

A Review of the ESMAP Rural Energy and Renewable Energy Portfolio

April 2004

Joint UNDP/World Bank Energy Sector Management Assistance Programme
(ESMAP)

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Abbreviations and Acronyms

ADB	Asian Development Bank
APL	Adaptable Program Loan
ASTAE	Asia Alternative Energy Program
CBK	Cooperative Bank of Kenya Ltd.
CNE	Comisión Nacional de Energía
CPTS	Centro de Promoción de Tecnologías Sostenibles
ECA	Europe and Central Asia
ESMAP	Energy Sector Management Assistance Program
GEF	Global Environment Facility
GVEP	Global Village Energy Partnership
IADB	Inter American Development Bank
ICT	Information and Telecommunication
K-REP	Kenya Rural Enterprise Program
LCR	Latin America and the Caribbean Region
LPG	Liquefied Petroleum Gas
MDB	Multilateral Development Bank
MENA	Middle East and North Africa
MFI	Micro Finance Institution
O&M	Operation & Maintenance
MDGs	Millennium Development Goals
MFI	Microfinance Institution
NBP	National Biomass Program
NGO	Nongovernmental Organization
OOPP	Object Oriented Project Planning
PCD	Project Concept Document
PDR	People's Democratic Republic (Lao PDR)
PV	Photovoltaic
RE	Rural and Renewable Energy
REAP	Renewable Energy Action Plan
REC	Rural Electric Cooperative
RIC	Rural Information Center
SEIER	System Efficiency Improvement, Equitization, and Renewable
SHS	Solar Home System
SMEs	Small and Medium Enterprises
UNDP	United Nations Development Programme

USAID United States Agency for International Development
WBG World Bank Group
WSSD World Summit on Sustainable Development

Executive Summary

Objectives

1. This is summary of a review of the Energy Sector Management Assistance Program (ESMAP) Rural and Renewable Energy (RE) Portfolio activities from 1997 to 2002 addresses three questions: (1) what have we done, (2) what has been the impact, and (3) what have we learned?

Methodology

2. The review 1) evaluated intellectual leadership and innovations in the ESMAP RE Portfolio; 2) assessed the impacts of ESMAP interventions in RE through identifying the outputs —capacity and knowledge; and downstream activities -- World Bank Group (WBG) lending, investment and funding from other multilateral development banks (MDBs) and donors, and follow-up actions and replications by local governments, nongovernmental organizations (NGOs), and the private sector in client countries; and 3) captured lessons learned and best practices. It was based on a review of ESMAP reports and project files, as well as interviews with ESMAP task managers and other World Bank staff who contribute to the projects.

Portfolio Overview

3. Over the past five years, ESMAP supported 70 RE projects at a total cost of approximately US\$16 million, which represents 37 percent of total ESMAP project costs over the same period. Among the 70 rural energy projects, there are 20 in the Latin America and the Caribbean (LCR) Region, 20 in the Sub-Saharan Africa Region, 13 global projects, 8 in the East Asia and Pacific Region; 5 in the South Asia Region, 3 in the Middle East and North Africa (MENA) Region, and 1 in the Europe and Central Asia (ECA) Region. Two large programs in Bolivia — the Bolivia Country Program and the National Biomass Program, totaling US\$4,176,544 — accounted for a large share of the LCR Portfolio.

ESMAP support in the RE area has been focusing on six critical areas:

- 1) Delivery mechanisms: pilot activities to demonstrate innovative institutional and financing delivery mechanisms.
- 2) Policy changes: technical assistance in policies and regulatory frameworks for rural electrification and renewable energy.
- 3) Knowledge generation: analytical methodologies for rural and peri-urban electrification and the impacts of reform on the poor .
- 4) Beyond electricity: household energy surveys and strategies.
- 5) Advocacy: participatory stakeholder workshops.
- 6) Bottom-up partnership: the Global Village Energy Partnership (GVEP).

Overall Impacts

4. ESMAP has played an important role in raising the profile of and mainstreaming RE within the World Bank and client countries. ESMAP's intellectual leadership in the RE area has contributed to the WBG Energy Business Renewal Strategy in terms of direct poverty alleviation, environmental and social sustainability, and governance and private sector development. ESMAP analytical efforts have substantially improved and expanded regional and anchor energy diagnostic work.

Delivery Mechanisms

5. ESMAP pilot activities have demonstrated a wide range of innovative institutional and financing delivery mechanisms, including (a) micro-finance models in Kenya; (b) financing mechanisms for entrepreneurs in Bolivia (the Biomass Fund) and the Philippines (the Village Power Fund); (c) "concession" models in Comoros and Kenya; (d) new rural electrification service models in Bolivia (fee-for-service solar home systems, a rural electrification fund design, and NGO-based service delivery); (e) management service and private property and management service models in Peru; (f) rural energy service company model in Laos PDR; (g) productive use applications in Honduras (a low-cost model for information, telecommunication, and education applications from solar-powered systems) and the Philippines (ice-making applications from micro-hydropower); and (h) women's micro-enterprise models in Bangladesh and Ghana. These ESMAP activities increased access to financing for consumer groups to purchase solar home systems and for local micro-entrepreneurs to provide rural energy services. They also substantially strengthened local institutional capacities in client countries. The Bolivia Country Program, for example, established a sustainable institution for promoting RE, the Centro de Promoción de Tecnologías Sostenibles. In addition, an ESMAP project in Bangladesh empowered women in providing modern energy services. This project has demonstrated that with the right investment in their capacities, rural women who have less than high school-level education can participate in the provision of modern energy services. These women have experienced a major transformation in their self-esteem and the gender roles in their households. Furthermore, these activities engaged the private sector and leveraged scale-up private investment in delivering rural and renewable energy services. In Kenya, an ESMAP project attracted local manufacturers to produce low-cost, small-scale solar batteries, making solar home systems affordable for the low-income population. In Comoros, an ESMAP project invited foreign firms to participate in the solar market development through an innovative concession scheme, which jump-started the solar market in that country. These pilot projects have also leveraged scale-up investments from WBG lending and Global Environment Facility (GEF) funding in, for example, Bolivia ("Decentralized Infrastructure for Rural Transformation Project") and the Lao People's Democratic Republic ("Southern Provinces Rural Electrification in the Lao PDR"), as well as funding from other MDBs and donors, for example, from the Inter-American Development Bank in Honduras. These ESMAP activities provided key inputs to scaling up energy access.

Policy Changes

6. ESMAP has been providing technical assistance in improving RE policies and regulatory frameworks, including (a) regulatory framework of rural electrification in Argentina, Bolivia, Brazil, Cambodia, Nicaragua, and the Philippines; (b) rural electrification strategies in Brazil, Cameroon, Chad, Guinea, Uganda, and Zimbabwe; (c) renewable energy action plans in Cambodia and Vietnam; and (d) renewable energy policies and programs in Mexico, Nicaragua, and the Philippines. In the Philippines, for example, an ESMAP project recommended an investment management contract model to improve performance of rural electric cooperatives, who are responsible for implementation of rural electrification. In Mexico, an ESMAP project conducted an economic analysis to compare the costs of renewable energy with those of thermal power plants, developed an optimal energy portfolio diversification scenario, and recommended a renewable energy policy instrument, the auction based least-cost subsidy mechanism (Non-Fossil Fuel Obligation). These activities are critical to secure support in RE from decision makers in client countries and WBG. ESMAP support has played a catalytic and pioneering role in leveraging WBG lending and GEF funding in Brazil (“Rural Energy Project”), Cambodia (“Rural Electrification and Transmission Project”), Mexico (“Large-Scale Mexico Renewable Energy Development Project”), Nicaragua (“Off-Grid Rural Electrification for Development”), and Vietnam (“System Efficiency Improvement, Equitization, and Renewable Project” and “Rural Energy Project”). They have also brought policy changes in client countries. In the Philippines, for example, the regulatory framework and subsidy scheme for rural electrification recommended in the ESMAP project are incorporated in the government policy on private participation in remote generation and rural distribution.

Knowledge Generation

7. ESMAP played an intellectual leadership in generating new knowledge on rural and peri-urban electrification and the impact of reform on the poor. An ESMAP study identified successful factors and lessons learned for grid-based rural electrification programs in eight countries -- Bangladesh, Chile, China, Costa Rica, Mexico, the Philippines, Thailand, and Tunisia. Another ESMAP study on economic benefits of rural electrification concluded that the total net benefit of providing electricity to an un-electrified rural Philippine household would be between US\$81 and US\$150 per month. These analytical studies have been disseminated and incorporated in the project design of the World Bank loan projects – “Rural Electrification and Renewable Energy Development” in Bangladesh and “Rural Energy Project” in Vietnam, and they have generated demand for replication in client countries. In addition to rural electrification, an ESMAP study examined viable commercial approaches to provide electricity services to peri-urban areas, where 40 percent of the world’s poor live. Furthermore, ESMAP activities also filled in a knowledge gap by assessing the impacts of sector reform on the poor in Central America and Africa. The study in Central America concluded that the rural energy access issues are generally left out of the sector reform process. It

recommended that the governments establish political and institutional infrastructure to ensure the success of rural electrification programs in the context of power sector reform.

Beyond Electricity

8. ESMAP activities played intellectual leadership in providing non-electric rural energy services. ESMAP conducted detailed household energy surveys in Bangladesh, India, Nicaragua, Swaziland, and Yemen, and developed household energy strategies in these countries. These studies found out that in many developing countries, traditional biomass fuels — wood, straw, and dung — still dominate in rural energy use, primarily for cooking. These fuels have caused serious indoor air pollution problems, which are annually responsible for 2.5 million premature deaths of women and children from respiratory diseases. The shift to clean petroleum fuels, such as liquefied petroleum gas (LPG), for cooking, however, is primarily constrained by its high start-up cost and subsequent high price. Worldwide experience has shown that kerosene and LPG subsidies typically benefit middle-class and higher-income families and hence are not pro-poor. As households move up the energy ladder from solid fuels to kerosene, LPG, and electricity, the burden of collecting and using these fuels eases substantially, and women devote their time to more productive activities and pursuing leisure.

Advocate Stakeholder Workshops

9. ESMAP activities generated in-country interest and momentum for rural electrification and renewable energy through national participatory stakeholder workshops. The Nicaragua workshop resulted in an outline of a project concept for a private sector-led off-grid electrification project in Nicaragua. The Nigeria and South Africa workshops were among the first cross-sector efforts involving different ministries in these countries. The South Africa workshop, in particular, generated government requests for World Bank assistance. Consequently, two projects have been identified in South Africa: a project concept document for the “Renewable Energy Market Transformation Project” is completed, and the “Rural and Renewable Energy Housing Project” is in the pipeline .

Bottom-Up Partnership

10. The GVEP was successfully launched at the World Summit on Sustainable Development in Johannesburg, August 2002, with the goal of increasing availability and improving use of modern energy services for economic growth and poverty reduction in rural, peri-urban, and urban areas. To date, more than 250 partners have registered, including governments, communities, local user groups, NGOs, enterprises, private financial intermediaries, bilateral and multilateral development and financial institutions, and the WBG. The GVEP has held a number of regional stakeholder participatory workshops, including three African multi-country, multi-sector, multi-stakeholder energy-poverty workshops, a South Asia renewable energy practitioner workshop, a Latin America and the Caribbean regional energy-poverty workshop, and a pre-investment facility workshop.

A Close Link among Energy, Poverty, and the Millennium Development Goals

11. The ESMAP RE portfolio has increased energy access in client countries, thereby reducing poverty in rural and peri-urban areas. The ESMAP “Electricity Benefit Assessment” project clearly demonstrated economic benefits of rural electrification to better education, productive use, and improved livelihood. ESMAP projects in Bolivia, Honduras, and the Philippines linked energy services with education and livelihood improvement. ESMAP energy and gender projects such as “Opportunities for Women in Renewable Energy Technology Utilization in Bangladesh” promoted gender equity. ESMAP analytical work on biomass fuel use and indoor air pollution such as the “Rural Energy Study in India” and “Household Energy and Women’s Lives: The Case of India” addressed children’s and women’s health issues. The ESMAP renewable energy portfolio has contributed to environmental sustainability, and the program’s pioneering work on assessment of the impacts of sector reform on the poor linked energy access with market development. The GVEP initiative directly responded to the call in the Millennium Development Goals (MDG) for building global partnerships.

Lessons Learned

Scaling-Up Energy Access and Renewable Energy

12. Scaling up rural electrification and renewable energy should include both grid-based and off-grid alternatives. The two options should complement each other rather than compete. Grid-connected renewable energy, for example, can play an important role in improving environmental sustainability and energy security, while off-grid renewable energy can offer the least-cost options to increase energy access. A forgotten but important “win-win” opportunity to increase energy access is to promote peri-urban electrification, since peri-urban households are easier and cheaper to electrify than un-served rural households and they represent 40 percent of the world’s poor.

13. To increase access to modern energy services, we also need to go beyond electricity to provide household fuels for cooking and heating. Traditional biomass fuels have resulted in serious indoor air pollution problems in the developing world. More efforts should be put in place to promote large-scale deployment of improved stoves, improved biomass fuels (such as charcoal), and clean alternatives fuels (such as LPG, kerosene, and biogas).

Private Sector Participation

14. To ensure institutional and financial sustainability, rural energy programs must be operated as businesses. Experience to date has identified a number of business models to deliver energy services in rural areas. The implementing agencies of grid-connected rural electrificationⁱ can be integrated utilities, public distribution companies, decentralized distribution companies, and rural electric cooperatives (Barnes and Foley 2002). Even with a public utility model, the private companies can also be engaged through a management contractⁱⁱ. Examples of off-grid or mini-grid delivery mechanisms include a dealer model (cash or credit sale)ⁱⁱⁱ, a fee-for-service model (by energy service

company or community-based NGOs)^{iv}, a leasing model (by energy service company or micro-finance institution)^v, and a concession model^{vi}.

15. The private sector — both local entrepreneurs and large international companies — has a critical role to play in providing rural energy services. To create and nurture viable small- and medium-size rural energy entrepreneurs, it is critical to provide hand-holding enterprise development services combined with modest amounts of start-up financing.

16. One of the building blocks to scale up renewable energy is how to harness entrepreneurship. To date, a lot of efforts have focused on promoting self-sustaining small and medium-sized clean energy entrepreneurs. These interventions are valuable, but take very long time and produce mixed results. To scale up renewable energy, what is needed is “the entrepreneurs who can gain miles at a time” (The World Bank, 2002a). This requires to engage large private domestic and international players within and outside the traditional energy industry that have the resources and track record to start a new direction, such petroleum and electricity giants as Shell and EDF. In addition, it is more cost-effective to take advantage of existing rural infrastructure for renewable energy distribution rather than creating a parallel renewable energy delivery infrastructure. The existing local stores or micro-finance institutions, for example, are well positioned to sell solar home systems (SHSs) to rural consumers, compared to those dedicated SHS dealers.

The Roles of the Governments

17. It has proved to be unrealistic, however, to rely solely on the private sector to serve the poorest of the poor or the areas of low population density without any subsidy. In addition, the private sector usually demands greater returns, because they perceive rural electrification and renewable energy to be risky businesses. Therefore, the governments are needed to provide partial subsidies and risk-sharing schemes along with the private investment. ESMAP studies suggest that subsidies generally should be applied to access costs (connections), not to operating costs (ongoing consumption). It is also important that subsidy schemes are designed to benefit the poor. Regarding risk-sharing mechanisms, an ESMAP project in Comoros provided a good example of an innovative concession model that invites private participation in solar market development through a competitive bidding process for a certain amount of capital subsidy.

18. In addition, an ESMAP study of successful factors in rural electrification programs concluded that the governments should put in place a sound regulatory framework, an adequate tariff structure, and a dedicated rural electrification agency. Furthermore, rural electrification program should be an integral part of the power sector reform.

Increasing Access to Financing

19. First, domestic financing sources, particularly those from local financial institutions and governments, can play an essential role in meeting the huge financing

requirements for scaling up energy access and renewable energy. The lack of access to credit from local financial institutions, however, proved to be a primary constraint to rural energy projects in many countries. An ESMAP project in Kenya demonstrated that technical assistance and limited financial assistance to local micro-finance institutions are critical. In addition, ESMAP experience in setting up local renewable energy funds has shown that financial sustainability of such funds is a challenge, and technical assistance to entrepreneurs is important to generate high-quality deal flows.

20. Second, a lack of available financing is usually not a barrier to RE financing in many countries where there are sufficient liquidity in the banking sector. What is needed is to establish financing intermediaries between project developers and financiers, to bridge the knowledge and perception gaps between the two, and bundle small-scale RE projects to reduce transaction costs.

21. Third, to overcome the high first-cost barrier, it is crucial to tailor local market needs and promote low-cost, small-scale, renewable energy systems that are affordable for the low-income population.

Productive Use Applications

22. To achieve MDG, it is critical to link RE services with livelihood support activities. An ESMAP project in Honduras demonstrated a low-cost model to obtain internet access and other information and telecommunication (ICT) services via solar-powered packet radio transmission in remote, un-electrified rural areas. However, its implementation showed that it was more difficult than expected to develop ICT applications for businesses in rural areas, because low population density results in lack of critical mass of demand. This project also demonstrated that cost recovery mechanisms should be built into the project design so that at least the operation and maintenance costs can be recovered. Furthermore, in an ESMAP project in the Philippines, it was difficult to create funding synergies for the energy components and the livelihood components for productive use projects.

ESMAP Instruments

23. Overall, ESMAP activities influenced Bank operations through (a) incorporating the analytical work into the Country Assistance Strategy and the Poverty Reduction Strategy Paper, (b) generating interests of and requests from the client countries, (c) testing innovative approaches through pilot projects and producing upstream analytical work for scaling up to Bank lending projects, and (d) generating and disseminating new knowledge.

24. This review concluded that ESMAP instruments such as pilot activities, special technical assistance, studies, and workshops are effective. The pilot activities and technical assistance increased capacity of local stakeholders; leveraged scale-up investments from the WBG, other MDBs, donors, and the private sector, and led to policy changes in client countries. The analytical studies generated new knowledge, which have been applied in project design. The participatory workshops disseminated knowledge and

generated in-country momentum for RE. In the future, it is recommended that ESMAP should (a) link upstream activities closely with government policies and World Bank operations, which leads to more effective results; and (b) connect its wealth of knowledge to project design as a major part of the knowledge dissemination activities.

Recommendations for Future Focal Areas

25. In the future, ESMAP activities in RE should concentrate on strategies to scale up energy access and renewable energy, with an emphasis on (a) creating favorable enabling environments, particularly assisting governments in “smart” subsidy schemes that would attract private sector investments; (b) demonstrating innovative and replicable business models that engage both local small and medium enterprises and large, established private sector players and increase productive use applications; (c) piloting new financing models that can leverage financial resources from domestic markets and establishing financing intermediaries; and (d) expanding grid-based electrification services in peri-urban areas.

1

Introduction

1.1 At the World Summit on Sustainable Development (WSSD) held in Johannesburg in August 2002, energy issues, particularly energy access and renewable energy, were one of the critical elements of the negotiations and outcomes. The delegates agreed to work together to improve access to reliable, affordable, economically viable, socially acceptable, and environmentally sound energy services and resources, sufficient to achieve the Millennium Development Goals by 2015.

1.2 Increasing access to modern energy services is essential to achieve the Millennium Development Goals (MDG). It can enhance agricultural productivity, make it possible to provide clean drinking water and refrigeration for vaccines, light schools and health clinics, provide income-generating opportunities, and protect the environment. Renewable energy can play an important role in increasing access to modern energy services, protecting local, regional, and global environment, and improving energy security.

Objectives

1.3 This report summarizes a review of Energy Sector Management Assistance Program (ESMAP) activities in rural and renewable energy (RE) from 1997 to 2002 by addressing three questions: (1) what have we done, (2) what has been the impact, and (3) what have we learned? These questions correspond to the three principal review objectives:

- 1) To review and evaluate intellectual leadership and innovations of the ESMAP RE Portfolio.
- 2) To identify and assess the impacts of ESMAP RE projects on building institutional capacity, influencing policy changes, and leveraging downstream investments by the World Bank, multilateral development banks, donors, the private sector, and governments.
- 3) To capture and disseminate lessons learned from ESMAP RE projects to identify best practices and areas for improvements.

Consistency with ESMAP and World Bank Objectives

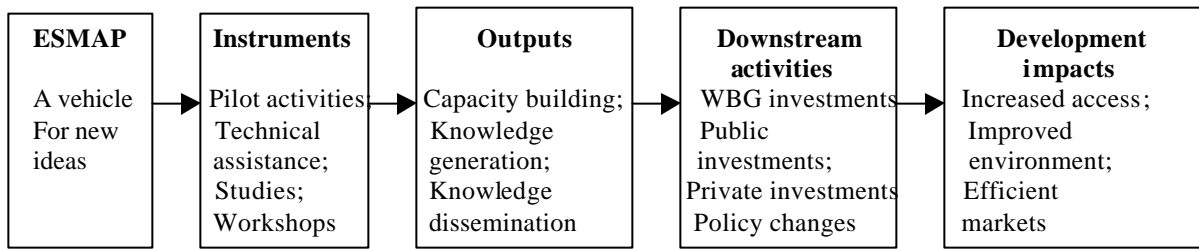
1.4 The ESMAP RE Portfolio is consistent with the World Bank Group (WBG) Energy Business Renewal Strategy, which focuses on (a) direct poverty alleviation -- “facilitating access to modern fuels and electricity, reducing the cost and improving the quality of energy supplied to low-income countries, promoting energy-efficient and less polluting end-use technologies for traditional fuels, creating energy service enterprises run by the poor, and supporting energy needed for social services” (World Bank 2001a); (b) environmental and social sustainability -- “removing market and regulatory barriers to renewable energy investments for power and biomass” (World Bank 2001a); and (c) governance and private sector development -- “strengthening local financial institutions to provide long-term financing for rural energy business” (World Bank 2001a). ESMAP upstream analytical work is also consistent with the new WBG Infrastructure Action Plan, which calls for expanding use of analytical work done by global programs and improving and expanding regional and anchor infrastructure diagnostic work.

1.5 The objectives of this review are consistent with the strategy documents -- the “ESMAP Business Plan for 2002–2004” (World Bank 2002b) and the “Energy & Mining Sector Board Quality Assurance Group Recommendations for Sector Strategy” (World Bank 2003a). Both documents call for ESMAP to disseminate lessons learned across energy trust-funded programs, provide clearer guidelines on connecting strategy to project design, and identify ways to leverage the impact of a global program such as ESMAP on other areas of World Bank operations and other energy sector stakeholders, country governments, bilateral organizations, other multilateral institutions, and the private sector.

Methodology

1.6 The upstream nature of ESMAP work makes measurement of its impact difficult. In addition, ESMAP interventions are only one of many channels shaping development impacts. Figure 1.1 shows ESMAP interventions as a flow from new ideas through a set of instruments to immediate outputs, which lead to downstream activities, eventually resulting in development impacts. ESMAP outputs — knowledge and capacity — are difficult to quantify in judging the program’s success. Ultimately, ESMAP success should be measured by development impacts — in this case, increased energy access and improved environment. It takes a long time, however, to generate development impacts from a new idea.

1.7 This review focuses on assessing outputs and downstream activities to measure the impacts of ESMAP interventions. However, given the complex set of factors involved in creating the downstream activities related to ESMAP projects, it is usually difficult to claim that ESMAP was solely responsible for the follow-up WBG or partner investment operations. Yet, in some cases, the connections between ESMAP projects and their downstream activities are more evident.

Figure 1.1 ESMAP: From New Ideas to Impacts

1.8 This study was based on a review of ESMAP reports and project files, as well as interviews with ESMAP task managers and other World Bank staff contributing to the projects. Given the time and budget available, in-country stakeholders could not be consulted. To achieve the three objectives, the framework of the review is organized by questions concerning the categories of intellectual leadership and innovation, impacts (outputs and downstream activities), and lessons learned:

- 1) Intellectual leadership and innovation:
 - a) What pilot activities and technical assistance are provided to client countries?
 - b) What new methodologies, approaches, or mechanisms are used in ESMAP projects?
 - c) What analytical knowledge or advice was conveyed in the ESMAP interventions?
 - d) What are the intellectual leadership and innovations in ESMAP activities?
- 2) Impacts (outputs and downstream activities):
 - a) What are the major achievements of ESMAP activities?
 - b) How did ESMAP interventions build local capacity?
 - c) What new knowledge is generated?
 - d) How is ESMAP knowledge disseminated?
 - e) How has ESMAP support influenced others and fostered project development at the Bank and in client countries?
 - f) What downstream activities are leveraged from ESMAP projects in terms of WBG lending, investment and funding from other multilateral development banks (MDBs) and donors, and follow-up actions and replications by local governments, NGOs, and the private sector in client countries?
 - g) What are the thematic impacts of the RE Portfolio?
- 3) Lessons learned:
 - a) What are the lessons learned and best practices?
 - b) What is ESMAP's comparative advantage?
 - c) Does ESMAP have the right instruments?
 - d) What are the areas for improvements in the future?

2

The ESMAP Rural and Renewable Energy Portfolio

Portfolio Overview

2.1 Over the past five years, ESMAP supported 70 RE projects at a total cost of approximately US\$16 million, representing 37 percent of total ESMAP project costs over the same period. Among the 70 rural energy projects, there are 20 in the Latin America and the Caribbean (LCR) Region, 20 in the Sub-Saharan Africa Region, 13 global projects, 8 in the East Asia and Pacific Region; 5 in the South Asia Region, 3 in the Middle East and North Africa (MENA) Region, and 1 in the Europe and Central Asia (ECA) Region (see table 2.1). Two large programs in Bolivia — the Bolivia Country Program and the National Biomass Program, totaling US\$4,176,544 — accounted for a large share of the LCR Portfolio.

Table 2.1 Summary of ESMAP RE Activities by Region, 1997–2002

<i>Region</i>	<i>Number of projects</i>	<i>Combined budget (US\$)</i>	<i>Total budget (%)</i>
LCR	20	6,843,788	44
Sub-Saharan Africa	20	3,321,652	21
Global	13	1,824,021	12
East Asia and Pacific	8	1,808,805	11
South Asia	5	1,180,750	7
MENA	3	585,009	4
ECA	1	125,102	1
Total	70	15,689,127	100

2.2 There are a number of key barriers to scaling up access to modern energy services in developing countries that are less technical and more financial, institutional, and regulatory. Many renewable systems have a high upfront cost, which is a major

financing obstacle. Evidence suggests that people are usually willing and able to pay for higher-quality energy services, but rural consumers or entrepreneurs often do not have access to financing because of a lack of collateral, poor creditworthiness as measured by conventional bank indicators, or the unavailability of long-term loans. In addition, international experience indicates that many rural energy projects fail because of a lack of sustainable institutional infrastructure, ranging from dedicated government rural electrification agencies to locally based rural energy service providers. These institutions often need extensive technical assistance, such as training and advisory services. Furthermore, a sound regulatory framework and a favorable investment climate to attract private sector investment are crucial to expanding rural energy access.

2.3 To address these barriers, ESMAP supports in RE have been focusing on six critical areas:

- 1) Delivery mechanisms: pilot activities to demonstrate innovative institutional and financing delivery mechanisms
- 2) Policy changes: technical assistance in policies and regulatory frameworks for rural electrification and renewable energy
- 3) Knowledge generation: analytical methodologies for rural and peri-urban electrification and the impacts of reform on the poor
- 4) Beyond electricity: household energy surveys and strategies
- 5) Advocacy: participatory stakeholder workshops
- 6) Bottom-up partnership: the Global Village Energy Partnership (GVEP).

Delivery Mechanisms: Pilot Activities to Demonstrate Innovative Institutional and Financing Delivery Mechanisms

2.4 A key factor in successful scaling up of rural energy access is the demonstration of replicable and sustainable institutional and financing mechanisms to deliver those services. Over the past five years, ESMAP supported pilot activities and national programs to demonstrate innovative delivery mechanisms in the numerous areas:

- ?? Supporting national programs in Bolivia
- ?? Promoting productive use applications of energy services in Honduras and the Philippines
- ?? Piloting micro-finance models in Kenya
- ?? Engaging the private sector in Comoros, Kenya, the Lao People's Democratic Republic (PDR), and Peru
- ?? Supporting women's micro-enterprises that promote energy and gender in Bangladesh and Ghana.

Bolivia Country Program and National Biomass Program

2.5 Bolivia is one of the targeted countries in which ESMAP decided to provide substantial funding to develop national programs. Previous ESMAP support helped develop sector reform strategies, which have been successfully adopted by the government. The second-phase ESMAP interventions have provided technical assistance,

institution building, and pilot activities in the areas of rural electrification, biomass energy, and energy efficiency, which had been left out in the Bolivian sector reform process.

2.6 The “Bolivia Country Program” supported a series of activities of in the areas of rural energy and energy efficiency (World Bank 2002c; personal communications with Philippe Durand and Kilian Reiche, the World Bank, January 2003). Among others, the Rural Energy Component demonstrated three business delivery models for rural electrification: (1) the rural electrification fund model, which would encourage existing private distribution companies to supply electricity to rural areas beyond their concession areas via grid extension; (2) the solar home system (SHS) model, in which local firms deliver SHSs on a fee-for-service basis to rural consumers, backed up by multinational photovoltaic (PV) manufacturers; and (3) the nongovernmental organization (NGO) model, in which local NGOs would assist in setting up mutually agreed, community-based systems for billing and collection in the most remote areas of Bolivia—Beni and Pando—which the private sector cannot reach even with substantial incentives. These delivery models have provided key inputs and lessons learned to the new rural electrification projects of the World Bank (“Decentralized Infrastructure for Rural Transformation Project” -- a three-phase Adaptable Program Loan (APL) with a first phase of US\$20 million, approved in 2003) and KfW (“Hydro Village Micro-Grids” -- €6 million, in preparation). This ESMAP project also implemented several small demonstration projects, such as water pumping for rural farms, PV-powered video equipment for rural learning centers, and passive solar energy for heating rural schools in the Bolivian highlands.

2.7 The highlights of the Energy Efficiency Component include (a) establishing a sustainable institution for promoting energy efficiency in rural areas, the Centro de Promoción de Tecnologías Sostenibles (CPTS), which is fully operational with the support of the National Chamber of Industry and additional funding from the Danish International Development Agency; and (b) supporting market-based institutional mechanisms through training several consulting companies that plan to evolve toward energy service companies.

2.8 ESMAP project for the “National Biomass Program” (NBP) provided technical assistance and institutional support to the program initiated by Bolivia in 1997 (The World Bank 2002d; personal communications with Philippe Durand and Kilian Reiche, the World Bank, January 2003). One of its major accomplishments is to establish a US\$1 million revolving Biomass Fund, with a US\$800,000 contribution from the government of the Netherlands and US\$200,000 from the Fundación para la Producción, a private, nonprofit organization that manages the Biomass Fund. The Biomass Fund supplies financial support to local industries that use biomass as the principal source of energy, with eligibility criteria of reduction in biomass consumption, increase in long-

term profitability, and improvement in environmental impacts. Each project should cost no more than US\$100,000, and the industry will contribute at least 5 percent of the project cost to project financing. The fund is now in operation, with 52 projects approved and 99 projects in the pipeline. The program has also demonstrated pilot projects in seven enterprises, all of which achieved substantial energy savings—20 percent reduction in energy consumption with annual savings of US\$200,000 and 18 months of payback period on investment. In addition, the NBP has built substantial local capacity in the energy sector and created a number of new energy service companies as a market-based institutional mechanism to promote efficient biomass energy technologies.

2.9 As a result, both projects substantially increased capacity of local stakeholders and strengthened institutional arrangements for rural energy and energy efficiency. The projects demonstrated a number of market-based delivery mechanisms and increased the financing available to local entrepreneurs. The pilot activities demonstrated productive use applications (education and livelihood improvements) of renewable energy and achieved substantial energy savings.

2.10 Important lessons were learned from these two programs:

- ?? ESMAP projects should focus strongly on one or two major activities that are likely to have a successful outcome.
- ?? Implementation of ESMAP projects should be started only when policymakers have shown a definite commitment to the project.
- ?? In a limited market such as Bolivia, it is difficult to achieve financial sustainability solely by relying on the private sector to deliver SHS services without any grant or subsidy.
- ?? Subsidies for conventional fuels should be reduced or removed for cleaner energy sources to stand better chances of being used as substitutes.
- ?? Energy efficiency technologies in small-scale rural industries can create substantial local value added, improve competitiveness, consolidate rural markets, and create employment opportunities.

Promoting Productive Use Applications of Energy Services

2.11 The “Technical Assistance to Proposed Expansion of Solar-Net Village Program in Honduras” demonstrated a low-cost model to obtain Internet access and other information and telecommunication (ICT) services via solar-powered packet radio transmission in remote, un-electrified rural areas (The World Bank 2003b; personal communication with Ernesto Terrado, the World Bank, January 2003). This ongoing project is assisting two villages in setting up rural information centers (RICs), which will provide Internet-based educational services for youth and business development services for such rural micro-enterprises as agriculture, the flower business, and ecotourism. There is little experience worldwide with the establishment and operation of RICs, which often need to be powered with stand-alone PV systems. In partnership with the

International Telecommunications Union, a United Nations agency, this project used inexpensive packet radio links between existing urban tele-centers and solar-powered RICs in villages up to 100 kilometers away to bring ICT services to the villages. These ICT applications are intended to allow the local communities to be less dependent on donor aid and generate income to help them become financially self-sustaining. In addition, the project closely involved local communities, who formed a community company to maintain the systems with training provided from the project. The project will also help the government determine the level of subsidy needed to provide the services to remote, un-electrified villages—a useful policy tool. ESMAP support helped set up a replicable model for low-cost energy applications to ICT and education, which will be used in the design of the RIC component in the US\$8.5 million project funded by the Inter-American Development Bank (IADB) in Honduras.

2.12 The important lessons learned from this project are:

- ?? It is important to set up a community-based mechanism to ensure the institutional sustainability of the system's operation and maintenance (O&M).
- ?? Given the low ability to pay among local communities, it is not realistic to expect 100 percent cost recovery of both capital and operation costs. The project, however, should target recovery of the O&M costs.
- ?? It is difficult to develop ICT applications for businesses because low population density results in lack of critical mass of demand.

2.13 The “Philippines Village Power Fund and Incubator for Renewable Energy Enterprises Project” aims to set up a not-for-profit Village Power Fund to provide financing to community-based micro-hydro operations that provide power to ice-making businesses in local communities in two barangays (villages) (The World Bank 2003b, personal communication with Selina Wai Sheung Shum, the World Bank, April 2003; personal communication with Grace Yeneza, PEI, the Philippines, February 2003) This ESMAP project is one of the first attempts in the Philippines to test innovative financing mechanisms for community-based energy projects. First, it adopted a participatory approach to identify the needs of the communities and prepare feasibility studies with locally based NGOs to ensure community ownership and institutional sustainability. The two pilot micro-hydro projects, in Binosawan, Rapu Rapu, Bagong Bayan, and Palawan, are demonstrating a credit model that provides partial loans to local NGOs. The pilot projects also intend to set up ice-making plants, which generate revenues for the local communities to pay back the loans. In addition, this ongoing project is preparing to set up the Village Power Fund to scale up these pilot efforts. This approach has a high replication potential, particularly with the national government's ambitious goal to electrify all barangays by 2006. The government agencies have already shown great interest in developing productive use applications from rural energy services, and the Asian Development Bank (ADB) is planning to fund project preparation for energy and

productive uses. This project has leveraged co-funding from the United Nations Development Programme (UNDP) and the Philippines Departments of Energy and Agriculture to support the pilot projects. This ESMAP support demonstrating a flexible, community-based Village Power Fund mechanism complements the World Bank's "Rural Power Project" in the Philippines, which is under preparation and provides partial risk guarantees to rural electrification projects through a commercial bank, the Development Bank of the Philippines.

2.14 The important lessons learned from this project are:

- ?? A consultative approach takes time during project development.
- ?? The need for capacity building is greater than expected.
- ?? Accommodating funding from multiple donors is not easy, because each donor has its own requirements; it is particularly important to create synergies of funding for the energy and livelihood components for productive use projects.

Piloting Micro-finance Models

2.15 Given the geographic diversity and different levels of institutional capacity in developing countries, a wide range of institutional and financing delivery models should be demonstrated. As mentioned before, innovative and flexible financing mechanisms to increase access to credit are crucial factors in increasing the affordability of RE systems, overcoming the high initial cost barrier, and ensuring the financial sustainability of energy services. ESMAP piloted micro-finance models in Kenya.

2.16 The ESMAP "Kenya Photovoltaics Financing Mechanisms for Solar Electric Equipment Project" successfully piloted innovative microfinance models that provided credits to rural consumer groups interested in installing SHSs in Kenya, one of the first efforts in Africa (The World Bank 2000a; personal communication with Robert van der Plas, Marge, the Netherlands, May 2003). The project worked with finance partners, technical partners, and rural consumer groups that want to acquire SHSs:

- ?? The finance partners make loans available to qualifying households and small businesses. This project tested two different financing approaches through working with two existing local microfinance institutions (MFIs), the Kenya Rural Enterprise Program (K-REP) and the Cooperative Bank of Kenya Ltd. (CBK). K-REP gives business loans to small, well-organized rural groups and small businesses, where members guarantee each other and lower default risks. They offer loans with a zero down payment, an 18.5 percent interest rate, and a two-year term, and they require customers to have savings that is more than 10 percent of the loan. The CBK provides loans to individuals through rural-based savings and cooperative credit organizations. Their loans require a 25 percent down payment and offer a 12 percent interest rate and a two-year term. Only

registered members are qualified to apply. ESMAP provided technical assistance and grant financing to both MFIs. One MFI used the grant as a guarantee fund and its own money to create the loan fund, and the other MFI matched the grant funds to double the loan fund.

- ?? A technical company is contracted to ensure that all systems are well designed, installed, inspected, and maintained. Rural-based service companies install and service the systems, and local artisans manufacture battery boxes and module mounts.
- ?? The third, and perhaps most important, player in this model is the selected rural customers who are organized for group loans and then purchase bulk packages of SHSs.
- ?? Contracts are drawn up between the finance partner and technical partner, and between the finance partner and rural loan groups. Loan agreements specify that the borrower will follow technical guidelines set up by the technical partner to ensure maximum system life.

2.17 This ESMAP project is among the first attempt to test consumer financing mechanisms in Kenya. As a result, this project increased access to financing for consumers, who appreciated the opportunity to be able to afford SHSs and increase their access to electricity. The local financial institutions gained sufficient experience to scale up the effort, and K-REP solar business loans are fully “mainstreamed” now.

2.18 Important lessons have been learned:

- ?? Working with existing rural credit groups proved to be the most effective way to develop SHS loan packages.
- ?? The existing financial institutions had no prior experience with SHS loans, thus to get the finance mechanism started, technical assistance for training and quality control was found to be critical, and it should be available over a long time. Limited financial assistance to slightly reduce the cost of the loans offered is also important at the initial stage.
- ?? It proved to be effective for the credit mechanisms to deal with groups of individuals, instead of directly with individuals.
- ?? SHSs are generally not for so-called productive uses, but most rural MFIs offer loans for productive purposes only.
- ?? Maintenance of SHSs was often a problem
- ?? Village-level installers played a key role.

Engaging the Private Sector

2.19 The “Solar Market Development in Comoros Project” tested an innovative “concession” model that invited competitive bidding from the private sector to participate in the solar market in Comoros (The World Bank 2000b; and personal communication with Robert van der Plas, Marge, the Netherlands, May 2003). Experience in Kenya and

Zimbabwe had demonstrated that private sector investment played a critical role in the sustainable solar market in those countries. In Comoros, however, there were no firms selling solar equipment. ESMAP launched a pilot project that adopted an innovative use of the concession model to trigger private market development. Through a competitive bidding process, the ESMAP project provided a revolving fund of US\$100,000 for the exclusive use of the selected private firm for a two-year period. The fund was managed by the government, and the company was responsible for installation and maintenance of solar equipment at its own risk. The government also granted the firm a three-year grace period for taxes and duties. The project received three bidders, and the contract was awarded to Solelec, a subsidiary of Total Energie, who created a joint venture (Enercom) with a local electrical service company.

2.20 As a result, this project jump-started the solar market in Comoros by convincing a foreign firm to start market development, which would never have happened otherwise. The company installed 16 kilowatt of solar home systems during the first two years and was able to repay the provided financing.

2.21 The important lessons learned are:

- ?? The government should provide financial incentives to attract private sector participation. Such incentives should be structured in a way that is easy to implement^{vii}
- ?? The lack of access to credit from existing financing institutions proved to be a main constraint to project implementation. The company has to develop its own financing mechanism, selling about 75 percent of the systems on credit.
- ?? Market surveys of the size and characteristics of the potential market and profiles of potential customers are essential.
- ?? The private company should act as a commercial firm rather than an NGO.

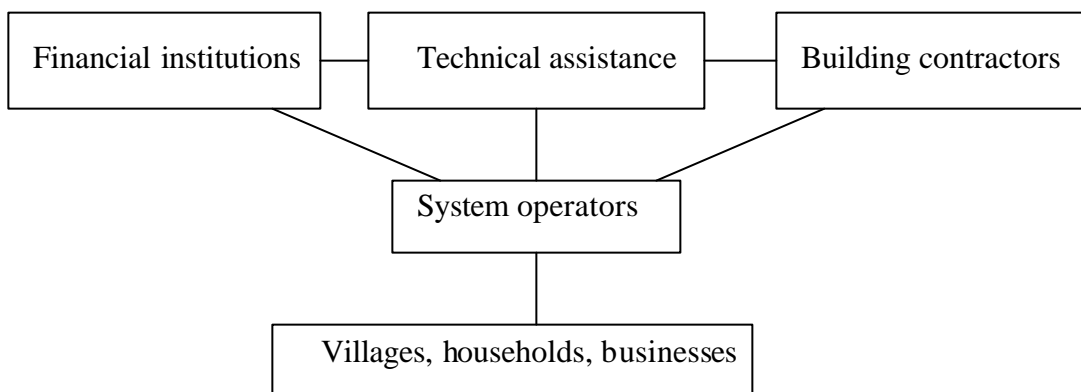
2.22 The “Lighting Services for the Rural Poor Project” opened the market for low-cost and locally manufactured small batteries (a capacity of 20–30 Ah) compatible with small-scale solar modules (10–15 Wp) in Kenya, making solar home systems affordable for low-income population (The World Bank, 2000c; personal communication with Robert van der Plas, Marge, the Netherlands, May 2003). Today, these small-scale batteries and solar modules form the bulk of the 200,000 solar PV installations in Kenya (Nieuwenhout, van Dijk, and others, 2001). The ESMAP project organized a tender to local manufacturers for bulk purchase of 800 small batteries for a marketing test, provided technical specification and certification of small solar batteries, and tested battery performance and conducted consumer survey. As a result, the project has generated interest in and rapid uptake of the small battery unit among both dealers and consumers. The battery manufacturer continued production, and sales exceeded 200 units

per month. The key lesson learned is that it is critical to tailor the project to local market needs and promote small-scale, low-cost SHSs that are affordable for low-income consumers.

2.23 The “Decentralized Rural Electrification in Laos PDR Project” designed a “rural energy service company” model for an off-grid electricity unit within the Ministry of Industry and Handicraft that provides technical assistance and credits to rural energy service company supplying off-grid rural electrification at the community level (The World Bank, 1999a; personal communication with Douglas Barnes, the World Bank, January 2003). This ESMAP project represents the first attempt at addressing institutional issues linked to developing off-grid electricity in the Lao PDR, as shown in figure 2.1. Under this project, the Ministry of Industry and Handicraft provides technical assistance to village committees, rural energy service companies, and NGOs, who then develop business plans and submit applications for loans to off-grid rural electrification committee. The committee, composed of representatives from government, utilities, and NGOs, reviews and approves loans. The Ministry then provides grants and arranges loans from financial institutions. The rural energy service companies utilize financing to selected contractors to construct systems. The Ministry supervises loans.

2.24 This institutional design has provided key inputs to a Bank project, “Southern Provinces Rural Electrification in Laos PDR,” one of the first Bank projects that packages decentralized energy systems with grid extension for rural electrification. Under the Bank project, the Ministry of Industry and Handicraft procured equipment in bulk and signed contracts with rural energy service companies, who were responsible for installation, operation, and maintenance of the systems (SHSs, diesel and micro-hydro mini-grids). As a result, the Bank project created four or five rural energy service companies providing off-grid services in the Lao PDR (personal communication with Chandrasekar Govindarajalu, the World Bank, May 2003).

Figure 2.1 Organization of Institutional Support for Off-Grid Electrification



2.25 The “Rural Energy Electrification in Peru Project” designed and piloted two different institutional delivery mechanisms — a management service model and a private property and management service model — for decentralized rural electrification based on micro-hydro systems (The World Bank 2001b; personal communication with Anke Meyer, the World Bank, January 2003). In addition, it conducted technology transfer, capacity building for local entrepreneurs and communities, and awareness building. These activities were carried out in several micro-hydro systems established with funding from an IADB revolving fund for implementing small hydropower plants in remote communities. The management service model, tested in Conchan district, Chota province, can be used for systems owned by the state or municipalities who are willing to hire a private company to take over the O&M and management of the small plants through a public contract. Under the private property and management service model, implemented in the Trinidad district, Contumaza province, small private companies promote and manage their own power plants. Compared with the traditional public sector approach, with the government providing 100 percent subsidies, this private sector approach can lower investment costs substantially and thus requires much less subsidy. This project introduced community involvement and a sustainable delivery mechanism of rural electrification to Peru for the first time. It generated experience in delivery mechanisms through the pilot activities, and improved local capacity and effectiveness of the IADB credit project.

2.26 The lessons learned are that successful management of isolated rural systems requires:

- ?? government regulatory support
- ?? sound financial mechanisms, such as credit programs
- ?? a sustainable institutional framework
- ?? extensive training of local capacities
- ?? adequate tariff structure.

Supporting Women’s Micro-enterprise to Promote Energy and Gender

2.27 The “Opportunities for Women in Renewable Energy Technology Utilization Project” created a women’s micro-enterprise that manufactures and markets energy products in Char Montaz, a rural island in the Bay of Bengal off the Bangladeshi coast (The World Bank 2002e). After a survey and an interview process, Prokaushali Sangsad Limited, a Dhaka-based development consultancy, selected 33 women for training in basic technical (soldering, lamp assembly, operation of a battery-charging station, quality control, and so forth), business, and marketing skills. Some of the women were given accounting and book-keeping training. Within a few months, a women’s cooperative was operational, offering its own brand of basic fluorescent lamps, the 8V or 12V rechargeable batteries that power the lamps, SHSs, electricity through a diesel-generated mini-grid, and other basic electrical goods. The first year of operation has seen

the women of the cooperative sell 770 lamps (with a one-year service warranty) and 235 batteries, establish two battery-charging stations in locations convenient to their customers, and establish a sales network among the area's shopkeepers. These women have experienced a major transformation in their self-esteem and the gender roles in their households in addition to a US\$2 increase in their average daily incomes. The community has benefited from the simple lamps through an extension of their work hours, using them for tailoring, retailing, and fishing at night. Lamps in households also allow schoolchildren to study after dark. ESMAP has provided continued support of Phase II funding that allows the women's energy cooperative to expand their businesses and achieve financial sustainability.

2.28 The Char Montaz women's energy cooperative has demonstrated that with the right investment in their capacities, rural women who have less than a high school-level education can participate in the provision of modern energy services. The cooperative has also provided the first test of a model that may be replicated in other parts of the world for refinement and subsequently presented for scale-up. This approach is now being replicated in Ghana. However, a lack of local financing mechanisms that provide credits to the women's cooperative and the limited market size on the island of Char Montaz constrained the financial sustainability of the women's micro-enterprise.

Policy Changes: Technical Assistance in Policies and Regulatory Frameworks for Rural Electrification and Renewable Energy

2.29 Any successful RE program requires a sound policy and regulatory framework in place, because both are key success factors for scaling up rural energy services and renewable energy. Over the past five years, ESMAP supported a series of projects that assist national policymakers and regulators in developing and improving national rural electrification and renewable energy strategies and policies, including off-grid, mini-grid, and grid-connected systems. The results of these projects have been or will be incorporated in national government programs, new World Bank rural electrification loan projects, and GEF renewable energy projects. These include:

- ?? Improving regulatory framework for rural electrification in Argentina, Bolivia, Brazil, Cambodia, Nicaragua, and the Philippines
- ?? Developing rural electrification strategies in Brazil, Cameroon, Chad, Guinea, Uganda, and Zimbabwe
- ?? Preparing renewable energy action plans in Cambodia, China, and Vietnam
- ?? Developing renewable energy policies and programs in Mexico, Nicaragua, and the Philippines.

Improving Regulatory Framework for Rural Electrification

2.30 The "Regulatory Issues of Off-Grid Energy Services Delivery as Part of National Rural Electrification Strategies Project" in Argentina, Bolivia, Brazil, and Nicaragua helps these countries to put in place a sound regulatory framework for off-grid

electrification, including setting tariffs, service quality, obligation to deliver services, technical standards, and etc. (The World Bank 2003b, personal communications with Kilian Reiche and Clemencia Torres, the World Bank, January 2003). It assists regulators and policy bodies in these countries in the enforcement and supervision of off-grid rural energy policies, as well as formulating detailed regulatory legislation based on national energy or electrification laws. In Argentina and Bolivia, the project is working with local regulators who have drafted off-grid regulatory frameworks. In Brazil and Nicaragua, the project has completed the analytical background work, and draft regulatory frameworks are under way. This project also promotes cross-exchange of information and experience among regulators and legislators in these countries. The results of the project are intended to be incorporated into the regulatory frameworks to be adopted by these countries and are also directly feeding into the design and implementation of several national rural electrification projects in these countries.

2.31 The “Rural Electrification Regulatory Framework” project in the Philippines is designed to support the government’s strategy to achieve universal access as it opens the market to the private sector (The World Bank, 2004a; The World Bank, 2004b; personal communication with Alan Townsend, the World Bank, January 2004). This project developed a framework for private sector participation in the management of rural electric cooperatives as well as regulatory framework that incorporates competitively award, output-based subsidies or tariff, while also providing the predictability and transparency required by investors. This ESMAP study recommended an investment management contract model to improve performance of rural electric cooperatives (RECs), who are responsible for implementation of rural electrification. With an investment management contract model, the RECs set up investment management contracts to the private sector to manage the distribution systems, while the ownership remains with RECs. The private sector will be chosen through competitive bidding, and they will bring their own risk capital at the initial stage. The recommendations made through this ESMAP study are incorporated in the government policy on private participation in remote generation and rural distribution.

Developing Rural Electrification Strategies

2.32 The “Brazil Rural Electrification Strategy Project” produced a Background Study for a National Rural Electrification Strategy, which analyzed rural electrification issues and made fifteen recommendations for both off-grid and grid extension systems. (The World Bank 2004b, personal communications with Kilian Reiche and Jayme Porto Carreiro, the World Bank, January 2003). The ESMAP study was coordinated closely with the Brazilian government at all stages. The recently appointed Brazilian Minister of Mines and Energy showed strong support for rural electrification, and is particularly interested in moving from strategy to action with the implementation of a national rural electrification program and several pilot programs at

the state level. This ESMAP study has been used by several donors for rural electrification projects and helped the Ministry of Mines and Energy define a series of follow-up activities. The result of this ESMAP project provides valuable inputs for a follow-up US\$650 million World Bank lending project on rural electrification that is under preparation in Brazil. One important lesson learned from this project is that linking ESMAP projects directly with government policies and World Bank operations can tremendously increase impacts on the ground; however, this process takes more time than traditional desktop studies because the ESMAP project may have to wait for government changes to take effect before being able to consult with the new government.

2.33 In addition, ESMAP also supported a series of “Rural Electrification Strategy Studies” in Cameroon, Chad, Guinea, Uganda (The World Bank 1999b), and Zimbabwe (The World Bank 2000d). These studies adopted the methodology of demand survey and assessment, which collected data on the type and quality of lighting and electricity services needed and associated monthly spending patterns in rural and peri-urban households, and supply survey and assessment, which evaluated grid-connected and off-grid options, including both fossil fuel and renewable energy sources. These surveys confirmed that the rural households are willing and able to pay high prices for electricity services^{viii}. These studies recommended that governments (a) permit the private sector to generate electricity in rural and peri-urban areas and sell it to third parties at mutually agreed prices, (b) provide tax and other fiscal incentives to investors, (c) consider all alternatives for rural electrification on an equal playing field, and (d) define the roles and responsibilities of each stakeholder group. In particular, the Uganda study put rural electrification on the agenda of the government, and changed the electricity law. It laid a foundation for the Bank’s ongoing lending project in Uganda, “Energy for Rural Transformation” (personal communication with Robert van der Plas, Marge, the Netherlands, May 2003).

Preparing Renewable Energy Action Plans

2.34 The “Vietnam: Renewable Energy Action Plan (REAP) Project,” with co-funding from the Asia Alternative Energy Program (ASTAE), adopted a participatory approach — object-oriented project planning (OOPP) methodology — to assist the government in developing REAP, a 10-year program to accelerate large-scale development of renewable energy for rural electrification and grid supply in Vietnam (The World Bank 2000e; Bogach and others 2001; personal communication with Susan Bogach, the World Bank, January 2003). This methodology identifies the key barriers to renewable energy development by eliciting ideas from stakeholders during brainstorming, creating consensus among stakeholders during workshops, establishing problem trees on the basis of the discussions, and maximizing the involvement of all the stakeholders (The

World Bank 2002d). The process identified 21 renewable energy options and selected the 4 most preferred options — mini-hydro for grid-connected and isolated grid, SHSs, and household-scale pico-hydro systems. The workshops also identified more than 100 barriers to renewable energy development in Vietnam.

2.35 The participatory approach has been highly successful in securing the interest and ownership of all stakeholders. The process convinced the government and the Bank country team that renewable energy can play a critical role in rural electrification. As a result, the recommendations made through this ESMAP project are now being implemented through two Bank lending projects in Vietnam: the “System Efficiency Improvement, Equitization, and Renewable (SEIER) Project” and the “Rural Energy Project.” Based on the recommendations of a community management approach for micro-hydro mini-grids in REAP, for example, the Bank SEIER Project is intended to create community-based, locally managed mini-utilities to provide sustainable energy to remote areas.

2.36 This project builds on the similar successful experience in China that was jointly supported by ESMAP and ASTAE, which has led to the US\$205 million “China Renewable Energy Development Project” (personal communication with Richard Spencer, the World Bank, June 2003). ESMAP is also supporting a similar effort in Cambodia, which replicates the same participatory approach to develop the “Cambodia Renewable Energy Action Plan,” which will be implemented through the Bank lending project in Cambodia, the “Rural Electrification and Transmission Project,” which is under preparation.

2.37 The important lessons learned include:

- ?? Government commitment is a prerequisite. The government of Vietnam committed to electrify 70 percent of households by 2010 and requested assistance before ESMAP approval.
- ?? The participatory approach, which is relatively new for the Bank, proved to be highly effective in reaching consensus and securing commitment from stakeholders.
- ?? It is essential to first build capacity and support strong institutional set-up before developing large-scale investments; market characteristics must be understood before an enterprise-driven energy project can be implemented.
- ?? ESMAP support played a catalytic and pioneering role in leveraging co-funding from ASTAE and follow-up investment from the World Bank and the Global Environment Facility (GEF).

Developing Renewable Energy Policies and Programs

2.38 The “Strengthening of Rural and Non-conventional Energy Development Program in the Philippines” assisted the government in identifying technology options, investment opportunities, and policy initiatives for both grid-connected and off-grid renewable energy development in that country (The World Bank 2001c; personal communication with Ernesto Terrado, the World Bank, January 2003). Renewable energy development in the Philippines over the past two decades has typically been stand alone and donor driven, which has led to little replication and sustainability. This ESMAP project first advised that the near-term investment priorities for renewable energy should focus on off-grid electrification for household lighting, public service centers, and productive uses, as well as grid-connected wind farms. It recommended that the Department of Energy should maximize the role of the private sector in off-grid rural electrification, clarify the roles of government agencies in rural electrification, and address key regulatory issues, including permitting private rural energy service companies to enter un-served franchise areas and providing financial incentives to wind farms. Many of the recommendations made in this ESMAP project were incorporated or reflected in the Electric Power Industry Reform Act of 2001. This project also prepared a Rural Power Sector Policy Note for Bank operation, which has led to a Bank rural power loan in the Philippines. It has also leveraged co-funding from other sources such as the United States Agency for International Development (USAID).

2.39 The “Policy and Strategy for the Promotion of Renewable Energy Resources in Nicaragua” project focuses on national energy policies for grid-connected and mini-grid renewable energy resources (The World Bank 2003b; personal communications with Charles Feinstein and Kilian Reiche, the World Bank, January 2003). It will assist the government in developing an overall national renewable energy policy, which includes increasing the share of wind power under new grid operational rules that require preferential dispatch for intermittent renewables, provided it can be shown that grid stability and economics are not significantly harmed; public-private risk-sharing mechanisms for developing geothermal resources; and developing an integrated national policy to develop hydropower resources. This ongoing project, with other ESMAP projects in Nicaragua — “Nicaragua Workshop on Private Sector-Led Mechanisms for Rural Energy Service Delivery” and “Regulatory Issues of Off-Grid Energy Services Delivery as Part of National Rural Electrification Strategies” — has laid a solid foundation for and complements the new World Bank-GEF lending project in Nicaragua, “Off-Grid Rural Electrification for Development,” which was approved in 2003.

2.40 The “Mexico Technical Assistance for Long-Term Program for Renewable Energy Development Project” works with the national government on policies and strategies for large-scale promotion of renewable energy in the country (The

World Bank 2003b; personal communication with Charles Feinstein, the World Bank, January 2003). It recommended that the United Kingdom's successful Non-Fossil Fuel Obligation model be adapted and replicated in Mexico. There are plans to carry out a comparative analysis of the economic costs of renewable energy and existing utility options, such as grid upgrading and natural gas combined cycle. Because of the projected increase in prices of imported oil and gas, renewable energy may become a competitive energy choice. This ongoing project will also assist the government in developing an energy portfolio diversification scenario. ESMAP support laid the ground work for a US\$70 million World Bank–GEF “Large-Scale Mexico Renewable Energy Development Project,” which is in preparation.

Knowledge Generation: Analytical Methodologies for Rural and Peri-urban Electrification and the Impacts of Reform on the Poor

2.41 In addition to demonstrating innovative delivery mechanisms and providing technical assistance in regulatory framework, ESMAP also supported a series of activities to develop analytical methodologies for rural and peri-urban electrification and the impacts of sector reform on rural access for the poor. These studies generated new knowledge that can be disseminated and replicated in future project design:

- ?? Successful factors and lessons learned for grid electrification
- ?? Economic benefits of rural electrification
- ?? A best practice manual for decentralized electrification
- ?? Peri-urban electrification
- ?? The impacts of reform on the poor.

Successful Factors and Lessons Learned for Grid Electrification

2.42 To provide modern energy services to the 2 billion people without access is a challenging task. However, some countries have been quietly and successfully providing electricity services to rural areas. ESMAP supported the “Best Practice for Grid Electrification Project,” which conducted a series of case studies to examine the success factors and lessons learned on best practices of grid extension in eight countries — Bangladesh, Chile, China, Costa Rica, Mexico, the Philippines, Thailand, and Tunisia (Barnes and Foley 2002; The World Bank 2003b; personal communication with Douglas Barnes, the World Bank, January 2003). This project demonstrated that rural electrification, though challenging, can be successful in developing countries if it is well planned, carefully targeted, and effectively implemented. In Thailand, more than 80 percent of rural people have electricity. In Costa Rica, cooperatives and the government electricity utility provide electricity to almost 95 percent of the rural population. In Tunisia, 90 percent of rural households already have electric power. Case studies in Chile also documented the success of rural electrification after power sector deregulation through the establishment of a rural electrification revolving fund.

2.43 Each of these countries follows different models and structures. For example, the implementing agency of rural electrification can be cooperatives in Bangladesh and Costa Rica, public companies in Thailand and Tunisia, or decentralized distribution companies in Chile and China. However, they share a few common principles that make their rural electrification programs a success:

- ?? Setting up effective institutions to deal specifically with the problems involved in rural electrification
- ?? Placing a strong emphasis on cost recovery
- ?? Keeping prices high enough to make rural distribution companies financially sustainable
- ?? Ensuring that subsidies encourage rather than discourage the development of the distribution business
- ?? Reducing initial connection charges demanded by the utility or spreading them over a period of several years
- ?? Making sure that local people are involved with the electricity business and perceive it to be both fair and responsive to their needs
- ?? Reducing construction and operating costs
- ?? Allowing both grid-based rural electrification and off-grid alternatives to coexist and complement each other.

2.44 These findings will no doubt benefit future rural electrification programs in other countries. In fact, two World Bank loan projects, “Rural Electrification and Renewable Energy Development in Bangladesh” and “Rural Energy Project in Vietnam,” have learned a great deal from the results of this ESMAP study. The government of the Kingdom of Lesotho is also intrigued by this study and interested in replicating some of the successful experiences of rural electrification programs in that country (personal communication with Amarquaye Armar, the World Bank, April 2003).

Economic Benefits of Rural Electrification

2.45 The “ESMAP Electricity Benefit Assessment Project” developed an analytical methodology to quantify the economic benefits of rural electrification for development (The World Bank 2002f; personal communication with Douglas Barnes, the World Bank, January 2003). Traditionally, the benefits of rural electrification have been quantified in terms of how much the demand for electricity (measured in lumens) is satisfied and how much cost is saved through the use of electricity in productive uses. These measures ignore the intangible benefits of electrification, such as the ability to study better, quality-of-life improvements that come from entertainment (radio, television, videocassettes, and so on), and improved health (from cleaner fuel for cooking, space heating or cooling, and so forth) (The World Bank 2002e).

2.46 ESMAP has supported the development of a more thorough methodology for measuring the benefits of rural electrification. The key assumption is that electricity is an input to the production of outputs and is desired not only for its own sake, but also for its ability to produce goods and services that are more directly desired. The study conducted surveys of 2,000 households in four barangays of the Philippines and attached dollar values to the benefits enjoyed as a result of the introduction of cheaper electricity and improved electricity services. The study concluded that under the assumptions of the survey, the total net benefit of providing electricity to a typical, previously un-electrified rural Philippine household would be between US\$81 and US\$150 per month, depending on the household's number of wage earners and whether it runs a home-based business. This raises the possibility that, in the long term, benefits will outweigh the costs of rural electrification, even for the poorest populations. The study's methodology for economic analysis has also been used in Bank rural electrification projects in Bangladesh and Vietnam. The conclusion was presented to the ADB, which expressed interest. The monetary measurement of the contribution of rural electricity services to better education, productive use, and improved livelihood demonstrated the strong linkage between energy and the MDGs.

Best Practice Manual for Decentralized Electrification

2.47 ESMAP's "West Africa Solar Project" (The World Bank 2001d) provided a step-by-step guide for Bank task managers to identify, develop, and implement decentralized electrification projects. The project recommended five project stages with concrete steps to follow for each stage:

- 1) Institutional and regulatory environment, which covers the role of government, the legal framework, market barriers, technical capacity, use of local NGOs and the financial sector, and the role of the private sector
- 2) market and project concept, primarily for conducting a detailed market assessment
- 3) technology and product options to evaluate supply options
- 4) delivery mechanisms, which include cash and credit sales, leasing of products, or provision of energy services
- 5) financing options, which include two options for consumer lending — cooperative financing (group lending to a village organization) and consumer credit — as well as working capital for service providers or dealers.

2.48 The study provided a wide range of case studies in Bolivia, Cameroon, Côte d'Ivoire, Guinea, Kenya, the Lao PDR, Madagascar, Mauritania, and Senegal to demonstrate how these principles are applied to real-world practices. It also demonstrated how to write a business plan for rural electricity services.

Peri-urban Electrification

2.49 About 40 percent of the world's poor — 1.3 billion people, a forgotten but important consumer group—live in peri-urban areas. ESMAP supported the “Peri-urban Electrification Project,” (The World Bank 2001e) which examined viable and commercial ways to provide electricity services to the urban poor. Promoting peri-urban electrification can be a “win-win” solution for utilities and poor consumers, and peri-urban households are easier and cheaper to electrify than un-served rural households. The study offered a range of technical and non-technical measures for commercially oriented distribution companies to reduce private consumers' arrears and improve cost recovery. The non-technical options include (a) advance payment for consumption, in which consumers have to make a down payment corresponding to one or two months of their consumption, which serves as a guarantee; (b) a prepayment method, in which an advance payment for future consumption is paid through either meters or Enerkey^x; and (c) reducing distance between the consumer and the billing office. The technical options include (a) reducing technical costs in the distribution network; (b) using load-limiting measures; or (c) low-cost, prefabricated wiring. In addition, to incorporate peri-urban electrification as part of sector reform, the regulatory framework should provide financial incentives as well as technical standards for distribution companies to extend their services to peri-urban areas. This study has led to another new ESMAP activity, “Design and Pilot Testing of Capacity Building ‘Product Line’ for Small and Medium Enterprises (SMEs) Utility Service Providers in West Africa”, which applied these principles to SMEs as sub-contractors to existing public utilities to provide infrastructure services for the peri-urban poor in Africa.

The Impacts of Sector Reform on the Poor

2.50 The liberalization and development of competition benefit society as a whole in terms of a greater, more efficient, and financially sustainable supply of energy services to support the development of economic and social activities. However, there has been little analytical work to document the impacts of reform on the poorer members of society and assist in poverty reduction. To date, studies on the impact of the energy sector reform processes have largely stressed the overall performance of the sector (reduced electricity tariffs or fuel prices, increased total number of connections to the grid, and so on), but in general they have not focused on the direct impact, if any, on the poor.

2.51 To fill this knowledge gap, ESMAP is supporting a number of projects to assess the impact of sector reform on the poor in Africa and Central America. The “Rural Electrification and Power Reform in Central America Project” examined four case studies in Central American countries (El Salvador, Guatemala, Nicaragua, and Panama) where the sector reform started later than in South America (The World Bank 2003c; personal communication with Douglas Barnes, the World Bank, January 2003). The

project assessed rural electrification strategies and priorities for both on-grid and off-grid alternatives when these countries undertake power sector reforms. All countries in this region have made progress in restructuring state utilities and privatizing power generation and distribution. The study found that most of the countries are aware that rural electrification needs to be incorporated into power sector reform; however, the poor in the rural areas are generally left out of the reform process, because of a lack of effective implementation strategies. The success of rural electrification programs in the context of power sector reform will depend on the establishment of the political and institutional infrastructure. The ESMAP project recommended that governments in this region should (a) set up well-designed and fully committed institutions to implement future rural electrification efforts; (b) provide technical assistance to rural electricity businesses; and (c) design a sustainable subsidy mechanism to make electricity affordable. Such subsidies generally should be applied to access costs (connections), not to operating costs (ongoing consumption)

2.52 The “Power Sector Reform in Africa: Assessing the Impact on the Poor and Influencing Policy Decisions” is intended to assess the impacts of power sector reforms on the poor and design strategies to ensure integration of pro-poor measures in the reform process in seven African countries (Ghana, Mali, Namibia, Senegal, South Africa, Tanzania, and Uganda). In addition, the “Assessing the Impacts of Energy Sector Reform on the Poor Project” identifies how poorer households’ use of energy can be directly affected by power sector reform, and it uses household survey results to assess how much impact sector reform has actually had on these links in four reforming countries: Botswana, Ghana, Honduras, and Senegal (The World Bank 2003b; personal communication with Robert Bacon, the World Bank, March 2003). ESMAP support in this area could have a wide replication in many developing countries undertaking the reform process.

Beyond Electricity: Household Energy Surveys and Strategies

2.53 In addition to rural electrification, ESMAP also supported a series of household energy surveys to better understand the demand and supply patterns of rural household energy and develop strategies to improve household energy services in Bangladesh, India, Nicaragua (The World Bank 2001f), Swaziland (The World Bank 1997), and the Republic of Yemen.

2.54 The ESMAP project, “Rural Energy Study in India” (The World Bank 2002g; personal communication with Douglas Barnes, the World Bank, January 2003) conducted a detailed household energy survey of more than 5,000 households in 180 villages in six states of rural India. The study found that traditional biomass fuels — wood, straw, and dung — account for more than 90 percent of the overall share of rural energy use, primarily for cooking purposes, and modern fuels (kerosene, charcoal, liquefied petroleum gas [LPG], and electricity) are used to meet lighting, cooling, and

other non-cooking needs. The study recommended strengthening improved biomass stove programs in India. The shift to cleaner petroleum fuels for cooking is constrained by high start-up cost and subsequent high price. This study found that most of the US\$3 billion annual subsidy for LPG from the Indian government went to higher-income households. Another recent ESMAP study, “Access of the Poor to Clean Household Fuels” in India (the World Bank, 2003d), drew a similar conclusion that the LPG subsidy and universal kerosene price subsidy have little few social benefits and did not reach the poor. There is a strong case for phasing out these subsidies. It is unlikely that a sustainable government policy can be found to induce rural households to increase substantially the use of kerosene and LPG for cooking. However, the urban poor appear to be a more promising group to target for targeted subsidies.

2.55 The ESMAP project, “Household Energy and Women’s Lives: The Case of India” (The World Bank 2004c) examined the tremendous difference that access to improved household energy services makes for the life of women in rural India. It conducted a detailed study of the time women spend on various daily activities, based on the household energy survey conducted in the ESMAP “Rural Energy Study in India Project.” The main findings of women’s time allocation in rural India are shown in table 2.2.

Table 2.2 Women’s Time Allocation in Rural India

<i>Women’s activities</i>	<i>Time allocation</i>
Collecting fuel	40 minutes
Fetching water	1 hour
Cooking	3 hours
Housework	6 hours
Income-earning activities	2 hours
Watching TV	30 minutes
Sleeping, leisure, and personal care	8½ hours
Miscellaneous activities	40 minutes

2.56 As households move up the energy ladder to use kerosene, LPG, and electricity, the burden of collecting and using these fuels eases substantially, and women devote their time to more productive activities and pursuing leisure. The study found out that use of biomass fuels is pervasive, even among the wealthier rural households. The level of literacy in the family and reading by women are directly related to electricity status and income of the households — for example, 90 percent of women who read resided in homes with electricity. The study concluded that an improved domestic energy policy that takes gender into account is needed.

Advocacy: National Participatory Stakeholder Workshops

2.57 In addition to pilot projects and analytical studies, ESMAP also supported a series of national participatory stakeholder workshops in Nicaragua, Nigeria, and South Africa that engaged the local stakeholders and generated in-country momentum for rural electrification and renewable energy.

2.58 ESMAP's "Nicaragua Workshop on Private Sector–Led Mechanisms for Rural Energy Service Delivery" (The World Bank 2002e, the World Bank 2002h) was held in Playa Montelimar, Nicaragua, on November 28 and 29, 2000. It was jointly sponsored by ESMAP, the World Bank, the Comisión Nacional de Energía (CNE) and Winrock International. About 50 participants from Nicaragua and other Central American countries attended, including potential private sector service providers, prospective investors, equipment suppliers, key government officials involved in rural development and energy, micro-credit and other rural financing institutions, and NGOs. At the conclusion, there was unanimous agreement that the workshop was successful in its objective of facilitating information exchange on the relatively new topic of off-grid national electrification programs, the changing roles of government and the private sector in the implementation of sustainable rural electrification projects, and prospects for renewable energy technologies as an environmentally benign, least-cost solution for remote off-grid areas.

2.59 The workshop featured presentations from international experts and practitioners in private sector–led off-grid electrification mechanisms, including representatives from Soluz (SHS provision in the Dominican Republic and Honduras), EJSEDSA (an off-grid concessionaire in Jujuy, Argentina), and ITDG Peru, among others. Delegates from Costa Rica, Guatemala, Honduras, El Salvador, and Panama also gave presentations on the rural electrification programs in their countries.

2.60 The workshop effectively complemented the study of "Market-Based Options for Rural Electrification of Off-Grid Areas in Nicaragua," which was carried out by the World Bank in collaboration with the CNE. This study was a precursor to the new World Bank–GEF "Rural Electrification Project" (PERZA), which was approved in 2003. Preliminary results of the INEC surveys in the selected pilot cities were presented at the workshop, as well as the outline for a project concept for private sector–led off-grid electrification in Nicaragua. Potential off-grid projects, as well as next steps that would need to be taken by all stakeholders, were discussed during the workshop. Representatives from the government of Nicaragua noted that rural electrification is a high priority for the government.

2.61 At the request of the government of South Africa, the "South Africa Workshop — People's Power Workshop" conducted extensive consultations with multi-sector stakeholders, one of the first cross-sector workshops in the country that involved

various ministries (personal communication with Arun Sanghvi, the World Bank, February 2003). It mobilized great momentum in RE in South Africa and resulted in government requests for World Bank assistance. Consequently, two projects have been identified in South Africa: a PCN for the “Renewable Energy Market Transformation Project” has been completed, and the “Rural and Renewable Energy Housing Project” is in preparation.

2.62 Similarly, the “Initiating the Bank’s Peri-urban/Rural and Renewable Energy Activities in Nigeria Project” held two national workshops on rural electrification and renewable energy in Nigeria (personal communication with Malcolm Cosgrove-Davies, the World Bank, March 2003). After extensive stakeholder consultation and the consensus-building process, the workshop recommended that a rural electrification fund should be included in the proposed Rural Electrification Bill and produced a rural electrification action plan. ESMAP support played a catalytic role in engaging the government and the Bank country team in both rural electrification and renewable energy in Nigeria. In particular, this activity was instrumental in encouraging the government to include a rural energy technical assistance component in the Bank “Privatization Support Project,” and a project concept note was developed.

2.63 Both the South Africa and Nigeria workshops were supported by ESMAP and implemented by Africa Rural and Renewable Energy Initiative staff. Important lessons learned include:

- ?? Innovation and cross-sector work require extra efforts for preparation and consensus building, and ESMAP funding can play an important role in this process.
- ?? Effective use of small amounts of funding can play an instrumental and catalytic role in generating ownership in client countries.
- ?? It is important to provide “just-in-time” support to governments when requested.

Bottom-Up Partnership: The GVEP

2.64 The GVEP is a flagship activity at ESMAP and an important business line in the ESMAP Business Plan 2002–2004 (The World Bank 2003b; personal communication with Dominique Lallement and Katharine Gratwick, the World Bank, January 2003). The partnership was successfully launched at the WSSD in August 2002, with the goal of increasing availability and improving use of modern energy services for economic growth and poverty reduction in rural, peri-urban, and urban areas.

2.65 The GVEP was launched for several reasons: (a) stagnation or slow progress in making modern energy services available to a larger proportion of un-served low-income populations, (b) continued limited access to electricity and high reliance on fuelwood in developing countries, (c) energy requirements to achieve the MDGs and

foster economic growth, and (d) individual efforts that were not paid off because of weak political commitments, market barriers, insufficient enterprises, lack of information and lesson sharing, inadequate financing, and lack of accountability for results.

2.66 The GVEP provides five types of services:

- 1) Action plans — goals for service delivery, policy framework, demand assessment and priorities, and supply and investment options.
- 2) Capacity development — for entrepreneurs, financial institutions, consumer groups, and technicians.
- 3) Funding facilitation — registry of funding sources, training for financial intermediaries, and a pre-investment facility.
- 4) Knowledge exchange — models of actions plans, projects, financial mechanisms, lessons learned, toolkits, websites, radio and television programs, printed information dissemination, a network of trained and knowledgeable individuals, and a help and advisory desk.
- 5) Results and impact monitoring — public accountability for results and assessment of development impact.

The partnership is expected to achieve the following outcomes within ten years:

- ?? A large number of national and community-based programs and fewer barriers to entry
- ?? A greater number of energy service enterprises in developing countries
- ?? Greater availability of a range of technical options
- ?? At least 400 million more people served with modern energy
- ?? Higher incomes to purchase energy services
- ?? Fifty thousand communities equipped with schools, dispensaries, and telecommunications and more effective education, health, communications, and transport services
- ?? Greater flow of energy investments toward low-income areas and customers.

The GVEP achieves its goals through several structures:

- ?? Action plans are devised through multi-stakeholder workshops that are held at the request of stakeholders.
- ?? Programs and projects are implemented by partner organizations and states.
- ?? The GVEP Technical Secretariat, hosted by ESMAP through December 2003, provides resources, guidance, and supervision.
- ?? The board of directors, elected by the partners for two-year terms, provides oversight and strategic guidance to both the Technical Secretariat and the partnership as a whole.

The partnership has made substantial progress as of July 2003:

- ?? More than 250 partners have registered, including (a) governments; (b) communities, local user groups, and NGOs such as the Organization of American States, KITE of Ghana, Energy and Environmental Concerns for Zambia, TERI of India; (c) the private sector including BP Solar, RAPS Consulting Ltd of South Africa, ORMAT International, and etc; (d) private financial intermediaries; (e) bilateral and multilateral development and financial institutions including the Canadian International Development Agency, USAID, the Department for International Development, the United Nations Environment Programme, UNDP, and others; and the (f) WBG.
- ?? A number of regional stakeholder participatory workshops have been held. In partnership with ESMAP and the World Bank Africa Region Energy Unit, African energy-poverty workshops involving several countries, various sectors, and numerous stakeholders were held in Addis Ababa, Ethiopia, in October 2002 (The World Bank 2003e); Dakar, Senegal, in February 2003; and Douala, Cameroon, in July 2003. The participating countries have prepared preliminary energy-poverty reduction action plans aimed at enriching the poverty reduction strategic documents and identifying energy interventions to achieve the MDGs. As requested by Burkina Faso, Mali, Mauritania, Senegal, Tanzania, Uganda, and Zambia, follow-up is planned for national-level activities to support the development of investment programs. A South Asia renewable energy practitioner workshop was held in Colombo, Sri Lanka, in June 2003. An LCR regional energy-poverty workshop was held in Santa Cruz, Bolivia, in July 2003. A pre-investment facility workshop was held in Berlin, Germany, in April 2003.
- ?? The governance structure for the partnership has been finalized and the first partnership board elected. The first board meeting was held in May 2003.
- ?? A three-year work plan, with input from focus groups, has been developed and circulated to donors, and preliminary funding commitments have been made.
- ?? Publication of four monthly newsletters, with input from partners, and collaboration with existing village power updates have begun.
- ?? A website has been established.

3

Impacts of ESMAP RE Portfolio

Intellectual Leadership — What We Have Done

3.1 Table 3.1 summarizes project clusters, ESMAP instruments, project approaches, and project impacts of the ESMAP RE Portfolio.

Table 3.1 Summary of Project Clusters, Instruments, Approaches, and Impacts

<i>Project clusters</i>	<i>ESMAP instruments</i>	<i>Project approaches and activities</i>	<i>Project impacts</i>
Delivery mechanisms 17 projects (11 completed)	Pilot activities, Technical assistance	<ul style="list-style-type: none"> ?? Micro-finance models in Kenya ?? Village Power Fund in the Philippines and Biomass Fund in Bolivia ?? Concession models in Comoros and Kenya ?? SHS fee for service, a rural electrification fund design, and NGO-based service delivery in Bolivia ?? Management service and private property and management service model in Peru ?? Productive use applications in Bolivia, Honduras, and the Philippines ?? Women’s micro-enterprise models in Bangladesh and Ghana 	<ul style="list-style-type: none"> ?? Demonstrated innovative market-based mechanisms ?? Provided key inputs to scale up energy access ?? Increased access to financing ?? Increased local capacity ?? Generated new knowledge ?? Lowered costs of RE systems ?? Jump-started RE markets ?? Engaged the private sector and leveraged private investment ?? Leveraged scale-up investment from WBG lending, other MDBs, and donors ?? Demonstrated energy, poverty, and gender linkages ?? Increased energy access ?? Achieved energy savings
RE policies	Technical assistance, Studies, Workshops	<ul style="list-style-type: none"> ?? Regulatory frameworks for rural electrification in Argentina, Bolivia, Brazil, Cambodia, Nicaragua, and the Philippines ?? Rural electrification strategy in Brazil, Cameroon, Chad, 	<ul style="list-style-type: none"> ?? Brought policy changes ?? Generated in-country ownership ?? Generated and disseminated new knowledge ?? Leveraged scale-up

23 projects (17 completed)		Guinea, Uganda, and Zimbabwe ?? REAP in Cambodia and Vietnam ?? Renewable energy policies in Mexico, Nicaragua, and the Philippines	investment from WBG lending, other MDBs, donors, and government ?? Provided key inputs to scale up energy access
New knowledge 12 projects (9 completed)	Studies	?? Success factors for grid electrification ?? Economic benefits of rural electrification ?? Peri-urban electrification ?? Impacts of reform on the poor	?? Generated and disseminated new knowledge ?? Demonstrated energy-poverty linkages ?? Provided inputs to new project design
Household energy 8 projects (5 completed)	Studies, Technical assistance	?? Household energy surveys and strategies in Bangladesh, India, Nicaragua, the Republic of Yemen, and Swaziland	?? Generated new knowledge ?? Demonstrated energy, poverty, and gender linkages
National workshops 4 projects (all completed)	Workshops	?? National stakeholder participatory workshops in Nicaragua, Nigeria, and South Africa	?? Generated in-country momentum and commitment ?? Disseminated knowledge ?? Played catalytic role in leveraging WBG lending
GVEP 6 projects (3 completed)	Workshops, Pilot activities, Technical assistance	?? Action plans ?? Capacity development ?? Funding facilitation ?? Knowledge exchange ?? Results and impact monitoring	?? More than 250 partners registered ?? Generated in-country momentum ?? Disseminated knowledge

Delivery Mechanisms

3.2 ESMAP supported a series of pilot activities to demonstrate innovative and replicable institutional and financing mechanisms to deliver rural energy services, including (a) micro-finance models that provide credits for consumer groups to purchase SHSs in Kenya; (b) financing mechanisms for entrepreneurs in Bolivia (the Biomass Fund) and the Philippines (the Village Power Fund); (c) concession models that attract local manufacturers to produce small-scale solar batteries in Kenya and invite foreign firms for solar market development in Comoros; (d) new rural electrification service models in Bolivia (SHS fee for service, a rural electrification fund design, and NGO-based service delivery); (e) management service and private property and management service models in Peru; (f) rural energy service company model in Laos PDR; (g) productive use applications, such as solar energy for rural schools and water pumping in Bolivia, a low-cost model for ICT and education applications from solar-powered systems in Honduras, and ice-making applications from micro-hydro in the Philippines; and (h) women's micro-enterprise models in Bangladesh and Ghana.

Rural and Renewable Energy Policy

3.3 ESMAP provided a series of technical assistance in developing policies and regulatory frameworks for rural electrification and renewable energy. This includes (a) regulatory framework of rural electrification in Argentina, Bolivia, Brazil, Cambodia,

Nicaragua, and the Philippines. In the Philippines, for example, an ESMAP project recommended an investment management contract model to improve performance of rural electric cooperatives, who are responsible for implementation of rural electrification; (b) rural electrification strategies in Brazil, Cameroon, Chad, Guinea, Uganda, and Zimbabwe; (c) renewable energy action plans in Cambodia and Vietnam with a participatory approach — the OOPP methodology; and (d) renewable energy policies and programs in Mexico, Nicaragua, and the Philippines. In Mexico, for example, an ESMAP project conducted an economic analysis to compare the costs of renewable energy with those of thermal power plants, developed an optimal energy portfolio diversification scenario, and recommended a renewable energy policy instrument, the auction based least-cost subsidy mechanism (Non-Fossil Fuel Obligation).

New Knowledge

3.4 ESMAP supported development of new analytical methodologies and knowledge, which includes (a) successful factors and lessons learned for grid electrification; (b) economic benefits of rural electrification; (c) a best practice manual for decentralized electrification; (d) peri-urban electrification; and (f) the impacts of sector reform on the poor. The ESMAP project, “Best Practice for Grid Electrification,” conducted a series of case studies to examine the success factors and lessons learned on best practices of grid-based rural electrification programs in eight countries—Bangladesh, Chile, China, Costa Rica, Mexico, the Philippines, Thailand, and Tunisia. The ESMAP “Electricity Benefit Assessment Project” concluded that, under the assumptions of the survey, the total net benefit of providing electricity to a typical un-electrified rural Philippine household would be between US\$81 and US\$150 per month, depending on the household’s number of wage earners and whether it runs a home-based business. The ESMAP “West Africa Solar Project” provided a step-by-step guide for Bank task managers to identifying, developing, and implementing decentralized electrification projects. The ESMAP “Peri-urban Electrification Project” examined viable and commercial ways to provide electricity services to the peri-urban areas, where about 40 percent of the world’s poor live. In addition, ESMAP played an intellectual leadership role in assessing the impacts of sector reform on rural energy access for the poor in Central America and Africa. The ESMAP study in Central America concluded that the rural energy access issue is generally left out of the sector reform process. It recommended that governments establish political and institutional infrastructure to ensure the success of rural electrification programs in the context of power sector reform.

Household Energy

3.5 In addition to electrification projects, ESMAP supported a series of activities that conducted detailed household energy surveys in Bangladesh, India, Nicaragua, the Republic of Yemen, and Swaziland, and developed household energy strategies in these countries. These studies found out that in most of the countries surveyed, traditional biomass fuels (wood, straw, and dung) still dominate rural energy use, primarily for cooking. These fuels have caused serious indoor air pollution problems,

which are annually responsible for 2.5 million premature deaths of women and children from respiratory diseases. The shift to clean petroleum fuels, such as LPG, for cooking, however, is constrained by high start-up cost and high price. Worldwide experience showed that kerosene and LPG subsidies typically benefit middle-class and higher-income families and thus are not pro-poor. As households move up the energy use ladder from solid fuels to kerosene, LPG, and electricity, the burden of collecting and using these fuels eases substantially, and women devote their time to more productive activities and pursuing leisure.

National Workshops

3.6 ESMAP held a series of national stakeholder participatory workshops in Nicaragua, Nigeria, and South Africa. The “Nicaragua Workshop on Private Sector–Led Mechanisms for Rural Energy Service Delivery” facilitated information exchange on off-grid electrification programs and the changing roles of government and the private sector in the implementation of sustainable rural electrification projects. It resulted in an outline of a project concept for a private sector–led off-grid electrification project in Nicaragua. The Nigeria and South Africa workshops (“Initiating the Bank’s Peri-urban/Rural and Renewable Energy Activities in Nigeria” and “South Africa Workshop—People’s Power Workshop”) were among the first cross-sector efforts in these countries involving various ministries. They mobilized great momentum for rural electrification and renewable energy among local stakeholders.

The GVEP

3.7 The partnership was launched at the WSSD in August 2002, with the goal of increasing availability and improving use of modern energy services for economic growth and poverty reduction in rural, peri-urban, and urban areas. More than 250 partners have registered, including governments communities, local user groups, NGOs, enterprises, private financial intermediaries, bilateral and multilateral development and financial institutions, and the WBG. The GVEP has made substantial progress to date. Particularly, GVEP held a number of regional stakeholder participatory workshops, including three African multi-country, multi-sector, multi-stakeholder energy-poverty workshops, a South Asia renewable energy practitioner workshop, a Latin America and the Caribbean regional energy-poverty workshop, and a pre-investment facility workshop.

Impacts, Outputs, and Downstream Activities — What the Impacts Have Been

3.8 ESMAP played a substantial role in raising the profile of and mainstreaming RE within the Bank and client countries. ESMAP’s intellectual leadership in the RE area has contributed to the WBG Energy Business Renewal Strategy in terms of direct poverty alleviation, environmental and social sustainability, and governance and private sector development. ESMAP analytical efforts have substantially improved and expanded regional and anchor energy diagnostic work.

Played Intellectual Leadership and Demonstrated Innovative Mechanisms

3.9 ESMAP is the leader in generating new RE knowledge in the areas of (a) going beyond rural electrification to peri-urban electrification and household energy, (b) filling knowledge gaps in assessing the impacts of sector reform on the rural energy access for the poor, and (c) promoting energy and gender through creating and nurturing women's micro-enterprises to deliver energy services. In addition, ESMAP launched the high-profile flagship GVEP, which demonstrated intellectual leadership in building bottom-up partnerships with a wide range of stakeholders to accelerate energy access in the developing world. Furthermore, ESMAP pilot activities demonstrated innovative and replicable institutional and financing delivery mechanisms for RE, which provided key inputs for scale-up energy access.

Brought Policy Changes

3.10 ESMAP technical assistance activities helped improvement in policies and regulatory frameworks for RE in several countries, and played a key role in securing support in RE from decision makers in client countries and WBG. In Brazil, the results of the ESMAP "Rural Electrification Strategy" study helped the Ministry of Mines and Energy define a series of follow-up activities and was used by several donors for rural electrification projects. In Cambodia and Vietnam, the participatory approach adopted in ESMAP projects proved to be highly successful in securing the interest and ownership of all stakeholders. The process convinced the government and the Bank country team that renewable energy can play a critical role in rural electrification. In the Philippines, the recommendations made in ESMAP's "Strengthening of Rural and Non-conventional Energy Development Program" were incorporated or reflected in the Electric Power Industry Reform Act of 2001. A recent ESMAP activity in the Philippines, "Rural Electrification Regulatory Framework," recommended a regulatory framework and subsidy scheme for rural electrification, which integrated in the government policy on private participation in remote generation and rural distribution (personal communication with Alan Townsend, the World Bank, January 2004).

Generated and Disseminated Knowledge

3.11 ESMAP RE activities generated new knowledge on (a) RE delivery and financing mechanisms; (b) RE productive use applications; (c) energy and gender; (d) RE policies and regulatory frameworks; (e) best practice for grid electrification; (f) economic benefits of rural electrification; (g) a best practice manual for decentralized electrification; (h) peri-urban electrification; (i) the impacts of sector reform on the poor; and (j) household energy. These knowledge has been applied to the principles in Bank project design (please see the WBG lending section for details). ESMAP also conducted extensive knowledge dissemination activities within and outside the Bank through workshops, "South-South" exchange of information, Brown Bag Lunch series, and publications. Particularly, the GVEP initiative played a critical role in promoting knowledge exchange and dissemination in the RE areas in developing countries.

Generated In-Country Support and Momentum

3.12 ESMAP activities substantially increased RE awareness and mobilized great momentum in client countries through holding a series of stakeholder participatory workshops, adopting participatory approaches, and demonstrating pilot activities. The South Africa workshop, for example, generated government requests for World Bank assistance. Consequently, two projects have been identified in South Africa: a PCD for the “Renewable Energy Market Transformation Project” has been completed, and the “Rural and Renewable Energy Housing Project” is in preparation. Regional stakeholder participatory workshops on energy poverty under the GVEP have raised awareness and generated interest in energy-poverty reduction strategies among a range of stakeholders from various sectors.

Increased Capacity of Local Stakeholders

3.13 ESMAP activities considerably increased local capacities and strengthened institutional arrangements for RE. In Bolivia, for example, an ESMAP project established the CPTS, a sustainable institution for promoting rural energy and energy efficiency. In Kenya, as a result of the ESMAP “Kenya Photovoltaics Financing Mechanisms for Solar Electric Equipment Project,” the local financial institutions gained substantial experience in consumer financing for SHSs, and solar business loans are fully mainstreamed at K-REP, an MFI that participated in the project.

Increased Access to Financing

3.14 ESMAP activities increased access to financing for both consumers and local entrepreneurs in several countries. In Kenya, for example, the micro-credit mechanisms tested through an ESMAP project increased consumers’ ability to purchase SHSs. In Bolivia and the Philippines, local entrepreneurs have increased access to loans and credits through dedicated revolving funds established through ESMAP projects.

Engaged the Private Sector

3.15 ESMAP activities engaged the private sector and leveraged private sector investment in delivering RE services. In Kenya, the ESMAP “Lighting Services for the Rural Poor” project opened the market for low-cost and locally manufactured small batteries, compatible with small-scale solar modules (10–15 Wp), making SHSs affordable for the low-income population. As a result, this ESMAP activity has generated rapid uptake of and interest in the small battery among both dealers and consumers, and the battery manufacturer continued production and sales after the project was completed. In Comoros, an ESMAP pilot project, “Solar Market Development in Comoros,” jump-started the solar market in that country by convincing a foreign firm to start market development through an innovative concession scheme. In Peru, the private sector approach to developing micro-hydro systems, demonstrated through ESMAP’s “Rural Energy Electrification in Peru” project, requires much less government subsidy and lowered investment costs.

Empowered Women

3.16 Women have been empowered by ESMAP activities in providing modern energy services. In Bangladesh, an ESMAP project demonstrated that with the right investment in their capacities, rural women who have less than high school education can participate in the provision of modern energy services. These women have experienced a major transformation in their self-esteem and the gender roles in their households.

Demonstrated a Close Link Among Energy, Poverty and the MDGs

3.17 The ESMAP RE Portfolio has increased energy access and thereby reduced poverty in rural and peri-urban areas. The “Electricity Benefit Assessment” project clearly demonstrated the economic benefits of rural electrification to better education, productive use, and improved livelihood. ESMAP projects in Bolivia, Honduras, and the Philippines linked energy services with education and livelihood improvement. ESMAP energy and gender projects, such as “Opportunities for Women in Renewable Energy Technology Utilization in Bangladesh,” promoted gender equity. Analytical work on biomass fuel use and indoor air pollution, such as the “Rural Energy Study in India” and “Household Energy and Women’s Lives: The Case of India,” addressed children’s and women’s health issues. The ESMAP renewable energy portfolio contributed to environmental sustainability. ESMAP pioneering work on assessment of the impacts of sector reform on the poor linked energy access with market development. . The GVEP initiative directly responded to the call in the MDGs for building global partnerships.

Influenced Bank Operations

3.18 ESMAP activities played an important role in mainstreaming RE into Bank operations through (a) incorporating the analytical work into Country Assistance Strategies and Poverty Reduction Strategy Papers; (b) securing support in RE from decision makers in client countries and WBG, and generating requests for WBG assistance from client countries; (c) testing innovative approaches through pilot projects, and producing upstream analytical work, which are scaled up through Bank lending projects; and (d) generating and disseminating new knowledge. ESMAP support allowed Bank task managers to conduct innovative, in-depth, and forward-looking work.

Leveraged World Bank Lending

- ?? In Brazil, the ESMAP “Brazil Rural Electrification Strategy Project” provided valuable inputs for a follow-up US\$650 million World Bank lending APL on rural electrification that is under preparation.
- ?? In Bolivia, the ESMAP “Bolivia Country Program” and the “National Biomass Program” provided key inputs and lessons learned to the World Bank’s “Decentralized Infrastructure for Rural Transformation Project” (a three-phase APL with a first phase of US\$20 million, approved in 2003), and KfW project “Hydro Village Micro-Grids” (€ million, in preparation).

- ?? In Vietnam, the recommendations made through the ESMAP-ASTAE project, “Renewable Energy Action Plan,” are now being implemented through two Bank lending projects, the “System Efficiency Improvement, Equitization, and Renewable Project” and the “Rural Energy Project”^x. Similarly, in Cambodia, the recommendations made through ESMAP’s “Renewable Energy Action Plan” are being implemented through a Bank lending project, the “Rural Electrification and Transmission Project,” which is in preparation.
- ?? In Nicaragua, a series of ESMAP activities (“Policy and Strategy for the Promotion of Renewable Energy Resources in Nicaragua,” “Nicaragua Workshop on Private Sector–Led Mechanisms for Rural Energy Service Delivery,” and “Regulatory Issues of Off-Grid Energy Services Delivery as Part of National Rural Electrification Strategies”) laid a solid foundation for the design of the new World Bank–GEF “Off-Grid Rural Electrification for Development (PERZA)” project, which was approved in 2003.
- ?? In Mexico, the “Technical Assistance for Long-Term Program for Renewable Energy Development” project laid the groundwork for the US\$70 million World Bank–GEF “Large-Scale Mexico Renewable Energy Development Project,” which is in preparation.
- ?? In the Lao PDR, the ESMAP “Decentralized Rural Electrification in Laos PDR” project provided key inputs to the Bank’s “Southern Provinces Rural Electrification in Laos PDR” project, one of the first projects in the Bank that packages decentralized off-grid energy systems with grid extension for rural electrification.
- ?? The results and methodology used in the ESMAP “Best Practice for Grid Electrification and Electricity Benefit Assessment” projects have been disseminated and incorporated into the project design of two World Bank loan projects, “Rural Electrification and Renewable Energy Development” in Bangladesh and the “Rural Energy Project” in Vietnam.

Leveraged Funding from Other MDBs and Donors

- ?? In Honduras, the replicable model for low-cost energy applications in ICT and education demonstrated through an ESMAP project, “Technical Assistance to Proposed Expansion of Solar-Net Village Program in Honduras,” will be used in the design of a US\$8.5 million project funded by the IADB.
- ?? The “Philippines Village Power Fund and Incubator for Renewable Energy Enterprises” project leveraged co-funding from the UNDP and the Philippines Departments of Energy and Agriculture. The project also stimulated the interest of the government and the ADB in scaling up the

productive use approach. In addition, it complements the World Bank “Rural Power Project” in the Philippines, which is in preparation.

What We Have Learned

Scaling-Up Energy Access and Renewable Energy

3.19 Scaling up rural electrification and renewable energy should include both grid-based and off-grid alternatives. The two options should complement each other rather than compete. Grid-connected renewable energy, for example, can play an important role in improving environmental sustainability and energy security, while off-grid renewable energy can offer the least-cost options to increase energy access. A forgotten but important “win-win” opportunity to increase energy access is to promote peri-urban electrification, since peri-urban households are easier and cheaper to electrify than un-served rural households and they represent 40 percent of the world’s poor.

3.20 To increase access to modern energy services, we also need to go beyond electricity to provide household fuels for cooking and heating. Traditional biomass fuels have resulted in serious indoor air pollution problems in the developing world. More efforts should be put in place to promote large-scale deployment of improved stoves, improved biomass fuels (such as charcoal), and clean alternatives fuels (such as LPG, kerosene, and biogas).

Private Sector Participation

3.21 To ensure institutional and financial sustainability, rural energy programs must be operated as businesses. Experience to date has identified a number of business models to deliver energy services in rural areas, including a dealer model (cash or credit sale), a fee-for-service model (by energy service company or community-based NGOs), a micro-finance institution model, a concession model, a rural electric co-operative model, a management contract model, and a utility grid extension model.

3.22 The private sector — both local entrepreneurs and large international companies — has a critical role to play in providing rural energy services. To create and nurture viable small- and medium-size rural energy entrepreneurs, it is critical to provide hand-holding enterprise development services combined with modest amounts of start-up financing.

3.23 One of the building blocks to scale up renewable energy is how to harness entrepreneurship. To date, a lot of efforts have focused on promoting self-sustaining small and medium-sized clean energy entrepreneurs. These interventions are valuable, but take very long time and produce mixed results. To scale up renewable energy, what is needed is “the entrepreneurs who can gain miles at a time” (The World Bank, 2002a). This requires to engage large private domestic and international players within and outside the traditional energy industry that have the resources and track record to start a new direction, such petroleum and electricity giants as Shell and EDF. In addition, it is more cost-effective to take advantage of existing rural infrastructure for renewable energy distribution rather than creating a parallel renewable energy delivery

infrastructure. The existing local stores or micro-finance institutions, for example, are well positioned to sell SHSs to rural consumers, compared to those SHS dealers.

The Roles of the Governments

3.24 It has proved to be unrealistic, however, to rely solely on the private sector to serve the poorest of the poor or the areas of low population density without any subsidy. In addition, the private sector usually demands greater returns, because they perceive rural electrification and renewable energy to be risky businesses. Therefore, the governments are needed to permit the private sector to provide energy services in rural areas, and provide partial subsidies and risk-sharing schemes along with the private investment. ESMAP studies suggest that subsidies generally should be applied to access costs (connections), not to operating costs (ongoing consumption). It is also important that subsidy schemes are designed to benefit the poor. Regarding risk-sharing mechanisms, an ESMAP project in Comoros provided a good example of an innovative concession model that invites private participation in solar market development through a competitive bidding process for a certain amount of capital subsidy. This project demonstrated that the government financial incentives were instrumental in attracting a foreign firm to start solar market development in Comoros, which would never have happened otherwise. Such incentives, however, should be structured in a way that is easy to implement. An ongoing ESMAP project in Nicaragua is also investigating public-private risk-sharing mechanisms for developing geothermal resources.

3.25 In addition, an ESMAP study on successful factors for rural electrification programs concluded that the common principles include (a) setting up effective institutions to deal specifically with the problems involved in rural electrification; (b) keeping prices high enough to make rural distribution companies financially sustainable; (c) ensuring that subsidies encourage rather than discourage the development of the distribution business; and (d) making sure that local people are involved with and perceive the electricity business to be both fair and responsive to their needs. Furthermore, successful management of rural energy systems also requires strong government regulatory support and clearly defined roles and responsibilities of government agencies. In the context of sector reform, governments need to set up well-designed and fully committed institutions to implement rural electrification efforts. A rural electrification fund without dedicated staff and sufficient funding would not work.

Increasing Access to Financing

3.26 First, domestic financing sources, particularly those from local financial institutions and governments, can play an essential role in meeting the huge financing requirements for scaling up energy access and renewable energy. The lack of access to credit from local financial institutions, however, proved to be a primary constraint to rural energy projects in many countries. An ESMAP project in Kenya demonstrated that technical assistance for training and quality control is critical and should be available over a long period. Limited financial assistance to slightly reduce the cost of the loans offered is also important at the initial stage. In Kenya, it has also proved to be effective

for the credit mechanisms to deal with groups, instead of directly with individuals. In addition, ESMAP experience in setting up local renewable energy funds has shown that financial sustainability of such funds is a challenge, and technical assistance to entrepreneurs is important to generate high-quality deal flows.

3.27 Second, a lack of available financing is usually not a barrier to RE financing in many countries where there are sufficient liquidity in the banking sector. What is needed is to establish financing intermediaries between project developers and financiers, to bridge the knowledge and perception gaps between the two, and bundle small-scale RE projects to reduce transaction costs.

3.28 Third, to overcome the high first-cost barrier, it is crucial to tailor local market needs and promote low-cost, small-scale, renewable energy systems that are affordable for the low-income population.

Productive Use Applications

3.29 To achieve MDG, it is critical to link RE services with livelihood support activities. An ESMAP project in Honduras demonstrated a low-cost model to obtain Internet access and other information and telecommunication (ICT) services via solar-powered packet radio transmission in remote, un-electrified rural areas. However, its implementation showed that it was more difficult than expected to develop ICT applications for businesses in rural areas, because low population density results in lack of critical mass of demand. This project also showed that it is important to adopt a community-based management approach to ensure the institutional sustainability of the system operation and maintenance. Cost recovery mechanisms should be built into the project design so that at least the operation and maintenance costs can be recovered. Furthermore, in an ESMAP project in the Philippines, it was difficult to create funding synergies for the energy components and the livelihood components for productive use projects. Finally, productive use projects also need to assist local entrepreneurs in marketing their products and reducing the high transaction costs resulting from energy systems designed specifically for productive use applications.

ESMAP Instruments

3.30 This review concluded that ESMAP instruments such as pilot activities, special technical assistance, studies, and workshops are effective. The pilot activities and technical assistance increased capacity of local stakeholders; leveraged scale-up investments from the WBG, other MDBs, donors, and the private sector, and led to policy changes in client countries. The analytical studies generated new knowledge, which have been applied in project design. The participatory workshops disseminated knowledge and generated in-country momentum for RE.

3.31 In the future, it is recommended that ESMAP should

- ?? Link upstream activities closely with government policies and World Bank operations, which leads to more effective results, and government commitment is a prerequisite;

- ?? Focus on one or two major activities likely to have a successful outcome instead of covering too many activities;
- ?? Connect its wealth of knowledge to project design as a major part of its knowledge dissemination activities;
- ?? Build capacity and support strong institutional set up before developing large-scale investments, and understand market characteristics before an enterprise-driven energy project is implemented; and
- ?? Define measurable indicators for outputs and outcomes in the proposals, for monitoring and evaluation purposes.

Recommendations for Future Focal Areas

3.32 In the future, ESMAP activities in RE should concentrate on strategies to scale up energy access and renewable energy, with an emphasis on (a) creating favorable enabling environments, particularly assisting governments in “smart” subsidy schemes that would attract private sector investments; (b) demonstrating innovative and replicable business models that engage both local small and medium enterprises and large, established private sector players and increase productive use applications; (c) piloting new financing models that can leverage financial resources from domestic markets and establishing financing intermediaries; and (d) expanding grid-based electrification services in peri-urban areas.

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Annex 1

Terms of Reference (TOR)

A1.1 This TOR defines responsibilities and deliverables of the impact evaluation of projects under the ESMAP Rural and Renewable Energy Portfolio that were approved from 1997 to 2002 and listed in the ESMAP database, including projects closed, to be closed, under publication, and under implementation.

A1.2 The objective of this review is to evaluate thematic impacts and lessons learned from the ESMAP Rural and Renewable Energy (RE) Portfolio. Xiaodong Wang, an energy specialist at ESMAP, will conduct the review and write the report.

A1.3 The review deliverables will comprise:

- ?? An ESMAP report
- ?? A presentation to ESMAP Consultative Group Meeting in April 2003.

A1.4 The responsibilities will include:

- ?? Review ESMAP projects and reports and project files
- ?? Interview ESMAP task managers and other World Bank staff contributing to the projects, interview or e-mail in-country counterparts when necessary and appropriate
- ?? Evaluate (a) intellectual leadership and innovations of the ESMAP RE Portfolio; (b) outputs and achievements of each project; (c) ESMAP's role and influence through downstream activities in terms of World Bank Group (WBG) lending, investment and funding from other multilateral development banks (MDBs) and donors, and follow-up actions and replications by local governments, nongovernmental organizations (NGOs), and the private sector in client countries; and (d) lessons learned and best practices.

A1.5 The evaluation should assess the following issues:

- ?? What are pilot activities and specific technical assistance provided to client countries?
- ?? What new methodologies, approaches, or mechanisms are used in ESMAP projects?

- ?? What analytical knowledge or advice was conveyed in the ESMAP interventions?
- ?? What are the intellectual leadership and innovations in ESMAP activities?
- ?? What are the major achievements of ESMAP activities?
- ?? How did ESMAP interventions build local capacity?
- ?? What new knowledge is generated?
- ?? How is ESMAP knowledge disseminated?
- ?? How has ESMAP support influenced others and fostered project development at the Bank and in client countries?
- ?? What downstream activities are leveraged from ESMAP projects in terms of WBG lending, investment and funding from other MDBs and donors, and follow-up actions and replications by local governments, NGOs, and the private sector in client countries?
- ?? What are the thematic impacts of the RE Portfolio?
- ?? What are the lessons learned and best practices?
- ?? What is ESMAP's comparative advantage?
- ?? Does ESMAP have the right instruments?
- ?? What are the areas for future improvements?

Annex 2

ESMAP Rural and Renewable Energy Projects By Region, 1997–2002

<i>Status</i>	<i>Project ID</i>	<i>Title</i>	<i>Region</i>	<i>ESMAP Approved amount</i>	<i>Task Manager</i>
1. EAP		8	11.5%	\$1,808,805	
Under Implementation	P076113	Cambodia - Renewable Energy Action Plan	Cambodia	\$308,000	Rebecca Sekse
Publication in process	P075883	Designing a Poverty-focused, Gender-sensitive Monitoring and Evaluation Plan for a World Bank Renewable Rural Electrification Project	Cambodia	\$95,000	Douglas French Barnes
Closed	P041579	Renewable Energy Assessment	China	\$176,746	Ernesto N. Terrado
Closed	P048066	Decentralized Rural Electrification	Laos	\$208,662	Douglas French Barnes
Under Implementation	P072413	Philippines - Village power fund and incubator for renewable energy enterprises	Philippines	\$355,500	Selina Wai Sheung Shum
Closed	P044279	Electricity Benefits Assessment	Philippines	\$239,085	Douglas French Barnes
Closed	P053242	Strengthening of Rural & Non-conventional Energy Development Program	Philippines	\$210,000	Ernesto N. Terrado
Closed	P065452	Renewable Energy Action Plan	Vietnam	\$215,812	Susan V. Bogach
2. SAR		5	7.5%	\$1,180,750	
Under Implementation	P077887	Opportunity for Women in Renewable Energy Technology Utilization (Phase 2)	Bangladesh	\$220,000	M. Iqbal
Closed	P065453	Opportunity for Women in Renewable Energy Technology	Bangladesh	\$188,979	Nilufar Ahmad

		Utilization			
Under Implementation	P072626	Towards Formulating a Rural Energy Strategy	Bangladesh	\$310,000	Douglas French Barnes
Publication in process	P070938	Household Energy & Women's Lives: The Case of India	India	\$50,000	Douglas French Barnes
Closed	P035324	Rural Energy Study	India	\$411,771	Douglas French Barnes
3. LCR		20	43.6%	\$6,843,788	
Publication in process	P056928	National Biomass Programme	Bolivia	\$2,569,113	Philippe J-P. Durand
Publication in process	P056929	Country Programme - Phase II	Bolivia	\$1,607,431	Philippe J-P. Durand
Closed	P045287	Renewables for Rural Electrification	Bolivia	\$10,944	Ernesto N. Terrado
Under Implementation	P074149	Brazil - Rural Electrification Strategy	Brazil	\$250,000	Jayme Porto Carreiro
Closed	P045123	Northeast Renewable Energy Identification	Brazil	\$116,892	Anke S. Meyer
Under Implementation	P079802	Stimulating the Market for Family-Hydro for Low-income Households in Ecuador	Ecuador	\$141,000	Philippe J-P. Durand
Under Implementation	P075127	Technical Assistance to Proposed Expansion of Solar-Net Village Program	Honduras	\$197,000	Clemencia Torres
Under Implementation	P073535	Mexico – TA for long-term program for renewable energy development	Mexico	\$100,000	Oscar Avalué
Under Implementation	P078519	Policy & Strategy for the Promotion of Renewable Energy Resources in Nicaragua	Nicaragua	\$250,000	Clemencia Torres
Closed	P073842	Nicaragua- Workshop on private sector- led mechanisms for rural energy service delivery	Nicaragua	\$37,786	Ernesto N. Terrado
Closed	P053228	Modernization of Fuelwood Sector	Nicaragua	\$175,000	Rene Masse
Closed	P064698	Sustainable Charcoal Production in the Chinandega Region	Nicaragua	\$70,000	Willem M. Floor
Closed	P043318	Rural Energy Electrification	Peru	\$214,143	Anke S. Meyer

Under Implementation	P076709	Lessons on Off-grid Electricity, Business Development Services and Microcredit	LCR	\$15,000	Kilian Reiche
Under Implementation	P076081	Regulatory issues of off-grid energy service delivery as part of national rural electrification strategies	LCR	\$150,000	Clemencia Torres
Publication in process	P053523	Rural Electrification & Power Reform in Central America	LCR	\$300,000	Douglas French Barnes
Under Implementation	P070922	Central America Gender in Sustainable Energy	LCR	\$225,000	Maria C. Correia
Under Implementation	P078599	Village Power Partnership for Latin America and the Caribbean (VPP-LCR)	LCR	\$140,000	Dana Rysankova
Closed	P073536	Evaluation of Bank Experience with Integrated Rural Electrification Projects - Seed Funding	LCR	\$15,000	Dana Rysankova
Closed	P067624	Renewable Energy For Development: Assessing Opportunities for Investments in the LCR Region	LCR	\$259,479	Ernesto N. Terrado
4. AFR		20	21.2%	\$3,321,652	
Under Implementation	P080820	Power Sector Reform in Africa: Assessing the Impact on the Poor and Influencing Policy Decisions	AFR	\$186,000	Robert W. Bacon
Under Implementation	P081979	Energy and Poverty Workshop (Francophone)	AFR	\$250,000	Laurent Durix
Publication in process	P077595	Energy and Poverty Reduction Workshop	AFR	\$276,130	Laurent Durix
Publication in process	P077534	Workshop on Rural Energy and Sustainable Development	Cote d'Ivoire	\$10,000	Koffi Ekouevi
Under Implementation	P078016	Women's Energy Enterprise: Developing a Model for Mainstreaming Gender into Modern Energy Service Delivery	Ghana	\$70,000	Kofi-Boateng Agyen
Publication in Process	P044275	Decentralized Rural Electrification	Cameroon	\$249,999	Rene Masse
Closed	P045205	Solar Market Development	Comoros	\$168,120	Robert J. van der Plas
To be Closed	P044276	Decentralized Rural Electrification	Guinea	\$250,000	Rene Masse

Closed	P065306	Low-cost Electrification Pre-feasibility Project	Kenya	\$104,775	Robert J. van der Plas
Publication in Process	P044764	Rural Energy Development	Malawi	\$322,554	Mangesh Hoskote
To be closed	P073965	Initiating the Bank's Peri-Urban/Rural and Renewable Energy Activities in Nigeria	Nigeria	\$45,000	Malcolm Cosgrove-Davies
To be closed	P063180	South Africa Workshop - People's Power Workshop	South Africa	\$35,000	Arun P. Sanghvi
Closed	P039834	West Africa Solar Project	AFR	\$360,000	Willem M. Floor
Closed	P041577	Renewables for Rural Energy Supply	Southern Africa	\$47,941	Ernesto N. Terrado
Closed	P044166	Kenya Photovoltaics Financing Mechanisms for Solar Electric Equipment	Kenya	\$257,594	Robert J. van der Plas
Closed	P064912	Rural Electrification Study	Chad	\$72,500	Robert J. van der Plas
Closed	P043924	Household Energy Strategy Study	Swaziland	\$77,190	Robert J. van der Plas
Closed	P056574	Solar Market Development	Swaziland	\$179,877	Robert J. van der Plas
Closed	P044561	Uganda-Rural Electrification Study	Uganda	\$170,931	Robert J. van der Plas
Closed	P053421	Decentralized Rural Electrification	Zimbabwe	\$188,041	Robert J. van der Plas
5. MENA		3	3.7%	\$585,009	
Under Implementation	P080572	Energy Poverty and Access	Yemen	\$447,980	Richard Jeremy Spencer
Closed	P050683	Solar Thermal Power Options	Egypt	\$50,000	Richard Jeremy Spencer
Closed	P043925	Renewable Energy Strategy and Institutional Strengthening	Egypt	\$87,029	Richard Jeremy Spencer
6. ECA		1	0.8%	\$125,102	
Closed	P044466	Renewables Subsector Strategy	Central Asia Republican	\$125,102	Achilles Adamantiades

7. Global		13	11.6%	\$1,824,021	
Closed	P048934	Rural Electrification : Success Factors (Phase 1)	Global	\$59,827	Douglas French Barnes
Publication in process	P066021	Best Practices for Grid Electrification - Phase 2	Global	\$280,000	Douglas French Barnes
Under Implementation	P070797	Advancing Modern Biomass Energy Opportunities & Challenges	Global	\$233,000	Boris Utria
Under Implementation	P072999	Alternative Energy Applications	Global	\$8,027	Patrick Labaste
Under Implementation	P073751	Assessing the impacts of energy sector reform on the poor	Global	\$430,000	Robert W. Bacon
Under Implementation	P074622	Global Village Energy Partnership	Global	\$331,831	Dominique Lallement
Closed	P071569	Village Power 2000 (renamed GVEP)	Global	\$62,727	Dominique M. Lallement
To be Closed	P039359	Solar Initiative Regional Strategy	Global	\$74,993	Ernesto N. Terrado
To be Closed	P044460	Regional Project Identification Strategy II	Global	\$120,150	Ernesto N. Terrado
Closed	P044763	Lighting Services for the Rural Poor	Global	\$90,100	Robert J. van der Plas
Closed	P061190	Peri-urban Electrification Project	Global	\$15,000	Willem M. Floor
Closed	P053230	Cost of Grid Extension for Rural Electrification	Global	\$68,366	Willem M. Floor
Closed	P070041	Accelerating Grid Based Renewable Energy Power Generation Conference	Global	\$50,000	Dominique M. Lallement
Total		70	100.0%	\$15,689,127	

ESMAP Rural and Renewable Energy Projects By Strategic Areas, 1997–2002

<i>Status</i>	<i>Project ID</i>	<i>Title</i>	<i>Region</i>	<i>ESMAP Approved amount</i>	<i>Task Manager</i>
1. Delivery Mechanisms -- Pilot Activities		17	44%	\$6,914,186	
Under Implementation	P079802	Stimulating the Market for Family-Hydro for Low-income Households in Ecuador	Ecuador	\$141,000	Philippe J-P. Durand
Under Implementation	P075127	Technical Assistance to Proposed Expansion of Solar-Net Village Program	Honduras	\$197,000	Clemencia Torres
Under Implementation	P072413	Philippines - Village power fund and incubator for renewable energy enterprises	Philippines	\$355,500	Selina Wai Sheung Shum
Under Implementation	P077887	Opportunity for Women in Renewable Energy Technology Utilization (Phase 2)	Bangladesh	\$220,000	M. Iqbal
Under Implementation	P078016	Women's Energy Enterprise: Developing a Model for Mainstreaming Gender into Modern Energy Service Delivery	Ghana	\$70,000	Kofi-Boateng Agyen
Under Implementation	P070922	Central America Gender in Sustainable Energy	LCR	\$225,000	Maria C. Correia
Publication in process	P056928	National Biomass Programme	Bolivia	\$2,569,113	Philippe J-P. Durand
Publication in process	P056929	Country Programme - Phase II	Bolivia	\$1,607,431	Philippe J-P. Durand
Closed	P065453	Opportunity for Women in Renewable Energy Technology Utilization	Bangladesh	\$188,979	Nilufar Ahmad
Closed	P048066	Decentralized Rural Electrification	Laos	\$208,662	Douglas French Barnes
Closed	P043318	Rural Energy Electrification	Peru	\$214,143	Anke S. Meyer
Closed	P045123	Northeast Renewable Energy Identification	Brazil	\$116,892	Anke S. Meyer

Closed	P044166	Kenya Photovoltaics Financing Mechanisms for Solar Electric Equipment	Kenya	\$257,594	Robert J. van der Plas
Closed	P044763	Lighting Services for the Rural Poor	Kenya	\$90,100	Robert J. van der Plas
Closed	P065306	Low-cost Electrification Pre-feasibility Project	Kenya	\$104,775	Robert J. van der Plas
Closed	P045205	Solar Market Development	Comoros	\$168,120	Robert J. van der Plas
Closed	P056574	Solar Market Development	Swaziland	\$179,877	Robert J. van der Plas
2. RE Policies -- Technical Assistance		23	24%	\$3,698,248	
Under Implementation	P076081	Regulatory issues of off-grid energy service delivery as part of national rural electrification strategies	LCR	\$150,000	Clemencia Torres
Under Implementation	P074149	Brazil - Rural Electrification Strategy	Brazil	\$250,000	Jayme Porto Carreiro
Under Implementation	P076113	Cambodia - Renewable Energy Action Plan	Cambodia	\$308,000	Rebecca Sekse
Under Implementation	P073535	Mexico - TA for long-term program for renewable energy development	Mexico	\$100,000	Oscar Avalle
Under Implementation	P078519	Policy & Strategy for the Promotion of Renewable Energy Resources in Nicaragua	Nicaragua	\$250,000	Clemencia Torres
Under Implementation	P072999	Alternative Energy Applications	Global	\$8,027	Patrick Labaste
Publication in Process	P044275	Decentralized Rural Electrification	Cameroon	\$249,999	Rene Masse
Publication in Process	P044764	Rural Energy Development	Malawi	\$322,554	Mangesh Hoskote
To be Closed	P039359	Solar Initiative Regional Strategy	Global	\$74,993	Ernesto N. Terrado
To be Closed	P044460	Regional Project Identification Strategy II	Global	\$120,150	Ernesto N. Terrado
To be Closed	P044276	Decentralized Rural Electrification	Guinea	\$250,000	Rene Masse
Closed	P064912	Rural Electrification Study	Chad	\$72,500	Robert J. van der Plas

Closed	P044561	Uganda-Rural Electrification Study	Uganda	\$170,931	Robert J. van der Plas
Closed	P053421	Decentralized Rural Electrification	Zimbabwe	\$188,041	Robert J. van der Plas
Closed	P053242	Strengthening of Rural & Non-conventional Energy Development Program	Philippines	\$210,000	Ernesto N. Terrado
Closed	P065452	Renewable Energy Action Plan	Vietnam	\$215,812	Susan V. Bogach
Closed	P067624	Renewable Energy For Development: Assessing Opportunities for Investments in the LCR Region	LCR	\$259,479	Ernesto N. Terrado
Closed	P045287	Renewables for Rural Electrification	Bolivia	\$10,944	Ernesto N. Terrado
Closed	P041579	Renewable Energy Assessment	China	\$176,746	Ernesto N. Terrado
Closed	P044466	Renewables Subsector Strategy	Central Asia Republican	\$125,102	Achilles Adamantiades
Closed	P050683	Solar Thermal Power Options	Egypt	\$50,000	Richard Jeremy Spencer
Closed	P043925	Renewable Energy Strategy and Institutional Strengthening	Egypt	\$87,029	Richard Jeremy Spencer
Closed	P041577	Renewables for Rural Energy Supply	Southern Africa	\$47,941	Ernesto N. Terrado
3. New Knowledge		12	13%	\$2,063,278	
Under Implementation	P076709	Lessons on Off-grid Electricity, Business Development Services and Microcredit	LCR	\$15,000	Kilian Reiche
Under Implementation	P080820	Power Sector Reform in Africa: Assessing the Impact on the Poor and Influencing Policy Decisions	AFR	\$186,000	Robert W. Bacon
Under Implementation	P073751	Assessing the impacts of energy sector reform on the poor	Global	\$430,000	Robert W. Bacon
Publication in process	P053523	Rural Electrification & Power Reform in Central America	LCR	\$300,000	Douglas French Barnes

Publication in process	P075883	Designing a Poverty-focused, Gender-sensitive Monitoring and Evaluation Plan for a World Bank Renewable Rural Electrification Project	Cambodia	\$95,000	Douglas French Barnes
Publication in process	P066021	Best Practices for Grid Electrification - Phase 2	Global	\$280,000	Douglas French Barnes
Closed	P048934	Rural Electrification : Success Factors (Phase 1)	Global	\$59,827	Douglas French Barnes
Closed	P044279	Electricity Benefits Assessment	Philippines	\$239,085	Douglas French Barnes
Closed	P061190	Peri-urban Electrification Project	Global	\$15,000	Willem M. Floor
Closed	P039834	West Africa Solar Project	AFR	\$360,000	Willem M. Floor
Closed	P053230	Cost of Grid Extension for Rural Electrification	Global	\$68,366	Willem M. Floor
Closed	P073536	Evaluation of Bank Experience with Integrated Rural Electrification Projects - Seed Funding	LCR	\$15,000	Dana Rysankova
4. Household Energy		8	11%	\$1,774,941	
Under Implementation	P072626	Towards Formulating a Rural Energy Strategy	Bangladesh	\$310,000	Douglas French Barnes
Under Implementation	P080572	Energy Poverty and Access	Yemen	\$447,980	Richard Jeremy Spencer
Under Implementation	P070797	Advancing Modern Biomass Energy Opportunities & Challenges	Global	\$233,000	Boris Utria
Publication in process	P070938	Household Energy & Women's Lives: The Case of India	India	\$50,000	Douglas French Barnes
Closed	P035324	Rural Energy Study	India	\$411,771	Douglas French Barnes
Closed	P053228	Modernization of Fuelwood Sector	Nicaragua	\$175,000	Rene Masse
Closed	P064698	Sustainable Charcoal Production in the Chinandega Region	Nicaragua	\$70,000	Willem M. Floor
Closed	P043924	Household Energy Strategy Study	Swaziland	\$77,190	Robert J. van der Plas
5. National Workshops		4	1%	\$127,786	
Publication in	P077534	Workshop on Rural Energy and	Cote	\$10,000	Koffi Ekouevi

process		Sustainable Development	d'Ivoire		
To be closed	P073965	Initiating the Bank's Peri-Urban/Rural and Renewable Energy Activities in Nigeria	Nigeria	\$45,000	Malcolm Cosgrove-Davies
To be closed	P063180	South Africa Workshop - People's Power Workshop	South Africa	\$35,000	Arun P. Sanghvi
Closed	P073842	Nicaragua- Workshop on private sector- led mechanisms for rural energy service delivery	Nicaragua	\$37,786	Ernesto N. Terrado
6. GVEP		6	7%	\$1,110,688	
Under Implementation	P074622	Global Village Energy Partnership	Global	\$331,831	Dominique Lallement
Under Implementation	P078599	Village Power Partnership for Latin America and the Caribbean (VPP-LCR)	LCR	\$140,000	Dana Rysankova
Under Implementation	P081979	Energy and Poverty Workshop (Francophone)	AFR	\$250,000	Laurent Durix
Publication in process	P077595	Energy and Poverty Reduction Workshop	AFR	\$276,130	Laurent Durix
Closed	P071569	Village Power 2000 (renamed GVEP)	Global	\$62,727	Dominique M. Lallement
Closed	P070041	Accelerating Grid Based Renewable Energy Power Generation Conference	Global	\$50,000	Dominique M. Lallement
Total		70		\$15,689,127	

ⁱ Utility grid extension is perhaps the most common approach for rural electrification. The implementing agencies can be an integrated utility as that in Tunisia and Vietnam, a public distribution company as that in Thailand, decentralized distribution companies as those in Chile, China, and Guatemala, or Rural Electric Cooperatives (REC) as those in Bangladesh, the Philippines, and the US (Barnes and Foley 2002).

ⁱⁱ With an investment management contract model, the rural electric cooperatives (REC) set up investment management contracts to the private sector to manage the distribution systems, while the ownership remains with RECs. The private sector will be chosen through competitive bidding, and they will bring their own risk capital at the initial stage. This model is proposed in the Philippines (The World Bank 2004a). A similar management contract model is used in Peru and Tanzania, where public utilities hire private companies to take over the O&M and management responsibilities.

ⁱⁱⁱ With a dealer model, private dealers sell energy systems to rural households. The system is owned by the households, which are responsible for servicing the debt (Martinot and McDoom, 1999). It is critical for the dealers to provide maintenance and after-sale services. Dealer model examples include cash sales as those in China, consumer credit by suppliers as those in India, and consumer credit by micro-finance organizations as those in Kenya and Sri Lanka.

^{iv} With a fee-for-service model, an energy service company or a community-based NGO provides electricity to rural households for a fee that is either fixed or based on consumption. The system is owned and maintained by the energy service company or the NGO (Martinot and McDoom, 1999). The fee-for-service model can provide energy services to mini-grid, for example, the community cooperatives own and operate micro-hydro systems in Sri Lanka, or to individual households, for example, Soluz Inc. sells solar home systems in Dominican Republic and Honduras.

^v With a leasing model, an energy service company or a micro-finance institution (MFI) owns and maintains the system. After consumers pay off loans, they resume the ownership of the system. In Bangladesh, for example, an MFI acts as a dealer and a micro-financer to distribute SHSs with the leasing model.

^{vi} With a concession model, franchise rights for rural service territories are granted to concessionaries that offer bids through competitive bidding to service rural households and community centers. The winners are chosen with either the lowest bidding subsidy, or the lowest bidding tariff, or the largest service areas/population. Consumers pay a connection tariff and monthly service fee (Barnes, Jechoutek, and Young, 1998). The concession model is used in Argentina, Comoros, and etc.

^{vii} A simple interest-free loan with a fixed repayment schedule, rather than the complicated revolving fund, would have been more effective.

^{viii} In Uganda, nearly 5 percent of all rural households spent US\$120 annually, equivalent to US\$3.00 per kilowatt hour (kWh), for batteries to power their lights and television sets. In Zimbabwe, more than 14 percent of rural households pay US\$1.40–2.10/kWh for batteries, and nearly 5 percent of households pay US\$0.70–0.90/kWh for SHSs, compared with the utility rate of US\$0.020–0.040/kWh.

^{ix} Enerkey is a plug-in key that, when inserted in the contact, triggers the electricity supply. When the key's charge is exhausted, it has to be recharged at a level ranging from one week's to one month's worth of consumption.

^x This approach builds on the similar successful experience in China that was supported by ESMAP and ASTAE, which has led to the US\$205 million "China Renewable Energy Development Project."