THE WORLD BANK/IFC/M.I.G.A.

OFFICE MEMORANDUM

DATE: October 1, 2001

TO: Mr. Ken King, Assistant CEO, GEF Secretariat
Att: GEF PROGRAM COORDINATION

FROM: Lars Vidaeus, GEF Executive Coordinator 

EXTENSION: 3-4188

SUBJECT: **Bangladesh: Rural Electrification and Renewable Energy Development Project (Multiple Off-Grid Electrification Initiatives)**
Submission for Work Program Inclusion

Please find enclosed the electronic attachment of the above mentioned project brief for work program inclusion. We would appreciate receiving any comments by October 9, 2001. The project was cleared for pipeline entry under the name "Multiple Off-Grid Electrification Initiatives".

The proposal is consistent with the *Criteria for Review of GEF Projects* as presented in the following sections of the project brief:

- Country Drivenness: please see Section 1.2 (*Governments' Rural Electrification Strategy*) and Section 3.2.4 (*Indications of Borrower Commitment and Ownership*) for a discussion of country ownership of the off-grid program; these sections start on pages 4 and 23 respectively.
- Endorsement: Endorsement letter for the project has been received from the Bangladesh country focal point (Ministry of Environment) and is attached.
- Program Designation & Conformity: The project is consistent with GEF Operational Program 6 in Climate Change; please see Section 1.4 *(Global Environment Objectives and Consistency with the GEF's Operational Strategy and Renewable Energy Operational Program*) and Section 2.4.1 on (*Project and Global Objectives)*, starting at pages 5 and 10 respectively.
- Project Design: please see section 2.4.2 (*Summary of Project Outputs*) starting on page 10, section 2.4.3 (*Project Components)* starting on page 11, and Annex 1 (*Project Design Summary*).
- Sustainability and Replicability: please see Section 4.11 (*Sustainability and Replicability*) starting on page 27.
- Stakeholder Involvement: for a discussion of project stakeholders, please see Section 2.4.5 *(Project Stakeholder and Benefits*) on page 14; for a discussion of the involvement of stakeholders in preparation and implementation, please see Sections 4.8 (*Social*) and 4.10 (*Participatory Approach*) on pages 26-27. Please also see Section 4.4 *(Institutional Assessment)* on page 25 and Annex 5 *(IDCOL Program-Institutional Setup)*.
- Monitoring & Evaluation: Monitoring is a particular focus of the proposed project. A socio-economic monitoring unit is being established in the Rural Electrification Board

and details of M&E activities are presented in Section 2.4.8 on page 17 *(Monitoring and Evaluation)*. M&E indicators are presented in Annex 1 (*Project Design Summary*).

- Financing Plan: please see the summary project cost table in Annex 2 and the Blended Project Financing Plan in Annex 4.
- Cost-effectiveness: a quantitative assessment of cost-effectiveness has not been attempted; rather a discussion of alternatives considered and rejected is presented in Section 3.2.1 (starting on page 20). Quantitative assessment in terms of $/t-C indicates nearly 258,000 tons of carbon dioxide avoided each year (see Annex 2) and given a GEF grant value of $ 8.54 million, implies cost effectiveness of $33.1/t of CO2, or $121.4/t of Carbon.
- Core Commitments and Linkages: please see the discussion of the project's linkage to the World Bank Country Assistance Strategy Section 1.3 starting on page 4.
- Consultation, Coordination and Collaboration between IAs: A reasonably effective donor coordination mechanism is operating in Bangladesh. For the main implementing agencies involved in this project, effective consultation and coordination arrangements exist. Details in this regard are available in Section 2.4.11, page 19 *(Project Coordination)*. Please also see Section 3.2.2 (*Major related Projects financed by the Bank and/or other development agencies*) for a discussion of other donor programs with links to the proposed project as well as coordination with GEF-supported initiatives, page 20.

Response to GEFSEC Review at the time of pipeline entry: At the time of Pipeline Entry Review (January 2001), the Secretariat team recommended that the Bank preparation team address the following prior to WP entry:

(a) ***The Project is vague and needs definition***: The project has been spelt out in greater detail and both design and implementation features are now fully described. The design is based on a more precise identification and understanding of barriers to development of renewables in Bangladesh, based on a pre-appraisal mission carried out in May 2001. Technical assistance program to address these barriers has been developed in consultation with the stakeholders. Please refer to sections 2.4.2 and 2.4.3 in this regard.

(b) ***Project design should account for and explicitly target those applications and delivery models that will provide additional income-generation and other tangible social benefits to rural households:*** PDF Block B and other project preparation funds are being used to narrow the focus of activities targeted at increasing productive use of electricity in Bangladesh. The program relies heavily on strong and well established rural non-government organizations (NGOs) and micro-finance institutions (MFIs) in Bangladesh who have a track record in promoting income generation activities and delivery of social services. The bulk of the solar program is proposed to be implemented through community-based organizations. In addition, the rural electricity cooperatives already implement a social component as a part of electricity services in rural areas. The project proposes to strengthen this component through the establishment of a socio-economic unit in the apex rural electricity organization – the Rural Electrification Board (REB).

(c) ***Project design should be flexible and Brief should describe how market will be sustainable without subsidies and how costs will decline over the project:*** the project envisages three different institutional designs for delivering solar systems to consumers –

through well established rural electricity cooperatives, NGOs, MFIs, and the private sector. The project also envisages three business models – pay for service by the rural cooperatives, micro-credit financed through NGOs and MFIs, and direct sale or hire purchase by the private sector. The project is flexibly designed around these models and the requirement for grant support is expected to decline as a result of grant-funded capacity building and barrier removals activities to be carried out in the first three years of the project. The project intends to address the reduction of grant support both through declining costs of equipment delivery, financing and servicing systems, and increasing share of Government funding for capacity building TA during the life of the project. The project financing includes contributions from consumers, government and IDA resources. The micro-credit elements of the Bangladesh economy are operating on a sustainable basis and it is expected that with adequate attention to market promotion and capacity building through the project, MFIs will establish the solar financing business also along sustainable lines.

(d) ***Attention to replication, including mechanisms to adapt and replicate successful models to rest of Bangladesh:*** the potential for replication is very high. The rural electrification business in Bangladesh has been successfully operated by rural cooperatives, which are now being replicated all over the country. There are today more than 60 of these cooperatives and their business model is both sustainable, and following a period of initial subsidies, also financially viable. The solar program implemented by such cooperatives on a fee for service basis is expected to be replicable once solutions to market barriers are implemented under this project. Five such cooperatives have been selected and replication to other cooperatives will be addressed during the project life itself. For the NGO and private sector models, replicability is considered high because of the dynamic and growing influence of NGOs in delivering micro-credit and social services in the country. For example, the NGOs have established sustainable community-driven activities for rural women in income generation, empowerment, and health and wellness. The participation of NGOs with good track records in the solar program will provide opportunity for replication. The project provides a specific TA component to develop a replication strategy and recommend steps for its implementation.

(e) ***Emphasis on stakeholder analysis and providing sound data base and mechanisms for promotion of income generating activities for rural households:*** the project places significant importance on the use of electricity for income generation. The project includes a specific component to promote productive consumption of electricity by rural households. The electricity cooperatives already implement such programs, but these would be increased in scope and the quality of such initiatives would be strengthened by inclusion of stakeholders like NGOs, micro-credit institutions and other community-based organizations. Both during the preparation phase, and PDF B activities, the stakeholder identification and analysis has been carried out and will continue under the project, as will ongoing socio-economic monitoring of opportunities and results.

(f) ***The need for monitoring income generation and social benefits***: under this project, comprehensive monitoring and evaluation of electrification benefits is being introduced for the first time in Bangladesh. A socioeconomic monitoring unit is being set-up in the REB, which will define and monitor both income generation and social well-being indicators for rural families with and without access to electricity. In addition, monitoring for opportunities

to increase productive consumption of electricity and evaluate impacts of electrification will also be a part of the M and E program.

(g) ***Justify subsidy arrangements and provide sources of cofinancing:*** the grant elements of the program have been kept to a minimum. In fact, the grant on solar systems is proposed to be capped at US$ 90 for all systems greater than 36Wp. Given the low family incomes in Bangladesh, initial market promotion will depend both on grant financing as well as barrier removal investments. However, the delivery models take into account the viable alternatives of fee for service and micro-credit financing. The fee for service scheme is developed with a lower grant element – only US$ 50 per system. The expectation is that the grant component of solar financing can be reduced as the market builds up, supply chains are established and initial delivery and service costs begin to decline. The PDF will be used to carry out a comprehensive evaluation of sustainability aspects, including level of grant funding in future years of the project. Accordingly, the grant regime is flexibly designed to accommodate changes during the life of the project. The current financing plan for the blended Bank/GEF project includes a 21 percent cost contribution by participating governments, consumers and local institutions, totaling some $39.05 million. IDA contribution is approx. US$140 million and the GEF component is US$8.2 million. Bilateral donor contributions are still under discussion, and will be firmed up during preparation.

(h) ***Stress learning and linkages to other projects:*** the Brief outlines lessons learnt and incorporated in design of the project under section 3.2.3. The project seeks to build off-grid electricity provision on the successes of Bangladesh's rural electricity cooperative model and the work of its world-class NGOs and micro-credit institutions. We expect that the project will be watched with great interest by countries that aspire to replicate Bangladesh's success in rural development institutions. The project has some linkage to the parallel efforts to reform the electricity sector in Bangladesh, mainly in the growing role of the rural electricity cooperatives and in their takeover and rehabilitation of poorly performing areas handled by the main utilities. The track record in this regard with prior Bank funded rural electricity projects is highly satisfactory.

The World Bank recognizes that it is very important for this project to demonstrate that community based organizations have a role to play and deliver successful and measurable outcomes in respect of rural electricity access and its positive effects on income generation and social well-being. The blended IDA/GEF project is in an advanced stage of preparation and project appraisal is expected to be complete by January 2002.

Please let me know if you require any additional information to complete your review prior to inclusion in the work program. Many thanks.

Distribution:

Messrs.: E.Torres, UNDP
A. Djoghlaf, UNEP (Nairobi)
K. Elliott, UNEP (Washington, DC)
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PROJECT BRIEF

1. IDENTIFIERS:

PROJECT NUMBER:	GEF-PO71794
PROJECT NAME:	**Bangladesh: Rural Electrification and Renewable Energy Development**
DURATION:	5 years
IMPLEMENTING AGENCY:	World Bank
EXECUTING AGENCY:	Infrastructure Development Company Ltd (IDCOL) Government of Bangladesh
REQUESTING COUNTRY OR COUNTRIES:	Government of Bangladesh
ELIGIBILITY:	Bangladesh ratified UNFCCC on April 15, 1994
GEF FOCAL AREA:	Climate Change
GEF PROGRAMMING FRAMEWORK:	OP6: Barrier Removal

2. SUMMARY:

Rural electricity provision is critical to economic development and quality of life improvements in Bangladesh. The Rural Electrification Board (REB), which is responsible for rural electrification in Bangladesh, has made impressive gains in increasing access for rural populations to nearly 25 percent from less than ten percent, two decades ago. For many parts of the country however, grid expansion is uneconomic due to low level of use by households, primarily for lighting, and its high costs and environmental effects. Solar photovoltaic energy holds great promise for Bangladesh. Market assessments conducted in the last two years indicate significant potential. The demand for solar home systems (SHS) in Bangladesh is estimated to be nearly two million systems. Use of SHS is not new in Bangladesh. Several government and non-government organizations (NGOs) are involved in small demonstrations and sales, with mixed results. For a large scale, sustainable program to be implemented with any degree of success, a more concerted effort to overcome critical market barriers and assured funding is necessary.

The focus of this part of the blended IDA/GEF project is on promoting solar energy, implemented by successful and well established Bangladeshi institutions. These include, rural electricity cooperatives (called Palli Bidyut Samitis or PBSs), community-based organizations (CBOs), NGOs, microfinance institutions (MFIs) and the private sector. The project recommends a package of interventions to support these institutions in overcoming key market barriers: a) increasing awareness of SHS among consumers and providers; b) building technical and management capacity to design, implement and evaluate SHS programs; c) providing technical and business development support to implementing institutions; d) introducing standards and programs for testing and certification, e) financing grants to buy-down capital costs and increase affordability of SHS; f) promoting electricity as a means for income generation and social wellness; and g) identifying mechanisms to promote sustainability and replicability. Multiple approaches to SHS delivery are being proposed, including a "fee-for-service" program by PBSs, purchase supported by micro-credit through NGOs and MFIs, and hire-purchase/direct sale programs by private dealers and NGOs.

The baseline scenario in absence of this project would be limited to installation of 12-15000 systems over a 5 year period, primarily through one or two large NGOs, few private dealers and the REB. The GEF alternative proposes accelerated market development through actions for removing market barriers and introduction of a larger number of players to serve the market. The alternative would result in installation of an additional 50,000 systems over the same time frame and will involve coordinated implementation through NGOs, PBSs, private entrepreneurs and MFIs. Considering the socio-economic characteristics of the rural consumer, small systems in the 20-50Wp range are likely to be preferred.

Potential for mini-hydro and wind based energy also exists in Bangladesh, albeit limited due to its particular geographic conditions. The coastal areas are likely to have good wind potential and the hill tracts possibilities for small hydroprojects. This project proposes to support the Government of Bangladesh to firstly, explore available potential, and if found feasible, secondly, to develop an appropriate commercial framework, through pilots where appropriate.

The overall blended IDA/GEF project will in addition, support (i) economic grid expansion and takeover and rehabilitation of lines from less efficient utilities; (ii) design, development and financing of private sector owned and operated mini-grid systems in remote rural areas (Remote Area Power Supply Systems – RAPSS); and (iii) programs to increase productive uses of electricity and enhance its impact on poverty reduction.

3. COSTS AND FINANCING (MILLION US$):

GEF - Project:	8.20
GEF- PDF-B:	0.34
Sub total GEF:	8.54
Co- financing – Other International:	17.15
Co-financing – Other Donors	TBD
Co-financing – Government	1.92
Co-financing – Consumers equity	3.33
Sub total co-financing:	22.40
Total cost of GEF project:	30.94
Blended IDA project-other components:	157.00[1]
Total Project Cost:	**187.94**

4. ASSOCIATED FINANCING (MILLION US$) N/A

5. OPERATIONAL FOCAL POINT ENDORSEMENT:

Name: Mr. Mahfuzul Islam
Organization: Ministry of Environment and Forest
Title: Secretary
Date: September 30, 2001

6. IA CONTACT:

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[1] Refer Annex 4 for Financing Plan of Blended IDA/GEF project

1. Background

1.1 Sector Context

Rural electrification has made remarkable progress in Bangladesh. With nearly 85 percent of the population living in rural areas, nearly 25 percent of rural households have access to metered electricity as compared to less than 10 percent two decades ago.[2] However, even at the present rate of expansion - about 400,000 new households gaining access every year - it would still take more than 40 years to reach all households. Rural electricity access rates have to increase dramatically to accomplish the Government's stated goal of providing universal electricity access by 2020. In addition to grid expansion therefore, Government strategy considers implementing off-grid renewable energy technologies, such as solar home systems (SHS), micro-wind power systems in coastal areas, and mini-hydro projects in the mountainous regions as a priority.

The vertically integrated Bangladesh Power Development Board, (BPDB) and the Dhaka Electricity Supply Authority (DESA), which retails power in the Dhaka metropolitan area, together account for nearly 75 percent of power sales in Bangladesh. The Rural Electrification Board (REB) oversees rural electrification and supply through a network of more than 60 Palli Bidyut Samitis (PBSs) or village electricity cooperatives. The operational and financial performance of the main utilities – BPDB and DESA - has been historically poor and a slow program of institutional reform is underway to address their shortcomings[3]. In contrast to these utilities however, the PBS/REB system is more successful in delivering reliable services and displays much better operational performance. The superior performance of the rural electricity cooperatives is manifest in lower system losses, better billing and collection performance, higher tariffs and greater financial discipline.

Bangladesh's key objectives in the sector are to expand access for accelerated economic growth and increase the efficiency of supply. This project addresses the first objective fully and the second partially.[4] It supports the Government's access expansion strategy by providing assistance to energize areas that are remote from the grid or where grid expansion is uneconomic. It aims to improve the efficiency of rural supply through several institutional development and financial restructuring measures directed at the REB and PBSs.

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[2]There is some controversy about the extent of rural coverage due to the uncertainty of how many families receive service from a single meter. The total number of rural meters is now close to 3 million. If the estimate of average 1.5 families per meter indicated by some recent studies is used, the number of households covered is 4.5 million, or a population of nearly 27 million. This is approximately 25 percent of the rural population. A recent national random sample survey indicates that about 24 percent of rural households have some form of electricity service.

[3] The ADB and the Bank are supporting investments and technical assistance to address the fundamental policy and institutional reforms in the main power sector.

[4] Sector reform is not the direct focus of the blended Bank-project - the Bangladesh Rural Electrification and Renewable Energy Development Project. However, government efforts to reform the sector are drawing support under other ADB and IDA initiatives. The principal reforms contemplated include unbundling of the utilities, privatization of electricity distribution and independent sector regulation.

1.2 Government Rural Electrification Strategy

The Government of Bangladesh, through the Rural Electrification Board, has consistently promoted the 'area coverage' concept'[5] in expanding grid access to rural areas. This strategy has yielded good results in the past, but its efficacy is being constrained by: (i) rising costs of grid extension as load densities decline; (ii) shortage of power supply from BPDB to the rural grid; and (iii) financial sustainability of PBSs against declining subsidies. While these constraints are being addressed and the grid is providing access to nearly 400,000 new rural consumers each year, it has become clear that alternatives to the grid are required to raise access levels high enough if the Government is to accomplish universal coverage goal by the year 2020.

To address the three constraints mentioned above, firstly, the Government is promoting the rationalization of distribution networks by handing over BPDB-operated power systems in secondary towns to REB to increase efficiency of supply and reduce overall costs of electrification. Furthermore, REB is introducing greater prudence in selection of lines and revisiting revenue and cost assumptions that have governed the area coverage program thus far. Therefore, off-grid options are being promoted for grid-remote areas. Secondly, to address the shortage of adequate bulk power supply, REB and the Government have introduced a policy to promote localized power generation through small privately operated plants, supplying directly to PBSs. Thirdly, the financial viability of PBSs is being tackled through a package of measures. These include, (i) revenue enhancing measures such as actions to transfer of pocket areas and critical load centers from BPDB; (ii) debt restructuring in the form of increased grace periods or adjustment of debt against grants; (iii) selective investments that could enhance revenue and performance profiles; and (v) expanding productive uses of electricity to increase consumption patterns.

The Government strategy emphasizes promoting off-grid options in areas that are unsuitable for grid expansion. It has made a good start by eliminating import duty on solar home systems in April 2000. The strategy emphasizes the pivotal role of well functioning rural organizations in promoting off-grid options. The strategy builds on the acknowledged strengths of the PBSs and Bangladesh's world-class non-government organizations (NGOs) and micro-finance institutions (MFIs). The proposed project provides support for the Government's off-grid promotion strategy and endorses the approach to use well-functioning rural community-based organizations (CBOs) to leverage grass-roots reach and established credibility to improve electricity provision significantly.

1.3 Link to CAS Priorities/Bank Program

The Bank's most recent Country Assistance Strategy (2000) acknowledges the success of rural, community-based institutions in provision of electricity and micro-credit. It encourages building on the success of rural energy cooperatives to address Bangladesh's poverty and

[5] Under the area coverage concept comprehensive load surveys are carried out for a large area and recticulation patterns designed to accommodate future load expectations. The networks designed consist of backbone lines (main load flow conduit) and laterals (supplies to specific areas). Thus while initial cost can be high, with time the overall development of the networks is least cost. In contrast, many utilities extend networks to one town at a time resulting in high costs over an extended period.

development challenges. The Strategy emphasizes the central importance of increasing electricity access more rapidly, increasing efficiency and undertaking reforms in the electricity sector. The proposed project design is consistent with these strategies because it would enable the country to rapidly expand rural electricity access by supplementing grid with renewable technologies. The project would also promote stronger partnerships among private sector, NGOs, CBOs, and MFIs to identify, finance and implement off-grid rural energy solutions.

1.4 Global Environment Objectives and Consistency with the GEF's Operational Strategy and Renewable Energy Operational Program

The project's global environment objective is to reduce the risk of climate change by mitigating Bangladesh's greenhouse gas emissions, even as it strives to increase electricity access. This will be achieved by promoting renewable energy technologies as alternatives to and substitutes for GHG-emitting diesel and kerosene fuels.

The project is fully consistent with the GEF's Operational Strategy and with its Operational Program # 6: Promoting the Adoption of Renewable Energy by Removing Barriers and Reducing Costs. The major barriers it will address are: lack of government, private and financial sector capacity to plan, provide and finance renewable energy systems; the high initial costs of renewable energy equipment in the currently small Bangladesh market; and lack of awareness of and confidence in renewable energy among potential suppliers and consumers.

2. Promoting Renewable Energy for Rural Electrification

2.1 Problem statement

Rural electricity provision is critical to economic development and quality of life improvements in Bangladesh. Despite impressive gains in rural electrification, much remains to be done. The problems in continuing to provide access with grid options alone are: (i) poor economics due to combination of rising costs of penetration and low intensity of electricity use. A significant proportion of rural households (nearly 40%) use less than 40 kwh of electricity per month, primarily for lighting purposes; (ii) need for large investments and subsidies; and (iii) environmental effects. Hence one of the key solutions to the access problem lies in introducing other options, that can be implemented with lesser degree of state-support, and that are commercially and environmentally sustainable. A solar energy program that targets households, and is implemented by the private sector, PBSs and CBOs/NGOs, financed through established MFIs would satisfy these criteria.

The potential market for solar energy in Bangladesh is very large. A recent study assessed the existing market size on a fee-for-service basis alone to be nearly 500,000 households[6]. In an extended time frame the potential market has been estimated to be over 2 million households. Prior attempts to develop renewable energy in Bangladesh have met with limited success due to institutional, policy and financial barriers. This project seeks to reduce these barriers and provide a sound and sustainable implementation framework to tap the solar energy potential of Bangladesh.

[6] Market Assessment Survey of Solar PV Application in Bangladesh, Prokaushali Sangsad Limited, July 1998.

2.2 Baseline

2.2.1 Prior Initiatives

The rural electricity program is based on supply by independent consumer owned cooperatives or PBSs functioning under the umbrella of an apex organization, the REB. The latter functions both as a quasi-regulator and a financial manager of the program and provides a wide range of technical and institutional support to the PBSs. The REB has a highly satisfactory track record of project implementation. The REB undertook the Narshingdi Solar Electrification Pilot Project in 1995 where about 900 households within a 29 sq.km riverine island area, received electrification through three solar charging stations and stand alone systems. The Narshingdi experience has provided REB and PBSs with experience in implementing a SHS project. The project has clearly demonstrated technological suitability of SHS and possible success of the fee-for-service approach. Since the program was predominantly grant based, it has not provided adequate clues for financial viability or operational sustainability. It is notable that the program was more or less directly implemented by the REB, and the concerned PBS (Narsingdi) had little say in its design and implementation. Limited solar electrification of a number of cyclone shelters has also been carried out by the local government engineering department, as well as by government defense and telecommunications departments.

A GEF medium size project (MSP) has been approved to develop SHS and other renewables in Bangladesh through public sector entities. Its focus is on off-shore island areas. The MSP aims at development and operation of a Renewable Energy Information Network (REIN) to overcome the information barrier, capacity building activities primarily targeted on local government/public entities, demonstration activities including pilot financing mechanisms such as establishment of a revolving fund and a "pay for service" for about 500 systems within PBS off-shore areas.

Evidence that a solar program rooted in private and community based initiatives could be more successful is recent. In the non-government sector, the Grameen Shakti, a subsidiary of the Grameen Bank, has been involved in financing SHSs for the last two years, during which nearly 5000 systems have been installed. Bangladesh Rural Advancement Committee (BRAC), the largest national NGO, has also recently embarked on a SHS financing program for its beneficiaries, and is planning to extend its activities. Apart from these, other organizations, including a private sector dealer, have also been involved in a limited manner in solar energy. With assistance from the IFC and GEF, Grameen Shakti has evolved another program for sale of SHS, but has reached only a small segment of the market.

2.2.2 Project Baseline

From the standpoint of the current state of solar program initiatives, it is estimated that only 12-15000 households would gain access in the next 5 years. Such households are more likely to be in the relatively higher-income earning families with incomes in excess of US$ 1000 per annum. For poorer families, the cost of a solar system is too high and affordability is an issue in

the absence of capital support. Market and supply chain development is also necessary. So far the role of private sector has been limited to hardware supply for SHS installations. Solar panels are currently imported into Bangladesh, holding manufacturer's specifications[7] and international trademarks. Although at present there are a limited number of suppliers carrying stocks of solar PV hardware within the country, representatives of international manufacturers of solar panels including British Petroleum, Shell, Siemens and other suppliers from neighboring India are willing to establish a presence in the country. If designed right, the project will bring the benefit of competition by introducing players from the international market. Quality standards and assurance mechanisms need to be introduced, both for imported and locally manufactured components.

Developing supply chains and building technical and service capacity in the rural areas will require significant investments. With capital support to households and adequate investments to develop markets and build capacity being available, the off-take of SHS could exceed 60,000 systems in the next five years. In the absence of the alternative, these 45-48,000 incremental households will not be covered by solar PV and continue to use kerosene. For the other renewable options - wind and hydro – commercial feasibility would need to be established. Hence the proposed project only considers these alternatives on a pilot basis. Scaling up to commercial levels would be contingent on pilots being successful.

The key baseline elements are summarized in the following table.

Baseline Element	Status as of September 2001	Expected at end of Project
# of households using solar home systems	Approximately 5000, expected to reach 12-15,000 over the next 5 years in the absence of assisted development	At least 60,000
# of institutions (public, private, community based) directly involved in promoting, marketing or financing solar home systems	Six; two public (LGED, REB), two private dealers (Rahim Afroz, Grameen Shakti), and two NGOs/MFIs (BRAC and Grameen Shakti)	At least fourteen organizations involved in the sale, finance and promotion of SHS.
Fee for service access for solar	Non-existent (except in Narsingdi Pilot project area)	Awareness nationwide, with actual fee for service programs operating in 5 PBSs installing and operating nearly 14000 systems
Other renewables, wind and hydro	Small, isolated projects tried by various agencies with mixed results	Complete at least two pilot projects and evaluate prospects for commercial development of small hydro and wind projects.

The baseline scenario is based on no project intervention taking place. GEF participation for barrier removal is critical without which IDA credit support and TA alone would not produce desired outcomes. Therefore, baseline achievements are those expected from current initiatives

[7] The Board of revenue of GOB has removed the import duty and VAT from solar panels in order to encourage its extended use.

by few institutions. The GEF Alternative scenario is based on IDA, GEF and Government participation in barrier removal, credit and grant support.

2.3 Barriers

Renewable energy development in Bangladesh faces a number of barriers that need to be overcome. These barriers have been identified primarily based on the past experience in renewable energy project implementation and recent studies specifically commissioned during project preparation.

a) Policy barriers: A suitable policy of non-exclusive provision of rural energy does exist in Bangladesh, but this needs to be formalized and articulated. REB also needs to develop a framework for SHS implementation through the PBSs. This is being addressed as part of the project. For hydro and wind, there is no framework presently under which electricity generated can be sold directly to customers or purchased by the utility. Part of the reason for this policy vacuum is that such technologies have not been developed in a commercial manner and there is still some doubt whether these could be viable in Bangladesh. Prior studies indicate limited potential for hydro in the hilly areas of Bangladesh, where implementation is difficult due to political-economy reasons. Studies on wind also indicate average speeds below the threshold of 7 meters per second necessary to use existing technologies. However, there are indications that in some coastal areas, potentially higher wind speeds exist. Addressing the policy barrier before establishing commercial potential for such renewable technologies would be premature. Hence, the project proposes to definitively determine whether potential exists, and if so, demonstrate its viability or otherwise through selected pilot projects. The policy regime would then develop from the evaluation of the pilot projects to provide a future implementation framework.

b) Institutional barriers: Bangladesh has a number of well functioning rural institutions in energy, microfinance and social mobilization. The project is based on taking advantage of these institutional strengths. Some barriers do exist which are more specific to the participation of these institutions in the renewable energy business. The key institutional barrier is limited managerial skills and implementation capacity of grass root organizations (NGOs/MFIs) for this relatively new development activity. This stems from a combination of inadequate knowledge about available technologies, lack of trained technicians for installation and operation of SHSs, inability to identify and mobilize target groups and effectively market solar equipment and services, and create mechanisms for financing households and solar energy marketing on a business basis. Similarly, though PBSs have pushed for solar programs, they have done so without developing sustainable provision models, such as fee-for-service provision. The relatively low degree of private sector participation in infrastructure provision is another key issue. There are historical factors responsible for this and the project cannot be expected to change the culture in a short period of time. The project model is therefore predicated on promoting private sector participation in conjunction with other robust institutional models, such as cooperatives, NGOs and MFIs.

c) Financial/Economic barriers: In a poor country like Bangladesh, the high initial capital costs of renewables, in particular that for SHS, poses a significant barrier to its adoption. This

hypothesis has been confirmed in recent studies[8]. Particularly, high cost of solar modules, import items of solar systems requiring foreign currency, high cost of batteries and of suitable lamps are notable barriers. At a micro-finance level, though there are several well established and financially sound credit providers, availability of sufficient credit to households for SHS remains a problem. Firstly, micro-finance institutions prefer to make household loans only for income-generating activities. Secondly, for SHSs to be viable, credit terms have to be for 3-5 years which is contrary to established practice in Bangladesh micro-finance. The trend is to limit household credit to 12-24 months. Many of the MFIs that would potentially participate under the program would require some funding enhancements to create 3-5 year liquidity and also assistance in terms of conducting a micro-credit program for solar systems.

d) Social and Information barriers: There are a number of social and information barriers to be overcome. While the program suffers from a belief that SHS adoption by a village or geographic area could delay or preclude grid access, lack of awareness and information dissemination about: (i) renewable energy technologies including SHS; (ii) socio-economic characteristics of potential rural consumers, including the unserved population;[9] (iii) possibility of using solar lighting for purposes other than home lighting such as community level/public usage in educational institutions, hospitals, clinics, mosques; and (iv) availability of maintenance services and warranty of SHS components; constitute significant barriers. From the standpoint of electricity consumption Bangladesh lags many developing countries. Rural consumption is less than 40 kwh per month for more than 40 percent of consumers. Promoting the productive use of electricity and increasing its consumption to promote income generation impact and also improve the financial viability of rural utilities. Furthermore, the potential to use electricity for improving delivery of social services such as health, clean water, information services and education is limitless. This project intends to focus on addressing this critical barrier through forging a partnership among key rural institutions and CBOs.

e) Technical barriers: In view of particular climactic conditions of Bangladesh where light intensity could remain poor to fair for several days during the prolonged monsoon season, efficacy of SHS operation has been questioned. Studies have shown that this does not impair performance significantly, though there could be short periods of low performance. The mitigation lies in proper education about performance expectations, proper battery usage, and greater attention to proper selection of the best system for each customer taking into account economic condition, load requirement and ability to pay.

2.4 GEF Alternative

2.4.1 Project and Global Objectives

Project Objectives

[8] Feasibility Study for a Solar Home Systems project Within the Context of Alternative Options Rural Electrification, Prokaushali Sangasad Ltd., March 1, 2000.

[9] This is not essentially an information issue – the PBSs have excellent socio-economic data. It is making this information more widely available to other organizations which constitutes a barrier.

The blended IDA/GEF Bangladesh Rural Electrification and Renewable Energy Development project supports the Government's development strategy to increase rural electricity access, and thereby promote social development and economic growth.

This objective is sought to be achieved in the following four ways: (i) assisting the REB to expand and intensify rural grids, improve the operational and financial performance of the PBSs, and reduce power outages in the rural grid systems; (ii) facilitating development of decentralized, mini-grids, based on natural gas, diesel, wind and hydro sources where feasible; (iii) promoting use of solar home systems in rural areas inappropriate for grid expansion; and (iv) increasing productive use of electricity and enhancing poverty impacts. [10] (see annex 4 for a description of the blended project). This GEF project seeks support for (i) promotion and marketing of SHS and (ii) determining commercial feasibility for wind and hydro resources.

Global Objectives

The global objective, consistent with GEF Operational Program 6 in Climate Change, is to achieve GHG reductions through the removal of policy, information, and financing barriers that currently hinder renewable energy technology dissemination and market development in Bangladesh, specifically with respect to SHS. The proposed project will actively engage the PBSs, NGOs and the private sector in commercially sustainable activities in order to reduce long-term implementation costs, and offer strong potential for learning and replication.

GEF assistance would be essential in evolving multiple off-grid electrification initiatives, implemented through the PBSs and NGOs. The core objective of the GEF supported project is to accelerate solar market development by these organizations in (a) isolated and remote areas without the prospect of grid electrification service, and (b) areas not to be served by the national rural electrification grid within the next 5 to 10 years. The project would need to establish mitigation mechanisms such as buy-back programs, to address consumers inability to use SHS in villages where the grid access becomes available within 10 years of SHS installations.

While the direct impact of the project will be felt only on about 60,000 households, a key contribution of this program would be in developing implementation models which could be replicated and scaled-up in a sustained manner, with lower level of capital support in the future. The specific focus of the program would be to develop implementation models to serve the lower end of the market segment on a fee-for-service basis, hire purchase or direct purchase.

2.4.2 Summary of Project Outputs

The project defines the institutional models, the stakeholders and implementing agencies, and financing and implementation details developed to place the renewables component within the context of a larger rural electrification strategy for Bangladesh. The blend IDA/GEF project will support this strategy, and a part of the IDA credit will be employed to promote large-scale application of renewables with investment and technical assistance resources.

[10] The blended IDA project is currently under appraisal and has a significant grid component, in addition to the off-grid components. It envisages IDA and GEF assistance of nearly US$151million, and will be presented to the IDA Board/GEF Council jointly.

(i) Establishment of a SHS based pre-electrification program for PBSs

The project will enable REB and five PBSs to develop a 'fee-for-service' SHS market and install 14,000 SHS in rural households on this basis. IDA and Government will provide credit resources, with GEF grants to finance the SHS program. Besides investment funding, TA resources are to be provided to strengthen institutional capacity, develop a sustained 'fee-for-service' PV market, provide implementation support and training, establish arrangements to test and certify equipment, monitor project progress, establish and operate a socio-economic cell in REB to design, implement and evaluate programs to use electricity to increase rural incomes and social well being, and establish sound performance monitoring and evaluation methods.

(ii) Establishment of a SHS credit line and TA to support private sector, NGOs and MFIs

The project will specifically support capacity building of private sector, PBSs, NGOs and MFIs to enter into and implement solar development programs. Capacity building would include generating awareness about solar based opportunities, disseminating information widely and effectively, developing skills among 'institutions' and 'people' to implement and manage the program and training for solar technicians, community mobilizers and microfinance practitioners. The project envisages GEF financed TA, matched by IDA and Government, for market development and solar promotion. To overcome financing barriers, a renewable energy credit line from IDA resources and a GEF cofinancing grant is proposed to be set-up and operated by the Infrastructure Development Company Limited (IDCOL) on commercial terms to finance 50,000 SHS. IDCOL will on-lend to MFIs (or NGOs as the case maybe) and solar businesses to facilitate the purchase of solar home systems by consumers.

(iii) Development framework for other renewables

The project will provide support for assessment of wind resources in the coastal areas of Bangladesh and for run-of-the-river mini hydros in the hilly regions. If assessments indicate positive potential, IDA would support development and implementation of pilots to confirm commercial feasibility. Support will in that case be extended to formulate a policy framework for commercial development of these resources, including development of Small Power Purchase Agreement (SPPA) and incentives.

2.4.3 Project components

The **off-grid investment component** would have two sub-components:

a) a SHS program implemented by the REB and selected five PBSs; (US$5.98 million investments, US$ 2.5 million TA). The selected PBSs are Barisal PBS 1, Natore PBS 2, Pabna PBS 2, Patuakhali PBS, and Sirojgonj PBS and will cover about 14,000 households. These PBSs would implement a fee-for-service SHS program, using systems ranging from 20Wp to 72Wp.

b) a SHS credit program operated by IDCOL, a financial intermediary in the implementation of an NGO/MFI/private sector based solar program (US$ 20.42 million investments and US$ 1.4 million TA). In addition to two large NGOs (Grameen Shakti and

BRAC), three or more selected medium NGOs (beginning with SRIJONI, TMSS, COAST) will be involved. All the five selected NGOs are currently supported by various micro-credit loans from the Palli Karmik Sahayak Foundation (PKSF), an apex funding agency for MFIs in Bangladesh. PKSF receives IDA credits for this purpose, and therefore the selected MFIs are all currently complying with the Bank's requirements in respect of financial management and audits. Systems ranging in size from 20Wp to 72Wp will be offered and the program plans to reach over 50,000 households in the 5-year project term.

The market assessment studies conducted thus far have considered two primary levels of service (i) Level 1: a 20Wp SHS for households with levelized monthly spending between $3.1 and $5.5, and (ii) Level 2: a 40 Wp for households with monthly expenditure above $5.5. An average level 1 user household would spend about US$ 3.11 (US$ 5.51 for level 2) per month on kerosene and batteries which could be displaced by solar. This implies a 15 year net present value of costs of about US$ 259 for level 1 households and US$ 459 for level 2 households. The 15 year net present value of a 20 W solar home system is estimated at US$344 and that of a 40 W system is estimated to be about US$556. This implies an incremental cost of $ 85 per 20 W system and $ 97 per 40 W system. Accordingly, the project recommends US$ 80 per 20 Wp system and US$ 90 per 40 Wp system as capital buy-down grants. The implementing agencies, REB and IDCOL are currently carrying out further evaluations of market demand for different systems as a part of their business planning. Indications are that for fee-for service and micro-finance models, several households show a preference for 50 Wp systems. Since customer preferences may vary, in order to maximize the grant leverage for solar access, the project proposes to cap the capital grant at US$ 90 per system, irrespective of size. (Please see Attachment B, in Annex 3(b) for details of incremental cost calculations).

Broadly, the **Technical Assistance component** would support institutional capacity building and market development assistance. Capacity building within the PBSs, NGOs and the private sector to design, finance, implement and evaluate SHS programs will be one key area of focus of the technical assistance package. The other key area would to provide market development assistance by supporting awareness programs, development of better standards and certification procedures, assistance in the policy development, coordination between the two programs, assistance for technician training, and assistance to private sector for business planning and supply chain development. Some design and implementation planning for the sub-components has been carried through Bank/IDA funding and more detailed work is being undertaken, supported by a separate PDF B exercise. The ongoing activities under PDF B will precede and set the stage for this project by piloting the institutional models that the project will implement. During the PDF-B phase, the organizations who will be carrying out the implementation of each of the models in the field will: (a) fine-tune their implementation strategies for large-scale application during the project; (b) identify their own capacity building needs; (c) establish the technical specs and quality assurance criteria; (d) develop the templates for contractual agreements between various parties; and (e) identify a sustainablity strategy beyond the main project. The PDF-B activities would be completed by the end of 2002, though the formal closure is June 2003, whilst the blend project (including this GEF project) will be ready for implementation in FY2003.

Sub-components are as follows:

- **Awareness Programs**: Removal of social and information barriers is key to accelerate market development of solar products in Bangladesh. The project will support wider awareness programs for consumers through media advertisements, leaflets, posters, permanent sign boards and motivation programs conducted by NGOs and local community. Installation of SHS Demonstration units in educational institutions, hospitals, clinics, mosques, community buildings would also be supported as part of the project.

- **Training Programs**: In order to create local technical capacity, the project will support training programs for technicians open to individuals, private sector, PBSs and NGOs. Considering the wide range of stakeholders, training programs will be developed to accommodate participants with different levels of capability. A technician accreditation program will also be established to ensure consistent quality of skills of the practitioners.

- **Capacity Building/Business Development**: One of the major barriers to the development of solar industry in Bangladesh is the lack of the management capacity within the NGOs, private sector and PBS develop and implement SHS programs. Suitable business development assistance will be provided to the participating PBSs, NGOs, MFIs and the private sector entrepreneurs in the form of support for developing business plans, training to develop strategic partnerships, and improve project and financial management aspects, including insurance. Based on experience in other countries in South Asia, this would help develop strategic plans for greater coverage, better service, and possibly lower costs through competition.

- **Renewable Energy Policy Development**: Assistance will be provided to the REB to develop a policy for SHS implementation covering legal, operations, recruitment, training, and all other issues in implementing SHS program. Support will also be provided under the project to assess the wind and mini-hydro resources and develop a policy framework for their commercial development.

- **Technical Issues**: Initial specifications for SHS will be developed through the PDF B. However, additional support in evolving better testing and certification standards will be provided through this project.

- **Implementation Support**: Both REB/PBSs and IDCOL will receive implementation support in the form of fixed grants based on actual installed pv capacity. This will enable the implementing agencies to carry out required due-diligence and effective supervision and monitoring. (provision for this support has been included as a fee per Wp installed in the investment component, on a declining scale basis over the project life)

- **Learning**: Assistance will available to the implementing agencies and stakeholders to track performance of programs, and evaluate results. The performance indicators and systems for tracking are being developed under the PDF. A socio-economic monitoring

unit is being established in REB. These activities will facilitate learning and knowledge dissemination.

- **Income Generation and Social Improvements**: The project will help identify and develop avenues to increase the productive consumption of electricity in rural Bangladesh, both to enhance income generating opportunities and promote social wellness. TA is to be provided to forge a strategic partnership among PBSs, NGOs, MFIs and other government/non-government development-oriented agencies with the single purpose of using electricity for production of goods and improvement of services. This includes establishment and operation of a socio-economic cell in REB to coordinate this activity and provide a database and monitoring focus.

- **Wind and Hydro Development**: Funding requirements to the tune of US$0.3 million for wind and mini hydro assessment and design of pilot projects have been included. If assessments indicate positive potential, IDA funds would be available to develop and implement pilots and establish a commercial framework.

The estimated cost of the TA component is a total of 4.2 million, split approximately between GOB, GEF and IDCOL on a 20%, 40% and 40% basis. The cost table below describes the various components and estimated costs/financing sources.

2.4.4 Estimated project cost

The total renewable energy financing package is estimated to be US$30.6 million.

Component	*Total Cost*	*Govt./Others*	*IDA*	*GEF*
SHS Investment program-REB/PBSs	5.98	1.71	3.43	0.84
SHS Investment program- IDCOL	20.42	2.76	12.16	5.50
TA – SHS	3.90	0.78	1.56	1.56
TA – Wind/Hydro	0.30	0.00	0.00	0.30
Total	30.60	1.92	17.15	8.20

2.4.5 Project stakeholders and benefits

The stakeholders involved in the project will be the Government of Bangladesh; the Rural Electrification Board (REB) and Palli Budyut Samities (PBSs); private PV system suppliers in Bangladesh and the region; micro finance institutions(MFIs); several NGOs; and Bangladesh University of Engineering and Technology (BUET). The beneficiaries will be rural households, who will benefit from receiving electricity for income generation activities and improving their quality of life.

The direct benefit outcomes are:

- Electricity made available to more than 60,000 rural customers through solar home systems.
- Markets for off-grid renewable energy technologies developed.

- Greenhouse gas emissions and local polluting effects of burning 5.76 million liters of kerosene equivalent will be avoided annually.
- Future greenhouse gas emissions from operating nearly 3.2 MW of generation capacity with conventional fossil fuel technologies or natural gas will be avoided.
- Electricity used more productively, producing greater economic and social benefits.

The program related outcomes are:

- Incorporation of environmentally sustainable renewable energy technologies within the planning framework for pre-grid rural electrification
- Acceptance by consumers, project developers and financial institutions of the viability of off-grid systems for electricity production and delivery;
- Built capacities among various stakeholders in planning and implementing off-grid renewable energy projects.

Global environment benefits:

The project will displace roughly 257,664 tons[11] of Co2 over a 15 year life based on avoided kerosene use, yielding a cost effectiveness of US$33.1 per ton. Details are provided in Attachment B to Annex 3b. The CO2 displaced is much higher if the contributions to CO2 emissions from fuel used for battery charging facilities are counted. However, this is difficult to estimate in Bangladesh and has not been attempted.[12]

Target population:

The principal target and beneficiaries of this project are the rural customers, who will be able to have improved access to clean and reliable electricity services, and benefit from access in terms of improved incomes and social wellness. In addition, several other stakeholders will also be targeted under various components:

Solar home systems and village/community systems – Rural energy entrepreneurs, village level cooperatives, community institutions, NGOs will be targeted to act as project developers and managers.

Capacity building – This activity under the technical assistance component will target a range of stakeholders including government (Ministry of Energy and Mineral Resources, Rural Electrification Board); financing institutions and NGOs (IDCOL, Grameen, BRAC, Srijony, TMSS and COAST), 5-6 PBSs, village level SHS technicians who will receive training in various aspects related to project design, implementation, and technical issues and private sector suppliers of SHS equipment and related services.

[11] Reference: Nieuwenhout, FDJ, PJNM van de Rijt, and EJ Wiggelinkhuizen, 1998 Rural Lighting Services A comparison of lamps for domestic lighting in developing countries. Energieonderzoek Centrum, Netherlands

[12] Purely for academic purpose, the CO2 avoided on a lumen equivalence basis is also calculated to be 540,000 tons of C02 yielding about US$ 11/ton of Co2. Lumen equivalence basis treats one 20 W SHS system as roughly the light equivalent of 2 mantle lanterns.

2.4.6 Project execution

Implementation period: Five years (FY2003-2008)
Executing agencies: IDCOL , REB

The overall responsibility for project implementation will be with the Ministry of Energy and Mineral Resources, Power Division, Government of Bangladesh. However, actual project execution will be carried out by REB (for PBSs) and IDCOL (for NGOs, CBOs, private sector and MFIs).

(a) The REB will receive funding under the project (both IDA and GEF funds) from GOB, and will in turn on-lend these to the PBSs for purchase and installation of SHS in their respective selected areas. These SHS will be operated on fee-for-service basis and the GEF grant funds would be applied to initial cost of SHS to achieve corresponding reductions in monthly payments from the consumers to the PBSs. In addition to direct funding for SHS, REB will also execute the following technical assistance activities: (i) establishment and operation of socio-economic monitoring cell; (ii) capacity building of PBSs for SHS market promotion and project implementation, including standards for equipment supply, testing and certification; (iii) promoting productive uses of electricity; (iv) SHS demonstration and market promotion in PBS areas outside the five selected PBSs for future implementation; and (v) training of village level technicians.

(b) IDCOL will receive funding under the project (both IDA and GEF funds) from GOB, and will in turn on-lend these to the identified NGOs and MFIs for financing SHS systems. These SHS will be installed on direct purchase or hire-purchase bases and the GEF grant funds would be applied to initial cost of SHS to achieve corresponding reductions in monthly payments from the consumers to the MFIs. In addition to direct funding for SHS, IDCOL will also execute the following technical assistance activities: (i) capacity building of NGOs and MFIs for SHS market promotion and project implementation, including training where appropriate; (ii) market assessment and prospects for further SHS development; (iii) selection and registration of MFIs and NGOs, providing capacity building assistance for new NGOs/MFIs that are accepted during the course of the project; (iv) continued SHS demonstration and market promotion in new areas; and (v) implementation of pilot mini-hydro and wind energy pilot projects and possible development of commercial framework for mini-hydro and wind energy projects if pilots demonstrate feasibility. See Annex 4 for participants, roles and institutional arrangements.

2.4.7 Accounting, Financial Reporting and Auditing arrangements: The key point to stress is that all executing institutions under the project are or have been in the recent past involved in World Bank funded projects. The IDA III Rural Electrification project executed by REB and PBSs concluded in June 2000 with a 'highly satisfactory' rating. IDCOL is currently executing the credit line under the IDA Private Sector Infrastructure Development Credit, Grameen Shakti is financed in part by IFC, and the selected NGOs and MFIs receive IDA funds through the Palli Karmik Sahayak Foundation, an IDA-funded financial intermediary. Therefore, all these institutions have adequate accounting, financial management and reporting and auditing systems in place, and are in full compliance of Bank's fiduciary requirements.

The Credit Program Component

(a) The REB and IDCOL will maintain program-related records, incorporating, among other things, (i) classification and approval of PBSs and NGOs/MFIs to participate in the program; (ii) classification of subprojects by size and geographical distribution; (iii) approval of subprojects and disbursement made in respect thereof; and (iv) classification of subloans and grants approved by size, maturity pattern and geographical distribution.

(b) Both implementing agencies will maintain separate disbursement records and accounts with respect to each PBS/NGO/MFI under the Credit Program; keep on file supporting disbursement documents as well as bank accounts relating to disbursements; and maintain a Project Account. All records, documents and accounts are to be maintained in accordance with sound accounting practices for independent audits and for review by the Bank and GEF missions.

(c) Both implementing agencies will prepare/submit quarterly statistical reports on the Credit Program and other periodic reports (including semi-annual loan collection performance reports) as required by GEF and the Bank.

(d) An annual external audit is required of the Project Account and Special Account, and a separate opinion on Statement of Expenditures (SOEs), not later than four months after the close of each fiscal year.

(e) An annual external audit is required of each PBSs and NGO/MFIs financial statements, within four months of the end of the fiscal year, to confirm their continued compliance with the eligibility criteria and use of project funds.

Technical Assistance and Capacity Building Component

(a) The REB and IDCOL will submit to the Bank audited project expenditures (Statement of Expenditures and Special Account) within six months of fiscal year end as well as unaudited financial accounts within 4 months, and audited accounts within 6 months of fiscal year end.

(b) The REB and IDCOL will provide the Bank semi-annual reports on the TA and capacity building components presenting the progress achieved during the semester against the implementation plan agreed with the Bank from time to time.

2.4.8 Monitoring and Evaluation.

Monitoring and evaluation will be coordinated by the project management units in the REB and the IDCOL. The key performance indicators that will be gathered and assessed are summarized in logframe (Annex 1). IDCOL and REB will prepare semi-annual progress reports for review by the IDA. The IDA will comprehensively review progress in project implementation (including the performance indicators) twice per year. In addition to its regular supervision, IDA will jointly conduct a Mid-Term Review about three years after project

effectiveness. This Review will identify and disseminate best practices and constraints, if any, to project implementation, and find ways to address them.

The Credit Line Component

The Bank will examine and approve the eligibility of potential PBSs, NGOs and MFIs and monitor continued eligibility of these implementing agencies on the basis of: (i) periodic reports submitted by each agency through REB and IDCOL as the case may be; and (ii) periodic supervision missions (six-monthly in first two years and annually thereafter).

The Bank will also review the first two subloan proposals, irrespective of size, presented by each PBS or NGO/MFIs to REB and IDCOL respectively. The Bank will provide comments on subloan proposals promptly, and approve them as appropriate, assuring itself that they are consistent with the developmental objectives of the Project and Operating Policy Guidelines for the Credit Program and GEF Grant funds.

The TA Components

The Bank will oversee efficient implementation of TA components with a view to maximize desired outcomes, and follow its established procedures in terms of defining the work packages, approving procurement and supervising outputs. As part of preparation, a coordination group consisting of the key project personnel from all stakeholders is in place. The coordination group arrangement will be formalized for project implementation - to generate ideas, discuss strategies and monitor outcomes. The group will play a key role in articulating TA needs, terms of reference and implementation parameters, as well as monitoring the quality of TA outputs.

Social Benefits and Income Generation Impacts

One of the key aspects of the project is introduction of systematic monitoring of economic and social impacts of electricity access in Bangladesh. To this end, a socio-economic cell is being established in REB with the specific objective of: (i) compiling a socio economic database on variables of interest and conduct surveys/studies to determine specific impacts of electricity provision in rural areas; (ii) establish the framework for an institutional partnership to undertake initiatives for raising productive consumption of electricity and its increased use for social services delivery, and (iii) assist all implementing agencies and the Bank to monitor the project, oversee quality of outputs and measure outcomes.

The indicators proposed to be used include comparators on incomes of households with and without electricity, social services using electricity such as clinics, schools and community centers. Protocols for the evaluation methodology, data gathering and analysis and reporting will be identified and developed during the appraisal process and PDF B implementation. These will be reflected in the final project appraisal document.

2.4.9 Timing

Five years, with the initial two years for laying the foundation in which investments take place on a small level, after which the investments will gradually increase in volume.

2.4.10 Other Donor Involvement.

Involvement of other donors, notably bilaterals, is being explored. If donor cofinancing becomes available, these would be directed towards expanding involvement of PBSs and NGOs in taking the target beyond 60,000 SHSs. The project will coordinate implementation arrangements, particularly selection of target areas for SHS promotion, with UNDP in order to share learning and implementation experience from its GEF-funded MSP.[13]

2.4.11 Project Coordination

A reasonably effective donor coordination mechanism in the energy sector is operating in Bangladesh. For the main implementing agencies involved in this project, effective consultation and coordination arrangements are in place in the form of a consultative group consisting of all stakeholders, which was established during the project concept stage. The group, convened by CEO of IDCOL, meets regularly to exchange ideas, identify initiatives necessary for the project and informally monitor progress. The Bank's project team is an integral part of the consultative group. This coordination arrangement is planned to be formalized and entrusted with project oversight and supervision responsibilities. In addition, at a more disaggregated level, REB will coordinate the implementation of the project by PBSs, whereas, IDCOL will perform that role for the other institutions.

3. Justification and rationale for GEF support

3.1 Country Eligibility.

Bangladesh ratified UNFCCC on 4/15/1994.

3.1.1 Relevant GEF Operational Program.

The proposed project falls in GEF Operational Program 6 on Climate Change - promoting the adoption of renewable energy by removing barriers and reducing implementation costs. The project envisages a programmatic approach to strategically develop its renewable energy sources, especially solar, on a sustainable basis, providing these resources with a key role in Bangladesh's rural electrification and development strategy.

3.1.2 Rationale for GEF Project

The Government is committed to renewable energy development and increased access for rural areas. The sound rationale for this Bank/GEF project stems from: (i) complementation of ongoing operations in renewables (IFC support to Grameen Shakti and GEF assistance to UNDP MSP), leading to widespread applications for solar. This project will provide the necessary institutional and financial springboard to scale up the efforts on barrier removal and market

[13] The UNDP implemented MSP is titled 'Removing Barriers to the Widespread Application of Solar Energy Technologies in Offshore Islands of Bangladesh' and was approved by GEF in June 1999.

development; (ii) key interventions proposed for barrier removal will enable a sustainable and affordable proliferation of renewables in Bangladesh well beyond the term of this project; (iii) the Bank/GEF project will provide the entry point for more number of private sector stakeholders and introduce quality standards, competition in provision and micro-finance sustainability; and (iv) the unique learning and experience of GEF and its stakeholders from other countries can be brought to bear in developing workable solutions for Bangladesh's renewable energy development, such as use of the renewable energy information network (REIN).

3.2.1 Project alternatives considered and reasons for rejection:

With respect to grid based rural electrification there is hardly any alternative worth considering in the Bangladeshi context than the continuation of the successful REB/PBS model that has a proven track record over many years. However this model will be further developed and strengthened to address (a) limiting grid development to economically acceptable areas and (b) establishing the financial viability of PBSs. A main alternative to the project grid expansion philosophy is to allow BPDB to continue supplying the isolated 'pocket' areas and limiting PBS coverage to presently unelectrified areas. This alternative is rejected on account of BPDB's poor commercial and technical performance in these isolated areas.

With respect to the off-grid component, one alternative is to allow this development to be addressed only by commercial vendors. It is now well established (by experience in many countries) that provision by commercial vendors alone does not reach adequate number of lower income consumers. Furthermore Bangladesh has a wide network of successful NGOs and MFIs which can expand their activities to the rural energy field. The project envisages the participation of these institutions to develop a large scale coverage of SHS to the middle and lower income categories of rural populations (in addition to the high income groups). A further alternative is to leave the PBSs out of the SHS program. Such limitation is not considered desirable as, in the absence of alternatives and the pressures from prospective consumers the PBSs are now being more and more pushed to extended grid supply to unprofitable areas. Many residents within PBS territories are inaccessible to grid supply but can be provided electricity through SHS. The proximity of such communities to the existing PBS infrastructure would enable consumers to be serviced at least cost. Thus the SHS component includes the involvement of a variety of alternative suppliers, private dealers, NGO/MFIs and PBSs to enable the most widespread proliferation of this technology which is most appropriate to the low consumption patterns of rural communities.

3.2.2 Major related projects financed by the Bank and/or other development agencies

The following World Bank/GEF-supported projects have guided the design of the renewable energy activities proposed within this project:

- Indonesia Second Rural Electrification Project which supported five pilot mini hydro projects;
  and the Indonesia Solar Home Systems Project which followed private sector approach for solar home system development, involving commercial banks and regular businesses to develop the market.

- India Renewable Resources Development and the India Renewable Energy II Project which supported a range of renewable energy technologies with a heavy involvement of the Government.
- China Renewable Energy Development which will support large scale investment in Wind and Solar systems.
- Vietnam Rural Energy I which supported among other things the piloting of a cooperative owned micro hydro hybrid system.
- Uganda Energy for Rural Transformation Project which will establish a Rural Energy fund.
- Sri Lanka Energy Services Delivery Project which is providing support to renewable energy development through the commercial sector. For mini hydro projects the development of a standardized power purchase agreement was supported to streamline the negotiation process between the small entrepreneurs and the national utility.

3.2.3 Lessons learned and reflected in proposed project design

These lessons learned from these projects that are reflected in the design are:

- Participation of institutions with demonstrated success in rural development and micro-finance: The challenge of promoting renewable energy is substantial and should involve as many stakeholders as possible. This means private businesses, commercial banks, micro finance institutions, NGOs, research organizations, government agencies at different levels, donors, etc. Understanding the objectives, roles and responsibilities of the different institutions will accelerate the implementation of the project. The project relies on two well-functioning institutional structures – the PBSs and the NGOs/MFIs. The PBSs are already in the business of providing rural electricity through grid systems on a near-commercial basis. They have superior organizational and technical infrastructure and the PBS SHS program will follow their established commercial practice. The NGOs and MFIs are in the business of social mobilization and financing small, family-based income generating activities. The supply and financing for solar systems will utilize their established and successful business models.
- Participatory approach is essential: Ownership and understanding of the key issues facing the sub-sector is paramount in addressing them effectively. Workshops and consultative meetings are examples of how this could be achieved. This also results in building on existing infrastructure rather than designing a new one. Accordingly, a number of demonstration, awareness building and mobilization activities have been undertaken during project preparation. The design is flexible enough to promote increased participation by community based organizations.
- Capacity building in new markets is key to success: Development of the renewable energy market requires several years of capacity building, institutional set-up and rural infrastructure building before major acceleration can take place. This phase should be recognized and sufficient up-front funds should be available. TA activities planned under the project give high priority to capacity building.
- Grant is necessary, but grant criteria and application should be transparent and flexible: Grants should be managed transparently and designed according to performance indicators and co-financing principles. Given the low income levels in Bangladesh,

households face a high barrier in terms of initial capital costs of the system. Hence an initial grant-based buy-down of first costs would be necessary to promote the program and develop the market. Grant support is also required for investments in market promotion, awareness building, service delivery and training. In experience from other successful projects, it is clear that grant support enables solar programs to continue in a sustainable manner beyond the initial project targets. In this case, while the project goal is to meet electricity needs of about 60,000 un-electrified households, market assessments indicate a significant potential of over 4 million households. Both the PBSs and the NGOs would have to establish adequate infrastructure to assess market demand and ensure supply of good quality systems, to last well beyond the 60,000 systems that this project will support. Therefore, the initial infrastructure costs for the participating institutions are high and will need grant support. However, the grant regime would be flexible enough to accommodate changes during the project, consistent with the declining costs of putting delivery systems and institutional capacity in place.

- Making program eventually sustainable is essential: Global experience argues in favor of making programs sustainable and weaning them away from grants. Solar projects are seen to be sustainable if: (i) sound supply and financing mechanisms to satisfy households' energy demand effectively and in an affordable manner are developed; and (ii) appropriate delivery and service mechanisms are established by private vendors. Accordingly, the operational sustainability of this program will stem from creating sound delivery and service mechanisms, where none exist today. Once SHSs gain general acceptance, significant scale of operations are established, and well-functioning delivery systems are in place, the costs of supply will decline. Equipment costs are expected to decline as well, since locally available hardware and low cost alternatives will replace imported components. Increased business volume, both for suppliers and micro-finance institutions, would help reduce transaction costs per unit. Therefore, it is expected that the need for grant support will also decline over time. The GEF PDF envisages support for a comprehensive evaluation of sustainability aspects, including level of grant funding in future years of the project. Accordingly, the grant regime will be flexibly designed to accommodate changes during the life of the project.
- Sound financial engineering is a key ingredient for success: In Bangladesh, both the PBSs and MFIs are adopting tried and tested financial engineering solutions for reaching poor households. In the case of PBSs, under the current grid program, even households using less than 40 Kwh per month are regular in paying bills. This consumption at current tariffs represents a cost of about 150 taka per month, and the PBS fee for service tariffs per month are in the range of 250 takas. The established culture of bill collections would be promoted in the case of SHS fee-for-service as well. The MFIs are engineering the schemes on the basis of savings made in kerosene and battery charging and are flexible in exploring longer repayment periods 3-5 years (against established practice of 1-2 year loans). Key characteristics such as willingness and capability of consumers to pay and prior credit history are important considerations in selecting beneficiaries under the project.
- Leveraging private sector participation: In most projects in India, PV schemes (and small hydro and wind projects) have been developed in the non-government and private sectors, similar to approach being proposed for Bangladesh. However, the general reluctance of the commercial sector and suppliers in India to take rural credit risk has

limited the penetration of solar systems. Hence, the preference in Bangladesh to follow a time-tested rural micro-credit model that has fared well in other areas of community-driven development initiatives. Support for the micro-credit model comes from Sri Lanka, where the sale of solar home systems has risen dramatically since the leading rural micro-finance institution there – SEEDS - started playing an active role. Several of the project's proposed initiatives on barrier removal and capacity development are directly modeled on lessons learnt from Sri Lanka and India. Consistent with South Asia experience, the project intends to engage the PV industry as an active partner in developing and serving the solar market in Bangladesh. The current state of the PV industry in Bangladesh consists of a few dealers, but several major players have shown interest in entering the market through this project window. The project provides for TA to develop private sector partnership and introduce both quality standards and competitive provision of equipment and services.

3.2.4 Indicators of borrower commitment and ownership

The Government is strongly committed to increasing electricity access in rural areas. In fact, the constitution of Bangladesh requires the State to adopt effective measures to bring about rural transformation inter alia through electrification (Article 16). After a long history of reliance on REB/PBS led grid based development, the Government has recently expressed support for both renewable energy and private sector involvement. A renewable energy policy paper has been drafted and is under discussion at present (MEMR, the utilities and chambers of commerce and industry). This policy has provision for a number of incentives for renewable energy supplies including tax and import duty concessions.

As the first phase of the current project, the Government has approved a SHS project targeting 6,000 households in areas which will be inaccessible to the grid for some years to come. The proposed project components to be managed by REB will be based on these proposals for grid and SHS development. The concerned implementing agencies, REB/PBSs and IDCOL have completed preparation of Project Implementation Plans and mobilized and identified personnel for preparation and future implementation respectively.

3.2.5 Value added of World Bank and GEF support

The success of the rural electricity system model in Bangladesh has prompted widespread support from other donors, including ADB and JBIC. This is a welcome development since the investment requirements of this sector are very large. The Bank's comparative advantage does not therefore lie in providing investment resources, but in promoting substantial improvements in the policy framework necessary to facilitate both grid and off-grid solutions. With respect to the former, there is a tendency for grid expansion to be carried out to less and less profitable areas due to the strong pressures for electrification from rural populations and the availability of easy credit. Such costly expansion lowers the financial viability of many PBSs and places the whole program at risk. The Bank's involvement will enable the establishment of appropriate standards for selection between grid and off-grid options, and serve to rationalize investment decisions.

The financial strength of PBSs is expected to be protected by two other measures; suitable adjustments to PBS tariffs and additional income and reduced investment costs as a result of the

area rationalization exercise. The Bank's involvement will also help in establishing the appropriate initial policy regime for renewables, by involving not only the PBSs, but also the private sector, NGOs and non-PBS community organizations in rural electrification. Issues related to this component have already been extensively documented in two studies carried out under a wider Bank initiative. These include a market survey for SHSs and the feasibility of a SHS program in the context of alternative options. In addition to the experience gained during these studies, the Bank presence will facilitate wider consultations at the community level to add value in defining project concepts with a pro-poor, socio-economic focus.

The Bank has a history of success in working with CBOs, NGOs and MFIs in Bangladesh. The value-added of Bank and GEF support would enable extending this successful partnership to rural energy and renewables.

4. Issues requiring special attention

4.1 Economic Assessment

An economic assessment for the two project implementation scenarios – one by REB and one by IDCOL were conducted. The analyses, performed in constant dollars, over a lifetime of twenty years, with a discount rate of 12%, and without taxes and duties, shows that both options have a potential positive Net Present Value (after cost reductions), which indicates that both are sound investment opportunities for the country. This economic assessment is to be further confirmed and documented during the appraisal of the IDA project. The nature of benefits considered include: (i) reduction in kerosene and battery use; (ii) demonstration of commercially viable PBS or private sector/NGO executed project; (iii) mobilization of investment from the REB/PBS system and from MFIs and consumers; and (iv) reduced government investment in rural electrification through subsidized grid electrification. The costs include: (i) financing costs; (ii) installation and O&M costs; (iii) replacement and costs of spares. The analysis assumes that 14000 families in the case of REB/PBS and 50,000 in the case of IDCOL/NGOs will adopt SHS of varying sizes from 20Wp to 72 Wp over a five year period. Costs of systems range from US$ 185 to US$ 640, with a 20 year economic life.

The following table summarizes the key findings of the economic assessment.

(all amounts in US$ million)

Benefits	31.27
Costs	24.93
Net Benefits	6.35
ERR	21%

4.2 Financial Assessment

Initial financial assessments of the SHS program from the REB's and IDCOL's standpoint produce positive net cash flows and FIRRs in the range of 12%. The financial viability of financing for households is also established (see Annex 3b, Attachment A). From a project standpoint however, the key financial viability of MFIs is still being evaluated and detailed

financial analysis is under progress as the implementing institutions proceed to finalize their respective business and project implementation plans.

4.3 Technical Assessment

The solar home systems technology supported by the project is technically sound and its successful operation has been demonstrated worldwide, and in Bangladesh. While Bangladesh has limited experience in technical development and dissemination, reputed suppliers like Siemens and Shell Solar are exploring market opportunities in Bangladesh which would ensure availability of high quality products.

4.4 Institutional Assessment

Executing agencies

The grid components and the off-grid solar on a fee for service basis would be executed by REB and selected five PBSs. The non-PBS off-grid components will be executed through IDCOL and selected NGOs and MFIs. The PBSs function under the umbrella of the REB, which functions both as a quasi-regulator and a financial manager of the program and provides a wide range of technical and institutional support to the PBSs. Both REB and the PBSs have maintained a good track record in terms of operational and financial performance. IDCOL is a financial institution and company established under the Financial Institutions Act and the Companies Act respectively. It is the executing agency for the IDA sponsored Private Sector Infrastructure Development Project and has well established institutional, operational and financial management capacity and oversight mechanisms. The participating NGOs have been selected from a list of 38 such organizations based on: (i) performance and spread of their micro-finance activities; and (ii) degree of interest and proactivity in promoting solar energy to their members. A brief profile of the NGOs is provided in the attached table.

Selected Medium NGOs for SHS Program

1. BRAC was established as a relief organization in 1972 and has evolved into a large, multifaceted development organization with the twin objectives of poverty alleviation and rural empowerment. It launched a SHS program in 1997 and has to date installed 2250 systems covering 155 villages

2. GRAMEEN SHAKTI is a not-for-profit company and a subsidiary of the Grameen Bank, a pioneering, and now globally renowned rural micro-credit agency. The Grameen Shakti supplies and finances a range of renewable energy technologies – solar, wind and biomass. It has established 37 branches in 12 districts and has to date sold close to 5000 solar systems.

3. SRIZONI is a medium size NGO having micro-credit operation in 589 villages under 16 Thanas with 48,000 beneficiaries. It is using loan from PKSF[14] for micro-credit operations. SRIZONI is preparing for pilot scale SHS project and selecting areas for its beneficiaries.

[14] Palli Karmo Shahayak Foundation is a financial intermediary for rural credit in Bangladesh

4. TMSS is largely active in 90 Thanas of the Rajshahi division covering 2726 villages with 400,000 beneficiaries. It has a large micro-credit program, and is a partner organization of the PKSF. TMSS has already begun pilot scale SHS project for gaining field experience.

5. COAST is medium NGO with the main area of operation in the remote coastal regions with its head quarters in Bhola district. It has ongoing micro-credit operation with 25,000 beneficiaries. It has experience with SHS in the un-electrified coastal areas.

4.5 Project management

Project management of the REB/PBS activities will be carried out by the projects division of REB which has proved to be quite capable of addressing this aspect in the previous IDA projects. The non-PBS off-grid components will be managed by IDCOL which has been determined to have the required capacity and financial management systems. IDCOL is currently the executing agency for an ongoing IDA project – the Private sector Infrastructure Development Project. This project, IDCOL's project implementation capacity as well as its institutional development status are rated satisfactory.

4.6 Procurement issues

Direct procurement under the project would only be for goods and services to be purchased by REB. REB has a good procurement track record from previous Bank lending operations including use of SBDs. Procurement for on-lending projects (through IDCOL) would follow commercial practice.

4.7 Financial management issues

REB has demonstrated good financial discipline in previous projects and all audit reports (inclusive of those of PBSs) have been submitted in a timely manner without any major inconsistencies. With respect to the on-lending to NGOs/MFIs (IDCOL component) identification of appropriate credit mechanisms and terms and procedures will be determined and agreed to during project appraisal.

4.8 Social Assessment

There are no special issues to be addressed for social aspects under the project. The overall social impacts of the project are expected to be positive. The project promises several social benefits accruing from the increased access to electricity. One of the key project outputs is promoting higher levels of rural growth and poverty reduction, as well as socio-economic transformation and marked improvement in the quality of life in villages all over the country. In Bangladesh, social involvement in rural electrification is part of the cooperative system of delivery of electricity services. Member involvement in PBS administration is encouraged through a number of channels. Prior to formation of the PBS, members are involved directly in the organizational process with direct input provided via focus group meetings and membership drives. Member services personnel from REB organize membership committees to encourage community participation in the organization and formation of the PBS. Prior to energization and

for all years afterward, members are involved in election of board officers during annual general meetings. Members are kept aware of key issues by providing information in the form of customer information bulletins that are circulated when bills are distributed each month. Information is also distributed in area consumer meetings and through village electrification committees. The village "advisor program" is a relatively new arrangement where community leaders are invited to participate on a periodic basis with PBS member representatives to discuss the means by which customer concerns can be most effectively addressed by PBS management. The village advisors meet every six months and are most often selected from the community of school teachers serving their respective communities.

Another issue that is handled well by the REB/PBS electrification program is the coverage of households in an electrified village. The evidence from other countries indicate that more extensive coverage of rural households leads to greater equitability and higher returns. The 'area coverage' concept adopted by REB facilitates access and has proven quite successful in yielding satisfactory returns on investment in distribution assets. The project will build on these positive features and increase emphasis on 'intensification' of network coverage (i.e. more laterals rather than extended 'back bone' lines to new areas) to encourage greater electrification in the villages already supplied.

4.9 Environmental Assessment

The proposed project would yield net positive environmental effects. The off-grid electrification sub-projects would reduce use of kerosene and lead-acid automotive batteries. No significant negative impacts are envisaged from the run-of-stream village-hydro projects, because of their small size. No resettlement is envisioned because the project does not involve land acquisition or creation of transmission lines and reservoirs. Power generated from renewable energy sources would correspondingly reduce emissions from fossil fuel burning, with benefits to the local and global environment.

4.10 Participatory Approach

In addition to the strong participatory nature of the rural electrification program as outlined above, the involvement of community based organizations and micro-finance institutions like BRAC and Grameen would provide increased grass-root orientation.

A suitable consultative process is already established in the REB/PBS system of cooperatives. Involvement with NGOs will also be facilitated in developing non-grid components. The project will look to NGOs to assist in the delivery of renewable energy options for rural communities, either as project developers or promoter through technical assistance.

The project preparation process included extensive consultations with various stakeholders and participants. Two major studies were undertaken by the Bank and implemented through Bangladesh based NGO consultants for project preparation. In both these studies the consultants identified stakeholders from villages, PBSs and NGOs and organized discussions/demonstration visits. In several of these sessions, team members also participated. The meetings were open to all community based organizations in that area. Details of recent consultations, stakeholder meetings and SHS demonstrations are available in Annex 6.

4.11 Sustainability and Replicability

The sustainability of the project will mainly be depend upon the initiatives taken by the NGOs and the PBSs for market development. It has been assumed that the PBSs, medium and large NGOs will initiate market demand to allow the project to reach the desired goals. Only sufficiently lucrative market will encourage the suppliers and private sector to participate as multiple competitors, without which the efficiency to be gained with economies of scale can not be realized. Most important issue in the context of sustainability is therefore removal of the information barrier through an awareness buildup in selected project areas. Large scale awareness programs, media advertisement and other efforts for effective marketing drives should be launched to gain public support for the program well ahead of its field implementation.

Since the SHS program is functionally more decentralized than the conventional grid electrification programs, a key issue of sustainability is the local presence of competent institutions for project operation. This requires individuals with adequate training to reach the project areas effectively, especially during the initial periods. Mere presence and availability will not substitute for knowledgeable and trained personnel. Therefore operational sustainability of the program will be highly dependent on the effectiveness and management skill of the local organizations, and the training programs and assistance to be deployed by REB and IDCOL. Basic training programs listed in this report are initially identified as a guideline for preparation of training modules.

The sustainability of the solar project depends on: (i) developing supply and financing mechanisms to satisfy households' energy demand effectively and in an affordable manner; and (ii) Establishing sound delivery and service mechanisms.

Private sector suppliers will compete for the market if the solar business is developed along commercial lines. Under this project, the goal is to develop supply and financing systems that satisfy these criteria. On the supply side, two well-functioning institutional structures – the PBSs and the NGOs/MFIs – will be involved. The PBSs are already in the business of providing rural electricity through grid systems on a near-commercial basis. The use of solar systems by the PBSs to provide electricity to households in grid-remote areas will follow established commercial practice. The NGOs and MFIs are in the business of providing support and finance for small, family-based income generating activities. The supply and financing for solar systems will follow this successful institutional model. However, given the low income levels in Bangladesh, households face a high barrier in terms of initial capital costs of the system. Hence an initial grant-based buy-down of first costs would be necessary to promote the program and develop the market. This also implies investments in market promotion, awareness building, service delivery and training.

The operational sustainability of the program will stem from sound delivery and service mechanisms being established. The project would implement multiple delivery systems for SHS, pay-for-service, hire purchase and out right sales. While the project objectives are to meet electricity needs in about 60,000 un-electrified households, market assessments indicate a significant potential of over 1.7 million households for the 20W systems and over 430,000 households for 40W systems. Both the PBSs and the NGOs would have to establish adequate

infrastructure to assess market demand and ensure supply of good quality systems, to last well beyond the 60,000 systems that this project will support. This will entail working with suppliers to establish rural sale and service outlets and training sufficient number of local technicians who can participate in both sale and maintenance of systems. In parallel, the PBSs would have to establish consumer service, billing and collection systems for pay-for-service scheme, while the NGOs would need to do the same in respect of micro-credit provision. Practical problems associated with installation and maintenance of SHS in the remote locations should not be underestimated and the potential service providers should be encouraged to make realistic cost estimates for covering their operations. Therefore, the initial infrastructure costs for the participating institutions are high and will need grant support.

Once SHSs gain general acceptance, significant scale of operations are established, and well-functioning delivery systems are in place, the costs of supply will decline. Equipment costs are expected to decline as well, since locally available hardware and low cost alternatives will replace imported components. Increased business volume, both for suppliers and micro-finance institutions, would help reduce transaction costs per unit. Therefore, it is expected that the need for grant support will also decline over time. The PDF will be used to carry out a comprehensive evaluation of sustainability aspects, including level of grant funding in future years of the project. Accordingly, the grant regime is flexibly designed to accommodate changes during the life of the project. TA under this project will be used to carry out a study on replicability and recommend measures to be introduced in the latter part of the project.

4.12 Critical Risks

Project Outputs to Development Objectives	Rating	Risk Minimization Measure
Interest of PBS, NGOs and Private Sector in renewable energy wanes	Moderate	i) Training and capacity building; ii) Have a few best practices in place during first and second year of operation. iii) Reputational implication for NGOs iv) Timely dissemination of benefits
Pace of solar market development is slow	High	i) Appropriate interventions to address barriers with timely review ii) Flexibility to change based on learning
Project Components to Outputs		
Financial sector constraints affect implementation, such as interest rate changes reducing credit availability	Moderate	i) Select well established MFIs to participate in the program ii) Availability of credit line over life of the project
Technical Assistance does not benefit all stakeholders	Moderate	Close supervision and rigorous monitoring and evaluation
REB/PBS Procurement delays	High	i) Upfront procurement planning ii)Capacity building in procurement management

Overall project risk rating	Moderate

4.13 Possible controversial aspects

The impact of SHS adoption by rural consumers on proposed grid expansion has been discussed during project preparation. There are two controversial aspects: (i) would adoption of SHS by villagers deprive them of access to the grid?; and (ii) the timing of grid access to a village may render SHS investments unproductive. This is clearly one of the crucial design issues, and the project team discussed this issue in detail with the Rural Electrification Board during the pre-appraisal mission. The design offers several mitigation measures. Firstly, selection of areas for SHS under the PBS program has been done carefully and only areas not likely to receive grid connections in the next 10 years are chosen. Secondly, under the fee-for-service scheme, the PBSs can recover the systems if and when the grid becomes available in a SHS area and move them to other remote villages. Thirdly. the NGOs before targeting households for SHS also ensure that grid will not be available in the area as per the current PBS program for next 10 years. And finally, the project will explore the necessity and viability of providing buy-back programs. Coordination among the agencies with the information (REB, PBSs) and the institutions making the investments (IDCOL, NGOs, MFIs, private sector) is essential and the coordinating mechanism described earlier therefore, becomes very important.

ANNEX 1
Project Design Summary

Hierarchy of Objectives	Key Performance Indicators	Monitoring & Evaluation	Critical Assumptions
Sector-related CAS Goal	**Sector Indicators:**	**Sector/country reports:**	**(from Goal to Bank Mission)**
CAS goals Increase electricity access, improve efficiency and undertake sector reforms.	1.1 Households having electricity 1.2 Reduction in losses and improved financial performance of sector entities 1.3 Unbundling of utilities and introduction of independent regulation	PRSP indicators Socioeconomic surveys (by unit established in REB) (Note: This project and the blended project address only increase in electricity access and improved financial performance of rural electricity entities).	Macroeconomic conditions (related to the rural economy) are favorable and productive usage and modern energy facilities will lead to poverty alleviation and improved social conditions
GEF Operational Program Promote renewable energy by removing barriers	Greater adoption of renewable technologies and increase in the number of institutions providing it.	Project progress reports and supervision	Renewable energy investments protect the environment by reducing greenhouse gas emissions
Project Development Objective	**Outcome/Impact Indicators**	**Project reports:**	**(from Objective to Goal)**
The development objective of the IDA/GEF project is to increase rural access to electricity, to promote social development and economic growth.	The GEF Outcome indicators are: (i) Connected rural households with solar 2006: 27,500 HHs 2007: 44,800 HHs 2008: 64,000 HHs (cumulative numbers) (ii) Increase in incomes of HHs with electricity relative to HHs without electricity	REB socio economic monitoring unit surveys, project statistics, progress reports and supervision missions.	Rural consumers will use grid and off-grid supply for enhancing social and economic improvement
The GEF objective is to remove barriers to solar home systems market development and establish a framework for development of other renewables such as wind and hydro.	(i) same as (i) above (ii) increase in the number of institutions providing solar home system equipment, financing and services (iii) completion of assessment and commercial feasibility for wind and hydro	REB socio economic monitoring unit surveys, project statistics, progress reports and supervision missions.	Renewables are considered economically and socially as viable alternatives for rural electrification Barriers to renewable energy development have been correctly identified and targeted

Output from each GEF Project Component	Output Indicators:	Project reports:	(from Outputs to Objective)
1. Role of PBSs enhanced to provide off-grid electricity services to consumers through SHS	(i) PBSs develop capacity to handle SHS delivery in addition to grid supplies (ii) Number of SHS installed by PBSs 2006: 6000 HHs 2007: 9500 HHs 2008: 14000 HHs (cumulative numbers)	REB socio economic monitoring unit surveys, project statistics, progress reports and supervision missions.	PBS are committed and enabled to implement SHS program effectively
2. Promote role of NGOs/MFIs in providing SHS	(i) Build capacity within at least 5 NGOs/MFIs to implement SHS programs (ii) Number of SHS installed by NGOs/MFIs 2006: 21500 HHs 2007: 35000 HHs 2008: 50000 HHs (cumulative numbers)	REB socio economic monitoring unit surveys, project statistics, progress reports and supervision missions.	NGOs and MFIs will be able to promote SHS as a viable alternative to rural households IDCOL will be committed and enabled to coordinate and oversee the program.
3. Demonstration of commercial viability of wind and hydro projects	Completion of assessment and commercial feasibility for wind and hydro	Site inspections, commissioning, documentation and progress reports/supervision missions	Hydro and wind potential in Bangladesh can be commercially exploited Replicability of pilots for wider application

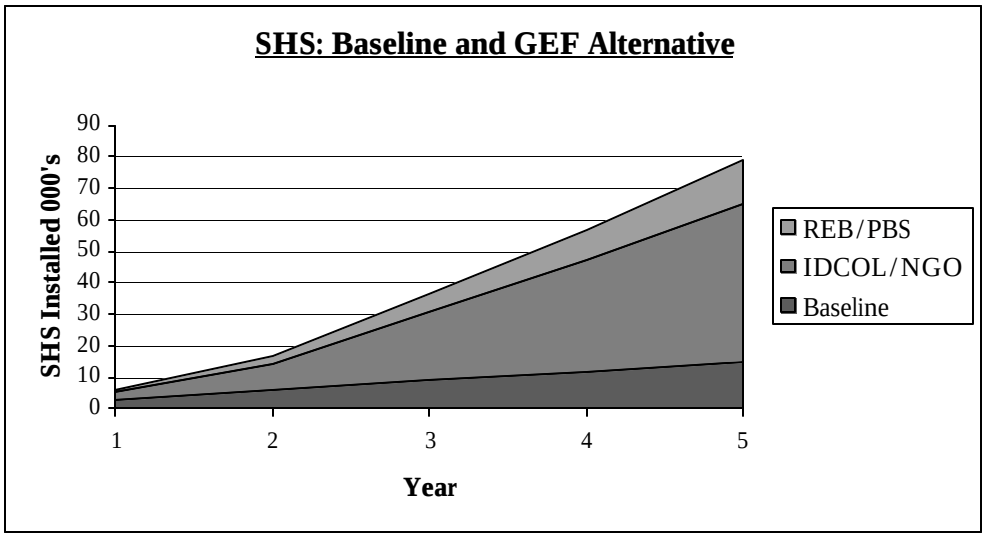
GEF Project Components/Sub-components	Inputs (budget for each component)	Project reports	(from Components to Outputs)
SHS program implemented by REB/PBSs	US$ 5.98 million IDA $3.43 million GEF 0.84 Consumers 0.57 Government 1.14	- Progress reports and disbursement reports - Supervision mission reports	Effective information dissemination and consumer service Rural consumers ability to pay for services Private sector providers and investors will participate in program
SHS implemented by IDCOL/NGOs/MFIs/pvt. sector	US$ 20.42 million IDA $12.16 million GEF 5.50 Consumers 2.76	- Progress reports and disbursement reports - Supervision mission reports	Sharing of learning and experience within NGOs/MFIs Adequate interest by local entrepreneurs and international solar industry Success of technical support measures Rural consumers ability to pay for services Suitable financing arrangements
Technical assistance for capacity building and demonstration projects	Total US$ 4.20 million IDA $1.56 million GEF 1.86 Government 0.78	- Progress reports and disbursement reports - Supervision mission reports	Barriers to market development are correctly identified Interventions to overcome barriers are timely and appropriate

Annex 2

INCREMENTAL COST MATRIX

For the description of the context, development goals, barriers, objectives, baseline, GEF alternative, and sustainability see text in main body. Below the incremental cost matrix based on this information.

	Baseline	Alternative	Increment
Domestic Benefits	Slow Solar market development. At best SHS installations by NGOs/MFIs without support may reach 15000 in the next 5 years.	Accelerate market development through support to NGOs, MFIs and Dealers. Estimated SHS installations in the next 5 years will be 50,000 systems through this approach.	Barriers (Information, first cost etc.) to commercial development removed. Strengthen PV capabilities within businesses and NGOs, increase consumer awareness and confidence, and provide a grant to buy-down first cost.
	Limited grid-extension by the PBSs/REB to provide access in rural areas. Demonstration of SHS applications in some areas.	PBSs implement a "fee for service" SHS Program for about 14,000 households in 5 separate PBSs in addition to the 50,000 SHS above. Total SHS 64,000 in 5 years. (see chart below)	In addition to measures described above, build capacity within PBSs to design, implement and evaluate SHS Programs.
	Limited development of PV business models; Service delivery through large NGOs such as BRAC only. Pay for service, dealer sales model only available in pilot areas.	Project promotes multiple approaches- feefor service through PBSs, sales through several NGOs, and direct sales by dealers.	Successful demonstration of a range of business approaches and incremental social awareness and acceptance for SHS.
	Slow development of other renewables including micro and hydro and micro wind	Support for hydro and wind market development and building an enabling policy/regulatory framework	Policy barriers to wind, mini hydro removed.
Global Environmental Benefits	Power development and rural energy service provision relies on batteries, diesel and kerosene.	Offset of GHG emissions through application of SHS	Nearly 250,000 tons of carbon dioxide avoided



	Baseline	*Alternative*	*GEF Increment*
Cost by Component	(million US$)	(million US$)	(million US$)
1a. Solar home system – investments (including implementation support and credit line management)	5.30	26.40	6.34
1b. Solar home system – technical assistance	0.0	3.90	1.56
2. Other Renewables – Technical Assistance	0.0	0.30	0.30
GEF Incremental Costs			8.20

Notes: (1)The Baseline scenario is a 'no project' scenario, because without GEF participation for barrier removal, IDA credit support and TA alone would not result in any significant change to SHS promotion. Therefore, baseline achievements are those expected from current initiatives by few institutions.
(2) The GEF Alternative scenario is based on IDA, GEF, GOB participation in barrier removal, credit and grant support.

Project Financing Plan

in US$ mln

	Consumer	Government	IDA	GEF	Total
REB/PBS					
SHS Investments	0.57	1.14	3.43	0.84	5.98
SHS T.A.	0.00	0.50	1.00	1.00	2.50
Other T.A. "(1)	0.00	0.00	0.00	0.30	0.30
Sub-total	0.57	1.64	4.43	2.14	8.78
IDCOL					
SHS Investments	2.76	0.00	12.16	5.50	20.42
SHS T.A.	0.00	0.28	0.56	0.56	1.40
Sub-total	2.76	0.28	12.72	6.06	21.82
Total	**3.33**	**1.92**	**17.15**	**8.20**	**30.60**

NOTE (1):Other TA for wind and hydro development

ANNEX 3a
STAP review

September 27, 2001

(by J. P. Painuly, Senior Energy Planner, UNEP Collaborating Centre on Energy and Environment (UCCEE), RISØ National Laboratory, Post Bag 26, Roskilde, DK- 4000, Denmark)®

Review of the document **"PROJECT BRIEF – BANGLADESH RURAL ELECTRIFICATION AND RENEWABLE ENERGY DEVELOPMENT PROJECT"**

Overall Comments: The proposal is well developed and comprehensive in nature. It seeks to accelerate penetration of solar PV home systems (SHS) in rural areas of Bangladesh building on the strengths of existing institutions and employing innovative measures to remove the barriers. Since the project targets the poor rural households with limited paying capacity, it may need to ensure that calculations of repayment requirements for the SHS and paying capacity are reliable. The project can benefit from the experiences in Africa and Asia where rural consumers have been targetted for solar PV usage. The project also explores potential for mini hydro and wind energy in the Bangladesh.

Project Relevance : Rural electrification is one of the important measure to improve quality of life and most of the target population is not expected to have access to electricity in near future in absence of the project. It is also in line with the Bangladesh Government strategy to promote off-grid options in such areas. The project meets the GEF funding criteria under its operational programme and also meets FCCC objectives of mitigating greenhouse gas emissions.

Background Information: It is presented fairly well in the document.

Other Features: The project takes a participatory approach in which various stakeholders are involved. This is very useful for resolving the problems and future extension of the concept. PV industry is not explicitly mentioned as an active partner. Their participation can be useful for training and confidence building about the product through maintenance contracts. Such maintenance can be done by local technicians trained by them. Capacity building is an important component of the project, which is useful for its large-scale application to realise the potential. Project is replicable and hence can contribute to climate change mitigation in other regions also.

The project should refer to the successful experiences in countries in South Asia and benefit from that.

Scientific and Technical Assessment:

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(i) **System selection:** It is very important that appropriate system is selected. A 20Wp system appears to be on lower side considering following factors:

- **(a)** The peak watt capacity normally refers to a radiation level of 1000 w/m^2 and 25^0 C. Performance falls at higher temperatures. Therefore, it is to be derated for available radiation level (which may be low during monsoon) and temperature.
- **(b)** Factors such as energy losses in the system, efficiency of the battery may result system performance upto 75% (Alsema, 2000). When you take various other effects also into consideration, actual output of a typical system may be less than half of rated value (Stamenic, 1995).

Therefore, a 20 Wp system may hardly be able to support two bulbs of 7W. Is it enough for the lower level identified in the project? It is possible if they were using only 2 kerosene lamps / lanterns. But in that case, they may be consuming 4 to 6 litres kerosene per month only. How much they will spend on this? Anywhere between $1 (if subsidized) to $2.5 (if no subsidy) per month. If they are spending $3.11 (as mentioned on page 11), they have more than 2 light points. In that case, 20Wp is not adequate. Similarly, 40Wp may be a poor substitute for those spending monthly $5.84 on kerosene for lighting.

Also, if the system is designed to meet minimum electricity demand, it may turn out to be insufficient to meet the expanding demand (with income growth) long before end of its working life. Currently, it is quite expensive to upgrade the system. In a recent study Lee (2001) assumes a 50 Wp system suitable for a household consuming kerosene about 10 litres / month. This may be too high but indicates that 20 Wp may be low.

(ii) **Financial assessment**: It is important that programme is financially viable for all the stakeholders; SHS users, suppliers, IDCOL, MFIs etc.

On page 11: Expenditure of US$3.11 per month over a period of 15 years yields $259 for level 1 and 487 for level 2 (it appears a discount rate of 12% was used). Cost of solar home systems is taken as $344 and 544 for 20 and 40 Wp systems.

Since break-up is not given, it is not clear whether all the costs have been factored in or not. These include system costs, installation costs, maintenance costs and financing costs. Financing costs can be quite high; IDA costs, IDCOL costs and MFI costs. MFIs typically lend at rates 18% and above unless special arrangement exists for SHS financing. Some of these are barrier removal costs but need to be accounted for.

3-5 year loans from MFIs are planned (page 8). Even if SHS level consumer were to be financed 100% ($259 loan + $85 subsidy), their monthly outgo to repay the loan will be many times their monthly expenditure on kerosene. This is because, they spend this amount over 15 years, but need to pay over 5 years. How is this problem sorted out ?

More detailed calculations on financial assessment for each stakeholder may throw light on all these issues.

(iii) Funding requirements for wind and mini hydro assessment, and pilot project have not been included in the proposal.

(iv) Data on diesel use for battery charging and how this will be substituted by SHS is not available in the proposal.

Global Benefits:

In the calculations of direct benefit, it is mentioned that 5.76 million litres of kerosene will be avoided. This works out to 8 litre per HH per month. (divide by 60000*12). This is not consistent with expenditure on kerosene ($3.11 and 5.84). The kerosene saved should be much higher.

Cost of carbon is given as $32.8 /ton CO2 (or $120/ t C). No calculations have been provided. Incremental cost and carbon cost calculations should be given.

The calculations on lumen equivalence basis may not be relevant considering the implicit assumption in this about triple kerosene consumption.

Editorial Comments:

1. Add a list of acronyms or expanded form when first used (for example for CAS on page 4 and PRSP on page 27).

2. Page 6, 2.2 Baseline: Baseline is also used for cost calculations. For clarity, please mention that in the baseline, these incremental households not covered by solar PV will continue to use kerosene (45-48000).

3. Page 10: What happens to SHS if grid comes in 5 years (to 10 years?). What is payment period for consumers? What about buyback of 5-10 year old ? What about result of this on GHG savings calculated ? These could be explored, if necessary.

4. Page 10: 2.4.2: Figures and headings on costs on page 10 and 29 are not consistent. Following discrepancy exists.

(A) In (i) ; SHS through NGO and MFIs: Figures are 11.16 and 4.5 against 12.16 and 5.5 on page 29. Also "finance 60000 SHS" should be changed to 50000 as on page 11 (2.4.3 (b)).
(B) In (ii) SHS through PBS: figures are 3.29 and .7 against 3.43 and .84 on page 29.
(C) In (ii) SHS through PBS: TA amount of US$1 million each mentioned is not reflected on page 29 in the component SHS programme implemented by PBS. This appears to have been added to the wrong component. See (A) above. Logically, this should have been added to last component on page 29 (technical assistance for capacity building and demo projects).
(D) For (iii); Development of framework for other renewable: No funding allocation is shown.

5. Page 12, last para: "The estimated cost of the TA component is a total of 4.2 million". But from page 10, total TA adds upto 1.56+1.56+2= 5.12 (from i and ii).

6. Page 19 Last Para: "In the case of PBSs, under the current grid program, even households using less than 40 Kwh per month are regular in paying bills and the cost of SHS fee-for-service is not likely to be much higher."

MFIs do have excellent record of recovery. But comparison with 40Kwh consuming HH is not relevant. This is because this (40 Kwh) represents almost 16times output provided by SHS (of 20W, 4 hours daily), allowing consumer to use TV and other appliances with the same amount.

7. Page 21, Economic assessment: Calculation details should be included (as Annexe).

8. Page 21, Financial assessment: Calculation details should be included (as Annexe).

9. Page 25, last para: "market assessments indicate a significant potential of over 1.7 million households for the 20W systems and over 430,000 households for 40W systems."

The above data indicates a total of about 2.13 million for 20 and 40W systems. Total market estimate is given as 4 million elsewhere (page 6). How is it arrived at?

References:

Alsema, E.A., E. Nieuwlaar, 2000. Energy Viability of Photovoltaic Systems. Energy Policy 28 (14): 999-1010.

Lee, Robert F., Ian Simm and Bruce Jenkyn-Jones, 2001. "Could carbon financing appreciably accelerate the diffusion of Solar Home Systems?", PCF Plus, Washington DC.

Staminic L and G. Ingham, 1995: Solar Photovoltaic Revolution. A Canadian Handbook for Electricians, Engineers, Inspectors and Builders. Sunology International Inc. Vancouver B.C. Canada.

Annex 3b

Response to the STAP Review

The STAP review generally endorses the project and commends some of its key features, such as participatory approach and replicability.

In response to the comment about referring to South Asia experience on renewables, the Project Brief describes a broad range of lessons learnt from various projects, including those from South Asia. The principal experience in this regard is from India and Sri Lanka. In most projects in India, PV schemes (and small hydro and wind projects) have been developed in the non-government and private sectors, similar to the approach being proposed for Bangladesh. However, the general reluctance of the commercial sector and suppliers in India to take rural credit risk has limited the penetration of solar systems. Hence, the preference in Bangladesh to follow a time-tested rural micro-credit model that has fared well in other areas of community-driven development initiatives. Support for the micro-credit model comes from Sri Lanka, where the sale of solar home systems has risen dramatically since the leading rural micro-finance institution there – SEEDS – took an active role. Several of the project's proposed initiatives on barrier removal and capacity development are directly modeled on lessons learnt from Sri Lanka and India.

Regarding the comment on the positive role of the PV industry, the project intends to engage the PV industry as an active partner in developing and serving the solar market in Bangladesh. The current state of the PV industry in Bangladesh consists of a few dealers, but several major players have shown interest in entering the market through this project window. The project provides for TA to develop private sector partnership and introduce both quality standards and competitive provision of equipment and services. Based on experience in other countries in South Asia, this would help to develop strategic plans for greater coverage, better service, and possibly lower costs.

The following responses broadly follow the ordering of the comments in the review note (Annex 3a):

(i) System selection: We completely agree with the comments. Intuitively one would believe that low income rural families in Bangladesh would be able to afford only 20Wp systems. However a growing body of implementation experience and feedback from NGOs and micro-finance institutions (MFIs) is producing a different picture. 36Wp and 40Wp systems appear to be preferred over the 20Wp systems. This is also the experience from Sri Lanka where consumers like to upgrade 20Wp systems within a few weeks of installation and the market share of 20Wp systems is declining. This latent preference for higher watt systems explains to some extent the ambiguity reflected in the report. The analysis conducted during preparation is based on 20 and 40 watt peak systems; however the delivery systems and business planning is likely to stress 36-50 Wp sizes and higher, both for fee-for service schemes and MFI credit programs. Eventually, as the implementing agencies finalize their business plans and the PDF B is mobilized to enable NGOs to prepare marketing programs, a more appropriate selection of system sizes would emerge.

From an analytical standpoint, it is to be noted that the US$ 3.11 value for households stems from costs of both kerosene and battery maintenance and charging costs. Batteries are extensively used in rural Bangladesh. The cost of charging a battery approximately every 15 days, along with associated transport and time costs (often boat journeys involving several hours) is in the range of 250-400 takas per month (about 4-6 US$). The US$ 3.11 and US$ 5.84 values are average estimates of a range of lighting and battery use options. Clearly, households used to employing batteries would not be satisfied with a 20Wp system, which is consistent with earlier statements regarding preference for larger systems.

(ii) Financial assessment: Attachment A illustrates cash flows for a household purchasing a 40Wp system with 3 year credit from MFI with a grant element of US$ 90. The calculations take into account all the costs, including taka 800 per year for maintenance, and taka 7000 every five years for battery replacement and other spares. The life of the panel and controller is taken to be conservative 15 years (it can be upto 20 years) and a 20% equity contribution by the consumer is factored. The net cash flow for the

HH is positive, with an FIRR of 13%. In the first three years, besides the equity contribution of 4000 takas, the HH has to pay out nearly 165 takas per month over and above the savings realized on kerosene and battery charging. From the 4th year onwards there is a net saving. The pattern of financing is not different from practice being followed by MFIs for other activities, where loans range from 1-3 years. In order to account for the fact that the solar system does not generate additional incomes, the project will try to encourage MFIs to lend for 5 years in order to make systems more affordable. Detailed business planning work is currently underway to determine the financial viability of each enterprise (NGO and/or MFI) and PBS in providing systems, credit and services to consumers. The reviewers advice of taking account of all costs to the HH are duly noted. The outcomes of the detailed business planning will determine the nature and extent of financing criteria under IDA credit lines to the implementing institutions and the financing terms to consumers.

(iii) Funding requirements for wind and mini hydro assessment, and pilot projects have been included. These are shown as 'Other TA' in the Project Financing Plan in Annex 2. The GEF provision is US$300,000, and if assessments indicate positive potential, IDA funds would also be available to develop and implement pilots and establish commercial framework.

(iv) Data on diesel use for battery charging is difficult to ascertain with a reasonable degree of confidence in Bangladesh. The reasons are several, the main ones being (i) battery charging stations are largely operating in the informal sector; (ii) in many places these are operated through grid connections, and grid power uses a mix of natural gas, diesel and hydro for generation; (iii) seasonal variations in availability and cost of battery charging facilities is very high, e.g. in the flood season, many centers would be inaccessible and households would also move to flood and cyclone shelters. Hence, the estimates worked out for carbon savings are probably on the low side as savings from diesel use for battery charging has been ignored. The number of battery charges vary from 20-27 per annum, and the levelized monthly costs therefore range from US$2.1 p.m. to US$ 3.3. The incremental cost calculation takes an average for 23 charges leading to a levelized cost of US$2.85 per month* for the equivalence of a 40Wp system. Please see details in Attachment B. (* this has resulted in a slight correction in valuing benefits for determining incremental costs – the 40Wp equivalence is now valued at US$5.51 instead of US$5.84 previously. This results from taking an average view on the number of battery charging by HH annually)

Global Benefits:

As mentioned earlier, the cost savings of US$3.11 and US$5.51 are worked out on the basis of kerosene usage and actual costs of battery charging. Incremental cost calculations and carbon benefits are shown in Attachment B. The point about calculations on lumen equivalence basis not being relevant is well taken, these are furnished for illustrative purposes only. Text in the project brief has been amended to reflect this.

Editorial Comments

The comments are gratefully acknowledged and the inconsistencies have been addressed in the report. Some specific responses on substantive issues raised follow:

3. Page 10: *What happens to SHS if grid comes in 5 years (to 10 years?). What is payment period for consumers? What about buyback of 5-10 year old ? What about result of this on GHG savings calculated ? These could be explored, if necessary.*

This is clearly one of the crucial design issues, and the project team discussed this issue in detail with the Rural Electrification Board during the pre-appraisal mission. Selected areas under PBSs are not likely to receive grid connections in the next 10 years. Under the fee-for-service scheme though, the PBSs can recover the systems in an electrified village and move them to other remote villages. The NGOs before targeting households for SHS also ensure that grid will not be available in the area as per the current PBS program for next 10 years. However, the project will explore the necessity and viability of providing buy-back programs.

6. Page 19 Last Para: The comment is: *"In the case of PBSs, under the current grid program, even households using less than 40 Kwh per month are regular in paying bills and the cost of SHS fee-for-service is not likely to be much higher." MFIs do have excellent record of recovery. But comparison with 40Kwh consuming HH is not relevant. This is because this (40 Kwh) represents almost 16times output provided by SHS (of 20W, 4 hours daily), allowing consumer to use TV and other appliances with the same amount.*

The 40kwh per month example is used for comparison with PBS fee-for-service scheme only. This consumption at current tariffs represents a cost of about 150 taka per month, and the PBS fee for service tariffs per month are in the range of 250 takas. A willingness to pay in this range in unelectrified villages has been clearly established through surveys. The MFIs on the other hand are using the savings from kerosene as the basis for the viability of financing the SHS and no equivalence with 40 kwh consumption is imputed. The text has been reworded to remove this impression.

7. and 8. Calculation details in respect of economic and financial assessment are not included in the interest of keeping the report to a reasonable length, but are available for review. These are being provided to the STAP reviewer.

9. Estimations of solar market demand: The demand numbers are based on two field studies carried out in Bangladesh over the last 3 years. The various inconsistencies on assessed demand in the report have been addressed. The overall picture is as follows: Nearly 4.8 million households earn more than US$50 per month. Of these, HHs that spend more than US$ 3.11 per month and US$ 5.51 per month on battery charging and kerosene costs are 36% and 9% respectively. This provides about 1.70 million HH that can potentially purchase a 20Wp system, and 0.43 million households that can potentially purchase a 40Wp system, with some grant support. The market for 20Wp and 40Wp systems is therefore assessed as 2.13 million. The figure of 4 million systems is an approximation of HHs earning more than US$50 per month and not connected to the grid, without considering current expenditures on kerosene and battery charging. In order to reduce confusion with different estimates, the report now uses only the 2.13 million HHs number consistently.

Attachments:

Attachment A: Financial Assessment for HH adopting SHS
Attachment B: Incremental Cost Analysis and Global Carbon Benefits

Attachment A

Financial Assessment of SHS By Households

Figures in Taka

Assumptions

Exchange Rate (Taka/$)	57	
Discount Rate	12%	
Interest Rate (Flat)	15%	
Repayment Period	3	Years
Savings from kerosene/battery charging	$0.15	$/Wp/Month
Equity Contribution	20%	
Grant	$90	
Capacity of System	40	Wp
Cost of System	20,000	
Recurring 5 year costs	7,000	
Other Service and Maintenance Cost (P.A)	800	
System Life	15	Years
Equity	4,000	Taka
Grant	5,130	Taka
Debt	10,870	Taka
Annual Debt Service	5,254	Taka

Year	Equity	Debt Service	Recurring Costs	Service Costs	Total Costs	Savings	Net Flow
0	(4,000)				(4,000)		(4,000)
1		(5,254)		(800)	(6,054)	4,104	(1,950)
2		(5,254)		(800)	(6,054)	4,104	(1,950)
3		(5,254)		(800)	(6,054)	4,104	(1,950)
4				(800)	(800)	4,104	3,304
5				(800)	(800)	4,104	3,304
6			(7,000)	(800)	(7,800)	4,104	(3,696)
7				(800)	(800)	4,104	3,304
8				(800)	(800)	4,104	3,304
9				(800)	(800)	4,104	3,304
10				(800)	(800)	4,104	3,304
11			(7,000)	(800)	(7,800)	4,104	(3,696)
12				(800)	(800)	4,104	3,304
13				(800)	(800)	4,104	3,304
14				(800)	(800)	4,104	3,304
15				(800)	(800)	4,104	3,304

NPV of Inflows	27952
NPV of Outflows	(27626)
NPV of Flows	326
FIRR	13%

Attachment B

Incremental Cost Analysis and Global Carbon Benefits

(i) Incremental Cost Analysis:

					Life Cycle Cost Calculations	
	Exch rate	57 tk/$				
	Disc rate	12% p.a.		Year	20Wp	40Wp
	Life Cycle	15 years		0	12000	20000
				1	600	800
		20Wp	40Wp	2	600	800
				3	600	800
Life Cycle Costs of SHS				4	600	800
Cost of system	Takas	12000	20000	5	4600	7800
Cost of system	US$	210.5	350.9	6	600	800
Life Cycle Costs (15 years)	US$	344.6	555.7	7	600	800
				8	600	800
				9	600	800
Traditional costs (levelized)				10	4600	7800
Kerosene use	US$/month	1.59	2.66	11	600	800
Battery charging	US$/month	1.52	2.85	12	600	800
Total	US$/month	3.11	5.51	13	600	800
Total life cycle costs (15 years)	US$	259.1	458.7	14	600	800
				15	600	800
				LC		
Incremental costs	**US$**	**85.5**	**97.0**	costs	19,644.12	31,674.49

Note: Kerosene use and battery charge savings are based on findings of an ongoing study 'Bangladesh Solar Home Program Preparation' still in draft - being prepared by Prokaushali Sangsad Ltd; Bangladesh. The report equates 20 Wp system to using 2 kerosene wick lanterns with 5 years life, consuming 5 liters of kerosene per month, yielding a levelized monthly cost of US$ 1.59 for lighting plus an additional US$1.52 for battery use. The corresponding figures for the 40 Wp equivalent are 4 lanterns, 8 liters of kerosene per month, US$2.66 for kerosene and US$ 2.85 for battery use.

(ii) Global Carbon Benefits:

A recent paper on rural lighting[•] provides the following emission figures for kerosene fueled lamps and other lighting sources.

Non electric Lights	Watts	Lumens Output	Klmh per KgOE	Klmh per kWh	CO2 g/hr	SOX g/hr	NOX g/hr
Paraffin Candle	60	11.8	2.33	0.20	31.4	0	0.001
Kerosene Wick	118	11.4	1.15	0.10	61.3	0.193	0.002
Kerosene Hurriucane	198	32	1.92	0.16	103.2	0.325	0.004
Kerosene Pressure	1380	2040	17.53	1.48	717.6	2.263	0.038
60 Watt Lamp on Coal Grid	60	840			65.5	0.504	1.250

Thus for the kerosene wick lamp, the CO2 avoided would be approximately as follows.

[•] Nieuwenhout, FDJ, PJNM van de Rijt, and EJ Wiggelinkhuizen, (1998) Rural Lighting Services - A comparison of lamps for domestic lighting in developing countries. Energieonderzoek Centrum, Netherlands

61.3*4hrs*365days*15years = 1,342,470 or 1.342 metric tons per lamp replaced in a household.

(This is also approximately the same amount of CO2 avoided from replacing a 60 watt light bulb powered by the grid. You can see that the kerosene pressure lamp produces 10 times more CO2.)

Assuming on an average 3 wick lamps replaced per SHS, the total Carbon dioxide savings are

1.342*3 systems*64,000 systems = 257,664 tons over life,

or 8,540,000/257,664 = 33.1 $/ton.

(GEF costs are: US$ 8.2 million for the blended project and US$0.34 for the PDF B)

Annex 4

Blended Project Description

The Grid component of the project will support: (i) expansion and intensification in areas currently under the PBSs; (ii) distribution area rationalization and rehabilitation of networks in new areas taken over by the PBSs; (iii) technical assistance for REB/PBS institutional development, financial restructuring, income generation, socioeconomic programs and poverty reduction aspects of electricity provision. The Grid component will be implemented by the REB. The off-grid component will support provision of electricity through: (i) financing and grant mechanisms for SHS through PBSs, NGOs and MFIs; (ii) financing of private sector remote area power supply systems (RAPSS); (iii) technical assistance for promotion of solar home systems and development of RAPSS; and (iv) development of pilot wind and micro-hydro potential. The table summarizes project components, costs and financing plan.

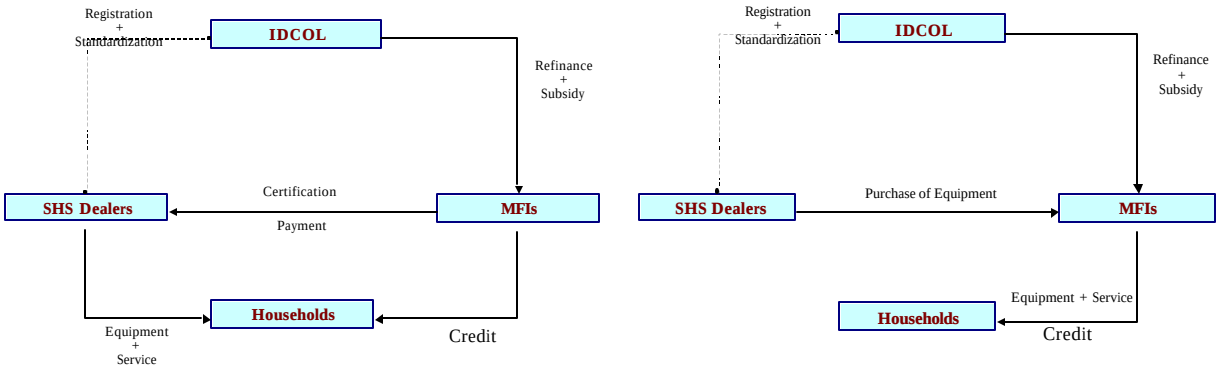
Blended Project : Financing Plan

Component	Indicative Costs (US$M)	IDA financing (US$M)	GEF financing (US$M)	Government and others
Grid: REB and PBSs				
Grid expansion/intensification - PBSs	110.00	90.00	N.A.	20.00
Rehabilitation of new taken over areas	35.00	25.00	N.A	10.00
Technical Assistance	4.00	3.20	N.A	0.80
Sub-total	***149.00***	***118.20***	***N.A.***	***30.80***
Off-Grid: Solar, RAPSS, wind/hydro				
SHS Investments and TA	30.30	17.15	7.90	5.25
RAPSS Investments and TA	8.00	5.00	N.A.	3.00
Wind and Hydro Development	0.30	0.00	0.30	0.00
Sub-total	***38.60***	***22.15***	***8.20***	***8.25***
Total Project Costs/Financing	**187.60**	**140.35**	**8.20**	**39.05**

Annex 5
IDCOL PROGRAM – INSTITUTIONAL SET-UP

There are four different types of participants that will be active in the Project implementation. The participants as well as their roles are identified in the Figure A-1 below.

Figure A-1
Participants and Their Roles[15]



(a) Role of IDCOL: IDCOL shall implement the Project by:

- On-lending credit and passing through subsidy;
- Establishing and updating equipment and service standards;
- Providing registration of SHS dealers based on agreed criteria;
- Approving MFIs for participation as per agreed criteria;
- Managing technical assistance for programme and institutional development; and
- Carrying out 4 types of checking to ensure compliance (through independent consultants engaged from an approved list) in following areas:
  - 100% design verification of suggested equipment as per specified standards, based on test certificates;
  - Random physical verification of systems and cross check with serial number quoted in refinance application;
  - Random technical verification to check system performance and site interview householder for satisfaction with service; and
  - Receive and investigate specific complaints.

(b) Role of MFIs: MFIs shall play the following roles:

- Identify households based on credit worthiness;
- Prepare SHS installation programme in partnership with SHS dealers;
- Approve credit based on application and deposit on equity margin;
- Verify system installation as per standards and borrower satisfaction;
- Upon certification, release payment to dealers after 30 days of installation; and

[15]Two models are proposed in Figure A-1. On panel A, SHS dealers assume the responsibility of supplying and installing SHS and providing required warranties. On panel B, MFIs themselves procure equipment from SHS dealers and provide warranties--the prevailing practice in Bangladesh. Participants' roles are described in this Annex based on panel A.

- Furnish periodic reports to IDCOL.

(c) Role of SHS Dealers : Dealers shall play the following roles:

- Furnish to IDCOL credentials to participate in the programme;
- Specify equipment and relevant test certificates for IDCOL's review;
- Complete registration;
- Identify households in partnership with MFIs and help complete application;
- Following credit approval by MFI, install system;
- Claim payment from MFI (borrower's equity, loan, and grant);
- Establish and maintain service/spares capability in programme villages (to be checked by MFI and IDCOL);
- Provide 10 years warranty on module and 1 year warranty on balance equipment, e.g., battery and light;
- 30 day money back guarantee if customer changes mind (no reasons required); and
- Buy back scheme if grid supply received within 3 years as per declining scale (although this is not a programme requirement, but suppliers may offer this as a marketing tool).

Eligibility of supplier to participate in the programme will be subject to on going compliance with agreed equipment and service standards. There shall be no restriction on entry of suppliers and any tender and procurement of systems by MFIs or IDCOL.

(d) Role of Households : Households shall play the following roles:

- Contribute equity up front;
- Own and operate the system as instructed; and
- Regularly pay debt service to MFIs.

Annex 6
Recent Record of Stakeholder Meetings and Consultations

Meetings with Stakeholders:

A series of meetings was held by the consultants with the potential stakeholders and relevant agencies. These meeting took place in the PBS offices, REB HQ in Dhaka, NGO offices in the districts and HQ in Dhaka and in PSL office in Dhaka. Dated list of meetings held are given below.

PBS/REB Meetings

Date of Meeting	Individual meetings	Regional meetings
March 13th	Mr. Samad, REB, Dhaka	
March 22nd	Mr. Halim Mollah, REB, Dhaka	
March 28th	Natore PBS 1	
March 28th	Natore PBS 2	
March 29th		Barisal PBS 1
April 4th	Comilla PBS1	
April 7th		Shirajgonj PBS
April 22nd	REB Board of Directors	

Meetings at NGO field offices and operation areas:
Following preliminary selection of the NGOs a short list was prepared for the SHS program. Selected NGOs of different districts were visited as shown below:

Date	**District**	**NGO Name**
March 26th	Barisal	Rural Development Organization (RDO)
March 27th	Barisal	Bikolpo Unnayan Karmashuchi (BUK)
March 29th	Bogura	Uttara Development Program (UDP)
March 29th	Bogura	Thangamara Mohila Shobuj Shangha (TMSS)
April 4th	Comilla	AID Comilla
April 4th	Comilla	DRISTI
April 4th	Comilla	ACD
April 6th	Bogura	Thangamara Mohila Shobuj Shangha (TMSS)
April 12th	Jhenaidah	SRIJONI
April 17th	Bhola	COAST
May 2nd	Jhenaidah	SRIJONI
May 3rd	Bhola	COAST

Meetings with NGOs and other offices in Dhaka

Meeting were held with the following organizations in Dhaka:

Date		
March 11th	Dhaka	BASIC Bank
March 12th	Dhaka	IDCOL
March 12th	Dhaka	PKSF
March 14th	Dhaka	South Asia Partnership (SAP) Bangladesh
March 15th	Dhaka HQ	ASA
April 1st(?)	Dhaka PSL office	Rahimafrooz
April 14th	Dhaka HQ	SAP Bangladesh
April 14th	Dhaka Liason office	SRIJONI
April 15th	Dhaka HQ	Grameen Shakti
April 15th	Dhaka	IDCOL
April 16th	Dhaka PSL office	SRIJONI
April 16th	Dhaka HQ	BRAC
April 18th	Dhaka PSL office	TMSS
April 22nd	Dhaka PSL Office	COAST
May 13th	Dhaka PSL Office	RDO

Regional Meetings at the PBS Offices:

Two regional meetings were held to discuss the technical, financial and management requirements of a SHS program. The first meeting was held in Barisal PBS 1 on March 29th,. PSL team consisted of H. Khan, A. Huque, L. Kabir, Md. Nasiruddin and M. Das accompanied by Mr. Raihan Elahi of the World Bank Dhaka Office visited Barisal PBS-1. They attended a meeting of PBS General Managers, other officers and the Board of Directors of the PBS. The GMs from Barisal PBS-1, Barisal PBS-2, Jhalokathi PBS, Pirojpur PBS and other PBS/REB officials were present. A list of participants is given below. Among others, retainer engineer, members of executive body and AGM of Bhola.
Similar meeting was held in Sirajgonj PBS. Detailed discussions were held in the PBS meetings on the installation, operational and maintenance requirements of SHS, and how the existing structure of the PBSs would meet the needs. By filling up questionnaires the participants responded on the training requirements for service delivery by the PBSs. Operation of a SHS was demonstrated in these meetings in order to provide background information on SHS hardware description, their availability and necessary standards. As a part of the operational requirements, the consultants discussed the possible arrangements for buy back of SHS following future grid electrification, and possible action against un-paid monthly bills. In order to facilitate information dissemination and publicity for SHS, site visits were also made to selected areas. In both the regional meetings list of potential areas for SHS implementation was collected from the PBSs, and recommendations were collected in the meetings through questionnaires. Barriers to SHS implementation were identified with probable solutions for their mitigation. Operation of a SHS were also demonstrated in the meetings at the PBS head quarters in Barisal 1 and Shirajgonj on March 29th and April 7th respectively.

Meeting held in Sirajgonj on April 7th was represented by Shirajgonj PBS, Natore PBS 1, Pabna PBS 1, Pabna PBS 2. During the discussions the General Managers of the PBSs took the lead in identifying areas which had potential for SHS.

Demonstration for SHS to the Potential Consumers

Following preliminary selection of areas, potential sites were visited to demonstrate the operation of two operating Solar Home Systems with controller, batteries and lamps. In some cases, the PSL team was also accompanied by the PBS staff. Temporary demonstration units were installed in public spaces of suitable locations in the un-electrified remote areas. Discussions were held with local people answering their queries on the prospects of SHS and its independence from the grid extension plans. Possible financial requirements and service options were also introduced during these demonstrations done in 10 locations. Demonstration and discussions were held in the following locations:

Barisal PBS-1

Date of Demonstration	Name of the Thana	Name of the Union	Village /Market Name
25th March 2001	Hizla	Memania	Takerhat
26th March 2001	Hizla	Hijla Gourabdi	Ekata bazar
1st April 2001	Hizla	Hijla Gourabdi	Aligonj
2nd April	Mehendigonj	Gobindapur	Kaligonj bazar
3rd April	Mehendigonj	Ulania	Ulania high school

Sirajgonj PBS

Date of Demonstration	Name of the Thana	Name of the Union	Village /Market Name
6th April	Ullapara	Udhunia	Udhunia bazar
7th April	Shajadpur	Kayempur	Kayempur bazar

Pabna PBS-2

Date of Demonstration	Name of the Thana	Name of the Union	Village /Market Name
9th April	Pabna Sadar	Dogachi	Komarpur bazar /high school /Collage
10th April		Char Taraarapur	Nabin bazar
11th April		Dhalar char	Dhalar char junior high school