



Energy-policy Framework Conditions for Electricity Markets and Renewable Energies

23 Country Analyses Chapter Bangladesh

Eschborn, September 2007

gtz

commissioned by:



Federal Ministry
for Economic Cooperation
and Development

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Chapter Bangladesh**

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Published by:

Deutsche Gesellschaft für
Technische Zusammenarbeit (GTZ) GmbH
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New Edition of the TERNA Country Survey

Since the first edition of the TERNA country survey appeared in 1999, there has been a distinct heightening of public and political awareness of the consequences of climate change and of energy provision as a key factor in sustainable development. In Germany and other industrialised countries, a political tailwind, effective promotion mechanisms and rising energy prices have created the conditions for a dynamic market in which renewable forms of energy are exhibiting high growth rates within the energy mix. In 2006, global new investment in renewables amounted to US\$ 70.9 billion – an increase of 43 % over 2005.

Strong economic development in many emerging countries has triggered rapidly rising demand for energy and competition on the international oil market. Against the background of the rising cost of fossil fuels, supply risks and damage to the environment, the significance of renewable energy as a means of generating electricity is growing – also in developing and emerging countries: according to analyses conducted by the Renewable Energy Policy Network for the 21st Century (REN21), 39 countries have set expansion targets for renewable energy sources and introduced promotion mechanisms, nine of which are developing or emerging countries. Of total new investment in renewable energy around the world, US\$ 15 billion was invested in developing and emerging countries. Nevertheless, the majority of countries still have a long road ahead of them before they overcome existing barriers to the successful introduction of renewable forms of energy.

The German and European market acts as the driving force for the wind energy industry and provides an indispensable background of experience. However, growth in the industry is also increasingly apparent in developing and emerging countries. It is the successes in countries such as India, China and Brazil which encourage commitment beyond the borders of industrialised nations. In those three countries there is a growing proportion of local content in the systems and equipment they produce – and not only for supply to their own domestic markets.

A number of other countries though, too, are erecting their first wind farms, thereby establishing the basis for gaining experience to be utilised in future markets.

To help interested players gain access to the new markets, this survey provides detailed descriptions of the framework conditions for electricity markets and renewable energy in 23 developing and emerging countries.

Latin America	Africa/Middle East	Asia
Argentina	Egypt	Bangladesh
Brazil	Ethiopia	China
Caribbean States	Jordan	India
Chile	Morocco	Indonesia
Colombia	Namibia	Pakistan
Costa Rica	South Africa	Philippines
Dominican Republic	Tunisia	Viet Nam
Mexico		
Nicaragua		

This latest country survey and the previous editions are available on our homepage: www.gtz.de/wind. For the first time, the publication is also available on CD-ROM. For information on how to obtain this, again, go to the homepage.

Our grateful thanks go to a large number of GTZ staff members and other experts in the field for their help in putting this information together.

Eschborn, September 2007

Legal Information

1. The data used in this study is based on both publicly accessible sources of information (publications, specialist articles, internet sites, conference papers etc.) and non-public papers (for example internal expert reports from promoting institutions), as well as personal interviews with experts (for example officials at energy ministries in the investigated countries and project staff at promoting institutions). Although all information has been checked as far as possible, errors cannot be ruled out. Neither the GTZ nor the authors can therefore provide any guarantee of the accuracy of the data included in this study; no liability can be accepted for any loss or damage resulting from use of the data included in the study.
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The TERNA Wind Energy Programme

There is great potential for generating electricity from renewable energy sources in many developing and emerging countries. Obstacles to the exploitation of such sources include a lack of knowledge of framework conditions in the energy industry and insufficient transparency with regard to the prior experience and interests of national actors.

The purpose of the TERNA (Technical Expertise for Renewable Energy Application) wind energy programme, implemented by GTZ on behalf of the Federal German Ministry for Economic Cooperation and Development (BMZ), is to assist partners in developing and emerging countries in planning and developing wind power projects. Since 1988 the TERNA programme has pursued the twin goals of laying the foundations for sound investment decisions while at the same time enabling partners to assess wind energy potentials, plan wind energy projects and improve energy-policy frameworks for renewable forms of energy.

The TERNA wind energy programme's partners are institutions in developing and emerging countries that are interested in commercial exploitation of wind power. These include, for example, ministries or government institutions which have the mandate to develop BOT/BOO projects, state-owned or private energy supply companies (utilities) and private enterprises (independent power producers).

TERNA offers its partners expertise and experience. In order to initiate wind power projects, favourable sites must be identified and their wind energy potential ascertained. To do this, wind measurements are normally taken over a period of at least twelve months and wind reports are drawn up. If promising wind speeds are found, the next step is to conduct project studies investigating the technical design and economic feasibility. TERNA also provides advice to partners on matters of finance, thus closing the gap between potential investors and offers of funding from national and international donors.

If required, CDM baseline studies can be prepared and advice can be offered to potential operators on setting up an efficient operator structure. In order to ensure as much transfer of know-how as possible, efforts are made to ensure cooperation between international and local experts, for example when preparing the studies.

In successful cases, TERNA initiates investment-ready wind farm projects by this method. TERNA itself is not involved in financing. In addition to the activities that are tied to specific locations, TERNA advises its partners on how to establish suitable framework conditions for the promotion of renewable energy sources.

Up until 2007, TERNA has been active in over ten countries around the world.

Further information on GTZ's TERNA wind energy programme, the application procedure etc. is available at www.gtz.de/wind or directly from:

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17 Bangladesh

17.1 Electricity Market

Installed capacities

As of June 2005, total electrical power generating capacity in Bangladesh amounted to 4.995 GW. Just under 5% of this capacity was provided by hydropower projects, while over 95% was based on conventional thermal energy conversion using, for example, steam turbines, which are installed in 48% of the country's power plants. As Bangladesh's most important energy source, domestically produced natural gas – which accounts for 85.5% of fuel fired for power generation purposes – plays a dominant role in shaping the power plant landscape. Mineral oil and diesel, 90% of which is imported, together constituted not quite 10% of the energy sources utilised for power generation in 2005. Preliminary figures indicate that installed electricity generating capacity totalled some 5.3 GW by mid-2006.¹

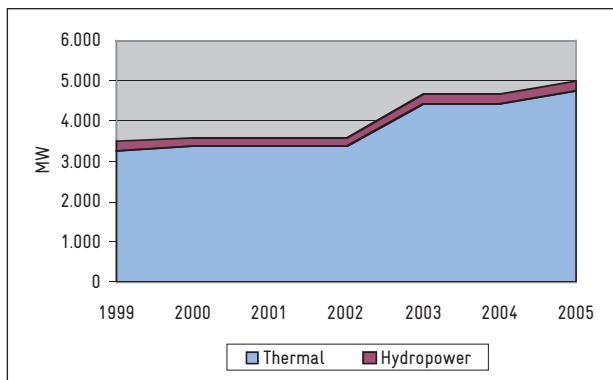


Fig. 1: Electricity generating capacities in MW; Bangladesh; 1999-2005²

Electricity generation

The total electrical power generated in Bangladesh in fiscal year 2005-2006 amounted to just under 23 TWh, representing an increase of 7.5% over the previous year.

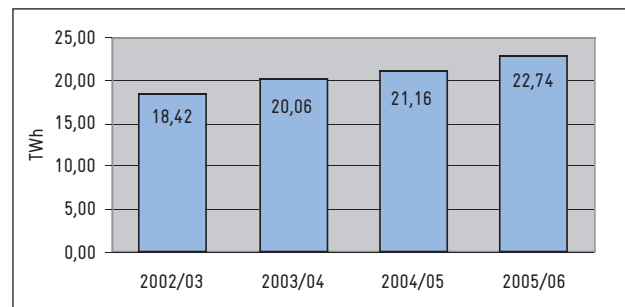


Abb. 2: Total electricity generation in TWh; Bangladesh; 2002/03-2005/06³

Most of the electricity in Bangladesh is produced in the eastern part⁴ of the country where the domestic natural gas resources are found.⁵ The Dhaka region alone is home to 61% of the nation's power plants. Power generation in the western area of Bangladesh is based on imported mineral oil and diesel.

¹ However, experts estimate actual available power plant capacity to be considerably less, at 3.2 GW, one reason for which being the advanced ageing of existing power plants. Currently, 23 of the country's total 102 power plant units are not in operation.

² Source: Bangladesh Power Development Board (BPDB) 2006. The data collections of state institutions in Bangladesh are based on fiscal years which end on June 30 of each year.

³ Source: Bangladesh Power Development Board (BPDB) 2006.

⁴ The River Jamuna forms the boundary between the eastern and western parts of the country.

⁵ All natural gas fields currently under exploitation are located in the eastern part of the country, as well as 21 of the 22 total known storage sites. Power generation costs are also correspondingly lower in the east, in 2001 lying between 0.68 and 1.01 euro cents/kWh. In the western part of the country, costs ranged anywhere from 0.97 to 6.98 euro cents/kWh.

Electricity transmission and distribution

Despite the relatively high population density, establishing and expanding a central electricity supply system in Bangladesh has proven a difficult undertaking. According to information provided by the World Bank, only 32%⁶ of the nation's population has access to electrical power, mainly in the eastern part of the country which is considered to be more advanced. The state-run power grid comprises transmission networks (132 and 230 kV) measuring some 6,000 km in total length, with transformer substations providing a transmission capacity of 8,830 MW. The distribution grids (33 kV and less) encompass a total of almost 210,000 km.⁷ Low-cost power is transferred from the country's eastern area to the west via a 230 kV line. Grid losses at the transmission level have changed little in recent years, the most recent figures showing losses of 3.5% (2005/06). Technical losses at the distribution level have decreased by almost 15% since 2003, but nevertheless remain considerable, at 19.1% (2005/06).

In recent years, financial losses in power plant operation have significantly hampered possibilities for grid expansion intended to stabilise power supply. Current plans still call for multi-layered expansion of existing transmission networks in broad areas of the country – a major component of which is the erection of a 400-kV line between the Meghnaghat and Aminbazar substations to improve power supply to the Dhaka region.

In areas not served by the central power grid there are also several systems in isolated operation driven by diesel generators or renewable energy sources.

Electricity consumption

Per capita power consumption is among the lowest in the world, at 134 kWh/year. In 2006, total electricity consumption amounted to 20.95 TWh. According to figures from 2001, the main customers are industrial consumers (44%) followed by private households (41%), commerce (8%) and agriculture (5%; others: 2%).

Bangladesh has an extremely high rate of electricity theft. In 2004, a mere 55 to 60% of consumed power was actually paid for.⁸

Electricity prices

Prices for electricity in Bangladesh are mainly determined by the state-owned electrical utility Bangladesh Power Development Board (BPDB), which oversees most of the power plant generating capacities and the entire power transmission grid. To some extent BPDB sells electricity to distribution companies who in turn take care of power supply to end-consumers in broad areas of the country, while in other cases it sells power directly to end-customers. On average, the electricity tariffs for customers in rural regions are higher than in urban areas. This is due to the higher standing charges⁹ that electricity customers in rural regions must pay as financial compensation for the structural difficulties of rural electrification.

Electricity tariffs were raised in early 2007.¹⁰ This price rise translated into a 5% increase for small consumers and 10% for major customers. Private households in rural regions were exempted from the tariff hike, as were customers in urban areas who consume less than 100 kWh/year.

6 This figure is a composite of the low degree of electrification in rural regions (19% in 2000) and the relatively high degree of electrification in the cities (2000: 80%).

7 The distribution networks (33 kV and below) are broken down into about 43,000 km of state-operated grid and other networks totalling some 167,000 km in length.

8 Influenced by these high rates of loss, foreign investors shy away from commitment to the energy sector in Bangladesh.

9 All customers of BPDB pay monthly standing charges of between 0.06 euro and 4.50 euro per month in addition to the electricity rates per kWh. Rural customers pay 4.50 euro per month.

10 Among other purposes, this measure could be a reaction to the financially tense situation at BPDB which, in recent years, has accumulated considerable debt, due to various circumstances: electricity sales prices which lie below power generation costs, high grid losses (e.g. due to grid failures, theft of electricity, etc.) and unpaid electricity bills.

Direct consumers/ distribution companies	Range of consumption	Tariff in € cents/kWh since Sept. 2003	Tariff in € cents/kWh starting early 2007
Private households	000-100 kWh	2.79	2.79
	101-400 kWh	3.35	3.5
	> 400 kWh	5.58	5.86
Agricultural irrigation and drainage	Flat rate	2.05	2.15
Small-scale industry	Flat rate	4.27	4.49
	Peak load period	5.98	6.27
	Outside of peak load period	3.4	3.57
Trade	Flat rate	5.85	5.92
	Peak load period	9.07	9.15
	Outside of peak load period	4.04	4.24
Public and non-profit facilities	Flat rate	3.57	3.74
"Dhaka Electric Supply Authority" (DESA)		2.37	2.6
"Dhaka Electric Supply Company" (DESCO)		2.42	2.66
"Rural Electrification Board" (REB)		2.29-2.7	2.52-2.97

Tab. 1: Electricity prices according to customer groups of the state-owned power provider BPDB in € cents/kWh; Bangladesh; 2003 and 2007¹¹

Expansion planning

The existing electricity supply system in Bangladesh is considered unreliable and beset with difficulties. For many customers, 24-hour power availability is not ensured.¹² Expansion of electrical generating capacity and distribution systems is viewed to be absolutely essential in order to meet existing demand for electric power.

There are plans to create an additional 20,496 MW of installed capacity by the year 2025¹³ – to be fired almost exclusively by increased use of domestic natural gas resources.¹⁴ In 2003 the government began promoting domestic coal mining to establish a second mainstay alongside the intensive use of natural gas, with the aim of ensuring a nationally independent electricity supply. The first coal-fired power plant (250 MW) went into operation in early 2006. With accessible coal reserves estimated to amount to 2,514,000,000 tonnes, i.e. sufficient to ensure long-term supply for a generating capacity of 4,000 MW, further coal-fired power plants are to follow. As domestic hydropower potential has been largely exhausted, current government plans additionally recommend the construction of large dams in neighbouring Bhutan to feed Bangladesh's domestic power supply system. The government intends to cover costs for expanding generating capacity and transmission systems with funds from state-run power providers, international donors and investment from the private sector.

17.2 Market Actors

Until 1977, the state-owned power provider Bangladesh Power Development Board (BPDP) was the sole institution responsible for power generation, transmission and distribution. Today, although BPDB is still directly or indirectly involved at all levels of the electricity market, changes have come to the state-organised electricity sector. In 2004 the government decided to transform BPDP into a holding company – a step, however, that to date has not yet been implemented.

11 Source: Bangladesh Power Development Board (BPDP) 2003, Daily News Bangladesh 2007.

12 In the capital Dhaka, power failures in 2006 sometimes occurred up to 10 times a day. In order to ensure power supply despite existing deficits, the state power provider BPDB opted to introduce a rotation system in which the individual power distribution units are temporarily taken off line in succession, one after another.

13 These figures come from the Master Plan for 2005-2025, an update of the Master Plan of 1995.

14 12 of 21 confirmed natural gas fields are being exploited to date. Expert estimates projecting how long existing gas reserves will last range between 2020 and 2050.

Power producers

BPDB accounts for over 70% of the electric power generated in Bangladesh. This share also includes the first BPDB-founded subsidiaries such as the Ashuganj Power Company (APS), which originated with the transformation in 2002 of the state-owned Ashuganj Power Station into a joint stock company. In addition, privately owned and operated independent power producers have been allowed since 1996. Between 1998 and 2005, a total of seven power plants belonging to independent power producers were put into operation, all told providing an installed generating capacity of more than 1,290 MW – mainly fired by natural gas.¹⁵ These plants thus represent a 26% share in the country's total electrical generating capacity. Current planning envisages construction of further power plants by non-state-run producers or joint state and private providers for a total output exceeding 1.590 MW.

Self-generators in Bangladesh account for 1.1 GW of installed capacity. Attempts by the government to integrate such autonomous suppliers into the public power supply system have to date remained without success.¹⁶

Power transmission company PGCB

Since 1996, responsibility for operation and expansion of the entire electricity transmission grid has lain with the Power Grid Company of Bangladesh (PGCB), founded as a subsidiary of BPDB.

Power distribution companies

In 1997 an institution specifically dedicated to rural electrification was founded – the Rural Electrification Board (REB). REB was mandated to assume responsibility for power distribution and supply in rural regions by way of electrification cooperatives, known as Palli Biddut Samities (PBSs). Since then, REB has been working with a total of 70 PBSs, which are organised on a cooperative basis.¹⁷ In addition to power distribution, the PBSs are increasingly supposed to take charge of some areas of power generation.

The state-owned company Dhaka Electric Supply Authority (DESA) was established to regulate power distribution in the capital Dhaka and surrounding vicinity. Since the start of the reform process in 1996, DESA, in turn, has shared electricity distribution operations in the capital with the Dhaka Electric Supply Company (DESCO) which was founded as a state-run joint-stock company. In addition, a further power distribution company – the West Zone Power Distribution Company (WZPDC) – was established in 2003 as a BPDB subsidiary is responsible for the country's southwest.

Other Actors

Energy policy institutions

In Bangladesh the electricity sector lies within the scope of responsibility of the Ministry of Power, Energy and Mineral Resources (MPEMR). The executing arm of the MPEMR comprises on the one hand Power Division, which has overall authority for the electricity sector, and on the other hand Power Cell, which at its founding in 1998 was given the mandate to manage and regulate development of the electricity sector, including implementation of reforms. In conjunction with this, Power Cell's scope of responsibility also encompasses the field of renewable energy. Power Cell thus coordinates and supports, for example, the implementation of renewable energy projects by non-governmental organisations (NGOs) and private actors.

Furthermore, under the auspices of the Energy Regulatory Commission Act of 2003, a regulatory authority was established for the entire energy sector – the Bangladesh Energy Regulatory Commission (BERC). It commenced its activities in 2004. BERC's duties include ensuring transparency in the determination of electricity tariffs. It also introduces uniform standards for operational procedures and ensures the quality of power supply.

15 One example of an independent power producer is the Rural Power Company Ltd. (RPC), equipped with installed capacities totalling 140 MW (4 x 35 kW). RPC generates electricity for rural areas. A 28% share of the company is held by the Rural Electrification Board (REB), while the rural electricity cooperatives Palli Biddut Samities (PBSs) own the remaining 72%.

16 The government hopes in the near future to gain some 500 MW from industrial autonomous suppliers for the public power supply. However, an initial offer directed to self-generators did not yield any positive feedback.

17 PBSs integrate the consumers within their respective areas of responsibility into the cooperatives' activities. This includes, for example, their inclusion in planning and management of distribution grids.

17.3 Legal Framework

The electricity sector of Bangladesh has been undergoing a process of reform since the mid-1990s. The main reform measures include restructuring (i.e. unbundling) of the state-owned energy supplier BPDB into separate companies responsible for power generation, transmission and distribution. Plans furthermore call for transformation of the corporate entities resulting from this process into joint-stock companies. The great need to expand the country's electricity supply system while the possible means for government investment remain deficient has led to the power generation and distribution segments being opened to outside private sector activities as well.

Reforms in the power sector

The National Energy Policy (NEP) of 1996, which has since been updated at regular intervals (most recently in 2002), constitutes the statutory superstructure of the reform process. It spells out the comprehensive guidelines for reforming the power sector and establishing a regulatory authority.

The legal basis for integrating private actors into the power sector is provided by the Private Sector Power Generation Policy of Bangladesh, which was likewise adopted in 1996 and then revised in 2004. The new electricity supply policy aims to introduce competition, attract foreign investment capital and mitigate power supply shortages. Among other things the following tax and financial incentives are designed to encourage private actors to commit to involvement in the power sector:

- Income tax exemption for a period of 15 years
- Exemption from customs duties, value added tax and other charges for importing plant, equipment and components¹⁸
- Avoidance of double taxation of foreign investors based on bilateral agreements
- Authorisation of foreign investors to enter into joint ventures

- Payment by the state of up to 50% of the salaries owed to foreign employees delegated to Bangladesh
- Support for local equipment manufacturers.

Projects initiated by independent power producers are to be implemented on a build-own-operate (BOO) basis. Power suppliers themselves must cover the cost of lines connecting their private-sector power plants to the given transmission networks. Local equipment manufacturers are to be strengthened by supporting them in their efforts to supply private-sector power plants with locally fabricated equipment which meets international standards.

In order to satisfy the needs for developing local and mostly small private-sector power generation projects, the government adopted a supplementary Small Power Generation Policy in 1998. This law explicitly supports projects providing electrical generating capacities of up to 10 MW. Such projects are seen as particularly relevant for isolated areas classified as being remote from established grids, or which are hit by an above-average rate of power failures. This legislation is also intended to enable the sale of surplus electricity from self-generators to surrounding regions.

Reform objectives

In 2000 the long-term objectives for the electricity sector, which are also intended to promote and support the economic and social development of the country, were compiled in a governmental statement entitled the Government's Vision and Policy. The three cornerstones of this statement are: 1. To make electricity available for all, 2. To ensure reliability and quality supply of electricity, and 3. To provide electricity at a reasonable price. With the aim of promoting implementation of the introduced reforms, this programme was supplemented to include the following objectives:

- Bringing the entire country under electricity service by the year 2020
- Making the power sector financially viable and able to facilitate economic growth

18 However, this only applies pro rata to 10% of the total value of the plant.

- Increasing the sector's efficiency and making the sector commercial
- Improving the reliability and quality of electricity supply
- Using natural gas as the primary fuel for electricity generation and exploring the possibility for export of power to augment and diversify foreign exchange earnings
- Increasing private sector participation to mobilise finance
- Ensuring a reasonable and affordable price for electricity by pursuing least cost options
- Promoting competition among the various entities in the power sector.

The aim of complete restructuring of the power sector is to provide the prospect of a multi-buyer and multi-seller market model and the establishment of a richly competitive market structure. While PGCB is to remain exclusively responsible for power transmission over the long term as well, it is intended that a large number of companies should become involved in the power generation and distribution segments.

17.4 Policy for Promoting Renewable Energy Sources

The importance of renewable energy sources was first spelled out in the National Energy Policy (NEP) of 1996. The NEP emphasises the need to secure optimum development of domestic resources, including renewable energy sources. In addition, it underlines the significance of renewable energy sources for supplying electricity to rural and at the same time sparsely populated regions – as an alternative to cost-intensive expansion of the central power supply system.

Draft law for a Renewable Energy Policy

Since 1996 the government has been documenting its concepts for national expansion, development and establishment of renewable energy sources¹⁹ in a dedicated draft law, the Renewable Energy Policy. Subsequent to several revisions, the draft of this law was most recently updated in 2004. It includes objectives such as acceleration of the electrification programme through the use of renewable energy sources and raising the proportion of electricity generated from renewables to 10% by 2020. Incentive mechanisms for promoting renewable energy and establishing a dedicated institution for renewable energy sources, the Renewable Energy Development Agency (REDA), likewise form part of this draft legislation.

According to the draft law, in addition to generally disseminating various renewable energy technologies, this institution dedicated to renewable energy sources is to assume a wide range of responsibilities and functions, including the following:

- Establish a Renewable Energy Trust Fund to finance renewable energy projects
- Integrate all political and governmental levels in efforts to promote renewable energy
- Formulate financing to enhance the affordability of renewable energy
- Encourage and support institutions such as non-governmental organisations and rural energy companies in establishing renewable energy use

¹⁹ According to the draft law, the category of renewable energy sources includes biomass, solar energy, wind, small-scale hydropower, geothermal energy, wave power and tidal power.

- Establish linkage of renewable energy with provision of all basic services, e.g. installation of drinking water systems.

At the end of 2005, the government decided to set up a Sustainable Energy Development Agency (SEDA) instead of REDA and to implement this decision within the shortest time possible by way of Power Cell.²⁰ The founding of SEDA was subsequently postponed. As of early 2007, adoption of the draft law for a renewable energy policy has also not yet come to fruition. Power Cell is officially mandated to execute all functions and responsibilities concerning development of renewable energy sources until such time that REDA or SEDA is established.

Instruments of promotion

For the most part, growth in the use of renewable energy in Bangladesh is being promoted indirectly: on the one hand by a number of NGOs as well as state-owned, parastatal and private institutions, and on the other hand by many national and international programmes. The decentralised application of renewable energy systems has emerged as the main area of emphasis of these promotion efforts.

Over 30 national institutions alone are conducting such programmes or projects. These include state-owned and parastatal institutions such as MPEMR (run by Power Cell), the state power supplier BPDB, and REB – the public body responsible for rural electrification – along with the Local Government Engineering Department (LGED). There are also a number of non-governmental organisations, such as the country's largest domestic development organisation, the Bangladesh Rural Advancement Committee (BRAC), and the Bangladesh Centre for Advanced Studies (BCAS). The not-for-profit enterprise Grameen Shakti²¹ is likewise a main player. Active research institutes include, among others, the Renewable Energy Research Centre of the University of Dhaka and the Bangladesh Council of Scientific and Industrial Research (BCSIR).

These various institutions are conducting a large number of programmes and projects, mainly in the field of solar power. At least four programmes concerned with wind power are currently underway, three are promoting biogas and one project is presently supporting micro hydropower. The programmes are being financed for the most part by international donors such as the World Bank, the Global Environmental Facility (GEF), the United Nations Development Programme (UNDP), the Asian Development Bank (ADB) and the two German development institutions KfW and GTZ.

Financial incentives

Special promotional incentives providing financial advantages are limited to measures defined in a directive from 1998 by which photovoltaic systems and equipment as well as wind turbines are exempt from value-added tax and customs duties. In addition, the generally applicable promotional incentives for private sector commitment in the energy sector also apply.

Financial incentives applied within the scope of currently ongoing promotion programmes essentially pursue two directions. First, considerable use is made of subsidies – in particular by state institutions such as BPDB and REB – such that renewable energy systems can be obtained at privileged prices. Secondly, financial support is provided to feed loan funds used to cover refinancing of micro-financed systems that are likewise destined for transfer to personal property.²²

20 See section on "Other Actors".

21 Grameen Shakti is a subsidiary of the well-known microfinance institution Grameen Bank. Translated, "shakti" means "energy". The enterprise is conducting 7 programmes solely dedicated to promoting renewable energy systems, encompassing the fields of photovoltaics, wind, biogas, training, solar-powered computers, research and development, rural information and communication technologies.

22 "Fee-for-service" models are also employed, but to a lesser extent. Instead of private property, such models target payment for use of a system. REB wants to broaden usage of this method in future.

Clean Development Mechanism

Bangladesh ratified the Kyoto Protocol at the end of 2001. The Bangladeshi Department of Environment (DoE) has assumed responsibility as the Designated National Authority (DNA). To date, national activities for utilisation of the Clean Development Mechanism (CDM) have remained very modest in scope. Several projects are in preparation. The DoE has approved two CDM projects and submitted these to the international Executive Board (EB). The first of these projects targets utilisation of landfill gas to generate electricity in Dhaka, yielding potential annual CO₂ savings of 566,000 tonnes. The second project centres on composting of organic residues also in Dhaka and represents an annual CO₂ savings potential of 89,259 tonnes. Both projects were developed in collaboration between two waste management enterprises, one a Bangladeshi company and the other Dutch.²³ Bangladesh's share of the total CO₂ emissions produced worldwide is 0.1 %.

The tentative nature of Bangladesh's efforts to initiate CDM projects is due, among other reasons, to a shortage of personnel capacity as well as to the transaction costs of CDM activities.

Given the flat topography of the country and the fact that it lies just barely above sea level, Bangladesh is considered particularly sensitive to climate change.

17.5 Status of Renewable Energy Sources

Measured against total installed electrical generating capacity, the proportion of power generated from renewable energy is extremely small. Among other things this is because renewable energy sources are barely used at all on a large industrial scale for generating electricity in Bangladesh. Weak infrastructure, high energy costs and the fact that a high proportion of the population lives in isolated areas remote from the established grid have resulted to a situation in which systems employing renewable energy are principally decentralised solutions in isolated, stand-alone operation.

While awareness of the power-generating potential of most renewable energy sources in Bangladesh is still only rudimentary, use of solar power has already developed into the foremost growth industry. One particular aspect in this regard is that the systems used are commercially available on a notably broad scale.

Renewable Energies	End of 2005	Tentative Target 2020
	MW	
Solar power	approx. 6	300
Biomass/small hydropower	< 1	600
Wind power	approx. 1.5	1000

Tab. 2: Installed capacities and targeted objectives of MPEMR to expand use of renewable energy, in MW; Bangladesh²⁴

²³ World Wide Recycling BV of the Netherlands and Waste Concern of Bangladesh.

²⁴ Source of objectives: Power Cell of MPEMR 2006.

The following aspects are considered obstacles to achieving widespread dissemination of renewable energy systems for generating electric power:

- Inadequate policy framework for developing renewable energy
- Absence of a dedicated governmental institution
- Lack of knowledge among the rural population of available options
- Deficient quality of the systems deployed
- High procurement costs and, at the same time, inadequate financing options
- Lack of transparency in governmental plans for area-specific grid expansion²⁵
- Lack of coordinated research and development within the country

Hydropower

The opportunities for harnessing small- or large-scale hydropower in Bangladesh are very limited. This is essentially due to the fact that the country is very flat – with the exception of a few regions in the north and southeast. What is more, the annual dry season in Bangladesh, which lasts several months, entirely rules out year-round use of hydropower in many locations. The sole major hydroelectric power station is located in Kaptai on the Karnafuly River, comprising 230 MW of installed generating capacity. With commissioning of a 100-MW expansion to this plant planned for 2009, the large-scale hydropower potential of Bangladesh is already considered to be largely exhausted.²⁶

Total potential for small-scale hydropower is estimated to amount to some 250 MW. To date, studies to identify specific sites have been conducted in only a few areas. These sites are located primarily in the hilly regions of the country considered to have the greatest exploitable potential. At least 24 sites with possible generating capacities of between 3 and 81 kW have been pinpointed.

The use of small hydropower schemes to generate electricity in Bangladesh began merely a few years ago. In order to ensure economical utilisation of hydropower despite wide fluctuations in water levels in many rivers, initial steps have been taken in Bangladesh to link such efforts with irrigation and flood protection measures. This option is currently being investigated within the scope of an irrigation project at Banskhalī in the Chittagong district being implemented by the Local Government Engineering Department (LGED), with estimates projecting that the site offers sufficient potential for a 20-MW hydropower plant. One example of a mini hydropower project is located at Monjoypara in the Bandarban district. There, a 10-kW hydroelectric unit installed by the inhabitants of the village of Marma supplies electricity to 40 households.

Expansion plans

A number of existing expansion plans in the field of small and micro hydropower are geared to isolated, stand-alone operations. These include three projects in the Bandarban district (1 x 20 kW, 1 x 25 kW and 1 x 30 kW). All three units are planned to provide 24-hour power generation between June and September and generate power for 2 to 6 hours a day in the period from October to May. The LGED is pursuing, among other goals, a technical expansion of existing concepts for hydropower utilisation by the indigenous population, e.g. at Bamerchara in the Chittagong district.

25 In a pilot project (1993-1998) targeting dissemination of renewable energy technologies, REB supported installation of solar home systems (SHSs) in Karimpur and Nanarpur using funds provided by the French government. DESA connected some of the locations in the areas concerned to the national electricity grid in 2003, with 735 households subsequently returning their SHS.

26 BPDB has identified two further sites for hydropower projects: one on the Sangu River for a 140-MW power plant, and one on the Matamuhuri River for a 75-MW project. Construction, however, is uncertain and does not form part of current planning.

Wind energy

Several systematic series of measurements of wind power potential have been carried out in Bangladesh. These include two studies conducted in parallel in the mid and late 1990s.²⁷ The findings showed that wind speeds on the coast are higher than in the country's interior, and are higher during the summer months than during the winter owing to the Monsoon. They also showed that on a yearly average the wind power potential in Bangladesh is rather low. This information was first confirmed and broadened within the scope of the Wind Energy Resource Mapping (WERM)²⁸ study and then following a comprehensive data gathering exercise for the Solar and Wind Energy Resource Assessment (SWERA) programme conducted by the Danish research centre Risø.²⁹ According to this information, locations with wind speeds of > 5 m/s are limited to a few areas on the coastline, which extends for over 724 km.

Due to the generally rather moderate wind speeds and the fact that the windy coastal regions lie far from the national power grid, conditions in Bangladesh appear to be particularly suited to decentralised use of wind-driven power generation. Options considered to be of particular interest in Bangladesh are wind-driven pumps, power generation in hybrid operation, battery charging stations at remote locations and powering isolated networks. Practical areas of application include shrimp production, fish and poultry farms, salt and ice production, the fishmeal industry, animal breeding centres, irrigation systems and drinking water treatment and supply systems for household use.

A number of small wind generators are operated in the coastal region. These include two units of 300 W and 1 kW, respectively, on the Chakaria Shrimp Farm operated by Grameen Shakti,³⁰ and eleven small units owned by the Bangladesh Rural Advancement Committee (BRAC). Financed by the state power supplier BPDB, four Vestas 250-kW wind generators fabricated in India were erected at the end of 2005 on an island off the coast northwest of Chittagong.

Biomass

Over 65 % of all energy consumption in Bangladesh is based on the use of biomass.³¹ The burning of biomass for cooking and heating purposes accounts for most of this. In addition, exploitation of biomass for energy recovery by means of biogas plants has gained in importance in recent years – in particular in households to provide energy for cooking and lighting as well as for value-adding treatment of fertilisers. According to estimates by the Bangladesh Council of Scientific and Industrial Research (BCSIR), there is a potential for 4 million systems in Bangladesh just for cattle manure biogas plants with a capacity of about 3 m³. At the commercial level there is growing interest in biogas plants for chicken farms, of which there are 100,000 in Bangladesh according to LGED estimates. The largest of these farms house some 200,000 animals.

27 1. An 18-month wind study at four sites conducted by GTZ in 1996 and 1997 within the framework of the TERNA project, initiated by REB and the Bangladesh Atomic Energy Commission (BAEC). 2. A one-year wind study of seven sites conducted in 1996 and 1997 at an elevation of 25 m on the coast by the Local Government Engineering Department (LGED) in collaboration with the Bangladesh Centre for Advanced Studies (BCAS).

28 Studies were conducted over a time period of more than one year at 20 different measuring stations throughout the country.

29 The data were compiled in a wind atlas and published in 2005. Further information can be found at: swera.unep.net

30 Furthermore, Grameen Shakti has installed four small units (3 x 1.5 kW and 1 X 10 KW) in the Barguna district on the coast. Plans call for these units to be incorporated into a hybrid operation in order to raise the energy output of the facilities.

31 Potential bioenergy sources which come under consideration in Bangladesh include wood, organic residues such as cattle manure, and residues from agricultural production such as straw, rice husks and bagasse.

As of 2004, some 25,000 biogas plants had been installed in Bangladesh. In addition to small units for supplying energy to households, these plants include installations at the municipal level.³² Although power generation from biogas is still in its infancy in Bangladesh, it is gaining increasingly in significance. At a poultry farm in the Faridpur district, a biogas pilot project is underway trialling the generation of electricity from poultry manure. Currently a 4-kW generator is being used, which in future is to be upgraded to 10 kW. One example of industrial use of biogas is provided by a steelworks in Jessore that fires a blast furnace with such gas.

Promotion and financing of biogas plants

Biogas technology in Bangladesh has been developed to the extent that many banks will grant loans to private consumers to build biogas plants, and applications for such loans are on the increase. Furthermore, use of biogas plants at poultry farms is receiving support from a GTZ project, Promotion of the Use of Renewable Energies (PURE). Within the framework of its ongoing Biogas Plant Pilot Project, the Government of Bangladesh fosters use of biogas units at the household level for cooking and lighting, subsidising each unit to the equivalent of some 84 euro.

Use of landfill gas

Concepts for extracting energy from landfill gas have been under development in Bangladesh since the 1990s. The energy use potential of landfill gas is recognised in the country's major cities, in particular in the capital Dhaka, where it is estimated that deposited waste is sufficient to fire a 30-MW power plant. Implementation of existing plans is moving forward by way of the two CDM projects already registered.

Solar energy

Average daily solar irradiation in Bangladesh ranges between 4 and 6.5 kWh/m², reaching its maximum levels during the periods of March-April and December-January. Deploying photovoltaic systems, consumers in rural regions of Bangladesh began utilising available solar energy potential as early as 1980. Installed PV capacity as of August 2004 was calculated to total some 3.1 MW, with over 50,000 PV systems in use.

Although most of the systems are ones installed to serve individual households, larger-scale systems are also employed: in a pilot project funded by the French government, a 62-kW facility was installed on the island of Narsingdi at the end of the 1990s to supply power to 850 island inhabitants. This project demonstrated the technical feasibility and socio-economic acceptance of PV systems in isolated regions remote from established grids, and proved instrumental in helping to further disseminate systems of this type.

Grameen Shakti

Of the total PV generating capacity installed in August 2004, as much as 2.15 MW, in the form of 42,000 solar home systems (SHSs), was attributable entirely to the activities of Grameen Shakti, a non-profit enterprise founded in 1996 that has specialised in the sale of this type of system in rural regions of Bangladesh. In addition to the equipment itself, the product package it offers customers includes installation, free customer training and maintenance services, a 20-year warranty and a financing option based on microcredit. The company markets SHSs throughout the country from a total of 100 local branch offices.³³

32 Within the scope of an LGED project in Madaripur, 15 systems were installed for a total of 123 families. The project also included training of three villagers in system construction, installation and maintenance.

33 Grameen Shakti ranks among the most successful companies worldwide in the field of rural electric power supply based on renewable energy. For some time now, the product range it offers has been expanding to include small wind generators, micro and mini hydropower systems as well as biogas plants.

Bangladesh's largest solar programme

Since 2003, development of solar energy use by means of SHSs in conjunction with rural electrification in Bangladesh has been supported by a programme carried out by the Infrastructure Development Company Limited (IDCOL).³⁴ These efforts are based on a fund financed by international donors for providing microloans to SHS customers. In addition, purchase of each small unit is subsidised to the equivalent of about 90 euro. To implement this programme, IDCOL is collaborating with a total of 16 partner organisations including non-governmental organisations, microfinance institutions and private enterprises.³⁵ These organisations market SHSs with the aid of microloans granted to their customers. Cooperation with local manufacturers of SHS components is viewed to be a contributing factor to the project's success.³⁶

Provisioned with funds from the World Bank and GEF totalling € 24 million, the programme initially pursued the goal of financing 50,000 SHSs by the year 2008. This target figure was reached as soon as 2005, with savings of almost € 3 million still on hand. With the approval of additional financial support from the World Bank, KfW and GTZ, the programme target was raised to 200,000 SHSs by 2009.³⁷ As of November 2006, the number of SHSs sold and installed within the framework of this programme increased by an additional 40,000 to, all told, 90,000 units. Grameen Shakti's share of this total at that time came to 64% (57,000 SHSs). The capacity of systems sold ranged between 30 and 100 W_p, with more 50-W_p systems than any other, accounting for almost half of the units.

17.6 Rural Electrification

In view of the fact that roughly 80% of the population of Bangladesh live in rural areas, development of the national power supply system is crucially dependent on rural electrification. Although the PBS cooperatives, active in 85% of all villages, have with time extended their coverage over almost the entire rural territory of the country, the degree of electrification in relation to the total number of individual households, at 19%, remains rather low.³⁸ Slightly less than one quarter of all rural households are connected to the national power grid.

A growing though still small proportion of these consumers now draw their power supply from stand-alone solutions based on renewable energy sources at the village level or, in particular, at the individual household level. In many rural homes in Bangladesh, systems based on renewable energy are replacing existing, traditional energy converters such as kerosene lamps³⁹ which, while they fulfil the need for lighting, nevertheless often pose a health hazard due to the smoke they generate as well as a fire hazard, and incur recurring monthly costs. Moreover, the cost of kerosene has risen in recent years by around 60%.

REB foresees that, by 2020, the grid will reach 84% of the rural population and 100% of all villages.⁴⁰ Adverse aspects hindering achievement of this target include the remote and widely dispersed locations of many households, the financial feasibility of realisation and the very limited financial resources available to erect central infrastructure for power supply. The cost for connecting one rural household to the national grid is estimated to be in the range of US\$ 500.⁴¹

34 The programme is known as IDCOL's Solar Programme or also as the Rural Electrification and Renewable Energy Development Project (REREDP). The programme was approved by the World Bank under the REREDP title.

35 Among others, these include Grameen Shakti, the BRAC foundation, Srizon Bangladesh, COAST Trust and the Centre for Mass Education and Science (CMES).

36 Among others, these include Rahimafrooz Batteries Ltd. In addition to producing rechargeable batteries in its own facilities, the company manufactures part of the SHSs. The solar modules used by Rahimafrooz have an output of 40 to 75 W_p, and are designed to power up to 6 lamps providing four hours of lighting per day.

37 The World Bank is funding an additional 60,000 systems. KfW, in an agreement with IDCOL, has promised to invest € 16.5 million for the installation of approximately 100,000 SHS units. Under contract from the Dutch government, GTZ is providing IDCOL with support beginning in 2007 for the installation of some 40,000 SHSs.

38 Compared with 3.7% in 1991.

39 A rural household consumes on average about 10 litres of kerosene per month.

40 Those villages that have not yet been reached by REB fall within the scope of responsibility of BPDB or DESA, as well as throughout the entire Chittagong district.

41 At an average customer density of 20 per 1,609 km (one mile). In the country's rural regions, every mile of distribution line costs US\$ 10,000.

Bangladesh's rural electrification programme

Since its founding in 1977, REB has been pursuing the Bangladesh Rural Electrification Programme with the goal of resolutely advancing electrification of the country's rural regions. The core of this programme concentrates on building up the rural electricity cooperatives (PBSs). REB is supported in its efforts by a large number of international donors such as the Asian Development Bank and the World Bank. To date, only a certain portion of the cooperatives are entirely financially self-supporting.⁴² To ensure that all PBSs become financially stable and self-supporting over the long term, REB makes agreements each year with the PBSs; compliance or non-compliance with these entails financial benefits or penalties.⁴³ In order to close supply gaps or shortages among existing PBSs, REB is increasingly concentrating on integrating renewable energy systems to create village-based stand-alone solutions alongside the distribution of electric power via the national grid to end-customers, which until now has received the most attention.

Part of the Bangladesh Rural Electrification Programme is based on collaborative efforts between the US organisation National Rural Electric Cooperative Association (NRECA), the Bangladeshi Rural Electrification Board (REB) and the United States Agency for International Development (USAID). NRECA has been providing technical and institutional support for establishing and strengthening PBSs since 1997. One characterising feature of this support, among other aspects, is the in-depth level of customer participation. For example, customers are involved in the development of local master plans for electricity supply, and the advisory board of each PBS is chaired by one female and one male customer.

As a result of the rural electrification programme 70 PBSs have been established to date, reaching more than 6.5 million customers in 85 % of all Bangladeshi villages. In addition, grid losses in these areas, which come to approximately 12 %, are below the national average, and almost 100 % of all electricity bills are being paid. All told, the programme has already attracted more than US\$ 1.3 billion from international donor organisations. It is considered to be one of the most successful rural electrification programmes in South Asia, enjoying an annual growth rate of 600,000 new customers and 12,000 km of new power distribution lines. Among improvement measures envisaged for the future is a plan to introduce a noticeable differentiation in end-customer tariffs, in which the differences in service costs between the various PBSs are more strongly reflected in the prices charged to customers.⁴⁴

Programme for sustainable energy supply

Projects are being implemented in Bangladesh under the name Sustainable Rural Energy (SRE) as part of the international Sustainable Energy Management Programme (SEMP), mainly by the Local Government Engineering Department (LGED). The object is to present renewable energy-based power generation concepts that offer broad possibilities for application and use at the municipal level. One example of an ongoing demonstration project is provided by the erection of an isolated grid for 50 shops in a marketplace at Gangutia in Jhenidah district based on a 1.8-kW_p PV system that is operated and maintained by a market committee. Nineteen SRE projects were installed between 1999 and 2002. Another element set up within the framework of this programme is a network for renewable energy in Bangladesh.⁴⁵

42 In order to ensure cheap electricity tariffs at the household level, PBSs make use of cross-subsidisation, i.e. higher rates are charged to commercial and industrial customers to compensate for the cheaper rates charged to private households. This financing concept is often not feasible, among other things because the number of household customers is usually far higher. Widely differing figures are quoted for the percentage of PBSs that are said to be financially self-supporting. For 2003, these range anywhere from 25 to 57 %.

43 The central parameters of this agreement (i.e. the Performance Target Agreement, or PTA) are, for example, system losses, paid bills and the annual growth in number of households reached by the grid. There are 22 central parameters in total.

44 In a purely theoretical sense, the end-prices set by the PBSs today are already determined on the basis of their respective service costs; in reality, however, the difference in end-prices is minimal.

45 For further information, go to www.lged-rein.org.

Microfinance

In the rural areas of Bangladesh microfinance has established itself as a successful method of commercial and sustainable dissemination of renewable energy systems, and in particular of solar home systems (SHSs) by Grameen Shakti. Microcredit is used predominantly to overcome the procurement costs of high-quality renewable energy systems. As many customers of Grameen Shakti were already accustomed to regular incurrence of energy costs due to their former usage of kerosene lamps, etc., microcredit offers them an opportunity to transform their running costs – such as for kerosene – into investment in an SHS. Once they have paid all the instalments owed for a microloan, they are then in possession of a renewable energy system that enables them to save ongoing operating costs. Tailored to the various possible options, Grameen Shakti offers, for example, a number of different SHS financing models that vary according to the amount borrowed and the length of the instalment payment period. A number of institutions involved in the rural electrification of Bangladesh are now making use of microcredit to finance renewable energy systems.

Exchange rates (12 February 2007):

1 Bangladeshi taka (BDT) = 0.01116 euro (EUR)

1 US dollar (USD) = EUR 1.2962

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There is great potential for generating electricity from renewable energy sources in many developing and emerging countries. Obstacles to the exploitation of such sources and to the involvement of foreign investors include a lack of knowledge of framework conditions in the energy industry and insufficient transparency with regard to the prior experience and interests of national actors. This fourth, updated and expanded edition is aimed at overcoming barriers such as these.

The electricity markets and their respective actors are investigated for 23 countries in various regions: Latin America, Africa - Middle East and Asia. The country studies analyse the energy-policy framework conditions and closely examine the status of and promotion policy for electricity generation on the basis of hydropower, wind power, solar power, biomass and geothermal energy. The chapters on each country are rounded off by information about rural electrification.

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