Evaluating the Potential for Scale-Up of Off-Grid Renewable Power

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CONTENTS

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ACRONYMS

AFRREI	Africa Rural and Renewable Energy Initiative, World Bank
ASTAE	Asia Alternative Energy Program, World Bank
CBO	community-based organization
CPC	community power corporation
ESMAP	Energy Sector Management Assistance Program, UNDP/World Bank
FAO	Food and Agriculture Organization, United Nations
GEF	Global Environment Facility
GVEP	Global Village Energy Partnership
IDA	international development agency
IEA	International Energy Agency
IFAD	International Fund for Agricultural Development, United Nations
IFC	International Finance Corporation
MCF	Million Connections Fund
MDG	United Nations Millennium Development Goals
NGO	non-governmental organization
PAD	project appraisal document
PID	project information document
PV	photovoltaic
PVMTIIFC	Photovoltaic Market Transformation Initiative
RE	rural electrification
SHS	solar home system
SMB	small modular biopower
SME	small and medium enterprise
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNF	United Nations Foundation
WBG	World Bank Group
WHS	Wind Home System
WSSD	World Summit on Sustainable Development

EXECUTIVE SUMMARY

STUDY OBJECTIVES

International Resources Group (IRG) was tasked by the World Bank to undertake a short study of the experience and potential roles of the World Bank Group in scaling up access of off-grid communities and enterprises to renewable energy-based modern energy services. The scope of this study is limited to a small component of rural electrification activities in developing countries, and primarily to Bank projects (see Annex 1 for consultant terms of reference). It does not address the broad challenges of bringing access to modern energy services to 400 million unserved households. Rather, it explores how the World Bank can further facilitate expansion of renewable energy-based electricity services by commercially based enterprises, including private companies, parastatal agencies, NGOs, and rural electric cooperatives.

The objectives of the IRG study were to: (1) review and characterize on-going and pipeline Bank Group projects that have off-grid energy supply components, and to estimate the outcomes they are likely to achieve; (2) conduct a similar review for planned Bank Group projects; (3) identify countries and regions most suitable for World Bank scale-up initiatives; and (4) draw conclusions from the first three tasks on the potential World Bank role(s) in scale-up. Within the context of the above four objectives, the Bank was interested in determining whether, and under what conditions, a scale up of effort to achieve one million additional connections within five years may be achievable. Additionally, the Bank requested IRG to identify the countries and regions where there is special need and opportunity for scale-up of off-grid modern energy services.

WORLD BANK OFF-GRID RENEWABLE ENERGY PORTFOLIO

Since 1993, the World Bank (IBRD/IDA in partnership with GEF) has undertaken 22 projects with country-specific off-grid renewable energy-based electricity supply components that are either completed or under implementation. Another 11 off-grid renewable energy projects are in the planning/preparatory stage. The collective goals for these 33 projects include establishment of ca. 1.5 million new pre-grid electricity connections to off-grid households, community services, and small businesses, with an additional 2.3 million *grid-based* connections associated with the projects.

The total portfolio investment in the off-grid energy component is $646 million, with total investments of approximately $3.6 billion including Bank loans and GEF grants amounting to approximately $1.8 billion. The majority of off-grid applications use photovoltaic (PV) solar home systems (SHS). Several projects (e.g., Nepal) have significant micro-hydro and mini-hydro components for community mini-grids, while others use free-standing PV and small wind electric systems for irrigation of small farms (Mexico), and for priority community services including potable water supply, public lighting, telecommunications, and electrified schools and health posts.

Much of the Bank's off-grid energy work is "embedded" in large-scale poverty alleviation, community development, and agricultural development projects. In many of the Bank projects in which grid power is not available or not sufficiently reliable to meet project goals, decentralized energy services are typically

procured using diesel gensets and other fossil fueled sources. Expanding knowledge about and availability of renewable energy equipment and services that could be used in such non-energy projects could help open a pathway to commercial applications of renewables in off-grid environments.

LESSONS LEARNED FROM BANK OFF-GRID PROJECTS

The costs for preparation and monitoring of Bank off-grid renewable energy projects have declined over the decade as a result of significant "learning effects". However, the cost of preparation still remains relatively high and, as a result, virtually all of the Bank projects with off-grid renewable energy components have used bilateral and GEF funds to support project preparation costs. In addition, virtually all of the Bank's projects with off-grid PV components employ one or more subsidy instruments (e.g., capital cost buy down, interest rate buy down for consumer purchases of PV equipment, buy down of risks to permit rural finance institutions to loan to both rural energy enterprises and to end users, etc.). Financing sources can include grants from Government funds and concessionary on-lending term loans from donor or GEF funds. A project-by- project approach with per unit grants that buy down the costs of off-grid renewable energy connections is not a viable or sustainable approach to scale up.

Essential market enabling conditions that emerge in an overview of off-grid renewable energy enterprises and of World Bank Group and other projects include but are not limited to the following:

- **Commercial Environment:** Supportive commercial/legal environment for private enterprises, NGOs, and cooperatives willing to deliver off-grid energy services;
- **Markets:** Favorable market characteristics and customer base (i.e., sufficient density and accessibility of customers with ability to pay for energy services);
- **Policy Environment:** Supportive public policies and regulatory framework that foster delivery of least-cost off-grid energy services (including community mini-grid systems);
- **Infrastructure:** Functioning institutional, commercial, financial and technical infrastructure for off-grid energy services;
- **Financing:** Availability of accessible and affordable financing for off-grid energy supply and services enterprises and for customers.

In addition to country buy-in, reasonable time and resources are needed to establish the enabling conditions for scale-up. Additionally, effective energy service delivery models must be tailored, adapted and established to meet local needs and practices. Financing of off-grid energy service enterprises and their customers has been addressed through a variety of mechanisms in Bank Group projects. One of the most successful approaches has been to work with existing micro-finance institutions (MFIs).

COUNTRIES AND REGIONS SUITABLE FOR SCALE-UP INITIATIVES

Wealthier developing countries including Argentina, Brazil, China, India, Mexico, the Philippines, and Sri Lanka *appear* to offer good opportunities for the Bank to facilitate significant scale-up. Even in these countries establishment of the enabling conditions for commercial investment and off-grid energy

services operations will require a mix of public and private sector initiatives. The Bank has off-grid rural energy projects underway in all these countries except for Brazil.

To the extent that widespread access to modern energy services is one of the conditions of sustainable economic and social development, the Bank and its partners will have to actively work to expand such access in very poor regions, notably sub-Saharan Africa and South Asia. However, most of the countries that most urgently need modern energy services in un-electrified areas are those that lack good conditions for scale-up.

BANK ROLE IN SUPPORTING SCALE-UP OF OFF-GRID RENEWABLE ENERGY

Since the Bank is a relatively small player globally in financing rural electrification, *the Bank Group's most effective contribution will be in helping to establish the conditions under which large-scale markets can operate in the rural developing world.* To help achieve this objective, the Bank can help support scale-up initiatives by at least undertaking the following:

- Establish support for scale-up programs at the highest levels of the Bank;
- Focus on country programs and foster enabling conditions for commercialization of off-grid renewable energy;
- Expand in-house capacity to link off-grid renewable energy /decentralized energy systems and services with non-energy programs and projects (e.g., agriculture, water supply, education, health services, communications);
- Increase affordable capital flows to off-grid consumers and to service providers;
- Provide and disseminate information to support the selection of off-grid renewable energy when it is the least-cost option;
- Encourage partnerships between equipment suppliers, service providers and financial institutions to support scale-up.

THE PROPOSED MILLION CONNECTION FUND

The proposed Million Connections Fund, as originally presented by Shell, is in essence *a parallel fund to the GEF,* providing capital cost buy-downs for PV systems. Moreover it is *much more narrowly focused than GEF grant co-financing for renewable energy.* It is designed primarily to support expansion of PV installations (primarily for household pre-grid electricity services). The proposed fund provides *no new value added to the Bank Group* in its search for effective and efficient means of facilitating scale-up in access to renewable energy-based off-grid energy services. The Bank Group off-grid renewables project portfolio already targets some 1.5 million connections.

It is certainly possible to achieve a specific target for connected households through a carefully crafted incentive program, including the use of grants to provide attractive profit margins (and risk buy down) for local off-grid renewable energy equipment and service providers. However, achieving a numerical target in and of itself does not tell us how the market is evolving, whether or not demand is real, or if the

willingness of customers to pay for specific off-grid electricity services really increases as reliable systems and dealers (with effective after-sales service) become available.

Bank projects with off-grid renewable energy components facilitate the growth of local off-grid energy equipment and service providers. *The MCF would not change this, and the argument has not been made why a new and separate fund should be established to do what the GEF is already doing.*

The MCF targets primarily countries where the conditions are best for scaling up access to RE-based off-grid electricity services, where there are growing markets for such services. The countries that are the focus of the Bank's poverty alleviation strategy are perforce not generally attractive in terms of markets for off-grid energy services. Where there are off-grid electricity and fuel (e.g., LPG) markets in these countries (primarily in sub-Saharan Africa and South Asia), they are associated with the relatively wealthy off-grid households and enterprises. In most of these countries off-grid households in the top 10–20% of annual income generally already have access to some form of electricity services (e.g., small diesel gensets) while those in the bottom 20–40% rarely have any access to electricity services.

1. INTRODUCTION AND OVERVIEW

OVERVIEW

Widespread access to modern energy services[1] is essential for the success of poverty alleviation and social and economic development initiatives. In rural and peri-urban areas of developing countries, electricity is needed for priority community services and for enterprises. Applications include water pumping for irrigation projects, lights for schools and government buildings, refrigeration for medical supplies, and numerous other essential services. For the 1.6 billion people living in developing countries without electricity or other important infrastructure services, access to modern energy services coupled with investments in development will be essential to move towards the World Bank vision of a world without poverty. Of the 410 million unelectrified households, 380 million are in rural areas, with the largest fractions of unelectrified households being in Sub-Saharan Africa and South Asia. At present electricity connection rates, 450 million additional people over the next 20 years will join the 1.6 billion who now lack access to modern energy services.

The Bank has indicated its commitment to finding ways to bridge the gap between the present level of expansion of modern energy services to unelectrified populations and what will be required if the Bank and its strategic partners world wide are to achieve the energy targets implied by the Millennium Development Goals (which make no explicit reference to modern energy services) and made specific by the Global Village Energy Partnership (GVEP) goals (below). However, the Bank is *not* the principal financier of rural electrification, and hence must expand its leverage of other resources in supporting scale-up of the delivery of off-grid modern energy services.

- **Millennium Development Goals (compared to situation in 1990)**

- Poverty reduction: reduce by at least 50% by 2015
- Education: universal primary education by 2015
- Environment: national sustainable strategy by 2005
- Infant and child mortality: 2/3 1990 level by 2015
- Maternal mortality: reduce 2/4 by 2015
- HIV/AIDS: Reduce by 25% globally before 2010
- Water: Halve people without safe water by 2015
- Upgrading slums: Improve lives of 100 million by 2020
- Building digital bridges: maximize access to new IT

[1] "Modern energy services" refers to the availability of reliable, high-quality, and affordable electricity, and clean liquid and gaseous fuels. This report focuses primarily on off-grid electricity services.

➢ Global Village Energy Partnership (GVEP) Goals

The energy-related GVEP goals supportive of the MDG, to be achieved within the coming ten years, are listed below. The goals for access to modern energy services will be achieved through a wide mix of technologies and means, but in the case of electricity services, most the 400 million previously unserved people will have access via grid extension and local mini-grids and micro-grids, not from free-standing renewable energy systems.

- A significant number of countries with nation-wide energy-poverty-reduction programs based on modern energy services.
- At least 400 million people (60–80 million households) previously unserved will have access to modern energy services.
- At least 50,000 new communities served (schools, hospitals, clinics).
- A cadre of trained entrepreneurs and institutions capable of developing and implementing village power projects and programs.
- Increases in productivity, income, environment, equity and quality of life, including gender equality.

➢ Metrics for Measuring Success

The use of household and community energy applications is not yet a purely commercially venture. The economic benefits of improved (electric) household lighting and radio/TV are difficult to quantify and monetize. But, where decentralized energy systems are making possible clean water, improved health services, and better education, this directly supports economic development provided investments are made in income generating (productive) activities that can use the energy services. To jump start investments in economically productive activities, reliable electricity supplies and/or shaft power must be available.

From a developmental perspective, the above metrics and the United Nations Human Development Indicators provide a sense of the rate and scale of human development. For rural PV businesses, the important metrics of success include annual sales/installations, net profit per installation, and the rate of market growth. Achievement of a million new off-grid renewable energy connections in five years in a dozen countries is not a useful *direct indicator* of progress in rural social and economic development. However, rural PV enterprises have built much of their business on the residential market, and this in turn has made possible the delivery of PV systems for community and enterprise applications. The private sector, where it can provide off-grid electricity and modern energy services, will seek the high-value markets, i.e. the top five to twenty percent of the off-grid population that generally can afford such services. The poor will be served by private enterprises only if there is support from government and other sources to make up the difference between the cost of service delivery (including profits) and the revenues from poorer customers. The good news for private sector enterprises is that in many developing countries the poor, especially poor women, are far better credit risks than the wealthier members of the population. In Sri Lanka, the repayment rate to SEEDS is close to 100%, and in Bangladesh the Grameen Bank has similar experience (lending to small groups of women for productive activities).

BACKGROUND

The Shell Million Connections Fund Proposal

In 2002 Shell Renewables proposed that the World Bank lead or facilitate the establishment of a more than $150-million fund to support accelerated and wider application of renewable energy technologies for off-grid energy services in developing countries. The goal of this *Million Connections Fund (MCF)* is facilitation over the next five years of a million new off-grid connections to basic electricity services using renewable energy technologies. This would be accomplished through off-grid electricity service components of World Bank Group projects. The fund would not be tied in any way to Shell, but would benefit off-grid renewable energy initiatives in the developing world. While a significant fraction of the funds would be used for photovoltaic (PV) applications, especially solar home systems, enterprises using other renewable energy systems would also be able to access this fund.

Shell proposed that the fund be used in the following ways:

- Assisting developing country governments in selection of policies that support rural energy services businesses to provide access to modern energy services, especially electricity, in a sustainable manner.
- Providing credit lines to potential customers.
- Providing modest cash grants per renewable-energy-connection to increase affordability and attract on-the-ground rural businesses investment and development.
- Finding effective ways to enhance social services and income generation through access to modern energy services from renewable energy systems.

The MCF would fund the per-connection grant that would be raised as new and additional funding from donors and the GEF. The GEF, which has collaborated with Shell on the concept, has indicated that it could provide as much as $60 million. The target fund size is $150 million, implying average per-connection subsidies in the range of $100–$150 depending on how much of the fund would be used for administration, technical assistance, and other purposes.[2] In subsequent discussions among representatives of Shell Renewables and Bank Group staff, Shell representatives indicated that they were not committed to just the uses indicated above, as long as the MCF were used to facilitate wider and more rapid applications of off-grid renewable energy-based electricity services.

The MCF would operate through existing institutions, and its uses would be based on the experience gained through projects now under implementation. The scale-up would be achieved through replication in larger format of such projects, adapted to the particular conditions in additional countries. In principle the fund could also help to underwrite commercial initiatives that would use other models. For example, such support could be cost shared with the leading durable goods suppliers such as General Electric and Siemens, to help these companies assess the market potential for a range of renewable energy products and services.

[2] The unit grant is based nominally on solar home systems sized at 30-50Wp, each of which would provide a household with basic lighting, radio and TV services for about 3 to 5 hours per day.

➢ The Logic behind the MCF Proposal

The apparent logic behind the MCF proposal is the following:

- Rural applications of PV systems have demonstrated positive social and economic developmental consequences. Practical availability of these and other distributed and decentralized renewable energy technologies in the developing world helps support the poverty alleviation goals of the Bank.

- But distributing and servicing rural PV systems is not an attractive business investment yet; perceived risks are often high and financial rewards are low, and in areas where the needs are greatest, such as Africa, the ability to pay is lowest. Thus the poor tend to be bypassed. *(Recent experience with dispersed renewable energy applications in Bangladesh suggests that in that country the financial risks can be very low and the returns sufficient to justify such investment.)*

- Capital cost subsidies and end-user financing have been central to the establishment and growth of off-grid PV equipment and services enterprises. Without these, international renewable energy players would generally not be present in developing country rural regions.

- Thus the proposed MCF would support the establishment, profitability, and growth of local renewable energy enterprises, in turn helping to support Bank goals.

- A successful growing commercial PV/renewable energy marketplace results in demonstration of reliable equipment and reliable PV enterprises to the public, government, and this helps bring government financial support for off-grid renewable energy systems.

➢ The MCF Connections Target in Context

The proposed Million Connections Fund, as originally conceived by Shell, is a parallel fund to the GEF, providing capital cost buy-downs for PV systems. However, this provides no new value added to the Bank Group in its search for effective and efficient means of facilitating scale-up. The Bank Group off-grid renewables project portfolio already targets some 1.5 million connections.

The goal suggested by Shell of facilitating one million new off-grid renewable energy-based (primarily PV) connections worldwide over the coming five years should be compared with the results of other approaches to providing off-grid communities with electricity services.

- For example, the *Indonesia Second Rural Electrification* Project achieved a connection rate of 10 million rural households and businesses in just five years, using a mix of grid expansion and diesel-powered AC minigrids. It was financially sustainable through cross subsidies from the Java grid to off-Java areas, until the financial crisis that engulfed Indonesia starting in 1997/1998.

- In the 5-year *Bangladesh Rural Electrification and Renewable Energy for Development project (RERED)*, initiated in 2002, some 700,000 new *grid-based* connections are expected to serve households, enterprises, and public institutions. Off-grid systems are expected to provide electricity to about 64,000 rural households and other customers.

It seems likely that most rural electrification over the next several decades will eventually be accomplished through grid-based AC services rather than through freestanding PV systems. The potential for use of renewables to power AC microgrids and minigrids (from 5 kWe to several

Megawatts) varies widely among countries, but in many developing countries it is significant. A few examples are noted here:

- In Nepal, Indonesia, India, the Philippines, and Sri Lanka, for instance, there are identified large resources of small and medium-scale hydro potential. India has ca. 10,000 MWe of potential capacity that could be exploited with minihydro plants (sub-megawatt to tens of megawatts). In the Bank's *India Second Renewable Energy Project*, 200 MWe of small hydropower capacity is being established by the private sector with Bank financing. In the Bank's co-financed *Nepal Power Development*[3] *Project,* new microhydro power systems of 2.5 to 3 MWe total generating capacity will service ca. 30,000 new customers.

- Small Modular Biopower (SMB) systems in the range of several kilowatts to several tens of kilowatts are emerging as commercial products. A commercial prototype successfully powered a full-time village AC minigrid system in the Philippines in 2001/2002, and is now being used in a productive uses application there. The SMB unit uses a widely abundant energy resource—discarded coconut shells. Coconuts grow in profusion in much of south Asia, Africa, and Latin America.

- Wind/fossil fuel hybrid units are providing full-time AC power to off-grid communities, commercial facilities, and government installations in the US, Europe, Japan, and elsewhere at a multi-megawatt scale. On a smaller scale, PV/wind/diesel hybrids have been used on a preliminary commercial basis for village power supply in such countries as Chile, China, Fiji, Indonesia, Mexico, and the Philippines. Under the Bank's *Viet Nam—System Efficiency Improvement, Equitization and Renewables Project*, a pilot of twenty community-based hybrid renewable-energy grids in remote areas will be implemented and evaluated.

➢ Bank Group Assessment of Options for Off-Grid Renewable Energy Applications Scale-up

While Shell indicated in its proposal that forthcoming connections under approved Bank projects could be considered as part of the million new connections, Bank staff decided to separate the assessment of what could reasonably be expected from current and pipeline projects and what could be accomplished through new initiatives involving the Bank.

The Bank as an institution is committed to supporting activities that address the United Nations Millennium Development Goals (MDG); it is also committed to the associated energy services goals of the Global Village Energy Partnership (GVEP). Renewable energy technologies and enterprises are increasingly contributing to off-grid electricity supply. Given these commitments and challenges, and in response to the Shell MCF proposal, President Wolfensohn indicated that it is timely to investigate how increasing the rate and scale of access to off-grid modern energy services might be possible, and what the roles of the World Bank Group might be.

If it were practical and possible for the Bank and a few partners, (e.g., the European Union, GEF, industry, foundations, etc.) to create a fund that provided the proposed range of capital cost subsidies for a million off-grid renewables connections, this would certainly accelerate existing PV business operations in those countries where this would alleviate a major primary barrier to wider and faster diffusion. However, such an approach could wither away once the cash grants disappeared. Shell Solar

[3] World Bank project P043311, approved 22 May 2003.

management have said that in spite of the present commercial growth in PV solar home systems in Sri Lanka, they don't know if this growth can be sustainable once the GEF grants are gone. In the absence of the capital cost grants in Philippines (via a Netherlands bilateral aid initiative), Shell Solar would not be operating there either. *This is why there is a need to shift to a more sustainable subsidy policy that provides support to both grid and off-grid options.*

2. WORLD BANK OFF-GRID RENEWABLE ENERGY PROJECT PORTFOLIO

INTRODUCTION

Since 1993, the World Bank (IBRD/IDA in partnership with GEF) has undertaken 22 projects with country-specific off-grid renewable energy-based electricity supply components that are either completed or under implementation. Another 11 off-grid renewable energy projects are in the planning/preparatory stage. The collective goals for these 33 projects include establishment of ca. 1.5 million new pre-grid electricity connections to off-grid households, community services, and small businesses, with an additional 2.3 million *grid-based* connections associated with the projects. The total portfolio investment in the off-grid energy component is $646 million, with total investments of approximately $3.6 billion including Bank loans and GEF grants amounting to approximately $1.8 billion. The majority of off-grid applications use photovoltaic (PV) solar home systems (SHS). Several projects (e.g., Nepal) have significant micro-hydro and mini-hydro components for community minigrids, while others use free-standing PV and small wind electric systems for irrigation of small farms (Mexico), and for priority community services including potable water supply, public lighting, telecommunications, and electrified schools and health posts.

Not included in these figures are the Photovoltaic Market Transformation Initiative (PVMTI) and Small and Medium Enterprise (SME) global funds established by the International Finance Corporation (IFC) to assist private sector enterprises in target countries. These initiatives are discussed in the main report. Bank projects that are in the concept phase are not discussed here, due to their preliminary and uncertain status. A summary of the World Bank projects in the off-grid renewable energy portfolio is presented in Annex 2 of this report.

Half of the existing or planned Bank projects are in Asian countries, reflecting the work of ASTAE over the past decade in mobilizing technical and financial resources to incorporate renewable energy in off-grid rural electricity initiatives. Africa and Latin America share the remaining projects. Africa lags Asia in the infrastructure and market aggregation opportunities that are important for the success of off-grid RE projects. In order for there to be serious private sector players in the off-grid energy services market, the client country governments, the Bank, and its strategic partners will have to establish or enhance the conditions under which commercial investment for off-grid energy services can be attracted to these regions. Additional measures must be taken to help mitigate investment risks, establish long-term investment support, and demonstrate economic commitment for social development.

OFF-GRID ENERGY SUPPLY IN NON-ENERGY BANK PROJECTS

Much of the Bank's off-grid energy work is "embedded" in large-scale poverty alleviation, community development, and agricultural development projects. In many of the Bank projects in which grid power is not available or not sufficiently reliable to meet project goals, decentralized energy services are typically

procured[4] using diesel gensets and other fossil fueled sources. Expanding knowledge about and availability of renewable energy equipment and services that could be used in such non-energy projects could help open a pathway to commercial applications of renewables in off-grid environments.

This situation is not limited to off-grid energy dimensions of non-energy Bank projects and programs. This was explored a few years ago in a review of 500 approved projects Bank-wide:

> *The Bank and Rural Infrastructure.* Rural infrastructure constitutes a substantial and growing component of Bank activities. Currently, over one-fifth of Bank lending in the rural sector is spent on infrastructure. That is substantially higher than the 1994 level of only 3% of total lending. Combined investments in rural transport and in rural water supply and sanitation account for 15% of rural sector projects and 20% of the funds approved for rural activities in FY 1999 and FY 2000. When other infrastructure sectors are considered—e.g., rural energy and rural telecommunications, as well as alternative multi-sector delivery arrangements (including, social funds and rural development funds)—the proportion is likely to be significantly larger—as much as 50 to 70% of total rural funding.2
>
> That the actual value of investment is substantially higher than indicated by single -sector investment data is supported by a detailed analysis carried out by the Bank's Rural Development Group. This review of 500 projects approved Bank-wide in FY 1999 and FY 2000 found that *more than two-thirds involved rural infrastructure or related activities, even though the majority of them were not identified as rural infrastructure projects.* Notwithstanding this analysis, the Bank does not have a clear understanding of the size of the rural infrastructure portfolio. Most projects are not coded. As a result, the total amount of investment in rural infrastructure cannot be captured.
>
> World Bank (October 2002). *Reaching the World's Poor.*
> Annex 7: Physical and Social Infrastructure.

As the study conducted in FY1999 and FY 2000 by the Bank's Rural Development shows, we do not know how many of the Bank projects involve dispersed and/or decentralized off-grid energy services, much less the extent to which renewables are used in them. A search through PADs for agriculture, rural development, and for community water supply, health, and educational initiatives, usually reveals no discussion or even simple mention of the role of electricity and other modern energy services in the projects.

The scope for use of renewables in Bank Group non-energy projects (e.g., small-holder irrigation, community water supply, etc.) depends on the extent to which the host country client agencies are interested in and able to make use of renewables. The project designers for World Bank co-financed projects are responsible for assessment of sustainable least-cost energy supply options. Although the Bank rules governing procurements of equipment and services do require life cycle cost comparisons among the reliably available options, renewable energy equipment and services will not be selected if quality equipment and after-sales services are not present in the project implementation region. While tenders can be services-based, it is simpler to specify equipment such as diesel or electric pumps for irrigation. Services-based tenders request quotations for specific services, such as provision of a certain

[4] IRG did not have the scope under this study to gather data about the mix of fuels and technologies used in non-energy rural projects. However, we assume that there are large numbers of distributed small pump sets, engines, and generators used in such projects. This applies primarily to projects that do not have access to reliable grid power.

minimum level of irrigation for 1,000 ha of cotton. It is then up to the bidders to determine the preferred technical options for providing the services.

OVERVIEW OF THE PORTFOLIO

The Bank's portfolio contains a mix of projects with one or more off-grid renewable energy components. The project categories are completed (closed), active, and pipeline. Additional projects are being planned. With few exceptions (e.g., Nepal hydro) these projects have been developed in partnership with and co-financed by the Global Environment Facility (GEF). Bilateral donor support (e.g., from Denmark, the Netherlands, Switzerland, the US, and others) has been essential in preparation and implementation of many of these projects.

The projects have tested a variety of models for delivery of off-grid energy service, including mechanisms to "jump-start" the market. Common to most of these projects has been the use of capital subsidies to buy down the initial capital cost of the renewable energy (primarily PV) systems using grants from the GEF and bilateral development assistance agencies. Most of the PV subsidies have been finite in duration, keyed to the size of the installed system (e.g., 20 Wp to 100 Wp), and declining costs ($/system) with increasing market penetration. Another feature of most of the projects has been access to affordable local financing for both end users (usually households purchasing solar home systems) and rural energy equipment and service providers. In most rural electrification projects subsidies are necessary for affordability. For off-grid services where service costs are higher and customers are poorer, the need for subsidies will be greater. The advantage of renewable energy equipment is that capital cost buy-down is an effective and often more sustainable subsidy approach, unlike in the case of diesels, where operating/recurring cost subsidies are needed.

Over the past decade there have been 22 approved Bank projects (Tables 1–3) that include off-grid renewable energy components. Three of these are completed and nineteen are active. Of these projects, eight received Board approval in 2002 and 2003.

Table 1: Projects Approved by Calendar Year

Calendar Year Approved	# Projects Approved
1997	4 (3 closed)
1998	1
1999	4
2000	2
2001	3
2002	5
2003	3 (through FY 2002)
1997-2003	**22**

The expected number of dispersed (freestanding) PV systems for *active projects* is ca. 685,000 systems at project end. Primarily via micro-hydro and mini-hydro systems powering isolated micro- and mini-grids, another 95,000 households would be served with AC power. Another 73,000 connections, primarily via PV systems, were established under the three closed projects in Indonesia, India, and Sri Lanka. Approximately 2 million grid-based (grid extension) connections are also projected. Somewhat more than 100,000 off-grid connections have been realized.

The total investment in these projects is just over $2 billion, with the Bank loans and credits accounting for about half of the total funding, the client country governments, bilateral development agencies, the GEF, and others providing the balance. Most of the off-grid renewable energy connections are still under development and the Bank projects are also catalyzing expanded off-grid use of renewables through the market conditioning and change that are resulting from these projects. The eventual impact of these projects, both numerically (connections) and in socio-economic terms will require ongoing periodic field-based assessments.

A review of projects closed or under implementation with an off-grid photovoltaic component shows that the average per-connection installed cost of those systems was approximately $540, while the overall cost per connection was $730 including both grid and off-grid components. GEF grant components are present in most. There is no GEF component in the Nepal Power Development Project (all hydro) or in the Vietnam Rural Energy project that had only a pilot for off-grid energy provision (100 connections in one village using micro-hydro power). GEF grants accounted for 15% of the Bank's financing of off-grid projects.

Each of these projects has a unique set of features. Together, the 34 projects encompass a wide range of renewable and hybrid energy technologies for both dedicated (single-purpose) distributed applications and for micro-grids and mini-grids. Technology options, while numerically dominated by the number of PV systems for household use, include other PV applications (e.g., water pumping for small cattle farms in Mexico, health clinics and schools, community water supply, public lighting, etc. and small enterprises).

Wind electric systems for household use (the small wind electric counterpart of solar home systems) are being introduced in the restructured Argentina project, and small portable PV/wind hybrid units are being used widely in the Western Provinces of China. The recently approved (May 22, 2003) *Nepal Power Development Project* will use micro-hydro and mini-hydro systems to provide AC power to 30,000 customers, and will operate without a GEF grant component and without any PV component. It's worth noting that in China small hydro systems cover far more households than PV and it is often difficult to give an accurate number of connections *ex-ante*. The Mexico Renewable Energy for Agriculture Project will demonstrate some 1,200 systems (mostly PV water pumping systems, with some PV milk refrigeration units), as a prelude to the ten-year dissemination of ca. 200,000 off-grid renewable energy systems for small farms. (There are 600,000 unelectrified small farms in Mexico).

Table 2: Active World Bank Projects with Renewable Energy Off-Grid Component

Project Name	ID	IBRD/IDA	Country	Status	Approval Date
Decentralized Energy, Information and Communications Technology for Rural Transformation Project	P073367	20	Bolivia	Active	6/17/2003
Power Development Project	P043311	75.6	Nepal	Active	5/22/2003
Off-Grid Rural Electrification for Development Project	P073246	12	Nicaragua	Active	5/15/2003
Energy Access Project	P049395	132.7	Ethiopia	Active	9/19/2002
Decentralized Rural Electrification Project	P074288	5	Guinea	Active	7/2/2002
System Efficiency Improvement, Equitization, and Renewables Project	P066396	225	Vietnam	Active	6/25/2002
Rural Electrification and Renewable Energy Development Project (RERED)	P071794	190.98	Bangladesh	Active	6/25/2002
Renewable Energy for Rural Economic Development Project	P076702	75	Sri Lanka	Active	6/20/2002
Energy for Rural Transformation Project	P069996	49.15	Uganda	Active	12/13/2001
Power and Communications Sectors Modernization and Rural Services Project (PROMEC)	P063644	23	Ecuador	Active	11/20/2001
Community-Based Rural Infrastructure Project	P062748	102.78	Vietnam	Active	6/26/2001
Renewable Energy (02) Project	P049770	130	India	Active	6/27/2000
Rural Energy Project	P056452	150	Vietnam	Active	5/30/2000
Renewable Energy for Agriculture Project	P060718	13.7	Mexico	Active	12/21/1999
Renewable Energy Development Project	P046829	100	China	Active	6/8/1999
Energy and Water Project	P040990	17.5	Cape Verde	Active	5/11/1999
Renewable Energy in the Rural Market Project	P006043	30	Argentina	Active	3/30/1999
Southern Provinces Rural Electrification Project	P044973	34.7	Lao PDR	Active	3/17/1998
Energy Project (02)	P000736	200	Ethiopia	Active	12/11/1997

Table 3: Completed World Bank Projects with Renewable Energy Off-Grid Component

Project Name	ID	IBRD/IDA	Country	Status	Approval Date
Renewable Energy Small Power (RESP) Project	P042882	66.4	Indonesia	Closed	6/24/1997
Energy Services Delivery Project (ESD)	P010498	24.2	Sri Lanka	Closed	3/18/1997
Solar Home Systems Project	P035544	20	Indonesia	Closed	1/28/1997

Table 4: Pipeline/Preparation World Bank Projects with Renewable Energy Off-Grid Components

Project Name	ID	IBRD/IDA	Country	Status	Approval Date
Energy Sector Reform Project		61	Burkina Faso	Preparation	
Rural Electrification and Transmission Project		30	Cambodia	Preparation	
Enhancing Access Through Off-Grid Electrification		178	India/Rajasthan	Preparation	
(No title)		5	Senegal	Preparation	
Energizing Rural Transformation (APL)		1.3	Swaziland	Preparation	
Energy for Rural Transformation (APL)		105	Tanzania	Preparation	
Energy Services Delivery Project	P074659	50	Madagascar	Pipeline	N/A
World Bank Household Energy and Universal Rural Access Project	P073036	36	Mali	Pipeline	N/A
Energy Reform and Access Program Project	P069183	40	Mozambique	Pipeline	N/A
Rural Power Project	P066397	10	Philippines	Pipeline	N/A
Rural Energy II	P074688	220	Vietnam	Pipeline	N/A

Half of the existing or planned Bank projects are in Asian countries, reflecting ASTAE mobilization of technical and financial resources to incorporate renewable energy in off-grid rural electricity initiatives. Africa and Latin America share the remaining projects. Sub-Saharan Africa lacks much of the commercial infrastructure and market aggregation opportunities that can support the success of off-grid rural electrification projects. The Bank will have to work with client countries and other lenders and donors to help establish or enhance the conditions under which commercial investment in off-grid energy services can be attracted to these regions.

Eleven projects with off-grid components were identified to be in the pipeline (5) or preparation (6) stages. These projects, shown in Table 6, indicate a shift to a greater ratio of off-grid connections to grid connections. Whereas the existing portfolio of active projects has almost three times the number of grid-based connections as off-grid, the pipeline has reversed this number. *The planned projects have a greater emphasis on establishing enabling conditions and less emphasis on total connections.* This is consistent with a shift in the Bank's role to primary focus on establishment of conditions conducive for sustainable large-scale application of renewables for off-grid energy services.

The Bank's portfolio of projects with off-grid components has yielded valuable lessons and insights. In addition, in the countries where the projects are being successfully implemented, it has been instrumental in setting the stage for commercial scale-up. Through these diverse projects, an approach to facilitating sustainable off-grid energy services is emerging.

The facilitative stimulatory impact of the various World Bank off-grid energy project initiatives will emerge gradually over the next 10–15 years. Even after the fact it will probably not be possible to separate out the impacts of various off-grid energy projects. The reality will be a complex of projects, investments, commercial initiatives, and other activities that taken together will presumably stimulate scale-up. In general the Project Appraisal Documents distinguish between the projected direct impacts of the project and the expected or hoped for national impacts in terms of scale-up of access to off-grid energy services. In monitoring and evaluation (M&E) terms this is to differentiate between the *outputs* of the projects and their *impacts*.

While a few projects were not able to realize their original design goals (e.g., Argentina and Mexico off-grid SHS concessions and Indonesia SHS), the contribution to the "lessons learned" has been very important, providing information on more effective project designs and modalities. The Argentina project has been reconfigured and is moving ahead, and the Mexico project is being re-introduced in a revised format. The Indonesia project was scaled back due to poor macro economic conditions (the Asian financial crisis). By developing a large portfolio of off-grid renewable energy projects, the Bank has built diversity and resilience into the overall effort. While that may not have been the strategic intention in the early 1990s, it appears to be what has happened.

Table 5: Active Bank Projects: Renewable Energy Goals

ID	Approval	Country	Project Name	Isolated	Mini Grid	Grid Tied
P073367	6/17/2003	Bolivia	Decentralized Energy, Information and Communications Technology for Rural Transformation Project	20,000	?	
P043311	5/22/2003	Nepal	Power Development Project	none	30,000 microhydro ~3 MWe	40 Mwe hydro
P073246	5/15/2003	Nicaragua	Off-Grid Rural Electrification for Development Project	6,000 SHS		4,000 1.6 Mwe hydro
P049395	9/19/2002	Ethiopia	Energy Access Project	6,000–7,000 PV		
P074288	7/2/2002	Guinea	Decentralized Rural Electrification Project	5,000 SHS	15,000 from picohydro local grids	
P066396	6/25/2002	Vietnam	System Efficiency Improvement, Equitization, and Renewables Project		10,000 from hydro/ hybrid grids	3 Mwe minihydro upgrades
P071794	6/25/2002	Bangladesh	Rural Electrification and Renewable Energy Development Project (RERED)	64,000 PV		
P076702	6/20/2002	Sri Lanka	Renewable Energy for Rural Economic Development Project	85,000 PV		
P069996	12/13/2001	Uganda	Energy for Rural Transformation Project	90,000 PV		
P063644	11/20/2001	Ecuador	Power and Communications Sectors Modernization and Rural Services Project	2,200		
P062748	6/26/2001	Vietnam	Community-Based Rural Infrastructure Project	PV for community services	10 microhydro isolated grids	
P049770	6/27/2000	India	Renewable Energy (02) Project	20,000 SHS		
P056452	5/30/2000	Vietnam	Rural Energy Project	100 PV		
P060718	12/21/1999	Mexico	Renewable Energy for Agriculture Project	1,000 PV water pumps		
P046829	6/8/1999	China	Renewable Energy Development Project	350,000		
P040990	5/11/1999	Cape Verde	Energy and Water Project	4,000		
P006043	3/30/1999	Argentina	Renewable Energy in the Rural Market	35,000		
P044973	3/17/1998	Lao PDR	Southern Provinces Rural Electrification	?	4,600 HH via hydro minigrids	
P000736	12/11/1997	Ethiopia	Energy Project (02)	6,300 SHS	35,000 HH	

Table 6. Pipeline and Planned Bank Projects: Renewable Energy Goals

Project	Off-grid Connections projected	Grid Connections projected
Madagascar	15,000	30,000
Mali	10,000	130,000
Mozambique	20,000	100,000
Philippines	145,000	None
Vietnam II	130,000	310,000
Subtotals	**325,000**	**570,000**
Burkina Faso	8,000	80,000
Cambodia	10,000	90,000
India/Rajasthan	250,000	None
Senegal	?	?
Swaziland	?	?
Tanzania	?	?
Subtotals	**268,000**	**170,000**
Totals	**693,000**	**740,000**

3. LESSONS LEARNED: PROJECT DESIGN AND IMPLEMENTATION

Lessons relevant to the design of scale-up initiatives have emerged from the Bank portfolio of off-grid energy services projects. Some of these are presented here.

OFF-GRID RE PROJECT PREPARATION AND MONITORING COSTS

The small size of off-grid energy initiatives compared with the usual scale of Bank lending raises concerns about the "overhead" in terms of required staff time and costs. However, preparation and monitoring of these projects appears to have been quite efficient. There appears to have been a strong learning effect over the decade of preparation of these projects.

The preparation of the Sri Lanka ESD project (20,000 connections) required 1 TTL. The Sri Lanka RERED project (more than 85,000 connections) also required 1 TTL and but required just one-fifth the preparation cost of the ESD project. The China REDP (350,000 connections) also required 1 TTL. The preparation costs for such projects (per connection realized by the project) can be expected to continue to decline with ongoing learning and experience. In the China Renewable Energy Development Project (REDP), Bank staff has found that monitoring costs are likely to be about *0.5 to 1 percent* of total project cost. This is not a "show stopper."

THE IMPORTANCE OF GEF AND BILATERAL ASSISTANCE

Virtually all of the Bank projects with off-grid renewable energy components have used bilateral and GEF funds to develop the projects and to buy down the costs of PV-based energy services. Support has included direct subsidies to end users and dealers, to backstopping local financing institutions to encourage them to lend to dealers and end users, and through revision of national policies where these have created impediments to the diffusion of PV systems. Bilateral funds from Bank members including Denmark, Japan, the Netherlands, the US, and Switzerland have been essential to the identification and development of these projects. Without the GEF and the bilateral (soft money) assistance, the World Bank Group might not have developed a portfolio of renewable energy projects. (In general, bilateral funds have been important in preparation, and GEF funds in implementation.)

The reason that GEF has supported the use of off-grid PV applications is not because of the greenhouse gas (GHG) mitigation potential of off-grid market development. Rather, it was to create a broad-based market for PV that would lower costs for all PV users and thus contribute to PV market growth in general. The relevance of the off-grid market as a cost reduction driver is less so today than in mid-1990s. Today the availability of large subsidies for grid-interactive PV systems in Germany, Japan, and California, among others, is the principal reason the PV market is growing and driving down costs and prices of PV systems. Also, by supporting PV market development and energy services diffusion, the GEF may also have helped to develop the infrastructure for wider use of a menu of renewable energy options for off-grid energy services.

THE ROLE OF SUBSIDIES

The issue of subsidies is important and remains a topic of considerable discussion and debate within the communities of stakeholders that includes the Bank Group, UNDP, UNEP, host country government agencies, bilateral donors, NGOs, and the private sector. A detailed discussion of subsidy issues is outside the scope of this study. However, some observations can be made based on some of the projects that were reviewed.

Virtually all of the Bank's projects with off-grid PV components employ one or more subsidy instruments (e.g., capital cost buydown, interest rate buydown for consumer purchases of PV equipment, buydown of risks to permit rural finance institutions to loan to both rural energy enterprises and to end users, etc.). Financing sources can include grants from Government funds and concessionary on-lending term loans from donor funds.

➢ Bangladesh

In the Bangladesh RERED project, grants are used in several ways. According to the Project Appraisal Document:

- Under this Project, the Government is to provide REB about US$92-million equivalent, spread over five years, as grants for investments. Impact on the Poor: As 90 percent of the country's poor are concentrated in the rural areas, the Project has a strong poverty alleviation focus.

- The Project proposes a flexible grant regime that will decline as the solar market grows. Over a five-year period, the household grants for the micro-finance program are expected to decline from US$90 per system to about US$50 per system. It is assumed that by the end of the Project period, affordability will have improved as system prices come down and commercial financing becomes available and feasible. The electricity cooperatives (*Palli Bidyut Samities* or PBSs) have an important role in this project. For the PBS fee-for-service program the grants do not decline during the Project. Once the REB and PBSs can establish that a fee-for-service program is viable, the future funding is expected from the mainstream rural electrification funding provided by the Government to REB and PBSs.

➢ Guinea

In the recently initiated Republic of Guinea *Decentralized Rural Electrification Project* financed under a Learning and Innovation Loan (LIL), the Bank has incorporated a framework for design and use of subsidies. The PAD explains that

> The provision of subsidies to buy down the high up-front cost of renewable energy technologies is necessary for private sector involvement in the spreading and use of these technologies … The LIL will address the issue of the high up-front cost of rural electrification equipment and particularly of renewable energy technologies (RETs). It will do this by developing a package of subsidies and loans (level, modalities) that will encourage private financiers and companies to invest in rural electrification schemes and provide a solid basis for further development of decentralized rural electrification (DRE) in Guinea.

➢ Uganda

For the Uganda *Energy for Rural Transformation* project now under implementation, a package of supports, including financial subsidies, is being developed to stimulate the commercial applications of renewable energy for off-grid communities.

Financial initiatives include activation of efficient and effective mechanisms (Rural Electrification Fund—RE Fund) and the Rural Communications Development Fund (RCDF), both of which are already provided for in the law, for transfer of grants. The grants are being provided by a variety of sources including IDA and bilateral donors—to subsidize initial capital investments by service providers in commercially unviable areas. Also, the help get the program going, the project provides financial instruments to support term financing by local financial institutions on commercial terms for private sector enterprises. Other support services being provided by the project are the following:

- ***Business development support services,*** including techno-economic information, to potential private sector participants: Uganda's private sector, particularly in the energy sector, lacks adequate experience with the development of financially sound business plans as well as their implementation for service provision in rural areas. These support services would be provided to potential energy sector participants by existing facilitating entities, such as the Private Sector Foundation, on a "business-to-business" cost-sharing basis;

- ***Technical assistance and capacity building and training,*** appropriately targeted to relevant public sector institutions (central and local) including a to-be-established Rural Electrification Board, in support of their roles as enablers in policy setting, promotion, regulation, and monitoring/evaluation of commercially-oriented rural electrification and ICTs, and to effectively operationalize cross-sectoral linkages necessary for rural transformation.

- ***Facilitation of community discussion*** and mitigation of concerns about the nature and scope of commercially-oriented service provision of electrification and ICT services. The agents for this would be community-based organizations and NGOs.

➢ UNEP PV Loan Support Program in India

Other agencies and institutions are also providing financial subsidies as incentives to expand access to solar home systems by households. UNEP has just launched an initiative that buys down the cost of consumer credit for solar home systems.

> In March 2003 the United Nations Environment Programme (UNEP) announced a $7.6 million initiative for domestic solar power units in India. UNEP is working with two of India's largest banking groups to provide low-interest loans to help 18,000 households install domestic solar power systems. Syndicate Bank and Canara Bank have begun offering loans to buy PV SHSs, with interest rates in the range of 5%/year compared to the 11-12%/year normally charged to consumers. UNEP is subsidizing this rate with $1.5 million provided by grants from the United Nations Foundation and the Shell Foundation. The two banks are offering the loans—including via 'group lending' schemes to enable the poorest families to participate—in the southern states of Kerala and Karnataka. Four companies have been approved by UNEP to offer systems paid for by the low-interest loans under the initiative. They are Selco, Tata-BP Solar, Shell Solar and Kotak Kurja.
>
> UNEP Press Release (March 7, 2003)

If client country governments choose to cross-subsidize rural development, including rural electrification, this can be considered an investment in social and economic development. It is unlikely that such development will occur without such subsidies. The Bank partners (e.g., GEF and bilateral agencies) can provide initial subsidies to demonstrate their value and impact, but this should segue to client country support within the life of the project if possible.

FINANCING OFF-GRID ENERGY SERVICE ENTERPRISES AND CUSTOMERS

Financing of off-grid energy service enterprises and their customers has been essential in most PV projects in facilitating market growth and profitability. The need for financing has been addressed through a variety of mechanisms in Bank Group projects. One of the most successful approaches has been to work with existing micro-finance institutions (MFIs). An effective approach has been established in Sri Lanka; this may serve as a possible model for scale-up, harnessing in-country MFIs and private sector renewable energy equipment and services. Because of the potential importance of this approach, it is summarized briefly here.

➢ Sri Lanka and Innovative Micro-Financing

> The solar PV business saw its unprecedented growth soon after the micro-finance institution (MFI) known as SEEDS established the micro financing schemes in partnership with the private sector vendors. Here, the vendor would sell and system and SEEDS would finance the customer. The vendor and the MFI have to develop a certain trust and good working relationship to ensure that good candidates for financing are chosen by the vendors as they sell and the system operates efficiently during the loan payment period. The vendors have committed to remove systems, if for any reason the customer does not continue the repayments. The repayment rate is over 90% with this system, but SEEDS being the only MFI in Sri Lanka lending on a large scale for solar, with the market pressure, leaves them vulnerable as their portfolio for solar PV increases over other rural lending (agriculture, housing etc.). As the market grows and the number of vendors now increasing to 9 (from only two in 1990) will require at least one more major MFI to come into the arena, or it will hamper further market developments.
>
> Lalith Gunaratne
> Colombo, Sri Lanka
> 21 April 2003

Better known by its acronym SEEDS, *Sarvodaya Economic Enterprise Development Services (Guarantee) Limited*[5] is a unique development organization, created in 1987 to focus on village level economic infrastructure, and to provide financial and non-financial resources to enable rural people to fulfill their potential, based on their inclusion and participation. It is the largest NGO in Sri Lanka.

SEEDS ensures a higher level of income among its clientele, and also builds their capacity and entrepreneurial skills. It has, moreover, ensured that they have access to better housing and improved quality of life. As of today, SEEDS has been able to establish over 500 Sarvodaya Development Banks,

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[5] This discussion of SEEDS is drawn from a presentation by Saliya J Ranasinghe, CEO/MD SEEDS, at the International Workshop on "*Sharing of Lessons Learned in Solar Home Systems Financing Programs in Sri Lanka, India and the Philippines*" 6 - 8 May 2002, in Manila, Philippines

which are sustainable grass-root level institutions managed by the people. It has partnered with the State, banks and other financial institutions in financing the rural sector. SEEDS has also serviced over 50,000 small businesses through an integrated package of business development services and capacity building.

It was estimated that prospective solar clients would be those who were spending heavily on kerosene-oil for lighting and battery charging for watching television. Others used torch batteries as well. A key issue to be taken into account when designing credit products for solar was the problem regarding the rural farmer community. Since they derived income from seasonal harvests, they had no regular monthly income for regular repayment of loans. Commitment of the beneficiary was thus considered essential so as not to incur any financial losses in the event of default. A credit product was developed that had the following features:

- Introduction of a 20% down payment;
- Formulation of a 5-year repayment scheme in order to match the current expenses for fuel. (This ensured that there were no additional expenses but the saving on fuel / batteries would be sufficient to cover the monthly loan commitment);
- Introduction of a bi-annual payment scheme for solar lending so as to address the issue of seasonal income patterns.

The service provided by SEEDS was a total service to match the cash flow and cover the risks to some extent. The following areas were covered:

- SEEDS' staff handled the marketing of the product and found buyers for solar home systems;
- As the financiers they would assess the credit-worthiness of the client. They would visit the client, obtain information, inspect business, check the existing liabilities, and be satisfied regarding repayment capacity.
- They check the technical suitability of the location and assess the lighting requirements and if satisfied, install the SHS and enter into a suitable repayment schedule with the client, and
- They provide after-sales service.

SOME ADDITIONAL OPTIONS

One option that the Bank has not considered (except perhaps in the Bangladesh project) is how to get rural electrification utilities to broaden their technology mix in delivering electricity services, and how to assist them in financing the associated higher unit energy service costs. Many developing country electric utilities avoid trying to address off-grid electricity supply – it is expensive, has a high staff overhead compared with grid extension, and is generally an unknown area for them.

Another approach is to find ways to encourage firms already operating in rural areas to get into the rural off-grid energy services business. That "encouragement" will almost certainly have to in the form of financial and technical assistance.

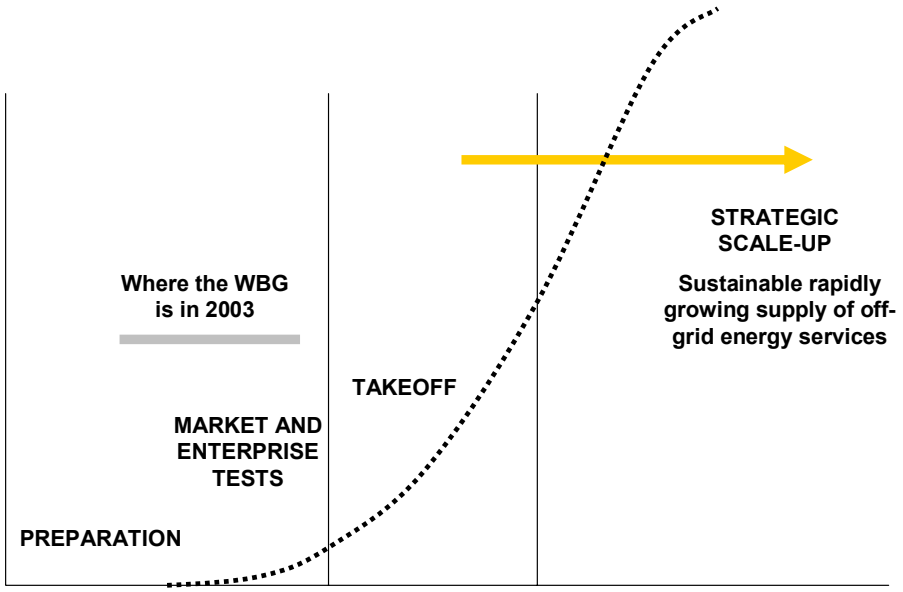
Yet another approach is to find a way to get international consumer durables companies such as General Electric and Siemens to get into the off-grid business (they are already selling gensets).

4. EVOLUTION OF THE OFF-GRID ENERGY MARKET: GETTING TO SCALE-UP

The development and evolution of off-grid renewable energy supply can be characterized in terms of four stages of development and implementation, illustrated in Figure 1. This schematic provides a conceptual framework within which to view the Bank Group off-grid electricity supply projects using renewables. Four stages of development and growth are distinguished in this framework.

Stage 1: Preparation. During this stage, relatively few if any systems are installed or connections made while the policy, financing, institutional, market development, and business development efforts are all underway. This stage can take several years once the project has been initiated.

Figure 1. Growth stages in off-grid renewable energy services



Stage 2: Testing Markets and Infrastructure. During this stage there are test marketing, pilot implementation, and the development of appropriate market-responsive business models. This is the phase in which the business or project gets established in terms of its ability to deliver systems and services on a sustainable basis. Subsidies, preferential financing, technical assistance, etc. may all be needed during this phase. This phase, if successful, can take several years to establish a growing and profitable operation.

Stage 3: Commercial Takeoff. During this stage there is growing investment by the rural energy service enterprises. They invest in market development, sales/leasing/energy service provision,

increasing visibility and acceptance by households, communities, off-grid enterprises, NGOs, and government. The impact of Bank Group initiatives (with strategic partners) is to establish an environment in which sustainable and rapidly growing service provision occurs. This stage is also characterized by an increasing number of competing enterprises entering the market. This has happened in Sri Lanka, with six solid commercial enterprises active in the off-grid PV applications marketplace.

Stage 4: Strategic Scale-Up. At some point in Stage 3 the enterprises are able to attract significant and affordable capital for investment and development. The rural energy enterprises increasingly may offer a variety of products and services that provide value added to the customers and increased revenues and profitability for the enterprises.

VIEWING THE BANK PROJECTS IN THE COMMERCIAL GROWTH MODEL PERSPECTIVE

For most of the relevant Bank projects, the off-grid energy services market and enterprise tests are in stage one, with a few (e.g., China, Sri Lanka, and arguably Bangladesh) in Phase 2. What we don't know is the extent to which the various projects will result in successful navigation by some of the off-grid rural energy enterprise models through the commercial takeoff and strategic scale-up stages.

The challenges to achieving initial market entry are different from those associated with major commercial expansion (scale-up) and sustainability. Much larger amounts of equity and debt financing will be required to sustain growth in stages 3 and 4, and the growth of the rural energy services enterprise may result in diversification of the business (e.g., to supply appliances suitable for use with the energy services). Inability to access such capital quickly can lead to the enterprise stagnating or even failing.

If this conceptual market penetration model is realistic, then the "slow" establishment of off-grid renewable energy services during the first several years of project implementation *does not necessarily mean that continuation of the slow pace is inevitable.* On the contrary, the initial slow pace of market development and penetration is fully consistent with eventual takeoff and then much larger-scale and accelerated market penetration. *Unfortunately we may need another half decade or so to know which of the slow starters are preparing the way for major commercial takeoff, and which ones are not going to get off the ground.*

However, since we do know the indicative timetable for World Bank project identification, design, development, appraisal, approval, initiation (2 – 4 years) and then 4 – 6+ years of implementation, we also know that *business as usual off-grid energy project development and implementation will not contribute significantly to the attainment of even a fifth of the GVEP energy development goals. Thus new approaches and new models are needed in which much shorter development time is required and where existing distribution and financial mechanisms (e.g., like General Electric and Siemens) can be tapped for far more rapid diffusion than possible with the present project-by-project approach.*

BANK PROJECTS: PATH-FINDING FOR SCALE-UP TO HELP MEET THE MDG?

The past decade has been one of serious experimentation, to find sets of conditions in which it is possible to facilitate growth in both freestanding PV and renewable energy (hydro, bioenergy) small grids for off-grid communities. These 'pilot' efforts, designed to chart the course to sustainable application of off-grid renewables, have involved not only the World Bank Group but many partners and stakeholders including the GEF, UNEP, UNDP, NGOs, the private sector, rural communities, and client country government agencies.

Although it will have taken over a decade to facilitate the establishment of ca. 1.2 million connections (most for households), the impact of many of these projects has been to prepare the way for a much larger growth over the subsequent ten years. In Sri Lanka, for example, the initial installation of 24,000 SHS in phase 1 will be leveraged to provide 84,000 systems by 2008. This would require growth in the number of connections at 30% per year, a high rate of growth but likely achievable if the necessary capital could be made available for both the energy supply enterprises and the customers. Continued growth along a typical market scale-up curve, coupled with the necessary financial and technical support to industry, government, and end-users would be necessary to achieve the MDGs.

This will require that the WBG undertake some pioneering and innovative approaches with strategic partners. A more interesting example is village hydropower development in Sri Lanka. The World Bank / GEF ESD Project had an original target of fostering 21 MW of grid-connected minihydro power by the private sector. By mid-2002, ESD accomplishments included installation of 31 MW of grid-connected minihydro power. At least six serious private-sector minihydro developers now operate in Sri Lanka and are planning more minihydro development. Instrumental in attaining these achievements was the resolution between the Ceylon Electricity Board (CEB) and the minihydro developers of the basis for determining the tariff that is defined in the standardized small power purchase agreement (SPPA) that was developed under the ESD project.

While the Bank/GEF was supporting on the order of 10 to 15 village hydro schemes, in parallel, provincial government and other donors have financed over 200 such schemes. This provides an example of how WBG/GEF funds can be leveraged by using such funds to come up with successful models, which can be scaled up with other support.

Thus, if the World Bank and its client country and financing partners can work to get the market conditions "right", they can establish the launching pad for high rates of growth to occur over the next one to two decades. Note that in a very different arena, grid-connected wind farms have grown from virtually nil in 1980 to some 30,000 megawatts by 2003, responding to market forces conditioned by government policies, GEF support (no longer needed), and "learning" to structure the market to permit such absorption. Such growth will continue at very high rates (25%/year or more) for at least another decade in the view of many wind electric power industry analysts.

This is perhaps an extreme example to use in considering options for stimulation of off-grid renewables. The development and commercial application of large-scale wind electric power plants ("wind farms") has been underwritten by large subsidies including government research and development support in many OECD countries. The policies adopted have been very forceful, including the use of premium prices and attractive long-term contracts, significant tax concessions, and mandatory purchase requirements including renewable portfolio standards. The predictability of such policies is important as was seen in a downturn in the Danish wind market after the current Government reduced some of the incentives. It is not clear the Bank client country governments will be as interested in or able to design and implement an analogous set of incentives for off-grid energy services.

5. ENABLING CONDITIONS FOR OFF-GRID RENEWABLE ENERGY ACCESS

The experience gained over the past 15 years by the private sector, the World Bank, NGOs and others indicates the necessity for specific enabling conditions that together are necessary to support sustainable, profitable, and growing off-grid renewable energy enterprises. Essential market enabling conditions that emerge in an overview of off-grid renewable energy enterprises and of World Bank Group and other projects include but are not limited to the following:

- **Commercial Environment:** Supportive commercial/legal environment for private enterprises, NGOs, and cooperatives willing to deliver off-grid energy services;
- **Markets:** Favorable market characteristics and customer base (i.e., sufficient density and accessibility of customers with ability to pay for energy services);
- **Policy Environment:** Supportive public policies and regulatory framework that foster delivery of least-cost off-grid energy services (including community mini-grid systems);
- **Infrastructure:** Functioning institutional, commercial, financial and technical infrastructure for off-grid energy services;
- **Financing:** Availability of accessible and affordable financing for off-grid energy supply and services enterprises and for customers.

As discussed below, the Bank's comparative advantages lie with addressing the three last items; the first two are not characteristics that can be shaped by the Bank's sectoral interventions.

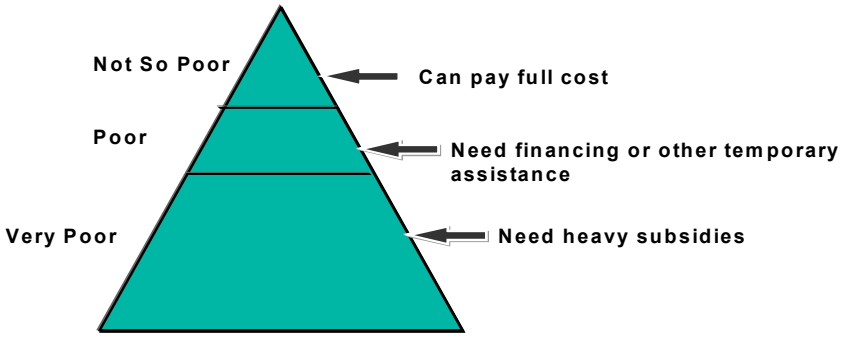
These conditions are relevant for presently used commercial off-grid energy supply enterprise models that employ sales (outright and financed), leasing, and energy services. These approaches target the top 5–40% of rural households (depending on the income profiles of the market areas), but without an additional revenue stream (e.g., from domestic cross-subsidies with the mainstream power sector), off-grid energy services enterprises will bypass the poor and target those with the capacity to pay.

The most suitable modality for provision of off-grid energy services will depend on specific market factors such as the levels of capability and willingness to pay (WTP) of different market segments, composition and magnitude of the loads, household density, and potential for attracting the interest of equipment vendors or private service providers to the particular locality. The difference between household incomes and WTP profile on the one hand and the monthly cost of service or equipment amortization on the other would determine the amount of public subsidies needed.

On average, an off-grid community will have a few households that can afford service without assistance, more households that can afford service with some long-term financing assistance or limited subsidies, and a large group that requires substantial subsidies (see Figure 2).

Source: E. Terrado, et. al.. (2001). *Strengthening the Non-conventional and Rural Energy Development Program in the Philippines: A Policy Framework and Action Plan.* World Bank: Energy Sector Management Assistance Programme (ESMAP).

Figure 2: The Income Pyramid for Rural Households



Source: E. Terrado, 2001 (op. cit.)

To assess the potential for scale up in all its dimensions, we need to look at other delivery models as well, especially those that lend themselves to rapid and efficient expansion and sustainable operations. To provide access to the poorest rural households, both subsidies and use of additional modalities/models will be required. The Bank may be able to take better advantage of existing public sector agencies that in some countries have better infrastructure to deliver off-grid services in addition to its traditional business of grid-based services. (However, many developing country electric utilities focus almost exclusively on providing electricity to the cities and towns, and resist or avoid rural electrification, especially by decentralized minigrid systems or dispersed systems.)

➢ Business Models for Off-Grid Renewable Energy Services

Data for the extent of access to electricity in the developing world reveal that there is considerable disparity in access depending on the wealth quintile. For example, in sub-Saharan Africa, virtually none of the population in the lowest 20% of wealth has electricity, and even the second and middle quintile populations have little access to electricity. Within the top 20% of the population (primarily in urban areas), electricity access ranges from 60% to 99%, depending on the country.

The business models established by companies such as Soluz in Honduras and Nicaragua, the Solar Electric Light Company (SELCO) in China, India, Sri Lanka, and Vietnam, Shell Renewables in India, the Philippines, and Sri Lanka and by others must, of necessity, target the high value markets. This top ten percent or so of the rural "rich" is where the cash and easily financed customers are. Only through subsidies by government, by richer family members, and others (e.g., GEF) can poorer households be provided with basic electricity services. For example, in Zimbabwe many urban professionals have purchased solar home systems and associated small DC appliances for family members living in the countryside.

From a developmental perspective, the question is what can and should be done to provide access to the poorest rural households. In some countries it seems possible to take advantage of public sector agencies that have better infrastructure to deliver off-grid electricity services in addition to the traditional electric utility business of grid-based services. Many developing country electric utilities have avoided taking on the provision of decentralized/dispersed electricity services due to lack of experience, staff, and financial and technical resources. It will require a partnership between the public and private sectors if the private

sector is to make serious investments in off-grid rural energy supply, whether by use of dispersed PV and wind electric units, or minigrids powered by diesel, hybrid, or renewable energy (hydro, biomass) sources.

The Bangladesh renewable energy project includes the provision of fee-for-service models for off-grid renewables through the rural electric cooperatives. These utilities have the additional advantage of being able to share the risk among broader customer base, unlike private entities whose sole business might be off-grid solar (e.g., Soluz, Selco). The spreading of risk is important if fee-for-service models are to be adopted, as the fees are affordable by poorer communities.

There is a variety of models involving the public and private sectors by which off-grid renewable energy services can be widely and sustainably provided. Some of these models were discussed and compared in detail in an ESMAP report[6] published in 2001.

The present business models appear suitable for scale-up, provided they can demonstrate strong profitability, market growth, and sustainability. The present PV energy services enterprises have not yet had the opportunity to do business in such an environment. If it is possible for off-grid energy service enterprises to make a good return on investment at an acceptable level of risk, and to be able to grow the business rapidly, the present business models may well work.

The great majority of connections will be residential, even though much smaller numbers of larger installations may have important local social and economic development impacts. However, rural PV enterprises have built much of their business on the residential market, and this in turn has made possible the delivery of PV systems for community and enterprise applications.

If it were practical and possible for the Bank and a few partners, (e.g., the European Union, GEF, industry, etc.) to create a fund that provided the proposed range of capital cost subsidies for a million solar home systems, this would certainly accelerate existing PV business operations in those countries where this would alleviate a major primary barrier to wider and faster diffusion. However, like a hothouse plant, such an approach could whither away once the cash grants disappeared. Shell Solar management have said that in spite of the present commercial growth in PV solar home systems in Sri Lanka, they don't know if this growth can be sustainable once the GEF grants are gone. In the absence of the capital cost grants in Philippines (via a Netherlands bilateral aid initiative), Shell Solar would not be operating there either.

Other models that could also work under these circumstances in the following, and should be explored further:

- ***Tapping the Global Durable Goods Marketplace:*** There is growing interest at General Electric Corporation in adding off-grid renewable equipment and energy *services* to their present durable goods marketing, sales, and service networks. General Electric operates in over 100 countries world-wide, has more than 300,000 employees, and had gross revenues in excess of $130 billion in 2002. Germany-based Siemens Corporation is another giant in the durable goods, electronics, and high technology arena. *There is interest within IFC in exploring potential collaborations with such companies to help*

[6] Ernesto Terrado (World Bank task manager), Donald Hertzmark, Chris Rovero, and Jerome. Weingart (November 2000, Annex update June 2001). *Strengthening the Non-Conventional and Rural Energy Development Program in the Philippines: A Policy Framework and Action Plan.* Energy Sector Management Assistance Program (ESMAP). 205 pp. Washington, DC: World Bank

them gain the renewable energy perspective and experience to decide whether or not to enter these markets. With their vast distribution infrastructure, they could possibly use this to introduce and diffuse off-grid renewable energy systems rapidly and on an unprecedented scale.

- ***Franchising Off-Grid Renewable Energy Services:*** The franchise model may be one option for achieving scale-up. It can provide a basis for delivery of relatively uniform equipment and services, and would support local off-grid energy enterprises with training in marketing and sales, business management, staff training, and technical aspects of RETs. This approach has yet to be tried, in part presumably because of the high initial investment required and poor understanding of how such an approach might fare. Yet the sales, installation, service, and financing of small diesel gensets, diesel engines, diesel pump-sets, and the like, is in essence a franchise operation world-wide. Perhaps this is a model that should be assessed in terms of how off-grid energy services can be provided through a mix of renewable and fossil energy systems. Franchise concessions could be competitively bid and regulated to ensure economic efficiency and customer protection.

Table 4 presents many of the important enabling conditions associated with promoting or inhibiting project and program success, in both Bank projects and other initiatives. "Success" is defined as programs and projects implemented in a timely fashion, with functioning and growing markets, reliable supply of equipment and services (energy services, maintenance and replacement services, etc.), local private rural energy enterprises that grow and become profitable, and satisfied customers. Because it is likely that micro-grids and mini-grids will increasingly support provision of off-grid electricity services, these enabling conditions were applied both the dispersed (PV and other free-standing systems) electricity supply and decentralized grid options.

No single factor can account for the success or failure of off-grid initiatives and enterprises in the developing world. However, some of the most essential enabling factors that continue to appear include the following, with the caveat that the conditions that are conducive to present levels of off-grid energy business activities may not be sufficient for large-scale initiatives. Our preliminary assessment of the relative importance of specific enabling conditions to achieving sustainable off-grid use renewables for energy services is presented in Table 7.

Table 7: Enabling Conditions for Project Success and Sustainable Scale-Up of Off-Grid Rural Energy Services

ENABLING CONDITIONS	Importance for:	
	PV, other free-standing	Micro- and mini-grids
Public Policy Environment and Regulatory Framework		
Stable client country: A stable and supportive social, political, legal, commercial, and financial environment.[7]	Important (but not essential)	Essential
Supportive public policy framework. The sales of PV systems are roughly equivalent to sales of household appliances, and can flourish independently of any policy framework short of their outright ban. Kenya is a good example. However, independent grids will attract the government energy sector regulators once they have begun to succeed as new enterprises. The appropriate policies should be developed before these enterprises fly into the regulatory radar.	If no government interference, not an issue	Essential
Off-grid energy programs: Programs and projects requiring or encouraging the use of renewable energy equipment for electricity delivery	Useful to very important	Very important
Enforcement of standards: and enforced by a local agency/regulatory body (i.e. electricity board) or required by financial institutions for end user and supplier finance. *Note that this is a widely debated issue, since some advocate letting the market decide on the basis of product and service quality (for free-standing units). The latter may be true in markets with good information, and access to such information, as has gradually happened in Kenya.*	Very important to ensure quality in products and services	Technical standards including safety are essential.
Political involvement: Insulation of off-grid energy initiatives from political interference at the national, provincial, and local levels. *Such interference has limited the ability of small renewable energy suppliers / installers to operate, and has also basically killed several carefully designed commercial rural PV projects. On the other hand, political support, with senior government officials as champions for renewables is necessary if additional funding is needed for scale up.*	Essential	Essential, and it is also necessary to gain government involvement and "ownership"
Responsibility of the Government Systems: E.g., accountability of employees, especially regional government employees. If those employees are responsible for administering grants and incentives for off-grid energy enterprises, there must be accountability to minimize delays and informal "fees."	Important only if government projects / financing drive the market	Important because of government regulatory needs
Market-Based Systems: Electric power sector that allows and encourages private participation in the electricity market.	Generally not relevant, not significant but helpful	Essential, with clear and explicit terms and conditions
Rural Electrification Law: Small pilot projects (e.g., Shell/CPC microgrid in Aklan, Philippines) may demonstrate the technical, cost, and market characteristics of a greatly scaled up approach. However, such projects often fly below the regulatory radar, and may hit serious obstacles in terms of government actions in response to proposed large-scale off grid initiatives. Both the laws and the enabling regulations must be clear and explicit.	Usually not relevant	Essential for scale-up, but not always needed for pilot projects

[7] This means, among other factors, that the country is socially and politically stable and that the rule of law applies. It means that contracts are enforceable, and that foreign companies can do business in a variety of ways, e.g., as wholly owned companies or as joint ventures. For countries with eroding currency exchange rates, predictability in such erosion dynamics is important, when it is even possible.

ENABLING CONDITIONS	Importance for:	
	PV, other free-standing	Micro- and mini-grids
Market Characteristics and Customer Base		
Per Capita GDP and Rural GDP – the capacity and willingness to pay for off-grid energy services (e.g., on a fee-for-service basis). *Note, however, that government cross-subsidies from the urban / commercial electric power sector to rural electricity services may be needed in combination.*	Very important, unless offset by grants and other incentives	Essential for commercial sustainability and market growth
Actual or potentially available market aggregation mechanisms for off-grid energy services and equipment.	Very important to lower transaction / equipment / service costs	Essential, to ensure minimum acceptable numbers / density of customers
Population aggregation, sufficient numbers, spatial density, and accessibility of potential rural electricity customers with sufficient income to pay for off-grid energy services.	Very important; essential for full cost recovery	Essential to justify micro and minigrid systems
Large unserved and/or underserved population. *In some countries, where the grid in rural areas is often unable to provide reliable good quality AC power, there is a demand for PV systems in addition to and in parallel with the grid.*	Very important for investments in scale-up	Very important
Demonstrated end-user willingness and ability to pay for entry-level electricity services	Essential for investment decisions	Essential for investment decision
Access to information: Access by rural households, farmers, communities, and institutions to useful information about off-grid energy options.	Very important	Very important
Concessions: Granted to private companies for development & sale of technologies in designated areas *Concessions have not yet worked in the two WB/GEF PV projects that have attempted to use this approach (Argentina, Cape Verde), and may not work for small rural diesel-powered microgrids in the Philippines. This is still very much an experimental approach.* Where there are no dealers (Cape Verde), high value incentives will be needed to attract investment in PV equipment supply and PV-based energy services	Not needed if there is active competition that benefits customers and dealers.	Very high, to offset commercial risk of open competition, but profitability must be consistent with risks.
Financing for Off-Grid Energy Supply and Services		
Currency exchange issues: Programs (international and/or domestic) to underwrite currency exchange risks. Many developing countries have experienced currency devaluation relative to the US$ and Euro, raising the costs of equipment imported from OECD countries.	High, if needed	High, if needed
Donor funds for project and program preparation: Access to GEF and bilateral donor funds has been essential for WB task managers to prepare off-grid and on-grid renewable energy projects and obtain project co-financing.	Essential under present WBG practices	Essential under present WBG practices
Supplier grants / subsidies: Supplier grants (e.g., $50 - $100 per SHS, provided to the supplier after confirmation of (proper) installation of the system, to buy down the risk of supplier market development and promotion. Such grants should be designed, where possible, as "smart" subsidies, declining as the local industry becomes profitable and its risks decrease. For Sri Lanka RERED grant co-financing—limited to US$ 400 per kW of installed capacity, up to US$ 20,000 per installation—would be made available to developers of mini-grid village hydro.	Very important for attracting investment in and developing rural PV enterprises	Very important in some cases (e.g., Sri Lanka minihydro)

ENABLING CONDITIONS	Importance for:	
	PV, other free-standing	Micro- and mini-grids
Financial incentives: Availability of financial incentives including subsidies through government or as a project component, in the form of capital buy-down, below-market financing, or other mechanisms to facilitate market and infrastructure development for supply-side chain, co-ops, and end-users. Other important incentives include tax holidays and freedom from import duties for renewable energy system equipment.	Very important until market is established, competition is solid, prices are declining, and service quality improves.	Absolutely essential in order to create 'level playing field' for off-grid AC services
Debt Financing: The financing needs of the energy supplier range from minimal (e.g., EDF International's self-financed off-grid minigrid operations in Mali) to essential (innovative pioneers without access to patient capital).	Very important for financing rural energy enterprises	Depends on the developer / owner
Private Sector Investment or cost share. *Investors and lenders need to see the private sector agent at risk before they will lend and invest in off-grid energy services.*	Essential	Essential
Supportive Institutional, Commercial, Financial, and Technical Infrastructure		
Available supply and service infrastructure: Availability of equipment suppliers, installers, and maintenance service providers, consultants, etc. capable of designing feasible projects.	Essential (although some companies create it at great expense)	Essential, but may be contained within the rural energy services company.
Financial institutions: In-country rural finance institutions (e.g., rural banks, rural cooperatives that provide end-user finance, Grameen Bank-type institutions, agricultural development banks that can incorporate end-user financing for off-grid energy investments, NGOs with financial / lending operations, etc.). National development banks that can on-lend ODA funds to support local suppliers and end-users.	Essential	Essential in funding the productive end users and community services aspects.
Micro-finance infrastructure for refinance and community-level one-stop shopping for renewable energy equipment.	Highly desirable	Highly desirable
Capacity building for financial institutions, including the participating credit institutes and micro-finance institutes, on the technology and appropriate financing mechanisms	Most developing country financial institutions require extensive training in order to loan effectively for off-grid energy supply and productive and community end uses.	
Capacity building on enterprise management, including financial management for supply-side manufacturers, suppliers, distributors, installers, maintenance organizations, and end users	Extremely important to essential. AREED and BREED programs are providing this in Africa and Brazil	
Commercial Concerns		
Project in place: Whether or not an off-grid electrification project has been put in place in the country already. *Without an enabling framework for rural minigrid operations, minigrid enterprises will have to pioneer in the field, and few can afford to do this. For PV, having several (or more) growing commercial operations demonstrates market opportunity and market functioning.*	Previous / ongoing sustainable experience with PV very helpful	Very important to essential

ENABLING CONDITIONS	Importance for:	
	PV, other free-standing	Micro- and mini-grids
Performance standards: A system of equipment/system performance, installation, and maintenance standards that is accepted and implemented on a country-wide basis (e.g. PV-GAP, supported by the World Bank). For micro- and mini-grids, there are rural electrification technical standards in many developing countries (often developed in collaboration with the US National Rural Electric Cooperative Association – NRECA). World Bank studies show that there are opportunities for technical innovation and cost reduction for rural minigrids without decrease in performance or safety.	Very important	Essential, but the rural electrification grid standards are often too stringent for low power small isolated grids.
In-country production: In-country manufacture / production of key off-grid energy system equipment and value added (e.g., through systems integration), to decrease foreign exchange risks and components, to decrease costs in local currency, and to increase the stability and resilience of the in-country supply.	Desirable for some components (e.g., batteries). PV production mostly for large markets (Brazil, China, India, etc.)	Highly desirable for poles, transformers, meters, etc.
Project Design Factors		
Built-in scale-up phase of project	Important, perhaps essential	Important, perhaps essential
Education & Outreach on availability, reliability, and appropriate use of systems for cooperatives and/or end users	Essential	Essential

These factors apply to the existing delivery model. It would be useful to determine which of these are applicable to scaling up using other models. If other factors are essential, they should be noted. For example, a level playing field with respect to access to grants is needed, such as through Rural Energy Funds. Scale up will not happen if resources are mainly from WBG or GEF.

6. SCALE-UP CONSIDERATIONS

Some of the considerations needed in development of scale-up mechanisms for off-grid renewables are summarized below.

MARKET AGGREGATION MECHANISMS

Some of the projects have shown the importance of market aggregation as a condition for profitability and growth in off-grid energy services. For projects in Africa one of the most difficult challenges for suppliers of renewable energy equipment and services for the rural milieu is the lack of market aggregation mechanisms. Rural population densities are very low, roads range from poor to non-existent (tracks in the sand), and the lack of rural telecommunication services makes communication between service providers and customers difficult and erratic at best. Consequently the costs of marketing and providing off-grid energy services using small renewable energy units are extremely high. This applies to all small-scale energy services. Maintenance and repair of small diesel engines and gensets is very expensive if technicians must travel from the major cities and towns to the villages. In sub-Saharan Africa, wind-driven abrasive fine sand can destroy such units in months. Fuel supply and quality is often uneven, and the local delivered prices of fuel are often much higher than those at port of entry.

By assisting client country agencies *during the project design phase* in evaluating renewable energy options and, where appropriate, incorporating them in the procurement specifications and mechanisms in agricultural, rural development, small- and medium-enterprise, irrigation, community water supply, and telecommunications projects, the Bank Group can establish *aggregated markets that can be served and serviced efficiently*.

The financing requirements for renewables are very different from fuel-based systems (e.g., diesel engines and gensets). Renewables have high capital costs and little or no fuel costs; diesel systems have low capital costs and high operation, maintenance, and fuel costs. Therefore, the financing plan that is developed during the design phase must reflect the need for higher investment funding requirements. Once these aggregated markets can "pull" commercial enterprises into the off-grid rural energy service business, they presumably will work to develop residential markets for renewable energy equipment and services.

ROLES FOR INDEPENDENT AC MINIGRIDS

It is suggested in a recent GVEP presentation[8] that the *use of decentralized energy supply systems* may well permit many developing countries that have large unelectrified rural populations to reach these populations much sooner than traditional backbone power grid extension. Independent grid systems may have lower costs and provide highly superior electricity services compared with the use of PV systems, and these cost and technical advantages can facilitate relatively rapid scale-up in connections.

[8] Dominique Lallement, World Bank/ESMAP Manager. (2 November 2001). *Opportunities for Decentralized Opportunities for Decentralized Energy Services in Developing Countries* (available in PDF format for download from WB web site)

This assumes that the customers are sufficiently close proximity to justify the investment in a mini-grid. If so, mini-grid could be a least cost option.

In many cases the daytime loads are too small to justify providing 24-hour electricity and many minigrids may operate for 5 hours at night (typically 6 PM to 11 PM). Microhydro and minihydro systems can provide full-time AC power with per kWh costs an order of magnitude lower than for the limited DC electricity available from solar home systems, but if the hydro resource is not easily accessible, small diesel gensets may be even cheaper (Philippines Rural Power Project). One approach to building daytime loads and stimulating economic and social development is to establish rural productivity centers where basic infrastructure including clean water supply, 24-hour AC power, telecommunications, and other services are available in a delimited area. This could be a kind of micro industrial park.

BANK AND DONOR RECOGNITION OF SMALL ENTREPRENEURS' NEEDS AND LIMITATIONS

Virtually all of the companies that are providing off-grid energy services to rural households in the developing world are (1) small, (2) barely profitable at best, and often not profitable, (3) operating with internal cross subsidies from larger parent companies, and (4) operated by highly committed entrepreneurs, most of them with a strong social agenda behind their business operations. Therefore any time lag in project start up, or gaps in funding for phased projects, can affect projects in a very negative way—project developers may have gone home or gone bankrupt waiting. Small companies can't influence policy or the environment in which they operate; they have a limited ability to build the markets on their own.

This is at the crux of the matter. Scale-up requires a different model or models from those now used by the Bank, in which these small companies are the core local commercial resource for off-grid renewable energy services. Small companies by definition have limited capital and staff resources unless they are divisions of much larger organizations (e.g., Shell Solar, BP Solar). A challenge is how to get larger more capable players to enter the off-grid business *and* how to provide the smaller but often highly capable and knowledgeable small players with the resources to become larger.

7. COUNTRIES AND REGIONS SUITABLE FOR SCALE-UP INITIATIVES

There are few places in the world where off-grid energy services investments are being made by the private sector, and fewer still that have become profitable. The reality is that off-grid energy systems and their use for household and community applications is not a large-scale commercial activity anywhere. While the potential market appears large—at least 5%, or 20 million, of the 400 million unelectrified off-grid rural households in the developing world—large-scale investment in developing and servicing this "market" is still considered too risky and not profitable

Wealthier developing countries including Argentina, Brazil, China, India, Mexico, the Philippines, and Sri Lanka *appear* to offer good opportunities for the Bank to facilitate significant scale-up. Even in these countries establishment of the enabling conditions for commercial investment and off-grid energy services operations will require a mix of public and private sector initiatives. The Bank has off-grid rural energy projects underway in these countries except for Brazil.

To the extent that widespread access to modern energy services is one of the conditions of sustainable economic and social development, the Bank and its partners will have to actively work to expand such access in very poor regions, notably sub-Saharan Africa and South Asia. The suitability of various countries for scale-up initiatives is discussed below. We distinguish between the apparent *suitability* (in terms of the enabling conditions present in these countries) and the developmental *priorities* for various countries. Most of the countries that most urgently need modern energy services in unelectrified areas are those that lack good conditions for scale-up.

For the World Bank Group, building on existing and pipeline projects and programs is probably the most effective way to achieve rapid rural electrification initially, but this may eliminate many countries in which poverty alleviation is the most pressing need. The countries with the necessary enabling conditions are not those whose needs are the most urgent. Linking achievement of the MDG goals with off-grid service provision makes the task of scale-up extremely difficult. The need is in Africa, but enabling conditions are probably the best in Asia. Therefore, if the World Bank is sincere in its efforts to contribute to achieving the MDG through provision of modern energy services (and other infrastructure services), then we need to look for other models that can lead more quickly and economically to scale-up.

PRECONDITIONS FOR SUSTAINABLE OFF-GRID RENEWABLE ELECTRICITY SERVICES

Conditions associated consistently with successful off-grid renewable energy-based electricity services enterprises are summarized below. The first two are essentially "given", whereas the latter three conditions can be influenced strongly by the Bank if the client country government is interested and committed.

National Environment—a stable socioeconomic and political environment: Civil society—level of peace and security that permits long-term business investments. Supportive national legal, institutional, and policy environment, stable socio-political environment, degree of government proactive support for off-grid modern energy services from both fossil and renewable sources. This is a necessary precursor for any commercial or public/private initiatives that can have a chance to succeed.

Markets—a tangible market demand and functioning market infrastructure: A large potential market that has been actualized to some degree through pilot initiatives by PV and other enterprises, and where there are sufficient financial resources to pay for PV SHS and similar equipment or the services they can provide. Demonstrated ability to pay for such equipment and services is essential to attract enterprise into this arena. Other market aspects include the following:

- Sufficient numbers, spatial density, and accessibility of potential rural electricity customers with demonstrated willingness[9] and ability to pay for entry-level electricity services, insulation from local political interference, which has seriously impacted PV projects that were otherwise proceeding effectively,

- Potential decentralized energy *market aggregating mechanisms*, such as large regional and national cooperatives, ministries and programs for development of housing and community services (water, health, education, telecommunications)

- Programs and projects requiring or well-suited to the use of renewable energy equipment for electricity delivery,

- Standards for equipment and services that can help customers choose from reputable suppliers.

- Extension services and extension workers knowledgeable about rural energy options and the technical, operational, and financial characteristics of these options.

Infrastructure—Capable experienced local off-grid energy services enterprises: Where there are companies successfully doing business providing goods and services to rural populations, there is the opportunity to bring off-grid energy products and services into the marketplace. In some countries the potential for rapid scale-up may lie with the introduction of renewable energy product lines and services into the durable goods infrastructures. In some developing countries, the companies providing PV equipment and services are subsidiaries or affiliates of much larger main-stream enterprises in such fields as power electronics and civil engineering, in which cases the small size of the PV operations will not reflect the true technical and financial capabilities of the company.

Financing—Knowledgeable and supportive rural financing institutions: Most customers will need financial assistance in the form of short-term (3-5 years) terms, market or below-market rate interest. The latter is important where, e.g., market rates are artificially high due to limitations in liquidity of the rural financial institutions (RFIs) or where the rates are elevated due to lack of relevant knowledge and experience of the RFIs. *We note that the desirability of subsidizing loans for renewable energy systems is still a widely debated issue. However, it can be argued that it is "better" to have a one-time capital subsidy or its equivalent in a lowered short-term interest rate than to have to subsidize fossil fuels or fossil-generated electricity on an ongoing basis.*

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[9] Note that the willingness and ability to pay for rural energy services is typically "measured" or inferred from rural household energy surveys. These surveys document the amount of money that households pay each month for a mix of simple energy services that include automobile battery charging, kerosene, dry cell batteries, auto batteries (typically used and of unknown quality), and kerosene lanterns. The reality is that few rural households will disclose their actual income or available resources when asked by rural surveys. Moreover, with the availability of PV lighting kits come additional resources from family and friends in cities and from abroad. Consequently, *only through test marketing of reliable warranted products and services can the true ability and willingness to pay for such services (e.g., microgrid electricity, PV SHSs, etc.) be determined realistically.* Such willingness and ability to pay is often greater and sometimes *much* greater than indicated by rural household energy surveys.

Suppliers need both equity and debt in order to grow their businesses, expand into the marketplace, and improve and diversify their line of products and services. Solid, proactive financial institutions are needed to provide consumer credit and loans for renewable energy enterprises throughout the country or country region, experienced with PV and other renewable systems for off-grid applications. Commercial financing to support renewable energy off-grid product, business, and market development is still very limited and difficult to access.

Commerce—The presence of an established internationally accepted set of commercial practices: The client country commercial practices, commercial codes, enforceability of both domestic and international contracts, minimal import tariffs and duties on imported renewable energy equipment, stable and freely convertible currency, and similar factors are essential for development of an off-grid renewable energy services business.

There are other factors and considerations that can also be important. Government agencies should not complete with the private sector if the private sector can deliver off-grid rural energy services efficiently. Rather, partnerships are often needed between local government units and the private sector to ensure efficient access to off-grid customers.

Table 8 summarizes IRG's preliminary characterization of countries in terms of their potential for supporting scale-up initiatives. In Sub-Saharan Africa and South Asia, where the need for poverty alleviation projects and programs is greatest, the Bank can use these programs to establish opportunities for off-grid energy services, and to attract investment in provision of these services. The "rankings" from "poor" to "excellent" are not quantitative, but rather reflect our understanding of conditions in those countries for the five enabling conditions summarized above.

Table 8: Country Suitability for Renewable Energy-based Off-grid Scale-Up Initiatives

Country	Environment	Infrastructure	Financing	Markets	Commerce
Latin America and the Caribbean					
Argentina	Good	Fair	Fair	Good	Good
Brazil	Good	Good	Good	Fair	Good
Bolivia	Good	Fair	Fair	Fair	Good
D. Republic	Very Good	Good	Fair	Good	Fair
Mexico	Very Good	Very good	Good	Very good	Good
Nicaragua	Good	Fair	Good	Fair	Fair
Asia and Near East					
Bangladesh *	Good	Fair	Very good	Good	Good
Cambodia *	Fair	Poor	Poor	Fair	Fair
China *	Good	Fair	Fair	Good	Good
India *	Good	Good	Good	Good	Good
Indonesia *	Fair	Fair	??	Poor	Fair
Philippines *	Good	Fair	Fair	Good	Good
Sri Lanka *	Excellent	Very good	Very good	Good	Good
Vietnam *	Fair	Fair	Fair	Fair	Fair
Africa					
Burkina Faso	Fair	Fair	Fair	Good	Fair
Ethiopia	Fair	Poor	?	Fair	Fair
Ghana *	Fair	Fair	Fair	Good	Fair
Kenya *	Fair	Good	Fair	Good	God
Mali	Fair	Fair	Fair	Fair	Fair
Morocco *	Good	Good	Fair	Good	Good
Senegal *	Fair	Fair	Fair	Fair	Fair
South Africa *	Good	Very good	Good	Good	Good
Uganda *	Good	Fair	Good	Good	Good

Countries proposed by Shell for MCF consideration

8. POTENTIAL BANK ROLE IN RAPID SCALE-UP OF OFF-GRID RENEWABLE POWER

The first million off-grid connections (associated with Bank projects) will have taken almost 20 years (1993– 2010). To achieve with renewables a relatively small fraction (e.g., 20%) of the more than 60–80 million new connections that GVEP has targeted between now and 2015 (12 years) will require new approaches. The average installation rate would be over 1 million annually. It is assumed that most of the more than 400 million unelectrified households will eventually be electrified through some form of AC grid connection. Since the Bank is a relatively small player globally in financing rural electrification, *the Bank Group's most effective contribution will be in helping to establish the conditions under which such large-scale commercial use of renewables can occur in the rural developing world.*

BANK COMPARATIVE ADVANTAGES AND OPTIONS FOR SCALE-UP INITIATIVES

> The World Bank Group's comparative advantages derive from its ability as a multilateral lender to offer a combination of financing instruments and a comprehensive view of economic and social development from a global and sectoral perspective. The World Bank Group also brings a track record of impartiality and expertise in advising governments, a reputation for technical competence, access to senior policymakers and decision makers, a diverse range of investment and risk mitigation instruments, and vast experience working at the interface of poverty, macroeconomics, governance, and environment. All this equips the World Bank Group for supporting the design and implementation of reforms and capacity building for well-regulated and competitive energy markets, facilitating the transfer of knowledge among developing and transition economies, and catalyzing private investment flows to non-investment grade countries.
>
> *The World Bank Group's Energy Program: Poverty Reduction, Sustainability, and Selectivity*
> Energy and Mining Sector Board (2002)

In most rural areas of the developing world, provision of off-grid renewable energy-based services is not a profitable stand-alone business. In order to attract substantial capital, know-how, and corporate commitment to provision of off-grid energy services, the markets for such services must be transformed through funds, financial mechanisms, and policy initiatives that can attract major investors with expectations of good returns on investment. The returns for provision of off-grid energy services are marginal and the associated risks are high. Mainstream investors are not easily attracted to this sector.

In the broad sweep, the donor community will need to find effective ways to couple rural energy supply with economic and social development investments, and to underwrite this in ways that will attract the private sector to take risks, make investments, and provide services on a significant scale over the next several decades. What is clear is that rural electrification and rural economic development are closely coupled, and that major initiatives for poverty alleviation must include explicit provisions for meaningful off-grid energy supply and services.

The Bank is a wholesale lender for large-scale projects in the key sectors that address its poverty alleviation and economic development mission. Off-grid rural electrification projects, whether they use fossil or renewable energy equipment, are often relatively small by Bank lending and investment

standards. This is one of the problems that the Bank is trying to rectify through scaling up such projects. Possible models for accomplishing this are discussed in this report.

The Bank has made important contributions in (1) providing and mobilizing project financing, (2) preparation of the enabling environment, and (3) in coupling initiatives for decentralized and distributed modern energy services with other initiatives (Bank-funded and others) that can benefit from those services.

WHAT THE BANK CAN DO

On the supply side, the Bank can:

- Assist client governments in establishing supportive policies that encourage "least-cost" preferred energy service delivery and technology options;
- Work with the client country Governments to establish/enhance the regulatory framework for market development of off-grid energy services;
- Encourage governments to establish rural electrification funds that are equally accessible for all energy service options and by all energy service providers;
- Strengthen the capacity of financial institutions to lend for off-grid energy services;
- Expand the use of renewables in existing and pipeline *non-energy projects* in which dispersed and decentralized energy services are essential;
- Help build the national and local capacities[10] of viable energy service delivery agents.

On the demand side, the Bank can:

- Help improve the economic conditions in rural areas through support and coordination of investments in income generating activities with development of local energy services;
- Improve access to affordable rural credit to support economic development and growth;
- Improve access to health and education services as a means of improving the human economic potential; and
- Improve communications and disseminate information to support all of the above (including potentially through agriculture extension agents acting as rural energy extension agents)

[10] "National capacity" refers to such entities as national electric utility agencies and rural development agencies, and to centralized enterprises that provide renewable energy equipment and services. "Local capacity" refers in part to the capability of off-grid villages to identify, purchase, and help maintain rural electricity services, to local enterprises that can deliver, install, and maintain such equipment and provide decentralized energy services, and to NGOs, (CBOs, and commercial enterprises (e.g., farming, fishing, aquaculture) to making effective use of rural energy services.

Successful scale-up initiatives must build capacity in energy provision and foster the conditions that create friendly environments for investors. A project-by-project approach will not be sufficient to accomplish the significant levels of scale-up needed.

CROSS-CUTTING POTENTIAL OF BANK GROUP PROJECTS

Increasingly, the Bank Group is supporting the establishment of infrastructures that can deliver off-grid modern energy services on a large scale. Rural access to modern energy services, while essential for most development initiatives in agriculture, health, education, clean water supply, and enterprise development, rarely appears as an explicit integral component of Bank/IDA projects and programs in these areas. There remain opportunities to integrate rural energy with initiatives in poverty alleviation, agricultural development, enterprise development, rural health and education, and broad access to telecommunications services.

To initiate a significant scale-up in rate and impact of off-grid renewable energy, new initiatives must be consistent with the Bank Group's policies development policies and the best practices it has learned and documented widely over the years. In particular, the Comprehensive Development Framework (CDF) and the Bank's Strategic Framework Paper (SFP) provide the framework for supporting clients to fight poverty. A hallmark of the Revised Rural Development Strategy is the development of effective rural financial services. This will benefit rural off-grid energy equipment and service suppliers, enterprises that require these services, community organizations, and households.

Using dedicated funds and full-time professional staff positions, the Bank can develop a broader capacity to integrate sustainable energy options with non-energy projects. Most Bank projects in rural development, agriculture, etc. lack explicit acknowledgement of the roles of modern energy services, much less making these roles explicit in terms of technology, funding, etc. A standardized process for incorporation and specification of off-grid energy options in non-energy projects could facilitate scale-up.

TRAINING OF STAKEHOLDERS

The World Bank Institute should incorporate explicit concerns for energy into its activities, and sensitize and train stakeholders in relevant countries as to the use of renewables and other decentralized energy options in non-energy projects. The World Bank Institute's ***Clean Air Initiative*** illustrates the power of partnership. It brings together organizations from the public and private sectors, academic institutions and international agencies all fighting the battle against air pollution with in-kind or financial assistance. Being a partner gives organizations a unique ability to help shape the future of urban air quality by fostering improved governance, regulation, technology and public participation. Each partner contributes in its own way; cities and NGOs generally contribute staff time, while development banks and agencies provide technical expertise, and the private sector contributes both technical expertise and financial support. Many organizations have also contributed to the Initiative through other means including sponsoring local workshops. *There seems to be the potential for a similar approach to large-scale provision of off-grid modern energy services and other vital infrastructure services.*

THE ROLE OF THE GLOBAL VILLAGE ENERGY PARTNERSHIP

The Global Village Energy Partnership (GVEP) was established in 2002 to bring together developing and industrialized country governments, public and private organizations, multilateral institutions, consumers and others in an effort to ensure access to modern energy services by the poor. This Partnership of partnerships aims to help reduce poverty and enhance economic and social development for millions around the world. Its work will be carried out under a 10-year "implementation based" program. The Partnership's objectives are to:

- *Catalyze* country commitments to village energy programs and guide policies and investment in this area.
- *Bridge* the gap between investors, entrepreneurs and energy users in the design, installation and operation of replicable energy-poverty projects.
- *Facilitate* policy and market regulatory frameworks to scale up the availability of energy services.
- Serve as a *marketplace* for information and best practices on effective development and implementation of energy-poverty projects/programs.
- *Create* and maintain an effective coordination mechanism for addressing energy-poverty needs.

For off-grid energy initiatives to contribute to social and economic development, they need to be explicitly coupled with primary development initiatives. The challenges for these projects include the need for linkage, leverage, facilitation, and catalyzation that GVEP was established to address.

The GVEP Secretariat has been established at ESMAP, and is focusing on regional and international meetings and workshops to build the networks and commitments necessary to support the GVEP goals. However, GVEP remains seriously underfunded and understaffed, and without a major ongoing commitment from the Bank and other GVEP partners, it is unlikely that GVEP can achieve the objectives indicated above.

9. FINAL THOUGHTS

Through the work of the past two decades the Bank Group and its partners in the development community have created considerable expertise in off-grid renewable energy provision. Recognition of the importance of energy in development is growing, and a number of important multi-partner initiatives have formed to address and scale-up the role energy will play. The global community's attention is firmly fixed on energy provision as an enabler for social and economic welfare. Without energy for productive and social uses the world's developing communities cannot emerge from poverty.

The Bank is at a critical juncture; it must now choose to be a leader or a follower. Should it lead, the Bank group will fulfill the donor community's expectations of it as a compass in global development issues. Should it take a more passive role, the Bank group will remain in a responsive, rather than proactive role. To become a leader in the field, the Bank must recognize energy access as a necessary input for development, and the highest levels of Bank management must demonstrate this commitment.

ANNEX 1. CONSULTANT TERMS OF REFERENCE: EVALUATING THE POTENTIAL FOR SCALE-UP OF OFF-GRID RENEWABLE POWER

INTRODUCTION

The Shell Million Connections Fund

Shell has proposed a Million Connections Fund (MCF) which proposes to achieve an additional one million connections to basic electricity services using renewable energy technologies over the next five years. The basic principles by which these would be achieved are:

- Assisting developing country governments select policies that ensure sustainability and support rural businesses to provide connections;
- Providing lines of credit so that consumers can access loans for connections;
- Giving modest cash grants per renewable-energy-connection to ensure affordability and attract on-the-ground rural businesses to sell, install, and service connections; and
- Finding ways to enhance social services and income generation in conjunction with access to renewable electricity.

The central feature of the MCF would be to fund the per-connection grant which would be raised as new and additional funding from donors and the GEF (which has cooperated with Shell on the concept and is penciled in for $60 million). The target fund size is $150 million, implying per-connection subsidies in the range of $100–$150 depending on assumptions about how much of the fund was used for administration, technical assistance and other purposes[11].

The MCF would operate through existing institutions, and be based on the experience gained through projects now under implementation. The scale up would be achieved through replication of such projects, adapted to the particular conditions in additional countries.

A commentary on the MCF and the original proposal may be found in the Attachment.

Intended Bank Group Approach

In undertaking its due diligence on the MCF proposal, it became clear that the Bank would be likely to fall short of achieving one million new connections within the specified five year period. This assumes business as usual which in this case is the efforts that the Bank is now making through existing or pipeline project work. Given the scale of the problem, a relatively steady rate of increased connections and a growing global population, it is timely to investigate how increased scale might be possible.

[11] The unit grant is based nominally on solar home systems sized at 30-50Wp each of which would provide a household with basic lighting, radio and TV services for about 3-5 hours per day.

Based on existing experience, it would appear that for projects to be successful at any scale, necessary conditions, or a reasonable potential for the necessary conditions, are essential to support a significant scale-up of off-grid renewable power. These key factors include:

- A supportive policy environment and regulatory framework;
- Availability of rural credit at market-rates, including the delivery infrastructure;
- The presence of private companies, NGOs or cooperatives to deliver and service off-grid renewable energy systems;
- A significant number of potential customers (number unelectrified with adequate capacity to pay and limited likelihood of grid service in next ten years) and,
- Products and services that are affordable for significant numbers of rural residents.

The latter point on affordability, which can be addressed by the type of per-system subsidies at the core of the Shell proposal, is a necessary but not sufficient element in this set of enabling conditions.

To determine whether a scale up effort is justified and if so, how it should be carried out, requires a review and consensus-building approach effort encompassing the Bank Group. Such an effort would include the following steps:

- Review and analysis of existing projects and other efforts in the off-grid field and an estimate of the outcomes they are likely to achieve. This stage will also seek to draw lessons on how the Bank Group might approach interventions so that they take greater advantages of economies of scale; in other words, to identify routes to scaling up achievements on the ground;
- Evaluation of potential countries, or regions of large countries, against this framework. The evaluation will also assess the priority accorded to this sector by Bank Group client countries;
- Development of a method for estimating of economically-justified levels of support for off grid systems, given the general principle that while capital costs may be subsidized, ongoing operating and maintenance costs should not;
- Discussions within the World Bank Group's energy practice on the approach for scale up, how it fits in with other rural energy initiatives (such as Global Village Energy Partnership) and how to manage it within a broader rural energy context.

The purpose of these terms of reference is to define the work program for a consultant in carrying out the first two tasks listed above.

OBJECTIVE

The objectives of the task are (i) to review and analyze projects in the off-grid field and make an estimate of the outcomes they are likely to achieve and in the light of that (ii) evaluate countries, or regions of large countries, which are potentially sites for increasing the scale of off-grid operations.

SCOPE OF WORK

The consultant shall undertake the following tasks:

- Identify and list existing Bank Group projects with an off-grid objective or component, giving details and, based on supervision information, estimate progress in meeting its objectives, likely overall levels of delivery, major obstacles etc. The purpose of this task is to list systematically the Bank Group's efforts and identify any common lessons that can be drawn, particularly in relation to the enabling conditions and the modalities of scaling up effort;

- Identify and list planned Bank Group projects with an off-grid objective or component, giving details. The purpose of this task is to list systematically countries and regions in which the Bank's efforts will be devoted and obtain estimates of likely levels of activity in the future;

- Identify and list countries or regions of large countries where there exist, or there is the potential for them to exist, the enabling conditions discussed in the introduction to these ToR. Where they are not fully in place (which is likely to be in the bulk of cases), the consultant should estimate the requirements to get the enabling conditions in place. This task is likely to require the consultant to identify and make use of sources of data from outside the Bank Group, including in the countries in question;

- Draw conclusions from the information developed in the first three tasks listed above, in particular relating to the potential for rapid scale up of operations, how the Bank might change its role as catalyst for such scale up, and how to involve other entities either as partners or contractors in implementing operations at a larger scale. The conclusions should be based on practical measures and assist in determining whether, and under what conditions, a scale up of effort to achieve one million additional connections within five years may be achievable. Any qualifications to the achievement of such a target should be clearly set out, as should any potential to exceed it.

QUALIFICATIONS OF THE CONSULTANT

The consultant should have the following qualifications:

- Familiarity with Bank operations in rural energy, particularly off-grid electrification;

- Familiarity with a broad range of other actors in the off-grid electrification field, at the international, regional and national level in developing countries;

- Strong analytical and integrative skills;

- Good presentation and communications skills.

DELIVERABLES AND TIMING

The consultant shall provide his findings in a written report. The report shall set out the tasks undertaken, the findings and the conclusions from the work, particularly relating to point (iv) above. The consultant should also be prepared to present his findings to the Energy and Mining Sector Board in the Bank.

It is considered that effort of about 8 staff weeks will be required for this task. Some travel may also be required.

The consultant will be required to start work by mid-February and complete his work by the end of May, with the delivery of the final report and presentation to the Energy and Mining Sector Board.

ANNEX 2. WORLD BANK GROUP RENEWABLE OFF-GRID ENERGY PROJECTS

❽ Denotes projects with an on-grid component Summaries of active projects are shown with shaded background

Project	*Off-grid renewable component*	*Off-grid connections projected*	*Off-grid connections to date*	*Grid connections projected*	*Funding ($US million)*
ARGENTINA Renewable Energy in Rural Markets Project ACTIVE (1999–2005) Project was restructured in 2002 **P006043**	The PERMER project (Proyecto de Energía Renovable en el Mercado Eléctrico Rural) is a component of PAEPRA in eight participant provinces. PERMER aims at providing electricity for lighting and social communication (radio and TV) to about 70,000 rural households and 1,100 provincial public service institutions through eight private concessionaires using mainly renewable energy systems. Concession approach did not attract bidders. Mid-term revision of goal to 35,000 connections.	35,000	1,600	None	Off-Grid: $86.9 GEF: $10 IBRD: $30 Total: $121
❽ **BANGLADESH** Rural Electrification and Renewable Energy Development: (RERED) Grid and Off-Grid Development (2002-2008) ACTIVE **P071794**	SHS dealer support through Grameen Shakti (and other MFIs) and energy-service concessions to be tendered by electric coops and utilities. 14,000 SHS Rural Electrification Board fee for service; Infrastructure Dev. Co. Ltd. (IDCOL) support for 50,000 SHS. 700,000 grid-based systems for HH, SMEs, public institutions; 64,000 off-grid systems for rural areas. Bank investment in PV estimated at $30m.	64,000	1,000	700,000	Borrower: $92 GEF: $8 IDA $191 Local: $7 Total: $298
❽ **BOLIVIA** Decentralized Energy, Information and Communications Technology for Rural Transformation ACTIVE **P073367**	Solar PV Market Development sub-component will implement private-sector led off grid service delivery models, providing rural households, micro-enterprises, schools and health posts with sustainable electricity by offering a menu of decentralized service. World Bank PV specific investment at $38.6m.	60,000	N/a	Unknown	Off-Grid: $38.6 IDA: $20 Total: $60

Project	*Off-grid renewable component*	*Off-grid connections projected*	*Off-grid connections to date*	*Grid connections projected*	*Funding ($US million)*
❽ **BURKINA FASO** Energy Sector Reform Project UNDER PREPARATION	Project will open institutional (health clinics, schools, NGO posts, and private businesses) market for PV systems to local competitive procurement, and establish the financial, technical, and business development intermediation mechanisms for local suppliers. It will support cash purchases of institutional-size PV systems as well as smaller household-size PV systems. Financial intermediation would be via the Universal Access Fund for channeling GEF/bilateral grants. If commercial banks show interest, an on-lending window to re-finance consumer credit extended by private solar PV dealers may be considered during project preparation. Targets 80,000 grid or minigrid connections. The program would also aim to provide 8,000 solar home systems for lighting and TV or lanterns to rural households and small commercial users, by private solar PV dealers on commercial terms with some subsidies. Qualifying solar PV dealers would receive competitive subsidy support, and may be able to refinance consumer credit. A suitable financing scheme will be designed. Bank funding for solar is $3m.	8,000	0	80,000	Off-Grid: $3 GEF: $3.5 Bank: $61.2 Total: $114.4
❽ **CAMBODIA** Rural Electrification and Transmission Project UNDER PREPARATION	Project will support: (a) institutional development and capacity building; (b) grid extension to rural areas by EDC; (c) off-grid electricity expansion and quality improvement of Rural Electricity Enterprises; (d) commercial investments in mini hydro projects; (e) solar home systems and improved used of batteries for household electricity supply. Up to 100,000 new grid & off-grid connections customers would receive electricity. The off-grid pilot projects are to be the basis for further initiatives to supply electricity to isolated population centers. Bank investments include $11.8m for renewables, $4m for PV.	10,000	0	90,000	Off-Grid: $4 IDA: $30 GEF: $5.7 Total: $85.6

Project	*Off-grid renewable component*	*Off-grid connections projected*	*Off-grid connections to date*	*Grid connections projected*	*Funding ($US million)*
CAPE VERDE Energy & Water Sector Reform & Development (1999-2004) ACTIVE **P040990**	4,000 SHS in households through regulated energy-service concessions, though very little interest has been shown by local enterprises. No bidders have been interested to date. Bank investment in PV at $2.5m.	4,000	0	None	Off-Grid: $2.5 GEF: $4.7 Bank: $17.5 Total: $48
CHINA Renewable Energy Development Project (2001) ACTIVE **P046829**	The project includes 20 MW of wind farms on two sites Shanghai, 10 MWp of SHS and PV-wind hybrid systems installed through private dealers to 300-400,000 households and institutions in remote areas of six Northwestern provinces; and support for technology upgrading to improve the performance and reduce the costs of solar PV technologies in China. Off-grid installations to be made at a rate of 30,000/year. Bank investment in PV at $145m.	350,000	30,000	None	Off-Grid: $144.9 GEF: $35 Bank: $100 Total: $444
❽ **ECUADOR** Power and Communications Sectors Modernization and Rural Services project (PROMEC) ACTIVE **P063644**	The Project supports the Government's efforts to deepen reforms in the telecommunications and electricity sectors, by strengthening regulatory institutions and improving environmental management of the sectors' activities, fostering competition and increasing private participation, promoting efficient use of energy, extending coverage in underserved areas and providing modem information and communication technologies (ICT)-supported services to micro and small businesses (MSBs), and enhancing communication and consultation in the sectors. 2,000+ SHS administered by government agency. It is expected that grid extensions will connect about 750,000 additional persons.	2,200	N/a	750,000	Off-Grid: $1.5 GEF: $2.84 IBRD: $23 Total: $43.25

Project	*Off-grid renewable component*	*Off-grid connections projected*	*Off-grid connections to date*	*Grid connections projected*	*Funding ($US million)*
❽ **ETHIOPIA**: Energy Access Project (2002 – 2007) ACTIVE **P049395**	Project's development objectives are (i) establish a sustainable program for expanding the population's access to electricity and improving quality and adequacy of electricity supply, thus supporting broad-based economic development and helping to alleviate poverty; (ii) reduce environmental degradation and improve energy end-use efficiency; (iii) reduce barriers to the wide spread adoption of renewable energy technologies, especially Solar photovoltaic (PV) and micro-hydro power generation in rural areas, thereby contributing to the reduction in greenhouse gas (GHG) emissions via displacement of kerosene and diesel that would otherwise be used for lighting and electricity generation. 6,300 PV installations (Bank PV investment of $5.4m), 70,000 urban households and 135,000 rural households targeted for grid or mini-grid.	~100,000	0	~100,000	Off-Grid: $5.4 GEF: $4.93 IDA: $132.7 Total: $199.12
GUINEA: Decentralized Rural Electrification Project PAD: April 2002 (2002-2006) ACTIVE **P074288**	Project will test institutional, financial, and delivery mechanisms to promote better access to electricity in rural and peri-urban areas. Project seeks to: (a) Test institutions, regulations and delivery mechanisms to develop, decentralized and affordable village electrification schemes; and (b) Test financial mechanisms to deliver increased access to electricity and mobilize private sector financing for energy projects in rural communities. GEF goal is the provision of "electricity services" to about 20,000 households over a five-year period through the promotion of at least 5,000 SHS in 50 villages and 80 pico-hydro associated with low-cost local grids.	20,000	N/a	None	Off-Grid: unknown GEF: $2 IDA: $5 Total: $17

Project	*Off-grid renewable component*	*Off-grid connections projected*	*Off-grid connections to date*	*Grid connections projected*	*Funding ($US million)*
INDIA: Enhancing Access Through Off-Grid Electrification (Rajasthan) PIPELINE FY03 estimated Board date	The project supports Rajasthan's Power Sector Reform Policy, which calls for improved access of remote rural areas to energy services, including through promotion and development of renewable energy systems. The project would involve electrification of about 500 villages and 500 hamlets envisaged to be serviced by stand-alone solar photovoltaic (PV) Systems, PV minigrids, biomass, diesel, among others. Technical assistance local capacity building to facilitate market development, and to assist Government of Rajasthan in formulating off-grid/minigrid action plans and regulatory framework aligned with ongoing power sector reforms.	250,000	N/a	None	Off-Grid: unknown WB: $178.2 Total: $266.8
ⓈINDIA Renewable Resources Development Project (1991) CLOSED ←	The solar PV component ($55.0 million) addressed the financing, delivery and installation of up to 3 MW of equipment for lighting, water pumping and other applications. Fourteen wind power projects with a total capacity of 49.9 MW. 19 small hydro projects with a total capacity of 43.5 MW. Bank PV at $24m.	45,000	45,000	None	Off-Grid: $24 GEF: $26 Bank: $115 Total: $450
INDIA: Renewable energy (02) project (6/27/2000) ACTIVE **P049770**	Objectives are 1) increase power supply; 2) mobilize private sector investments in renewable energy power projects; and 3) promote energy efficiency and demand-side management (DSM) investments. Power supply component is for hydropower. Subcomponent of 5 MWe of freestanding microhydro (<100 kWe each) projects.	10,000–20,000 if HH only		Most hydro will be grid-connected	Private: $140 IREDA: $25 Bank: $80 IDA: $50 GEF: $5 Total: $300

Project	*Off-grid renewable component*	*Off-grid connections projected*	*Off-grid connections to date*	*Grid connections projected*	*Funding ($US million)*
INDONESIA Solar Home Systems Project (1995). CLOSED	Solar home system investments funded and/or implemented by the private sector, NGOs and cooperatives. Within the framework of a least-cost rural electrification strategy, the project supports investments in approximately 70,000 solar home systems to areas not expected to receive grid-connected electrical services for at least three years. Components include technical assistance for developing energy strategies and strengthening institutional capacities. Restructured (2001) goal revised to 4,000 SHS.	4,000	4,000	None	Off-Grid: $3.8 GEF: $24 Bank: $20 Total: $118 (revised to $0.5m WB, $11m GEF)
❽ **LAO PDR** Southern Provinces Rural Electrification Project (1998-2004) ACTIVE **P044973**	20 solar battery charging stations by national utility and village electricity assoc. Project to pilot off-grid electricity through various renewable options incl. microhydro and diesel minigrids for 46 villages (4,600 households), 50,000 grid or minigrid connections targeted. $1.7 million off-grid energy component financed by GEF grant and IBRD loan.	4,600	4,000	45,000	Off-Grid: $1.3 GEF: $3.5 IDA: $34.7 Total: $39.5
❽ **MADAGASCAR** Energy Services Delivery Project Projected Board Date: May 2002	45,000 new connections to households and industries, one third of which will be in peri-urban and dynamic rural areas; serve additional demand of about 240 million kWh/year; increase the reliability of supply and reduce losses from 18 to 12% of net generation; substitute hydro-electricity for more expensive thermal generation by extending life of existing hydro plants, and by connecting several centers (about 1,000 kW), now served by diesel plants to systems that have surplus hydroelectric capacity; (e) reduce fuelwood consumption by 100,000 tons/year through efficiency improvements in production and use of fuelwood and charcoal in 16 cities. Bank investment of $7.5m in 15,000 PV connections.	15,000	N/a	30,000	Off-Grid: $7.5 IDA: $148 Total: $160

Project	*Off-grid renewable component*	*Off-grid connections projected*	*Off-grid connections to date*	*Grid connections projected*	*Funding ($US million)*
❽ **MALI**: Household Energy and Universal Rural Access Project PIPELINE **P073036**	Support the GOM efforts to increase access to energy services to help achieve its poverty reduction targets including those linked with the MDGs, including accelerating the use of modern energy in rural and peri-urban areas, strengthening the energy sector reform processes and institutions, and strengthening local capacity for absorption of RET and on providing private sector led off-grid energy services to the poor. 350 communities on mini-grid or grid connections. Bank PV investments at $5m.	10,000	N/a	~130,000	Off-Grid: $5.0 GEF: $3.5 IDA: $27.8 Total: $53.3
MEXICO: Renewable Energy for Agriculture (2000 – 2004) ACTIVE **P060718**	Would catalyze a national market for farm-based renewable energy systems among Mexico's estimated 600,000 unelectrified livestock farms. It is expected that the project would catalyze the penetration of renewable energy systems among one-third of the country's unelectrified farms within ten years. 1,000 PV water pumping systems and 200 other units expected for an investment of $5m.	1,230	0	None	Benef: $6.9 Gov: $1.8 GEF: $8.9 IBRD: $13.7 Total: $31.3
❽ **MOZAMBIQUE**: Energy Reform and Access Project (2003) PIPELINE **P069183**	The development objectives are to: accelerate the use of electricity for economic growth and social services and thus improve the quality of life in un-served and under-served areas (peri-urban and rural); and strengthen Mozambican capacity to increase access to modern energy. Estimated 100,000 grid or mini-grid connections. Estimated 9,600 PV connections with a Bank investment of $12.5m.	20,000	N/a	100,000	Off-Grid: $12.5 GEF: $3.1 IDA: $31.2 Total: $67.27
NEPAL: Power Development Project (2003-2009) Active	Objectives: (a) develop Nepal's hydropower potential in environmentally and socially sustainable manner, (b) improve access of rural areas to electricity services, and (c) promote private participation in the power sector as a way to improve sector efficiency and to mobilize financing for the sector's investment requirements. 30,000 micro-grid connections through mini-hydro.	30,000	N/a	none	IDA: $50.4 Total: $133.4

Project	*Off-grid renewable component*	*Off-grid connections projected*	*Off-grid connections to date*	*Grid connections projected*	*Funding ($US million)*
NICARAGUA: Off-grid Electrification and Private Sector Development Project ACTIVE **P073246**	Assisting the Government in the design and implementation of its national rural electrification strategy, implementing innovative public/private off-grid electricity delivery mechanisms in several pilot sites for later replication on a national scale, and demonstrating in the pilot areas the potential of targeted rural micro-finance and business development services (BDS) to significantly enhance the development impact of rural electrification. Design and actual implementation of 10 to 12 off-grid pilot sites. The private sector based delivery mechanisms piloted in these sites will later be replicated on national scale, as part of PLANER. The electrification of these pilot sites will add up to 2.8 MW of installed distributed generation capacity and serve up to 17,000 new users. 6,000 PV systems anticipated for a $3m investment.	17,000	N/a	None	Off-Grid: $3 GEF: $4.41 IDA: $11.9 Total: $22.2

Project	*Off-grid renewable component*	*Off-grid connections projected*	*Off-grid connections to date*	*Grid connections projected*	*Funding ($US million)*
PHILIPPINES: Rural Power Project UNDER PREPARATION Board FY 04 **P066397**	SHS through GEF-cofinanced competitive private sector initiatives. Diesel microgrids for some village centers. Objective is to assist the country in making available affordable, reliable and adequate electricity to meet the needs of rural communities in a sustainable manner over a 10-15 year period. The core investment component of the proposed APL1 will develop and implement new public/private partnership business models for decentralized electrification as well as improved energy efficiency in existing rural cooperatives. If successful, these models are to be replicated and scaled up in other parts of the country under subsequent phases of the APL. Project will provide, through GEF and government funds, subsidies to lower the cost to consumers, and financing to spread out the payments. The suppliers would offer small PV systems (20-60 Wp), financial intermediaries such as rural banks and microfinance institutions would be provided funds to enable them to provide consumer loans. This subcomponent targets 200,000 households and other users to be provided PV systems over full program duration, with a modest target of 11,000 for APL1. The total cost of this component for all the phases of APL is estimated to be about $130 million, of which GEF support is estimated at about $0.7 million for APL1. Total Bank PV funding across phases estimated at $105 million.	145,000	N/a	None	Off-Grid: $107 Bank: $105 Total: $130
SRI LANKA Energy Services Delivery Project (1996) CLOSED	Provision of grid and off-grid energy services using renewable energy and DSM investments. The project includes an ESD Credit Program Component to help finance investments by the private sector, NGOs and cooperatives in off-grid solar PV and village hydro schemes, of grid-connected mini-hydro sites and other renewable energy applications. The other components are (a) CEB-executed grid-connected Pilot Wind Farm; and (b) technical assistance to the CEB to strengthen its capacity to (i) help ESD Credit Program subproject developers and (ii) to undertake DSM activities, including DSM program design and implementation, load research and an energy efficient building code.	19,500	24,000	None	Off-Grid: $7.8 GEF: $5.9 IDA: $24.2 Total: $55.3

Project	*Off-grid renewable component*	*Off-grid connections projected*	*Off-grid connections to date*	*Grid connections projected*	*Funding ($US million)*
SRI LANKA Renewable Energy for Rural Economic Development (RERED) (2002–2008) ACTIVE **P076702**	This project is a follow-up to ESD I. The objective of ESD II is to expand commercial use of renewable energy resources and pursue economic development and improvement in quality of life through more productive and efficient use of rural energy resources. 85,000 SHS targeted. Village hydro also to be used. Project market 550,000 SHS. Potential market 1.1 million SHS	85,000	0	None	Off-Grid: $28.3 GEF: $8 IBRD: $75 Total: $133.7
❽ **UGANDA** Energy for Rural Transformation (2001–2006) ACTIVE **P069996**	Support the Government goal of reaching 10% rural electricity access – approximately 400,000 + new connections via a combination of investments in grid, mini-grid, solar PV and cross-sector linkages with health, agriculture, education and water. Ultimately, 100-300,000 SHS over 12 years through various mechanisms. Bank PV investment estimated at $67.7m.	90,000	0	None	Off-Grid: $67.7 GEF: $12.2 IDA: $49.1 Total: $123.31
❽ **VIETNAM** Rural Energy Project (2000–2004) ACTIVE **P056452**	This project will provide energy to about 450,000 households in 32 provinces in rural Vietnam through the use of renewable energy to supplement grid supply or serve isolated communities where renewables are the least cost option. Construction of transmission lines, substations, and consumer meters, etc. in northern, southern, and central regions. Provision of technical assistance and capacity building for project management and coordination. Off-grid component is a pilot only, for a micro-hydro grid in one commune level.	100	0	450,000	Off-Grid: $0.1 IDA: $100 Total: $131
VIETNAM System Efficiency Improvement, Equitization, and Renewables Project (SEIER) (2002-2006) IMPLEMENTATION **P066396**	Electrification in various areas of Vietnam, including rural areas, through improved transmission systems, and expansion of associated substations, rehabilitation, and equitization of small hydro plants, as well as construction, and operation of community-based hybrid renewable energy grids. About 20 communes will be electrified with micro-hydro or solar PV.	~80,000	0	None	Off-Grid: $5.8 GEF: $4.5 IDA: $225 Total: $352.4

Project	*Off-grid renewable component*	*Off-grid connections projected*	*Off-grid connections to date*	*Grid connections projected*	*Funding ($US million)*
VIETNAM Community-Based Rural Infrastructure Project ACTIVE **P062748**	Construction of micro hydropower schemes (2 to 8 KW), serving about 8 to 35 HH at a maximum investment of US$ 200 per HH. Where feasible, installations would be provided with battery charging facility to be available for HH not directly connected. Solar systems, including photovoltaic panels, substructure, batteries, and distribution lines (DC and/or AC) for public use at sites where no other power source (national grid, micro hydro power) is available and where there is no prospect of such availability within the next three years. Solar power generators would be designed to suit health stations, schools, community halls and other public buildings in remote mountainous communes. Costs would range between US$ 3,000 and 15,000 per installation depending on size and diversity.				Borrower: $16.8 IDA: $102.8 Local: $3.8 Total: $123
VIETNAM Rural Energy Project II (2005–2009) PIPELINE **P074688**	This project will follow Rural Energy I, and will provide power to 200 to 400 communes in initial stage and supplemental work. 60,000 to 200,000 connections provided through micro-hydro, solar PV, and wind-diesel systems. The first stage will electrify around 100 communes over four years. The second stage, phased in at a two-year interval will electrify an additional 100-300 communes.	~130,000	0	None	Est. Alt energy = $45. (Additional information not yet available.)

Total Connections Existing or Planned (Grid, Mini-Grid & Off-Grid) ≈

Total Off-grid Connections Planned =

INTERNATIONAL FINANCE CORPORATION INITIATIVES

Country/Initiative	*Description/Objective*	*Connections*	*Funding*
Global: PV Market Transformation Initiative (1996)	Finance commercial SHS business ventures in India, Kenya, and Morocco; Funded projects: India, Morocco, Kenya	Not measured	IFC: $30 m Total: $90-120m
Global: Small and Medium Scale Enterprise Program Replenishment (1997)	Loans to Solar Home Systems Companies through SME Program. Finance commercial SHS business ventures in Bangladesh, Vietnam, Honduras, Dominican Republic	To date: 15,800	IFC: $16.6m To date: $1.9m
Global: Renewable Energy and Energy Efficiency Fund (1998)	Invests in mid-sized renewable energy and energy efficiency projects	Not measured	IFC: $95-240m
Global: Solar Development Group (1998)	Finance PV-related business and provide business services	Not measured	IFC: $16 m Total: $50 m

SMALL AND MEDIUM ENTERPRISE (SME) PROJECTS

Country	*Description*	*Connections*	*Funding*
Vietnam	Loan to Selco Vietnam - rural solar home systems	1,500	IFC $0.6m Total $0.6m
Bangladesh	Direct loan to Grameen Shakti - rural solar home systems	11,500	IFC $0.75m Total $4.6m
Honduras	Direct loan and equity to Soluz Honduras - rural solar home systems	1,400	IFC $0.5m Total $0.56m
Dominican Republic	Subproject loan to Soluz Dominica through a main borrower, EEAF - rural solar home systems	1,400	IFC $0.075m Total $0.56m

PHOTOVOLTAIC MARKET TRANSFORMATION INITIATIVE (PVMTI) PROJECTS

Country / Region	*Project Name*	*Objective and Status*	*Connections*	*Funding $million*
Morocco (Approved)	Al Amana & Noor Web	Provision of micro-credit to end users to purchase PV Systems and expansion of Noor Web infrastructure	Not measured	IFC/GEF: 0.7
Morocco (Approved)	Salafin	Provision of loans to end users to purchase PV Systems	Not measured	IFC/GEF: 1.0
India (Approved)	Shri Shakti Alternative Energy	Expansion of a network of "Energy Stores" in Southern India, selling PV and other alternative energy products.	Not measured	IFC/GEF: 2.2
India (West Bengal) (Approved)	SREI International Finance	Development of retail and service network and provision of consumer finance for sale of solar home lighting systems and portable PV power packs in West Bengal Region. SREI is a well-established financial services with a dedicated renewable energy unit. For implementation, SREI has an agreement with the Ramakrishna Mission (RKM) Ashrama, Narendrapur, which has a strong grass-roots presence in rural areas of West Bengal.	Not measured	IFC/GEF: 3.5
India (Approved)	Sunlit Media Solutions	Establishment of a network of PV powered advertising signs.	Not measured	IFC/GEF: 2.3
India (Approved)	Aqua Solar (P) Ltd.	Establishment of a network of PV powered water pumping, purification and bottling stations in rural areas of India.	Not measured	IFC/GEF: 3.0
India (Approved)	Shell Renewables	Expansion of a network of Shell Solar Centres in Southern India and establishment of a credit scheme for end users in partnership with local financial institutions.	Not measured	IFC/GEF: 4.0

Country / Region	Project Name	Objective and Status	Connections	Funding $million
Kenya (Approved)	Muramati Solar	Development of retail and service network and provision of loans to members of Muramati Tea Growers SACCO to finance purchase of SHS. Muramati is one of Kenya's leading Savings and Credit Co-operatives (SACCOs). SACCOs operate like credit unions and are instrumental in providing basic financial services to groups typically excluded from the conventional mainstream banking sector. For Muramati, the membership consists of 15,000 farmers in the tea and coffee industry. PV systems will be installed and maintained by ASP (K) Ltd, a Kenyan solar company with over 20 years' experience in the sector, which is expanding its infrastructure into the region to service the project.	Not measured	IFC/GEF: 0.6
Morocco (pipeline)	Zakoura	Credit packages to buyers of SHS in compliance with the PVMTI technical guidelines.	Not measured	IFC/GEF: $0.92m Total: $3.4m
India (pipeline)	SELCO	The project encompasses the expansion of Selco India's business in the Southern states of India.	Not measured	IFC/GEF: $1.1m Total: $2.3m
Kenya (pipeline)	GEF/PVMTI KCB – SACCO loans	SACCOs receiving loans under this project will provide "solar loans" to their members to purchase solar home systems. The project aims to enhance significantly the rate of consumer adoption of high quality PV systems sold with consumer finance and after sales service.	Not measured	IFC/GEF: $2.0m

ANNEX 3. ANALYSIS OF SELECTED COUNTRIES FOR SCALE-UP

Country	*Electrification Rate*	*Relevant WBG and other initiatives*	*Comments, Potential for Scale-up over Next 10+ Years*
Afghanistan	25.4 million unelectrified 2% elec rate	***World Bank note*** USAID is funding infrastructure services construction and operation.	Poor but improving. Extremely low GDP at $98. Post-war donor funding still low, poorly coordinated, and focused on immediate needs. **Major and extensive effort needed to establish priority infrastructure services**, including dispersed and decentralized energy services.
Argentina	37 million people elec 2 million people unelectrified, primarily rural 90% electrification rate	WB/GEF *Renewable Energy for Rural Markets* project	Good: Third largest population in Latin America. GDP reached US$ 290 billion in 1996, with a per capita income of over US$ 8,000, highest in the region. 10% of the population lacks access to electric power, mainly in rural areas with 2.3 million people without electricity. Economy now rebounding. Difficulties were encountered by the World Bank off-grid rural electrification project to create grid rural energy concessions. The Project has been reconfigured and the goal for PV SHS is 35,000. 750 units have been installed and another 750 are in process of installation under contract.
Bangladesh	Unelectrified: 100 million Electrified: 27 million	WB/GEF *Rural Electrification & Renewable Energy Development*	**Excellent potential**: The rural PV market is already established. High rural population density and strong network of micro-finance partners, espec. Grameen Bank. Government financial support from Infrastructure Development Corp. Other projects and initiatives (e.g. Grameen Shakti) have established dealers, financial support, public awareness, and government commitment to renewables. Rural electrification program is aggressive. WB/GEF project will support 64,000 off-grid rural households to be supplied via distributed renewables. The 2000 Country Assistance Strategy (CAS) acknowledges the success of rural, community-based institutions in providing electricity and micro-credit and encourages building on the achievements of rural energy cooperatives in addressing poverty and development challenges. The strategy emphasizes the central importance of widening access rapidly, increasing efficiency and undertaking reforms in the electricity sector

Country	*Electrification Rate*	*Relevant WBG and other initiatives*	*Comments, Potential for Scale-up over Next 10+ Years*
Brazil	20 million people in 60,000 isolated unelectrified communities One-third of rural households lack electricity. In the Northeast, where villagers and smallholders lack many basic requirements, less than half of rural households have access to electricity.	WB/IDA *Rural Poverty Reduction Projects* in 5 northeast states. Project funding available in principle for off-grid electrification services. ESMAP (July 2000) study indicates potential for 60,000 PV systems in Northeast.	**Excellent potential**: Extensive experience in country with PV and other off-grid / minigrid renewable energy applications. Bank of the Northeast of Brazil has two financing mechanisms that promote energy generation and distribution to isolated communities. The first is the Sunlight Program, which supports solar electric energy in small communities of the Northeast, financing small entrepreneurs in the operation of small battery charging stations. This program is run in partnership with the Teotônio Vilela Foundation. The national components are financed by Bank of the Northeast, while others are financed by U.S. Exim Bank. Second mechanism is the Program for Renewable Energy for the Northeast (PROERNE), which funds productive applications (especially in agriculture and tourism), as well as equipment production. It will support, within a limited R&D scope, dissemination of information and training.

Country	*Electrification Rate*	*Relevant WBG and other initiatives*	*Comments, Potential for Scale-up over Next 10+ Years*
Burkina Faso	7,000 unelectrified villages. 10.4 million people unelectrified, 1.6 million electrified, virtually all in capital and towns. Decentralized funding and decision-making authority recently shifted to village level. Ca. 13,000 SHS in four years (goal will probably take 6+ years to achieve).	IDA/GEF *Universal Access to Electricity and Telecommunications* (pipeline) IDA Community Based Rural Development Project UNIFAD country program UNDP/GEF expansion of multi-function platform program to Burkina Faso from Mali (underway)	Fair (near-term) to Good (longer-term) potential: Only a few undercapitalized PV equipment supply, installation, and maintenance companies in country. Very low per capita income, highly dispersed population, poor and dangerous roads. Banking system lacks experience with renewable energy lending. $114 million ($12 million GEF) World Bank Universal Access Project (to electricity and telecommunications services) in preparation, in collaboration with UNDP / GEF. UNDP/GEF component includes piloting a rural off-grid energy extension service function. AstroPower/ATERSA (US/Spanish PV company) installing PV systems in over 200 villages, with local supply and service company support. World Bank / IDA supporting many major projects in rural development, agriculture, health, and other areas that can use off-grid renewables and hybrid systems. The Bank's Community-Based Rural Development Project is also a potential source of generating and financing PV systems demand. The project proposes a $55 million "Local Investment Fund" with grants-eligible projects in several areas including water supply infrastructure, social and economic infrastructure, and 'renewable energy.' Through cross-sectoral implementation, projects under the country UNIFAD program could also be a market for off-grid renewables. Burkina Faso and Mali would be good candidates for a scale-up program tailored to the needs, absorptive capacity, and financial limitations of a sub-Saharan country
Cambodia	10.3 million unelectrified 1.9 million electrified (1998)	WB/IDA Rural Electrification Project	Potential: Fair for now. Country is at peace and economy is stabilizing, with promising recent economic performance in the post-conflict period. Embryonic rural financing structure, with possibility to replicate SEEDS-based growth for interested financial intermediaries. Embryonic rural PV market, with local players focused on institutional and NGO/tender demand. There are potential attractive provinces with high population densities and sufficient communications infrastructure. Up to 100,000 new connections by mix of off-grid and grid-based electrification. Economically productive uses of electricity to be promoted. *Not ready for scale-up except in context of integrated rural development and rural infrastructure development.*

Country	*Electrification Rate*	*Relevant WBG and other initiatives*	*Comments, Potential for Scale-up over Next 10+ Years*
China	17 million unelectrified people (1.4%), mostly in western rural areas. Government committed to total electrification.	WB/IDA/GEF with UNDP *Rural Energy Development Project*	Potential: Very Good. China is almost entirely electrified except for dispersed rural populations. *Not clear that a scale-up initiative is needed*, given the Government commitment to expanding electrification to 100%. Several Chinese manufacturers and retailers are competing in the rural PV market, although Dutch grant financing has hurt the fragile private sector. Most commercial activities are cash sales of smaller PV systems. China considered important for low-cost manufacture of off-grid power units including small modular biopower and wind electric / hybrid units. WB project includes addressing weak financing arrangements for renewable energy companies and end users in off-grid areas. SELCO operating successfully in China.
Ethiopia	61.3 m unelectrified 4.7% elec rate. WB ORE Proj: Pipeline	WB/GEF Energy Access Project	Potential: Poor. Recently emerging objectives and strategy for increasing energy access. Extremely low per capita GDP (US$100). Shortage of investment resources because of low tariffs (until about five years ago), limitations in management and technical expertise. Low level of access to infrastructure services.
Ghana	10.6 million unelectrified 8.7 million electrified	No WB/GEF rural energy initiatives. UNDP/GEF Rural Energy Services Project	Potential: Fair. Population densities and disposable income levels relatively high for sub-Saharan Africa. Spanish grant aid provided $2 million+ in PV systems with no support of maintenance or service or commercial applications. That project provied unsustainable and unproductive. UNDP/GEF Renewable Energy Services Project (RESPRO) was operating well but was undermined by both local and national political interference. Weak energy policy and institutional environment. Active *disinterest* in PV by the two distribution utilities.
Guinea (Republic of)	5% elec rate	WB/GEF: Decentralized Rural Electrification	Potential: Fair. Guinea GNP per capita of US$451, which is just below average for sub-Saharan Africa. Abundant natural resources, including significant hydro capacity. Government has adopted a new strategy for the Decentralized Rural Electrification (DRE), and enacted law allowing for private sector infrastructure projects.

Country	*Electrification Rate*	*Relevant WBG and other initiatives*	*Comments, Potential for Scale-up over Next 10+ Years*
India	437 million unelectrified, plus many more with inadequate grid service. 70% of rural households lack electricity. Strong interest of finance organizations. Well organized commercial and banking sectors. Extensive solar energy experience.	WB/IDA/GEF. *Second Renewable Energy Project.* On-lending through IREDA New UNEP SHS financing initiative for 18,000 SHS	Potential: Good. A major target for poverty alleviation and rural income generation. Multi-decade experience with renewables, including PV SHS. Some commercial enterprises now operating, e.g. SELCO India, which is now profitable. Several hundred financing institutions now financing SHS installations. Government commitment to village electrification and strong public demand for modern energy services New US$7.6 million initiative launched between UNEP and two of India's largest banking groups to help 18,000 southern Indian households finance SHS. In Karnataka state, Syndicate Bank and Canara Bank have begun offering new loans in which UNEP is buying down the financing cost of PV SHS from 12% to 5%. Funding from UN Foundation and Shell Foundation. WB Second RE Project has minor off-grid renewable energy component.
Indonesia	98 million unelectrified 112 million electrified, but many rural electrified customers have limited service availability and quality	No current projects. Some private sector interest once/if economic stability and growth returns. Winrock International has renewable energy program.	Potential: Poor (until economic revitalization occurs and currency stabilizes at value consistent with necessary rural purchasing power). The now closed WB project helped develop a small but viable rural network for delivery of PV systems. This network would continue to be nurtured by the MCF. *risk. Excellent potential for off-grid energy market aggregation. The Ministry of Transmigration remains a potential market aggregation mechanism, but private sector involvement will require risk underwriting, including both political risk and FOREX.*
Kenya	27+ million unelectrified 2.4 million electrified *New government and presence of UNEP could support wider diffusion and more reliable equipment.*	IFC/PVMTI Market Transformation Initiative	Potential: Good. Robust informal commercial market for PV SHS, with ca. 80,000 solar home systems (SHSs) sold. Installed PV capacity over 2 MWp, with typical individual systems from 10 - 40 Wp, and costs per system between US$250 and US$1,000. Lack of equipment or service standards, with high rates of failures of PV systems, and lack of end user financing have been problems. PVMTI has extended credit lines to two financing intermediaries to provide financing for SHS.
Lao PDR	8% elec rate rural, 60% urban	S. Provinces Rural Electrification Project	Potential: Fair. Poorest and least developed country in the region, with a GNI/capita of $320. Government monetary policy has improved towards market-based economy, GDP growth is around 6%. Regulatory environment uncertain. Commercial banking capacity, particularly credit and risk assessment skills, is limited. Poor rural infrastructure, insufficient access to markets, and the limited network of all-weather feeder roads

Country	*Electrification Rate*	*Relevant WBG and other initiatives*	*Comments, Potential for Scale-up over Next 10+ Years*
Madagascar	14.3 m unelectrified 8% electrification rate	WB/IDA: Energy Services Delivery Project	Potential: Fair. Relatively low GNI/capita at US$260. In recent years, the financial sector has been strengthened through bank restructuring and privatisation, while economic policy has improved towards markets. Significant political instability.
Mali	9,000 unelectrified villages, decentralized funding and investment decision making authority to village level. Rural financial institutions unfamiliar with renewables.	WB/IDA/GEF (with UNDP). $98 million Universal Access (to electricity and telecommunications services). Pipeline (2004 expected Board date)	Potential: Fair (near-term) to Good (longer-term). Almost all rural communities lack electricity access, and decentralization has provided funding and autonomy for community infrastructure investment and development. UNDP/GEF is piloting a rural energy extension function in collaboration with WB/GEF project. Bank project would provide financing support to end users and communities. With a strong rural energy extension capacity in place, the market could be substantial over the next decade, given 2 million unelectrified households.
Mexico	Ca. 5 percent of population without access to electricity, including 5 million people, 88,000 villages and 600,000 livestock farms.	WB/GEF Renewable Energy for Agriculture project	Potential: Very Good. This is first WB/GEF project to promote renewables for agriculture by unelectrified farmers. Mexico has the second largest population in Latin America, with 90 million inhabitants. US$ 330 billion GNP ranks second in Latin America, with a per capita income of US$ 3,700—low compared with most of the OECD nations, but higher than average for the region. The nation-wide power network services close to 95% of the total populace. Urban areas are fully supplied with electricity, while 21% of rural dwellers—some five million people—still lack formal access to electricity. A major World Bank project development initiative (year 2000) focused on using renewables for a mix of productive, community, and household uses, ended with the change in political parties in 2000. The current federal administration does not seem to have rural renewable energy as a priority, but an updated version of the earlier off-grid renewable energy project is now being identified.
Morocco	8.3 million unelectrified 20.4 million electrified	IFC/PVMTI	Potential: Good. Several PV companies are operating successfully. PVMTI is supporting two local companies. Strong electric utility support for use of renewables.
Mozambique	16.4 m unelectrified 7.2% elec rate	WB/GEF: Energy Reform and Access Project	Poor to Fair. Economic reform measures have resulted in positive growth & external invesments. Strong natural resources base. CON: Low per capita GNI. Historically unstable political environment.

Country	*Electrification Rate*	*Relevant WBG and other initiatives*	*Comments, Potential for Scale-up over Next 10+ Years*
Nicaragua	2.7 m unelectrified 48% elec rate	Off-grid Electrification and Private Sector Development Project	Potential: Fair to good. The largely rural eastern part of the country along the Atlantic Coast remains heavily underserved in terms of electricity supply. Nicaragua's power sector underwent a deep restructuring during the late 1990s. The new Electricity Law unbundled the generation, transmission and distribution and allowed privatization. Has one of the lowest rural electrification rates in all Latin America. More than half of the country remain outside of the concession areas. Lack of a sustainable financial mechanism for RE. Regulatory uncertainties in restructered power sector, no regulation outside of concession areas. Distortions and taxes on renewable energy due to hydrocarbon subsidies
Philippines	9.5 million unelectrified 66.1 million electrified Significant fraction of unelectrified households can afford entry-level electricity from renewables Market seriously poisoned by two decades of failed grant aid PV projects.		Fair (near-term) to very good (longer-term): The WB/GEF is currently preparing a diesel micro-grid and SHS project for the Philippines. Minigrids would provide evening lighting and entertainment for most households. The WB rural credit facility for SHSs (developed by ASTAE for this project) will help facilitate market expansion. WB Development Marketplace grant for Aklan Center for Productive Uses of Renewable Energy (PURE) developing markets for renewables, especially small modular biopower units for rural economic activities. [Community Power Corporation]. Two decades of dozens of failed PV projects, virtually all donor-financed grant aid initiatives, have limited commercial off-grid renewable enterprises. Shell Renewables is only serious commercial player in the country, and offers systems with limited company-based capital subsidy and local commercial bank financing; this business is growing. (2,000 SHS in 2002, 4,000 SHS projected for 2003).
Senegal	6.6 million unelectrified 2.9 electrified people	Several WB/IDA projects in agriculture and rural infrastructure development	Fair to good: Population densities and disposable income levels relatively high in comparison to sub-Saharan averages, with some areas of higher income rural households.
South Africa	14.5 million unelectrified 28.3 electrified people		Fair but very important: Government has not been successful with promotion of rural energy services model for PV in unelectrified townships. There has been poor experience with the PV concession approach by ESKOM; of the PV services suppliers, only Shell Renewables has installed systems. Shell has recently disconnected 1,500 customers for non-payment, and reorganized its local business, with repayment rate up from 30% in 2001 to 88% in 2003..

Country	*Electrification Rate*	*Relevant WBG and other initiatives*	*Comments, Potential for Scale-up over Next 10+ Years*
Sri Lanka	7.4 million unelectrified 12 million electrified Strong network of commercial PV equipment / service suppliers	WB/IDA/GEF Renewable Energy for Rural Economic Development	Excellent: National goal is provision of electricity to 75% of population by 2007. RERED facilitates linking off-grid energy supply with economically productive activities and priority community services. Off-grid systems including microgrids to provide electricity access for 100,000 households, 1,000 SMEs and community services. Shell, SELCO, and several other successful commercial PV operations are present. Government establishing subsidy mechanism for rural electricity access. One of the better environments for commercial renewable companies for off-grid applications. Excellent potential for serving as a model for scale-up within higher income developing countries.
Tanzania	30.2 million unelectrified 3.5 million electrified		Fair? Potential future WB Rural Energy project. Government position broadly supportive of renewable energy. Currently there is a lack of financing intermediaries that are willing to extend credit for PV purchases.
Uganda	22.5 million unelectrified 0.9 electrified Most unelectrified people are in poor rural areas, with little or no access to primary infrastructure services.	WB/IDA/GEF *Energy for Rural Transformation* project, a multi-phase APL-financed initiative WB/IDA *National Agricultural Advisory Services* project	Good to Excellent: A potentially attractive market in East Africa. WB/GEF project is potentially a development flagship for sub-Saharan Africa that links energy access with economic productivity and social development as well as residential uses. Significant telecommunication component. PV component split into institutional and private SHS components. Institutional sales to act as an incentive for retailers to set up network in rural areas and begin selling direct to private households. *A strong national agricultural extension service is operating effectively, and can be harnessed to provide rural energy extension services as well.*

Country	*Electrification Rate*	*Relevant WBG and other initiatives*	*Comments, Potential for Scale-up over Next 10+ Years*
Vietnam	19 million unelectrified 59.5 million electrified	WB/IDA Community-based rural infrastructure project WB/IDA *Rural Energy Project*	Good to Excellent: Rural electrification (RE) is a critical element of the Government's program to eliminate poverty and redress imbalances in development. An ambitious RE target has been established and work towards meeting them has commenced. Securing adequate investment resources, defining and implementing methods of rural grid management, and designing efficient tariff structures are key issues in rural electricity delivery and management. Potential market considerable. There is a strong rural agricultural economy, so disposable income of the average rural household is potentially high. Failure of financing mechanisms and lack of investment in marketing infrastructure currently constrains growth. Cooperatives might offer the best route to successful provision of micro credit. SELCO operating commercially through the National Woman's Cooperative (financing and PV system promotion system)