Electricity for All
Electrification and Development in Rural Bangladesh
About the Centre

Created in 1999, the Centre for Policy Research is a nonprofit research and educational institution, linked to IUBAT – International University of Business Agriculture and Technology.

Its goals are to identify current and emerging economic and social issues facing Bangladesh; to analyse options for public and private sector responses; to recommend, where appropriate, particular policy options; and to communicate the conclusions of its research in an accessible and nonpartisan form, in both English and Bengali.

Simon Fraser University in Burnaby (Vancouver), Canada, has entered into a memorandum of understanding with IUBAT. By this agreement, SFU will encourage participation by its faculty and students in projects of the centre.

While the centre takes care to assure the quality of published research, the conclusions of individual studies lie with the authors. Conclusions do not necessarily represent the opinion of IUBAT, SFU or the members of the centre’s management committee.

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ISBN 984-861-000-6
U.S. $15.00 • Taka 200.00

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Contents

Acknowledgements ............................................................................................. 4
Foreword ............................................................................................................. 5
Executive Summary .......................................................................................... 6
I. Introduction .................................................................................................. 14
Difficulties of Electrification in Developing Countries ...................................... 16
II. Institutional Structure of the Power Sector ................................................. 18
 III. Problems Facing the Power Sector .......................................................... 21
Load Shedding .................................................................................... 22
Operating Inefficiency ........................................................................... 23
System Loss .............................................................................................. 24
Financial Losses ...................................................................................... 26
IV. The Rural Electrification Programme ........................................................ 27
Institutional Structure .................................................................................. 27
Extension of the Distribution System ......................................................... 28
Financial Support for the REB and the PBSs .............................................. 29
Electricity Purchases, Tariffs and Connection Costs ...................................... 30
V. Achievements So Far .................................................................................. 31
Accounting Indicators .................................................................................. 31
New Developments: Generation and Renewables .......................................... 33
Building Local Involvement and Trust ......................................................... 35
VI. Dimensions of Concern ........................................................................... 37
Quality of Electrical Supply from the BPDB ............................................... 38
Financial Performance and Tariff Structure ................................................ 38
Donor Support: A Mixed Blessing ............................................................... 39
Lack of Managerial and Financial Autonomy for PBSs ................................. 40
VII. Recommendations ................................................................................... 42
Notes ................................................................................................................. 48
References ........................................................................................................ 49
Glossary .......................................................................................................... 51
Abbreviations ................................................................................................. 52
Foreword

I am pleased to introduce this second major publication by the Centre for Policy Research.

As the opening paragraph states, “Electricity is vitally important for Bangladesh – both as means to relieve poverty and as means to accelerate economic growth.” This report brings together in one document a great deal of practical information about the power sector in Bangladesh, plus a series of practical reforms to improve its performance and, in particular, reforms to accelerate rural electrification.

We are honoured to publish the ideas of Nuruddin Kamal, a retired Additional Secretary to the Government of Bangladesh and former chairman of the Bangladesh Power Development Board. He has a wealth of practical knowledge about the energy sector. Rose Murphy is a research associate at Simon Fraser University in Vancouver, Canada. She is currently working on energy policy in Canada with Professor Mark Jaccard, who was one of the authors of the Centre’s first publication dealing with natural gas policy. Rose Murphy spent several months in 2001 studying the operations of the Rural Electrification Board and visiting its facilities throughout the country. Professor John Richards is also from Simon Fraser University. He has been a visiting faculty member at IUBAT for many years.

IUBAT – International University of Business Agriculture and Technology was the first non-government university established in Bangladesh. Since its founding in 1991, it has become a valuable source of intellectual activity in our country. The Centre for Policy Research is another step forward for IUBAT. I hope that, in the years to come, the Centre will serve both IUBAT and our country as a forum for serious, nonpartisan research into the economic and social issues facing Bangladesh.

I thank Mr. Muhammad Sirajuddin, Mr. Abdur Raquib and Dr. F. R. Al-Siddique for agreeing to join me as members of the management committee of the Centre for Policy Research. Simon Fraser University has entered into a memorandum of understanding with IUBAT whereby this Canadian university encourages its faculty and students to contribute to the work of the Centre. Professor Richards serves as advisor to the Centre.

Dr. M. Alimullah Miyan
Founder and Vice-Chancellor,
IUBAT – International University of Business Agriculture and Technology

Acknowledgements

The authors would like to thank two colleagues: Professor M. Alimullah Miyan, Vice-Chancellor, IUBAT – International University of Business Agriculture and Technology, and Professor Mark Jaccard, Simon Fraser University, for the extensive comments and aid they provided during preparation of this report.

We also acknowledge Dr. Mujibur Rahman Khan, Professor M. Nural Islam and Professor Muhammad Sirajuddin for their advice and input. At the REB, Abdul Halim Molla (Member, Engineering) and Belayet Hossain Chowdhury (Deputy Director, Program Planning), were extremely helpful in providing information on the structure and function of the rural electrification program. Sk. Ahmed Ali (Director, Finance) and Luna Sharmin (Assistant Director, Program Planning) were also very accommodating. We would like to thank PBS General Managers M. A. Sabur (Dhaka PBS-1), Saleh Ahmed (Mymensingh PBS-2) and Md. Samiul Haque Khan (Moulvibazar PBS) for their time and hospitality. James Ford and Kent Wick of the NRECA, Md. Kamaruzzaman of the USAID and Md. Iqbal of the World Bank all were kind enough to share their expertise in the area of rural electrification. The faculty and staff at IUBAT were always helpful. Finally, thank you to Mahmuda Khanum for playing a fundamental role in getting the research for this report started.

Nadene Rehnby prepared the text for publication. Sanchay Kanti Barua helped make possible the international communications between Dhaka and Vancouver.
Executive Summary

The Bangladesh power sector faces several key problems:

- **Load shedding and voltage variation**: The state-owned Bangladesh Power Development Board (BPDB), which controls nearly three-fourths of the total generation capacity in Bangladesh, has resorted to load shedding as a means to reconcile demand to the available capacity. Load shedding is a significant constraint on growth of the economy.

- **Operating Inefficiency**: The power sector does not fare well in terms of operating efficiency. For example, Bangladesh requires considerably more employees per customer served than is the case in many countries.

- **System loss**: System loss occurs both for technical reasons and for reasons of inefficiency and corruption in administration. Exact figures of loss are unknown, but, at approximately 30 per cent, the net country-wide system loss is probably among the highest in the developing world. The losses incurred differ dramatically across the various utilities.

- **Unadjusted tariff structures and ineffective billing procedures**: Many countries have been unable to establish tariff structures and billing procedures that enable the power sector to be financially self-supporting. The resulting losses require subsidies from government or donor agencies that divert revenue away from other important programmes, such as education and public health. This problem has afflicted the Bangladesh power sector entities to varying degrees.

Why do power sector problems persist in Bangladesh? What can be done to solve them? This report assesses the barriers to accelerated electrification — in particular the barriers to rural electrification — and puts forward practical recommendations.

In any discussion of rural electrification, the point of departure is 1977. In that year the Rural Electrification Board (REB) was created. It has responsibility for distribution in rural Bangladesh, and provides to its customers a fourth of the country’s electricity. The REB arose from a recommendation by the National Rural Electric Cooperative Association (NRECA), an organisation of consumer-owned cooperatives in the United States. These cooperatives played a role in electrifying rural regions of the United States in early decades of the 20th century. Rural electric cooperatives – Palli Biddhat Samitees (PBSs) – are also key to the electrification strategy of the REB.

The PBSs operating under the supervision of the REB are a positive force within the power sector in Bangladesh. Their customers trust them and support their efforts to supply electricity. Since the inception of the REB, 67 PBSs have been established covering almost 90 per cent of the area of Bangladesh. Over 34,000 of a total of about 64,000 villages have been electrified and almost 4 million connections have been made. The REB realises markedly lower system losses for distribution than either the BPDB or the Dhaka Electric Supply Authority (DESA), which is responsible for distribution in metropolitan Dhaka. The REB also exhibits superior performance in terms of bill collection.

Despite these impressive accomplishments, a great deal remains to be done. If Bangladesh is to prosper economically, an efficient power system with majority access is a necessary component of the country’s infrastructure. To reach this objective will require a rapid acceleration in the pace of rural electrification. Below are our recommendations for achieving meaningful progress in rural electrification.
If this strategy is to have a major impact in increasing the proportion of rural Bangladesis with access to electricity, there is a need for significant private investment by independent power producers (IPPs). Ideally, private firms will invest in build-own-operate plants that in turn sell power to the REB at reasonable rates on the basis of long-term contracts.

Power generation by the REB will indirectly aid the BPDB by lowering the demand by REB customers on BPDB generating capacity. Another benefit from any major expansion of the REB into power generation is that this will relieve pressure on the Government of Bangladesh from oil and gas companies to undertake gas exports. Such exports are not in the best long run economic interest of Bangladesh and are politically unpopular among the majority. Besides other considerations, institutional reform of the power sector is a must to counter the arguments for export.

**RECOMMENDATION TWO**

Establish a regulatory regime capable of assuring appropriate tariffs throughout the REB / PBS network.

The critical point in expanding rural electrification hinges on the ability and willingness of customers to pay.

Across the PBS system, the average tariff per kilowatt hour (kWh) falls short of the cost of providing service. This situation persists despite subsidised electricity rates from the BPDB. Revenues from consumption in the higher industrial and commercial rate categories are insufficient to offset losses incurred due to low rates in the domestic and agricultural categories. The current state of affairs is not sustainable.

Widespread expansion of independent power generation, as described in Recommendation One, will be difficult under the current tariff structure. Significant private investment may not be forthcoming unless the REB can credibly assure investors that they will be able to recover their costs over the lifetime of the projects. If the PBSs substitute power generated by IPPs for power previously purchased from the BPDB at preferential rates, average tariffs charged may need to be adjusted. Raising tariffs will not be easy, but it is important that individual PBSs realise financial self-sufficiency in the long run.

**RECOMMENDATION THREE**

Initiate a more sophisticated relationship between the REB and the PBSs: allow those PBSs that are competent more autonomy and take under temporary trusteeship those with particularly poor financial records.

Given current energy sector trends and advances in small-scale generation technology, it may well be that further decentralisation — in the sense of the REB yielding more financial and managerial power to the mature PBSs — is now required and desirable.

Admittedly, the REB must maintain some aspects of control from Dhaka. The REB sets guidelines that act as a foundation for maintaining standards and ensuring consistency in terms of the engineering, financial, human resources, and commercial aspects of PBS management. Nor can the REB delegate its responsibility for competent transparent auditing. Many PBSs do not currently have the managerial strength to undertake complex negotiations — such as are required to negotiate with IPPs.

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The REB has been reluctant to give autonomy to PBSs for fear that they mismanage it. Among some PBSs that fear may be valid; among others it is not. The financially healthy PBSs with positive margins are a valuable source of managerial competence in the Bangladesh power sector. Their role could be expanded. They should be granted greater financial autonomy, and encouraged to undertake more ambitious projects, such as contracting with IPPs, redesigning their tariff structures so as to increase connections, and improving service quality for customer-members.

**RECOMMENDATION FOUR**

Extend micro-credit to households for the financing of investments in electrical access.

Although the costs of securing a residential connection are low, they may present a substantial barrier for those living at a near-subsistence level. However, low income does not mean an unwillingness to pay for electrical service, particularly if the service is reliable. On the contrary, if they currently have no access to electricity, poor families may stand to gain large benefits from incremental consumption, and would therefore be prepared to pay according to the cost of service.

If the rural poor are willing and able to pay electricity tariffs, but are held back by an inability to finance a connection, this represents a policy failure. Either the REB or an existing micro-credit organisation (such as the Grameen Bank or BRAC) should extend credit, with appropriate loan guarantees.

**RECOMMENDATION FIVE**

Consider various forms of distributed generation alongside grid extension when electrifying a new area.

Given that the REB has followed a policy of connecting the most economically attractive areas first, further expansion of service will be to increasingly remote areas with weak loads. Decentralised alternatives such as diesel, biomass, solar and wind may be cheaper than grid extension in these areas, and should be considered as part of the planning process.
Electricity for All • Electrification and Development in Rural Bangladesh

1997, the Centre for Policy Research of IUBAT, a project funded by the World Bank, published a report titled "Electricity for All: Electrification and Development in Rural Bangladesh." The report focused on the electrification of rural areas in Bangladesh, highlighting the importance of access to electricity for economic development and poverty reduction.

The report discussed various strategies and initiatives aimed at increasing access to electricity in rural areas, including the expansion of grid infrastructure, the use of renewable energy sources, and the implementation of community-based electrification programs. It also highlighted the challenges and obstacles faced in achieving universal electrification, such as the high cost of electrification, the need for long-term commitment from the government and stakeholders, and the importance of involving local communities in the decision-making process.

The report concluded with recommendations for policymakers, stakeholders, and international donors to collaborate and invest in electrification programs to ensure sustainable and inclusive development in rural Bangladesh.
Electricity for All • Electrification and Development in Rural Bangladesh

Centre for Policy Research of IUBAT • Summer 2002

12

13
I. Introduction

“Electricity is the key which opens the door into the modern world” (Foley 1992,145).

Electricity is vitally important for Bangladesh – both as a means to relieve poverty and as a means to accelerate economic growth. Table 1 summarises the many benefits realised by the poor when improved energy services become available. But it is not only the poor who benefit. In the case of Bangladesh, electric motors power the machines required for the garment industry, the key sector earning foreign exchange. Electric irrigation pumps improve agricultural yields, something crucial for realising food self-sufficiency.

Yet too many Bangladeshis still lack access to electricity service. And, for those with access, too often the service is subject to voltage variation and is interrupted by load shedding.

A study released in 1996 (Unnayan Shamannay) found a wide array of benefits associated with rural electrification in Bangladesh. The study compared electrified and non-electrified households in electrified villages, as well as households in non-electrified villages, which served as a control group. Electrification was associated with higher incomes and increased savings, less poverty, greater job opportunities, higher agricultural productivity, better health care and sanitation, improved educational opportunities, a stronger position for women in society and a reduction in the isolation of villages. Commercial enterprises were found to benefit and there was some evidence that electrification had a positive impact on industrial development.1

The Palli Biddyut Samitees (PBSs), rural cooperatives operating under the supervision of the Rural Electrification Board (REB), are a positive force within the power sector in Bangladesh. The study compared electrified and non-electrified households in electrified villages, as well as households in non-electrified villages, which served as a control group. Electrification was associated with higher incomes and increased savings, less poverty, greater job opportunities, higher agricultural productivity, better health care and sanitation, improved educational opportunities, a stronger position for women in society and a reduction in the isolation of villages. Commercial enterprises were found to benefit and there was some evidence that electrification had a positive impact on industrial development.1

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Table 1: Potential Effects of Improved Energy Services in Alleviating Poverty

<table>
<thead>
<tr>
<th>Direct effects on well-being</th>
<th>Direct effects on health</th>
<th>Direct effects on education</th>
<th>Direct effects on economic opportunities for the poor</th>
<th>Trickle-down effect of increased productivity</th>
<th>Effects on government budgets and services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved access to lighting, heat and refrigeration</td>
<td>Improved indoor air quality through cleaner fuel</td>
<td>Improved access to lighting, allowing more time to study</td>
<td>Improved productivity of businesses that employ the poor</td>
<td>Improved employment in infrastructure service delivery</td>
<td>Smaller fiscal burden and higher fiscal returns from more efficient services</td>
</tr>
<tr>
<td>Savings in time and effort (due to reduced need to gather biomass and other fuels)</td>
<td>Reduced fire hazard</td>
<td>Savings in time and effort, releasing time and energy to channel to education</td>
<td>Creation of employment in infrastructure service delivery</td>
<td>Improved health and education and savings in time and effort, increasing individual productivity</td>
<td>More benefits to the poor if government spending is effectively channelled to welfare-enhancing services</td>
</tr>
<tr>
<td>Improved access to information (through radio, television, and telecommunications)</td>
<td>Improved quality of health services (through better lighting, equipment, and refrigeration)</td>
<td>Easier establishment of health centres</td>
<td>Easier establishment and greater productivity of businesses in general (including through positive impact on the environment)</td>
<td>Higher fiscal returns associated with higher growth, coupled with pro-poor policies</td>
<td></td>
</tr>
</tbody>
</table>

Source: adapted from Price (2000,27)
Difficulties of Electrification in Developing Countries

The planners, politicians and economists who analysed the prospects of developing countries in the mid-20th century assumed foreign financing or donor aid would be forthcoming, and that rapid electrification was readily achievable. Relative to that early optimism, experts are now more circumspect. Many power systems – in South Asia and elsewhere – have experienced disappointing results in terms of financial viability, access, and quality of electrical service. These results have in turn brought into question the desirability of large government or donor assistance to the power sector.

In thinking about the results of electrification programs in developing countries, it is important to understand the nature of the power sector. Many of the difficulties arise from the sector’s technical and institutional complexity, the large-scale investments required, the interactive determinants of electricity demand, and the potential for debilitating conflicts over distribution of the costs and benefits of electrical service:

- **The power sector is among the most complex industrial sectors of a modern economy.** A power system requires generation facilities to transform some primary energy source into electricity. It requires high voltage power lines to transmit over long distances; it requires transformers and low voltage lines to distribute electricity locally among the ultimate users. It requires a retailing operation to organise connections, respond to customer problems, and collect revenue for the state, cooperative and private enterprises providing electricity. Efficient operation of a power system requires honest managers supervising the work of engineers, electricians, bill collectors and many others.

- **Expansion of the power sector requires large-scale investments in generation, transmission and distribution capacity.** Recent technical advances in small-scale generators have allowed efficient investments to be made. Nonetheless, successful expansion still requires relatively large investments.

- **Demand for electricity is integrated with other aspects of development.** Investment in generation, transmission and distribution is not always a sufficient stimulus for electricity demand. Electrification cannot succeed without the development of complementary infrastructure, such as communications and transportation networks, and appropriate institutions, like credit facilities, available to the ultimate users.

- **Throughout the world, serious debates arise over tariffs; these debates tend to be particularly acute in developing countries.** While power system expansions are costly, once initial investments have been made, the operating cost per kilowatt hour (kWh) of additional consumption by connected customers may be quite low. Many customers expect low electricity tariffs reflecting only operating costs; some expect to use electricity while paying nothing. Fortunately, most customers are prepared to pay the full cost of electricity, and admittedly there are legitimate debates over tariff design. But, in too many developing countries – and sometimes also in developed countries – these debates are not resolved in ways that permit the power sector to be financially viable. When rates are set too low or bills are uncollected, the power sector requires ongoing subsidies, either from government or from foreign donors, and users face few incentives to use available electricity efficiently.

In many countries, a syndrome arises that defeats programmes intended to accelerate electrification. Interest groups among users pressure for low tariffs and less-than-diligent bill collection. Public sector unions increase costs of supply by insisting on unnecessarily large employment levels. Politicians confound the problem through lax accountability for state-owned enterprises and weak regulation of private firms able to exercise monopoly power. The syndrome results in a poorly functioning power sector, financial losses for the firms involved and the need for ongoing subsidies from scarce general government revenues. Where this syndrome is deeply entrenched, the power sector may languish in an unsatisfactory condition for years. And the years stretch into decades.
II. Institutional Structure of the Power Sector

At the time of partition of India in 1947, the total generating capacity of East Bengal was a mere 21 megawatts (MW), all of it privately owned. A half-century later, in 2001, total capacity was an estimated 4555 MW—more than a 200-fold increase. This is an impressive achievement but, as we shall explore in more detail, there remains a great deal to be accomplished.

After 1947, vertically integrated and state-owned enterprises came to dominate the power sector. What is now the Bangladesh Power Development Board (BPDB) was created in 1958. The BPDB was the only large-scale enterprise generating, transmitting and distributing electricity for sale in Bangladesh until the late 1970s.

The first major institutional innovation came in 1977, with the bifurcation of the BPDB and creation of the Rural Electrification Board (REB) with responsibility for distribution in rural Bangladesh. The REB arose from a recommendation by the National Rural Electric Cooperative Association (NRECA), an organisation of consumer-owned cooperatives in the United States. These cooperatives had played an important role in the early decades of the 20th century in electrifying rural regions of the United States. Rural electric cooperatives—Palli Biddyut Samitees (PBSs)—are also key to the electrification strategy of the REB.

The next significant institutional change was establishment of the Dhaka Electric Supply Authority (DESA) in 1991. This government agency was given responsibility for electricity distribution in the metropolitan Dhaka area. Unfortunately, neither the BPDB nor the DESA achieved acceptable levels of efficiency and, in the early 1990s, major multilateral donors withdrew all financial support from generation, transmission and distribution projects administered by the two agencies.

In the mid-1990s, the Government of Bangladesh responded by initiating a series of reforms, laid out in its Energy Policy in 1995 (gazetted in 1996). An organisation called Power Cell has been created to design, promote and otherwise oversee implementation of the reforms. The Bangladesh Electricity Act, 2002, a statute enabling the reforms, has been approved in principle. Draft legislation has also been prepared for the Regulatory Commission whose duties will include licensing, setting tariffs and establishing standards within the power sector.

The reforms entail transfer of some BPDB and DESA activities to new agencies, which will be “corporatised” and mandated to behave in a financially autonomous manner. For example, the Dhaka Electric Supply Corporation (DESCO) will handle a portion of the customers formerly served by the DESA. In 1996, the Power Grid Company of Bangladesh (PGCB) was launched, with the understanding that it would ultimately take over the role of transmission from the BPDB.

As part of an effort to attract private investment in generation, a Private Sector Power Generation Policy was adopted in late 1996. Independent Power Producers (IPPs) currently operate three barge-mounted power plants and one land-based combined cycle gas turbine (CCGT) plant with total capacity of 690 MW. This capacity has been hooked into the national grid. By 2003, an additional 450 MW of private generation capacity is expected to come into operation. This capacity will also be based on CCGT technology. (See What is a Gas Turbine? on page 34.)

Figure 1 illustrates the share of total generating capacity attributable to each of the major institutions within the Bangladesh power sector, while providing several million rural people with electrical connections.
Electricity for All  •  Electrification and Development in Rural Bangladesh

The power sector in Bangladesh is underdeveloped. At 110 kWh per year, average per capita electricity consumption is among the lowest in the world. To put this number in perspective, annual per capita consumption in developed countries is approximately 100 times higher. It is also several times higher in most of Bangladesh’s neighbours. In 1996, China consumed 7.1 and India 3.6 times more on a per capita basis (Jaccard, Khan and Richards 2001,1).

One reason for low utilisation of electricity in Bangladesh is limited access. Throughout the country, the distribution network reaches fewer than 20 per cent of the population. Among the rural population, the percentage with access is even lower, probably about 15 per cent. Estimates, however, are uncertain.

In its recent Vision Statement, the Government of Bangladesh acknowledged the enormity of the task yet to be accomplished with respect to electrification:

Access to electricity in Bangladesh is one of the lowest in the world – coverage [in 2000] stands at less than 20 per cent of the total population; consumption of power is also meagre, only about 110 kWh per capita per annum. Shortage of power supply, at times very acute and unreliable, has constrained economic growth (2000b,1).

There are a number of problems leading to low utilisation and inadequate access to electricity in Bangladesh. These issues are discussed below. Load shedding and voltage variation discourage individuals and firms from accessing and consuming electricity; while operating inefficiencies, system losses, poor bill collection and inadequate tariff structures lead to debilitating financial losses. The lack of funds in turn constrains budgets for maintenance and the installation of new capacity, leading to additional supply problems. There is not

III. Problems Facing the Power Sector
It must be acknowledged, however, that Bangladesh is not alone in grappling with problems in its power sector. Similar issues have arisen in Indian states. The World Bank (2000, 41) reports that “The power sector in almost all [Indian] states faces a twin crisis: severe power shortages and heavy financial losses to the state electricity boards... subsidies are a major element in the deterioration of state finances.”

### Load Shedding

In many developing countries, generation and transmission capacity is inadequate to meet the peak demand among those connected. Power authorities manage by load shedding—eliminating power to regions of the country, or neighbourhoods within cities, on a rotating basis. Despite reforms over the 1990s to encourage generation by IPPs, and despite the installation of new power plants, the expansion of transmission lines and the augmentation of distribution networks, the Bangladesh power system remains inadequate to the demands of connected customers – to say nothing of the potential demand by the majority of Bangladeshis who have no access to electricity. The BPDB has resorted to significant load shedding as a means to reconcile demand with available capacity.

Load shedding worsened over much of the last decade. (See Table 2.) In 1997-98, for example, load shedding occurred on 346 days, during 2119 hours (out of a total of 8760 hours in a year). The minimum estimated demand curtailed was equivalent to 44 MW; the maximum, 711 MW. The problem improved somewhat in 1998-99 and 1999-2000 as new generating capacity came on stream.

Load shedding is a significant drain on the economy and a major irritant to the public, both in rural areas and cities. To minimise shedding, the BPDB postpones plant shutdowns for routine maintenance – which in turn may give rise to unexpected plant shutdowns at later dates. Given the inadequate level of capacity, old plants are not retired.

### Operating Inefficiency

The Bangladesh power sector does not fare well in terms of operating efficiency. For example, Bangladesh requires considerably more employees per customer served than is the case in most countries. Among the sample of countries in Table 3, only Nepal has a higher ratio of employees to customers.

### Table 2: Load Shedding 1989-90 to 1997-98

<table>
<thead>
<tr>
<th>Year</th>
<th>Minimum Load Shedding (MW)</th>
<th>Maximum Load Shedding (MW)</th>
<th>Days of Load Shedding (days)</th>
<th>Duration of Load Shedding (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989-90</td>
<td>15</td>
<td>180</td>
<td>29</td>
<td>51</td>
</tr>
<tr>
<td>1990-91</td>
<td>15</td>
<td>340</td>
<td>70</td>
<td>113</td>
</tr>
<tr>
<td>1991-92</td>
<td>25</td>
<td>550</td>
<td>232</td>
<td>660</td>
</tr>
<tr>
<td>1992-93</td>
<td>20</td>
<td>480</td>
<td>264</td>
<td>638</td>
</tr>
<tr>
<td>1993-94</td>
<td>23</td>
<td>540</td>
<td>210</td>
<td>670</td>
</tr>
<tr>
<td>1994-95</td>
<td>10</td>
<td>537</td>
<td>230</td>
<td>763</td>
</tr>
<tr>
<td>1995-96</td>
<td>10</td>
<td>545</td>
<td>301</td>
<td>1007</td>
</tr>
<tr>
<td>1996-97</td>
<td>20</td>
<td>674</td>
<td>338</td>
<td>2872</td>
</tr>
<tr>
<td>1997-98</td>
<td>44</td>
<td>711</td>
<td>346</td>
<td>2119</td>
</tr>
</tbody>
</table>

*Source: BPDB (quoted in Kamal 2001, 193)*

### Table 3: Power Sector Employees per 1,000 Customers, Selected South and Southeast Asian Countries, 1995

<table>
<thead>
<tr>
<th>Country</th>
<th>Employees per 1,000 Customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>24</td>
</tr>
<tr>
<td>China</td>
<td>4</td>
</tr>
<tr>
<td>India</td>
<td>15</td>
</tr>
<tr>
<td>Malaysia</td>
<td>8</td>
</tr>
<tr>
<td>Nepal</td>
<td>29</td>
</tr>
<tr>
<td>Pakistan</td>
<td>20</td>
</tr>
<tr>
<td>Philippines</td>
<td>6</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>20</td>
</tr>
<tr>
<td>Thailand</td>
<td>9</td>
</tr>
</tbody>
</table>

*Source: calculated from data in World Bank (2001, Appendix D)*
System Loss

The difference between electricity generated and electricity for which customers are billed is referred to as system loss. System loss occurs at both the high voltage transmission stage and the lower voltage distribution stage. Estimates of loss are inevitably uncertain but, at approximately 30 per cent, the net country-wide system loss incurred by the Bangladesh power sector is probably among the highest in the developing world. The losses incurred differ across the various utilities. The REB realises markedly lower system losses for distribution than either the BPDB or the DESA. (See Table 4.)

Some portion of system loss stems from the technical characteristics of the equipment used to transmit and distribute electricity from a generation plant to end users. The remainder stems from non-technical causes, such as unauthorized connections and corruption of the billing process. A recent report described the situation in Bangladesh as follows:

> By one estimate, about half the total system losses of the [BPDB and DESA] are accounted for by mismanagement and petty corruption surrounding electricity metering. Hard facts are difficult to come by, but anecdotal evidence from electricity consumers and articles in the local press suggest pervasive corruption by some power sector employees. Meter readers frequently delegate the actual task of meter reading to informal operators and focus their own efforts on developing a business in illegal connections (Lovei and McKechnie 2000, 69).

Table 4: System Loss at the Distribution Stage, Selected Years

<table>
<thead>
<tr>
<th></th>
<th>BPDB (per cent)</th>
<th>DESA</th>
<th>REB</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1992-93</td>
<td>36</td>
<td>31</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>1995-96</td>
<td>22</td>
<td>29</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>1997-98</td>
<td>22</td>
<td>28</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>

Source: BPDB (quoted in Kamal 2001, 196)

Financial Performance of the Bangladesh Power Development Board

The BPDB’s financial management system is weak; its accounts do not comply fully with generally accepted accounting / auditing procedures (GAAP). Annual operating losses over the years 1994 to 1997 averaged nearly Tk 2 billion (US$40 million), and the average return on net fixed assets before financing charges was consistently less than one per cent. This compares to a desirable minimum return of eight per cent.

The main factors contributing to poor performance are the following:

1. The BPDB has been unable to charge tariffs above costs. The average tariff between 1994 and 1997 was about Tk 1.9 per kWh; the effective tariff, after allowing for losses of a fifth on gross generation, was less than Tk 1.5 per kWh. The average cost of supply, about Tk 1.6 per kWh of gross generation, therefore exceeded the effective tariff.

2. The BPDB bills an unacceptably low percentage of its net generation. The BPDB billed in 1999 below 80 per cent of its net generation (Kamal 2001, Table 7.9). If we assume 80 per cent billing (on about 9,600 GWh of 12,000 GWh net power generated), and if we evaluate the unbilled power at a conservative price of Tk 1 per kWh, the unaccounted for electricity implies lost revenue of about Tk 2.4 billion (US$48 million) annually.

3. The BPDB suffers from uncollected billings. The BPDB experiences persistent liquidity constraints due to the ongoing problem of uncollected receivables.

The financial problems of the BPDB have serious implications:

1. The BPDB depends on external financial assistance. The result of cascading inefficiencies – inefficient generation, high system and non-technical losses, and poor collections – is a cash crunch that forces the BPDB to rely on external financial assistance from the Government of Bangladesh to meet its operational deficit, debt service obligations and investment activities. The accumulated BPDB deficit amounts to Tk 30 billion (US$600 million). There have been periodic infusions of government equity, which serve to lower the corporation's debt burden. Currently, this government equity is nearly Tk 60 billion (US$1.2 billion). In addition, the BPDB enjoys a subsidised price for natural gas, the basic energy source used for electricity generation. It enjoys long-term loans via government and foreign aid.

2. The BPDB’s level of investment is inadequate. Due to the BPDB’s financial crunch, its investment programme has been inadequate. The firm invested approximately Tk 6 billion (US$120 million) annually in the mid-1990s. Given levels of population growth, load shedding and other indicators of unmet demand, the annual investment rate should be doubled at least – to Tk 12 billion (US$240 million). Introduction of IPPs in the late 1990s has improved the level of aggregate investment in generation capacity.
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Financial Losses

Many countries have been unable to establish tariff structures and billing procedures that enable the power sector to be financially self-supporting. The resulting financial losses divert available government revenues away from establishing new electric connections, not to mention other important programmes, such as education and public health.

In the mid-1990s, the Bangladesh power sector registered annual financial losses in the range of Taka (Tk) 4 billion (US $80 million) (World Bank circa 1996). Much of these losses were absorbed by the national government. The majority of the shortfall arose from the provision of electricity to urban dwellers who enjoy, overall, superior access to that of rural Bangladeshis. Given its overwhelming importance in the power sector of Bangladesh, it is necessary to appreciate the financial problems faced by the BPDB. (See Financial Performance of the BPDB on page 25.) Later on, we will discuss financial difficulties faced by the REB.

One aspect of the financial problems incurred by the power sector is actual collection of bills presented to customers. For the fiscal year 1999, bill collection rates for the BPDB and the DESA were estimated at 71 per cent and 75 per cent respectively (quoted in Kamal 2001, Table 7.9). One consistent feature of the REB is a higher rate of collection.

Institutional Structure

The REB and the PBSs have been designated as the organisations responsible for rural electrification in Bangladesh. The functions of the REB can be summarised as follows:

- Organising new PBSs and initiating development in project areas,
- Planning and designing the distribution network of the PBSs and constructing the sub-station and electric lines,
- Providing training for PBS personnel,
- Negotiating funding for the overall programme,
- Monitoring the performance and function of the PBSs,
- Acting as a link between the PBSs and their bulk power suppliers, as well as other government agencies, and
- Conducting elections for a board of directors within each PBS.

The PBSs are non-profit organisations owned by their members, who are also the consumers of electricity. Within each PBS, members elect a board of directors to formulate policy and to oversee PBS managers. Directors hold their position for a period of three years. Each year elections are held to replace one third of the board. Women may stand for election, and are also encouraged to participate as lady advisors—the board nominates a maximum of three. The directors hold monthly meetings as well

IV. The Rural Electrification Programme
as special meetings as required. Board mem-
bers are compensated when called on offi-
cial business, but otherwise the positions are
honorary.

The board hires a general manager to
conduct everyday operations of the PBS.
This appointment is subject to REB ap-
proval. The general manager is responsible
for developing the programmes and organ-
ising the staff necessary to meet the objec-
tives and needs of the PBS. Assistant gen-
eral managers head the following divisions:
general services; construction, operation
and maintenance; finance; member service;
and engineering. The REB is the ultimate
arbitrator in the event of a conflict arising
between the board of directors and the man-
agement of a PBS.

Extension of the Distribution System

The REB prioritises areas for electrification,
on both a division-wide and a country-wide
basis, ultimately leading to the establishment
of new PBSs or to the annexation of new
areas to existing PBSs. The ranking system
is based on several criteria: road infrastruc-
ture, number of households, state of indus-
trial and commercial development, existing
social and community institutions, number
of pumps and tube wells for irrigation, and
percentage of the area prone to flooding.
Access to a BPDB 33kV line and adequate
capacity at the grid sub-station are also nec-
sary. Feasibility studies are required prior
to granting approval for a new PBS.

Within each PBS, a distribution network
capable of providing service to the entire
area is designed. This is the basis of Area
Coverage Rural Electrification (ACRE), a
distribution strategy that differs from the
usual practice of running lines only to eco-

nomic growth centres. Under ACRE, pri-
mary distribution backbones are con-
structed that, in turn, may eventually feed
into laterals and secondary lines connect-
ing every village. As with the establish-
ment of PBSs themselves, laterals and secondary
lines are constructed on a priority basis, the
selection criteria being economic (deter-
mmed by benefit-cost ratios) and social (as-
suring reasonably equitable distribution
within the PBS).

Financial Support for
the REB and the PBSs

Rural electrification in Bangladesh has re-
ceived favourable attention from the donor
community in the form of grants and loans
under generous conditions. Cumulative as-
sistance from 16 bilateral and multilateral
donors is close to US$1 billion. Donor loans
are transferred from the Government of
Bangladesh to the REB at an annual interest
rate of 2 per cent, with a long repayment
period and a grace period before repayment
begins. The government forgives one third
of the loan charges to the REB. In turn, the
REB loans to the PBSs at a rate of 3 per cent
over 30 years, retaining the 1 per cent as a
margin to cover central programme man-
agement costs.

It is expected that revenues of a PBS may
fall short of expenses during its initial years
of operation. Areas that are not immediately
viable may become profitable, given time
to build distribution infrastructure and de-
velop a load base. A programme of initial
financial support has therefore been estab-
lished. For the first five years following
energisation, PBSs are not required to make
principal payments on loans provided by
the REB. Interest charges during this period
are only 0.75 per cent annually and are capi-
talised into the investment cost of the origi-
nal loan (NRECA 2000,27). Some cash flow
support may also be provided to a PBS as a
direct subsidy during the first five years,

Table 5: Typical Tariff Structure for a PBS

<table>
<thead>
<tr>
<th>Category</th>
<th>Domestic*</th>
<th>Commercial</th>
<th>Charitable Institutions</th>
<th>Irrigation</th>
<th>Industrial General Power</th>
<th>Large Power</th>
<th>Street Lights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taka per kilowatt hour</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.45b</td>
<td>3.60</td>
<td>5.35</td>
<td>4.60</td>
<td>2.85</td>
<td>2.55</td>
<td>3.55</td>
</tr>
<tr>
<td>U.S. cents per kilowatt hour</td>
<td></td>
<td>4.0c</td>
<td>7.2</td>
<td>10.7</td>
<td>9.2</td>
<td>5.7</td>
<td>5.1</td>
</tr>
</tbody>
</table>

c Tariffs are according to monthly consumption. Minimum bill charges may also apply.
b Tk50=US$1. Prices have increased about Tk 0.1 since this data was collected.
Source: NRECA (2000)
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subject to annual reviews. After this grace period, PBSs are expected to be financially self-sustaining. A PBS that still cannot cover costs is allowed to incur so-called negative margins by using its depreciation allowance to cover the deficit between revenues and operating costs.

**Electricity Purchases, Tariffs and Connection Costs**

The PBSs currently purchase electricity from the DESA and the BPDB at wholesale rates of Tk 2.05 and Tk 1.95 per kWh, respectively. The PBSs enjoy a preferential rate from the BPDB, paying significantly less than regular industrial consumers. However, their tariffs will probably increase over the next year to Tk 2.5 per kWh to reflect the actual cost of generation.

Retail tariffs charged by the PBSs vary and are approved by the REB (REB 1988b, section 9.d). Consideration is given to the ability of consumers within the PBS to pay, although adequate cost recovery across the entire programme must also be maintained. The tariff structure cross-subsidizes domestic and agricultural consumers by levying rates on them below the cost of service and levying rates above the cost of service on industrial and commercial consumers. (See Table 5.) Virtually all domestic connections have consumption below 300 kWh per month and fall into the lowest rate category.

To secure a residential connection, an individual must pay a membership fee and a security deposit, and must also cover the cost of house wiring. These expenses are summarised in Table 6. (If the new connection is beyond 100 feet from an electric pole, additional line extension charges may apply. These costs are not expressed in the table.)

<table>
<thead>
<tr>
<th>Table 6: Costs Associated with a New Residential Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Taka</strong></td>
</tr>
<tr>
<td>Membership Fee</td>
</tr>
<tr>
<td>Security Deposit</td>
</tr>
<tr>
<td>House Wiring</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

* Tk 50 = US$1.
* Minimum cost estimates.
Source: interviews with general managers of Dhaka PBS-1, Mymensingh PBS-2 and Moulavibazar PBS

**Accounting Indicators**

Since its inception in the late 1970s, rural electrification in Bangladesh has made significant progress. Out of the grand total of 75 planned PBSs, 67 have now been approved and organised, and 66 have been energised. About 90 per cent of the geographical area of the country is included in energised PBSs. Within the existing PBSs, over 34,000 villages have been electrified and almost four million connections established. Of the total connections, 84 per cent are to domestic consumers and 11 per cent are to commercial operations. Almost 3 per cent are for irrigation and nearly 2 per cent are for industrial uses (REB 2002). To supply this vast consumer base, over 135,000 kilometres of distribution line have been constructed and energised, served by 260 33/11 kV sub-stations.

The performance of the REB has been superior to that of the BPDB and the DESA in terms of two key accounting indicators: system losses and bill collection rates. REB system losses are currently at 16 per cent, compared to distribution losses of 21 and 28 per cent respectively by the BPDB and the DESA. (Refer back to Table 4.) If we eliminate the six PBSs that have recently taken over lines and consumers from the BPDB and the DESA, the result is closer to 13 per cent. In 1999, the REB collected 92 per cent of its billings, while collection rates for the BPDB and the DESA were estimated at 71 per cent and 75 per cent respectively (quoted in Kamal 2001, Table 7.9).

The intent upon establishing the REB was that all rural areas eventually be turned over to the PBSs. This rationalisation of territory has only recently been effected. The performance of PBSs at and following the acceptance of takeover areas provides additional evidence that the rural systems are more efficiently managed. Table 7 tracks system loss and bill collection for Mymensingh PBS-2 through the takeover process.
New Developments: Generation and Renewables

In recent years, the REB has entered into power generation and has made advances in renewable energy. In 1995, the REB established the Rural Power Corporation (RPC) under the Companies Act to construct a power plant at Mymensingh. Five PBSs became part owners of the RPC, together holding a 49 per cent share of equity. The REB retained the balance. The Mymensingh plant began commercial operation in March 2000 and now supplies 140 MW to the national grid. The REB has sold part of its initial share – to the five founding PBSs and some new PBSs – and currently owns only 28 per cent of equity. Eventually, the REB will completely divest its RPC equity to the PBSs.

The problem of inadequate generation capacity in the national system has also led the REB to explore dedicated generation options. It recently entered into an agreement with United Summit Power Company Limited (USPCL) for the purchase of power from three 11 MW gas-fired turbine plants at Dhaka-1, Comilla-1 and Narshingdi PBSs. (See page 34 for an explanation of gas turbine generation technology.) All three plants are now in operation and supplying power. These small plants provide electricity at Tk2.0 to 2.1 per kWh, which is less than the actual cost of BPDB power but more than...
the current subsidized tariff to the PBSs. The potential exists to expand the capacity of each of the USPCL plants to 22 MW. A formal analysis by the NRECA recently found that power requirements at both Dhaka and Narsingdi could support an increase in capacity; however, expansion of these plants has been delayed. The REB is currently reviewing the process and contents of a new request for proposals for future additions in generation.

Between 1996 and 1998, the REB undertook a 62 kW pilot project, with financial assistance from the Government of France, to provide solar photovoltaic (SPV) power to four remote Meghna River islands falling within the boundary of Narsingdi PBS-1. The use of solar energy is expected to grow in Bangladesh. Some private companies are now installing SPV systems. The REB is in the process of expanding its SPV project to include several PBSs. SPV technology is especially applicable to rural communities that either have a long wait ahead of them for grid service or are so remote that the grid will never be extended to them.

Other forms of renewable energy are also being considered. Wind does not appear to be viable, given the low average wind regime in the country. Likewise, mini- and micro-hydro do not show much promise, although investment in these options in combination with irrigation and flood control projects might be worthwhile. The Canadian International Development Agency recently funded a feasibility study on the potential for building a hybrid power plant in the southern part of Bangladesh. As a result, a project has been designed that would use 20 per cent wind, 40 per cent solar and 40 per cent biogas. The plant is under consideration by the Energy Ministry.

### What is a Gas Turbine?

Gas turbines are heat engines that are used in a variety of applications, including jet airplanes and power generation plants. Within the turbine system, a fuel is burnt to run a compressor. As they expand, hot compressed gases power a turbine. The exhaust gases from the turbine can be used to directly turn a generator, producing electricity. This is referred to as a “simple cycle” gas turbine. Heat from the exhaust gases may also be collected to produce steam. To derive the maximum electrical output for a given amount of fuel, a “combined cycle” steam turbine operating a second generator is added to the process. A flow diagram of a combined cycle gas turbine (CCGT) system is shown below.

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A girl stands in front of a rural home with an electrical connection. PBS consumer members are at the heart of the rural electrification program, which represents a departure from the norm of centralized decision-making.
Employees are involved in the success of the PBS through performance target agreements, negotiated annually between each PBS and the REB, based on performance data from the previous year. Targets are set in up to 21 key areas including system loss, accounts receivable, revenue per kilometre of line, cost control, efficient load management, annual growth in consumers, annual growth in electrical consumption and payment of debt service liability. Each target is assigned a weight factor, which may vary according to the equity and age of the PBS. Employees of PBSs that perform well relative to their targets are rewarded with pay bonuses of up to 15 per cent, while employees of PBSs with poor performance receive either no bonus or a 1 per cent penalty. PBS employees do not belong to a trade union and can be dismissed if found to be dishonest or incompetent.

To discourage corruption and build trust with consumer-members and funding agencies, an emphasis on transparency has been built into the rural electrification programme. Detailed manuals and policy instructions, as well as monthly operational statistics, are available to concerned parties. The PBSs are subject to regular management and financial audits by the REB. Annual reports are published by each PBS and are discussed at annual general meetings.

Adequate customer service is also important for maintaining enthusiasm among PBS members, and for achieving high bill collection rates. Despite load shedding – over which the REB has no control – an effort is ongoing to show due respect to consumers by presenting bills promptly (so that they have enough time to pay), setting up convenient bill payment locations, and providing one-point service (combining several types of service at one location). Line crews are available to take complaints on a 24-hour basis. The REB notes that the distribution system is constantly maintained and upgraded to ensure reliability of the electricity service.

In addition to the above, other innovative measures enhance the performance of the PBSs and discourage cheating. For example, the working routes of employees who read meters and serve bills are changed regularly, and the billing assistant positions within each PBS are reserved for women. This latter policy is intended to generate employment for women, but it may also have the effect of reducing dishonest practices.

Despite the accomplishments described previously, the disconcerting fact remains that a quarter century after creation of the REB, probably only one person in seven in rural Bangladesh has access to electricity. Under the REB’s Master Plan most of the villages will be energised by the year 2020. This will not solve the problem of access, however, given that in the energised areas less than 35 per cent of the population has taken up service.

Electricity is one of the keys to development, as suggested by Foley at the beginning of this report. If Bangladesh is to prosper economically, an efficient power system with majority access is a necessary component of the country’s infrastructure. In its recent Vision Statement, the Government of Bangladesh committed itself “to make electricity available for all.” It proposed to bring the entire country under electricity service by the year 2020 (2000b,5). This is an ambitious objective that will require a rapid acceleration in the pace of rural electrification. The present annual rate of new rural connections is about 200,000. A doubling of that rate would result in about 50 per cent access by 2025.

Accelerated rural electrification will be difficult due to a number of factors. First, aggregate aid to developing countries has been decreasing, and donors have become less willing to finance power sector expansions. Second, most areas where electrification is economically attractive have already been targeted through the REB’s selection process. Third, the REB’s preferential bulk power rate from the BPDB is not expected to endure.

How can the pace of rural electrification be reconciled with the goal of bringing electricity to all by 2020, especially given factors that may make achievements in electrification increasingly difficult to realise? In our efforts to answer this question we have identified what we believe are the key barriers to accelerated rural electrification in Bangladesh.

VI. Dimensions of Concern
Quality of Electrical Supply from the BPDB

Among the factors constraining connection rates are some inherent to the rural system: low household incomes and the financial inability on the part of the PBSs to respond to new requests for connections. However, of central importance is the low quality of electrical supply by the BPDB to the PBSs. The BPDB supply is characterised by excessive voltage variability and a high incidence of load shedding. To those who are poor, connection costs are significant and will only be incurred for a reliable service. Load shedding discourages commercial and industrial connections, since firms requiring uninterrupted power must retain captive generating capacity.

Financial Performance and Tariff Structure

It is troubling that many PBSs continue to encounter budgetary shortfalls, even after more than 10 years of operation. Of 39 PBSs energised from the beginning of the programme until the end of 1990, in financial year 1998–99, 22 did not bring in enough revenue through tariffs and other charges to meet the cost of providing service. No longer eligible for subsidies, these PBSs incurred “negative margins.” They financed their deficits using their depreciation allowances (NRECA 2000, 28). Currently, out of 67 PBSs, 12 are in profit, 21 are breaking even and the rest are incurring losses. PBSs charge lower rates for domestic and agricultural consumers than for industrial and commercial consumers. Unfortunately, growth in the industrial and commercial load has not been enough to balance the losses arising from the low domestic and agricultural rates. (Refer back to Table 5. Figure 3 provides the most up to date information from the REB on the share of electricity consumed by each customer category.)

The average cost of providing service across all PBSs was Tk 3.30 per kWh in the late 1990s (NRECA 2000). Weighting the tariffs for each category (in Table 5) by the respective share of power consumed, the NRECA calculated the average revenue at Tk 3.05 per kWh, implying an overall loss of Tk 0.25 per kWh across the REB system.

To appreciate the order of magnitude of reduction in cross-subsidisation required to eliminate negative margins, the NRECA estimated the impact from increasing the lowest residential tariff from Tk 2.45 to Tk 3.20, an increase of 30 per cent. They found that under the new tariff regime, all but 6 of the 22 mature PBSs that had been incurring negative margins would have generated positive margins.

To summarise this dimension of the problem, the extent of cross-subsidisation and a tariff structure that, on average, results in sales of electricity below the present cost of service are slowing the rate of electrification and endangering the financial integrity of the programme. Furthermore, the REB relies on the willingness of the Government of Bangladesh to furnish power generated by the BPDB at a preferential tariff below the BPDBs cost of generation.

Donor Support: A Mixed Blessing

Past support by donors has enabled average REB tariffs to be lower than otherwise, and enabled rural electrification projects to proceed that might otherwise have stalled at the design stage due to a lack of professional input. However, donor support is a mixed blessing.

The danger of long-term reliance on donor financing is that PBS members may come to view electricity as a form of aid to be distributed without regard for willingness to pay, and they may refrain from undertaking worthwhile projects that should go ahead with or without donor aid.

When people use power for activities whose value exceeds the cost of the electrical service, then the economy is growing. The basic indicator for whether the value growth in the industrial and commercial load has not been enough to balance the losses arising from the low domestic and agricultural rates. (Refer back to Table 5. Figure 3 provides the most up to date information from the REB on the share of electricity consumed by each customer category.)

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Past support by donors has enabled average REB tariffs to be lower than otherwise, and enabled rural electrification projects to proceed that might otherwise have stalled at the design stage due to a lack of professional input. However, donor support is a mixed blessing.

The danger of long-term reliance on donor financing is that PBS members may come to view electricity as a form of aid to be distributed without regard for willingness to pay, and they may refrain from undertaking worthwhile projects that should go ahead with or without donor aid.

When people use power for activities whose value exceeds the cost of the electrical service, then the economy is growing. The basic indicator for whether the value
of electricity in any activity exceeds its cost is the willingness of people to pay for using it. As the following energy consultant writes, estimating what people are willing to pay for electrical services of reasonable quality is hard to do in developing countries:

**Lack of Managerial and Financial Autonomy for PBSSs**

At the time the rural electrification programme was launched in the late 1970s, most experts assumed that key decisions within the electricity sector would always be made by the central agencies responsible for power generation and the high voltage transmission grid. This conventional wisdom made sense, because generation technology at the time favoured large plants in the 500 – 1000 MW range. Small plants meant inefficiently high generation costs per kWh.

Experience has shown, however, that central control within the power sector can result in inefficiencies remaining unresolved, and in investments in generation and distribution projects being missed that could improve the well being of local customers and be financially self-sustaining. Furthermore, with the change in generation technology over the last two decades decentralisation is now more feasible. Small generating plants of less than 50 MW, using CCGT technology, can realise full levelised costs that formerly could be realised only in plants 100 times larger (Powell and Starks 2000).

Governments in many countries have been attempting to create a regulatory environment where competition and private investment are encouraged, and where local firms – whether state-owned, cooperatives or private – can make decisions on a decentralised basis. (Rural Electrification in Chile, below, briefly discusses an interesting international precedent for successfully introducing these principles into a rural electrification programme.) Rural electrification in Bangladesh, however, is still very much dependent on central decisions made by the REB in Dhaka. In particular, the REB has the last word on rates charged to PBS member consumers, and has conducted all negotiations with IPPs.

**Rural Electrification in Chile**

In 1992, almost half of Chile’s rural population did not have access to electricity. To improve coverage, the country initiated a rural electrification programme in 1994. This programme was to maximise the results achieved within a given budget, implementing projects with the greatest impact per dollar invested first. It has been extremely successful. The percentage of rural households with electricity increased from 53 per cent in 1992 to 76 per cent by the end of 1999. The state invested US$112 million in the programme from 1995 to 1999 – below the projected cost estimate of $150 million to reach 75 per cent coverage.

Under the Chilean strategy, government subsidies are competitively allocated among private electricity distribution companies within each region of the country. During an annual bidding process, companies present rural electrification projects that are evaluated on the basis of cost-benefit analysis, the amount that the company is willing to invest itself, and social impact. Projects must have a positive social net benefit and a negative private net benefit in order to be considered. Once a distribution project has been carried out, the company involved continues to be responsible for operation, management and maintenance, using tariffs set by a regulatory agency to cover costs.

Subsidies from a special fund are distributed among regions by the central government, but decision making on a decentralised basis. Under the Chilean strategy, government subsidies are competitively allocated among private electricity distribution companies within each region of the country. During an annual bidding process, companies present rural electrification projects that are evaluated on the basis of cost-benefit analysis, the amount that the company is willing to invest itself, and social impact. Projects must have a positive social net benefit and a negative private net benefit in order to be considered. Once a distribution project has been carried out, the company involved continues to be responsible for operation, management and maintenance, using tariffs set by a regulatory agency to cover costs.

Subsidies from a special fund are distributed among regions by the central government. Regions that have been successful over the past year in increasing rural coverage, yet which still have many households without access stand to receive the largest subsidy. The regions themselves also contribute resources to the programme as do the users who ultimately benefit.

While suppliers and consumers will look to managers within the sector to improve the quality of service, they should nonetheless expect to cover costs of operation and debt servicing from customer revenues. Donor aid must be a secondary matter.
RECOMMENDATION ONE

The REB should place a high priority on major expansion of power generation independent of the national transmission grid in off-grid areas.

The crucial advantage that the REB currently enjoys relative to other power sector agencies in Bangladesh is its reputation for efficient management. What is now required is that the REB extend the scope of its activities beyond distribution into the sphere of power generation – and potentially transmission of electricity among PBSs. If the REB can develop a sound strategy for independent power generation, it may be feasible to persuade one or more major donors to provide significant long term financing on generous terms.

One of the key factors slowing the rate of electrification in rural Bangladesh is the low quality of the electrical service supplied by the BPDB. The extent of load shedding and voltage irregularity complicates the task for PBSs in imposing tariff structures adequate for cost-recovery: customers strongly resist paying higher tariffs for an unreliable service. It also discourages applications for connections.

VII. Recommendations

Starting with PBSs geographically close to the existing natural gas pipeline distribution system, the REB might launch a strategy of investment in a large number of small gas turbines. The electricity thereby generated would be locally distributed independently of the national grid. In due course, as more plants are built, transmission facilities to more distant PBSs might be required.

In considering such a strategy, there is probably no single financial model to adopt. The REB could invest in some additional turbines – thereby retaining ownership – and operate them as pilot projects to discover and resolve implementation problems. (Recall the discussion in part V indicating that three small turbines are already in operation serving some PBSs.) Alternatively, groups of PBSs may come together to finance pilot projects. It is now economically feasible to expand capacity by means of small generators that could be financed and owned by groups of PBSs.9

If this strategy is to have a major impact in increasing the percentage of rural Bangladeshi with access to electricity, there is, in addition to investment by the REB and PBSs, a need for significant private investment. Given the level of capital investment required, it is not feasible for the REB or the Government of Bangladesh to assume the risk and provide the finance. (A Ten-Year Agenda for Rural Electrification on page 45 illustrates the investment required to realise a meaningful improvement in rural access to electricity.) Ideally, private firms will invest in build-own-operate plants that in turn sell power to the REB at reasonable rates on the basis of long-term contracts.

Another prerequisite for success would be an expansion of the managerial capacity within the REB and PBSs. At present, the REB and PBSs have put in place complex administrative procedures to assure honesty, maintain low system loss and high bill collection rates, plan new connections and so on. Were the REB to plan for construction of a large number of additional gas turbines over the next decade, present rules and procedures would be inadequate. Expansion on the scale envisioned would require growth in the senior managerial capacity of the REB, and a corresponding expansion in local managerial activities within the affected PBSs.

In some cases, it might be appropriate to arrange contracts whereby surplus power is sold to the national BPDB grid. Whether or not power is sold, generation by the REB will indirectly aid the BPDB by lowering the demand by REB customers on BPDB generating capacity.
Another benefit from any major expansion of the REB into power generation is that this will relieve pressure on the Government of Bangladesh from oil and gas companies to undertake gas exports. Such exports are not in the best long run economic interest of Bangladeshis and are politically unpopular among the majority. Besides other considerations, institutional reform of the power sector is a must to counter the arguments for export.

If the strategy outlined above proves successful, it will provide a useful demonstration effect that could well accelerate implementation of reforms within the BPDB. In turn, if the BPDB succeeds in improving the quality of its power, this will launch a virtuous cycle: more connections, greater willingness to pay on the part of customers, increased revenues, increased investment in new capacity and transmission facilities, and relief of the chronic financial crunch faced by the state-owned power company.

RECOMMENDATION TWO
Establish a regulatory regime capable of assuring appropriate tariffs throughout the REB / PBS network.

The critical point in expanding rural electrification hinges on the ability and willingness of customers to pay.

Across the PBS system, the average tariff per kWh falls short of the cost of providing service. This situation persists despite subsidised electricity rates from the BPDB. Revenues from consumption in the higher rate categories are insufficient to offset losses incurred due to low rates in the domestic and agricultural categories. The current state of affairs is not sustainable, especially given the likelihood that subsidised access to BPDB power will not continue.

Widespread expansion of independent power generation, as described in Recommendation One, will be difficult under the current tariff structure. Significant private investment may not be forthcoming unless the REB can credibly assure investors that they will be able to recover their costs over the lifetime of the projects. If the PBSs substitute power generated by IPPs for power previously purchased from the BPDB at preferential rates, average tariffs may need to be adjusted. Raising tariffs will not be easy, but it is important that individual PBSs realise financial self-sufficiency in the long run.

At the same time, the REB must be able to assure its customers that the quality of service will be high and that it will not be subject to load shedding and voltage variation. Otherwise, customers will be reluctant to connect and pay tariffs higher than those prevailing in the past.

An expanded REB regulatory regime will be required to maintain and reinforce the principle that PBSs be financially self-sufficient. Financial self-sufficiency is a means to assure that local PBSs concern themselves with efficient use of electricity within their respective geographic areas. A recent NRECA report summarises this idea as follows:

Another issue of great importance with regard to program sustainability is the need to rationalize tariffs for all customer categories. Each PBS needs to operate as an independent electric utility ensuring its own sustainability by managing costs and realising sufficient revenue to cover these costs (2000,37).

A Ten-Year Agenda for Rural Electrification

The target of the following agenda is to provide the average rural household in Bangladesh (assumed to contain five people) with access to 1000 kWh of electricity annually by 2012. This is a target used in other rural electrification projects in developing countries. We assume the target will be met through an expansion of REB generating capacity, eliminating by 2012 the need to buy power from the BPDB.

If the population of Bangladesh grows by 2 per cent annually and, in 2012, three quarters live in rural areas, this implies a rural population of 120 million out of a total of approximately 160 million. If one assumes that new generating capacity achieves an average 50 per cent load factor over the course of a year, an additional capacity of 5400 MW must be installed by 2012 in order to meet our target.

To have a meaningful impact on rural access to electricity in Bangladesh, any programme will require major investments—by private and public agencies—and a corresponding elaboration of regulatory and managerial procedures. If the REB can successfully organise a regulatory regime that assures competition in contracts to build generating capacity, it may be possible to realise a price of Tk 40,000 (US$800) per kW of installed capacity.

The critical point in expanding rural electrification hinges on the ability and willingness of customers to pay.

To meet our target, the REB more than double the present generating capacity available throughout Bangladesh. On the other hand, it is important to appreciate that meaningful improvement in rural access to power requires an undertaking of this magnitude.
RECOMMENDATION THREE

Initiate a more sophisticated relationship between the REB and the PBSs: allow those PBSs that are competent more autonomy and take under temporary trusteeship those with particularly poor financial records.

In according an important role to the PBSs in organising electricity distribution, the rural electrification strategy in Bangladesh modified conventional wisdom that key decisions within the electricity sector must be made by central government agencies. Given current energy sector trends and advances in small-scale generation technology over the past two decades, it may well be that further decentralisation – in the sense of the REB yielding more financial and managerial power to the mature PBSs – is now required and desirable.

Admittedly, the REB must maintain some aspects of control from Dhaka. The REB sets guidelines that act as a foundation for maintaining standards and ensuring consistency in terms of the engineering, financial, human resources and commercial aspects of PBS management. Nor can the REB delegate its responsibility for competent transparent auditing. Were the rural electrification programme to lose its reputation for honesty, it would suffer a major blow. Many PBSs do not currently have the managerial strength to undertake complex negotiations – such as are required to negotiate with IPPs.

The REB has been reluctant to give autonomy to PBSs for fear that they mismanage it. Among some PBSs that fear is valid; among others it is not. The financially healthy PBSs with positive margins are a valuable source of managerial competence in the Bangladesh power sector. Their role could be expanded. They should be granted greater financial autonomy, and encouraged to undertake more ambitious projects, such as contracting with IPPs, redesigning their tariff structures so as to increase connections, and improving service quality for customer-members.

The financial resources of the healthy PBSs should not be called upon to cross-subsidise those PBSs with historically poor results to the extent that is presently occurring. If the cross-subsidisation remains large, the probability remains unacceptably high that financially weak PBSs abandon the drive for efficiency and increased load, and rely instead on continued subsidies from the financially strong PBSs.

In cases where a PBS does not meet its potential in terms of financial performance, some dramatic restructuring may be required – including higher average tariffs, a one-time write-off of accumulated debts, and a change of managers. On the other hand, some of the financially weak PBSs have such a low load factor that it is not feasible to expect them to achieve financial self-sufficiency for many years. In such cases, a modest cross-subsidisation is in order.

RECOMMENDATION FOUR

Extend micro-credit to households for the financing of investments in electrical access.

Although the costs of securing a residential connection are low (see Table 6), they may present a substantial barrier for those living at a near-subsistence level. Unless financing is available, the poor may choose not to electrify. Furthermore, line extension charges for those not situated close to an existing pole are much higher than indicated in Table 6.

Low income does not mean an unwillingness to pay for electrical service, particularly if the service is reliable. On the contrary, if they currently have no access to electricity, poor families may stand to gain large benefits from incremental consumption, and would therefore be prepared to pay according to the cost of service. A single light bulb can extend the workday by several hours, for example, thereby allowing a family to supplement its income by engaging in a cottage industry.

If the rural poor are willing and able to pay appropriate electricity tariffs, but are held back by an inability to finance a connection, this represents a policy failure. Either the REB or an existing micro-credit organisation (such as the Grameen Bank or BRAC) should be prepared to extend credit, with appropriate loan guarantees.

RECOMMENDATION FIVE

Consider various forms of distributed generation alongside grid extension when electrifying a new area.

Given that the REB has followed a policy of connecting the most economically attractive areas first, further expansion of service will be to increasingly remote areas with weak loads. Decentralised alternatives such as diesel, biomass, solar and wind may be cheaper than grid extension in these areas (Sinha and Kandpal 1991), and should be considered as part of the planning process.
Electricity for All • Electrification and Development in Rural Bangladesh


Jaccard, Mark, Mujibur Khan and John Richards, 2001, Natural Gas Options for Bangladesh, Centre for Policy Research, International University of Business Agriculture and Technology, Dhaka.


References

Notes

1 In evaluating studies like this, however, it is not always clear to what extent the better outcomes are due to electrification or to other factors.

2 Including a captive capacity of 550 MW in various industries and commercial enterprises.

3 However, by late 1996 at least one major multilateral donor and many bilateral donors agreed in principle to continue to support electricity development activities.

4 Throughout this report, an exchange rate of Tk 50 to US$1 has been used.

5 In exceptional cases, subsidies may be granted for six or even seven years.

6 Depreciation allowances are annual expense items established by accountants to spread the cost of long-lived asset acquisitions over their useful lifetime.

7 In 2000, the BPDB sold power to industrial customers at an average rate per kWh of Tk 2.45, whereas the REB paid only Tk 1.77 (NRECA 2000,28).

8 Most of these were constructed by the REB, although some were taken over from the BPDB and the DESA.

9 It should be noted that there is no consensus among experts in the field of rural electrification as to whether or not the PBSs should be allowed to become directly involved in generation. While we contend that some direct involvement may be beneficial, others believe that allowing PBSs to own and operate generation would open the door to greater inefficiencies and higher costs in generation. For example, in a recent communication, the NRECA suggested that decentralised generation may not be advisable in Bangladesh, recommending that dispersed generation, coordinated and planned by REB, be pursued instead.

10 In the first monograph published by the Centre for Policy Research, Mark Jaccard discussed the requirements of regulatory regimes in the context of power sectors in developing countries. See Jaccard, Khan and Richards (2001).
Electricity for All • Electrification and Development in Rural Bangladesh


Glossary

**Capacity** The maximum amount of electricity necessary at any given moment, or the maximum rate of supply of energy, normally measured in kW or MW. The electric system must produce and distribute sufficient electrical power at any one moment in time, while maintaining a margin of safety for equipment maintenance and unscheduled outages on critical system components. Capacity is analogous to the maximum rate of supply a municipal water system can provide at any one instant, which, in turn, depends on the water intakes at the storage reservoirs, water mains, etc.

**Debt** A financial liability of a corporation owed to a third party who is not the owner of the corporation.

**Deficit** Net income is the difference between revenues and expenditures of a corporation over a period, such as a year. This is often referred to as a surplus if positive, and a deficit if negative.

**Distributed Generation** Electricity generation that is independent of the power system grid. This generation is usually on a small scale and located close to customers.

**Capacity Demand** The maximum instantaneous load occurring over the same period.

**Load Factor** The ratio of the average load supplied during a given period to the maximum load occurring over the same period.

**Load Shedding** Occurs when power authorities manage excess demand by eliminating power to regions or neighbourhoods on a rotating basis.

**Palii Biddyut Samitee** Rural cooperative involved in electricity distribution in the REB network.

**Peak Demand** The maximum instantaneous capacity demand experienced by a power system.

**Power** The instantaneous rate at which electrical energy is produced transmitted or consumed, measured in kW or MW. See also Capacity.
System Loss  The difference between electricity generated and electricity for which customers are billed. Technical system loss refers to the energy that is lost as heat in electrical equipment and along transmission lines, due to resistance as electricity is transferred from one location to another.

Tariff  The price paid for electricity. (The term Rate is also used.)

Transmission System  Electrical facilities used to transmit electricity over long distances at high voltage.

Voltage  Electromotive force or potential difference expressed in volts (V).

Source: most of the electricity system definitions were taken from the 1995 Integrated Electricity Plan of BC Hydro, the publicly owned electric utility in the Canadian province of British Columbia

Abbreviations

ACRE  Area Coverage Rural Electrification
BPDB  Bangladesh Power Development Board
BRAC  Bangladesh Rural Advancement Committee
CCGT  Combined Cycle Gas Turbine
CIDA  Canadian International Development Agency
DESA  Dhaka Electric Supply Authority
DESCO  Dhaka Electric Supply Corporation
GAAP  Generally Accepted Accounting / Auditing Procedures
GWh  Gigawatt hours (10^9 watt hours), a measure of electrical energy
IPP  Independent Power Producer
IUBAT  International University of Business Agriculture and Technology
kV  Kilovolt (10^3 volts), a measure of electrical force

kW  Kilowatt (10^3 watts), a measure of electrical capacity
kWh  Kilowatt hours (10^3 watt hours), a measure of electrical energy
MW  Megawatt (10^6 watts), a measure of electrical capacity
NRECA  National Rural Electric Cooperative Association
PBS  Palli Biddyut Samitee
PGCB  Power Grid Corporation of Bangladesh
REB  Rural Electrification Board
RPC  Rural Power Corporation
SPV  Solar Photovoltaic
Tk  Taka, the unit of Bangladesh currency (throughout this report, we have used the exchange rate of Tk.50 = US$1)
USAID  United States Agency for International Development
USPCL  United Summit Power Company Ltd.