

# সবার জন্য বিদ্যুৎ

বাংলাদেশে পল্লি বিদ্যুতায়ন ও উন্নয়ন

## Electricity for All

Electrification and Development in Rural Bangladesh

### **Rose Murphy**

Research Associate  
Energy and Materials  
Research Group  
School of Resource and  
Environmental Management  
Simon Fraser University  
Vancouver, British Columbia  
Canada

### **Nuruddin Kamal**

Senior Research Fellow  
Centre for Policy Research  
IUBAT – International University  
of Business Agriculture  
and Technology  
Dhaka, Bangladesh

### **John Richards, PhD.**

Faculty of Business  
Simon Fraser University  
Vancouver, British Columbia  
Canada  
Fellow-in-Residence  
C.D. Howe Institute  
Toronto, Ontario  
Canada

## 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.

## About the Authors

Rose Murphy is a research associate with the Energy and Materials Research Group at Simon Fraser University. She has a Master's degree in resource management, with a specialisation in energy management. She spent the summer of 2001 at IUBAT as a visiting research fellow.

Nuruddin Kamal is a senior research fellow at the IUBAT Centre for Policy Research. He has a Master's degree in Geology, with a specialisation in Petroleum economics. Professionally, he spent three decades in public service, including responsibilities as Chairman, Bangladesh Power Development Board.

John Richards is a professor of public policy at Simon Fraser University. He is also a fellow-in-residence at the C.D. Howe Institute, a major Canadian policy institute. Professor Richards has a long-standing relationship with IUBAT as a visiting faculty member.

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## For information about activities and publications of the Centre for Policy Research, contact:

Dr. M. Alimullah Miyan  
Founder & Vice-Chancellor,  
IUBAT – International University of  
Business Agriculture and Technology  
Tel: 912 4226, 912 4201,  
811 6064, 811 6074  
135, Road 9A, Dhanmandi R/A  
Fax: (88-02) 811 0494, Dhaka 1209  
GPO Box No 2857, Dhaka 1000  
e-mail: info@iubat.edu

John Richards, Ph.D.  
Faculty of Business  
Simon Fraser University  
Burnaby (Vancouver)  
British Columbia, Canada, V5A 1S6  
Tel: (604) 291-4568  
Fax: (604) 291-4920  
e-mail: jrichard@sfu.ca

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# Foreword

## Acknowledgements

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

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. FR. 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

# Executive Summary

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 installed capacity was an estimated 4555 MW – more than a 200-fold increase. This is an impressive achievement. By international standards, however, per capita consumption of electricity in Bangladesh remains extremely low. Only about one in five Bangladeshis has access to power; among those in rural areas the ratio is probably about one in seven.

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 20<sup>th</sup> century. Rural electric cooperatives – Palli Biddiyut 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.

## 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.**

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.

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 find and resolve implementation problems. Alternatively, groups of PBSs may come together to finance pilot projects.

If this strategy is to have a major impact in increasing the proportion of rural Bangladeshis 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 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.

#### 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.



The paths of the Padma and Jamuna rivers divide Bangladesh into six major regions. (The great Himalayan rivers Ganges and Brahmaputra are given these names as they flow into the country).

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.

## মূল বক্তব্য

১৯৪৭ সালে ভারত বিভক্তির সময় পূর্ব বাংলার মোট বিদ্যুৎ উৎপাদনের ক্ষমতা ছিল মাত্র ২১ মেগাওয়াট যার মালিকানা পুরাতাই ছিল বেসরকারি খাতে। এর অর্ধশতাব্দী পরে, ২০০১ সালে দেশে স্থাপিত উৎপাদন ক্ষমতার পরিমাণ আনুমানিক ৪৫৫৫ মেগাওয়াট, যা পূর্বের তুলনায় ২০০ গুণেরও বেশী। এটা অবশ্যই এক উল্লেখযোগ্য সাফল্য। তবে আন্তর্জাতিক মানদণ্ডে বাংলাদেশে মাথাপিছু বিদ্যুৎ ব্যবহারের হার খুবই স্বল্প। বাংলাদেশে পাঁচজনের মধ্যে মাত্র একজন বিদ্যুতের সুবিধা পান। গ্রাম বাংলায় বিদ্যুতের সুবিধা পান প্রতি সাতজনে একজন।

বাংলাদেশের বিদ্যুৎ সেক্টর বৈশিষ্ট্য কয়েকটি মৌলিক সমস্যায় জর্জরিতঃ

- লোডশেডিং ও ভোল্টেজ উঠানামা : রাষ্ট্রীয় মালিকানাধীন বাংলাদেশ পাওয়ার ডেভেলপমেন্ট বোর্ড(বি পি ডি বি) বাংলাদেশে উৎপাদিত বিদ্যুতের দুই-তৃতীয়াংশ নিয়ন্ত্রণ করে। বিদ্যুৎ চাহিদার সাথে উৎপাদন ক্ষমতার সামঞ্জস্য বিধানের জন্য বি পি ডি বি লোডশেডিং করে। দেশের অর্থনৈতিক অগ্রগতির ক্ষেত্রে লোডশেডিং এক গুরুত্বপূর্ণ প্রতিবন্ধক।
- কার্যক্রম পরিচালনায় অদক্ষতা : বিদ্যুৎ সেক্টরে কার্য পরিচালনায় দক্ষতার অভাব পরিলক্ষিত হয়। উদাহরণ স্বরূপ বলা যায় যে অনেক দেশের তুলনায় বাংলাদেশে গ্রাহকপিছু সেবা প্রদানে উল্লেখযোগ্য মাত্রায় অধিকতর জনবল নিয়োজিত।
- সিস্টেম অপচয় : সিস্টেম অপচয়ের কারণ মূলত দুটি : প্রযুক্তিগত এবং অদক্ষতা ও প্রশাসনে দুর্নীতি। প্রকৃত সিস্টেম অপচয়ের মাত্রা অজ্ঞাত, তবে অনুমান করা যায় যে অপচয়ের পরিমাণ শতকরা ৩০ ভাগ। বাংলাদেশ জুড়ে বিদ্যুৎ খাতে সিস্টেম অপচয়ের পরিমাণ সম্ভবত উন্নয়নশীল দেশগুলির মধ্যে সর্বোচ্চ। বিভিন্ন জন উপযোগের ক্ষেত্রে এই অপচয়ের ভারতম্য নাটকীয় পর্যায়ে।

- অসম্মিত ট্যারিফ কাঠামো ও অকার্যকর বিলিং পদ্ধতিঃ বিদ্যুৎ খাতকে আর্থিকভাবে স্বনির্ভর করার উপযোগী ট্যারিফ কাঠামো ও বিলিং পদ্ধতি উদ্ভাবনে পৃথিবীর অনেক দেশেই সক্ষম হয় নাই। এর ফলে সৃষ্ট লোকসানের দায়ভার মিটাতে সরকার বা দাতা সংস্থার থেকে ভর্তুকি প্রয়োজন হয়। এই ভর্তুকি দেয়ার জন্য অত্যন্ত গুরুত্বপূর্ণ কর্মকাণ্ড যেমন শিক্ষা, জনস্বাস্থ্য ইত্যাদি খাতে বরাদ্দকৃত রাজস্ব স্থানান্তর করতে হয়। বাংলাদেশের বিদ্যুৎ খাতের সবগুলি প্রতিষ্ঠানই বিভিন্ন মাত্রায় এই সমস্যায় জর্জরিত।

বাংলাদেশে বিদ্যুৎ খাতে এই সমস্যাগুলি কেন অব্যাহত থাকছে? এই সমস্যাগুলি সমাধানের জন্য কি ব্যবস্থা নেয়া যায়? এই রিপোর্টে দ্রুত বিদ্যুতায়ন, বিশেষ করে পল্লি বিদ্যুতায়নের ক্ষেত্রে বাধা সমূহের মূল্যায়ন করা হয়েছে। একই সাথে এই বাধাসমূহ দূর করার জন্য কিছু বাস্তবধর্মী সুপারিশ রাখা হয়েছে।

পল্লি বিদ্যুতায়নের উপর যে কোন আলোচনায় ১৯৭৭ সালকে ভিত্তি সাল হিসাবে গণ্য করা যায়। কারণ এ বছরই পল্লি বিদ্যুতায়ন বোর্ড (আর ই বি) গঠন করা হয়। আর ই বি'র দায়িত্ব হলো বাংলাদেশের পল্লি এলাকায় বিদ্যুৎ সরবরাহ করা এবং এই বোর্ড দেশের

প্রায় এক চতুর্থাংশ বিদ্যুৎ তাদের গ্রাহকদের সরবরাহ করে থাকে। ন্যাশনাল রুরাল ইলেকট্রিক কো-অপারেটিভ এসোসিয়েশন (এন আর ই সি এ) এর সুপারিশক্রমে আর ই বি গঠন করা হয়। এন আর ই সি এ, মার্কিন যুক্তরাষ্ট্রের ভোক্তা-মালিকদের সমবায় সমূহের দ্বারা গঠিত একটি সংস্থা। এই সমবায়গুলি বিংশ শতাব্দীর প্রথম দিকে মার্কিন যুক্তরাষ্ট্রের পল্লি বিদ্যুতায়নে গুরুত্বপূর্ণ অবদান রাখে। আর ই বি বিদ্যুতায়নের জন্য যে কৌশল অবলম্বন করেছে তার মূলে আছে পল্লি বিদ্যুৎ সমবায় সংগঠনসমূহ যেগুলি পল্লি বিদ্যুৎ সমিতি (পি বি এ স) নামে সুপরিচিত।

আর ই বি'র তত্ত্বাবধানে পরিচালিত পি বি এ স সমূহ বাংলাদেশের বিদ্যুৎ খাতের মধ্যে একটি ইতিবাচক শক্তি। পি এ বি এ সগুলির উপর তাদের গ্রাহকগণের আস্থা আছে এবং বিদ্যুৎ সরবরাহে তাদের প্রচেষ্টাতে গ্রাহকগণ সহায়তা করেন। আর ই বি'র শুরু থেকে বাংলাদেশের প্রায় ৯০ শতাংশ এলাকা জুড়ে ৬৭টি পি বি এ স গঠিত হয়েছে।

চৌত্রিশ হাজারের বেশি গ্রাম বিদ্যুতায়ন করা হয়েছে এবং প্রায় চল্লিশ লক্ষ বিদ্যুৎ সংযোগ দেয়া হয়েছে। আর ই বি বিদ্যুৎ সরবরাহের ক্ষেত্রে বি পি ডি বি অথবা ঢাকা বিদ্যুৎ সরবরাহ অথরিটি (ডি ই এস এ) যা ঢাকা মেট্রোপলিটন এলাকায় বিদ্যুৎ সরবরাহ করে, তাদের অপেক্ষা উল্লেখযোগ্য পরিমাণ কম সিস্টেম অপচয় করে থাকে। আর ই বি বিল আদায়ের ক্ষেত্রেও অধিকতর সাফল্য প্রদর্শন করেছে।

এত সব আকর্ষণীয় সাফল্য সত্ত্বেও, বাংলাদেশে বিদ্যুতায়নের ক্ষেত্রে আরো অনেক কিছু করার বাকি আছে। বাংলাদেশকে অর্থনৈতিকভাবে সমৃদ্ধি অর্জন করতে হলে দেশের অবকাঠামোতে এমন একটি কার্যকর বিদ্যুৎ সংগঠন থাকতে হবে যা দেশের অধিকাংশ লোকের কাছে বিদ্যুতের প্রাপ্যতা নিশ্চিত করবে। এ উদ্দেশ্য পূরণ করার লক্ষ্যে গ্রামীণ বিদ্যুতায়নের গতি ত্বরান্বিত করতে হবে। গ্রামীণ বিদ্যুতায়নে অর্থপূর্ণ সফলতা আনার জন্য নিম্নের সুপারিশসমূহ পেশ করা হল :

সুপারিশ এক

আর ই বি'কে স্বাধীনভাবে বিদ্যুৎ উৎপাদনের প্রতি অগ্রাধিকার ভিত্তিতে অধিক গুরুত্ব দিতে হবে, বিশেষ করে জাতীয় সঞ্চালন গ্রীড বহির্ভূত এলাকাসমূহে।

বাংলাদেশের পল্লি এলাকায় বিদ্যুৎ সম্প্রসারণে শ্রুতগতির অন্যতম প্রধান কারণ হলো বি পি ডি বি কর্তৃক সরবরাহকৃত বিদ্যুৎ সেবার নিম্নমান। ঘনঘন লোডশেডিং ও ভোল্টেজ উঠানামার কারণে পি এ বি এ সগুলির পক্ষে ব্যয়ভার পুনরুদ্ধারযোগ্য ট্যারিফ কাঠামো প্রবর্তনে জটিলতার সৃষ্টি হচ্ছে। বিদ্যুৎ সেবার অনির্ভরযোগ্যতার জন্য গ্রাহকগণ বর্ধিতহারে ট্যারিফ আরোপে বাধা সৃষ্টি করেছে। নতুন বিদ্যুৎ সংযোগের আবেদনও একই কারণে নিরুৎসাহিত হচ্ছে।

আর ই বি অনেকগুলি ছোট ছোট গ্যাস টারবাইনে বিনিয়োগের কৌশল অবলম্বন করে স্থানীয়ভাবে বিদ্যুৎ উৎপাদন করার বিষয় বিবেচনায় আনতে পারে। প্রাকৃতিক গ্যাস বিতরণ পাইপ লাইন এর কাছাকাছি অবস্থিত পি এ বি এ সগুলিতে এই উৎপাদন শুরু করা যেতে পারে। এইভাবে উৎপাদিত বিদ্যুৎ জাতীয় গ্রীড লাইনের বাইরে আলাদাভাবে স্থানীয় পর্যায়ে বিতরণ করা যেতে পারে। স্থানীয়ভাবে উৎপাদন স্থাপনা সম্প্রসারণের পরবর্তী পর্যায়ে দূরবর্তী পি এ বি এ স সমূহকে সংযুক্ত করার জন্য আরো বিস্তৃত সঞ্চালন ব্যবস্থা গড়ে তোলার প্রয়োজন হবে।

উপরোক্ত কৌশল মূল্যায়নে সম্ভবত কোন একটি সুনির্দিষ্ট আর্থিক মডেল অনুসরণ করা সঠিক হবে না। আর ই বি কিছু কিছু নতুন টার্বাইনে বিনিয়োগ করতে পারে। নিজস্ব মালিকানা এই টার্বাইনগুলি পাইলট প্রকল্প হিসাবে চালিয়ে এইগুলির বাস্তবায়ন সমস্যা ও সমাধান চিহ্নিত করতে পারবে। বিকল্প ব্যবস্থা হিসাবে কিছু কিছু পি বি এ স যৌথভাবে পাইলট প্রকল্পগুলির অর্থায়ন করতে পারে।

এই কর্ম কৌশলের মাধ্যমে পল্লি এলাকায় ব্যাপক আকারে বিদ্যুৎ সম্প্রসারণের জন্য প্রয়োজন হবে, স্বতন্ত্র বিদ্যুৎ উৎপাদনকারীদের (আই পি পি) মাধ্যমে উল্লেখযোগ্য মাত্রায় বেসরকারি পর্যায়ে বিনিয়োগ। এই ব্যাপারে সবচাইতে উত্তম পস্থা হবে যদি বেসরকারি প্রতিষ্ঠানসমূহ বিদ্যুৎ উৎপাদন কেন্দ্র বিনিয়োগ করে এবং নিজস্ব ব্যবস্থাপনায় বিদ্যুৎ উৎপাদন করে তা দীর্ঘমেয়াদী চুক্তির মাধ্যমে, ন্যায়সঙ্গত দরে, আর ই বি'র কাছে বিক্রি করে।

আর ই বি উৎপাদিত বিদ্যুৎ, বি পি ডি বি'র বিদ্যুৎ উৎপাদন ক্ষমতার উপর আর ই বি'র গ্রাহকদের চাহিদার চাপ হ্রাসের মাধ্যমে বি পি ডি বি'কে পরোক্ষ ভাবে সাহায্য করবে। আর ই বি'র বড় আকারে বিদ্যুৎ উৎপাদন সম্প্রসারণের আর একটি সুবিধাজনক দিক হবে আন্তর্জাতিক তেল-গ্যাস কোম্পানিগুলির বাংলাদেশ সরকারের উপর গ্যাস রপ্তানির চাপ হ্রাস। গ্যাস রপ্তানি বাংলাদেশীদের দীর্ঘমেয়াদী অর্থনৈতিক স্বার্থের অনুকূল নয় এবং রাজনৈতিকভাবে দেশের জন-সাধারণের বৃহত্তর অংশের কাছে জনপ্রিয় নয়। বিদ্যুৎ খাতের প্রাতিষ্ঠানিক সংস্কার, অন্যান্য কারণ ছাড়াও, গ্যাস রপ্তানির যুক্তি খণ্ডনের জন্য অবশ্য করণীয়।

### সুপারিশ দুই

আর ই বি ও তার নেটওয়ার্ক পি এ বি এস সমূহের সর্বত্র যথাযথ ট্যারিফ নিশ্চিত করার সুযোগ সম্বলিত একটি রেগুলেটরী ব্যবস্থা গড়ে তুলতে হবে।

পল্লি বিদ্যুতায়ন সম্প্রসারণের সবচাইতে গুরুত্বপূর্ণ নির্ণায়ক হল ভোক্তাদের ত্র্যক্ষমতা এবং মূল্য পরিশোধের সদিচ্ছা।

পি এ বি এস সমূহে বর্তমানে প্রচলিত বিদ্যুতের কিলোওয়াট আওয়ার গড় ট্যারিফ সেবা প্রদানের ব্যয়ের চেয়ে কম। বি পি ডি বি দ্বারা আর ই বি'কে সরবরাহকৃত বিদ্যুৎ হারের উপর সরকারের ভতু কি দেয়ার পরও এই অবস্থার পরিবর্তন হচ্ছে না। শিল্প ও বাণিজ্যিক ব্যবহারের ক্ষেত্রে গৃহস্থালী ও কৃষি কাজে ব্যবহারের তুলনায় অধিক হারে বিদ্যুতের মূল্য

ধারণা করা হয়। তবে শিল্প ও বাণিজ্যিক খাতে বিদ্যুতের ব্যবহার গৃহস্থালি ও কৃষি খাতের তুলনায় অনেক কম এবং এর ফলে সার্বিকভাবে বিদ্যুতের মূল্য হারের সমন্বয় সম্ভব হচ্ছে না। বর্তমান অবস্থা কোনভাবেই অব্যাহত রাখা সম্ভব নয়।

বর্তমান ট্যারিফ কাঠামোর আওতায় ১নং সুপারিশ অনুসারে ব্যাপক আকারে স্বতন্ত্র বিদ্যুৎ উৎপাদনের ব্যবস্থা করা কঠিন হবে। আর ই বি যদি নির্ভরযোগ্য পর্যায়ে বিনিয়োগকারীদেরকে আশ্বস্ত করতে না পারে যে প্রকল্পের আয়ুষ্কালেই খরচের টাকা উঠে আসবে তাহলে উল্লেখযোগ্য মাত্রায় ব্যক্তিগত বিনিয়োগ উৎসাহিত নাও হতে পারে। পি এ বি এসগুলি যদি বি পি ডি বি থেকে ভতু কিসহ সরবরাহকৃত বিদ্যুতের বদলে আই পি পিগুলি থেকে বিদ্যুৎক্রয় করে, তবে ট্যারিফের গড় হার সমন্বয় করার প্রয়োজন হতে পারে। ট্যারিফ বৃদ্ধি করা কঠিন কাজ, তবে প্রতিটি পি এ বি এস'র দীর্ঘমেয়াদী পর্যায়ে আর্থিক দিক দিয়ে স্বাবলম্বী হওয়ার বিষয়টি অত্যন্ত গুরুত্বপূর্ণ।

### সুপারিশ তিন

আর ই বি ও পি এ বি এস'র মধ্যে আরো ও মার্জিত সম্পর্ক স্থাপনের উদ্যোগ নেয়া প্রয়োজন যাতে সমর্থ পি এ বি এসগুলিকে অধিকতর স্বায়ত্ত্বশাসন দেয়া যায়, আবার অন্যদিকে আর্থিক দিক দিয়ে দুর্বল পি এ বি এসগুলিকে সাময়িকভাবে অধিকতর কেন্দ্রীয় নিয়ন্ত্রণভুক্ত করা যায়।

বর্তমান সময়ে শক্তি সেক্টরের উন্নয়নের ধারায় এবং বিগত দুই দশকে বিদ্যুৎ উৎপাদনের কৌশলগত উন্নতির ফলে ছোট ছোট আকারের বিদ্যুৎ উৎপাদন প্ল্যান্ট স্থাপনে অর্থনৈতিক ঝুঁকি নাই বললেই চলে। এই অবস্থার পরিপ্রেক্ষিতে, আর ই বি'র অধিকতর বিকেন্দ্রীকরণের মাধ্যমে পূর্ণাঙ্গ পর্যায়ের পি এ বি এসগুলিকে আরো ব্যাপকভাবে আর্থিক ও ব্যবস্থাপনার ক্ষমতা দেয়া আবশ্যিক এবং বাঞ্ছনীয়।

অবশ্য স্বীকার করতে হবে যে পল্লি বিদ্যুতায়ন কর্মসূচির সাফল্য নিশ্চিত করার জন্য কিছু কিছু ক্ষেত্রে

কেন্দ্রীয় নিয়ন্ত্রণপ্রয়োজন। পি এ বি এসগুলির ব্যবস্থাপনার প্রকৌশল, আর্থিক, মানবসম্পদ ও বাণিজ্যিক বিষয়াদিতে মাণরক্ষা ও সামঞ্জস্য বিধানের জন্য আর ই বি'র সুনির্দিষ্ট নির্দেশনা অত্যাবশ্যিক। অন্যদিকে, দক্ষ ও স্বচ্ছ হিসাব নিরীক্ষার দায়িত্ব অবশ্যই আর ই বি'র নিয়ন্ত্রণে থাকতে হবে। অনেক পি এ বি এস, আই পি পি এস'র সাথে জটিল দরদস্তুরের অভিজ্ঞতা অর্জন করে নাই এবং তাদের কাছে সে ধরনের উপযুক্ত জনবলও নেই।

আর ই বি, অব্যবস্থাপনার ভয়ে পি এ বি এসগুলিকে স্বায়ত্ত্বশাসন দিতে আর্থী নয়। কিছু কিছু পি এ বি এস'র ক্ষেত্রে এই ভয় যথার্থ, তবে অন্য অনেকগুলির ক্ষেত্রে তা সঠিক নয়। আর্থিকভাবে সচল এবং উদ্ধৃতি সম্পন্ন পি এ বি এসগুলি, বাংলাদেশের জ্বালানী খাতে ব্যবস্থাপনা দক্ষতাসম্পন্ন জনবলের একটি মূল উৎস। এই প্রকারের পি এ বি এসগুলির ভূমিকা সম্প্রসারণ করা যেতে পারে। এইগুলিকে অধিকতর আর্থিক স্বায়ত্ত্বশাসন দেওয়া উচিত এবং একই সাথে অধিকতর উচ্চাভিলাষী প্রকল্প যেমন আইপি পি সমূহের সাথে চুক্তি সম্পাদন, সংযোগের সংখ্যা বৃদ্ধি এবং গ্রাহক সদস্যদের সেবার মান উন্নত করার জন্য বিদ্যুতের ট্যারিফ আরো পদ্ধতির পুনর্বিদ্যায়ন ইত্যাদি হাতে নিতে উৎসাহিত করা যেতে পারে।

### সুপারিশ চার

বিদ্যুৎ সেবা গ্রহণে বিনিয়োগের প্রয়োজনে গৃহস্থালি পর্যায়ে ক্ষুদ্র ঋণ (মাইক্রো ক্রেডিট) এর সুবিধা সম্প্রসারণ করা উচিত।

আবাসিক বিদ্যুৎ সংযোগের ব্যয় কম হলেও শুধুমাত্র প্রায়বেঁচে থাকার মত আর্থিক সঙ্গতিসম্পন্ন মানুষের ক্ষেত্রে এই ব্যয়ভার সংযোগ নেওয়ার জন্য বিরাট প্রতিবন্ধক হয়ে দাঁড়ায়। নিম্ন আয়কে বিদ্যুৎ সেবার জন্য মূল্য পরিশোধের অনাগ্রহ হিসাবে গণ্য করা সঠিক হবে না। বিদ্যুৎ সেবার মাণ নির্ভরশীল পর্যায়ে নিশ্চিত করতে পারলে নিম্ন আয়ের লোকও সেবার মূল্য পরিশোধ করতে আর্থী হবে। অন্যভাবে বলা যায় যে, বর্তমানে বিদ্যুৎ সেবার সুযোগ বঞ্চিত জনগোষ্ঠীর

মধ্যে আপেক্ষিকভাবে গরিব পরিবারগুলিই বিদ্যুৎ সেবা ভোগের মাধ্যমে সবচাইতে বেশী উপকৃত হবে এবং এরফলে তারা সেবার খরচের সমতুল্য মূল্য পরিশোধ করতে আর্থী হবে।

বিদ্যুৎ ক্রয়ের বিল প্রদানে সমর্থ এবং আর্থী পল্লির গরিব জনগণ যদি শুধুমাত্র বিদ্যুৎ সংযোগ অর্থায়নের অসমর্থতার কারণে বঞ্চিত থাকে, তবে এরজন্য দায়ী হবে সঠিক নীতি নির্ধারণে ব্যর্থতা। এক্ষেত্রে হয় আর ই বি বা কোন ক্ষুদ্র ঋণ প্রদানকারী সংস্থা যেমন গ্রামীণ ব্যাংক বা ব্র্যাকের উচিত হবে যথোপযুক্ত ঋণ নিশ্চয়তা প্রক্রিয়ার মাধ্যমে ঋণ দানের ব্যবস্থা করা।

### সুপারিশ পাঁচ

নতুন এলাকায় বিদ্যুতায়নের ক্ষেত্রে ভিন্ন ভিন্ন পন্থায় উৎপাদনও বিতরণ (ডিস্ট্রিবিউটেড জেনারেশন) বিষয় বিবেচনায় রাখা উচিত।

আর ই বি অর্থনৈতিকভাবে আকর্ষণীয় এলাকায় প্রাথমিকভাবে বিদ্যুৎ সংযোগ দেওয়ার নীতি অনুসরণ করায়, প্রত্যন্ত এলাকায় কম চাহিদার কারণে বিদ্যুৎ সম্প্রসারণ লাভজনক হবে না। এইসব প্রত্যন্ত এলাকায় উৎপাদনের বিভিন্ন বিকেন্দ্রীকৃত বিকল্প যেমন ডিজেল, জৈব গ্যাস, সৌর শক্তি, বায়ু প্রবাহ ইত্যাদি পরিকল্পনা পদ্ধতিতে অন্তর্ভুক্ত করা বাঞ্ছনীয়। কারণ এইসব উপায়ে উৎপাদিত বিদ্যুৎ বর্তমানে প্রচলিত উচ্চ চাপ সম্পন্ন সঞ্চালন খীড পদ্ধতির মাধ্যমে বিতরিত বিদ্যুতের চেয়ে সুলভ হবে।

# 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.<sup>1</sup>

The Palli Biddiyut Samitees (PBSs), rural cooperatives operating under the supervision of the Rural Electrification Board (REB), are a positive force within the power sector in Bangladesh. Their customers trust them and support their efforts to supply electricity to villages. Since the inception of the REB in 1977, 67 PBSs have been established covering almost 90 per cent of the area of Bang-

ladesh. Over 34,000 villages have been electrified and almost four million connections have been made.

The progress made by the REB over the past 25 years has been impressive, yet over 80 per cent of people in rural Bangladesh still lack access to electricity. This is critical, because despite high urban growth rates, four out of five people still live in rural areas. Providing electricity to these areas has been and will continue to be an enormous task. In particular, small loads make it difficult to support the cost of constructing lines and providing service.

Why does access to electricity remain so low in Bangladesh? What can be done to solve this and other power sector problems? This report assesses the barriers to accelerated electrification – in particular the barriers to rural electrification – and puts forward practical recommendations.

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

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

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 more modest than in past decades. 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



A bicycle rickshaw passes by a row of commercial enterprises in Dhaka PBS-1. A rural electrification success story, Dhaka PBS-1 turns a profit through its operations just outside the capital city. Financial independence is much more difficult to achieve for the PBSs located in remote, undeveloped areas.

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.

*A glossary of energy terms is provided on page 51.*

*A list of frequently used abbreviations is provided on page 52.*

## 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<sup>2</sup> – 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 20<sup>th</sup> century in electrifying rural regions of the United States. Rural electric cooperatives – Palli Biddiyut 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



Md. Abdur Sabur is the General Manager of Dhaka PBS-1. PBS and REB employees are proud of their role in the rural electrification program, which has demonstrated honest and efficient management within the Bangladesh power sector while providing several million rural people with electrical connections.

all financial support from generation, transmission and distribution projects administered by the two agencies.<sup>3</sup>

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.

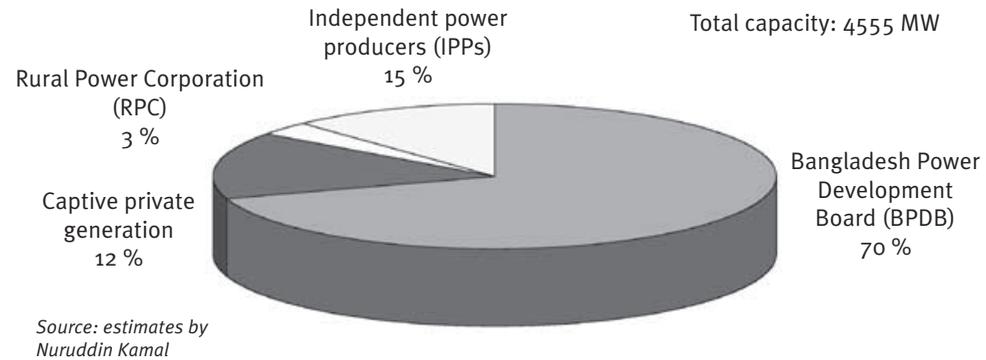
The reforms entail transfer of some BPDB and DESA activities to new agencies, which will be “corporatised” and mandated to behave in a financially autonomous manner. For example, the Dhaka Electric Supply Corporation (DESCO) will handle a portion

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.

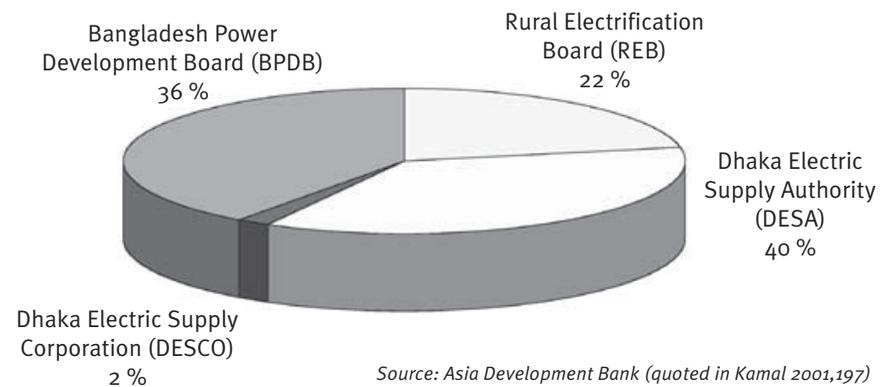
As part of an effort to attract private investment in generation, a Private Sector Power Generation Policy was adopted in late 1996. Independent Power Producers (IPPs) currently operate three barge-mounted power plants and one land-based combined cycle gas turbine (CCGT) plant with total capacity of 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

**Figure 1: Generation Capacity in 2001 by Institution**



**Figure 2: Electricity Distribution in 1999 by Utility**



## III. Problems Facing the Power Sector

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 2001,5).

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

power sector. Of the estimated 4555 MW of generating capacity currently available, that of the BPDB is estimated at 3175 MW (70 per cent). Capacity among independent power producers (IPPs) now comprises in total about 690 MW (15 per cent). Historically linked to the REB is the quasi-private Rural Power Corporation (RPC). It accounts for 140 MW (3 per cent) of capacity. Finally, captive non-distributed capacity is around 550 MW (12 per cent). Much of the captive capacity is located as backup to the BPDB for firms requiring uninter-

rupted power for their operations.

Figure 2 shows the portion of electricity distributed by each of the utilities. The DESA and the DESCO together account for 42 per cent of electricity distribution. This is an indication of the overwhelming importance of the Dhaka metropolitan area in electricity consumption, relative to the rural areas. The BPDB distributes somewhat over a third of all electricity, to rural and urban areas outside of Dhaka. The REB provides to its rural customers between a fifth and a quarter of all electricity distributed.

enough money available for expanding the distribution system and financing new connections.

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

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

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

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



A woman gathers leaves for her cooking fire. In Bangladesh, per capita use of commercial fuels (such as kerosene and natural gas) and electricity has been one of the lowest in the developing world. People rely heavily on biofuels like wood, crop residues and animal dung, especially in rural areas. Gathering these fuels is labour- and time-intensive; burning them can lead to health problems.

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

Bangladesh	24
China	4
India	15
Malaysia	8
Nepal	29
Pakistan	20
Philippines	6
Sri Lanka	20
Thailand	9

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



Two little girls pose for a photograph outside the IUBAT campus.

## 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.)

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

	BPDB	DESA (per cent)	REB
1992-93	36	31	16
1995-96	21	29	15
1997-98	21	28	16

*Source: BPDB (quoted in Kamal 2001,196)*

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. A recent survey by the Bangladesh chapter of Transparency International revealed that public utility employees were regarded as the most corrupt officials after the police and lower judiciary. 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).*

## 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.



Electrical meters outside a building at Dhaka PBS-1. The REB and the PBSs have established a good reputation for keeping track of and collecting payment for electricity distributed. System losses are low and bill collections are high.

## 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).<sup>4</sup> 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.

# IV. The Rural Electrification Programme

## 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



The Buriganga river is a bustle of activity as it flows past Old Dhaka. All types of boats – from overcrowded ferries to cargo boats to the small wooden crafts pictured here – move back and forth. (The old city, with its bazaars, mosques, and Mughal and Raj era palaces and forts, is located on the north bank of the river.)

as special meetings as required. Board members are compensated when called on official 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 approval. The general manager is responsible for developing the programmes and organising the staff necessary to meet the objectives and needs of the PBS. Assistant general 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 management 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 infrastructure, number of households, state of industrial 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 necessary. 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 economic growth centres. Under ACRE, primary distribution backbones are constructed that, in turn, may eventually feed into laterals and secondary lines connecting every village. As with the establishment of PBSs themselves, laterals and secondary lines are constructed on a priority basis, the selection criteria being economic (determined by benefit-cost ratios) and social (assuring reasonably equitable distribution within the PBS).

## Financial Support for the REB and the PBSs

Rural electrification in Bangladesh has received favourable attention from the donor community in the form of grants and loans under generous conditions. Cumulative assistance 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 management 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 develop a load base. A programme of initial financial support has therefore been established. 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 capitalised into the investment cost of the original 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**

Domestic <sup>a</sup>			Commercial	Charitable Institutions	Irrigation	Industrial		Street Lights
≤300 kWh	301-600 kWh	>600 kWh				General Power	Large Power	
<b>Taka per kilowatt hour</b>								
2.45 <sup>b</sup>	3.60	5.35	4.60	2.85	2.55	3.55	3.45	3.30
<b>U.S. cents per kilowatt hour</b>								
4.9 <sup>b</sup>	7.2	10.7	9.2	5.7	5.1	7.1	6.9	6.6

<sup>a</sup> Tariffs are according to monthly consumption. Minimum bill charges may also apply.

<sup>b</sup> Tk50=US\$1. Prices have increased about Tk 0.1 since this data was collected.

Source: NRECA (2000)



A ferry carries passengers along the Buriganga river.

subject to annual reviews.<sup>5</sup> 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<sup>6</sup> 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.<sup>7</sup> 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 6: Costs Associated with a New Residential Connection**

	Taka	US Dollars <sup>a</sup>
Membership Fee	20	0.40
Security Deposit <sup>b</sup>	150	3.00
House Wiring <sup>b</sup>	600 – 1000	12.00 – 20.00
Total	770 – 1170	15.40 – 23.40

<sup>a</sup> Tk 50 = US\$1.

<sup>b</sup> Minimum cost estimates.

Source: interviews with general managers of Dhaka PBS-1, Mymensingh PBS-2 and Moulavibazar PBS

# V. Achievements So Far

## 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.<sup>8</sup>

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.

## Per cent of Villages Energised per PBS

### Dhaka Division

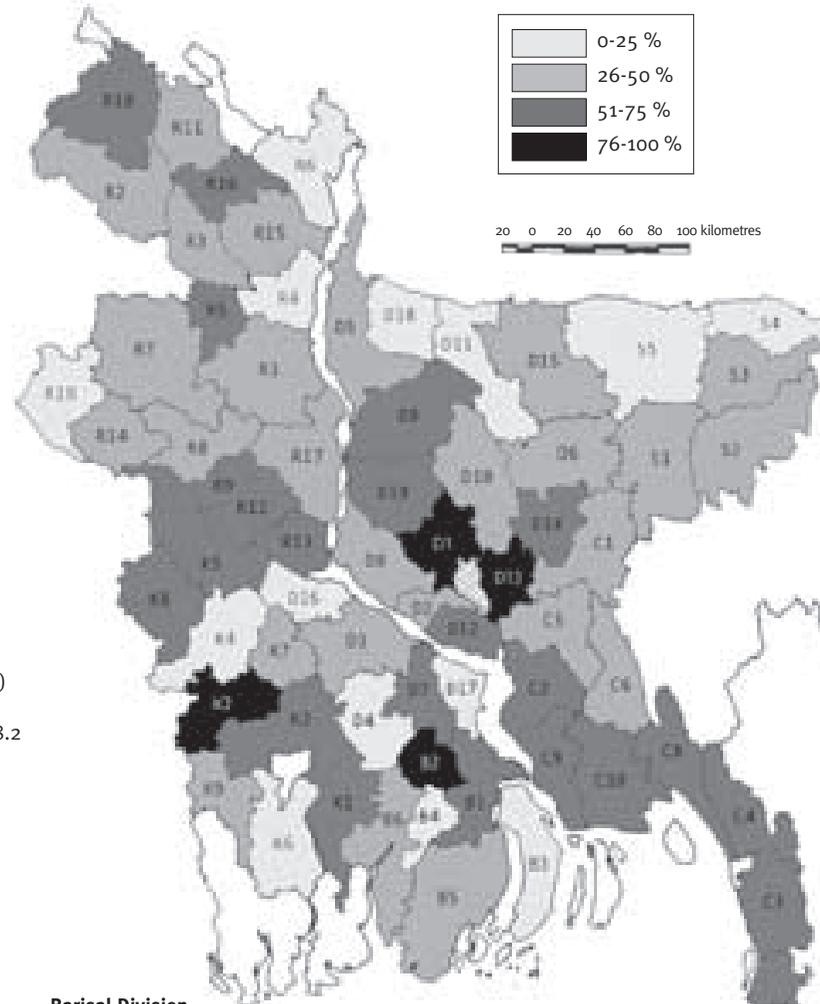
D1	Dhaka PBS-1	81.1
D2	Dhaka PBS-2	47.3
D3	Faridpur PBS	28.4
D4	Gopalganj PBS	19.8
D5	Jamalpur PBS	26.6
D6	Kishoreganj PBS	38.8
D7	Madaripur PBS	66.9
D8	Manikganj PBS	32.3
D9	Mymensingh PBS-1	58.1
D10	Mymensingh PBS-2	38.0
D11	Mymensingh PBS-3	1.7
D12	Munshiganj PBS	64.5
D13	Narsinghdi PBS-1	75.8
D14	Narsinghdi PBS-2	50.8
D15	Netrokona PBS	45.6
D16	Rajbari PBS	7.8
D17	Sariatpur PBS	18.5
D18	Sherpur PBS	12.9
D19	Tangail PBS	51.5

### Rajshahi Division

R1	Bogra PBS	42.6
R2	Dinajpur PBS-1	44.4
R3	Dinajpur PBS-2	40.0
R4	Gaibanda PBS	n/a (new)
R5	Joypurhat PBS	50.4
R6	Kurigram-Lalmonirhat PBS	18.2
R7	Naogaon PBS	33.6
R8	Natore PBS-1	43.7
R9	Natore PBS-2	65.9
R10	Nawabganj PBS	22.7
R11	Nilphamari PBS	41.0
R12	Pabna PBS-1	50.6
R13	Pabna PBS-2	60.0
R14	Rajshahi PBS	34.5
R15	Rangpur PBS-1	48.7
R16	Rangpur PBS-2	72.4
R17	Sirajgonj PBS	41.5
R18	Thakurgaon PBS	51.4

### Chittagong Division

C1	Brahmanbaria PBS	28.8
C2	Chandpur PBS	51.0
C3	Chittagong PBS-1	57.0
C4	Chittagong PBS-2	64.7
C5	Comilla PBS-1	48.6
C6	Comilla PBS-2	38.6
C7	Cox's Bazar PBS	59.9
C8	Feni PBS	53.6
C9	Laxmipur PBS	68.3
C10	Noakhali PBS	54.3



### Barisal Division

B1	Barisal PBS-1	53.4
B2	Barisal PBS-2	100.0
B3	Bhola PBS	11.7
B4	Jhalakathi PBS	20.2
B5	Patuakhali PBS	29.8
B6	Pirojpur PBS	33.3

### Sylhet Division

S1	Hobigonj PBS	34.5
S2	Moulavibazar PBS	26.3
S3	Sylhet PBS-1	48.1
S4	Sylhet PBS-2	3.8
S5	Sunamganj PBS	0.2

### Khulna Division

K1	Bagerhat PBS	55.0
K2	Jessore PBS-1	83.4
K3	Jessore PBS-2	54.7
K4	Jhenaidah PBS	23.5
K5	Kushtia PBS	53.8
K6	Khulna PBS	21.8
K7	Magura PBS	30.0
K8	Meherpur PBS	73.0
K9	Satkhira PBS	43.2

Source: REB (2001b)



Labourers work on the expansion of an industrial complex supplied with electricity by Mymensingh PBS-2. Currently a cotton mill and a pop bottling factory are located on the site. Industrial activity is critical to the development of rural areas, bringing employment and improved infrastructure.

## 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 Tk 2.0 to 2.1 per kWh, which is less than the actual cost of BPDB power but more than

**Table 7: Comparison of System Loss and Bill Collection for Mymensingh PBS-2 Before and After Takeover of Areas from the DESA**

	Just Before Takeover (June 2000)	Just After Takeover (July 2000)	Present (May 2001)
System Loss	21.7	57.8	24.6
Bill Collection	88.1	36.5	78.6

(per cent)

Source: Mymensingh Palli Bidyut Samity-2 (2001)

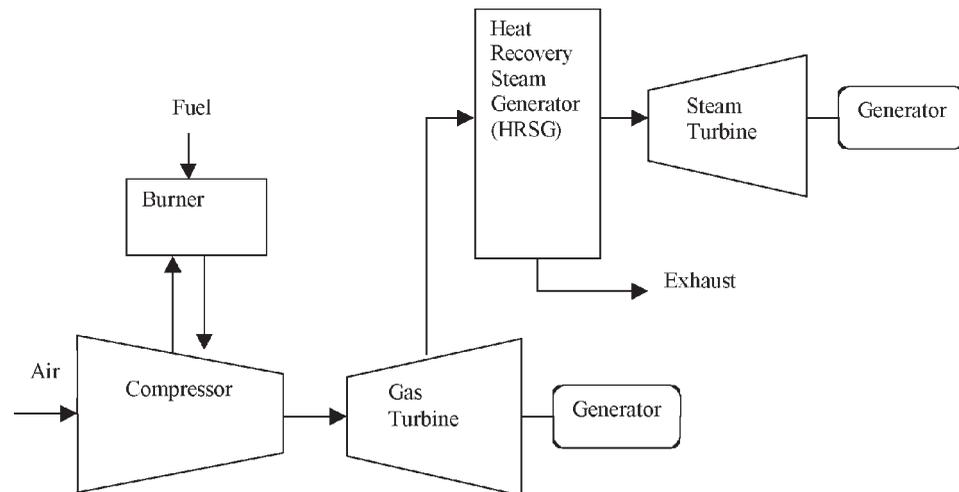
the current subsidized tariff to the PBSs.

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 tech-

### What is a Gas Turbine?

Gas<sup>a</sup> 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.



<sup>a</sup> The word “gas” here refers to the compressed gases used internally to the system to power the turbine, not to the type of fuel used as an input. Natural gas as well as other fuels can be combusted in gas turbines.



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.

nology 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.

### Building Local Involvement and Trust

Much of the success of the rural electrification programme has been due to community-level involvement through the PBS system. Local people have an understanding of their physical and social environment that officials in Dhaka cannot expect to achieve. Furthermore, where a sense of commitment exists at the local level, individuals who attempt to cheat the system by installing illegal connections, tampering with meters, recording false meter readings or preparing erroneous bills are less likely to be tolerated. It is easier to develop a culture for timely bill payment in this type of environment. Participation on the part of PBS members is stimulated through ownership and a vested interest in the viability of the organisation.



Female office workers at Mymensingh PBS-2.

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.

## VI. Dimensions of Concern

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.



Workers carry their loads to a weighing station at a tea estate at Moulavibazar PBS. The tea bushes are planted in neat rows, interspersed with shade trees. Sylhet is a lovely area, with lush rolling hills and a temperate climate.

## 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 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 Gov-

ernment of Bangladesh to furnish power generated by the BPDB at a preferential tariff below the BPDB’s cost of generation.

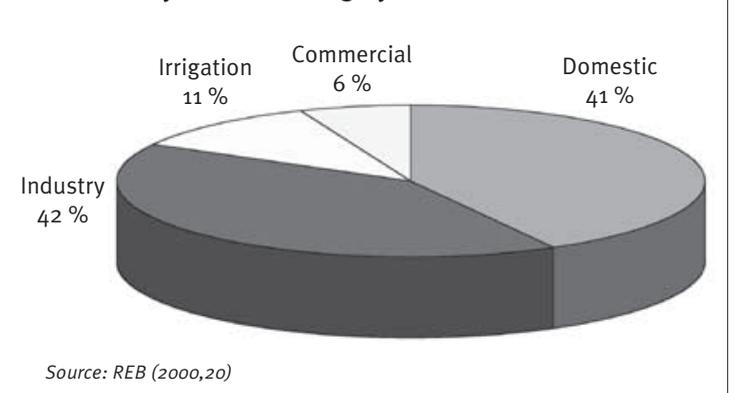
## Donor Support: A Mixed Blessing

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

**Figure 3: REB Electricity Use in 1999-2000 by Customer Category**



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:

*Difficulties in measuring demand for energy services, particularly among low-income households in developing countries, are well known. Survey questions may suffer from unrecognized biases. The answers too may suffer from biases, and they may not reflect actual demand responses. Selecting a representative sample is always difficult. And the analysis of the survey results is inevitably simplified to a point where conclusions may be less than useful ...*

*In many countries years of chronic undersupply, miserable quality, rampant theft of electricity or nonpayment, gross mispricing, and poor performance by state-owned monopoly suppliers have made willingness to pay even more difficult to assess. Moreover, baseline information on access and payments is generally in short supply in developing countries (Townsend 2000,12).*

Despite these difficulties, the concept of willingness to pay must not be lost in the financial detail of donor aid.

Some cross-subsidisation of electricity rates may well be desirable for reasons of equity, but the core principle underlying tariff design – for the BPDB, the DESA, the REB and other agencies – must be to raise revenues adequate to cover the costs of generation, transmission and distribution. Behind this principle is the need to encourage a culture among both suppliers and consumers of electricity such that this commodity

is used only where its value exceeds its cost. 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.

## **Lack of Managerial and Financial Autonomy for PBSs**

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. 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.

The evidence from Chile suggests that the performance of rural electrification programmes – once the almost exclusive domain of state-owned enterprises – may be improved by introducing competition, private sector involvement and decentralised decision making. These elements are consistent with the broader principles of energy sector reform that are currently being applied in countries around the world.

*Source: Jadresic (2000)*

## VII. Recommendations

### 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.

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



Labourers at a road work site in Dhaka carry materials for making concrete mix in the baskets on their heads. In the absence of electrical and mechanical equipment, manual labour is required. The work is physically exhausting: the strain on the head and neck takes its toll as the years pass.

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.<sup>9</sup>

If this strategy is to have a major impact in increasing the percentage of rural Bangladeshis 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.



A woman at Savar (part of Dhaka PBS-1) takes a break from her work and allows her photograph to be taken.

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<sup>10</sup> 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.<sup>a</sup> This implies in total a capital investment in generating capacity of Tk 215 billion (US\$4.3 billion) over the next decade. Additional investment would be required for transmission and distribution facilities.

This agenda is very ambitious, given past rates of capacity expansion. It implies, for example, that 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.

<sup>a</sup> This is equivalent to US\$8 million for a small gas turbine plant of 10 MW capacity.

### 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



A worker at a cotton mill at Mymensingh PBS-2. Factory jobs, especially within the garment sector, are allowing women to achieve greater independence within Bangladesh society.

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.

# Notes

- <sup>1</sup> 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.
- <sup>2</sup> Including a captive capacity of 550 MW in various industries and commercial enterprises.
- <sup>3</sup> However, by late 1996 at least one major multilateral donor and many bilateral donors agreed in principle to continue to support electricity development activities.
- <sup>4</sup> Throughout this report, an exchange rate of Tk 50 to US\$1 has been used.
- <sup>5</sup> In exceptional cases, subsidies may be granted for six or even seven years.
- <sup>6</sup> Depreciation allowances are annual expense items established by accountants to spread the cost of long-lived asset acquisitions over their useful lifetime.
- <sup>7</sup> 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).

- <sup>8</sup> Most of these were constructed by the REB, although some were taken over from the BPDB and the DESA.
- <sup>9</sup> 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.
- <sup>10</sup> 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).

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**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.

**Distribution System** Electrical lines, cables, transformers and switches used to distribute electricity at low voltage over short distances from substations to the customer.

**Energy** The amount of electricity produced or used over a period of time, usually measured in kWh or GWh. (A kWh is the average kilowatts demanded in one hour.)

**Equity** The value of a corporation to its owners – individuals in the case of private firms and governments in the case of state-owned enterprises. Equity is the residual after subtracting all corporate debts from the value of corporate assets.

**Generation** The production of electricity.

**Independent Power Producer** The operator of a privately owned electricity generation facility which is usually connected to a utility's transmission system to sell electricity.

**Load** The amount of electricity required by a customer or group of customers at any given time, typically measured in MW.

**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.

**Palli Bidyut 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 (10E9 watt hours), a measure of electrical energy

**IPP** Independent Power Producer

**IUBAT** International University of Business Agriculture and Technology

**kV** Kilovolt (10E3 volts), a measure of electrical force

**kW** Kilowatt (10E3 watts), a measure of electrical capacity

**kWh** Kilowatt hours (10E3 watt hours), a measure of electrical energy

**MW** Megawatt (10E6 watts), a measure of electrical capacity

**NRECA** National Rural Electric Cooperative Association

**PBS** Palli Bidyut 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.