class. Poorer women put in more labour compared to women in rich households to meet the same energy demand.

[7] Wahidul K Biswas etc., "Model for Empowering Rural Poor Through Renewable Energy Technologies in Bangladesh", *Environmental Science and Policy*, Vol.4, 2001, p 336.
[8] Ibid.

- For low income households the gap between the demand and consumption is termed as suppressed demand. The quality of life of poorer households is affected due to unfulfilled demand for energy.[9]

If there is no energy security for the poor, they would have been starved for energy. They have to pay more for the smallest energy source. The whole country will be in economic turmoil because whole nation is dependent on poor and their agricultural production. The gap between the rich and the poor will be further widened.

The main issue that impinge upon the energy security is that availability of energy resources at affordable prices. The poor always hopes for getting the energy resources at very cheapest prices and within short time frame. Poverty results in less consumption of energy due lack of enough resources.

**Women and Energy Security**

Energy is both necessary for survival and a critical factor affecting economic and social development. As such, energy can contribute to widening opportunities and empowering people to exercise choices. Conversely, its absence can constrain both men and women from contributing to economic growth and overall development.

Energy's relationship to women's work and well being in particular is evident in women's roles as:

- Users of energy resources (both traditional biomass and modern fuels) for household, subsistence and income-earning activities;
- Producers of traditional biomass fuels and providers of "human energy" services;
- Those most vulnerable to energy scarcity, environmental damages from energy production and use, and adverse impacts of technological changes in the energy sector; and

[9] Atiur Rahman, (et al), *People's Report on Bangladesh Environment 2001 – Vol.I Main Report*, (Dhaka: The University Press Limited, 2001), p 181.

• Educators concerning the collection, management and use of fuels, and activists in energy and environmental debates and action. Women are the major users of traditional and biomass energy resources for household and income-earning activities, and they also play major roles in the use of modern energy by households:

• Biomass fuels account for 80% of all household fuel consumption in developing countries, mostly for cooking, which is done primarily by women. Women have practical interests and applied expertise in the burning properties of different fuels, fire and heat management, fuel-saving techniques, and the advantages and disadvantages of different fuels and stoves.

• Women do most of the cooking when using modern fuels as well, and purchase, or influence the purchasing patterns, for fuels, stoves and other energy-using appliances. Perhaps even more important, women influence the direct and indirect energy consumption patterns of their households, the use of heating and air conditioning, hot water and electrical appliances as well as the time of use, and therefore peak energy use. Household consumption and purchasing patterns for products and services which may be more or less energy-intensively produced, as well as the transport systems used by households are directly influenced by the gendered division of labour and the decisions of women.

• Many income activities of women in the informal sector are fuel intensive, and the viability of these activities is affected by energy prices and availabilities. Examples include food-processing industries, kiln-using manufacturing activities and numerous service-sector activities. Women often participate on a seasonal or part-time basis in many income-earning activities, providing off-farm income that is essential for ensuring family food security, especially for very low-income and landless households.

• Women walk and take public transport more frequently than men. In many countries there are large differences between men and women in automobile ownership and access as well as in possession of driver's licences. Women tend to make a number of shorter and more complex daily trips for shopping, schools, part-time employment and volunteer work. Current urban transport systems are not only energy-intensive, but

can often restrict the mobility of those who do not use them (e.g. pedestrians, cyclists and users of public transport).[10]

In Bangladesh a major proportion of total energy is consumed in the domestic sector for cooking and lighting. Women are in the forefront of the management of domestic energy. But most of the women in low income households spend a larger amount of time in collecting cooking fuels from the surrounding places. Sometimes they have to spend more time and put labour, when they have to walk a long to gather fuels. Women cooking with biomass fuels face a highly polluted environment inside the kitchen due to incomplete combustion of biomass fuels.[11] Since women in Bangladesh particularly rural women are in a disadvantageous insecure energy position, there is a need to find way outs so that they would not suffer of any health related problems.

Thus in this situation for rural women energy security refers to availability of fuel wood at a nearest possible place, at a shortest span of time and at cheap affordable prices. Since cooking is done by women they are at a vulnerable position to risk their health since would fuel release emissions which affects the health. Therefore it has become necessary to find more efficient fuel wood which will emit fewer smokes.

If the energy security is threatened then women have to suffer more. They have to move long places in order to collect fuel wood. The time spent on collecting energy sources will be too much. Its impact on health is likely to be very serious. Ultimately it is women who will be at disadvantageous position.

**Population and Energy Security**

An assumed exogenous impact of population on energy is the conventional, and obvious, aspect of the population/energy connection. Population levels influence energy demand in a straightforward way. The larger the population, the more the total energy required, with the magnitude of this total energy depending on the per capita energy consumption.

[10] http://www.undp.org/seed/energy/chapter2.html.
[11] Rahman, n 6, p 181.

This is the conventional approach to the energy-population nexus. Population is an external factor influencing energy consumption.

There can be another connection in which energy strategies contribute to a reduction of the intensity of the population "burden." If energy consumption and population growth are a dialectical pair-each transforming the other, and each being the effect when the other is the cause, then the pattern of energy consumption could also have an effect on population growth. This is an alternative perspective in which energy consumption patterns influence the rate of population growth through their effect on the desired number of births in a family and the relative benefits and costs of fertility. Ultimately, these patterns can retard or accelerate the demographic transition.

This dimension of the energy-population nexus will be illustrated through the influence of energy consumption on population growth at two levels: the micro-level of villages in developing countries and the macro-level of the world.[12] The implication is that an important task for energy is to help accelerate the demographic transition, particularly by achieving dramatic reductions in fertility to stabilize global population as quickly as possible and at as low a level as possible.

While many believe that population growth in developing countries represents the most serious threat to the global atmosphere via global warming, the continued high and/or growing levels of fossil fuel consumption in the industrialized countries and among the rich in developing countries are making far greater impacts on the global atmosphere than the poor in developing countries, even though the populations of the industrialized countries and the rich in the developing countries are growing very slowly.

Increasing population is matter of concern for Bangladesh in recent times. The large size of the population is arguably the most critical problem of the country. With a size of population which is half a size that of USA, Bangladesh is now facing a problem of

[12] http://www.undp.org/seed/energy/chapter2.html.

facilitating energy to most of the population with its energy resources at its disposal. The population of Bangladesh is around 133 million. But during the past two decades, however, Bangladesh successfully retarded its population growth rate and brought it down from some 3.0% to 1.67%.

Apart from a few city-states, Bangladesh's population density is considered to be the highest in the world. The growing pressure of increasing population added to the stress on natural resources including land and water. The most abundant natural resources of Bangladesh are non-renewable in nature. The population of Bangladesh is growing at a faster rate than that of the natural resources, whose gestation period normally long. Thus it made a compulsion for Bangladesh to look for other sources of energy in order to meet the increasing energy demand.

Even though for the last some years Bangladesh has been successful in bringing population growth under control still they have huge section of them living in rural areas whose energy demands are still unmet with. For Bangladesh every increase in population refers to increase in energy demand. Biomass which is the main source of energy is also vanishing due to the deforestation. Natural gas resources are also not last for too long. So it has become a burden to meet the extra demand for energy which arising from the new population. Rural people spend most of their time in collecting fuel wood for household purposes. Thus they at a very insecure energy position. That is why in Bangladesh increasing population been treated as threat.

**Environment and Energy Security**

The main use of natural resources is to generate energy. Every human action intended for energy generation alters the prevailing environment in one form or the other. The environment affects and is affected by human actions. Environmental impacts can be reversible and permanent (irreversible or too costly to reverse). The impact is irreversible when it changes certain ecological functioning forever. Therefore, the ethical question of making the right inter generational decision is very much present when we talk about resource development.

The environmental issues of energy development are complex and difficult. They extend beyond national borders and defy national capacity to act alone. For example, emissions of carbon dioxide in coal burning affect bordering nations as well as the whole atmospheric system. Extracting and using fossil fuels emits wastes and Chloro Floro Carbons (CFCs) which affects the global climate.[13]

Energy production and use have linked to environmental concerns. Air pollution, oil spills, and their impact on habitats are among the many challenges confronting government and the energy industry. However, the energy industry's primary source of international friction may revolve around the issue of global climate change, as amply demonstrated by the contentious debate over the cost and benefits of the Kyoto Protocol.[14] Some of the studies reveal that by 2020 energy consumption by the developing countries of the world is expected to exceed energy consumption by the developed countries. This may hold particular implications for the environment.

Bangladesh's indigenous fuels are, on average, very clean in terms of contents of sulphur and nitrogen. Natural gas known to be a high-grade fuel. It is thus expected that in terms of common energy related pollution Bangladesh would not fare badly. The major sources of pollutants are impurities laden imported liquid fuel and coal. In 1990-91 about half of the imported liquid fuel was refined in the only oil refinery of the country, the rest being imported directly as finished products. The scenario has changed somewhat by the year 1995-96 when about two-thirds of the imported liquid fuels came as finished product. Since the main subscriber of liquid fuel is the transport sector, non-point sources are the major pollutants for Bangladesh. It is no wonder that the air quality of the capital city Dhaka is one of the worst amongst the Asian cities, because majority of the vehicles concentrate in the largest city and the economic heart of the country.

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[13] *An Overview of Environmental Concerns in Energy Development*, (Kathmandu: Water and Energy Commission secretariat, 1995), p 2.

[14] Atiq Rahman etc., *Development and Climate Change: Bangladesh Country Case Study—Phase I*, in http://www.developmentfirst.org/studies/BangladeshCountryStudies.pdf

Some of the important environmental issues related to energy sector in Bangladesh can be identified as follows:

- Deforestation to satisfy rural energy requirements has caused problems of flooding, soil erosion and siltation in many areas.
- The use of livestock manure for fuel in rural areas deprives the soil of natural fertilizer and leads to nutrient depletion and the loss of soil organic matter.
- There has been reluctance for alternative renewable rural energy resources to be developed (such as solar, wind and micro-hydropower) and the technological base in Bangladesh for developing such sources is inadequate.
- Energy conservation awareness is generally low throughout the country.
- Flat commercial rates for natural gas encourage wastage of the resource.[15]

In Bangladesh when it comes to use of energy the major source of pollutants are impurities laden imported liquid fuel and coal.[16] Since the main subscriber of the liquid fuel is the transport sector, it is one of the major pollutants. Most of the rural people in Bangladesh and for majority of Bangladeshis the main source of fuel is biomass. Use of forest resources like fuel wood and its emissions are creating concerns about the increasing level of environmental pollution. The major source ensuring energy security for majority section of the population i.e. fuel wood, is on its way of depletion at a faster rate threatening the energy supply for the future.

Energy and environment are essential for sustainable development. Environmental degradation and lack of access to clean affordable energy services disproportionately affect the poor. These issues are also global as climate change, loss of biodiversity, and ozone layer depletion cannot be addressed by countries acting alone. In Bangladesh, United Nations Development Programme (UNDP) helps strengthen capacity to address these challenges at global, national and community levels by seeking out and sharing best

[15] Philip Gain, (ed), *Bangladesh Environment Facing the 21st Century*, (Dhaka: Society for Environment and Human Development, 2002), p 179.
[16] Ahsan Uddin Uddin, *Energy and Sustainable Development in Bangladesh*, (Dhaka: Bangladesh Unnayan Parishad, 2002), p 18.

practices, providing innovative policy advice and linking partners through pilot projects that help poor people build sustainable livelihoods.

At the global level, Bangladesh is a strong supporter of international agreements aimed at environmental protection. UNDP supports national capacity building for compliance with these global conventions and regulatory regimes, as well as national participation in global funding mechanisms for environmentally sustainable development. As a result the nation has already slashed the production of the ozone depleting CFCs by 60 percent and is now on target to meet commitments under the Montreal Protocol.[17] In addition UNDP is supporting the Government to integrate global environmental concerns and commitments into national development planning and policy.

At the national level, following the Rio Earth Summit, UNDP assisted the Government to identify and prioritize environmental concerns, which included management of natural resources, and protection as well as the regeneration of biodiversity unique to Bangladesh. Out of that exercise came the comprehensive Sustainable Environment Management Programme (SEMP), which was the first national attempt to target critical environmental challenges through one umbrella programme, which works at the policy as well as the community level.[18] Also at the national level, UNDP is supporting the Government to improve disaster management, enhance food security, strengthen national capacity for environmental policy and legislation development as well as fosters strategic partnerships and coordinate with other donors.

**Renewable Energy and Energy Security**

One of the major objectives of the National Energy Policy (NEP) has been to ensure the optimum development of all the indigenous energy resources (e.g. commercial fuels, biomass fuels and other renewable energy sources.[19] Renewable energy can help in tackling the problems of poverty, energy shortage and environmental degradation such as

[17] Rahman, n 11.
[18] http://www.undp.org/seed/energy/chapter2.html.
[19] Government of People's Republic of Bangladesh, *National Energy Policy*, (Dhaka: Ministry of Power, Energy and Mineral Resources, May 2004), p 40 as in http://www.petrobangla.org/

desertification, energy insecurity, biodiversity depletion and climate change effects in Bangladesh.[20] In most of the remote places of Bangladesh and in some islands there is too much scarcity of energy. Therefore it was decided to provide energy to these remote areas through renewable energy technologies.

From the long term perspective of energy security of Bangladesh it is very significant to apply and use renewable energy in larger quantities. Because the largest commercial energy source in Bangladesh i.e. natural gas is going not going to last for centuries. The extent of biomass resources are also on the verge of exhaustiveness due to decrease in forest cover. In order to extend the availability of energy resources in the near future now it has become a compulsion to encourage and develop renewable energy sources in Bangladesh.

The Bangladeshi government is keen on investing on modern and cleaner technologies for electricity generation, which received impetus from the NEP. But there has not been any appreciable investment in clean technologies (both renewable and cleaner) between 1990-91 and 1995-96. Since 1996-97, with donor assistance, the government of Bangladesh has taken pilot project to offer solar power to about 1100 families in a riverine (char) island, an area which was otherwise deprived of grid-based electricity due to its remoteness.[21] The initial success prompted to extend the idea and provide solar-based home systems in other island areas where grid system cannot be extended economically. A total of about 2000 families are now enjoying solar-photovoltaic system based electricity services.[22]

Again in 1995-96, the government carried out a study on possibilities of harnessing wind power, especially from the coastal areas. The wind velocity was found to be erratic and unsuitable for continuing operation of conversion into electricity through wind turbines. The reliable wind speeds at suitable heights in a number of locations were found to be

[20] Md. Amzad Hossain, *Renewable Energy: the Panacea for Village Bangladesh*, as in http://www.itee.uq.edu.au/~aupec01/052%AUPECol.pdf
[21] Ibid.
[22] Ibid.

less than the threshold values and future of development of wind energy has virtually been shelved thereon.

The government is now contemplating to extend the capacity of the only hydro electricity plant located in Kaptai lake area. The uncertainty of relocation of many adversely affected families and other socio-cultural and environmental aspects make the proposal particularly unsuitable for the country, despite potential for high financial returns.

Although it is enshrined in the National Energy Policy (NEP) that higher emphasis will be given on the promotion of renewable energy technologies very little has been done in the past. Two separate projects on promotion of solar photovoltaic electricity supply systems for individual households in remote rural areas have been taken between 1990 and 2000 and about 2000 households have been brought under the project with solar lights. But in both the cases the units are subsidized heavily because otherwise the initial investment costs appear to be much higher than the 'willingness to pay' of the poor customers for the energy services. The photovoltaic chips are promoted and despite repeated plea to the government by the environmental advocacy groups, the government did not relax its import duties and other value added taxes and tariffs on those items. As a result the photovoltaic systems could not be promoted.

Table 4.1

**Potential Renewable Energy Sources in Bangladesh**

| Renewable Source | Advantages | Disadvantages |
|---|---|---|
| Wind Power* | -Very feasible due to steady winds<br>-Clean<br>-724 km coast<br>-Many small islands | -Limited to parts of Chittagong valley, Cox Bazaar, the coast and Bay Islands<br>-Cost |
| Solar power* | -Plentiful<br>-Clean<br>-Easy to use in rural areas and decentralized areas. | -Expensive |
| Hydroelectric power | -Possible<br>-Clean<br>-One existing dam | -Limited location<br>-Limited by seasons |
| Tidal power | -Coastal country | -Navigation Problems<br>-Limited to channels inside Sunder bans area<br>-Cost |
| Nuclear power | -Feasible<br>-Clean | -Disposal issue<br>-New equipments<br>-Cost |
| Biomass (Dung) | -Biogas feasible<br>-Easy to use in rural areas and decentralized areas. | -Conservation |

*Most feasible options, research is currently being done.
Source: http://www.bu.edu/cees/classes/binna/304/energy_profiles/bangladesh.htm

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 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.[23] However, other biomass fuels, such as animal dung, will be used as they traditionally have been and will increase in the future.

If we look at Bangladesh from an energy use and environmental perspective, it needs to look for other sources of energy besides biomass fuel from agricultural resources, tree residues, fuel wood and dung. At current rate of biomas 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.[24] The use of biomass is also extremely detrimental to the environment. The forest cover has been reduced from 15.6% to 13.4% between 1973 and 1987.[25] Some reports state that the present forest cover is less than 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%.[26] In 1995-96 the forest cover of the country was 13.6%.[27]

*Wind energy* has a lot of potential to be harnessed for power generation in Bangladesh. The *wind resource* in the country is still to be adequately mapped and the process has been started only within the last few years.[28] Several small wind generators have been installed and several pilot programmes are underway.[29] Although wind energy has not been fully explored, it has the potential to be a source of decentralized energy for Bangladesh.

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[23] http://www.bu.edu/cees/classes/binna/304/energy_profiles/bangladesh.htm
[24] http://www.bu.edu/cees/classes/binna/304/energy_profiles/bangladesh.htm
[25] Hossain, J., "*Optimising Use of Bangladesh's Gas Resources*", (Dhaka: The Centre for Policy Dialogue, 1999), in www.cpd_bangladesh.org/report14.PDF
[26] http:/, n 18.
[27] Government of the People's Republic of Bangladesh, n 4, p 160.
[28] M.A.R. Sarkar etc., "Issues Relating to Energy Conservation and Renewable Energy in Bangladesh", *Energy for Sustainable Development*, Vol.VII, No.2, June 2003, p 83.
[29] Hossain J., n 19.

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 percentage of the population dwelling in rural areas.[30] Solar energy is environmentally sound and Bangladesh gets an abundance of solar radiation for solar energy applications. The daily average solar radiation varies between 3 and 6.5 kWh/m2.[31] The monthly variation shows that the period February to June gives excellent insolation over Bangladesh, followed by reasonably good sunshine during September and October. Despite having a long rainy season, the conditions for solar energy application in Bangladesh are very good throughout the year. Although there are good prospects for solar photovoltaic systems, potential market development has limited it in practice. The government, private sectors, and non-governmental organizations are taking steps toward initiating development of solar energy utilization.[32]

The production of renewable energy can create economic development and employment opportunities, especially for rural people, that otherwise have scanty opportunities. Renewable energy can thus help villagers achieve self-reliance through increased productivity. It would also reduce pressure upon urban migration. It is a regular phenomenon that many rural poor and unemployed go to cities to work and live there.

**Gas Export and Energy Security**

Generally speaking, gas resources are non-replenishable (sometimes called nonrenewable or exhaustible resources) and non-recyclable.[33] The extraction of these types of resources imposes an intergenerational externality. Because if we extract or abuse too much today little or none will be there for tomorrow's generation. Moreover, common property is a property that is owned by all; nobody in a country can be excluded from the ownership and authority over that property. Natural resources like gas are a common property owned by the people of Bangladesh.

[30] www.eia.doe/emeu/cabs/bangla.html
[31] M.A.R. Sarkar etc, n 28.
[32] Hossain J., n 25.

Gas export has remained an issue of contention ever since a number of gas fields were discovered by Petrobangla, along with the involvement of the International Oil Companies in the late 1990s.[34] Disagreements over the issue of gas exportation differ on various levels. Gas export has remained an issue of contention ever since a number of gas fields were discovered by Petrobangla, along with the involvement of the International Oil Companies in the late 1990s. Disagreements over the issue of gas exportation differ on various levels.

Export is an important part of global economic activities today. But it would be naive to think that any export can ensure growth whether export would contribute positively or not to the economy depends on various factors: 1) what is being exported at what cost ? 2) Who are really taking the benefits ? 3) What is happening with revenue ? and 4) what are the linkage effects ? This is obviously unwise and illogical to oppose export of something i) which add more value than utilizing within the country, ii) export of which has less opportunity cost and iii) which by being exported would help other sectors of the economy by bringing in foreign exchange and expertise etc and iv) it would be either environment friendly or non damaging.

Again it would be unjustified economic act and considering collective interest it would be a criminal act to go for export of any good. These happen under following situations. i) Real export earning of which is much less than it's potential to earn much more within the country, ii) if its export has huge opportunity cost, iii) if by being exported it would damage the potential of productive growth of other sectors within the country and iv) Export of which might be environment-disastrous for the country as a whole.

The success of the natural gas exploration efforts of Petrobangla and the International Oil Companies (IOCs) has created an enviable policy debate for Bangladesh, one that many developing countries would love to have. How best to develop and use a probably

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[33] Anu Muhammad, *Anti-development Global Coalition and the Question of Fueling the Economy with Gas Resources*, in http://www.e-mela.com/lekha/gas_condition_Anu022102.html

[34] Nawrin Samrina, *Energy Security for Bangladesh: Prospects and Strategic Implications of Natural Gas*, in http://www.acdis.uiuc.edu/homepage_docs/pubs_docs/PDF_Files/Samrina/contents/part1.html

abundant natural gas resource ? The issue of gas export has remained a subject of public debate in Bangladesh. Part of the debate is driven by the pathology of the domestic dialectic governing Indo-Bangladesh relations.

We have already observed that vast differences prevail in estimates of the gas potential of the country. Uncertainty over reserve estimates hampering, delaying and jeopardizing natural gas export process. Different studies reveal varied kinds of reserves. According Intercom Kanata Management Ltd. (IKM) study the gas initially in place and recoverable reserves in Bangladesh are 24.745 TCF and 15.51 TCF respectively. The Bangladesh University of Engineering and Technology (BUET) study shows the Gas Initially in Place (GIIP) and recoverable reserves as 28.49 TCF and 24.401 TCF respectively. As per the Shell study the estimation of total resource base of the country is 38 TCF. The results of Unocal Bangladesh Ltd. (UNOCAL) study show the existing reserves of Bangladesh as 16 TCF.

In the past, the Bangladesh government has tried to obscure the issue by inflating projections of future domestic demand. In an interview a Western diplomat said, "One way of not dealing with this issue is to pretend you really don't have so much gas in the first place. They don't trust themselves, they are afraid of becoming another [corruption-riddled] Nigeria."

When look at the case of Nigeria, a big oil exporting country from an energy export point of view that appears to be the worst case of the whole scenario. In Nigeria, not only rate of growth but also absolute per capita Gross National Product have been sliced less than half between 1980 and 2000, from US$870 to US$310.[35] According to Jeffrey Sachs, Nigeria spent five times its public health budget on debt servicing in 2000.[36] In that 'oil exporting' country 42.8 per cent of people were below the national poverty line in 1992, by now it reached to 65.6 per cent.[37]

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[35] Anu Muhammad, n 33.
[36] Ibid.
[37] Ibid.

Interestingly, the two main political parties of Bangladesh—the Bangladesh Nationalist Party (BNP) and the Awami League (AL)—only vehemently oppose export while they are in the opposition, in order to gain popular support. Prime Minister Khaleda Zia's Bangladesh Nationalist Party opposed gas exports while it was in opposition from 1996 to 2001. After forming the new government in October 2001, the BNP lawmakers in a number of public statements demonstrated subtle indications of a possibility of gas exportation if needed. In an interview given to BBC, Bangladesh's Energy Minister, Mosharraf Hossain, commented that "if exporting is found to be economically beneficial, the government will definitely decide to allow it."[38] Finance Minister Saifur Rahman also stated that the administration of Prime Minister Zia might go for natural gas export "provided that it is beneficial for the country" and that "no resource in the true sense is a resource if it remains under the soil."[39] These indications have come under tremendous pressure from the general people and the government has now declared that the country should first be assured of fifty years of reserves before any decision on export is taken. The government also believes that domestic use of natural gas is far more beneficial for the Bangladeshi people as consumers than exportation, because this is the cheapest source of energy for the country.

The people who are arguing against export of natural gas are of the opinion that the size of the domestic resource is really not well known, and in any case still very modest, so that any dedication of gas export is premature. There is a risk that export would hasten domestic shortage. Export opponents point out that Bangladesh has a limited geographic region with natural gas potential and that expansion of reserves, even with substantial further exploration, may not occur. Also, if Bangladesh does not start to run out of natural gas, it has less ability than do wealthier countries, like the US or Canada, to develop or

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[38] Walliur Rahman, "Bangladesh Edges toward Gas Export," *BBC News*, October 31, 2001, http://news.bbc.co.uk/hi/english/world/south_asia/newsid_1630000/1630925.stm

[39] "Bangladesh in Debate over Natural Gas Export," Alexander's Gas and Oil Connections, *News and Trends: East and Southeast Asia*, Volume 6, Issue 24, December 19, 2001, http://www.gasandoil.com/goc/news .

purchase other sources of energy. This is especially so if alternatives involve significant imports.

In another instance some others argue that, even if the domestic resource is found to be plentiful, natural gas is so valuable that all of it should be devoted to domestic use and domestic economic development, even if that use is far in the future. Revenue from exports can never compensate the foregone benefits of domestic use.

Others argue that exports of natural resource endowment are dangerous for a developing country like Bangladesh. Unless carefully managed—which means public debate over appropriate institutions for regulating the sector and for spending the revenues arising—the natural gas may do little improve lives of the country's citizens. There are unfortunate examples of other countries, in similar circumstances, that have squandered the possible benefits from resource export through mis-investment, corruption, and poor negotiations with IOCs. Mismanaged rapid resource development may trigger higher inflation, and may distort wages and prices in sector or region that experience a rapid increase in demand. It may be better to develop the resource slowly and strictly for domestic use, thereby minimising possible negative effects from misused revenues arising from rapid export-led development.

Mohammad Tamim of BUET while taking into consideration sensitivity and public concern in Bangladesh about export of gas illustrated;

> "the basic problem was that gas as an export commodity was a new concept to the general public. The fear in the public was two-fold: one is that since it is as exhaustible resource, we cannot regenerate it once we have exported. The other problem is the lack public confidence in our financial system which makes the possibility of a huge amount of liquid money to be generated in the system a frightening notion for the public who fear gross mismanagement of the accrued funds. The root of the problem lay in the political arena. The focus should be on getting back public confidence in the nation's financial and political system".[40]

One argument given in support of gas export by its proponents, which is also behind the concept of limited gas export, is that International Oil Companies have to be paid for their gas if gas export is not allowed and that is to be paid, according to the terms and conditions of the Production Sharing Contracts (PSCs), in foreign exchange at international prices. However, the following arguments do show that there are genuine alternative ways of raising the funds, which will serve national interest admirably.

In Attachment B (3), Annex 18 to the report on gas utilization, it has been shown that the annual payment to be made to the IOCs is of the order of US$ 150 to 200 million.[41] The report has suggested that "these financial obligations, both in terms of domestic revenues and foreign currency outflows, are bearable and, therefore, affordable. It has, therefore, been recommended that all IOC gas could be purchased and [the committee] sees no reason for the IOCs to complain".[42] Indeed, if the IOCs get paid, there is no financial reason why they should not come forward and invest resources in further explorations under equitable agreements which will need to be negotiated.

Another argument offered in favour of gas export is that electricity generation capacity needs to be increased obviously gas-based, of which scope exists to expand the availability of electricity from the current 20 per cent of the population. Gas export would provide the financial resources to do that. But the export of gas from the current supplies will reduce the number of years for which gas will be available say, from around 15 years down to 10 years or less. What will then happen to the gas-based electricity generation capacity in the country? Gas import does not appear to be a feasible option because the country is unlikely to achieve financial capacity in 10 years time to import substantial quantities of gas on a secure basis. Also there is the question as to where gas would be imported from. Hence, given that 85 per cent of the currently generated electricity is gas-based, the proposed expansion programme to be funded by export of gas, the country

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[40] Azim Uddin Ahmad, *Changes and Challenges: A Review of Bangladesh's Development 2000*, (Dhaka: University Press Limited, 2001), p 298.
[41] Report No.24, *Bangladesh Gas Sector Development: Status, Policy Options and Challenges*, (Dhaka: Centre for Policy Dialogue, May 2000), p 163.
[42] Ibid.

will, in the absence of availability of gas plunge into darkness. This will not actually lead to expanded availability of electricity, initiating a downward economic and social slide.

M. Asaduzzaman while remarking on natural gas export in the context of energy security enumerates;

> "As such, if we decide to export gas and earn money there is no harm in that except that there shall have to be enough of it for our own development by meeting our own increasing energy and non-energy needs. But, if the sale to a foreign country is contemplated because Bangladesh cannot purchase its own gas and the money from the sale goes to a foreign company, the question naturally arises as to why we should develop the gas field in the first place? If we ourselves develop the gas fields and decide that there is an exportable surplus, then we shall sell it to whosoever, neighbours not excepting, will give us the best economic deal above the minimum asking price.... The development of the energy sector has to be an integrated one, integrated over forms of energy, pricing and timing, keeping in view the various development needs of the country. After all gas is a primary commodity. The more value we add to it (by transforming it into another commodity) before it is exported, the better are such developments needs fulfilled"[43]

Now, India is the only practical market for the gas, which could be distributed through pipelines. At the same time, Bangladesh's relations with India are very problematic. India literally encircles Bangladesh on three sides, border skirmishes are common, and the two constantly tussle over important issues, such as shared waters and cross border migration. New Delhi enjoys a huge trade surplus but is still a niggardly negotiator, feeding a perception in Bangladesh that the behemoth of the subcontinent is a bully.

To further complicate matters, Bangladesh's government has declared that there can be no gas exports until 50 years' worth of domestic supply is assured. In a rare display of unanimity, the country's two major political parties agree on this point. But this ill-defined target has created a catch-22 situation: The only way to prove that more reserves

[43] M. Asaduzzaman, "Energy Security of Bangladesh: Issues, Perspectives and Prospects, in Mohammad Humayun Kabir", (ed), *National Security of Bangladesh in the 21st Century*, (Dhaka: Academic Press and Publishers Limited, 2000), p 137.

exist is through more exploration, but no further exploration can occur unless the multinational energy giants are assured that they can export the gas.[44]

Some other arguments based upon which the gas export has been opposed are as follows:
1) Natural gas in Bangladesh is not proved to be sufficient, far less than abundant, when one look at the present and potential demand of gas within the country
2) The export will be environmentally disastrous. Since export requires more exploitation of natural gas more drilling activities will be carried out which results in land degradation.
3) By exporting natural gas Bangladesh will fall into trap of more spending in foreign exchange on importing petroleum goods, power, fertilizer and other gas-related goods.
4) Regarding the economy of gas export, taking the Unocal proposal as an example, the country's earnings are a projected US $3.7 billion, but it will take twenty years to earn. When the country's annual export income is over US$ 6 billion, annual income of US$ 160-185 million from gas will not be very impressive.[45]

**Energy Conservation and Energy Security**

Energy consumption is linked with economic growth. In Bangladesh the growing need for energy is mainly due to two factors, first is the growth in population and second is the need for improving the standard of living of the people. The latter calls for rapid and intensive industrial activities to satisfy the needs of the people.[46] There is good potential for reducing energy demand through conservation measures (introduction of efficient technologies and better management practices) in all the end-use sectors: domestic industrial, commercial, transport and agriculture.[47]

Slowing the growth of energy consumption by means of rational conservation measures can save a great deal of money. Although technological improvements to increase energy efficiency often require some additional capital investment over conventional practice,

[44] Anu Muhammad, n 33.
[45] Unocal Corporation, *Bangladesh-to-India Natural Gas Pipeline*, http://www.unocal.com/globalops/
[46] P.C. Sinha, (ed), *International Encyclopaedia of Sustainable Development Vol. 18: Energy Crisis*, (New Delhi: Anmol Publishers Private Limited, 1998), p 225.

that investment is usually less than the investment that would be needed to produce from new sources an amount of energy equal to that saved.[48] In this sense, conservation is the cheapest new energy source.

In Bangladesh efficiency in energy production and supply has remained a critical issue for a long time. Unfortunately, these issues have so far remained neglected. Efficiency in distribution particularly in electricity is more troublesome than production efficiency.[49] Of the net generation much is lost in transmission and distribution. Some are technical loss and the rest called non-technical loss is actually pilferage in one form or the other.[50] Because of the sensitivity of the issue, the authorities have been trying to reduce it to manageable proportions but so far without much success.

In Bangladesh, the conservation programme was initiated in 1984 with the establishment of the Energy Monitoring Unit (EMU), which was later named Energy Monitoring and Conservation Centre (EMCC) under the Ministry of Energy and Mineral Resources. Considering the importance of the industrial sector in the national economy and heavy dependence of the industrial sector on commercial energy sources, the activities of the EMU have been concentrated on energy conservation in industries and the power sector.[51] Various technical assistance projects have been undertaken by EMCC to assess the energy conservation potential and to strengthen institutional capacities. Most of them were sponsored by International Development Agency.

During the period from 1988-1993, EMCC implemented a technical assistance project with a grant from the Overseas Development Assistance (ODA), UK. The project was aimed at undertaking energy auditing in selected industries and to train the professionals of the EMCC. The Task Force Report of 1991 projected energy demand at five intervals

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[47] M.A.R. Sarkar etc., n 28, p 80.
[48] S.K. Shukla, P.R. Srivastava, (eds), *Environment Energy Impact Analysis*, (New Delhi: Commonwealth Publishers, 1992), p 165.
[49] Q.K. Ahmad, (et al), *Resources, Environment and Development in Bnagladesh: With Special Reference to the Ganges, Brahmaputra and Meghna Basins*, (Dhaka: Academic Publishers, 1994), p 87.
[50] Ibid.
[51] M.A.R. Sarkar etc, n 28, p 80.

up to the year 2010.[52] It envisages two scenarios: with and without conservation. The information has been enlisted in the following table.

Table 4.2

**Total projected energy demand for selected energy sources with and without conservation: Bangladesh 1995 to 2010**

| Year | Conservation Strategy | Gas (MMCF) | Electricity (GWh) | Agricultural Residue (000 Tons) | Wood fuel (000 tons) | Animal dung (000 tons) |
|---|---|---|---|---|---|---|
| 1995 | Without | 139000 | 10044 | 27694 | 9836 | 6339 |
| | With | 133490 | 9764 | 25269 | 9124 | 5831 |
| | Savings (%) | 3.96 | 2.79 | 8.76 | 7.24 | 8.01 |
| 2000 | Without | 198000 | 19106 | 30775 | 10733 | 6662 |
| | With | 188100 | 18164 | 26780 | 9329 | 5248 |
| | Savings (%) | 5.00 | 4.93 | 12.98 | 13.08 | 21.22 |
| 2005 | Without | 233000 | 28382 | 32931 | 11447 | 7000 |
| | With | 221330 | 27236 | 27296 | 9496 | 5600 |
| | Savings (%) | 5.01 | 4.04 | 17.11 | 17.04 | 20.00 |
| 2010 | Without | 265000 | 40400 | 35756 | 12326 | 7200 |
| | With | 252150 | 38868 | 28130 | 9611 | 5400 |
| | Savings (%) | 4.85 | 3.79 | 21.33 | 22.03 | 25.00 |

MMCF = Million Metric Cubic Feet
GWh = Giga Whatt
Source: Adapted from Task Force Report (1991, pp 116-124), as in Mohammad Alauddin and Clement Allan Tisdell, *The Environment and Economic Development: An Overview Concentrating on Bangladesh*, (Hampshire: McMillan Press Limited, 1998), p 183.

An examination of the table suggests that greater reliance on saving biomass energy sources as the key element in the energy demand projection model. Given Bangladesh's

[52] Mohammad Alauddin, Clement Allan Tisdell, *Environment and Economic Development in South Asia: An Overview Concentrating on Bangladesh*, (Hampshire: McMillan Press Limited, 1998), p 183.

limited landmass and growing population, the pressure on biomass supply will tend to increase. In order to undertake regulatory measures so that to implement energy conservation, the EMCC took the initiative in May, 1992 to formulate the National Energy Conservation Act and have it adopted.[53]

The domestic and industrial sectors use only a small fraction of natural gas consumption. Thus the prospects for gas conservation is unlikely to be bright if one were to concentrate primarily on these sectors. The bulk of the gas consumption is accounted for by fertilizer production and electricity generation. Unless production efficiency in these gas sectors gas conservation on a significant scale is unlikely to happen.

**Other Concerns**

Management of gas reserves and deciding whether and under what conditions to export it has been a difficult issue for many governments. Each of the successful countries export some gas to create resources that could be used right away to improve the lives of their people, rather than holding it all in reserve for extended periods. Some dealt with the tradeoff between present and future needs by establishing a required reserves-to-production ratio (R/P). Because production frequently results in expanded reserve estimates as the existing fields are better explored, countries adopting this approach have generally loosened their policy over time, either by considering other factors besides the R/P ratio or by reducing the number of years' reserve they insist on holding.

Based on the consistent experience of countries that have reorganized their energy sector, Bangladesh would benefit by reorganization of its current government energy institutions. At present, Petrobangla, the government gas monopoly, is involved in policymaking, regulation, and several different aspects of operations. It is also involved in negotiating concessions. The "unbundling" approach used in Bolivia and Argentina, coupled with a new, independent regulatory function separate from gas operations would be a suitable goal. This represents an enormous change, so a phased program would be appropriate. A first step would be to separate operational from policy and regulatory

[53] M.A.R. Asarkar etc., n 21, p 81.

functions, together with completing the planned spin-off of transmission functions to the Gas Transmission Company Ltd. and its separation from distribution. Petrobangla would give up its role in gas operations and its monopoly of gas purchases, and would concentrate on coordination and regulation, both of them key functions especially during the transition period.

Another issue related to energy security in Bangladesh is feasibility of using nuclear energy for its energy security. Some nuclear scientists are of the view that Bangladesh is basically an energy-starved country. The main fuel source in the country for producing electric power is natural gas. There is some coal and very limited hydro-electricity. It is known fact that conventional sources even if more gas and coal are discovered, will be exhausted soon. Then it has to depend on imported fuel for production of electricity.

The argument that is put forward in favour of nuclear power generation is that it is environmental friendly. Nuclear power stations do not emit Green House Gases. Bangladesh Atomic Energy Commission (BAEC) is actively engaged in developing possibility electricity through nuclear power stations. Supporters of nuclear power stations hold the view that in order to achieve energy security as envisaged in National Energy Policy (1996), all options for the production of electricity have to be kept open.

Thus it is clear that energy is a crucial national issue, and natural gas is an invaluable resource. The poverty-ridden country of Bangladesh, which is still struggling hard with its development, cannot afford to make mistakes regarding the utilization of natural gas. At present the whole country is intensely focused on this debate, but the solution to its long-term energy security does not depend only on the decision of whether or not to export. Whether it exports or not, Bangladesh is going to run out of conventional natural gas anyway, either within twenty years, or at best within fifty years. The country should focus more on its long-term energy security. The export decision should be a part of the country's broader energy policy.

# CHAPTER V

# ENERGY SECURITY IMPLICATIONS FOR BANGLADESH

# *Chapter V*

# ENERGY SECURITY IMPLICATIONS FOR BANGLADESH

Bangladesh offers an excellent case-study of a transitional economy. At the time of independence in 1971, it inherited an economy of mostly public enterprises with a few private ones. Key monetary and strategic sectors such as banking, telecommunications, power and energy were nationalised in the early seventies and run as state monopolies.

Bangladesh today is at a critical juncture in its move towards an open market economy. Some key sectors that have traditionally been kept under state control are being gradually liberalised. After opening up the banking sector, initiatives to allow private participation in the energy sector were taken in the early 1990s. As a result of the 1993 Petroleum Policy independent power generation was allowed for the first time in the country, and four production sharing contracts were signed with multinational oil companies for gas exploration.[1]

In the past energy development programme suffered long term perspectives. Decision-making in energy sector projects in particular was influenced by the donor assistance and political parties own agendas. In some cases, projects have remained heavily underutilized due to lack of synchronisation of implementation of schedule. As a result the nation suffered immensely and the country submerged into an energy crisis. The shortcomings of the energy sector may have far reaching implications for energy security of the country. Here analysis of each and every issue and their implications on energy security becomes foremost task.

[1] M. Tamim, "Policies and Priorities in Gas Sector Planning", *Energy for Sustainable Developemnt*, Vol.7, No.2, June 2003, p 57.

**Implications of Gas Export**

It is being argued with good reason that export of gas would not be in the national interest of Bangladesh. The question tagged to this issue is one of quantum and the country's own short-term as well as long-term requirement. It must never be forgotten that natural gas is a non-renewable energy source and perhaps the country's only resource of great value. Proven and provable resources alone, should last including incremental demand at least quarter of a century.[2] With more sophisticated techniques and satellite imaging available now, it is possible not only to extract more from a particular field but also to gather more information about its potential. This factor alone should considerably enhance the potential of existing gas fields under Petrobangla.

Commenting about export of natural gas, Mohammad Nurul Islam of Bangladesh University of Engineering and Technology (BUET) says that;

> "Any decision to export from known reserves of natural gas will affect the energy security of the country, so necessary sustainable human development. In that case in future years the country may have to re-import natural gas to meet its long-term energy demand. From the long-term perspective, the net economic gain for the country from the export of gas will be far less in comparison to its indigenous use. It is advisable to conserve natural gas to ensure long-term energy security for the country".[3]

Although there is a tremendous pressure on Bangladesh to export gas to India in particular none of the two major political parties, Awami League and Bangladesh Nationalist Party, seem to be agreed on exporting natural gas immediately. The then Prime Minister of Bangladesh Sheikh Hasina told the US president Bill Clinton during his visit to Bangladesh in 2000 that Bangladesh would be willing to export gas only after the country has guaranteed meeting of domestic demand for 50 years.[4]

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[2] *Report No.24 – Bangladesh Gas Sector Development: Status, Policy Options and Challenges*, (Dhaka: Centre for Policy Dialogue, May 2000), p 162.

[3] Asit K. Biswas, (et al), *Contemporary Issues in Development*, (Dhaka: Academic Press and Publishers, 2002), p 63.

[4] Philip Gain, (ed), *Bangladesh Environment Facing the 21st Century*, (Dhaka: Society for Environment and Human Development, 2002), p 168.

Thus when it comes to the question of export, Bangladesh is over-conscious about the security of supply to meet the future demands. No one is sure about the authenticity of the estimated reserves. That is why there is fear and ambiguity regarding the export of natural gas. Besides there are allegations that secret attempts have so far been made by the International Oil Companies (IOCs) in connivance with local bureaucrats and vested interest groups to export gas in the mode and manner designed by external forces behind the curtain. All these complicated the export process, which otherwise now in the name future energy security has been withheld.

**Depleting Natural Resources**

Natural resources are both renewable and non-renewable in nature. The most abundant natural resources in Bangladesh are non-renewable in nature. The advancement of technology has made it possible to estimate the reserve in precision and to recover the more potential reserves. No doubt that the present reserves are fixed and depletable. It is obvious that more one consumes the less would be the reserve, whatever may be the eventual volume of gas underground. Once this stock is depleted it is gone forever. Therefore in Bangladesh at present, once a particular gas field is exploited under Production Sharing Contract (PSC) at the rate of 7.5 per cent of the discovered reserve annually the present stock will not last for long time.[5]

Table 5.1

**Annual Depletion of Existing Reserves and Required Replenishment of Reserve**

| Year | Daily Demand (MMCFD) | Annual Consumption (BCF) | Cumulative Production (BCF) | Remaining Reserve (BCF) | Replenishment (BCF) |
|---|---|---|---|---|---|
| | - | - | - | 9030 | - |
| Jan-Jun'99 | 884 | 161 | 161 | 8869 | - |
| 1999-00 | 948 | 346 | 507 | 8523 | - |
| 2004-05 | 1454 | 531 | 2761 | 6269 | - |
| 2009-10 | 1915 | 699 | 5894 | 3136 | - |
| 2010-11 | 2031 | 741 | 6635 | 2395 | - |
| 2011-12 | 2156 | 787 | 7422 | 1608 | - |
| 2012-13 | 2290 | 836 | 8258 | 722 | - |
| 2013-14 | 2436 | 889 | 9147 | -117 | 117 |
| 2014-15 | 2593 | 947 | 10094 | -1064 | 1064 |
| 2015-16 | 2763 | 1008 | 11102 | -2072 | 2072 |
| 2016-17 | 2946 | 1075 | 12177 | -3147 | 3147 |
| 2017-18 | 3144 | 1148 | 13325 | -4295 | 4295 |
| 2018-19 | 3358 | 1226 | 14551 | -5521 | 5521 |
| 2019-20 | 3589 | 1310 | 15861 | -6831 | 6831 |

BCF = Billion Cubic Feet
MMCFD = Million Metric Cubic Feet per Day
Source: Petrobangla, as in *Changes and Challenges: A Review of Bangladesh's Development 2000*, (Dhaka: University Press Limited, 2001), p 171.

The forecast of depletion given in the above table would naturally vary on the basis of any change in gas consumption. The table shows Petrobangla's capability of meeting the country's accelerated gas demand up to 2013, even without further discoveries. But in order to ensure energy security the experts feel the reserves should last beyond 2013-14.

[5] Ahm Mustain Billah, Md. Abdul Aziz Khan, "Gas Extraction and Its Implications for Economic Sustainaility of Bangladesh", *The Bangladesh Development Studies*, Vol.XXVII, September 2001, No.3, p 7.

The reason for the depletion of the resources is increasing demand for power and fertilizer which are the largest consumers of natural gas.

From the table it is evident that the demand for gas will increase at faster rate till 2009-2010 after that there will be steady increase. But the recoverable reserve which at disposal of Bangladesh may not meet the demand requirement of the country for a long time. As the table shows after 2013 there will be scarcity of gas which is very necessary to meet demand requirements of power and fertilizer sector. Thus there will be an insecure energy position. This insecure energy position ultimately results in import of energy to meet the demands of power and fertilizer sector, resulting in increased power and fertilizer price which the Bangladeshis can't afford.

**Import Burden of Petroleum on Energy Security**

Despite the fact that the energy security of the country is maintained by biomass based traditional fuels and indigenous natural gas, the importance of the imported fuels increasing is day by day. Following the acceptance of the NEP by the parliament in 1995 a number of multinational companies have brought foreign direct investment for exploration of natural gas fields all over the country.

In 1990-91 the country's non-renewable energy imports amounted to about 97.5 Peta Joules (PJ), which increased to about 162 PJ in 1995-96.[6] It is expected that this trend will be observed till, perhaps, till 2005 and a reverse will be observed thereafter. If it does not happen then Bangladesh may adversely be hit.

Liquid hydrocarbons (crude oil) have not yet been discovered in any commercial quantities in Bangladesh. In course of routine drillings, only the Haripur - 7 wells were found to yield paraffin based crude oil. It was a 'non-eruptive' production, which started with an initial flow of about 600 billion barrels/day (bbls/day), but later went down to less than about 200 bbls/day.[7] The well was eventually closed, the production having been reduced to very insignificant yields. The natural gas of Bangladesh, however,

[6] Gain, n 4, p 172.

contains condensates, comprising of higher liquid hydrocarbons in the Motor Spirit (MS) and diesel fractions and are fractioned and used as such. However, the quantity of such indigenous liquid hydrocarbons is very insignificant, being in the range of about 10-12,000 Metric Tons /Year. To meet its demand of petroleum products, Bangladesh consumed in the range of about 2,500,000 – 3,500,000 tons of various petroleum products, over the last decade, i.e. on the average about 3,000,000 tons of petroleum products between 1994-95 – 2003.[8]

Table 5.2

**Unit price index of petroleum (Base: 1988-89=100)** (mega ton)

| Year | Unit Price Index |
|---|---|
| 1995-96 | 124.93 |
| 1996-97 | 132.30 |
| 1997-98 | 141.05 |
| 1998-99 | 148.05 |
| 1999-2000 | 139.93 |
| 2000-2001 | 189.61 |

Note: Units are mentioned as mega ton. Commodity terms of trade is obtained by dividing unit price index of export by unit index of imports multiple by 100.
Source: Government of the People's Republic of Bangladesh, *Statistical Bulletin Bangladesh*, (Dhaka: Bangladesh Bureau of Statistics, April 2003), p 101.

The table shows the extent of import of petroleum by Bangladesh. The imported petroleum used in household and transport sector. Even though it is not so high, decreasing energy reserves of the country supports the case for import of more petroleum which negatively affects the economy. So there is immense pressure on Bangladesh to develop alternative source of energy in order to avoid more import of petroleum products.

On the average, annually about 1.3 million tonnes of crude oil is imported, valued at about US$ 150 million, which is refined to various petroleum products in the only

[7] Atiq Rahman etc., *Development and Climate Change: Bangladesh Country Case Study—Phase I*, in http://www.developmentfirst.orrg/studies/BangladeshCountryStudies.pdf.
[8] Ibid.

refinery – Eastern Refinery Limited (with a design capacity of about 1.5 million tons/year).[9] Apart from crude oil to meet the demand of deficit products – primarily diesel and kerosene (transport, agro, rural lighting use), about 1.7 million tons of refined petroleum products are imported from abroad, valued at an average US$ 266 million. This puts annually a total import burden of an average of about US$ 416 million/year on Bangladesh's hard-earned foreign currency. Since external dependence on energy have national security implications, higher imports of petroleum products are not wished for in the interest of national and energy security.

**Low Efficiency Energy Use with High System Loss**

One of the major aspects that offers both challenges and opportunities to secure energy supply from Bangladesh on the long run, is the current low levels of efficiency, as well as high system losses, at which the conventional energy sources are being used – both in primary fuel use and electricity sectors.

An International Development Agency (IDA) financed study, conducted in 1984/85 (Energy Audit) identified and quantified the low level of efficiencies at which large public sector units in the industrial, fertilizer and power sectors are operating. Most industrial boilers and furnaces in Bangladesh, as sampled through energy efficiency measurements in 47 such large public sector industries (fertilizer plants, jute and cotton mills were found to be operating with efficiency levels lying 8% below (on the average) of their rated name plate efficiencies.[10] Energy Efficiency Improvement Options (EEIOs) can be suggested for the following sectors as recommendations:

- Fertilizer Plants (furnaces, boilers, turbines, e-motors, insulation/trap losses)
- Power Plants (furnaces, boilers, turbines, e-motors, insulation/trap losses)
- Sugar Mills (furnaces, boilers, turbines, steam use insulation/trap losses)
- Jute Mills (boilers, e-motors, steam use, insulation/trap losses)
- Cotton Mills (boilers, e-motors, steam use, insulation/trap losses)

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[9] Ibid.

[10] Ahsan Uddin Ahmed, *Energy and Sustainable Development in Bangladesh*, (Dhaka: Bangladesh Unnayan Parishad, 2002), p 16.

- Glass and Ceramic Industries (furnaces, e-motors, process, insulations)
- Tea Factories (burners/dryers, e-motors, process, insulations)[11]

The EEIOs aims at most efficient use of available energy through various combinations of energy efficiency components. The objectives behind carrying out this is to cover loss reduction, load management, plant operational improvements, better operating procedures, energy-enterprise management and institutional strengthening.[12] Energy efficiency also aims to reduce dependence on imported energy, especially oil. In Bangladesh even though there has been efforts to achieve energy efficiency at the most possible level, the programmes has been constrained by lack of information, technologies and incentives, unavailability of conservation services, lack of the necessary pressures to avoid wasting resources.[13]

In the days when the energy resources all over the world are depleting at an alarming rate it is evident to pursue energy efficiency techniques in order to secure some energy for the future so that energy security is there for the time being. In this context the energy efficiency improvement options are pertinent to Bangladesh's energy security since it is facing the adversities of system losses.

[11] Atiq Rahman, n 6.
[12] The World Bank, *Energy Efficiency and Conservation in the Developing World: The World Bank's Role*, (Washington D C: The World Bank, 1995), pp 21-23.

Table 5.3

**System Loss of BPDB, DESA, REB and DESCO**

| Financial year | BPDB % of net production | DESA % of import | REB % of import | DESCO % of import | Combined % of net production |
|---|---|---|---|---|---|
| 1991/92 | 28.3 | 35.5 | 15.7 | - | 39.1 |
| 1992/93 | 20.6 | 31.05 | 15.6 | - | 34.0 |
| 1993/94 | 19.2 | 31.34 | 15.4 | - | 33.3 |
| 1994/95 | 17.7 | 30.0 | 15.7 | - | 31.9 |
| 1995/96 | 17.0 | 29.47 | 15.2 | - | 31.3 |
| 1996/97 | 16.0 | 27.29 | 15.8 | - | 30.0 |
| 1997/98 | 16.5 | 27.89 | 16.8 | - | 31.3 |
| 1998/99 | 16.8 | 24.98 | 18.6 | 40.61 | 30.9 |
| 1999/00 | 15.5 | 25.51 | 20.1 | 32.47 | 37.1 |
| 2000/01 | 13.85 | 25.63 | 15.0 | 27.86 | 35.82 |
| 2001/02 up to Dec.01 | 12.82 | 26.21 | 18.25 | 29.00 | 36.85 |

Source: Ministry of Power, Energy and Mineral Resources, as in *Bangladesh Economic Review 2002*, (Dhaka: Ministry of Finance, June 2002), p 77.

Newly established DESCO commenced functioning, though in a limited way, from mid-1998/99.[14] The table shows an alarming situation in the power sector with regard to system loss. The table clearly reveals that DESCO is incurring the largest portion of system losses, on the other hand BPDB and REB's system losses are comparatively less. In addition a large portion of the electric bills are not paid for. During the last twenty five years overall transmission and distribution losses varied between 27.2% to 40.2% of net

[13] World Energy Council, *Energy for Tomorrow's World—the Realities, the Real Options and the Agenda for Achievement*, (New York: ST. Martin's Press Inc., 1993), p 215.

[14] Government of Bangladesh, *Bangladesh Economic Review 2002*, (Dhaka: Ministry of Finance, June 2002), p 76.

generation.[15] All these are making the energy security scenario of Bangladesh worst. A high proportion of transmission and distribution losses include non-technical losses like theft, pilferage. Thus system losses are resulting in wastage of energy, which in turn weakening country's energy security position.

**Emission of Greenhouse Gas from Energy Sector**

Commercial energy consumption in Bangladesh is growing at a very rapid rate. With population growth and economic development, energy consumption will increase further. The energy sector is a high priority area for the government because industrial production and commercial activity are being severely hampered due to the chronic shortage of electricity. The highest priority is on power generation, and the shortfall is being met through the participation of Independent Power Producers. In the natural gas sector, the government is trying to increase supply by leasing out exploration and development of gas blocks through International Oil Companies. Other energy sector priorities are rural electrification, which is undoubtedly a moral obligation of the government, and the introduction of Compressed Natural Gas (CNG) as a transport fuel, which arises out of the need to reduce the reliance on foreign oil.

In the energy sector, the two largest GHG (Green House Gases) emitting sources are electricity generation and non-energy use (urea fertilizer production). These emit approximately 50% of all the GHGs. The other significant GHG emitting sources are traditional biomass burned for energy (non-CO2 emission – CH4 and N2O), diesel for transport, kerosene for rural lighting, and coal for manufacturing bricks.[16]

In 1990, the emission from energy sector was 21,186 Kilo ton (Kt) including CO2 and non-CO2 gases, which was approximately 30 per cent of total greenhouse gas emission of Bangladesh.[17] It is found that emission of greenhouse has become almost double in every five years since 1990. The energy sector emission from 1990 to 2000 is given in the table.

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[15] Government of People's Republic of Bangladesh, *National Energy Policy*, (Dhaka: Ministry of Power, Energy and Mineral Resources, May 2004), p 12 as in http://www.petrobangla.org/

[16] Atiq Rahman, n 5.

[17] Ibid.

Table 5.4

**Energy Sector Emission from 1990 to 2000 (in kt)**

| | 1990 | 1995 | 2000 |
|---|---|---|---|
| Agriculture, Fisheries and Forestry | 680 | 1300 | 1830 |
| Commercial and Institutional | 239 | 187 | 274 |
| Residential | 2082 | 2800 | 4290 |
| Transport | 1892 | 4080 | 4760 |
| Manufacturing Industries and Construction | 3623 | 5880 | 8030 |
| Energy Industry | 4763 | 7612 | 13145 |

Note: Units are expressed in kilo ton (kt).
Source: Atiq Rahman etc., *Development and Climate Change: Bangladesh Country Case Study—Phase I*, in http://www.developmentfirst.orrg/studies/BangladeshCountryStudies.pdf.

Many factors will play a role in determining future GHGs emission of which the supply of natural gas is an important one. However, the fact that the emissions from coal and oil will also increase implies that the supply of natural gas is limited due to lack of infrastructure and cannot be used to meet the demands. Increased demand for oil is due to the increased demand of transport sector, and captive generation for uninterrupted power supply for industrial units. The reason for the significant growth of demand for commercial fuels is that there will be a perceptible shift in cooking fuel preference from biomass to commercial fuels like Liquid Petroleum Gas (LPG), coal and kerosene.

**Energy shortfall: Implications**

During the 1980s Bangladesh faced a power crisis and consequent load shedding hurting public life and industrial activities. The so-called system loss crossed 42 per cent mark in the late eighties. Situation however, improved due to enhanced supply through new installed capacity, but the huge system loss continues to remain major issue. The first five years in the 1990s did not face serious power supply problems due to addition in generation in the late 1980s.

Non-attention on the subject and inadequate development of power and gas during that period (1991-96) led to severe crisis in the second half of the 1990s. Beneath the apparent political turmoils in the mid nineties, and non-availability of fund for rehabilitation of plants, and transmission components, in particular, the demand for power continued to grow and finally in 1997 it outstrip the supply. The nation was plunged into darkness with frequent and prolonged load shedding and even occasional power disruption. Although donors' assistance and financing for some important projects were at hand, clear negligence in undertaking gas well development (for production) and inordinate delay in critical high pressure gas pipeline construction, the supply of gas became acute, even uncertain for long time.

Even though the contribution of energy sector to the national income not stands at the first place it has also got major share. Even though there is not much direct contribution, indirectly through industries which are consuming larger portion of energy resources. So if in any case there will be shortages of energy it directly affect the industries and thereby national income.

Any approach to planning of energy security in Bangladesh has always been faced with the high capital cost constraints of transmission and distribution of both primary and secondary energy to the rural areas of the country. Shortages of energy will lead to demands of the people to be unmet. Thus not meeting the demands of the long waiting people may risk the political stability because people of Bangladesh are very sensitive to such issues. Thus shortage of energy not only stakes the energy security but also political stability.

For rural women and people shortages of energy refers to shortage in biomass resources. It not only risks their energy security position but also affects their daily life, living standards, income. Since there will be shortage they have to look for alternative sources which will take their time and require huge investments.

**Reform Measures**

An excess of bureaucracy, coupled with a general failure among politicians to grasp the realities and principles of administration in the energy sector has contributed to the making of conditions where public sector reforms, among a host of other things, became critically important. The power sector is one vital area where the need for reforms has over the years assumed serious and critical dimensions. That is of course obvious. Witnessing that a country struggling to enter the truly developmental process, Bangladesh has a compelling need to provide energy to a population which, for lack of clear political leadership, grows increasingly disillusioned with the government.

And once the facts are taken into account, the picture which emerges is one bad management going into the sector over the years. Compounding the problems of management has been the existence of powerful pressure groups in the sector. The failure of the management and the labour unions to work out a *modus operandi* towards a smooth operation of a power sector is yet another critical aspect.

To make bad situation worse, a woeful lack of accountability has characterised the sector. The power sector, which in the industrial world is privy to autonomy, in Bangladesh has been constrained by its dependence on bureaucratic control leading to a terrible arbitrariness in billing and poor collections. All these suggest that there is huge scope for unnecessary loss of energy resources.

Various attributes have been contributing to energy insecurity in Bangladesh. They are, political insensitivity to long term energy planning; irrational national pricing policy; lack of good governance; weak institutional capabilities at planning and implementation

levels; lack of financial capability and technological capability; and lack of management capabilities.

**Public Sector Management of Energy**

In the past about 20% of all capital investment made by the government was for the development of energy sector. The Foreign Direct Investments (FDIs) came into play since 1995-96 through the multinational companies and private sector investment has become significant in the following years. The vector value for the year 1995-96 was estimated at 0.13, suggesting participation of private sector in energy development and management activities as recommended in the National Energy Policy.

The initial trend for private sector participation was to invest in natural gas exploration. Since 2000-01, private sectors have become a significant player in natural gas production, production of liquefied petroleum gas (LPG) for small-scale commercial and cooking purposes, and production of electricity. Due to an increase in private sector participation the production of natural gas reached its National Energy Policy suggested maximum limit of 1000 Million Metric Cubic Feet per Day (MMCFD), 24% of which supplied by the International Oil Companies (IOCs). Obviously it is expected that private sector's role is steadily likely to increase even further in coming years.

Energy infrastructure development has been in the public sector domain in most countries due to its strategic importance, large costs and long gestation periods. Several factors such as increasing energy demand, fiscal constraints, and poor operational and financial performance have led to structural changes leading to greater private sector participation.

But there is a disagreement on more private sector participation in the energy sector, which is both upheld by policy makers and also by the general public due to lack of confidence in the private investors. The main reason for that is, the private investors in the natural gas sector are pressurising the government for export of gas to India. The other reason is, the manner in which the private investors are extracting natural gas, i.e., they extract at maximum possible limit prescribed by the government, for which the

government has become suspicious of their motives and become much more conscious about the energy security position of the country.

**Energy Infrastructure and Energy Security**

Bangladesh, a country of teeming millions has been facing an acute power crisis. For a developing country, power is most essential element to industrialize the country and to advance its economy. Around 80 per cent people do not have access to electricity. It is therefore, a foregone conclusion that Bangladesh has a long way to go in power sector in order to enable its economy take off. It has become imperative in this background that Bangladesh needs to take stock of its energy infrastructure, adopt policy to develop it and make best use of the resources.

In Bangladesh there are many blocks where natural gas reserves are left unexplored. While this may be a mere approximation, in a highly prospective gas area, it is most likely that there will be additions to existing reserves as exploration proceeds. Therefore, it appears that Bangladesh does not suffer from natural gas scarcity in terms of the needs of the overall economy. The problem is chronic one of shortfall in deliverability infrastructure, i.e. field development transmission and distribution pipelines and facilities. Severe load shedding is currently done due to this limitation in infrastructure. Thus underdeveloped infrastructural facilities will have negative implications for energy security.

The present government-controlled structure of the power sector has not been able to deliver in accordance with the country's growing needs. It now faces a major challenge of improving low coverage, bad quality and poor reliability. The sector needs to mobilize around US$ 6.6 billion in funds during this decade to build up the energy infrastructure.[18] Traditional sources of investment funds will be insufficient. Major sector reform and increased private participation will be needed to mobilize this investment.

[18] *Energy, Environment and Sustainable Development III: Energy Infrastructure Policies and Issues—Energy Resources Dvelopment Series No.36*, (New York: United Nations, 1999), p 97.

The report of M/s. London Economics recommended separation of the generation, transmission and distribution business, which is currently being carried out by BPDB.[19] For private sector participation, it was recommended that private finance should be used for new generation and transmission links. Contracts, they argued would be used for rehabilitation of generation and to develop private sector participation in distribution. They opined that once confidence was built, and other necessary conditions were met, trade, sales, distribution and generation businesses could also be considered.

Much more serious consideration should now be given to the appropriate role of the public sector in the provision and maintenance of infrastructure. This implies that the private sector, foreign and domestic, has a critical part in investment and operations in power generation and distribution, the oil and gas sector, telecommunication, water and sewerage operations, ports and all forms of transportation, and suggests that various levels of the public sector must became more actively involved and that a proper regulatory role for the state must be made explicit.[20]

Local authorities and municipalities should be given more autonomy and managerial discretion in investment and the maintenance of infrastructure.[21] Where funding and institutional capabilities are weak, these should be progressively strengthened. In clearly commercial areas such as the oil and gas sector, telecommunications, and power, public ownership has not optimised exploration, production, or distribution. There is clearly a place for private sector partnership in these sectors in Bangladesh. Where public corporations remain, they must be allowed considerable managerial autonomy and discretion to operate on purely commercial lines.

Project design must pay much closer attention to sustainability issues in infrastructure projects. Expanding generation capacity or urban access to potable water serves little purpose if non-technical system losses are not addressed vigorously or if cost recovery

[19] Ibid., p 98.
[20] World Bank, *Bangladesh: Progress Through Partnership*, (Washington: IBRD and World Bank, 1999), p 21.
[21] Ibid, p 21.

remains dilatory. Expanding the rural and road network without maintaining the existing network undermines the development impact of the investments made. A recurrent theme throughout projects in the energy and infrastructure sectors is the sub-standard performance of responsible institutions and a general approach to governance that reduces accountability rather than enhancing it.[22] This is not the result of limited human capital and technical skills, but rather a function existing bureaucratic and administrative systems.

Tinkering with the internal structures will achieve little unless the reward/sanction philosophy within the service provider groups is changed. The much better collection performance of the Rural Electricity Boards (REB), compared with Dhaka Electricity Supply Authority (DESA), illustrates what might be achieved. Annual performance contracts that bind senior management to achieving organizational and operational targets would certainly help. The reverse of this coin, of course, is the need to encourage broad managerial autonomy and discretion.

In Bangladesh rural electrification is a constitutional obligation. Article 16 of the constitution provides that, "the state shall adopt effective measures to bring about a radical transformation in the rural areas through the promotion of an agricultural revolution, the provision of rural electrification, the development of cottage and other industries, and the improvement of education, communications and public health in those areas, so as progressively to remove the disparity in the standards of living between the urban and rural areas."[23] The provision of Article 16 does not allow REB to ignore the guarantee assured in Article 19.[24]

Many donors have provided assistance to all aspects of infrastructure development in Bangladesh. Much has been achieved in the past two decades. In some cases, however, most notably the power and oil and gas sectors, the flow of concessional resources may

[22] Ibid., p 22.
[23] Atiur Rahman, (et al), *People's Report on Bangladesh Environment 2001: Vol.I-Main Report*, (Dhaka: The University Press Limited, 2001), p 181.
[24] Ibid.

have perversely undermined the perceived urgency for reform and domestic resource mobilization.[25] While there is indeed a shortage of reliable generating capacity in the country, much could be achieved by a determined programme to reduce system losses and improve collections. These deficiencies represent a tax on the poor who are without adequate electrical power.

While the power sector will need external resources, these should only accompany a demonstrated commitment to improving institutional performance. This may suggest a more programme-based approach by International Development Agency (IDA) in the power sector, with solid agreement with the government on policies, objectives, strategies, and expenditures. Disbursements could then be linked to policy performance and clearly monitorable indicators of system performance.[26]

**Implications of Energy Pricing On Energy Security**

The international market recorded sharp rises in energy prices in the 1970s and in the first half of the 1980s. This notwithstanding, prices of products in Bangladesh have been pegged at a level below that of world economic prices even though some periodic upward revisions have been made. However, since the fall of crude oil prices in the international market in the year 1985-86, the domestic market of Bangladesh did not see a significant lowering of prices. Only minor adjustments were made on some occasions although gas and electricity prices rose on an average by 15 and 10 per cent respectively.[27]

In Bangladesh energy pricing is fully regulated by the government. The energy supplying agencies such as Power Development Board, Petrobangla, REB, and Bangladesh Petroleum Corporation are government entities. The major objectives of these agencies seem to be based on the premise that the energy industry must under no circumstances be allowed to be an exploitative monopoly. The pricing policy for gas has historically been designed to provide a disguised subsidy to power and fertilizer whose users have

[25] Bangladesh, n 16, p 22.
[26] Ibid, p 22.
[27] Mohammad Alauddin, Clement Allan Tisdell, *Environment and Economic Development in South Asia: An Overview Concentrating on Bangladesh*, (Hampshire: McMillan Press Limited, 1998), p 181.

benefited from a double subsidy through both the input and output price. This may lead to over exploitation of natural resources and may ultimately threaten energy security.

Therefore, the guiding principles energy pricing should include among other things the following:

- To operate as financially viable organizations but not to earn above normal profits;
- To keep prices as low as possible – equity rather than profit maximisation;
- To provide adequate service to the entire public even if it requires cross-subsidization of different consumer groups.[28]

The Task Force Report of 1991 has correctly pointed out, the most important source of distortion lies in heavy under-pricing of natural gas. It also pointed out that economic price of 1000 cubic feet of natural gas should be at least 132 taka. It actually sells at a very low price. For example, in the financial year 1990 the following was the tariff structure for major consumers.

Table 5.5

**Tariff Structures of Major Consumers in 1990**

| Consumers by Sector | Price (in Taka)/MCF (thousand cubic feet) |
|---|---|
| Power | 37.95 |
| Fertilizer | 32.82 |
| Industries | 80.50 |
| Tea Estates | 90.62 |
| Commercial | 126.50 |
| Domestic | 74.75 |

Note: The gas tariff structure is fixed by the government annually in conclusion with Petrobangla. The structure has surely undergone change over the years but the principle of variable pricing has remained intact.

Source: Report no.24, *Bangladesh Gas sector Development: Status, Policy Options and Challenges*,(Dhaka: Centre for Policy Dialogue, May 2000), p.164.

The heavy subsidised price seems to have resulted from, a rather mistaken view that Bangladesh has a relatively unlimited supply of gas. The other reason may be the view that gas is Bangladesh's own resource and therefore can be supplied at any cost price. However, the cost price calculations employed by the agency concerned imply that price is set far below the economic price, with the further implication that it entails sacrificing economic value of this non-renewable resource. This may have some serious repercussions on energy security of the country. The gas prices were adjusted in December 01, 1998. The prices are presented in the following table.

Table 5.6

**Gas Tariffs and Economic Cost of Supply (1998)**

| Consumer Category | Tariff (TK per cubic meter) | Tariff (US$/MCF) | Long-run Marginal Cost (US$/MCF) | Ratio of tariff to long-run marginal cost |
|---|---|---|---|---|
| Power | 1.93 | 1.10 | 1.55 | 0.7 |
| Fertilizer | 1.68 | 0.96 | 1.48 | 0.6 |
| Industry | 4.2 | 2.40 | 1.74 | 1.4 |
| Commercial | 6.0 | 3.43 | 3.11 | 1.1 |
| Tea Garden | 4.6 | 2.63 | 1.83 | 1.4 |
| Brick Field | 4.2 | 2.40 | 1.74 | 1.4 |
| Brick Field (Seasonal) | 5.2 | 2.97 | 1.83 | 1.6 |
| Domestic with Meter | 3.35 | 1.92 | 2.97 | 0.6 |
| Single Burner Fixed Charge (Per Month) | TK. 160 | US$ 3.7 | - | - |
| Double Burner Fixed Charge | TK. 290 | US$ 5.9 | - | - |

[28] Ibid., pp 181-182.

| (Per Month) | | | | |
|---|---|---|---|---|
| Average Consumer Price | 2.32 | 1.33 | 1.67 | 0.80 |

Note: The exchange rate is TK 49.5 = US$ 1.00
Source: The World Bank, as in *Changes and Challenges: A review of Bangladesh's Development 2000*, (Dhaka: University Press Limited, 2001), p 166.

Favourable pricing for power and fertilizer is self explanatory. For example, if gas tariff is increased by a dollar, the price of fertilizer shall increase by more than TK. 2000 per metric ton.[29] The same is true of power generation, although the impact on power tariff would be marginally less. Any enhancement in gas tariff and as consequence in power tariff will result in increasing the cost of domestic product to the degree of its dependence on either or both of them. For example, in case of Urea fertilizer, gas dependence being very high the impact of increase would be such higher than for a product with lesser degree of dependence.

Now tariff adjustment on the basis of price differential (International Oil Companies supply price vis a vis existing tariff) has become a matter of urgency; because the greater the delay, the heavier would be the financial burden on the Petrobangla group, and in the final analysis on the macro-economic balances of the government.[30] But tariff adjustments are not the solution to the problem. Every increase in tariff will automatically enhance the production cost of power and urea, which would ultimately have to be borne by the consumers. So a gas price rise would have a more pervasive socio-economic impact, both at the macro and micro levels.

Thus the energy pricing policy itself has led to significant inefficient use of energy resources, threatening the energy security position of Bangladesh. Energy prices do not reflect their social marginal costs. The system of user pays does not seem to have adhered to pricing of energy resources in Bangladesh.

[29] Report No.24, *Bangladesh Gas Sector Development: Status, Policy Options and Challenges*, (Dhaka: Centre for Policy Dialogue), p 165.

**Energy Supply and Energy Security**

Bangladesh has a large unmet need for commercial energy. Against the backdrop of pent-up demand, lost growth, and social inequity, some recent developments may brighten a sombre picture. In hydrocarbon sector even with enough reserves of natural gas, if the exploitation well managed, it can fuel the country's commercial energy needs in an ecologically benign manner and acts as an engine for rapid economic growth.[31]

But in Bangladesh, despite all efforts it has not been possible to ensure sustainable supply of natural gas and electricity to consumers. As a consequence it has it has affected economic activities. Supply of biomass fuels has been continuing in an unorganised manner. Over-exploitation of biomass fuels and its effect on the environment is a case of great concern.[32] So there is a pressure on the government to supply more conventional energy sources. In this regard, the government is focusing on the feasibility of renewable energy sources in meeting the increasing demand for energy.

Although renewable, in addition to the associated problems mentioned above, the supplies of biomass are unsustainable. Gas is non-renewable with a rather limited proven supply and uncertain prospects for additional supplies. Hydropower potential is virtually non-constant; and the coal resources are available in several areas amounting to about 1.5 billion.[33] However, the production of coal is yet to start and it can be quite expensive. It particularly polluting both as a health hazard and in the context of climate change. Clearly, the people of Bangladesh, particularly the large majority, who are already deprived, face a high degree of energy insecurity. This is a major negative dimension in relation to the prospects of sustainable development in the country.

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[30] *Changes and Challenges: A Review of Bangladesh's Development 2000*, (University Press Limited, 2001), p 167.
[31] Report No.24, n 29, p 157.
[32] http://www.developmentfirst.org/studies/BangladeshCountryStudies.pdf.
[33] Ibid.

Even though agricultural residues are used in highest manner as fuels, the supply from this source is unpredictable as it depends on the area under different crops every year.[34] So automatically demand for other fuel increases. Bangladesh is certainly blessed with a reasonable reserve of the relatively clean fossil fuel – natural gas. However, the country has been unable to reach this primary energy and its economic benefits to the grass-root level, i.e. to the majority of the population.

The questions that arise here are, will the rural people be able to enjoy the benefits of natural gas even in the long term ? If not, what will be the strategy to secure the primary energy supply in the long term to rural areas and how this can be achieved in an efficient manner ? On the secondary energy side, which is a major input for accelerated development, only around 30% of the population of the country has access to electricity. This still remain primarily an urban facility. This raised a significant question about securing energy to rural areas, i.e. can renewable energy technologies play significant role in energy supply to rural areas?

There are many reasons which can be pointed out as the cause for energy supply distortions. They are;

- No improvements in the operational efficiency of the energy supply companies.
- No institutional reform
- Malpractices like corruptions, bribery in the administration of supply
- Transmission and distribution constraints
- Shortages of gas and electricity
- Inadequate funding for the operation and maintenance of facilities
- Insufficient investments in new facilities
- Low tariffs
- Excessive central intervention
- Inefficient expertise

[34] QK Ahmad (et al), *Resources, Environment and Development in Bangladesh: With Particular Reference to the Ganges, Brahmaputra and Meghna Basins*, (Dhaka: Academic Publishers, 1994), p 82.

Thus many issues are hampering the development of the energy sector in Bangladesh. For most of the problems the government seems less sensitive. Environmental aspects in Bangladesh are less cared for, even by the policy planners and decision makers. Remedial measures are not usually undertaken, which also affects energy security. Thus, there is a great necessity to consider optimum use of available energy sources to ensure energy security for the sustainable human development in the long-run.

# CHAPTER VI

# CONCLUSION

# *Chapter VI*

# CONCLUSION

Bangladesh is encountering difficulties in supplying energy to maintain its economic growth. The gap between demand and supply is gradually increasing. Although it has some reserves of commercial energy resources, because of economic and technical constraints it is unable supply sufficient energy. The dependence on imported fuel (oil and coal) is gradually increasing, and the rural population, which uses a fair amount of imported fuel (kerosene and diesel), is largely disadvantaged because of its low purchasing power. Most of the commercial energy used is derived from natural gas and imported oil, while the main consumers are power generation, transport and industry. The share of the total energy consumption in Bangladesh is from biomass fuels comprising agricultural wastes, animal wastes and fuel wood. The biomass is mainly used in the rural households. Because of shortage of land there are limited prospects of increasing the supply from biomass sources.

Efficiency of energy production and its utilization in Bangladesh is generally poor. The demand for energy exceeds the available resources and this gap is projected to increase significantly in the near future. The extent of energy conservation initiatives in the country has been limited. The Energy Monitoring and Conservation Centre (EMCC) of the government have almost no regulation-enforcing authority, and the National Energy Conservation Act is still under consideration by the legislators. Significant and concerted attempts to increase energy efficiency and conservation measures in the various sectors have not been widely applied in the country. Efforts have been made to increase energy efficiency and implement conservation measures in some industries such as sugar mills, spinning mills and fertilizer factories, and also in the rural domestic sector by the expansion of the use of improved cookers.

In Bangladesh, the per capita energy consumption is relatively low. It is one of the country's formidable development challenges. The present rate of consumption has been

constraining Bangladesh's efforts towards attracting sizeable foreign direct investment, accelerating rural development and improving the quality of life of Bangladeshis.

The most predominant need of the time is 'power-driven predominantly privatized economy' for its meaningful participation in the globalization process and in the free market. The term 'power' here refers to steam, water power, wind power, gas power and other power agencies.

The factors involved in the country's energy equation have both intra and inter-generational implications. Bangladesh, in one hand, is required to create and meet energy demand at the level that could facilitate a speedier economic growth and human development, among the others. It is required, on the other hand, to establish initial conditions for the future generation to meet their energy requirement on a counting basis.

Energy has the power to empower Bangladeshis economically, politically, socially and intellectually. It can help build the future of Bangladesh on a solid foundation. A higher rate of per capita energy consumption could assist Bangladeshis in their fight against poverty, law and order situation, corruption, distribution related disparities and other developmental deficiencies. It can at the same time de-accelerate country's progress, if not managed properly. An energy based approach to national development, if poorly managed, can help promote, among other things, a culture of easy money making.

Interesting though, there exists a relationship between energy centred development and good governance. A wide gap between the two or a shortfall on both counts can, among other things, affect a country's developmental effort. It is one of the reasons why a number of energy rich world countries are still struggling to cope with their developmental challenges at the basic level.

Bangladesh would need, among other things, a sound strategy, a more productive management system, a bunch of good management practices and above all, cooperation, as well as commitments of all concerned to deal with its energy related challenges and

opportunities. The strategy mentioned should inter alia be holistic, futuristic, pragmatic, result oriented and conducive to power driven economic developments. A productive management of the country's – energy future, energy requirement, energy reserve, energy utilization, energy recycling, energy politics, energy diplomacy, energy trade, energy security, energy environment nexus and energy potential for development – could ensure a quicker and optimal return on its energy related investments.

It is expected that the people of Bangladesh and the political parties (both within and outside of the government) would jointly take appropriate measures for ensuring a better management of the country's energy resources, including gas. The decision on whether or not to export gas to India should, among other things, be time sensitive, opportunity driven, forward looking, optimal return oriented and satisfying to Bangladeshis. The decision should be taken on hard realities and not on emotional premises, and in a non partisan manner. In this connection many have suggested for holding a national referendum on gas export. If the suggestion is acceptable to all concerned, it is hoped the government, the political parties, the donors and civil society would, prior to the referendum, explain to the people of Bangladesh in more concrete terms about the comparative advantages of say, exportation of gas to India. It would then help them to take a more informed decision in pertinent areas in the event of referendum mentioned.

Bangladesh would need to consider besides other things, various renewable and non-renewable energy options and pertinent technology alternatives in its effort to improve the energy situation. In this respect, wind, solar, and wave could, among others, be potential candidates for consideration, relative to time, space, resource level, comparative advantage, affordability and return on investment.

Present day wind turbines are less noisy, more reliable and capable of generating more power at a lower cost. They can be monitored even from remote locations. It has been made possible by connecting a set of sensors (outfitted with the turbines) with a network that enables the remote monitoring of turbines say, from a laptop. For the wind direction

and force, the turbines now-a-days depend on an electronic system which can predict that approximately a day in advance.

The adjustment of the orientation of the rotor, as well as the pitch of individual blades can be made on the basis of the above prediction for maximum efficiency and output. For practical reasons, wind turbines should be supported by a back up system because they cannot be fully relied upon for a continuous supply of power to consumers. Further, the turbines generally need supply power to operate.

Wind is an environment friendly energy source. Bangladesh should explore the feasibility of harnessing wind power especially for empowering rural Bangladesh and Bangladeshis. It can seek technical or non-technical (or both) advices from the local experts, countries that are currently using wind power with success and world renowned companies that are involved in the turbine business, such as: General Electric (GE), the biggest domestic turbine manufacturer in the US. The bottom line is: Bangladesh can no longer afford 'wait and see' strategy for bringing about drastic improvements in its energy sector; the time is overdue for the country to act more aggressively and decisively in the pursuit of a higher level of energy outcome.

In the context of the country's energy security, it is absolutely necessary to pursue extensive gas explorations. Since economic and social progress is closely linked with energy security and since gas is the only commercial energy source securely available for the next decade and half or so and more is likely to be discovered in future, no gas export must be considered unless there is a proven reserve which will contain excess supplies on top of the quantity required to meet the growing national gas requirements for at least 40 years. At the same time, efforts must be devoted to creating a strong enough economic base and social environment by then (i.e. in 40 years time) so that the country can face issues, including those relating to energy security, from a stronger and more secure position.

Also, it takes time to develop/expand other energy options, which may include solar power, wind power, biogas, improved biomass energy, and cross border power trade. The development of these options must be taken up earnestly in order to ensure energy security in the country in future. If no more or not much new gas is discovered, an energy crisis appears to be in prospect in about 15 years time. The approach therefore must be two-pronged: extensive gas explorations and serious and consistent efforts to develop/expand other energy options.

The donor attitude towards Bangladesh in the face of a decision not to export gas will likely be to argue that the nation has refused to help itself, so that its claim on resources from the foreign community is now less. It is the perfect reason for donors to scale down or stop operations in Bangladesh. To deny the benefits of natural gas exports seems to be willfully continuing poverty. While Bangladesh has a sovereign right not to export gas it has no right to demand foreign assistance at concessional rates if it will not develop its own resources. The donors will simply opt out of the energy sector; they have been doing very little in fact. One cannot count on either Asian Development Bank (ADB) or World Bank (WB) to finance exploration.

With a decision to export gas foreign direct investment will increase rapidly both within the natural gas sector but also in many other areas seeking to take advantage of the new markets that will emerge. The inflow of Foreign Direct Investment (FDI) will add one point to the Gross Domestic Product (GDP) growth rate over the next decade, it will bring much new technology, it will provide many employment opportunities for technically trained persons, and it will be accompanied by a genuine transformation of the economy over the next twenty years. These changes will promote the secular forces and work towards establishing a merit based, technically oriented society. Young talented Bangladeshis will be encouraged to remain or return home. Finally and most important accelerated progress can be made to reduce poverty. China, Thailand, Malaysia, and Indonesia all made FDI one of the pillars of their rapid economic growth. Exporting gas will enable the same large inflow of FDI to take place in Bangladesh. These inflows, we

emphasize, are not just gas related but will be broad based, reflecting interest in many facets of the economy.

Under the circumstances, all efforts should be geared to improving the country's energy security both at the national level and at the household level. This must be the key concept driving the nation's energy policy. Naturally, the pathway towards that goal should be a comprehensive process with clearly identified short, medium, and longer term targets to be achieved in, say, 5 or 10 years, 20 or 25 years, and 40 or 50 years respectively from now. The analytical framework must be based on economic, social, and environmental (i.e. sustainable development) considerations and not on political expediency.

The approach should be an integrated development and management of all energy sources which mainly include gas and biomass. The management of the sector has to be so designed as to ensure energy supplies, as they are developed, to different zones, sectors, and socio-economic groups on an equitable basis. In the absence of a great deal of scope of commercial energy development except for gas, appropriate support (policy, resource, institutional) needs to be given to the proper development of biomass fuels. Before taking up the issue of gas let it be pointed out that there are also other sources of energy such as coal, biogas, solar power, wind power which may be of marginal importance now but can be developed into important sources of energy in future if necessary attention is given from now on. Solar and wind power based electricity is environmentally clean and should be given due emphasis in terms of policy, institutional, and financial support.

The development and management of the gas sector should be carried out within the broad framework outlined above. The broad context is sustainable development and, hence, the utilization of gas for equitable benefit of all segments of society. Let me make two points in this regard. It is a glaring social and economic injustice that only about 4 per cent of the total households has access to piped gas and only about 20 per cent to electricity. Therefore, a policy of expansion of piped gas to more and more people at a

fast enough rates is called for. Similarly, generation and distribution of electricity need to be expanded to provide more and more people with opportunities to access electricity.

The key questions concerning the gas sector are: (a) what is the quantity of gas that is known to be available and how much more may be available in future? and (b) how may the available gas supplies be best utilized in national interest?

Gas and power prices in Bangladesh are too low to allow the public energy companies to achieve reasonable financial performance. The companies' poor financial performance is a function of weak management and poor governance as well as under-pricing, but it is clear that the current pricing structure is inadequate for the public companies to make adequate returns on their assets. Without internal surpluses and capacity to borrow, the companies will not be able to finance their expansion. Furthermore, an inadequate pricing structure discourages private entry into the sector. Bangladesh's objective should be to use private capital to relieve pressure on public finances.

The incidence of energy subsidies in Bangladesh indicates that they are very inequitable. The main beneficiaries are urban middle and upper-income households – along with utility employees who collude in the theft of power and gas. The rural poor are hardly served. As noted previously, the irrigation subsidies provide a significant benefit to a relatively small proportion of farmers, and, whatever the merits of fertilizer subsidies, rural farmers could be supported in more direct, transparent ways, without undermining the gas companies' finances.

In addition to being inequitable and inefficient, Bangladesh's energy pricing system is excessively politicized and non-transparent. The Government defers price adjustments as long as it can, and when the financial pressures become too great, it is forced to introduce adjustments. Although the public gets a general sense that the prices are being adjusted in relation to market trends, there are no consistent principles, and the adjustments appear to be arbitrary because the underlying decisions do not reflect transparent criteria. The whole process can be politically difficult.

Energy pricing policies should be based on sound and transparent pricing principles, including instituting automatic periodic adjustments, based on known indexes. I would like to suggest the following for consideration:

- Periodic adjustment in energy prices should be introduced, and the Government should disengage from fixing prices and focus on the formulation of policies, including pricing policies.

- Energy prices should be market-based and linked to costs, so as to give appropriate signals to consumers, as the cost of energy inputs fluctuates.

- A distinction should be made between variable and fixed prices. For gas, the cost of gas as a commodity is the variable cost, while for power, it is the cost of gas and diesel/furnace oil for generation. Prices should be adjusted frequently and automatically, up or down, to reflect actual fluctuations in variable costs -- "frequently" in this context means many times a year. The fixed components of prices include operating costs such as generation, transmission and distribution plus taxes, and they can be adjusted at fixed intervals, probably yearly. Once it is formed, the energy regulatory authority should be responsible for reviewing changes in the fixed cost components of energy prices.

- Tariffs, reflecting the cost of supply to different consumer groups, should be established, and cross subsidies, which are detrimental to the industrial and commercial sectors, should be phased out.

- Energy prices should be harmonized among petroleum, natural gas and electricity, so as to reduce economic rents.

- Transparent taxation principles should be implemented to create public awareness and facilitate revenue collections.

- Universal metering should be immediately initiated for gas consumers, and flat-rates phased out to reduce wasteful consumption.

Even if Bangladesh adopts market-based energy pricing policies, the current distortions are so large that it will not be feasible to eliminate them in one go. A more prudent approach would be to adopt and publicize pricing policies along the lines suggested, indicating the size of the adjustments that will ultimately be needed, and announcing a program to implement them in several steps over a few years. This phased adjustment would make the magnitude of future changes clear and give consumers time to adjust.

Since in Bangladesh most people of the people depend upon the biomass fuel for their energy needs, now there is a huge task before the government to preserve and develop biomass resources for the future. In order to reduce the overdependence on the biomass fuels it is pertinent to consider the option of supplying natural gas to as many households as possible.

The World Bank has rightly pointed out that, if Bangladesh wants to benefit adequately from its natural gas sector it has to take steps to eradicate all the setbacks occurring recently. The World Bank views that the government should give attention to the limitations of its economic resources, technology and the institutional weaknesses of Petrobangla. To reconstruct the gas sector the government should allow the private sector investment especially of the International Oil Companies (IOCs) in this sector and should promote commercialization or privatization of the existing management.

In case of Bangladesh, if one is talking in terms of energy security, it means reaching electricity and gas to all people, living in urban as well as rural areas, the latter, representing a vast majority of the country's population, located in areas with a very underdeveloped infrastructure. Any approach to planning of energy security in Bangladesh has always been faced with the high capital cost constraints of transmission and distribution of both primary and secondary energy to the rural areas of the country,

where the majority of the people live. Low purchasing power of rural people to pay fro any reasonable amount of service charges for electricity is another constraint, which should be taken into consideration. Over a long term planning horizon, when about 40% of Bangladesh's population is expected to live in urban areas, the number of rural population will still be an impressive number, comprising of about 100 million people, having right to access minimum amount of energy.

# BIBLIOGRAPHY

# BIBLIOGRAPHY

## Primary Sources


Ahmed, Ahsan Uddin, *Energy and Sustainable Development in Bangladesh*, (Dhaka: Bangladesh Unnayan Parishad, 2002).

Ahmed, Azim Uddin, *Report No.24 – Bangladesh's Gas Sector Development: Status, Policy Options and Challenges*, (Dhaka: Centre for Policy Dialogue, May 2000).

Ahmed, Azim Uddin, *Report No.7 – Negotiating Strategies for the Development of Bangladesh's Energy Reserves*, (Dhaka: Centre for Policy Dialogue, September 1999).

CPD Task Force Report, *Policy Brief on Development and Governance of the Energy Sector*, (Dhaka: Centre for Policy Dialogue, 2001).

Government of the People's Republic of Bangladesh, *2000 Statistical Yearbook of Bangladesh*, (Dhaka: Bangladesh Bureau of Statistics, June 2002).

Government of the People's Republic of Bangladesh, *Four and A Half Years of Progress 1996-2000*, (Dhaka: Department of Films and Publications, January 2001).

Government of the People's Republic of Bangladesh, *Statistical Bulletin Bangladesh*, (Dhaka: Bangladesh Bureau of Statistics, April 2003).

Government of the People's Republic of Bangladesh, *Statistical Pocketbook of Bangladesh 2001*, (Dhaka: Bangladesh Bureau of Statistics, December 2002).

*Human Development Report 1994*, (Delhi: Oxford University Press, 1994).

IEA, *Towards a Sustainable Energy Future*, (Paris: International Energy Agency/OECD, 2001).

IMF, *Bangladesh-Selected Issues*, (Washington D.C.: IMF, 1998).

Mastaller, Michael, Roger D Montgomery, Joseph A Weinstock, *Bangladesh toward an Environment Strategy*, (Manila: Asian Development Bank, 2000).

OECD, *Global Energy: The Changing Outlook*, (Paris CEDEX: International Energy Agency/OECD, 1992).

Peoples Republic of Bnagladesh, *Bangladesh Economic Review 2002*, (Dhaka: Ministry of Finance, June 2002).

Reddy, Amulya K.N., Robert H. Williams, Thomas B. Johansson, *Energy After Rio: Prospects and Challenges*, (New York: UNDP, 1997).

Rehman, Atiur, M. Ashraf Ali, Farooque Chowdhury, (eds), *People's Report on Bangladesh Environment 2001: Vol.I-Main Report and Vol.II-Database*, (Dhaka: The University Press Limited, 2001).

The World Bank, *Bangladesh: Progress Through Partnership*, (Washington D.C.: IBRD/The World Bank, 1999).

The World Bank, *Energy Efficiency and Conservation in the Developing World: The World Bank's Role*, (Washington D.C.: The World Bank, 1995).

UN, *Energy Issues and Prospects in the Asia Pacific Region*, (New York: UN, 1988).

UN, *Energy Statistics: Definitions, Units of Measure and Conversion Factors*, (New York: UN, 1987).

UN, *Energy, Environment and Sustainable Development III – Energy Infrastructure Policies and Issues: Energy Resources Development Series, No.36*, (New York: UN, 1999).

UN, *World Energy Assessment: Energy and the Challenge of Sustainability*, (New York: UNDP, 2000).

**Secondary Sources**

**Books**

Ahmad, Q.K., Nilufar Ahmad and K.B. Sajjadur Rashid, (eds), *Resources, Environment and Development in Bangladesh with Particular Reference to the Ganges, Brahmaputra and Meghna Basins*, (Dhaka: Academic Publishers, 1994).

Alauddin, Mohammad and Clement Allan Tisdel, *Environment and Economic Development in South Asia: An Overview Concentrating on Bangladesh*, (Hampshire: McMillan Press Limited, 1998).

Audinet, Pierre, P.R. Shukla and Frederic Grare, (eds), *India's Energy: Essays on Sustainable Develoopment*, (New Delhi: Manohar Publishers and Distributors, 2000).

Banerjee, Dipankar, (ed), *Security Studies in South Asia: Change and Challenges*, (Colombo: Regional Centre for Strategic Studies, 2000).

*Bangladesh 2020: A Long-run Perspective Study*, (Dhaka: The University Press Limited, 1999).

Barnett, Jon, *The Meaning of Environmental Security: Ecological Politics and Policy in the New Security Era*, (London and New York: Zed Book Limited, 2001).

Basrur, Rajesh M., (ed), *Security in the New Millennium: Views from South Asia*, (New Delhi: India Research Press, 2001).

Belgrave, Robert, Charles K Ebinger, Hideaki Okino, (eds), *Energy Security to 2000*, (Aldershot: Gower Publishing Company Limited, 1987).

Biswas, Asit K., J.S.A. Brichieri-Colombi, Amirul Islam Chowdhury, K.B. Sajjadur Rasheed, (eds), *Contemporary Issues in Development*, (Dhaka: Academic Press and Publishers, 2002).

Buzan, Barry, *People, State and Fear: An Agenda for International Security Studies in the Post-Cold War Era*, (London: Harvester Wheatsheaf, 1991).

*Changes and Challenges: A Review of Bangladesh's Development 2000*, (Dhaka: The University Press Limited, 2001).

Chari, P.R., (ed), *Perspectives on National Security in South Asia: In Search of a New Paradigm*, (New Delhi: Manohar Publishers and Distributors, 1999).

Chari, P.R., Sonika Gupta, (eds), *Human Security in South Asia: Energy, Gender, Migration and Globalization*, (New Delhi: Social Science Press, 2003).

Chaturvedi, Pradeep, (ed), *Financing of Energy Sector in Developing Countries*, (New Delhi: Concept Publishing Company, 1999).

Clansen, Patric L., (ed), *Energy and National Security in the 21st Century*, (Washington D.C.: National Defence University Press, 1995).

Diece, David A. and Joseph S. Nye, *Energy and Security*, (Cambridge: Ballinger Publishing Company, 1981).

Dodds, Felix, (ed), *Earth Summit 2002: A New Deal*, (London: Earthscan Publications Limited, 2001).

Dunkerley, Joy, William Ramsay, Lincoln Gordon, Elizabeth Cecelski, *Energy Strategies for Developing Nations*, (Maryland: Johns Hopkins University Press, 1981).

Dutt, Gautam and N.H. Ravindranath, *Energy End Use: An Environmentally Sound Development Pathway*, (Manila: Asian Development Bank, n.a).

Ebenhack, Ben W., *Energy Resources: Availability, Use and Impact*, (Oklahoma: PennWell Publishing Company, 1995).

Elliott, David, *Energy, Society and Environment: Technology for a Sustainable Future*, (London: Routledge, 1998).

Fesharaki, Fereidun, Harrison Brown, Corazon M. Siddayao, Toufiq A. Siddiqi, Kirk R. Smith, Kim Woodard, *Critical Energy Issues in Asia and Pacific- The Next Twenty Years*, (Boulder and Colorado: Westview Press Inc., 1982).

Field, Barry C, *Natural Resource Economics-An Introduction*, (New York: McGraw-Hill/Irwin, 2001).

Gaan, Narottam, *Environment and National Security: The Case of South Asia*, (New Delhi: South Asian Publishers Private Limited, 2000).

Gain, Philip, (ed), *Bangladesh Environment Facing the 21st Century*, (Dhaka: Society for Environment and Human Development, 2002).

Gibbons, John H. and William A. Chandler, *Energy-The Conservation Revolution*, (London and New York: Plenum Press, 1981).

Grubb, Michael, Mathias Koch, Abby Munson, Francis Sullivan, Koy Thomson, *The Earth Summit Agreements: A Guide and Assessment*, (London: The Royal Institute of International Affairs, 1993).

Iftekharuzzaman, (ed), *Regional Economic Trends South Asian Security*, (New Delhi: Manohar Publishers and Distributors, 1997).

Indian National Academy of Engineering, *Energy for Growth and Sustainability*, (New Delhi: Indian National Academy of Engineering, 1998).

Institute for Integrated Development Studies, *Regional Energy Grid in the GBM Region*, (Kathmandu: Institute for Integrated Development Studies, 2000).

Kabir, Mohammad Humayun, (ed), *National Security of Bangladesh in the 21st Century*, (Dhaka: Academic Press and Publishers Limited, 2000).

Lohani, Mohan P., (ed), *Security in South Asia*, (Kathmandu: Institute of Foreign Affairs, 2001).

Loulou, Richard, P.R. Shukla, Amit Kanudia, *Energy and Environment Policies for a Sustainable Future*, (New Delhi: Allied Publishers Limited, 1997).

Lucas, Nigel J.D., Jayaprakash Ambali, Eugene Chang, Marinette S. Forbes- Ricarte, Ram Manohar Shreshta, *Energy Policies in Asia: A Comprehensive Study*, (Singapore: McGraw-Hill Book Company, 1987).

Mahajan, V.S., (ed), *Studies in Energy and Economic Development*, (New Delhi: Deep and Deep Publications, 1991).

Mahajan, V.S., S.K. Agnihotri, R.P. Athparia, (eds), *Energy and Energy Resource Management*, (New Delhi: Deep and Deep Publications, 1999).

Martin, William F., Ryukichi Imai, Helga Steeg, *Maintaining Energy Security in Global Context*, (New York, Paris, Tokyo: The Trilateral commission, 1996).

Mazumdar, B., *A Text Book of Energy Technology: Both Conventional and Renewable Sources of Energy*, (New Delhi: APH Publishing Corporation, 1999).

Middleton, Nick, *The Global Casino: An Introduction to Environmental Issues*, (London: Edward Arnold, 1995).

*Migration and Globalization*, (New Delhi: Social Science Press, 2003).

Morony, John R., *Advances in the Economics of Energy and Resources Vol.XI, 1999*, (Connecticut: Jai Press Inc., 1999).

O'Callaghan, Paul W., *Energy Management*, (Berkshire: McGraw-Hill Book Company Europe, 1993).

Pachauri, R.K., (ed), *Glabal Energy Interactions*, (New York: Allied Publishers Private Limited, 1987).

Rahman, A. Atiq, Raana Haider, Saleemul Huq, Eiriq G. Jansen, (eds), *Environment and Development in Bangladesh: Vol.II,* (Dhaka: The University Press Limited, 1994).

Rao, Digumarti Bhaskara, (ed), *Earth Summit Part 1 and 2*, (New Delhi: Discovery Publishing House, 1998).

Razavi, Hossein, *Financing Energy Projects in Emerging Economies*, (Oklahoma: PennWell Publishing Company, 1996).

Sheenan, Michael, (ed), *National and International Security*, (Aldershot: Dartmouth Publishing Company Limited, 1996).

Shukla, S.K. and P.R. Srivastava, (eds), *Environmental Energy Impact Analysis*, (New Delhi: Commonwealth Publishers, 1992).

Sinha, P.C., (ed), *International Encyclopaedia of Sustainable Development – Volume 18: Energy Crisis*, (New Delhi: Anmol Publications Private Limited, 1998).

Smil, Vaclav and William E. Knowland, *Energy in Developing World: The Rural Energy Crisis*, (New York: Oxford University Press, 1980).

Stagliano, Vito, *A Policy of Discontent: The Making of a National Energy Strategy*, (Oklahoma: PennWell Corporation, 2001).

Stevens, Paul, (ed), *Economics of Energy – Volume I and II*, (Glos: Edward Elgar Publishing Limited, 2000).

Trivedi, P.R. and Julka B.R., *Energy Management*, (New Delhi: Commonwealth Publishers, 1997).

Waqif, Arif A, (ed), *Regional Cooperation in Industry and Energy: Prospects for South Asia*, (New Delhi: Sage Publications India Private Limited, 1991).

Weinbaum, Marvin G., Chetan Kumar, (eds.), *South Asia Approaches the Millennium: Re-examining National Security*, (Boulder: Westview Press,1995).

World Energy Council, *Energy for Tomorrow's World – the Realities, the Real Options, and the Agenda for Achievement*, (New York: ST. Martin's Press Inc., 1993).

World Watch Institute, *Vital Signs 2002-2003: The Trends that are Shaping Our Future,* (London: Earthscan Publications Limited, 2002).

Yergin, Daniel and Martin Hillenbrand (eds), *Global Insecurity: Beyond Energy Future – A Strategy for Energy and Economic Renewal*, (Middlesex: Penguin Books Limited, 1983).

**Articles**

Abdus Sabur, A.K.M., "Degradation of Environment as aThreat to the Security of Bangladesh: Sources and Challenges", *BIISS Journal*, Vol.22, No.1, January 2001, pp.88-109.

Bhaskar, C. Uday, "Post-Cold War Security", *Strategic Analysis*, November 1997, pp 1132-1149.

Billah, Mustain Ahm and Md. Abdul Aziz Khan, "Gas Extraction and Its Implications for Economic Stability of Bangladesh", *The Bangladesh Development Studies*, Vol.27, No.3, September 2001, pp.1-37.

Brock, Lothar, "Peace through Parks: The Environment on the Peace Research Agenda" *Journal of Peace Research*, Vol.28, No.40, 1991, pp.

Brown, N., "Climate, Ecology, and International Security", *Survival*, Vol.31, No.6, 1989, p 519-532.

Chaudhury, Akhter Husain, "Agenda 21 and the Role of Local Authorities in Urban Environmental Management", *Asia Pacific Journal of Environment and Development*, Vol.5, No.2, December 1998, pp.86-92.

Chawdhury, Naveed Ahmed, "Sustainable Development and Environmental Risk: Implications for the Financial Sector", *Asia Pacific Journal of Environment and Development*, Vol.5, No.2, December 1998, pp.75-85.

Gaan, Narottam, "Comprehensive Security for South Asia: An Environmental Approach", *BIISS Journal*, Vol.20, No.2, 1999, pp.102-114.

Hamour, El-Waleed A., "Some Contemporary Energy Issues and the OIC Countries", *Journal of Economic Cooperation*, Vol.21, Oct 2000, pp.29-42.

Jaccard, Mark, Mujibur Rahman Khan and John Richards, "Natural Gas Options for Bangladesh", *CPR Commentary*, No.1, Winter 2000, pp.1-61.

Kalam, Abul, "National Security of Bangladesh in the 21st Century", *BIISS Journal*, Vol.23, No.1, January 2002, pp.85-107.

Kumar, Sunil, "Rethinking Security in South Asia", *International Studies*, Vol.36, No.2, 1999, pp.106-118.

Lama, Mahendra P., "Economic Reforms and the Energy Sector in South Asia: Scope for Cross Border Trade", *South Asian Survey*, Vol.7, No.1, Jan-June 2000, pp.3-23.

Nuruzzaman, Md., "National Security of Bangladesh: Challenges and Options", *BIISS Journal*, Vol.12, No.3, 1991, pp.367-407.

Pachaury, R.K., "Energy and Environment in the Context of SAARC", *South Asian Survey*, Vol.4, No.2, July-Dec 1997, pp.295-307.

Sarkar, M.A.R., M. Ehsan and M.A. Islam, "Issues Relating to Energy Conservation and Renewable Energy in Bangladesh", *Energy for Sustainable Development*, Vol.7, No.2, June 2003, pp.77-87.

Tamim, M., "Policies and Priorities in Bangladesh Gas Sector Planning", *Energy for Sustainable Development*, Vol.7, No.2, June 2003, pp.57-65.

Tuchman-Mathews, Jessica, "Redefining Security", *Foreign Affairs*, Vol.68, No.2, 1989, pp 162-77.

**Web Sites**

http://news.bbc.co.uk/hi/english/world/south_asia/newsid_1630000/1630925.stm

http://www.acdis.uiuc.edu/homepage_docs/pubs_docs/PDF_Files/Samrina/contents/part1.html

http://www.businessweek.com/bwdaily/dnflash/may2001/nf2001056_893.htm

http://www.developmentfirst.org/studies/BangladeshCountryStudies.pdf

http://www.e-mela.com/lekha/gas_condition_Anu022102.html

http://www.emrd-gob.org/

http://www.gasandoil.com/goc/news

http://www.itee.uq.edu.au/~aupec01/052%AUPECol.pdf

http://www.nbr.org/regional_studies/Bangladesh/bangladesh_initial-study_VIII.html

http://www.petrobangla.org/

http://www.undp.org/seed/energy/chapter2.html

http://www.unocal.com/globalops/

www.cpd-bangladesh.com

www.dfid.gov.uk

www.eia.doe/emeu/cabs/bangla.html

www.usaid.gov/bd.html