LOW EMISSION DEVELOPMENT STRATEGY PRE-SCOPING MISSION ASSESSMENT– BANGLADESH

October 2010
This report was produced for review by the United States Agency for International Development (USAID). It was prepared by International Resources Group (IRG).

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ACRONYMS

ADB	Asian Development Bank
APERC	Asia Pacific Energy Research Centre
BBS	Bangladesh Bureau of Statistics
BCAS	Bangladesh Centre for Advanced Studies
BCSIR	Bangladesh Council of Scientific and Industrial Research
BER	Bangladesh Economic Review
BPC	Bangladesh Petroleum Corporation
BPDB	Bangladesh Power Development Board
BPSDB	Bangladesh Power Sector Data Book
BRAC	Bangladesh Rural Advancement Committee
CAIT	Climate Analysis Indicators Tool
CCSAP	Climate Change Strategy and Action Plan
CFL	Compact Florescent Lamp
DESA	Dhaka Electric Supply Authority
DFID	United Kingdom Department for International Development
EPA	Environmental Protection Agency
FDI	Foreign Direct Investment
FMP	Forestry Master Plan
INC	INC
GCC	Global Climate Change
GDP	gross domestic product
GERIAP	Greenhouse Gas Emission Reduction from Industry in Asia and the Pacific Initiative
GHG	greenhouse gas
GoB	Government of Bangladesh
IAST	Inter-Agency Scoping Team
ICEA	USAID Improved Capacity for Energy Access project
IFC	International Finance Corporation

IFRD	The Institute of Fuel Research and Development
IMF	International Monetary Fund
LEAP	Long-range Energy Alternative Planning
LEDS	low-emissions development strategies
LPG	liquefied petroleum gas
MPEMR	Ministry of Power, Energy, and Mineral Resources
MOEF	Ministry of Environment and Forests
MRV	monitoring, reporting, and verification
PBSs	Palli Bidyut Samitis
PRSP	Poverty Reduction Strategy Paper
PSMP	Power Sector Master Plan
RADP	Revised Annual Development Program
REB	Rural Electrification Board
RIMS	Resource Information Management System
SEDA	Sustainable Energy Development Authority
SMEs	small and medium enterprises
SNC	Second National Communications
UN	United Nations
UNDP	United Nations Development Program
UNEP	United Nations Environmental Program
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
USFS	U.S. Forestry Service
USG	U.S. Government
World Bank	World Bank
WRI	World Resources Institute

CHAPTER 1 – CONTEXT AND APPROACH

BACKGROUND

Developing countries are amongst the most vulnerable in the world to climate change. As a cross-cutting stressor on human and natural systems, climate change will exacerbate existing economic, social, and governance stresses, adding an additional challenge to the achievement of development priorities such as economic development, sustainable management of natural resources, and poverty alleviation. However, it may also offer opportunities for countries to stimulate employment and attract greater investment and financial flows through carbon markets. Addressing the challenges and leveraging the opportunities associated with climate change and development will require shifts in thought and behavior, capacity and resources, as well as creative methodologies and approaches.

To reduce their vulnerability, leverage their potential role in mitigating greenhouse gas (GHG) emissions, and support long-term climate-resilient development, the United States Agency for International Development (USAID) Global Climate Change (GCC) Program, in coordination with other US government (USG) agencies and international partners, has developed a methodology for low-emissions development strategies (LEDS) in select partner countries. LEDS are geared to the pursuit of development pathways that enhance countries' resilience to climate change, reduce GHG emissions over the long term, and provide opportunities to promote employment and investment flows through access to carbon markets. In recognition of the necessarily country-specific nature of a LEDS, USAID's GCC team has commissioned a series of assessments to be conducted in priority countries, including in Bangladesh and Vietnam.

OBJECTIVES

The objective of this assessment is to conduct and summarize in a report an analysis of the priority technical, institutional, and capacity needs and gaps related to LEDS development and implementation in Bangladesh. This report will be used to inform and guide a U.S. Inter-Agency Scoping Team (IAST) in its evaluation of the key LEDS-related needs and gaps in Bangladesh. The IAST's findings and recommendations will provide the basis for further U.S. engagement with and support to countries for the development and implementation of LEDS. Although it is meant primarily for the IAST, this pre-scoping assessment report may also serve as a useful reference for other USG entities, bilateral donors, multilateral development banks, and other development partners.

Drawing on an extensive review of official documents and other literature as well as in-country consultations in Dhaka from October 4-7, 2010, this report seeks to address the following questions:

- What are the priority technical, institutional, policy, capacity, and data needs and gaps for the development and implementation of a LEDS in Bangladesh, and the potential opportunities for USAID?
- Based on lessons learned from past initiatives, strategies, or plans, including those that are specific to relevant areas such as REDD+ or energy efficiency, what are the key considerations for the development of a LEDS in Bangladesh?

- Who are the key people to meet with in regard to a LEDS?

METHODS

The Assessment Process consisted of two main components, a comprehensive desktop study and consultations. The desktop study was carried out based on an extensive literature review (see Annex 1 for the list of documents) and consultation notes, where available. Source material included official documents such as national development and climate change strategies, Poverty Reduction Strategy Papers (PRSP), other reports and papers, and academic articles.

Consultations were held with 35 individuals from USAID (GCC team and Bangladesh mission), other USG agencies, multilateral development banks, bilateral donors, technical and research institutes, and private sector companies. Government of Bangladesh (GoB) officials were specifically excluded from this assessment. (See Annex 2 for a list of participants.) While consultations with USG agencies and those with key stakeholders took place at the front and back ends of the process respectively, the desktop review was conducted throughout the assessment. An iterative process was used, so that the desktop review was used to conduct an initial gap analysis of references, initiatives, strategies, policies, and data, which informed consultations. The information gathered through consultations was then used to further refine and augment the desktop review to ensure it was as current and complete as possible.

OUTLINE

The report is structured to follow the LEDS methodology, and Chapter 2 provides an overview of the country's location and geography, population, economy, government and politics, and foreign relations. Chapter 3 provides a summary of LEDS-relevant activities and initiatives that have been undertaken by GoB, multilateral and bilateral donors, technical and research institutes, NGOs, and the private sector. In Chapter 4, we describe previous and existing efforts relevant to the establishment of reference scenario, including the key source categories in the first and most recent GHG inventory, conducted as part of the country's Initial National Communication (INC) under the United Nations Framework Convention on Climate Change (UNFCCC), and assessments of mitigation options and potential.

In Chapter 5, we summarize priority development objectives and climate change impacts, followed by a discussion of studies on public and private sector capacity to achieve the objectives. The remainder of the chapter looks at the current status of renewable energy sources, energy efficiency, and land use policies and practices, and the key technical, academic, and government institutions. Chapter 6 examines the policy landscape and pathways analysis activities. Finally, in Chapter 7, we summarize the key findings of the report and provide a series of recommendations to the three questions the report seeks to address

CHAPTER 2 – COUNTRY OVERVIEW

LOCATION AND GEOGRAPHY

Bangladesh has a land area of about 130,200 square kilometers, and is situated in South Asia along the Bay of Bengal, bordering India and Burma. (See Table 1 for a regional snapshot.) It is a low-lying riparian country formed by a deltaic plain at the confluence of the Ganges, Brahmaputra, and Meghna Rivers, which accounts for its vulnerability to climate change impacts such as floods and sea level rise. It has a coastline of 710 kilometers (440 miles) on the northern littoral of the Bay of Bengal, and the coastal areas are subject to frequent tropical cyclones.[1] Hills feature prominently only in the Chittagong Hill Tracts in the southeast, and in the Sylhet division in the northeast. Of Bangladesh's total area, agricultural land accounts for approximately 65 percent (9.57 million hectares); forests 17 percent (2.52 million hectares); and urban areas 8 percent (1.16 million hectares).[2]

Bangladesh has a humid tropical climate. There are three seasons: a hot summer with irregular, intense rainfall events from March to June; a hot and humid monsoon season from June to October, providing two-thirds of total annual rainfall; and a cooler, drier winter season from November to March. Temperatures vary from 8°C (45°F) in December to more than 35°C (95°F) in summer. Mean annual rainfall ranges from 1200 mm (47") in the far west to 3800 mm (150") in the northeast.

Map 1. Bangladesh

Four types of ecosystems characterize Bangladesh, including coastal and marine ecosystems, inland freshwater ecosystems, forested ecosystems, and anthropogenic ecosystems. The Sundarbans are the world's largest mangrove forest at more than 410,000 hectares of land surface (larger than Rhode Island). A large number of wetlands around the country are globally important migratory bird areas in addition to providing critical fish protein to the population. The highest point in Bangladesh is in the Chittagong Hill Tracts (1,230 m), where one-third of all

[1] The International Disaster Database lists 157 cyclones between 1900 and 2009 (EM-DAT, 2010: http://www.emdat.be/search-details-disaster-list).

[2] FD http://www.bforest.gov.bd/land.php

flowering plant species in the country are found[3]. Forest types include tropical evergreens in the southeast, deciduous forests in the north and central plains, and the coastal mangroves. Besides the high diversity of birds and fish species, tigers, elephants, dolphins, and other wildlife are present.

Table 1. Regional Snapshot 2009

Country	Land Area(1) (km^2) (thousands)	Population(1) (million)	Pop. Density (1) (people/km^2)	GNI* per capita ($)[4]	HDI Ranking (2) (out of 182 countries)
Bangladesh	130.2	162.2	1,229	$590	146
India	2,973.2	1,155	383	$1,180	134
Burma	653.2	49.19	76	-	138
Nepal	143.4	29.3	201	$440	144
Bhutan	38.4	.0.697	18	$2,020	132

Source: (1) World Development Indicators Database, unless otherwise indicated

(2) Human Development Index, UNDP 2009, http://hdr.undp.org/en/statistics

Note: * GNI stands for Gross National Income

POPULATION

Bangladesh's population of approximately 162 million, of which 7.5 percent (+12 million) resides in the capital city of Dhaka[5] and its metropolitan area, is predominantly ethnic Bengali and Muslim, accounting for 98 and 83 percent[6] respectively. In terms of ethnic groups, the remainder of the population is comprised of Urdu-speaking minority groups of Indian origin as well as various tribal groups found primarily in the Chittagong Hills Tracts. Although Islam is the dominant religion, Hindus constitute a significant minority at 16 percent, and a small number of Buddhists, Christians, and animists also exist. In addition to Bangla, English is an official language, and is spoken in urban areas and amongst educated groups. Most of the population of Bangladesh is rural (72 percent) and employed in agriculture, forestry, and fisheries (63 percent).[7] However, urban areas in this densely populated country, where population density is 1,229 people per km^2, are rapidly expanding with an urban population growth rate of 3.13 percent.[8]

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[3] USAID 2005.

[4] Unless indicated otherwise, all uses of $ refers to the US dollar.

[5] Dhaka City Corporation (DCC) is a self-governing corporation that is associated with the task of running the affairs of the city. The incorporated area is divided into several wards. Each ward has an elected ward commissioner. The mayor of the city is elected by popular vote every five years. The incumbent mayor is Sadeque Hossain Khoka. http://www.dhakacity.org

[6] Ethnic Bengalis account for approximately 98 percent of the population. (US State Department)

[7] Eleven percent of workforce of 70.86 million is employed in manufacturing, and 0.2 percent in mining and quarrying (US State Department).

[8] CIA

Table 2. Key population statistics

Annual population growth rate (%) (2009)	1.38
World population rank (2009)	7
% Rural (2006)	72.38
Life Expectancy (2008)	66.15
World Life Expectancy Rank (2000-05)	167
Infant Mortality (per 1,000 live births) (2009)	41.2

Despite the advances that the country has made in recent decades, significant portions of the population remain impoverished, with 40% living below the poverty line[9], high mortality rates, and low life expectancy rankings. This is due to the fact that a significant proportion of the population still suffers from deprivation. Further improvements in poverty alleviation and health will require continued economic growth. Improved access to secure, adequate, and stable energy supplies, even while reducing overall GHG emissions over the long term, will be an important factor in both economic and human development.

ECONOMY

Following independence in 1971, Bangladesh adopted a state-led model of development, and much of the industrial sector was nationalized. Efforts were made to provide the private sector with greater scope to participate in the economy beginning in 1975, and in the 1980s economic policies sought to accelerate private enterprise establishment and investment, denationalization of public industries, reinstatement of budgetary discipline, and liberalization of the export regime. The International Monetary Fund (IMF) supported Bangladesh's efforts to implement economic reforms between 1991 and 1993 through the enhanced structural adjustment facility, to which the country successfully adhered. However, domestic political failures resulted in a failure to complete the structural adjustment program. Between 2003 and 2006, the IMF provided additional support to a $490-million plan as part of the Poverty Reduction and Growth Facility.

Despite some progress in implementing macroeconomic reforms since the 1970s, reform has proceeded at a slow pace. Efforts to privatize public sector industries have been impeded by worker unrest in affected industries, as well as the government's inability to resist demands for wage hikes in government-owned industries. Together with the politics of confrontation and the level of corruption, this has resulted in increasing frustration amongst foreign investors in a broad range of sectors.

Nonetheless, in recent years, the economy of Bangladesh has experienced relatively rapid economic growth, with its gross domestic product (GDP) expanding at a rate of 5.83 percent, despite being plagued with high rates of population growth, weak infrastructure, insufficient power supplies, and slow implementation of economic reforms.[10] Integral to continued growth will be reliable access to electricity and fuel at stable prices; in a country whose energy demands outstrip supplies, imports will play an important role in filling this gap. The largest contributors to GDP are services, which account for nearly 53 percent of GDP; industry which comprises approximately 29 percent; and agriculture which accounts

[9] World Development Indicators, figure is for 2005, http://data.worldbank.org/country/bangladesh

[10] For 2009, World Development Indicators Database.

for about 19 percent[11]. The country's greatest endowments are its human capital, rich agricultural land, and substantial natural gas reserves.

In the industrial sector the country's ready-made garment industry has been expanding rapidly, growing at double-digit rates through the 1990s and creating an estimated 1.8 million new jobs, mostly for women. The industry's exports make up three-quarters of Bangladesh's export base, with jute, leather, shrimp, pharmaceuticals, and ceramics accounting for the remainder. Other key industries include sugar, tea, leather goods, newsprint, pharmaceutical, and fertilizer production. Most of the country's steel needs are met by the ship-breaking for scrap industry. To increase the country's attractiveness to foreign investment in areas such as private power generation, gas exploration and production, cellular telephony, textiles, and pharmaceuticals, a board of investment was established to simplify approval and start-up procedures for foreign investors. Moreover, export processing zones have been created in Chittagong (1983), Dhaka (1994), Comilla (2000), Mongla (2001), Iswardi (2005), Uttara (2006), and Karnafully (2007).

Although agriculture only accounts for about 19 percent of GDP, approximately 45 percent of Bangladeshis are employed in the sector,[12] and there is growing concern regarding underemployment and the ability of the sector to absorb additional manpower. The primary agricultural crops are jute and rice, with the country largely self-sufficient in the production of the latter. Wheat production has increased in recent years, although some producers have been switching to maize due to the expansion of irrigation networks, which has contributed to the increasing importance of maize as well as vegetables. Despite the country's output of key grains, population growth continues to place pressure on productive capacity, contributing to deficits of food, particularly of wheat, and nutrition, with an estimated 10 to 15 percent of the population threatened by severe nutritional risk. Imports and foreign assistance help to fill this gap.

In addition, since 1971, Bangladesh has received about $15 billion of disbursements of grant aid and loans (more than $30 billion has been committed) from foreign donors such as the World Bank (World Bank), the Asian Development Bank (ADB), the United Nations Development Program (UNDP), the United States, Japan, Saudi Arabia, and west European countries. Furthermore, remittances from overseas workers are an important component of GDP, though they could decline following a slowdown in the number of Bangladesh workers working abroad.

Table 3. Key economic statistics

GDP (2009, current international $ in millions, PPP) (Rank in World based on 2007 PPP)	230,395 (48)
GDP/Capita (current international $, PPP) (2009)	550.97
GDP Growth Rate (%) (2009)	5.88
Inflation (consumer prices, annual %) (2009)	5.42
Balance of Payments - Current account balance ($ billion) (2009)	3.34
Balance of Payments (BoP) - Current account balance as % of GDP (2009)	3.74
Foreign Direct Investment, net inflows (BoP, current $ thousands) (2006)	674,247
Foreign Direct Investment as % of GDP (net inflows) (2005)	0.75

[11] CIA World Factbook.

[12] CIA World Factbook.

GOVERNMENT AND POLITICS

When British India was partitioned into India and Pakistan in 1947 largely along religious lines, the region of Bengal was divided, with the Muslim portion, East Pakistan, and current-day Bangladesh being made part of Pakistan, and Hindu West Bengal becoming the Indian state. Despite their shared religion, however, linguistic, ethnic, and cultural differences led to friction between East and West Pakistan, with the former opposing efforts to institute Urdu as the country's official language. These tensions escalated and ultimately led to Bangladesh's secession from Pakistan in 1971. Pursuant to independence, a parliamentary democracy headed by a prime minister, based on a modified Westminster model, was put in place, and Bangladesh remains one of the world's few Muslim democracies.

Bangladesh's history has been marked by intermittent political unrest. The country experienced military coups in 1975 and 1982, followed by the imposition of martial law for three and four years respectively; both were ostensibly motivated by widespread corruption, ineffective governance, and economic mismanagement. Moreover, Bangladesh occasionally experiences unrest on the part of wage workers, as in the case of the garment industry strikes in 2010. Nonetheless, democracy is strongly valued by Bangladeshis, who exercise their right to vote in large numbers. The current regime under Prime Minister Sheikh Hasina, who also held the office of prime minister between 1996 and 2001, is committed to achieving key development goals as well as reductions in emissions from automobiles and brick kilns, as laid out in the country's National Strategy for Accelerated Poverty Reduction II (Revised) for FY 2009-2011.

FOREIGN RELATIONS

Bangladesh was admitted to the United Nations (UN) in 1974, and was elected to Security Council terms in 1978 and 2000-2001. In addition to participating in numerous international conferences, the country had deployed over 10,000 military personnel on peacekeeping operations as of November 2009, and they have served or are serving in Sierra Leone, Somalia, Rwanda, Mozambique, Kuwait, Ethiopia/Eritrea, Kosovo, Timor-Leste, Georgia, Congo, Cote d'Ivoire, Western Sahara, Bosnia, and Haiti. In terms of US-Bangladesh relations, notwithstanding their initially troubled nature due to the former's ties with Pakistan, they are currently strong, and the U.S., primarily through USAID, has provided over $5.5 billion in development assistance to fund initiatives in key areas such as health, education, disaster response, rural energy, economic growth, human trafficking, natural resources management, and climate change.

CHAPTER 3 – BACKGROUND ANALYSIS

Adaptation is the climate change priority in Bangladesh due to its high vulnerability to impacts such as sea level rise and extreme events, and its status as a low-emitting country, as clearly evidenced in the Climate Change Strategy and Action Plan (CCSAP) (2008, updated 2009). Nonetheless, in the CCSAP, the Government has stressed its willingness to contribute to global mitigation efforts to reduce greenhouse gas emissions, as long as those efforts are also congruous with the nation's energy security and development needs, and financial and technological support is provided by the international community. Thus, mitigation and low carbon development have been included in the CCSAP as one of the six pillars, and 10 broad programs have been laid out to support low-emissions objectives. It is important to note that although an explicit link is not made in the CCSAP between pursuit of a LED pathway and the country's overall development and climate objectives, a LEDS can play an important role in reducing Bangladesh's vulnerability to climate change. Effective management of scarce natural resources, increased efficiencies in production and consumption, and diversification of the energy source, all of which are integral aspects of a LEDS, will enhance the country's ability to anticipate and respond to climate change, ultimately reducing its overall vulnerability.

The six critical areas in the CCSAP to promote a climate-resilient, low-carbon development path are: 1) food security, social protection, and health; 2) comprehensive disaster management; 3) infrastructure; 4) research and knowledge management; 5) mitigation and low carbon development; and 6) capacity building and institutional strengthening..

Adaptation is prioritized over mitigation, and the recently established National Climate Change Fund, which was initially capitalized at $45 million, later increased to $100 million, will focus primarily on adaptation. Potential initiatives identified to support mitigation and low-carbon development are focused on the energy and forestry sectors, and include the transfer of technologies such as "clean coal", energy efficiency measures, and expansion of the social forestry and coastal afforestation programs. Despite broad formal political support for the CCSAP within the government, progress on implementation of the various programs has been limited. Approximately twenty programs from the capacity building; knowledge management; and food security, social protection, and health pillars have been chosen for more immediate implementation.

Although relatively little has been done on low-emissions development under the CCSAP, the GoB has taken a number of actions and implemented various LEDS-relevant initiatives primarily in the energy and forestry sectors, which accounted for the bulk of the country's GHG emissions in 1994, according to the INC (2002). The wide range of multilateral development banks, bilateral donors, NGOs, research institutions, and private sector entities have also concentrated their low-emissions development efforts in these two sectors.

GOVERNMENT INITIATIVES AND FORUMS

POLICY DOCUMENTS AND STRATEGIES

Addressing climate change, particularly as it affects the poorest and most disadvantaged populations, has been recognized as a pressing need for Bangladesh. The INC prioritized adaptation over mitigation, and

focused on the impacts of climate change on the key sectors of fresh water resources, coastal zone and coastal resources, agriculture, forests and biodiversity, fisheries, human health, and socio-economic aspects. Even as it stressed its status as a low-emitting country, GoB also conducted an assessment of mitigation potential, focusing on the primary contributing sectors of energy, forestry, agriculture, and waste water management. (The mitigation options laid out in the INC are listed by sector in Chapter 4.)

The mitigation options are not clearly prioritized in the INC; however, according to it, the following mitigation projects were at an advanced planning stage or underway during the time this report was published. Most notably: (i) a shift to combined cycle power generation; (ii) phasing out two-stroke engines to 4 stroke-engines in auto rickshaws; (iii) conversion of the petrol driven vehicles with compressed natural gas (CNG) in the public transportation; (iv) solar home systems in rural areas; replacing incandescent bulbs with compact fluorescent lamps (CFLs); and (iv) improving efficiency in the brick manufacturing process.

SECTOR-SPECIFIC ACTIVITIES

POWER AND ENERGY

In the power sector, continuous shortfalls between the country's rapidly expanding energy needs and the ability of the three public sector entities, the Bangladesh Power Development Board (BPDB), the Rural Electrification Board (REB), and the Dhaka Power Distribution Company, to meet them have spurred government efforts to reform and restructure the industry. Restructuring has entailed:

- Opening of the sector to private companies and the establishment of the BPDB as a holding company under which companies offering generation, transmission, and distribution services are subsidiaries
- Separation of the power generation, transmission, and distribution functions
- Introduction of tariffs reflecting true costs
- Promotion of demand-side management measures
- Development of alternative and renewable sources of energy

The government also adopted the Renewable Energy Policy in 2008, which called for the establishment of the Sustainable Energy Development Authority (SEDA) to serve as a focal point for the development and promotion of sustainable energy, which encompasses renewable energy as well as energy efficiency and conservation. The Renewable Energy Policy lists the various responsibilities that SEDA would have. Two of these responsibilities are data collection and assessing the renewable energy resource base, and stimulating market development for sustainable energy technologies such as improved cookstoves and household biodigesters.

Despite some success including greater participation of the private sector, an increase in generation capacity of 1,328 MW by independent power producers, and reductions in systems losses, progress of the reforms has been limited. As a result, they are not viewed as successful, and the Government is frequently criticized for its inability to address the power deficit, and the resultant frequent load shedding. Policy implementation in other areas has also been slow. For example, although there was support for the establishment of SEDA in 2008 when the Renewable Energy Policy was passed under the previous government, it has waned since, largely for political reasons[13].

[13] The former head of the Power Cell, who was the driving force behind SEDA, has been vocal in his criticism of the current Government.

FORESTRY

Although the INC details a number of mitigation options considered in the land use and forest sector, Bangladesh is only now undertaking serious efforts to develop forest policies, rules and regulations, and programs that support a low-carbon strategy in the sector. Highlights of the emerging framework include the following (a complete listing of forest sector policies is provided in Annex 7):

- Bangladesh is one of eighteen official Observer countries for the UN-REDD Programme, and is likely to begin a country program in 2011.
- Applying to World Bank Forest Carbon Partnership Facility for REDD Readiness funding
- USAID IPAC and the U.S. Forest Service (USFS) have conducted a number of training events with district leaders from around the country to increase awareness and understanding of REDD. The Forest Department continues to request and receive USAID support for preparing REDD and afforestation/reforestation (A/R) projects for voluntary markets, including preparation of Social Forestry Rules which will provide for equitable distribution of benefits from community-managed forests.
- No national forest inventory has been conducted, although JICA has recently engaged Bangladesh Centre for Advanced Studies (BCAS) to produce its Second National Communication under the UNFCCC.

AGRICULTURE

Most of the GoB attention to agriculture is related to adaptation rather than mitigation. In their INC, a large number of mitigation options were mentioned by GoB, ranging from faster-maturing rice varieties that require less flooding to covered lagoons for capturing methane from livestock manure. However, no analysis was provided of the options, and many appear to be copied from US EPA (Environmental Protection Agency) manuals and literature rather than based on country-specific context and feasibility

Key national policy documents related to the agriculture sector include the following:

Agriculture and climate change

- Synthesis of Agricultural Policies in Bangladesh (Ministry of Agriculture and FAO 2006)

General agriculture

- Revised Poverty Reduction Strategy Paper II (2009-2011) – a Tk2,814.81 billion ($40.9 billion) effort of the National Economic Council, led by the Ministry of Planning and Ministry of Finance. Of the total, the agriculture sector is allocated 5.3% (149.28 billion taka, or $2.17 billion).
- National Food Policy (2006) and its Plan of Action (2008-2015) – focuses on food security rather than climate change; not directly relevant for LEDS.
- National Fisheries Strategy and Inland Capture Fisheries Strategy (2006) – produced by Ministry of Fisheries and Livestock, which has responsibility for GoB response to avian influenza, among other issues.

TRANSPORT

Traditional auto rickshaws that run on gasoline were seen as being a major source of air pollution in Dhaka due to the sheer numbers of rickshaws in operation and the major traffic congestion they caused. In January 2003, traditional auto rickshaws were banned from operating in Dhaka; only CNG-powered models were permitted. The success can be attributed to private sector participation, establishing many CNG stations (582 now), and decreases in the price of CNG (domestically produced and cheaper than gasoline). According to recent news[14], the Bangladeshi government will start to manufacture three-wheeler CNG-driven auto rickshaws domestically with a view to replacing the city's non-motorized rickshaws. This initiative is led by the Ministry of Industries and implemented by the Bangladesh Industrial Technical Assistance Centre and Bangladesh Steel and Engineering Corporation (BSEC), both autonomous bodies under the Ministry of Industries.

Photo: Energy Bangla

FORUMS

To implement the CCSAP and to oversee the country's climate initiatives, the National Steering Committee on Climate Change (NSCCC) and Climate Change Unit have recently been established or mandated. The former is tasked with overseeing the implementation of the CCSAP, and is chaired by the Ministry of Environment and Forests (MOEF), which also serves as the international focal point for climate change. The Secretaries of all climate-affected ministries and divisions as well as representatives from civil society and the private sector sit on the NSCCC. The proposed Climate Change Unit under the MOEF is expected to be made responsible for ensuring the integration of climate change into national planning, together with the Climate Change Focal Point of each of the ministries. The Planning Commission, under the Ministry of Planning, is responsible for the integration of climate change-related issues into the planning framework and acts as the final approving authority for programs and projects carried out as part of the CCSAP. Despite these efforts to mainstream climate change considerations, the tendency for the climate change focal points to represent their particular ministry's interests in intergovernmental negotiations has impeded broad integration of climate change considerations into the planning process.

No overarching forums exist to promote low-emissions planning activities. In terms of sector-specific forums:

- Renewable Energy and Energy Efficiency – Most initiatives on policy formulation for advancement of renewables and energy efficiency have been supported via development assistance from donor nations and international organizations rather than being driven by national stakeholders. There are no known inter-ministerial or stakeholder forums for coordinating policies and programs for renewable energy and energy efficiency.
- Land Use – No known inter-ministerial or stakeholder forums for coordinating policies and programs for land use policy decision processes exists.

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[14] "Bangladesh to manufacture CNG-driven auto- rickshaw" Energy Bangla, September 25, 2010. http://www.energybangla.com/index.php?mod=article&cat=GreenPage&article=2747

- Agriculture – There are no known inter-ministerial forums for agriculture; likewise, no forum exists among stakeholders in the sector. Lack of coordination was cited by FAO (2006) as a serious policy impediment. The Ministry of Food and Disaster Management, however, led a task force involving 11 ministries to produce the National Food Policy Plan of Action (2008-2015).
- Forestry – Forestry Department provides coordination internally with its home Ministry of Environment and Forests, and works/worked closely with USAID's Integrated Protected Areas Co-management (IPAC) project and its predecessor Nishorgo Support Program. There is limited inter-ministerial collaboration and no known stakeholder forum related to the forest sector.

MULTILATERAL AND BILATERAL DONORS' ACTIVITIES

There is currently a wide range of donor activities pertaining to low emissions development taking place in Bangladesh, with most focusing on the forestry and energy sectors. The majority of donor LEDS relevant activities have been concentrated in the energy sector, including renewable energy and energy efficiency. In terms of energy efficiency, GTZ has been promoting the use of improved technologies such as cookstoves, household biodigesters, kilns, and rice parboilers as well as eco-efficiency, with special emphasis on energy savings and measures in the ready-made garments sector. The World Bank has provided loans and technical assistance to reform the power sector, and the World Bank and GTZ have implemented numerous energy efficiency and renewable energy projects.

In the area of renewable energy, both have been supporting or working with local organizations such as the Infrastructure Development Company Limited (IDCOL) and Grameen Shakti to disseminate solar home systems to increase power access in remote areas. GTZ has also partnered with the International Finance Corporation (IFC) and local organizations to promote the industrial and commercial use of biogas digesters in slaughterhouses, dairy farms, and layer poultry farms as well as hostels, madrassas, schools, and police stations. They also have a pilot project that endeavors to produce electricity with captive biogas-powered generators on larger poultry farms.

Under the USAID project Improved Capacity for Energy Access (ICEA), a biomass resource assessment was conducted. The objectives were to evaluate the availability and potential supply capacity of biomass energy based on decentralized electricity options for rural electrification, and provide a summary of the potential to utilize biomass fuel for power generation in the range of 1 to 7 MW plant capacities. The biomass resources included in the assessment were rice husk, bagasse, corn cobs, coconut shell and husk, poultry droppings, and cow dung. (More details on donor projects can be found in Annex 4.)

In terms of forestry, the three most noteworthy initiatives are the GTZ forest conservation project in Chunoti Wildlife Sanctuary (pending approval by the government, $5 million over 3 years), and the previously mentioned USAID IPAC project. The latter is a successor to the Nishorgo Support Program, and has provided a series of trainings to Forest Department officials to strengthen their understanding of carbon estimation and monitoring of carbon projects, and has supported the Forest Department as it initiates dialogue internally and with other government entities regarding the development of a REDD+ policy and institutional framework. The third is another USAID funded initiative, the Arannayk Foundation, which is supported through a debt-for-nature swap under the U.S. Tropical Forest Act of 1998. A few key summary documents from these activities include the following:

- Making Conservation Work: Linking rural livelihoods and protected area management in Bangladesh (J. Fox et al., 2007)
- Rights Reference Manual for Zones of Good Governance (DeCosse and Ward, 2006) [USAID PN-ADK-882; available at http://dec.usaid.gov/]

- Conserving Forests for the Future: Arannayk Foundation Annual Report 2009 [available at http://arannayk.org/index.php]

Most donor agricultural activities related to climate change are focused on adaptation rather than mitigation. This includes a large number of donors actively involved with local and international NGOs from across the spectrum. Many of these projects include poverty-reduction and/or food security aspects in addition to climate change adaptation. A key documents in the sector is Feed the Future – Bangladesh Country Strategy (USAID 2010).

In addition to activities that are directly relevant to a LEDS, many donors' adaptation initiatives that seek to enhance the climate resilience of Bangladesh also yield mitigation co-benefits. For example, in the case of GTZ's Wetland Biodiversity Rehabilitation project, habitat restoration through the reintroduction of lost riparian and swamp tree species will also have sequestration benefits. There are also various donor efforts to address both mitigation and adaptation such as the United Nations Environmental Program (UNEP)'s Technology Needs Assessment, which assists select countries identify adaptation and mitigation technology priorities, the ADB's largely capacity building-focused technical assistance Supporting Implementation of Bangladesh Climate Change Strategy and Action Plan, and USAID's IPAC project, which uses a co-management strategy to enhance forest conservation.

RESEARCH INSTITUTES

There are several institutes conducting research on energy issues, including the development and dissemination of renewable energy and innovative energy technologies. (A list can be found in Annex 5.) One particularly prolific entity is the government institute the Bangladesh Council of Scientific and Industrial Research (BCSIR), which has developed numerous technologies to promote energy efficiency and renewable energy sources. They include improved cookstoves, portable biogas digesters, solar lamps, and insulating bricks. BCSIR has also developed a hybrid solar technology that can be connected to the grid, so that when the solar component works, power is generated and fed into the line. Despite the potential of some of these technologies, a major gap remains between development and dissemination, which has impeded uptake of many of these technologies.

In the forest sector, the Bangladesh Forest Research Institute (BFRI) conducted early research on carbon stock assessments in different forest types, and more recently was engaged by USAID's IPAC project to provide technical support to the forest inventory and carbon accounting portions of training on forest carbon project development.

The Ministry of Agriculture includes seven commodity-focused research institutes among its network of departments, agencies, and other institutions. None of these is focused on climate mitigation in the agriculture sector, although the Bangladesh Rice Research Institute (BRRI) is experimenting with drought- and salinity-resistant varieties.

Among universities in Bangladesh, several have faculty and graduate students with research interests in agriculture, forestry, and climate interactions. These include North-South University, Independent University of Bangladesh, Jahangirnagar University, Kulna University, Institute of Forestry and Environmental Sciences at Chittagong University and the Agricultural University of Bangladesh.

NGOs

A number of NGOs at the national and local levels have acted as implementing partners for donor-funded low emissions activities. (See Annex 5 for a more comprehensive list.) At the national level, Waste Concern has worked with UNDP and the MOEF to develop a policy and institutional framework for Clean Development Mechanism (CDM) projects under the UNFCCC, and had the CDM-approved project in the country and the first composting CDM project globally. Several local NGOs, such as the

Rural Services Foundation, have been involved in the World Bank's solar home systems initiatives, and have worked with IDCOL and Grameen Shakti to facilitate the dissemination of photovoltaic technologies in remote communities. Local NGOs in particular often play a key role in technology dissemination, as they work with communities to educate them about a technology, its uses, and benefits, and help to overcome social and cultural barriers.

Arannayk Foundation has supported 20 different projects run by local and national NGOs since 2006, at a total value of 126.8 million Taka ($1.84 milion). While none of these projects have involved either GHG mitigation or climate change adaptation, many have climate-related co-benefits to their main objectives. Those objectives typically involve habitat restoration, conservation education, natural resource-based enterprises using non-timber forest products, and community co-management of natural resources. The ecosystem and geographic spread has covered the coastal swamp forests, freshwater wetland areas, deciduous Sal forests (*Shorea robusta*), coniferous forests in the Chittagong Hill Tracts and a number of medicinal herbs and other non-timber species. The mixture of livelihoods, governance, and biodiversity in these projects lends itself well to integrating carbon sequestration and climate adaptation into future efforts. Arannayk Foundation executives have expressed interest in doing so.

COMPANIES

The two companies that stand out in terms of their involvement in activities relevant to low-emissions development are IDCOL and Rahimafrooz. IDCOL has been credited with the widespread distribution of the solar home systems and the success of the projects supporting them. Rahimafrooz, which consists of a group of companies, has a renewable energy company that has been providing solar energy technologies and solutions for households; key economic and development sectors such as agriculture, healthcare, education, and telecommunications; and government and private institutions It is also a pioneer in the development of solar hybrid technology. Recently, Rahimafrooz partnered with Carbon Planet of Australia to launch Bangladesh Carbon, a carbon trading consultancy, which offers services to develop, implement, and commercialize projects adhering to CDM guidelines. They currently have three projects in the stage of developing project design documents, at least one of which they are hoping to be able to submit in 2011.

BARRIERS

- A disconnect between different ministries, as well as a disconnect among policymakers, technical experts, and implementers, have hindered policy implementation.
- Lack of regulatory oversight by a strong enforcement body, due to the Bangladesh Energy Regulatory Commission's status as an entity under the Power Cell rather than an independent unit, offers little incentive for compliance with existing regulations in the power sector.
- Much of the activity in the area of sustainable energy is research-oriented, with few technologies being taken to the market, partly as a result of a lack of an appropriate legal, regulatory, and policy framework.
- Limited technical capacity to install, operate, manage, and maintain sustainable energy technologies has been a bottleneck to widespread diffusion.
- Low awareness amongst citizens as well as policy and other decision-makers regarding sustainable energy technologies and measures, and their development benefits has impeded their uptake.
- Limited information about and knowledge of sustainable energy technologies, weak technical capacity of citizens and businesses, technologies that are developed without consideration of cultural and social sensitivities, and a reluctance to switch from familiar methods and technologies to new ones have prevented the adoption and use of new technologies.

- Lack of after sales (post-installation) services has deterred potential customers.
- High initial upfront costs and lack of financing options have deterred the use of renewable energy and energy efficiency technologies in some cases.
- Corruption and weak enforcement of payment collection has resulted in an unwillingness to pay for electricity.
- The small and dispersed nature of renewable energy has prevented economies of scale.
- Awareness of REDD is becoming more widespread, but this has raised expectations far beyond the real potential in the country, whether relying on donor support or functioning markets.
- A very small subset of individuals has moved from awareness to understanding, with fewer still having demonstrable knowledge of AFOLU issues within the climate change arena.
- Arguably, the three most knowledgeable individuals in Bangladesh on REDD are the Chief Conservator of Forests at Forest Department, the Deputy Chief of Party for USAID's IPAC project (an Indian national), and the USAID FSN project manager for IPAC.

LESSONS LEARNED

- Private sector involvement will be increasingly crucial not only for the development of relevant technologies, but also for their application to achieve impact.
- For companies to adopt sustainable energy technologies or measures, the business case must be compelling, and the payoff period must not be longer than 36 months.
- Awareness raising and measures increasing the likelihood of technology access and continued use, such as microloans and long-term equipment maintenance assistance programs, are key to the success of sustainable energy measures at the industrial, commercial, and household levels.
- The range of REDD issues – from soil carbon assessment to tax treatment of offset sales – is large, complex, and full of uncertainties. Therefore, acquiring the ability to actively participate in carbon markets or other international mechanisms cannot be achieved through a few brief training sessions. Dedicated efforts at learning-by-doing will lead to better capacity.

GAPS

Energy and Power

- Most donor funded projects in the renewable energy sector are focused on rural applications, and there is a gap in the analytical work for grid-connected RE solutions and a policy framework that would promote the integration of RE into the power system, which to date have not been able to compete with thermal options.

Agriculture

- No known current ongoing research or field programs aimed at identifying viable ways to reduce methane emissions from paddy rice in the social, economic, and cultural context of rural Bangladesh

Forestry

- Current status not known of UN-REDD Programme application process

- World Bank Forest Carbon Partnership Facility interested in reviewing Chunoti, Sundarbans, and bundled protected areas projects for possible inclusion within its REDD Readiness operations
- Knowledge of REDD remains weak and thin within the implementation ranks of Forest Department despite proactive training efforts
- Senior FD official designated in charge of REDD readiness has limited knowledge about concepts, principles, or requirements for REDD policies and operations

CHAPTER 4 – DETERMINING THE REFERENCE SCENARIO

ACTIVITIES PERTAINING TO THE ESTABLISHMENT OF A LEDS REFERENCE SCENARIO

Emissions data and information are not readily available or accessible in Bangladesh. The first and most recent publicly available national GHG Inventory was prepared for base year 1994 and included in Bangladesh's INC. Overview of the key source categories is provided in the following section. Preparation of the INC was led by MOEF. The Second National Communication (SNC) is underway, and the Bangladesh Centre for Advanced Studies (BCAS) is conducting the GHG inventory for it. The SNC is expected to be presented to the MOEF shortly for review, and the Communication is anticipated to be ready for submission in December 2010, at which point in time the data will be publicly available.

In addition to a vulnerability assessment and adaptation measures, and a climate change response strategy, included in the INC are GHG mitigation options, summarized below by sector.

ENERGY

There were seventeen energy related mitigation options presented in the INC. These were organized in three major categories: (i) supply; (ii) demand; and (iii) process improvements. The mitigation options are summarized in the following table.

Table 4. Energy mitigation options in the INC

	GHG emissions reduction option	Estimated investment cost of options $/unit (1999 $US)	GHG emissions reduction, tons of CO2 equivalent/yr
	SUPPLY OPTIONS		
1	Combined cycle	140 million (210 MW)	67,320
	DEMAND OPTIONS		
	EFFICIENCY IMPROVEMENTS		
1	4-stroke 3-wheelers	2,900	0.17
2	Improved biomass cookstoves	3.5	0.18
3	Improved kerosene lamps	1.9	0.005
4	CFL	21	0.36
5	Efficient refrigerators	750	0.04
6	Efficient air conditioners	920	0.37
7	Gas boilers		
	Retrofit (Improved)	11,500	26
	Efficient	15,000	38
8	Improved coal boilers	9,2000	31
9	Improved fuel oil boilers	9,200	26
10	Improved biomass boilers	6,900	2.1

	GHG emissions reduction option	Estimated investment cost of options $/unit (1999 $US)	GHG emissions reduction, tons of CO2 equivalent/yr
11	Efficient motors		
	< 1 HP	80	0.05
	1 – 10 HP	190	0.15
	DEMAND-SIDE MANAGEMENT		
1	Metering of natural gas	70	0.18
2	Solar reflective glass windows	330	0.06
3	Housekeeping + Energy management	11,000	238
	PROCESS IMPROVEMENT		
1	Brick making	700,000	495
2	Paddy Parboiling	250	0.9

Source: INC (2002)

FORESTRY

The INC details a number of mitigation options considered in the land use and forest sector. These options were categorized into five themes, as follows:

1. Reduce the rate of deforestation through:
    a. Switching to more sustainable energy sources
    b. Increasing the efficiency of fuelwood use
    c. Increasing agricultural productivity to reduce pressure
    d. Placing regulations, taxes and other disincentives on forest conversion
2. Increase the area of forests through afforestation for carbon credits
3. Increase the carbon stocks of existing forest through:
    a. Forest protection and conservation
    b. Timber stand improvement
    c. Agroforestry
    d. Increase carbon in agricultural soils (e.g., low- or no-till)
    e. Urban and community forestry
4. Increased efficiency of wood use and enhanced wood utilization
    a. Improved recovery of wood products during harvest and milling
    b. Higher merchantable volume as a proportion of wood harvested
5. Substitution of wood for fossil fuels

AGRICULTURE

Fourteen options were listed by the Government in its INC, and these were organized according to the four general types of agricultural activity resulting in GHG emissions:

1. Rice production – Decrease methane emissions from anaerobic decomposition of organic matter in flooded paddy soils by increasing soil aeration

    a. Reduce the period of flooding on well-drained soils; requires secure and well-controlled water supplies to avoid yield losses from under-irrigation, therefore is less applicable or appropriate for rainfed farms

    b. Introduce new rice varieties that mature more quickly, thereby reducing the time required for soils to be flooded in order to produce sufficient yields

c. Substitute inorganic (i.e., commercial) fertilizers for organic matter such as green manure and straw; has the potential to acidify soils, increases farmer costs, and may increase emissions of N_2O

2. Animal husbandry – Decrease methane emissions from enteric fermentation by ruminant livestock, and the anaerobic fermentation of decaying manure

    a. Enteric fermentation reductions from a range of options, including:

        i. Increase feed digestibility through chemical or mechanical processing

        ii. Feed supplementation using molasses/urea, mineral supplements, or bioengineering of rumen biota

        iii. Use of enhancing agents such as bovine somatotropin, anabolic steroids, and similar compounds

        iv. Genetic improvement of livestock herds through cross-breeding

        v. Reproductive improvements to reduce the number of animals used for increasing herd size or replacing culled animals; techniques include embryo transplants, artificial insemination, and estrus synchronization

    b. Decomposing manure reductions by capturing the methane emitted during anaerobic processes, with three options considered:

        i. Small-scale digesters

        ii. Large-scale digesters

        iii. Covered lagoons

3. Biomass fuel crops – Reduce CO_2 emissions from fossil fuel use by substituting biomass fuels, which can also have lower requirements for agricultural chemical inputs and result in higher levels of soil organic carbon by reducing tillage; this last point is enhanced if the biomass fuel crops are perennials rather than annual crops

4. Windbreaks and shelterbelts – Sequester carbon into wood and soil by planting perennial shrub and tree crops that reduce wind erosion and plant desiccation

5. Nitrogen fertilizer application – Reduce conversion of woodlands to agriculture by increasing yields on farmed lands; requires careful management of soils to avoid offsetting increases in N_2O emission that counteract reductions in CO_2 from conversion

WASTE

Mitigation options for the waste sector presented in the INC are limited to the municipal solid waste subsector and include (i) methane extraction in landfills to either be flared or produce energy and (2) reductions in the amount of waste going into landfills through recycling or other waste management practices.

In terms of sectoral studies of mitigation potential, the UN initiative Greenhouse Gas Emission Reduction from Industry in Asia and the Pacific (GERIAP) conducted one prior its completion in 2006, but none have been carried out recently. More updated studies will be useful for developing initiatives targeting specific industrial concerns, as they may help to formulate the financial case required to convince the private sector to adopt energy efficiency measures. In terms of renewable energy, a comprehensive mapping and feasibility study of wind power, crucial for assessing the country's wind potential, has not yet been conducted.

KEY SOURCE CATEGORIES BASED ON MOST RECENT NATIONAL GHG INVENTORY

In the national GHG inventory submitted as part of the INC, total net GHG emissions in 1994 amounted to 55.9 $MtCO_2e$. The main sources of GHG were agriculture (54.0%), energy (27.2%), and forestry and land use change (14.0%).

Table 5. Bangladesh GHG Emissions (includes CO2, NH4, N20)

Emissions Sector	1994		1995		2000		2005	
	$MtCO_2e$	(%)	$MtCO_2e$	(%)	$MtCO_2e$	(%)	$MtCO_2e$	(%)
Energy	15.2	27.2	25.3	23.6	30.5	25.1	42.0	29.5
Industrial Processes	1.3	2.3	0.1	0.1	1.8	1.5	2.5	1.8
Agriculture	30.2	54.0	67.8	63.2	73.6	60.6	80.2	56.4
Forestry and Land Use Change	7.8	14.0	-	-	-	-	-	-
Waste	1.4	2.5	14.0	13.0	15.5	12.8	17.4	12.2
TOTAL	55.9	100.0	-	-	-	-	-	-
TOTAL without Forestry and Land Use Change	48.1	-	107.3	100.0	121.5	100.0	142.1	100.0

Source: 1994 GHG Emissions from the GHG Inventory of Bangladesh's INC on Climate Change to the UNFCCC and 1995, 2000, and 2005 GHG Emissions from the World Resource Institute (WRI) Climate Analysis Indicators Tool (CAIT).

ENERGY

Natural gas in the power sector (energy industries), manufacturing industries and construction, and the residential sector in the form of liquefied petroleum gas (LPG) is the lead contributor to GHG emissions in the energy sector. GHG emissions from transport derive from mostly diesel and gasoline for road transportation. Traditional biomass (cow dung, jute stick, rice straw, rice hulls, bagasse, firewood, twigs, leaves, other wastes) for household cooking is the largest fuel source; however, emissions from the combustion of traditional biomass are assumed to be offset in the regeneration process and not considered a contributor to the total net national emissions.

Table 6. Energy Sector GHG Emissions (GHG Inventory 1994)

Energy Sector	GHG Emissions ($MtCO_2e$)
Energy Industries	5750.98
Manufacturing Industries and Construction	3708.03
Transport	2538.12
Residential	2013.55
Agricultural/Forestry/Fishing	991.32
Commercial/Institutional	176.25
TOTAL	15,210.50
Traditional Biomass burnt for Energy*	58624.63

Source: INC on Climate Change to the UNFCCC (2002). *Traditional biomass for energy is not included in the national total of GHG emissions.

(Data used in the GHG Inventory for the energy sector were sourced from: petroleum fuel consumption – Bangladesh Petroleum Corporation (BPC); natural gas consumption – Bangladesh Oil, Gas and Mineral Corporation; coal – Bangladesh Bureau of Statistics.)

According to the World Resources Institute's Climate Analysis Indicators Tool (WRI-CAIT), estimated total emissions for Bangladesh in 2000 were 121.5 $MtCO_2e$ and energy-related emissions accounted for 30.5 $MtCO_2e$. According to the Asia Pacific Energy Research Centre (APERC) Energy Supply and Demand Outlook 2006, emissions from the energy sector are projected to reach 101.5 $MtCO_2e$ in 2010 with per capita emissions increasing to over 1 tCO2 per person, reaching about 301 $MtCO_2e$ in 2030 with per capita emissions at 2.8 tCO2e. In 2010, the relative shares of emissions are projected to be: industry – 33%, electricity generation – 27%, transport – 24%, residential – 7%, commercial – 6%, and other [non-power] combustion – 2%. APEC projects that energy intensity is projected to peak around 2010 at 167 ton of oil equivalent per $ million GDP (in constant 2000 prices) and remain relatively flat during the next two decades, mainly due to increased use of commercial energy over that of traditional biomass, increased use of natural gas for power generation and power system efficiency improvements.

INDUSTRIAL PROCESSES

In Bangladesh, the production of ammonia (78%), iron and steel (12.5%), limestone (5%), dolomite (0.05%), clinker (4.2%) and soda ash (0.2%) contribute to the generation of approximately 1282 $ktCO_2$ emissions.

(Data used in the GHG Inventory for industrial production were sourced from Bangladesh Chemical Industries Corporation, Bangladesh Bureau of Statistics 1998, and Chatak Cement Co. Ltd.)

AGRICULTURE

The GHG Inventory presents emissions estimates for four types of agricultural activities: (1) livestock – enteric fermentation and manure management, (2) rice cultivation – flooded rice fields, (3) field burning of agriculture residues, and (4) agricultural soils. The majority of GHG emissions in the agriculture sector come from methane emissions from anaerobic decomposition of organic material in flooded rice fields (50%); enteric fermentation from livestock (32%), mostly local non-dairy cattle and goats; and manure management and burning of agricultural residues (17%). (See table below.)

Source: Thomas Sennett / World Bank

Table 7. GHG emissions from agriculture sector in 1994

Subsector	CH_4 *(thousand tons)*	N_2O *(thousand tons)*	Total CO_2e *(million tons)*	%
Rice cultivation	662.23		16.56	51.00
Enteric fermentation	416.58		10.41	32.08
Savanna burning	0			-
Other (manure management and field burning of agricultural residues	48.92	14.32	5.49	16.91
Total	1,127.73	14.32	32.46	100

Source: MOEF 2002. INC under the United Nations Framework Convention on Climate Change

Data used in the GHG Inventory for the agricultural sector were sourced from: area of rice production – Bangladesh Bureau of Statistics; livestock – the Department of Livestock Services.)

FORESTRY AND LAND USE CHANGE

The Bangladesh GHG Inventory only took into account changes in forest and other woody biomass stocks from commercial harvests of round wood, bamboo, and fuel wood. Data on forest clearing, on and off-site burning, biomass decay and abandonment of forestland were not available. Carbon uptake by soil data was also not available. Total carbon uptake was 6155.73 Gg and carbon released was 8293.36 Gg. Net carbon emissions were equivalent to approximately 7.8 $MtCO_2e$. Biomass burning for household energy use emits approximately as much as all other sources combined (58 million tons CO_2e) yet was not included in national inventory data.

(Forest area data used in the GHG Inventory were sourced from the Forestry Master Plan (FMP, 1992).)

WASTE

GHG emissions were calculated only for municipal solid waste sub-sector. Anaerobic decomposition of organic materials in landfills results mostly in methane emissions. In 1994, the estimated GHG emissions from landfills was 1.2 $MtCO_2e$.

(Data used in the GHG Inventory for on municipal solid waste (MSW) generation and percentage of MSW disposed to solid waste disposal were collected from Dhaka City Corporation only. Estimations were made for other cities on the basis of population data availability.)

GAPS IN ACTIVITIES SUPPORTING ESTABLISHMENT OF A REFERENCE SCENARIO

- Data availability for the forestry and land-use sector and waste sector – The GHG inventory in these sectors in the INC was limited to only the changes in commercial forest stocks for the forestry sector and MSW for the waste sector. Other GHG emitting sub-sectors in forestry include forest and grassland conversion and abandonment of management land. For the waste sector, other sub-sectors besides MSW include methane emissions from domestic, commercial, and industrial wastewater. Emissions from these sub sectors were not calculated due mostly to lack of available data.
- National forest inventory – BFRI
- Carbon stock values by forest type – BFRI
- Legislative and policy review of all relevant laws to facilitate clear, separable, and transferable carbon rights, including harmonization of above-ground and below-ground carbon ownership

CHAPTER 5 – ASSESSING POTENTIAL AND ESTABLISHING GOALS

A number of national development and climate plans have been created for Bangladesh, and they highlight several priority development objectives and climate change impacts. Development objectives are outlined in the country's two Poverty Reduction Strategy Papers (2005, 2009); in PRSP II, explicit reference is made to global climate change. In the CCSAP, the overall vision for climate change is stated as: "The Government is fully committed to manage climate change in a way that the country is protected well from its adverse impact and that the growth path remains stable and moves to a higher plane."Bangladesh envisions a pro-poor climate change management strategy that prioritizes adaptation and disaster risk reduction, addresses low carbon development, mitigation, technology transfer, and mobilization of finance. The table below provides an overview of the manifestations of climate change and the impacts for key sectors.

Table 8. Key Climate Change Impacts

Climate Change	Climate Impacts
Increased frequency and severity of tropical cyclones	Coastal flooding, storm surges, coastal erosion and damages to coastal polders Contamination of water supplies, outbreaks of waterborne diseases, loss of lives Infrastructure and property damage
Heavier, more erratic rainfall in Ganges-Brahmaputra-Meghna River System (exacerbated by accelerated glacial melting in the Himalayas)	High flow rates and flooding River bank erosion and increased rates of sedimentation Contamination of water supplies, outbreaks of waterborne diseases, loss of lives Damages to agricultural crops and farm infrastructure Infrastructure and property damage
Lower, more erratic rainfall in northern and western regions of the country	Drought conditions Reduced water availability Reduced crop availability
Sea level rise (.18 to .79 meters by 2100)	Submergence of low lying coastal areas Saline water intrusion in groundwater aquifers and coastal rivers Reduced freshwater availability Damage to Sunderbans mangroves and biodiversity Damage to coastal polders and impacts on coastal agriculture due to increased salinity
Temperature increases	Increases in airborne diseases Increases in waterborne diseases (in combination with higher precipitation and flooding)

In the *Outline Perspective Plan of Bangladesh, 2010-2021: Making Vision 2021 a Reality*, energy security is highlighted as essential for the country's further economic development and the welfare of its citizens. Thus, low-emissions measures such as energy efficiency and conservation (e.g., the use of energy saving lightbulbs) and the use of renewable energies are highlighted, but only insofar as they support Bangladesh's ability to address the growing gap between energy supply and demand. The strategies for achieving energy security are listed as diversification of the primary sources for power generation, such as gas, coal, and liquid fuel; the use of two sources of fuel in power plants to the extent possible; the use of renewables, such as solar, wind, and small-hydro, to increase power generation; the establishment of nuclear power plants; financing power generation projects through public-private partnerships; and sector reforms to promote efficiency.

KEY REPORTS ON PUBLIC AND PRIVATE SECTOR CAPACITY AND BARRIERS

According to the CCSAP, power demand is expected to increase at a rate of 7.9% per year. Currently Bangladesh suffers from power shortages evidenced by daily load shedding in both urban and rural areas. The present generation shortfall exceeds 1000 MW during peak hours. The Government encourages increased efficiency in the development and utilization of conventional energy, such as natural gas and coal. There has been a growing reliance on natural gas for many important end uses such as power generation and fertilizer production. This growth cannot be sustained without significant new domestic production or access to imported gas.

The Government also encourages development of renewable energy, such as solar home systems and biogas plants for rural households; however, according to the Power Master Plan, grid-connected renewable energy projects identified in Bangladesh are not economical compared to thermal options and therefore are not included in the plan which emphasizes least-cost development.

In line with concerns over energy security and a commitment to mitigate climate change, the Government emphasizes in the Strategy that they will take the following steps related to the energy sector:

- Develop a strategic energy plan and investment portfolio to ensure national energy security and lower greenhouse gas emissions;
- Seek the transfer of state-of the art technologies (e.g., clean coal technologies) from developed countries to facilitate pursuit of a low-carbon growth path
- Review energy and technology policies and incentives and revise these, where necessary, to promote efficient production, consumption, distribution and use of energy

Specific energy sector related programs and actions listed in the Action Plan component of the document are:

- Improved energy efficiency in production and consumption of energy
    - Study the future energy needs of the country and find out the least cost energy supply path that satisfies future energy demand based on the desired growth path of the economy
    - Raise energy efficiency in power production, transmission and distribution through appropriate investments
    - Raise energy efficiency in agricultural and industrial processes through appropriate policies and investments
    - Raise energy efficiency in domestic and commercial/service sectors through appropriate policies and investments
    - Raise energy efficiency in transport sector through appropriate policies and investments.

- Gas exploration and reservoir management
    - Invest in gas exploration
    - Invest in Reservoir management
- Development of coal mines and coal-fired power station(s)
    - Review coal mining methods and undertake a feasibility study to assess the technical, economic, social and environmental feasibility of coal mining for power generation (including factors such as how to capture coal bed methane)
    - If the feasibility study is positive, invest in coal mining and coal-fired power generation plants using clean coal technology
- Renewable Energy Development
    - Investments to scale up solar power programs
    - Research and investment to harness wind energy, particularly in coast areas
    - Feasibility studies for tidal and wave energy
    - Study of the techno-economic, social and institutional constraints to adoption of improved biomass stoves and other technologies
- Rapid expansion of energy saving devices e.g. CFLs
    - A rapid assessment of potential of CFL in Bangladesh
    - Development of a project proposal for obtaining CDM benefits
    - Facilitate expansion of CFL with support from Carbon Credit Fund
- Energy and Water Efficiency in Built Environment
- Necessary adaptation of existing buildings and additional accommodation in new construction for collection and storage of rainwater
- Installation of solar thermal power or small windmills on rooftops or in close proximity to all buildings and infrastructure
- Revision of building code for inclusion of energy saving devices in all infrastructure and integration of energy efficient methods in planning of construction works.

Funding to implement some actions listed above have been secured from donors and some programs are operational or under development. The Solar Home Program implemented by IDCOL has been operational since 2003, and is financed by the World Bank and several other donors including the Global Environment Facility (GEF), ADB, KfW, GTZ, and the Islamic Development Bank. The initial target was to finance 50,000 SHSs by the end of June 2008 and this was met 3 years ahead of schedule. The program was continued with a revised target of 200,000 by the end of 2009 and this was achieved in May 2009. Now IDCOL's target is to finance one million SHSs by the end of year 2012. Up to August 2010, a total of 645,033 SHSs have already been installed under the program. The World Bank and other donors are continuing to support the scaling-up of the IDCOL program. Grameen Shakti has been a major participant in this program, installing approximately 63 percent of the solar home systems.

A demand side management program to distribute CFLs in dense urban areas is being financed by the World Bank and is implemented by REB. The first phase of the program has been completed and has been considered a success; the second phase is near the implementation stage.

A national program to support domestic biogas is also operational and being implemented by IDCOL, supported by the Dutch NGO, SNV Netherlands Development Organization, and KfW. Over 10,000 biodigesters have been installed to date and Grameen Shakti is responsible for over 50 percent of the installations.

CURRENT STATUS OF RENEWABLE ENERGY SOURCES AND ENERGY EFFICIENCY

RENEWABLE ENERGY

According to the Bangladesh Economic Review (MOF, 2009) approximately 20 MW of electricity from renewable energy (excluding large hydro) is now being produced in the country. Renewable energy sources, including large hydro, play a minor role in the electricity sector. Hydropower consists of only one plant, Karnafuli Hydro (2x40 MW+3x50 MW). Twelve projects (both generation and transmission and distribution) proposed in the Power System Development Plan were included in the Revised Annual Development Program (RADP) of FY2009 (BPDB). Out of the seven generation projects, one project is the rehabilitation of the existing Karnafuli Hydro and the rest are rehabilitation and new construction of thermal-based power plants.

BPDB's involvement in renewable energy remains negligible. According to their 2008 Annual Report, they have installed a total of approximately 150 kW of solar photovoltaic (PV) systems in villages and office buildings, approximately 2,000 kW of wind power, and 50 kW of micro-hydro. In addition, BPDB has installed four measuring towers at Muhuri Dam (Feni), Moghnama ghat (Cox-bazar), Purki Saikat (Patenga), and Kuakata area. The speed and direction of wind is being measured by two anemometers in each location at a height of 30 and 50 meters respectively. Regarding demand-side management activities, they have installed CFLs at several of their own office buildings. BPDB plans to continue installing solar PV systems in their office buildings and at the Prime Minister's office, and is planning larger RE systems such as 100 MW offshore wind farm and 4 to 5 grid-connected solar power plants totaling 10-15 MW. Other clean energy projects are focused on rural applications such as solar home systems and household biodigesters with support from bi-lateral and multi-lateral aid assistance as mentioned throughout this report.

The aforementioned USAID ICEA project biomass assessment on the availability and potential of rice husk, bagasse, corn cobs, coconut shell and husk, poultry droppings, and cow dung concludes that the potential for biomass power generation is encouraging but not tremendously significant, in light of the current power shortage in Bangladesh, as biomass fuels have the potential of providing from 124 to 131 MW of installed capacity. The types of biomass included in this assessment are considered to have no carbon impact therefore have a value in displacing GHG emissions from combustion of fossils, particularly natural gas and diesel fuel.

ENERGY EFFICIENCY

Power supply falls about 20 percent short of meeting demand and government efforts to be increase efficiency have focused on demand side initiatives to limit electricity consumption such as requesting stores and shopping malls of Dhaka to close down after 8 o'clock in the evening and to stagger industrial areas' holidays to save up to 300 MW of electricity (MOF, 2009).

TRANSMISSION AND DISTRIBUTION LOSSES

According to the USAID Bangladesh Energy Pre-Assessment Report (2009) it is estimated that the transmission and distribution system is incurring 30 to 40 percent losses, both technical and non-technical. The non-technical losses attributable to electricity theft, are approximately 10-20 percent of this amount. This is a major concern as these losses exacerbate the power outages in addition to being a major financial loss to the utilities. The report estimates that for every one percent of losses eliminated, approximately 40 MW of power would be made available to the system. The Pre-Assessment report provides a series of measures to reduce losses in the Bangladesh electricity system, most notably tamper proof metering capabilities.

OTHER ENERGY EFFICIENCY TECHNOLOGIES

The World Bank and GTZ prepared a roadmap for energy efficiency improvements, demand side management, and renewable energy (2009) and presented a menu of nineteen energy efficiency and renewable energy options to the Government. (See Annex 6.) Three main aspects were covered for each measure: (i) description of the current situation (business-as-usual) regarding equipment, process, or enduse related to the measure in Bangladesh; (ii) investment cost, savings, cost-effectiveness and possible financing arrangements; and (iii) estimated technical or market potential of the option, barriers and implementation arrangements.

The report lists several barriers for implementing energy efficiency measures. Most notably, the proper pricing of fuels and controlling energy pilferage (theft) are the two main obstacles to promoting energy efficiency, conservation and renewables. If energy is properly priced to its true economic cost, the savings through the use of efficient devices would justify the additional investment, and promote conservation of scarce resources critical for climate-resilient development in Bangladesh.

In addition, awareness and access to reliable data and information regarding energy efficiency and conservation practices for both commercial and residential consumers are not available. More expensive options that may save energy and money in the medium to long term are typically not considered.

CURRENT LAND-USE PRACTICES, POLICIES, AND INITIATIVES THAT SUPPORT SUSTAINABLE LAND-USE AND FOREST MANAGEMENT

Land use in Bangladesh is stymied by multiple ministerial jurisdictions and weak coordinating structures and mechanisms. As one example: leasing arrangements of water bodies for fish culture fall under the Ministry of Land, Ministry of Water Resources, and the Ministry of Fisheries and Livestock. The net effect of these overlapping mandates is a lack of cohesion in implementing national policy for identifying and addressing constraints. The National Agriculture Policy (1999) led to a National Plan of Action in 2003 which only a year later was followed by an Actionable Policy Brief (APB) because government determined that the Plan of Action could not be implemented as written. Six stakeholder groups have been identified to implement the National Agriculture Policy, but no mechanism is known to have been established for coordinating their input to that implementation. A table listing all relevant policies affecting land-use decisions is in annex 7.

Perhaps the most critical issues regarding land use – as highlighted in the National Land Use Policy (2001) – are rapid conversion of agricultural lands to non-agricultural uses (generally urbanization), and the subdivision of farmlands into small parcels insufficient to sustain a family. Both issues tie directly to matters of food security and population growth, highlighting non-climate stressors on these systems. It is conceivable that these challenges would remain with or without a well-designed and –implemented LEDS.

The forest sector is in relatively better position; the Ministry of Environment and Forests has sole jurisdiction over management of forestlands and implementation of the National Forestry Policy (1994). Key goals of that policy are to afforest 20% of Bangladesh's total land area, conserve and enrich biodiversity, and support national and international efforts and agreements related to development of land and water resources, in ways outline in the 1993 Forestry Sector Master Plan. The Forest Act of 1927 is still valid, with numerous amendments to update it over time. USAID's IPAC project currently supports review and revisions to the Act to institutionalize key concepts of community co-management into the legislation. As interim steps, new Social Forestry Rules have recently been developed and are working their way toward formal approval.

Bangladesh is a party to a number of international environmental agreements, including the UNFCCC and its Kyoto Protocol, the Convention on Biological Diversity, Convention to Combat Desertification, Convention on International Trade in Endangered Species, and the Ramsar Convention on Wetlands of International Importance.

KEY TECHNICAL, ACADEMIC, GOVERNMENT, OR NON-GOVERNMENTAL INSTITUTIONS

The Ministry of Power, Energy, and Mineral Resources (MPEMR) of Bangladesh is the sole authority administering all activities related to the nation's hydrocarbon and energy sectors, including rural and renewable energy. The state-owned and vertically aligned power utility is the BPDB, responsible for generation and transmission of power in the country and distribution in urban areas except Dhaka. The Dhaka Electric Supply Authority (DESA) is responsible for distribution of electricity in Dhaka, while REB is responsible for distribution in rural areas through a network of more than 60 Palli Bidyut Samitis (PBSs) or rural electricity cooperatives.

IDCOL is a government-owned non-banking financial intermediary and they are managing the implementation of the government SHS program and the national biogas program.

The Renewable Energy Policy adopted by the Government in December 2008 sets forth the establishment of a new institution call the Sustainable Energy Development Authority. SEDA is to be established as a focal point of sustainable energy development and promotion comprising renewable energy, energy efficiency, and conservation.

Other players that have been involved in the renewable energy sector over the past 20 years include:

IFRD. The Bangladesh Institute of Fuel Research and Development

Council for Scientific and Industrial Research, centers on small- and medium-sized biogas digesters

Local Government Engineering Department. The Department handles small- and medium-sized biogas digesters

BRAC. The Bangladesh Rural Advancement Committee, the largest national NGO, centers on SHS, having supplied nearly 1,200 systems, and biogas installations.

Proshika. A leading NGO, which focuses on biogas installations.

GAPS IN DATA AND/OR TECHNO-ECONOMIC AND MARKET ASSESSMENTS AND ACTIVITIES

- Lack of recent marginal abatement cost curves for key sectors in Bangladesh
- Limited data availability in the land-use and waste sectors
- Sectoral studies of mitigation potential
- Detailed mapping and feasibility study of wind power
- Woody biomass energy resource assessment and supply and demand study

CHAPTER 6 – POLICIES AND PATHWAYS ANALYSIS

POLICY LANDSCAPE AND ROADMAPS

ENERGY AND POWER

In the power sector, the availability of a reliable supply of power is a consistent problem in Bangladesh, largely due to inadequate energy resources and inefficiencies of production, distribution, and consumption. As a result of the three government-owned utilities', BPDB, DESA, and REB, inability to meet increasing power demands, considered crucial for economic growth, the Government has made efforts to open the energy arena to the private sector. To facilitate private sector investment, it has issued policy guidelines for their participation in electricity generation and distribution through the Private Sector Power Generation Policy, Remote Area Power Supply Systems, and the Small Power Policy. More recently, it has established the Renewable Energy Policy, which seeks to promote sustainable energy, establish SEDA, and target the CDM.

(Key policies for all sectors are summarized in Annex 7.)

The GoB's 1994 paper "Power Sector Reforms in Bangladesh" outlined a reform process focusing on institutional issues. The 2000 Vision and Policy Statement for the Power Sector Reforms discusses institutional issues for the power sector and has the following objectives:

1) Bringing the entire country under electricity service by the year 2020 in phases
2) Making the power sector financially viable and able to facilitate economic growth
3) Increasing the sector's efficiency
4) Introducing new corporate culture in the power sector entities
5) Improving the reliability and quality of electricity supply
6) Using natural gas as the primary fuel for electricity generation
7) Increasing private sector participation to mobilize finance
8) Ensuring reasonable and affordable price for electricity by pursuing least cost options
9) Promoting competition among various entities

The "Three-Year Roadmap for Power Sector Reform" provides an update of the progress of reform and also lays out a three-year time-bound roadmap for continued institutional reform to ramp up investment in generation to meet projected demand growth. The key reform measure is the continuation of unbundling and corporatizing power sector entities

The progress of reform related to grid-connected renewable energy development has been fairly negligible to date. However, in terms of rural energy programs, as discussed in Chapter 5, the solar home system program managed by IDCOL has been quite successful.

AGRICULTURE

Agricultural policies are primarily concerned with ensuring food security, and seek to support its achievement by enhancing crop productivity, improving the accessibility of food, and using natural resources more effectively and efficiently. In light of the threats posed by climate change for food security, the climate change efforts in the agricultural sector have been focused on adaptation, particularly to maintain or enhance the yields of key crops such as rice. Although no agriculture policies have been directed explicitly at integrating low-emissions development considerations, efforts to promote the sustainable use of natural resources and efficient production are relevant for LEDS. Key agriculture policies are overviewed in Annex 7.

LAND USE

As Bangladesh is one of the most densely populated countries in the world, the land use policies seek to enable effective management of critical and increasingly scarce land resources. Key policies include the Land Use Policy (2001, Ministry of Land) and the Coastal Zone Policy (2005, Ministry of Water Resources). The former provides guidelines for protection of agricultural land and water bodies through 28 policy directives, and introduces zoning as an instrument for land management. The latter delineates the coastal zone and promotes the use of integrated coastal zone management as a means to improve the socio-economic conditions of coastal communities as well as their ability to cope with disasters and environmental degradation.

FORESTRY

The National Forestry Policy (1994) supports implementation of the Forestry Sector Master Plan (1993). Key features of these document that relate to low-emissions development and co-benefits of livelihoods, conservation, and climate resilience include: (1) a goal to afforest 20% of total national land area by 2015; (2) establishing a Department of Social Forestry, which now oversees community co-management of reserve forests and other protected areas; (3) promoting agroforestry on homesteads, especially those owned by women; and (4) coastal reforestation and afforestation on accreted lands. This last item has co-benefits for both GHG mitigation through potential carbon offset credits from sequestration, and climate change adaptation by buffering the shoreline against storm surges while increasing the fish and mollusk nursery areas to enhance livelihoods of coastal communities.

LOW EMISSIONS PATHWAY MODELING AND COST BENEFIT ANALYSIS ACTIVITIES

ENERGY AND POWER

A key planning document from which GHG emissions scenarios can be determined for the power sector is the Power System Master Plan Update (2006) prepared by Nexant for Power Cell, Power Division of the Ministry Power, Energy and Mineral Resources and financed under the ADB-financed Power Sector Development Program II. The Master Plan provides load forecasts and generation and transmission expansion plans. The base case load forecast projects a 7.9% annual increase to 2025. Net generation in the base case would reach approximately 100,000 GWh and peak load would be approximately 19,300 MW.

The generation and transmission expansion plans are least-cost options. Fuel availability and cost drive the selection of generation options in this plan. Bangladesh has substantial proven reserves of natural gas and some proven reserves of coal. Both are available at reasonable cost. The plan states that Bangladesh's limited hydro potential will have been completely developed when the 100 MW extension of the existing Karnafuli plant is completed, thereby making additional hydro capacity an infeasible option for additional units. It also states that small-scale development of renewable resources are

peripheral to the issue of generating bulk electricity for the main grid; no renewable energy option was found economically suitable for this purpose.

The following table from the plan characterizes the generation technologies proposed in the plan, such as equipment costs and net heat rate. Renewable energy options are essentially excluded from this plan and are not included in this table.

Table 12. Cost Characterization of Generation Technologies

									Net Heat Rates at Grid, KCAL/KWH					O&M Cost	
Unit type	Net Unity Capacity (At Grid)	Thermal Parameters	Equipment Cost $/kW	Installation Cost $/kW	Total Project Cost $/kW	Construction Time Per Unit, Months	Plant Life, Years	Minimum Loads, % of Capacity	At 100% Power	At 75% Power	At 50% Power	Weeks/year Sched Maint	FOR, %	Fixed $/kW-month	Variable $/MWH
Steam (coal) with FGD	300	Note 1	1,097	269	1,366	60	30	50%	2,173	2,217	2,287	8	8%	0.58	1.80
Steam (coal) with FGD	500	Note 1	896	215	1,111	60	30	50%	2,154	2,198	2,268	8	8%	0.58	1.80
CC (natural gas)	300	Dual Pressure	438	232	670	36	25	50%	1,720	1,856	2,023	6	6%	0.42	2.00
CC (natural gas)	450	Triple Pressure	361	232	593	36	25	50%	1,686	1,819	1,984	6	6%	0.38	1.80
CC (natural gas)	700	Triple Pressure	322	180	502	36	25	50%	1,564	1,688	1,840	6	6%	0.38	1.80
SCGT (natural gas)	100		238	168	401	24	20	50%	2,687	2,986	3,161	4	4%	0.42	2.50
SCGT (natural gas)	150		227	122	349	24	20	50%	2,605	2,894	3,064	4	4%	0.42	2.50
Steam (natural gas)	300	Note 1	711	263	947	60	30	50%	2,127	2,171	2,239	6	6%	0.58	1.60
Steam (natural gas)	500	Note 1	579	211	789	60	30	50%	2,109	2,152	2,220	6	6%	0.58	1.60
Nuclear (light water reactor)	500	Note 1	1,739	978	2,717	60	40	50%	2,598	2,651	2,735	6	8%	1.67	0.50
Diesel (diesel fuel)	10	Medium Speed			450	24	15	50%	2,900	3,050	3,200	3	15%	0.83	3.00

The generation and transmission investment requirements over the next 20 years are substantial, averaging $2.7 billion for generation and $0.3 billion for transmission every five years.

Mondal and Boie (2010) modeled future demand scenarios of the Bangladesh Power Sector applying the Long-range Energy Alternative Planning (LEAP) model with three scenarios, namely low GDP growth, average GDP growth, and high GDP growth. The data sources that they used to feed the model are the following:

Annual electricity use

- BPDB, annual reports 2005 and 2006.
- REB, annual report 2006.
- Bangladesh Economic Review (BER) 2006, Finance Division, Ministry of Finance.
- Power Sector Master Plan (PSMP) 2005, MPEMR.
- Bangladesh Power Sector Data Book (BPSDB), Power Cell, MPEMR.

GDP value

- Bangladesh Economic Review (2004, 2008), Finance Division, Ministry of Finance.
- Bangladesh Bureau of Statistics (BBS), Ministry of Planning.
- Bangladesh Quarterly Economic Update 2006, ADB, Bangladesh Resident Mission.

FORESTRY AND LAND USE

In the AFOLU sector, low-emissions pathways analyses involve less modeling than policies, procedures, and mechanisms. Given current uncertainty regarding the direction of international negotiations on a REDD+ implementation mechanism, both national systems and project-based systems are advisable for Bangladesh. This entails several steps related to individual project designs, and to a national framework that facilitates projects. In the event that international agreement is reached that focuses on national and sub-national rather than a project-based structure for REDD+ (what is known as a "nested approach"), the following steps would still be useful.

- Project Description Document – whether the GoB, private sector, or a community organization wants to sell carbon credits in the compliance markets or voluntary markets, some form of a project design document will be necessary. The specific requirements for these vary from one market to another, but will generally need to include the following data:
    1. Carbon stocks – The initial level of carbon contained in the above-ground and below-ground biomass polls, and perhaps the soil carbon, leaf litter, and other pools of carbon
    2. Additionality – That is, that carbon offsets are in addition to any sequestration or emission reductions that would occur under either business as usual or reference levels.
    3. Carbon Quality Assessment – Primarily correlated to risk of leakage (causing emissions to occur outside the project area), risk of non-permanence (likelihood that any carbon stored, emissions reduced, or carbon sequestered in forests will not be emitted in the foreseeable future), and estimation risk (the likelihood that production of credits will not attain the estimated or anticipated volumes). Third-party audits are used to assess carbon quality.

4. Trend Analysis for changes in carbon pools – Requires being able to document background rates of deforestation, degradation, and (for existing forests) accumulation/sequestration. This requires knowledge and records of the forest dynamics that may be difficult for many of the protected areas in Bangladesh due to incomplete historical inventories.
5. Monitoring plan – The initial validation of carbon stock calculations, and verification of stock changes, as well as plans for how ongoing field-level monitoring, reporting, and verification – what is known as MRV – will be done, by whom, and how it will be financed.
6. Compliance with relevant local laws and regulations – Including demonstration of compliance. This could be challenging in Bangladesh, where protected areas laws and regulations are inconsistently implemented both in time and location, and not well documented.
7. Environmental impact assessment – When required by applicable legislation or regulation. This may include impacts on soils, water, other vegetation, or biological diversity, and restrictions on introducing alien species, applying fertilizers or pesticides, and other potential impacts.
8. Socio-economic description – A challenge in Bangladesh in that there may not be recent and accurate information available on the socioeconomic status and characteristics in project sites.
9. Stakeholder consultations – free and prior informed consent obtained through participatory processes with relevant stakeholders must be conducted and documented, and mechanisms and processes for ongoing involvement and communications must be provided.
10. Proof of title to the carbon – this could be one of the more problematic issues in a country where land titles are unclear and often overlapping. Sales of carbon credits without also selling other rights to land and forest resources requires that the carbon ownership rights be both separable (has a distinct legal identity separate from that of the forest land, trees, or other resources) and transferrable (can legally be transferred from one owner to another).

- National System Development – The following are some suggested actions for the GoB to consider for legal authorities needed for carbon projects to be conferred on the relevant agencies.

11. Legal clarity on carbon – Resolving project-level item #10 above at the national level so that all stakeholders have clear and transparent understanding. Currently, neither the Forest Department nor any other agency has legal authority to sell carbon rights from forestlands. There are some differences of opinion on whether below-ground biomass in root systems is legally considered to be part of the forest itself, or part of the mineral resources under the Ministry of Mines.
12. Dispute resolution – Another need is a mechanism and process for resolving disputes. This needs to involve the Ministry of Justice or possibly other branches of government who have little or no current knowledge of international climate change negotiations about forest carbon and its possible sale as, effectively, an exported commodity.
13. Carbon registry – All of the international organizations working on carbon finance for the past decade strongly recommend that a national system include a registry for accurately recording and tracking each carbon credit being generated, marketed, and transferred.
14. Financial flows – This could be one of the more troublesome aspects to decide, since it involves how monies will flow upon conclusion of transactions. For example, must funds go into the Ministry of Finance? If so, how do the communities surrounding the protected areas receive any incentive for not engaging in activities which could place the generation of credits a higher risk for non-permanence? Another question is how the Forestry Department or other government agency with managerial responsibility can be assured of receiving sufficient funding from the sales of credits to convince validators and verifiers that the land

managers have the wherewithal to implement the projects successfully. Finally, the question of whether and how income from carbon credit sales will be taxed is potentially complicated.

15. National MRV system – In addition to individual project MRVs, nearly all of the existing and planned systems (e.g., REDD-plus) strongly recommend and in some cases require that national governments, as Parties to the Convention, have established operating systems for ongoing monitoring, reporting, and verification of emissions reductions of carbon stock enhancements.

GAPS IN DATA, POLICY ANALYSIS, AND MODELING ACTIVITIES

Coal Mining and Clean Coal Technology Analysis (Integrating LEDS-relevant considerations into processes informing the development of coal-fired power plants) – The CCSAP includes the development of coal mines and coal-fired power stations as a program under their mitigation and low carbon development theme. The government is planning for more coal-fired power generation and two projects that utlize clean coal technologies are under consideration. The objective of the CCSAP related initiative is to maximize coal output and manage coal-fired generation in a carbon-neutral way. An action item presented in the CCSAP, for which there is no known donor support, is a comprehensive review of coal mining methods and clean coal technologies and feasibility studies to assess the technical, economic, social and environmental potential of coal mining methods such as capturing coal bed methane and coal plants utilizing clean coal technology.

Renewable Energy Resource Assessment - There is currently very limited information regarding specific renewable energy resource levels. There is no wind resource map for the country, and limited site-specific wind measurements have been developed to date. A comprehensive RE resource assessment with wind as the principal focus should be prepared, and a wind resource mapping plan should be implemented in cooperation with a reputable research institute. A program of site-specific measurements should be developed once the mapping exercise has identified promising wind farm sites beyond the few already known.

Biomass Energy Resource Assessment and Strategy for Sustainable Use – Electricity has reached only one-third of all households and with the exception of kerosene, commercial fuels such as liquefied petroleum gas (LPG) are beyond the reach of the majority of rural households. Approximately 95% of rural households collect and/or purchase biomass fuels for cooking, mostly with fixed clay stoves. Biomass fuels such as firewood, tree leaves, crop residue, and dung make up the majority of the energy supply in the country. According to the 1994 GHG inventory, GHG emissions from the combustion of biomass are not included in the national total because it is assumed that natural regeneration sequesters an equal amount of carbon that was emitted during combustion. However, discussions with policymakers and market trends reveal that firewood is not a renewable fuel. Firewood, collected mainly from the local environment only two decades ago, are fast becoming a marketed commodity as access to local biomass becomes ever more difficult and many rural residents are dependent on such fuels as agricultural residues, dung, and even leaves and grass for cooking (WB/ESMAP, 2010b), which is a clear indicator that firewood is non-renewable and a contributor to carbon emissions.

In addition to a lack of reliable data regarding the supply and demand of biomass energy, in particular the extensive use of firewood for residential cooking, no comprehensive resource assessment of biomass exists. Moreover, a plan to balance supply of biomass with demand, and a rural energy strategy to introduce more modern fuels and move away from scarce biomass resources have yet to be formulated.

Enabling Framework for Renewable Energy and Energy Efficiency – There is a lack of primary and secondary legislation and policy documents promoting the use of renewable energy and energy efficiency. Such a framework would support national programs, goals and targets, the preparation of

strategies and action plans, roles and responsibilities of public institutions and the private sector and financial incentives for investment such as feed-in-tariffs (FITs) for grid-connected renewable energy and high efficiency cogeneration power plants. The Renewable Energy Policy does set targets (five percent of total power demand by 2010 and ten percent of power demand by 2020) but there is no strategy or implementation plan for meeting these targets.

Energy Efficiency Awareness Raising – Awareness across a broad spectrum of society (e.g. government, industry, businesses, households) about the need for energy conservation and the benefits of energy efficiency technologies is limited. Some donors such as the World Bank are involved in supporting energy efficiency projects including CFL dissemination, but a broad education and awareness campaign at all level is not evident. Improving energy efficiency in the production and consumption of energy in the power, agriculture, transport, and commercial/services sector is a priority of the government and included in the CCSAP. Raising awareness about energy efficiency may include labeling products based on set standards as well as education and training programs for energy managers in industry and utilities, and teaching aids for primary, secondary, and vocational education.

Lack of modeling capabilities within the government or utilities, and the activities analyzing the co-benefits (e.g., environmental, energy security, economic, health) derived from different energy and land-use initiatives.

Policy impact analyses - Although each directorate (e.g., Forest Directorate in the Forest Department), has a planning and policy cell responsible for conducting policy impact analyses, and the Internal Monitoring and Evaluation Department within the Planning Ministry carries out similar analyses, particularly for GoB/donor funded development projects, the results often lack the rigor required to support robust policy-making processes.

CHAPTER 7 – CONCLUSION: SUMMARY AND RECOMMENDATIONS

As discussed in Chapter 1, the objectives of this assessment are to address three questions to inform the IAST's and the GCC Team's follow-up LEDS activities in Bangladesh. This chapter summarizes key findings and offers concluding remarks on the three questions and recommendations on options for USAID's engagement in the development of a LEDS.

Key findings include:

- Energy Security – Meeting energy demand is the key priority of the government so that the economy can develop with emphasis on developing its own energy resources (gas, coal) in order to achieve energy security. Energy diversification will be necessary to do as the demand on domestic natural gas in all sectors is increasing. Natural gas is by far the most important energy source in Bangladesh, dominating the power sector (approx. 90 percent of power generation coming from natural gas), fertilizer, industrial, commercial and domestic sectors. It is estimated that proven gas reserves in the country can meet demand up to 2025. To date, 23 gas fields have been discovered in the country, which contain 29.234 trillion cubic feet (tcf) of gas, of which 21.055 tcf is recoverable. As of June 2009, total 8.37 tcf gas has been produced leaving 12.678 tcf net recoverable (MOF 2009). Renewable energy and energy efficiency initiatives will be needed to reduce the demand for natural gas so that lifetime of reserves can be extended.

- Power – The Government's main efforts in the power sector have focused on developing a policy framework (discussed in more detail in Chapter 6 in the context of the existing policy framework) to support and guide reforms and the restructuring of the industry. They have been geared to increasing private sector involvement in the generation and distribution of power and the greater use of renewable energy sources, with the intention of enhancing the productivity of the sector and enabling it to better meet the country's growing energy demands.

- Energy efficiency – Efforts in this area have entailed working with industrial concerns to implement conservation measures as well as disseminating technologies such as compact fluorescent bulbs and improved cookstoves to households. Some donors, such as GTZ, are beginning to explore energy efficiency potential in the agricultural sector through the implementation of solar-powered irrigation pumps.

- Renewable energy – SEDA, mandated to be the focal point for the development of renewable energy sources and promotion of energy efficiency under the Renewable Energy Policy in 2008, has yet to be established. REB's and donors' efforts in renewables have focused on solar energy, and some donors have been exploring biogas potential. Nonetheless, these options, particularly the former, are largely currently considered viable only for small-scale off-grid electrification due to its relatively minimal generation power. Wind power is seen as having much greater generation potential in coastal areas but

technological and informational constraints have prevented it from gaining traction. A detailed mapping of potential is required to determine feasibility.

- Forestry –There is great interest in REDD+, but very little knowledge and understanding of the practical considerations that must be addressed before market-ready sequestration projects can be developed. Constraints include lack of an appropriate policy framework, weak technical capacity, and ineffective monitoring and enforcement in forested areas, including protected areas. The Forest Department is beginning to think about a REDD+ strategy and the steps required to establish an appropriate policy framework and a monitoring, reporting, and verification system.

- Agriculture – Most climate change-related agricultural activities have focused on adaptation, such as the development of saline-, drought-, or flood-resistant varietals and other measures to enhance the resilience of cropping, fisheries, and livestock systems and their ability to support the country's food security. However, some donors have begun to fund solar-powered irrigation pumps. There is also recognition of low-carbon co-benefits that may result from initiatives that promote more sparing use of fertilizer.

- Socio-Economic Benefits for the Rural Poor - More efficient and cleaner combustion of woody biomass with improved stove technologies will reduce GHG emissions and improve the health of rural households by mitigating indoor air pollution. The latter offers great advantages in terms of reductions in mortality and respiratory and other illnesses, especially for women and children, and more efficient use will save either money spent on purchasing firewood or time required to collect it. The overall benefits can lead to greater rural productivity and better quality of life for many of the rural poor (WB 2010a). As the promotion of sustainable energy technologies such as improved cookstoves are included in the government's policy for renewable energy it is expected that donors and NGOs will continue to develop strategies and implement programs for scaling-up improved cookstove dissemination.

- Despite some progress, a number of limitations remain when it comes to low-emissions development activities. The most significant ones are: limited awareness by policymakers not directly involved in climate change-related activities; the gap between technology development and dissemination; lack of awareness of the importance of sustainable energy (energy efficiency and renewable energy) efforts amongst industrial and commercial sectors as well as households; and weak technical capacity.

Question 1: What are the priority technical, institutional, policy, capacity, and data needs and gaps for the development and implementation of a LEDS in Bangladesh, and the potential opportunities for USAID?

- Bangladesh's coal mines, which have the potential to yield 2,000 megawatts, have not yet been exploited largely due to civil society resistance to open-pit mining and the difficulty of controlling the flow of groundwater caused by mining activities. However, the increasing gap between power supply and demand is likely to serve as the impetus for the development of coal power plants over the next five to 10 years. Thus, there is an opportunity for USAID to facilitate the integration of climate change considerations into initial discussions regarding the design of coal mines.

- During consultations, it was noted that a key barrier impeding the uptake of energy efficiency measures by businesses was their lack of awareness regarding the benefits. Quantitative analyses highlighting the financial benefits of such measures, particularly those at little or no cost, would help to convince businesses of their value.

- The other alternative energy source that is perceived as having potential is wind, particularly in the southern coastal areas. A feasibility study has not yet been conducted and would be an important first step.

- Biomass sources such as rice husks are seen as having greater large-scale potential than solar and biogas. Twenty percent of the country's 40 million tons of rice husks may be used to generate 2-3 megawatts of electricity. A feasibility study has been conducted under USAID's ICEA project. Supporting the development of a plan to use these resources as well as the dissemination of appropriate technologies may help to improve electricity access.

- Analytical and modeling capabilities within the Government are limited. Strengthening the ability to use these skills for activities such as policy impact analyses would enable more effective policy formulation.

- The inadequate aftercare and maintenance provided to households with SHSs places an additional burden on the PBSs, decreasing their willingness to promote the technologies. A program working with donors (e.g., World Bank), companies (e.g., IDCOL), and NGOs (e.g., Grameen Shakti) to improve aftercare services would increase the life of the technologies and help to obtain greater support for solar technologies from the PBSs.

- SHSs are expected to result in a significant number of used batteries. However, SHS programs often do not give adequate consideration to this potentially grave environmental threat.

- Remote sensing and GIS capabilities are also weak, with the exception of departments such as the Resource Inventory and Management System (RIMS) in the Forest Department and the Ministry of Water's Center for Environmental and Geographic Information Services. Strengthening these skills within different ministries would facilitate resource mapping of renewable energy sources, and would help to inform decisionmaking processes.

- Despite the fact that a large proportion of households relies on woody biomass for fuel, which is an important contributor to forest degradation and deforestation in the country, a resource assessment of woody biomass as energy supply has yet to be prepared. Moreover, a plan to balance supply of biomass with demand, and a rural energy strategy to introduce more modern fuels and move away from scarce biomass resources does not exist. There is opportunity for developing a program to evaluate current and future biomass energy resources and use; indicate targets and describe measures to ensure sustainable use of biomass, especially firewood (e.g. promotion of enhanced co-operation and information exchange between market players, data collection on biomass energy demand and supply, observation of price development and capacity building, scaling-up of more energy efficient stoves), and explore land-use practices to enhance the sustainable biomass resource over time. Such studies related to wood energy would help determine whether firewood is a non-renewable, which is a pre-requisite for accessing carbon finance for such projects such as improved cookstoves. A potential related activity is the establishment of production forests for fuelwood use, which could yield co-benefits such as pro-poor conservation financing.

- Awareness about REDD in Bangladesh is relatively high within the FD, although the reality of national potential may not match expectations, especially if markets are to be the primary source funding REDD activities. A critical need is for more in-depth capacity building to move from awareness to understanding and on to knowledge about the many complex issues. Included among these are a wide range of technical and policy issues, such as carbon stock assessments, carbon rights, benefits sharing and MRV systems. The recent pattern of brief (1-2 weeks) training sessions have successfully introduced the concepts, but dedicated efforts to transform this understanding to action-

oriented knowledge of REDD operational skills remain a critical need. Developing the capacity to access carbon financing, particularly pro-poor conservation financing, also has the potential to result in co-benefits related to poverty reduction objectives.

- Coastal afforestation activities could provide a number of mitigation and adaptation benefits and co-benefits. Carbon sequestration into growing biomass potentially generates saleable carbon credits while generating fuelwood from branches. Enhancement of fish and mollusk nurseries increases community livelihoods while also contributing to food security. Restoration of degraded coastal ecosystems reduces vulnerability to sea level rise and extreme weather events such as tropical storms. The combination of these livelihood, conservation, and climate adaptation co-benefits enhances the resilience of coastal communities and ecosystems.

- Very little has been done in the area of agriculture and LED in Bangladesh. However, improved water and fertilizer management would not only have important mitigation implications, but also facilitate objectives related to the sustainable use of natural resources and environmental protection.

Table 13. Opportunities for USAID and their support of CCSAP priorities

	Priority areas from CCSAP					
Potential areas of focus for USAID	**Food security, social protection & health**	**Comprehensive disaster management**	**Infrastructure**	**Research & knowledge management**	**Mitigation & low carbon development**	**Capacity building & institutional strengthening**
General						
Capacity building to develop analytical and modeling capabilities within national institutions (all sectors)					X	X
Power sector						
Integrating LEDS relevant considerations into processes informing the development of coal-fired power plants			X		X	
Energy efficiency (EE)						
Making the business case for EE and raising awareness amongst key industries regarding the benefits of EE measures					X	X
Promoting the dissemination of improved cookstoves	X				X	
Renewable energy						
Comprehensive wind power potential mapping and assessment to determine feasibility and possible target locations					X	
Maintenance and after care of photovoltaic technologies used in SHSs and solar irrigation pumps					X	
Reuse/recycling/disposal of batteries used in photovoltaic technologies					X	
Supporting piloting and/or market access of rice husk technologies					X	
Development of GIS and remote sensing capabilities to evaluate the potential of renewable energy sources					X	X
Forestry						
Resource assessment of woody biomass as energy	X				X	

	Priority areas from CCSAP					
Potential areas of focus for USAID	**Food security, social protection & health**	**Comprehensive disaster management**	**Infrastructure**	**Research & knowledge management**	**Mitigation & low carbon development**	**Capacity building & institutional strengthening**
supply to support preparation of a strategy for sustainable use of biomass as a fuel for households and SMEs						
Development of production forests for fuelwood use, with co-benefits for community and biodiversity	X				X	
REDD capacity building						
Coastal afforestation		X			X	
Agriculture						
Fertilizer and water management	X				X	

Question 2: Based on lessons learned from past initiatives, strategies, or plans, including those that are specific to relevant areas such as REDD+ or energy efficiency, what are the key considerations for the development of a LEDS in Bangladesh?

- Adaptation is the climate change priority in Bangladesh, and pursuit of a LED pathway is only considered desirable insofar as it coincides with the country's overall development objectives, particularly economic development, energy security, food security, and disaster management. Thus, an integrated approach balancing mitigation and adaptation considerations will be crucial for obtaining support from the government of Bangladesh for a LEDS. As a result most of the LED options presented above also have non-mitigation benefits.

- The private sector's role in mitigation, adaptation, and key sectors such as energy and forestry continues to be limited despite some efforts on the part of the government to engage them more deeply, particularly in the energy sector. However, the private sector will play an important role in the development and dissemination of technology solutions for both mitigation and adaptation. Moreover, it has the greatest in-country capacity and potential to develop projects for both the regulatory and voluntary carbon markets.

- Due to the broad range of climate change and sector-specific activities already taking place, donor coordination will be critical for effective engagement with the government. This will not only entail avoiding replication and promoting collaboration and leveraging where possible, but also ensuring that the donor community conveys a cohesive message to the government.

Question 3: Who are the key people to meet with in regard to a LEDS?

Energy

- MPEMR – Dr. Taufiq Elahi, Energy Advisor
- MOEF – Dr. Mihir Kanti Majumder, Secretary
- Ministry of Planning

- Rahimafrooz Renewable Energy Ltd. – Sohel Ahmed, General Manager and Head of Business
- Waste Concern – A.H. Md. Maqsood Sinha and Iftekhar Enayetullah, Co-founders and Executive Directorse (second approved CDM project in Bangladesh)
- Grameen Shakti – Dr. M.S. Islam, Head, International Cooperation and Development
- IDCOL
- World Bank/IFC – Mrinal Sircar, Program Manager, South Asia Enterprise Development Facility
- ADB = Jiangfeng Zhang, Senior Country Economist, Bangladesh Resident Mission; Arif Mohammad Faisal, Project Implementation Officer (Environment), Bangladesh Resident Mission
- JICA
- GTZ – Dr. Engr. M. Khaleq-uz-zaman, Senior Advisor, Sustainable Energy for Development

Forestry

- Dr. Mihir Kanti Majumder – Secretary, Ministry of MOEF
- Ishtiaq Uddin Ahmad – Chief Conservator of Forests
- Haradhan Banik – Conservator of Forests (point person on REDD)
- Md. Zaheer Iqbal – Deputy Conservator of Forest (head of RIMS unit in charge of GIS)
- GTZ – Berthold Schirm, Principal Advisor, Wetland Biodiversity Rehabilitation Project

ANNEX 1: REFERENCES AND RESOURCES

ENERGY

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ANNEX 2: DHAKA CONSULTATIONS

	Date	Name	Title	Organization	Category
1	October 4, 2010	Kaisar Ahmed	Director, Program Planning	REB	Technical institute
2	October 5 and 7, 2010	Azharul Mazumder	Environment Team Leader, Economic Growth Office	USAID/Bangladesh	Donor
3	October 5 and 7, 2010	Alamgir Hossain	Environment and Climate Change Specialist	USAID/Bangladesh	Donor
4	October 5 and 7, 2010	Denise Rollins	Mission Director	USAID/Bangladesh	Donor
5	October 5, 2010	Alexander Gazis	Second Secretary, Economic and Commercial Affairs	U.S. Embassy	Donor
6	October 5	Michael C. Schera	Science Advisor	U.S. State Department	Donor
7	October 5	Sumaiya Firoze		USAID/Bangladesh	Donor
8	October 5	Nasine Aziz	Program Officer	IUCN	NGO
9	October 5	Md. Shawkat Hossain	Program Officer (M&E)	Arannayk Foundation	NGO
10	October 5	Md. Mahib Kabir	International Climate Champion	British Council	
11	October 5	Gazi Shamsuzzamah	Head – Program Monitoring	COAST Trust	NGO
12	October 5	Ahmmad Ali	Director	CES BUET	NGO
13	October 5	Dr. M.S. Islam	Head, International Cooperation and Development	Grameen Shakti	NGO
14	October 5	Md. Momtajul Islam	Executive Director	Al-Falah Aam Unnayan Sangstha	NGO
15	October 5	Md. Iqbal Hossain	Project Coordinator	Al-Falah Aam Unnayan Sangstha	NGO
16	October 5	Shafiul Azam	Managing Director	Rupantarita Prakritik Gas Company Limited	NGO
17	October 5	Engr. A.I.M. Nusullah	Deputy General Manager	Rupantarita Prakritik Gas Company Limited	NGO
18	October 5	Prof. Dr. S.M. Imanuel Hq	Chairman	BCSIR	Research institute
19	October 5	Dr. Atiq Rahman	Executive Director	BCAS	Research institute
20	October 5	Dr. M.I. Sharif	Senior Fellow	BCAS	Research institute
21	October 5	Khandaker Moinuddin	Senior Fellow	BCAS	Research institute
22	October 5	Ashraful Amin	Senior Research Officer	BCAS	Research institute
23	October 6, 2010	Naren Chanmugan	Office Director, Economic Growth Office	USAID/Bangladesh	Donor
24	October 6, 2010	Mark Visocky	Deputy Office Director, Economic Growth Office	USAID/Bangladesh	Donor
25	October 6,	Mrinal Sircar	Program Manager	IFC	Donor

	Date	Name	Title	Organization	Category
	2010				
26	October 6, 2010	Jiangfeng Zhang	Senior Country Economist	ADB	Donor
27	October 6, 2010	Arif M. Faisal	Project Implementation Officer (Environment)	ADB	Donor
28	October 6, 2010	Berthold Schirm	Principal Advisor, Wetland Biodiversity Project	GTZ	Donor
29	October 6, 2010	Dr. Engr. M. Khaleq-uz-zaman	Senior Advisor, Sustainable Energy for Development (SED)	GTZ	Donor
30	October 6, 2010	Morshed Ahmed	Senior Advisor (Development Affairs)	Norwegian Embassy	Donor
31	October 6, 2010	Joanne Manda	Climate Change and Environment Advisor	DFID	Donor
32	October 6, 2010	Utpal Bhattacharjee	Manager – CDM	Rahimafrooz Renewable Energy Limited	Private company
33		Dennis Sharma, Ph.D.	Deputy Mission Director	USAID/Bangladesh	Donor
33	October 7, 2010	Kelly D. Hewitt	Chief of Party & Energy Regulatory Expert	USAID ICEA project	Donor – project
34	October 7, 2010	A.S.M. Bashirul Huq	Deputy Chief of Party	USAID ICEA project	Donor – project
35	October 7, 2010	James Ford	Rural Cooperative Expert	USAID ICEA project and NRECA International Ltd.	Donor - project

ANNEX 3: KEY ENERGY INFORMATION AND STATISTICS

In 2008, the total amount of installed capacity in Bangladesh was 5,493 MW (BPDB, 2009). The maximum available generation was only 4162 MW. The reasons for lower availability were: (1) some plants were out of operation for maintenance, rehabilitation, and overhauling, (2) capacity of some plants were derated due to aging, and (3) gas shortage. The breakdown of installed capacity and fuels is shown in the following table.

Installed Capacity 2008

By type of plant			By type of fuel		
Hydro	230 MW	4.19 %	Gas	4,542 MW	82.69 %
Steam Turbine	2,638 MW	48.03 %	Furnace Oil	280 MW	5.09 %
Gas Turbine	997 MW	18.15 %	Diesel	191 MW	3.48 %
Combined Cycle	1,359 MW	24.74 %	Hydro	230 MW	4.19 %
Diesel	269 MW	4.89 %	Coal	250 MW	4.55 %
TOTAL	5,493 MW	100.00 %	Total	5,493 MW	100.00 %

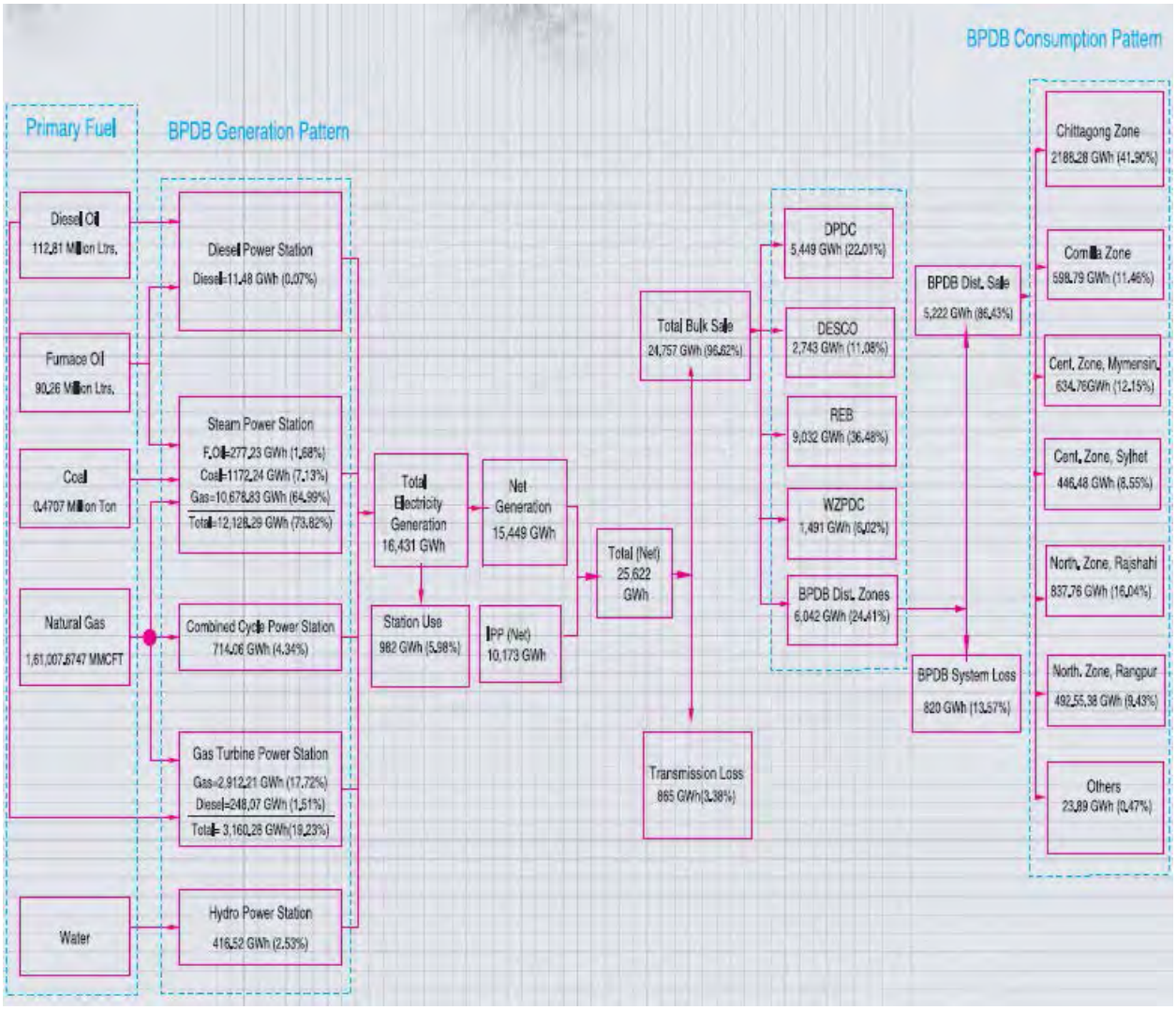
Source: Bangladesh Power Development Board 2008 Annual Report

The net electricity that was generated in 2008 amounted to 25,622 GWh, broken down the table below. The electricity was generated by a mix of public and private sector entities. The BPDB's generation was 15,499 GWh, BPDB purchased 10,173 GWh from IPPs and rental power plants in the private sector.

Power Generation Mix 2008

Fuel	Generation (GWh)	Percentage Share
Hydro	413.65	1.62%
Natural Gas	22660.75	88.44%
Furnace Oil	996.41	3.89%
Diesel	520.52	2.03%
Coal	1030.60	4.02%
TOTAL	25,621.93	100%

Source: Bangladesh Power Development Board 2008 Annual Report

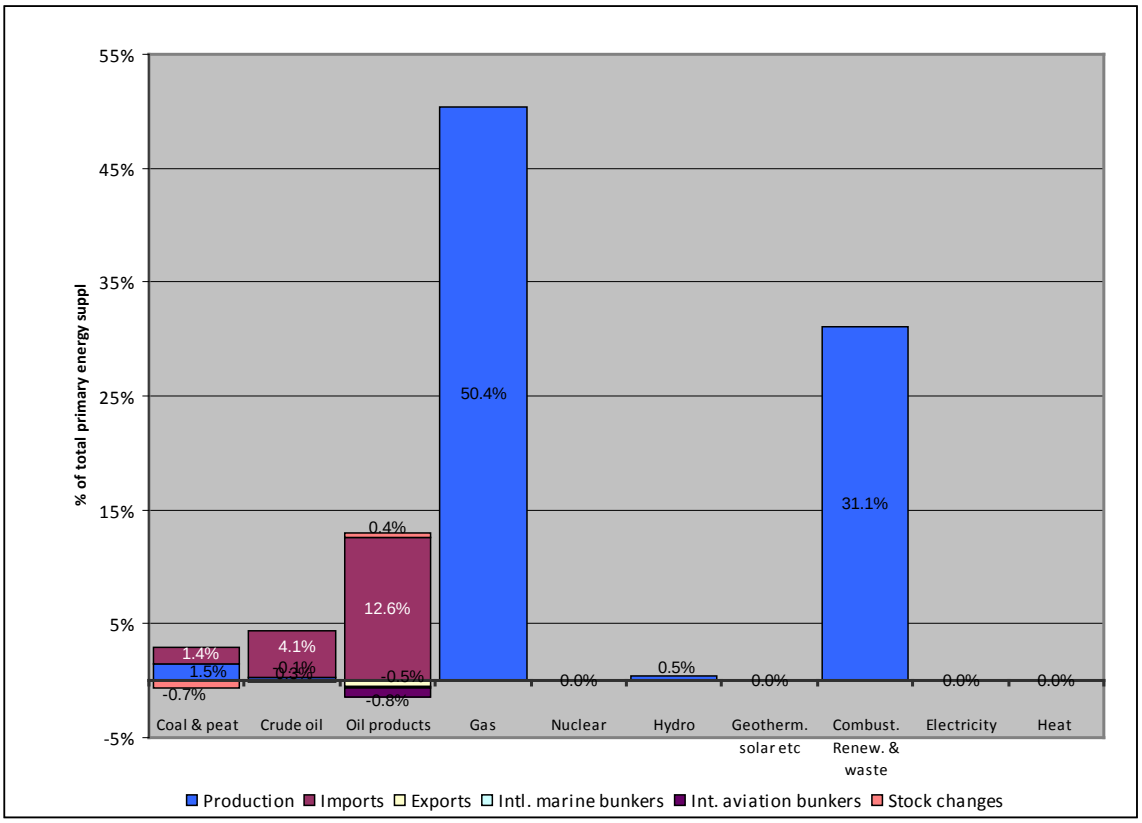

BPDB Consumption Pattern
Primary Fuel
BPDB Generation Pattern
Diesel Oil
112,81 Million Ltrs.
Furnace Oil
90,26 Million Ltrs.
Coal
0.4707 Million Ton
Natural Gas
1,61,007.6747 MMCFT
Water
Diesel Power Station
Diesel=11.48 GWh (0.07%)
Steam Power Station
F.Oil=277.23 GWh (1.68%)
Coal=1172.24 GWh (7.13%)
Gas=10,678.83 GWh (64.99%)
Total=12,128.29 GWh (73.82%)
Combined Cycle Power Station
714.06 GWh (4.34%)
Gas Turbine Power Station
Gas=2,912.21 GWh (17.72%)
Diesel=248.07 GWh (1.51%)
Total= 3,160.28 GWh(19.23%)
Hydro Power Station
416.52 GWh (2.53%)
Total Electricity Generation 16,431 GWh
Net Generation 15,449 GWh
Station Use 982 GWh (5.98%)
IPP (Net) 10,173 GWh
Total (Net) 25,622 GWh
Total Bulk Sale 24,757 GWh (96.62%)
Transmission Loss 865 GWh(3.38%)
DPDC 5,449 GWh (22.01%)
DESCO 2,743 GWh (11.08%)
REB 9,032 GWh (36.48%)
WZPDC 1,491 GWh (6.02%)
BPDB Dist. Zones 6,042 GWh (24.41%)
BPDB Dist. Sale 5,222 GWh (86.43%)
BPDB System Loss 820 GWh (13.57%)
Chittagong Zone 2188.28 GWh (41.90%)
Comilla Zone 598.79 GWh (11.46%)
Cent. Zone, Mymensin 634.76GWh (12.15%)
Cent. Zone, Sylhet 446.48 GWh (8.55%)
North. Zone, Rajshahi 837.76 GWh (16.04%)
North. Zone, Rangpur 492.55.38 GWh (9.43%)
Others 23.89 GWh (0.47%)

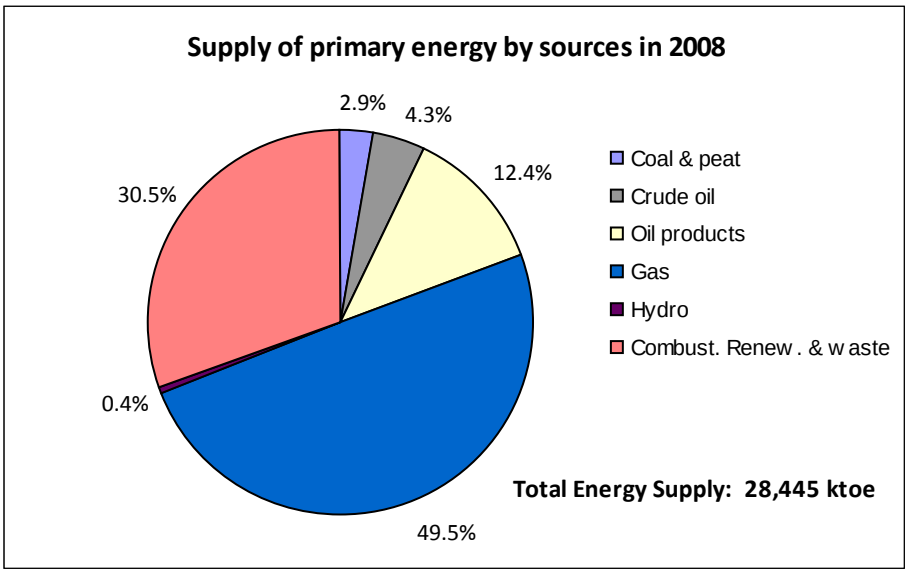
PLANT WISE GENERATION (FY 2009)

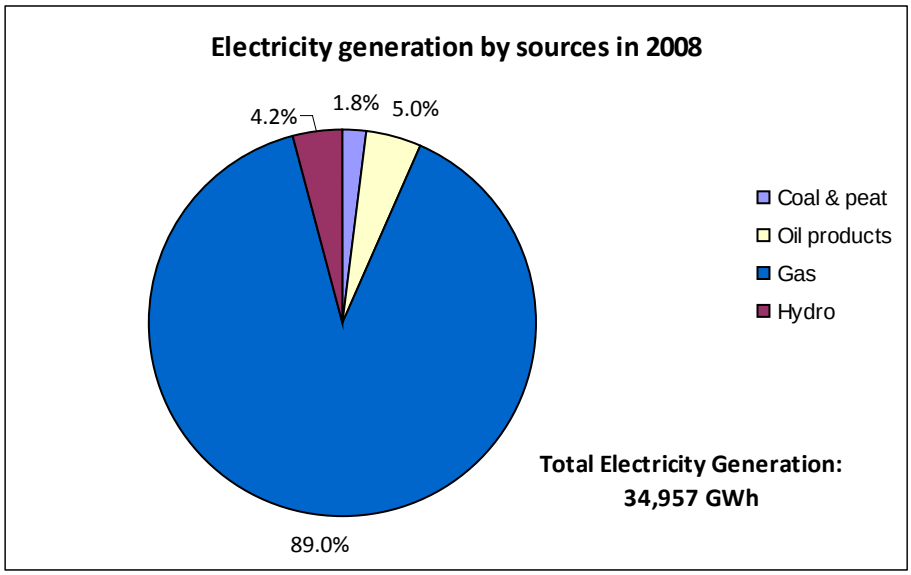
Sl. No.	Name of power plant	Type of fuel	Installed Capacity (As of June) (MW)	Derated Capacity (As of June) (MW)	Gross Energy Generation (GWh)	Annual Plant factor (%)	Efficiency (%) (Net)	Overall Thermal Efficiency(%) (Net)
1	Karnafuli Hydro(2x40 MW+3x50 MW)	Hydro	230	230	416.52	20.67		
2	Chittagong Thermal Power Plan Unit #-1	Gas	210	180	569.20	36.10	27.54	
	Chittagong Thermal Power Plan Unit #-2	Gas	210	180	521.60	33.08	28.06	
3	Sikalbaha 60 MW Steam Turbine	Gas	60	40	22.83	6.52	25.88	
	Sikalbaha 2x28 MW Barge Mounted GT	Gas	28	10	-	0.00	18.23	
4	Ashuganj 2x64 MW Steam Turbine	Gas	128	128	863.85	77.04	30.03	
	Ashuganj 3x150 MW Steam Turbine	Gas	450	380	2,853.68	85.73	31.98	
	Ashuganj GT 1	Gas	56	40	258.89	73.88	20.20	
	Ashuganj ST	Gas	34 CC	18	84.53	53.61	23.39	
	Ashuganj GT 2*	Gas	56	40	272.80	77.85	23.39	
5	Ghorasal 2x55 MW Steam Turbine (1+2nd Unit)	Gas	110	85	245.16	32.92	23.89	
	Ghorasal 2x210 MW Steam Turbine(3+4th Unit)	Gas	420	380	2,322.66	69.77	33.04	
	Ghorasal 2X210 MW S/T (5+6th Unit)	Gas	420	380	2,567.94	77.14	32.93	
6	Siddhirganj 210 MW Steam Turbine	Gas	210	190	711.91	42.77	33.41	
7	Haripur 3x33 MW Gas Turbine	Gas	96	96	194.70	23.15	21.79	
8	Tongi 100 MW Gas Turbine	Gas	105	105	454.99	49.47	26.83	
9	Shahjibazar Gas Turbine(4 units)	Gas	60	38	103.28	31.03	16.44	
	Shahjibazar 60 MW Gas Turbine	Gas	70	69	453.28	74.99	28.80	
10	Sylhet 1x20 MW Gas Turbine	Gas	20	20	78.29	44.69	24.70	
11	Fenchuganj C.C. (1st Unit)	Gas	97	91	599.86	75.25	40.20	
	Fenchuganj C.C. (2nd Unit)	Gas			29.67			
12	Khulna 1x110 MW Steam Turbine	F.oil	110	60	277.23	52.74	25.04	
	Khulna 1x60 MW Steam Turbine	F.oil	60	35	-	0.00	-	
13	Barisal 2x20 MW Gas Turbine	HSD	40	32	84.39	30.11	20.43	
	Barisal Diesel(9 units)	HSD	6	3.0	1.84	6.99	18.16	
14	Bhola Diesel	HSD	3.0	2.0	5.98	34.12	26.58	
		FO			-			
	Bhola New	HSD	2	2.0	1.46	8.36	35.37	
15	Bheramara 3x20 MW Gas Turbine	HSD	60	54	110.12	23.28	24.37	
16	Baghabari 71 MW Gas Turbine	Gas	71	71	463.27	74.49	27.83	31.99
	Baghabari 100 MW Gas Turbine	Gas	100	100	632.72	72.23	28.72	
17	Rangpur 20 MW Gas Turbine	HSD	20	20	21.28	12.14	21.02	
17	Saidpur 20 MW Gas Turbine	HSD	20	19	32.28	19.40	22.60	
18	Barapukuria 2x125 MW ST (COAL)	COAL	250	220	1,172.24	60.83	32.26	
19	Thakurgaon 3x1.5 MW Diesel***	LDO	3	3	0.48	1.84		
	Total(Grid)		**3815**	**3321**	**16428.92**	**56.4724**		
20	Isolated East	HSD			1.72			
	Isolated West	HSD			-			
	TOTAL BPDB		**3815**	**3321**	**16430.64**			
	BPDB Station Uses				**982.03 GWh**			
	IPP							
1	KPCL (Khulna,BMPP)	FO	110	106	748.24			
2	WEST MONT(Baghabari,BMPP)	Gas	90	70	505.45			
3	NEPC(Haripur, BMPP)	Gas	110	110	624.16			
4	RPC(Mymensingh)	Gas	210	175	957.34			
5	AES, Haripur	Gas	360	360	2,585.01			
6	AES, Meghnaghat	Gas	450	450	3,411.33			
	Sub-Total IPP		1330	1271	8831.52			
	RENTAL & SIPP							
1	Bogra Rental (15 Years)	Gas	18	18	137.11			
2	Khulna Rental (3 Years)	HSD	40	40	263.80			
3	Kumargoan (3 Years)	Gas	48	48	270.48			
4	Sahzibazar RPP (3 Years)	Gas	50	50	178.15			
5	Sahzibazar RPP (15 Years)	Gas	86	86	281.14			
6	Tangail SIPP (22 MW) (BPDB)	Gas	22	22	95.71			
7	Feni SIPP (22 MW) (BPDB)	Gas	22	22	67.33			
8	Kumargao 10 MW (15 Years)	Gas	10	10	27.28			
9	Barabkundu	Gas	22	22	20.79			
10	Jangalia, Comilla	Gas	33	33	-			
	Sub-Total RENTAL & SIPP		351	351	1341.79			
	Total Private (Net Generation)		1681	1622	10173.307			
	BPDB Net Generation				15,448.62			
	Total Net Generation(BPDB+IPP Net)				25,621.93			
	Total Generation(BPDB Gross+IPP& Rental net)		**5493**	**4940**	**26,603.95**			

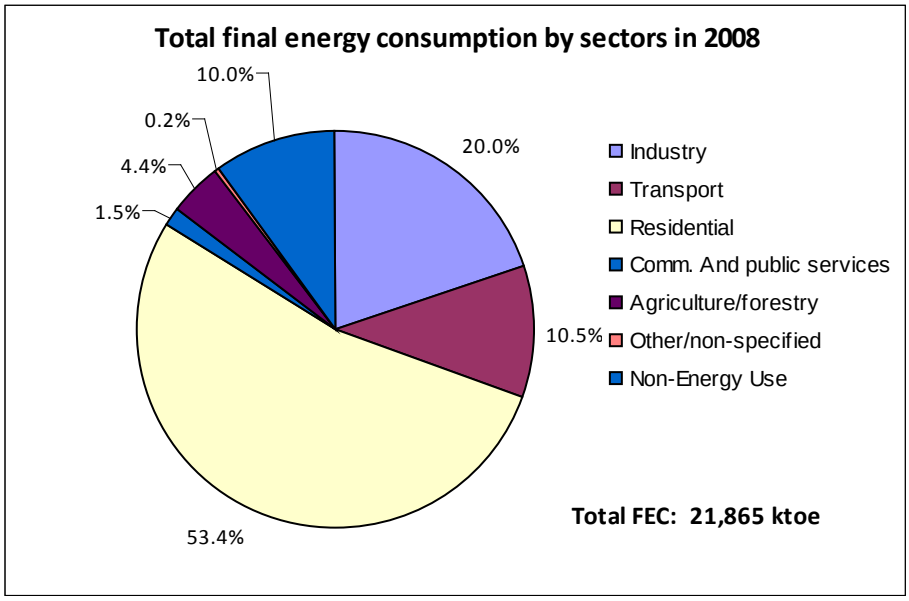
*** Install & Derated Capacity of Thakurgaon Diesel is shown 0 MW.

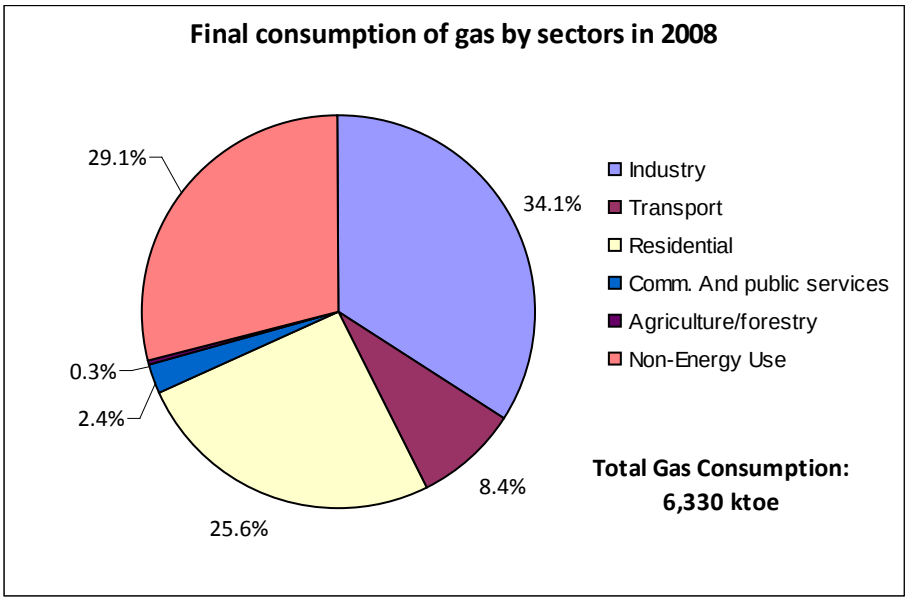
Energy Balance of Bangladesh by Primary Energy Sources 2008 (IEA data)






Electricity generation by sources in 2008
4.2%
1.8%
5.0%
89.0%
Coal & peat
Oil products
Gas
Hydro
Total Electricity Generation:
34,957 GWh


Total final energy consumption by sectors in 2008
10.0%
0.2%
4.4%
1.5%
20.0%
10.5%
53.4%
Industry
Transport
Residential
Comm. And public services
Agriculture/forestry
Other/non-specified
Non-Energy Use
Total FEC: 21,865 ktoe


Final consumption of gas by sectors in 2008
29.1%
34.1%
0.3%
2.4%
8.4%
25.6%
Industry
Transport
Residential
Comm. And public services
Agriculture/forestry
Non-Energy Use
Total Gas Consumption:
6,330 ktoe

Consumption of Natural Gas by Sector (billion cubic feet)

		Sectors									
Fiscal Years	Production	Power	Fertilizer	Industry	Captive Power	Tea Estates	B. Fields season	Commercial	Domestic	CNG	Total Sales
1999-00	332.35	147.62	83.31	41.52	-	0.64	0.35	3.85	29.56	0.00	306.8
2000-01	372.16	175.27	88.43	47.99	-	0.65	0.44	4.06	31.85	0.00	348.6
2001-02	391.53	190.03	78.78	53.56	-	0.72	0.53	4.25	36.74	0.00	364.6
2002-03	421.16	190.54	95.89	63.76	-	0.74	0.52	4.56	44.80	0.23	401.0
2003-04	454.59	199.40	92.80	46.49	32.03	0.80	0.12	4.83	49.22	1.94	427.6
2004-05	486.75	211.02	93.97	51.68	37.87	0.80	0.00	4.85	52.49	3.62	456.3
2005-06	526.22	222.72	88.58	63.44	49.02	0.76	0.00	5.24	57.13	6.71	493.6
2006-07	562.22	221.10	93.47	77.48	62.51	0.75	0.00	5.66	63.25	11.9	536.2
2007-08	600.72	234.28	80.23	78.67	92.19	0.71	0.00	6.60	69.02	22.8	584.5
2008-09	653.75	256.3	94.7	74.85	104.3	0.65	0.00	7.46	73.78	31.0	643.1

Source: Bangladesh Economic Review 2009, Ministry of Finance

ANNEX 4: DONOR PROJECTS

Donor	Project	Years approved and closed	Amount	Description
World Bank	GPOBA: Rural Electrification & Renewable Energy –	May 2010 – June 2014	$1.1 million (Global Partnership on Output Based Aid)	Implementing Agency is Infrastructure Development Company Limited (IDCOL)
World Bank	Bangladesh Brick Kiln Efficiency Project (Carbon Finance)	Approved August 2009	$14.3 (carbon finance)	Implementing Agency is Infrastructure Development Company Limited (IDCOL) (total project cost $14.3 million, 2009-N/A) – This project promotes the use of energy efficient Hybrid Hoffman Kilns by purchasing the Certified Emissions Reductions generated through their adoption, and plans to reduce and estimated 881,000 tons of CO2 during the project period 2010-2020.
World Bank	GPOBA Solar Home Systems Project –	March 2010 – September 2013	$7.2 million (Global Partnership on Output Based Aid)	Implementing Agency is Infrastructure Development Company Limited (IDCOL) It aims to improve access to electricity and reduce carbon emissions through loans that are extended to households for the purchase and installation of solar home systems.
World Bank	Efficient Lighting Initiative	Pipeline	$15 million	To simultaneously reduce the demand for and the access to electricity through the installation of 10.5 million high quality CFLs. Financed under the RERED initiative.
World Bank	Additional Financing for Rural Electrification and Renewable Energy Development Project (REREDP)	Approved August, 2009	130 million $ (Total project cost $300 million)	Implementing Agencies are Infrastructure Development Company Limited (IDCOL) and Rural Electrification Board (REB) The additional financing credit will help finance the costs associated with: (i) the installation of Solar Home Systems (SHSs); (ii) introducing CFLs; and (iii) rehabilitating electricity distribution networks in rural areas to reduce the system loss.
World Bank	Siddhirganj Peaking Power Project	October 2008 – March 2016	350 million $ (IBRD/IDA) (Total Project Cost $470	The Siddhirganj Peaking Power Project for Government of Bangladesh (GoB) development objectives are to increase the supply of power during periods of

Donor	Project	Years approved and closed	Amount	Description
			million)	peak demand in Bangladesh (GoB)
World Bank	Bangladesh - IDCOL Solar Home Systems Project (Carbon Finance)	Approval December, 2007	1 million $ (Carbon Finance)	Implementing Agency is Infrastructure Development Company Limited (IDCOL)
World Bank	Grameen Shakti Solar Homes Project	December, 2007	428 million $ ($9 million, active)	Its goal is to install 929,169 solar home systems providing facilities for lighting, TV, and radio, throughout Bangladesh between 2007-2015. Grameen Shakti is the implementing partner. The Solar Home Systems and Grameen Shakti Solar Homes projects are partly funded by the RERED, implemented by IDCOL.
World Bank	Bangladesh Power Sector Development Policy Credit	June, 2008	120 million $	The enhancement of governance and accountability, and of financial stability, in the power sector leading to better and more sustainable service provision
World Bank	Power Sector Development Technical Assistance Project	June 2004 – June 2011	15.5 million $ (IBRD/IDA) (Total Project Cost $20.5 million)	Implementing Agency: MPEMR To create the institutional and policy environment needed to scale up the development of the power sector, by addressing constraints such as inadequate coverage and poor quality of power supply.
World Bank	Rural Electrification and Renewable Energy Development	June 2002 – December 2012	190.98 million $ (IBRD/IDA) (Total project cost $290.1 million)	Implementing Agencies are Infrastructure Development Company Limited (IDCOL) and Rural Electrification Board (REB) To provide support for the development of on- and off-grid electricity services to extend their reach to 700,000 remote rural households and small businesses in Bangladesh. While grid development will consist of expansion and intensification of the Rural Electrification Board's (REB) distribution network in project areas as well as improvements in the operational and financial performance of the rural electricity cooperatives, the off-grid component will focus on renewable energy options, primarily solar home systems, and private sector operated mini-grids. Direct investments are to be made in the rehabilitation and expansion of the distribution system. Support of the small power generation component will consist largely of technical assistance as well as possible investments in associated basic infrastructure development, such as the provision of gas supply facilities to plants. The successful partnership between the REB and the cooperatives

Donor	Project	Years approved and closed	Amount	Description
				has been critical for these efforts. Additional financing of $130 million for the project was approved in August 2009.
World Bank	Renewable Energy Development Project	June 2002 – December 2009	8.2 million $ (GEF)	Implementing Agencies are Infrastructure Development Company Limited (IDCOL) and Rural Electrification Board (REB)
World Bank	Investment Promotion and Financing Facility	May 2006 – December 2014	50 million $ (IBRD/IDA) (Total Project Cost $105.2 million)	Implementing Agency: Bangladesh Bank Infrastructure services for private sector development, including the energy sector.
GTZ	Renewable Energy and Energy Efficiency Programme	March, 2007	16 million Euro	The aim of this program, which ran from 2007-2010, was to improve the decentralization of renewable energy supplies to household and business consumers, facilitate more efficient use of available energy, and promote the replacement of technologies such as traditional cookstoves and kerosene lamps that pose a health risk to poor individuals. It aimed to do this by advising the relevant public agencies on policy and strategy development, helping energy providers prepare for technical innovations, and informing stakeholder groups about projects to introduce renewable energy and energy-efficiency initiatives. One outcome is that the government is in the process of forming a coordination center for the promotion of renewable energy. The lead executing agency is the Power Division under the MPEMR.
United Nations Environment Programme's (UNEP) Division of Technology, Industry and Economics and the Risoe Centre on Energy, Climate and Sustainable Development on behalf of the United Nations Framework Convention on Climate Change	Technology Needs Assessment (TNA) Project			The TNA assists select countries determine technology priorities for the achievement of mitigation and adaptation goals as a means to promote climate resilient, low-emissions development. Its objectives are to promote the acquisition of environmentally sustainable technologies, enhance the capacity to support future investment and the removal of barriers, and diffuse priority technologies throughout key economic sectors through measures that are context-relevant and optimize local resources. It is implemented by the United Nations Environment Programme's (UNEP) Division of Technology, Industry and Economics and the Risoe Centre on Energy, Climate and Sustainable Development on behalf of the United Nations Framework Convention on Climate Change (UNFCCC) and the

Donor	Project	Years approved and closed	Amount	Description
(UNFCCC) and the Global Environmental Facility (GEF).				Global Environmental Facility (GEF). The Bangladesh government responsible entity is the MOEF.
ADB	Power System Efficiency Improvement Project	February, 2009	1.2 million $	To develop a least-cost project design and feasibility studies along with a power sector energy efficiency program
ADB	Tendering Process for Independent Power Producer (IPP) Plants	July, 2007	0.6 million $	To expand capacity and reliable, affordable power by contracting with selected private sector sponsors for developing 450 MW Sirajganj and 450 MW Meghnaghat Phase-3 gas-fired combined cycle power plants on a BOO basis.
ADB	Gas Transmission and Development Project	October, 2005	ADB-OCR 225 million $ Norway 5 million $	To enhance use of natural gas by consumers, industry, and commercial users by improving and expanding the gas transmission and distribution network system in project areas; conducting appraisals of gas fields to update gas reserve estimates and identify locations for future exploration; enhance financial performance, governance, and efficiency indicators through capacity building and greater private sector participation; and improve ambient and indoor air quality through provision of cleaner fuel. Progress Toward Outcome Loans became effective on 28 November 2006. Procurement activities have commenced.
ADB	Corporatization of Bangladesh Power Development Board	August, 2005	0.8 million $	(1) Detailed plan for BPDB corporatization, (2) Establishment of accounting and financial management system, (3) Computerized MIS, and (4) Draft personnel policies
ADB	Corporatization of the West Zone Distribution Operations of the Bangladesh Power Development Board (BPDB)	December, 2001	0.9 million $	Detailed plan for corporatization
ADB	Sustainable Power Sector Development Program (Project and Program Loan)	June, 2007	$465 million	This project builds on ADB's successful first power sector development program, approved in 2003. It seeks to support and assist the government in continued power sector reform, including financial and organizational restructuring, improved governance, greater private sector participation, capacity building, expanding clean fuel generation, enhancing transmission network reliability and efficiency, and improving the quality of supply in Dhaka.

Donor	Project	Years approved and closed	Amount	Description
ADB	Promotion of Private Sector Participation in the Power Sector	December, 2009	$600,000	The goal of the TA is to improve the reliability and sustainability of the electric power sector by further facilitating private sector participation and investment as well as PPP financing.
ADB	Power Sector Development Program	TA – February, 2009; Loan - 2011	TA - $120 million; Loan - $300 million (proposed)	This program consists of TA and a loan for a Power Sector Energy Efficiency Project (formerly the Energy Efficiency Improvement Project).
ADB	Public Private Partnership in Energy Development	February, 2008	$500,000	To assist the GoB determine how changes in the regulatory and pricing frameworks, corporate governance, and sector unbundling affect private sector participation in the energy sector.
ADB	Sustainable Rural Infrastructure Project		$60.5 million	
United Kingdom Department for International Development (DFID)	Intensification & Expansion of Distribution System of 9 PBS	2002-03	123 million $ 130 million $	Expansion of Distribution System of 9 PBSs 2nd Revised Expansion of Distribution System of 67 PBSs (2nd Revised)
DFID	Rural Electrification Development Project	January, 2003	$87.26 million	To increase access to affordable, sustainable electricity services in rural and peri-urban areas.
GTZ	Promotion of the use of Renewable Energies in the Rural Areas of Bangladesh	November, 2004	2.23 million $	To enable the rural population in non-electrified regions gain increased benefits from the use of Renewable Energies (RE) in a sustainable manner.
SNV Netherlands and KfW	Domestic Biogas and Manure Programme (NDBMP)	2006	EUR 23.61 million	The objective of the is to further develop and disseminate domestic biogas plants in rural areas with the ultimate goal to establish a sustainable and commercial biogas sector in Bangladesh
European Commission	RENDEV	2007		To promote development of income generating activities with renewable energy supply,
Islamic Development Bank (Jeddah based)	Solar photo voltaic electrification	Proposed	18 million US $	
JICA	Grid Substations and Associated Transmission Lines	2006	41.11 million US $	Enhance the capacity of existing 230/132 KV substation at Hasnabad in order to meet up the current demand of the Daudkhandi and Brahmanbaria. And release overload from the transformer in existing 230/132 KV substation at Comilla, Rampura, Haripur

Donor	Project	Years approved and closed	Amount	Description
Japan	New Haripur Power Plant Development Project II	2009	Japanese Yen 222	To meet the electricity demand of the country by developing a new power generation plant and to develop efficient institution, thereby contributing economic and social growth.
Japan	Central Zone Power Distribution Project	2009	Japanese Yen 9715	To improve reliability and efficiency of electricity distribution in Central zone; to meet increasing power demand in municipal areas of Central Zone; to enhance management efficiency and service levels by corporatization of distribution company; to improve customer service quality.

ANNEX 5: LEDS-RELEVANT STAKEHOLDERS

RESEARCH INSTITUTES

Renewable Energy Research Center- University of Dhaka, Bangladesh

Center for Energy Studies, Bangladesh University of Engineering & Technology (BUET)

Institute of Appropriate Technology (IAP), Bangladesh University of Engineering & Technology

Department of Farm Power and Machinery, Bangladesh Agricultural University, Mymensingh

Department of Mechanical Engineering; Khulna University of Engineering & Technology (KUET)

Chittagong University of Engineering & Technology (CUET), Chittagong.

Bangladesh Centre for Advanced Studies (BCAS)

Centre for Mass Education in Science (CMES)

NETWORKS

Renewable Energy Information Network, Bangladesh (REIN) – First website developed in Bangladesh to promote renewable energy in Bangladesh.

Bangladesh Solar Energy Society – Established in 1990 to cooperate on solar energy possibilities and potential in Bangladesh

PRIVATE COMPANIES

Rahimafrooz

First Bangladesh Technologies Ltd.

Micro Electronics

Energypac

GRENCON, Bangladesh

SOLARPAC, Bangladesh

Technolink International

Energy System/Prokaushali Sangsad Ltd.

ShineHardy Solar and Power Tech.

Fair Trade

Navana Batteries

RIMSU Batteries

Sun Energy

LIMITED COMPANIES

IDCOL

NGOS - NATIONAL

Grameen Shakti

Bangladesh Rural Advancement Committee

Waste Concern

ANONDO Group

COAST Trust

Thengamara Mahila Shabuj Shangha

Srizony Bangladesh

Integrated Development Foundation

NGOS - LOCAL

Shubashati

Upakulio Biddutayan O Mohila Unnayan Samity

Padakhep Manabik Unnayan Kendra

Bangladesh Rural Integrated Development For Grub-Street Economy

MUKTI Cox's Bazar

RuralServices Foundation

Hilful Fuzul Samaj Kalyan Sangstha

Palli Daridra Bimochan Foundation

Network for Universal Services and Rural Advancement

DABI Moulik Unnayan Sangstha

DESHA

Al-Falah Aam Unnayan Sangstha

Association for Village Advancement

ANNEX 6: ENERGY EFFICIENCY OPTIONS

	Investment (Million $)	Project Life (Year)	Energy Savings per Year	CO2 Reduction (Ton/year)	$Ton-CO2	Potential Per Year
Large Public Sector EE Projects						
Utilizing Pressure Reduction in Natural Gas Supply for Power Production (1.25 MW)	1.6	20	10 GWh	7,000	11.42	285 GWh
Retrofitting Urea Fertilizer Plants to Improve Energy Use (1 plant)	32.5	10	7 BCF	390,000	8.33	25 BCF
Replacement of Combined Cycle Gas Turbines (CCGT) for Baseload Power Generation (175 MW)	140	20	6.9 BCF	384,000	18.22	28 BCF
State-of-art or Aero-derivative Gas Turbines as Peaking Plants (135 MW)	34	20	1 BCF	56,000	30.35	1,050 GWh
Private Industry Sector						
Cogeneration in Industries with Captive Generators (100 units)	37.6	20	3.6 BCF	200,000	9.4	12 BCF
Bagasse Cogeneration at North Bengal Sugar Mills (NBSM)	7	20	24.3 GWh	17,000	20.58	280 GWh
Industrial Boiler Retrofits for Energy Efficiency (40 units)	1.44	10	0.27 BCF	15,000	9.6	6.4 BCF
Variable Speed Drive (and Cyclo Converters) for Commercial and Industrial Motors (1,000 units)	1.54	15	9.25 GWh	6500	15.79	540 GWh
Steel Mill Furnace Rehabilitation for Energy Efficiency (50 mills)	2.5	15	0.353 BCF	19,000	8.77	1.06 BCF
Domestic Gas Sector and Commercial Buildings						
Improved Natural Gas Cook Stoves (324,000 units)	6.67	10	0.88 BCF	49,000	13.61	4 BCF
Metering Household and Commercial Gas Water Heating Usage (5,000 meters)	0.63	N/A	N/A	N/A	N/A	N/A
Solar Water Heaters to replace Gas and Electric Heaters in Cities (200 units)	0.10	20	0.0082 BCF	460	10.86	0.615 BCF
Solar Powered Security Lighting in Urban Buildings (10,000 systems)	20	20	2 GWh	1,400	714+	50 GWh
Passive Cooling of Commercial Buildings (200 buildings)	8	15	31.4 GWh	22,000	24.24	157 GWh
Replacement of Diesel/Electric	0.45	20	0.10 ML	270	83.33+	100 ML

	Investment (Million $)	Project Life (Year)	Energy Savings per Year	CO2 Reduction (Ton/year)	$Ton-CO2	Potential Per Year
Pumps with Solar Irrigation Pumps (100 pumps)						
DSM in Private Industries and Commercial Establishments						
Ceiling Fan Replacement Program (500,000 fans)	15.3	15	46.8 GWh	32,700	31.19	140 GWh
Commercial and Industrial FL Re-Lamping Program (T8-to-T5) (350,000 lamps)	2.89	10	15.3 GWh	10,600	27.24	253 GWh
Fluorescent Lamp Reflectors (280,000 units)	1.88	10	11.8 GWh	8,200	22.92	400 GWh
Replacement of Electric Dryer by Solar Dryer (50 units)	0.4	15	1.5 GWh	1,050	25.39	30 GWh

Source: World Bank and GTZ Report (2009)

ANNEX 7: KEY POLICIES

ENERGY AND POWER

Policy	Description	Ministry
Energy		
National Energy Policy (Draft 2008)	Lays out the country's national energy priorities and plans. Encompasses policies for power, hydrocarbon resources, and coal.	MPEMR
Bangladesh Energy Regulatory Commission Act (2003)	Establishes the Energy Regulatory Commission, responsible for overseeing all aspects of the energy industry, including the quality and efficiency of machinery, determination of tariffs, enhancement of safety, conditions of licensees, energy statistics, codes and standards, accounting methods, and adherence to environmental standards.	MPEMR
Bangladesh National Building Code (1993)	Legally binding on all concerned by S.R.O. No. 84-Law/2006, dated May 22, 2006, and published in the Bangladesh Gazette on November 15, 2006. Housing and Building Institute was conducting a study to update the Building Code.	Ministry of Housing and Public Works
Bangladesh Environmental Conservation Act (1995)	Main legislative framework document pertaining to environmental protection in Bangladesh. Includes laws for conservation of the environment, improvement of environmental standards, and control and mitigation of environmental pollution. Established the Department of Environment.	
Power		
The Electricity Act (1910)	Provides a legal framework for the industry through a set of industry regulations and definitions of suppliers' and consumers' rights.	MPEMR
The Bangladesh Power Development Board's Order (1972) (President's Order)	Establishes the BPDB, which is responsible for planning, construction, and operation of power generation and transmission facilities countrywide, and for distribution, except in the Dhaka metropolitan area.	MPEMR
The Rural Electrification Board Ordinance (1977)	Establishes the REB, which is tasked with extending electrification service to rural areas.	MPEMR
Policy Statement on Power Sector Reforms (2000)	In addition to introducing greater competition by allowing private sector involvement in energy production and distribution through policy measures such as the Private Sector Power Generation Policy, the reforms seek to accomplish the following: separate the power generation, transmission, and distribution functions; promote commercialization in the industry; create a regulatory commission; introduce cost-reflective tariffs; implement demand-side management measures; and develop alternative and renewable sources of energy. The Power Cell was created under the Ministry of Energy and Mineral Resources in 1995 to design and monitor reform measures in collaboration with other relevant entities.	MPEMR
Private Sector Power Generation Policy of Bangladesh (1996, revised 2004)	In recognition of the country's burgeoning power needs and the ability of the three state-owned utilities, this policy seeks to stimulate private sector investment in the power sector and lays out guidelines for independent power producers to establish private sector generation capacity on a build-own-operate basis. It also provides fiscal incentives such as exemption from corporate income tax for 15 years, the import of equipment and spare parts up to ten percent of the total value of all equipment and spare parts without paying customs duties or VAT during the first twelve years, and exemption from the requirement to have insurance/reinsurance	MPEMR

	from the national insurance company, Sadharan Bima Corporation. Some incentives are specifically targeted to foreign investors, such as exemption from income tax for foreign lenders to private power companies and, for up to three years, for expatriate personnel employed in the industry. The Power Cell under MPEMR is responsible for soliciting and reviewing proposals.	
Remote Area Power Supply Systems (RAPSS) Guidelines	Geared to stimulating private sector participation in rural electricity production and supply by making private investors responsible as utility operators for the development and operation of electricity and supply, including generation, in a given area for up to twenty years.	MPEMR
Small Power Policy (1998, revised 2008)	Governs the establishment of small power plants by private investors. Plants up to 10 MW are covered; those exceeding this limit are required to obtain permission from the government	MPEMR
Vision Statement Policy and Statement of Power Sector Reform	This document identifies the most pressing energy sector reforms to ensure the needs of a growing economy continue to be met. Amongst the priority issues are: improving the performance of distribution entities to reduce system losses, enhancing efficiency and operations in generation stations, expanding transmission systems commensurate with increases in supply and demand, implementing an effective regulatory regime, setting tariffs that address considerations of both suppliers and users, and promoting energy efficiency measures.	MPEMR
Bangladesh Private Sector Infrastructure Guidelines	These guidelines clarify the procedures for the identification, development, and processing of private infrastructure projects.	MPEMR
Power Pricing Framework (2004)	The Framework provides guidelines for pricing electricity, so that tariffs not only cover costs, but allow for a surplus that can be used to increase coverage and supply as well as motivate users to utilize energy more efficiently. Under it, the government is permitted to provide subsidies to certain customer classes, differentiated on- and off-peak rates, and a two-part tariff covering with fixed (capacity) and variable (energy) components. Moreover, rates are to be reviewed at least quarterly and adjusted annually to reflect current costs.	MPEMR
Policy Guidelines for Power Purchase from Captive Power Plant (2007)	This document dictates the measures that must be followed for power plants that produce energy for their own or for a groups' own use (captive power plants) to sell electricity to utilities or other licensed distributors.	MPEMR
Policy Guidelines for Enhancement of Private Participation in the Power Sector (2008)	These policy guidelines overview the measures that the government plans to take in order to promote private sector participation in the energy sector. They include permitting them to establish commercial power plants to supply electricity to large consumers and to distributors, to use transmission and distribution lines of the Power Grid Company of Bangladesh and distribution licensees, to rehabilitate old an inefficient power plants owned by the public sector, and to enter joint ventures with the public sector.	MPEMR
Updated 3-year Road Map (2008-2010)	The Road Map lays out a plan, including rolling goals on a six-month basis, for achieving the reforms laid out in the Policy Statement on Power Sector Reforms, including the creation of the Bangladesh Power Development Board holding company to serve as an apex body under which the companies offering generation, transmission, and distribution services will be subsidiaries. The Road Map also calls for a Financial Restructuring and Recovery Plan for the sector, the use of captive power through an appropriate policy framework, and capacity building for sector stakeholders, mostly public but also companies involved in power generation	MPEMR
Renewable Energy		
Renewable Energy Policy of Bangladesh (2008)	To promote renewable energy sources and technologies, and energy efficiency as well as to target the CDM, a Sustainable Energy Development Agency (SEDA) is planned. It would serve as a focal point for sustainable energy (renewables and energy efficiency), and be responsible for: coordinating sustainable energy activities with other agencies; raising awareness; facilitating mainstreaming of sustainable energy policies; supporting new technologies, business models, and small and medium enterprises; developing financing mechanisms; implementing policies; and	MPEMR

	processing grid connected renewable energy projects. Until SEDA is formed, these tasks will fall under the purview of the Power Division of the MPEMR.	

AGRICULTURE

Policy	Description	Ministry
Cross-cutting		
Environment Policy (1992)	Seeks to improve environmental protection through reduction of pollution, promotion of sustainable use of natural resources, and participation in international initiatives to protect the environment.	MOEF
National Water Policy (1998)	Promote efficient development and management of surface and groundwater, equitable access, accelerated development of sustainable public and private water delivery systems, establishment of a legal and regulatory framework for private sector investment in water development, and capacity building for designing future water resource management plans.	Ministry of Water Resources
National Rural Development Policy (2001)	Aims to improve the incomes and livelihoods of rural people through improved rural infrastructure and marketing facilities, better local level planning, training of youths and women, and development of disadvantaged, small minority communities and hill tract regions.	Rural Development and Cooperative Division
National Food Policy (2004)	Has the goal of establishing a dependable food security system through which an adequate and stable supply of safe and nutritious food is offered at affordable prices, thereby increasing access and people's food purchasing power.	Ministry of Food and Disaster Management
Crops		
National Agriculture Policy (1999)	Overall objective is: "to make the nation self-sufficient in food through increasing production of all crops, including cereals, and ensure a dependable food security system for all." It seeks to accomplish this by improving profitable and sustainable production, land productivity and income gains, smooth input supplies, fair output prices, improved credit, marketing and agro-based industries, and protection of small farmers' interests.	Ministry of Agriculture (MOA)
National Agriculture Policy (2009 Draft)	N/A	MOA
New Agricultural Extension Policy (1996)	Calls for the provision of efficient decentralized and demand led extension services to farmers, training of extension workers, strengthening of research-extension linkage, and protecting the environment.	MOA
National Integrated Pest Management (IPM) Policy (2002)	To enhance farmers' ability to grow healthy, productive crops through the establishment of a national integrated pest management policy, and coordination of IPM activities nationwide.	MOA
National Seed Policy (1993)	Supports the breeding of crop varieties suitable for high-input and output agriculture; reproduction of quality seeds; balanced development of public and private sector seed enterprises; provision of training and technical support in seed production, processing, and storage; monitor, control and regulate seed quality and quantity.	MOA
Seed Rules (1997)	Delineates rules and regulations regarding functions of national seed board, registration of seed dealers, seed certification, marking truthful labels, and modalities of seed inspection.	MOA
Non-crop		
Livestock Policy and Action Plan (2005)	To improve small scale poultry and dairy farming replicating CLDDP; reform of DLS; enforcement of regulations regarding animal feeds, vaccines and privatization of veterinary services; adoption of a breeding policy; and establishment of a	Ministry of Fisheries and Livestock

	livestock insurance development fund and livestock credit.	(MFL)
National Fishery Policy, 1998	To facilitate development of fishery resources, increased fish production and self-employment, and improvements in public health.	MFL

FORESTRY

Policy	Description	Ministry
National Forestry Policy (1994)	Seeks to increase forest cover through afforestation programs to enhance conservation and industries dependent on forest resources such as tourism. Sets a target of bringing 20% of the country's land under government and private sector afforestation programs;	MOEF
Private Forest Ordinance (1959)	Enables the government to require management plans for private forests, and to take over management of improperly managed private forest lands, private lands that can be afforested, and land lying fallow for longer than three years.	MOEF
Forest Act 1927 (as amended up to 2000)	Aims to protect and conserve forests through the establishment of reserve, village, and protected forests, control over timber products, and collection of drift and stranded timber.	MOEF
Atia Forest (Protection) Ordinance (1982)	N/A	MOEF
Wildlife (Preservation) Order, 1973 (as amended upto 1974)	Supports conservation of wildlife, with primary responsibility in the hands of the FD. It allows the FD to declare any area a wildlife sanctuary, national park, or game reserve. No provisions are made for the establishment of buffer zones.	MOEF

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