Bank Experience in Non-Energy Projects with Rural Electrification Components:

A Review of Integration Issues in LCR

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

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Preface

This review of Bank experience with integrated rural electrification is provided to help decide whether to conduct a more detailed investigation and which issues to focus on. As a precursor to a more complete, in-depth study of this topic the following review will only raise the issues that could be covered – the actual full study would attempt to answer the questions posed here. The ultimate objective is to design more effective rural electrification projects integrated with other sector operations.

Of the 25 reviewed projects, six include significant energy components. Summaries of the identified projects and a list of literature on the topic are provided. It is recommended to center further analysis of the identified projects on the issues of efficiency, effectiveness, and sustainability.

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Introduction

1. The objective of this study is to gain an overview of current nonenergy projects with rural electrification components in LCR. The research included compiling a list of projects, contact information, and issues regarding the integration of rural electrification and other services and interviewing the relevant task managers. This report provides an overview of what effects are expected theoretically to happen, and what the initial actual findings in the identified projects were.

2. This review is provided to help decide whether to conduct a more detailed investigation and which issues to focus on. The ultimate objective is to design more effective rural electrification projects integrated with other sector operations. To design more effective rural electrification projects integrated with other sector operations effectiveness needs to be defined. Assuming that the ultimate goal is poverty reduction, the link between electricity and income-generating activities needs to be analyzed. Effectiveness will then be measured according to the project's impact on poverty and improvement in living standards. Linked to the effectiveness objective is the issue of sustainability. The projects will only be effective in the long run if adequate provisions for the maintenance of the systems are put in place to ensure the long-term viability of the investments.

3. Another important aspect is efficiency: How do the costs of rural electrification as a component of a nonenergy project compare with "pure-play" rural electrification projects?

4. Integrated Rural Electrification is the combination of electrification with projects in other sectors such as social investment, education, health infrastructure, water supply systems, irrigation, telecom, transport, or agriculture. There are different models of integration. Many of the social funds allow the target group to decide what to invest in; a private or public provider could bundle different services; or activities in different services could merely be coordinated. The different modes of integration will have an impact on efficiency, effectiveness, and sustainability.

5. In general, integration has the potential to capture economies of scope, although it might reduce the benefits of economies of scale. For example, a thorough knowledge of the project area and its needs for different services may allow for more appropriate project design (economies of scope), but a small number of systems or connections may increase the cost per system or connection (economies of scale). It is important to note, though, that the cost per system depends on the number of systems in a project, and not on whether it is an integrated project or a pure-play rural electrification project. The integrated projects in this study had relatively few systems, but it is possible to design integrated projects large enough to benefit from economies of scale. On the economies-of-scale side, a thorough knowledge of the project area can be achieved through diligent preparation for a pure-play rural electrification project as well, but this

means a loss in economies of scope, since the results are not leveraged across different sectors.

6. This research is required to gain a better understanding of all rural electrification measures that are implemented by the Bank, since significant activities are being managed by sectors other than Energy.

1

Research

1.1 The first step was to identify projects in the region that have a rural electrification component but are not part of the energy sector project portfolio. Information about existing projects was compiled from different databases and through interviews with Bank staff. The sector leaders for ESSD and HD were asked to verify the existence of electrification efforts in their respective countries and projects. Once potential projects had been identified, the project documentation was surveyed to gain a better understanding of the projects. One of the findings was that project documentation doesn't necessarily reflect actual results. For example, some projects that listed significant energy components in the Project Appraisal Documents (PAD) ended up not implementing them.

1.2 In addition, a recent summary of active LCR projects was consulted to identify electrification efforts.

1.3 The results of the projects that integrated electrification were summarized and a list of issues for further investigation was compiled. Brief interviews were conducted with the task managers of the identified projects to gain a better understanding of the project work.

1.4 A literature search on the topic was conducted with the Bank library and resulted in a list of publications and websites. This can be found in Annex 2.

Issues to be investigated

1.5 The follow-up activities should focus on investigating these three subjects: Efficiency, effectiveness, and sustainability.

Costs and efficiency of investment

1.6 Due to the small size of the individual subprojects, economies of scale are often lost which could be captured in more centrally planned interventions. In larger projects, the relatively high fixed costs of extending a network can be defrayed by a high number of end users. If only a few communities choose to invest in electrification, the cost of providing that service becomes relatively high, possibly leading to high levels of subsidies. This is not a result of the integrated nature of the project, but its small size – small pure-play rural electrification projects do not realize the economies of scale either.

Table 1: Potential Benefits and Constraints of Integrated Electrification Projects

	Benefits	*Constraints*
At the World Bank	- Economies of scope for planning costs - Access to funds and expertise from other sectors	- Lack of sector-specific knowledge, best practice, technologies, scale - Coordination problems
In the field	- Better link between RE and its productive and social uses. Access to funds from other sectors and potential economies of scope - If self selected by community: Increase in ownership	- Loss of economies of scale in small projects - Insufficient attention given to efficiency and sustainability of the investment, because RE is typically a marginal activity of the project - Risk of political influence on investment decisions - Coordination problems among various institutions

1.7 On the positive side, there might be some user participation such as the provision of labor in small community-driven projects. The contracting of local companies may be less costly than using a centrally hired company. The bidding process for contracts must be appropriate for the small size of the projects, taking into account the risk of excessive transaction costs and the need for minimum quality standards. Economies of scope can be realized if there is a significant amount of local knowledge available that can be leveraged across different sectors. For example, the experience with a community in a different sector can be used to assess the risk of providing sustainable electrification.

Effectiveness

1.8 The RE activities in the analyzed integrated projects tend to be driven by demand and linked to productive or social uses (such as agriculture or schools). The fact that the communities have to make a choice between RE and other investments ensures that electrification is the top priority of the community. This compares favorably with more regional programs that cover a lot of communities, whether or not access to electricity is their most pressing need. On the other hand, the process might be influenced by political interference of local leaders.

Sustainability

1.9 Sustainability is a key issue for both pure-play electrification projects as well as integrated projects. How many of the systems will be still functioning in a couple of years? The relevant issues in this regard are:

1. Responsibility for operations and maintenance.
2. Adequacy of tariffs.
3. Collection of tariffs and consequences of default.

1.10 Evidence from the analyzed projects indicates that sustainability is an issue, at least for some of the projects.

1.11 The follow-up activities should focus on answering the following questions:

- ?? What were successful integrated rural electrification measures in the past?
- ?? Why were they successful and can they be replicated?

1.12 To answer these questions, more in-depth interviews with beneficiaries in the project countries and project staff should be conducted and the available literature should be analyzed.

1.13 The first step is to identify successful applications.

1.14 Indicators of success include:

- ?? Positive (economic) return on the investment
- ?? Target group orientation
- ?? Sustainability

1.15 The second step is to assess the replication potential of successful combinations, the key conditions for the success (such as demand for electricity, other inputs, markets) must be identified and their existence in other countries or regions verified.

1.16 Issues to be investigated include:

- ?? Sustainability of projects
- ?? Efficiency
- ?? Effectiveness
- ?? The cooperation of different ministries or departments and their coordination.
- ?? User contribution: Tariff structure and collection issues.
- ?? Operation and maintenance arrangements.
- ?? Availability of financing and affordability.
- ?? Perception of the benefits of electrification by the users (why did so few demand-driven social funds invest in rural electrification?)
- ?? Productive and social uses.
- ?? The role of the public and the private sector, as well as the community.
- ?? Amount of subsidy and its allocation.

2

Results

2.1 Six projects in LCR have been identified that integrate rural electrification with another sector:

Table 2: Projects that Integrate Electrification

Project *(Year of Appraisal)*	***Loan amount, in U.S.$ millions***	***Electrification, in U.S.$ millions***
Brazil - Northeast Rural Poverty Alleviation Program (2001)	236	115
Peru - Social Development and Compensation Fund Project (FONCODES) (1996)	150	34
Mexico - Renewable Energy for Agriculture Project (1999)	8.9	8.9
Nicaragua - Rural Municipalities Project (1996)	30	.8
Panama - Rural Poverty and Natural Resources (1998)	22	.150
Panama - Social Investment Fund Project (1998)	28	
Total	**481.17**	**159**

2.2 A description of the project objectives and implementation results for these projects follows.

Brazil – Northeast Rural Poverty Alleviation Program

Report:

Staff Appraisal Report (Paraíba) (click on link for report)

Loan Amount: US$236 million.

Project Description:

2.3 By far the largest program in this study is the Northeast Rural Poverty Alleviation Program in Brazil. It consists of community-driven demand (CDD) projects and benefits a total of 280,000 people living in 5,700 villages by investing US$115 million in electrification (grid extension). Once a community agrees on the priority list of projects, it receives money for project implementation. The communities are responsible

for identifying and supervising contractors and providing 10-20 percent of the project costs through in-kind contributions, such as labor. The initial results of these activities seem positive, and costs of grid extension supervised by the communities and done by local contractors are reported to cost significantly less than centrally planned projects. Bank involvement is limited to monitoring processes, for instance making sure the identification of the priority is done with participation of the whole community. One of the benefits of this approach is that it matches competences with requirements. Communities have a good understanding of the conditions at the local level, and institutions such as the World Bank can provide the funding and ensure that its usage benefits the target group by supporting the project process.

2.4 The following states were involved: Bahia (US$20.6 million), Maranhão (US$20 million), Paraíba (US$34 million), Piauí (US$15 million) and Sergipe (US$20.3 million).

2.5 The Rural Poverty Alleviation Projects, based on the Northeast Rural Poverty Alleviation Program, assist the state governments in alleviating rural poverty by providing basic social and economic infrastructure, as well as employment and income-generating opportunities; decentralizing resource allocation and decision making; leveraging resources mobilized at the community level; and deepening the creation of social capital. The project has three components: community subprojects, which support small-scale investments selected and subsequently operated and maintained by beneficiaries; institutional development, which provides all implementing entities and communities with technical assistance and training to increase capacity and improve project implementation; and project administration, supervision, monitoring, and evaluation, which finances project coordination and activities to provide feedback on project performance and impact.

Example: Paraiba

2.6 The provision of water, electricity, and infrastructure has changed the socioeconomic outlook of the communities. The rural electrification component consisted of 1,263 subprojects benefiting 64,300 families by providing electricity for lighting, TV, appliances, and productive uses such as *maracujá* irrigation, production of industrial fodder, and operation of cereal mills.

2.7 Electrification-induced irrigation subprojects in Nova Floresta, benefited 169 families in four different communities. The provision of electricity has improved the well-being of these communities and increased sales and incomes of local businesses and agroindustries. It also led to complementary investments, financed through a special credit program of Banco do Nordeste, to produce maracujá,. Eighteen hectares of this high-value fruit are now being irrigated with electric pumps. This subproject exemplifies the complementarities discussed earlier; a relatively low-cost NRDP infrastructure subproject (about US$140 per person) was fully exploited by beneficiaries, with the support of their municipalities and local financing agencies, to increase family incomes and living standards.

2.8 A forage grinder subproject is a typical popular NRDP investment. The investment is extremely low in cost, as are the operating costs, while it can induce substantial benefits for the recipient communities.

2.9 A cereals processing subproject, benefiting 130 families, permitted the community of Meia Pataca to mechanize tasks formerly done manually (such as bean hulling) and carry out the value-added activity of corn milling locally.

2.10 A group of productive irrigation subprojects in Araca and Barragem da Farinha benefited 44 families, bringing 48 additional hectares under cultivation and sowing an expanded variety of produce.

Contact:

Luis O. Coirolo

Anna F. Roumani (recommended Tulio Barbosa)

Edward William Bresnyan

Issues:

Sustainability:

2.11 Do the users pay their bills? Does the utility maintain the grid extensions?

2.12 It seems that the majority of the target group uses electricity for productive applications. What is the impact on poverty?

Efficiency:

2.13 What is the long-term effect (such as maintenance issues) of target group participation in constructing the grid extension? Is this model replicable in other areas?

Peru Social Development and Compensation Fund

Reports (project is closed):

Implementation Completion Report (click on link for report)

Staff Appraisal Report (click on link for report)

Loan amount: About US$34 million (7 percent of total) for rural electrification.

2.14 In Peru, the Social Development and Compensation Fund Project (FONCODES) invested US$34 million in rural electrification through grid extension. The projects are demand driven. Rural electrification projects were successful in reaching the poor, with only about 5 percent going to nonpoor households. It seems that the payment culture for electricity services is not very developed: Only 58 percent of the beneficiaries under the project reported to be paying for the service. Beneficiaries estimated that the value of their houses increased significantly through the connection to the grid. The impact study found that households with access to the grid increased the number of electric appliances.

Project Objectives:

2.15 The objectives of the project were to assist the borrower in sustaining its poverty alleviation efforts, mitigating the social costs of its macroeconomic adjustment, and strengthening the institutional capabilities of FONCODES. In addition, the project aimed at generating employment and improving access to social services; promoting strong and self-reliant community organizations; complementing other nationwide projects in education and health; and maximizing support from other potential donors. These objectives were clear, realistic, and consistent with the Bank's CAS. Above all, at the time of project preparation, these objectives were crucial to Government of Peru (GOP) poverty alleviation efforts and to the re-establishment of social cohesion and government presence in areas of the country which had suffered the worst effects of years of civil disturbance.

2.16 One thousand two hundred seventy-eight (6.8 percent of all projects) and about 7 percent of all funds invested were in rural electrification. The agreement with the Ministry of Energy and Mines specifies that FONCODES only finance secondary electricity networks when a primary network is already in place.

Contact:

Task Manager: Livia Benavides

Issues:

Sustainability:

2.17 How does the fact of high default rates on bills affect sustainability and maintenance of the system? How does it impact the utilities' willingness to expand the grid to other poor areas?

Effectiveness:

2.18 Does the bill payment behavior reflect the priority of the target group—that is, is electricity the highest priority of the people who do not pay for it? What is the impact on poverty reduction?

Efficiency:

2.19 How does the per-system cost in this project compare with the per-system cost in pure-play projects of comparable size?

Mexico - Renewable Energy for Agriculture Project

Report:

Project Appraisal Document (click on link for report)

GEF Grant: US$8.9 million

Project objectives:

2.20 The objectives of the project are to provide unelectrified farmers with reliable electricity supply for productive purposes in a least-cost and sustainable manner

using renewable energy technologies; to increase the productivity and income of unelectrified farmers by supporting the adoption of productive investments and improved farming practices; and to improve FIRCO's ability to catalyze the penetration of renewable energy technologies in the agriculture sector.

2.21 This project is implemented by the agriculture sector, due to a decision of the counterpart that the emphasis is on agricultural productivity, and not on the technology used. The project levers funds from a Mexican program (Allianza para el Campo) and uses GEF funds to buy down the additional costs of using PV for pumping. Currently, about 50 demonstration systems are installed to provide drinking water for cattle on ranches in arid regions of Mexico. The project builds on work done by the University of New Mexico and Sandia Lab. In addition to providing drinking water, some of the systems are starting to provide irrigation to grow forage for the cattle, which increases productivity dramatically. The task manager mentioned that 0.5 hectares of irrigated land may produce as much forage as 1,000 hectares of natural pastures. The Allianza para el Campo program provides matching grants, and GEF pays for PV (total grant amount: US$8.9 million). The average system costs about US$8,000, and the components are locally manufactured (except the PV panels). Less than 15 percent of the total GEF grant amount have been disbursed so far. Profitability analyses for the systems are planned in the coming stages of the project.

2.22 To increase the scale of the market, one approach being investigated is to provide a loan guarantee to facilitate vendor financing, to defray the high up-front costs of renewable systems. Other applications that may be investigated are milk cooling, ice making, and using wind power.

2.23 The counterpart has knowledgeable staff regarding irrigation, and trainings are being implemented to increase the know-how regarding renewable energy. A certification program is being initiated with UNAM for electrical engineers.

2.24 The program is not focused on poverty impact, but requires a distance of at least one kilometer off grid. Due to the involvement of Allianza para el Campo, mostly small farmers are involved. After 14 months of service, no maintenance problems have been reported.

2.25 Ranchers value the convenience of not having to haul fuel or arrange for repairs of diesel generators.

Contact:

Michael G. Carroll

Issues:

Sustainability:

2.26 The system is too new to assess its sustainability. So far, there have been no maintenance issues (other than one farmer proposing to cover his PV panels to protect them from dust).

Effectiveness:

2.27 The project is limited to providing energy for water pumping, which is a very narrow application of rural electrification. Does it focus on poverty alleviation?

Efficiency:

2.28 How do these systems compare with diesel generators? Due to the isolation of the location, grid extension is not feasible.

Nicaragua - Rural Municipalities Project

Report:

Staff Appraisal Report (click on link for report)

Loan amount: US$30 million

Abstract:

2.29 The main objectives of the Rural Municipalities Project are to reduce rural poverty and to improve natural resources management. These objectives can be narrowed down more specifically to the following: to establish a mechanism based on municipal governments and community organizations for reducing rural poverty through rural investment in economic infrastructure, improved natural resource management and small-scale communal productive activities; to ensure that central government institutions acquire the capacity to provide a coherent overall framework for natural resource policy making and enforcement, accounting for global, national, and regional environmental priorities; and to promote the long-term integrity of a biological corridor along the Atlantic slope of Nicaragua, conserving key global biodiversity values. To meet these objectives, the project will have three components: rural municipalities development, including institutional development, information, participation, training, and grants; natural resources policies and institutions involving institutional development and an interinstitutional technical assistance program; and an Atlantic biodiversity corridor (GEF), which will include land use and biodiversity planning, monitoring, and evaluation and a financial mechanism to promote the sustainability of the corridor.

Electrification:

2.30 About US$800,000 was invested in rural electrification over three years, mainly in grid extension and training. There is also a microfinance component to support the purchase of appliances.

Contact:

Alejandro Sánchez in INIFOM (Institute for Municipal Development) Nicaragua.

Director of Operations (asanchez@ideay.net.ni)

Task Manager: Maurizio Guadagni

Issues:

Sustainability:

2.31 One issue that arose in the Nicaragua Rural Municipalities Project is sustainability: as some observers noted, local governments appeared to be "in the habit of building infrastructure, but not maintaining it". None of the subprojects that were analyzed in this project had a sustainability plan. How do these systems perform today?

Effectiveness:

2.32 Is access to electricity perceived as a priority by the target group? Has access had a measurable impact on poverty among the target group?

Efficiency:

2.33 How do the extension costs under the project compare with other grid extension projects?

Panama - Rural Poverty and Natural Resources

Report:

Staff Appraisal Report (click on link for report)

Loan Amount: US$22.5 million

Abstract:

2.34 The principal objectives of the Rural Poverty and Natural Resources Project are to apply, on a pilot basis, methodologies that will channel financial resources to rural communities to help them promote sustainable productive systems, and thereby reduce rural poverty, the degradation of natural resources, and migration; and to promote the sustainable use and conservation of selected priority biodiversity areas. Special emphasis will be placed on gender and indigenous aspects. Specific operational goals include creating capacity at the local level to organize, diagnose problems, plan activities, seek out and negotiate assistance, and act to resolve priority quality-of-life issues; establishing a demand-driven financing mechanism operating in high-poverty areas and providing matching grants to communities; and promoting long-term conservation and sustainable use of Panama's biodiversity resources. To meet these objectives, the project will finance three components: first, sustainable rural development, promoting community training, organization, planning, and investment; second, biodiversity conservation, financing research and planning and environmental impact assessment and monitoring, capacity building for participants, and institutional strengthening in environmental impact assessment processes; third, activities contributing to biodiversity conservation and sustainable use; and fourth, coordination of the two components by a unit also financed to provide technical assistance and studies related to rural development and natural resources management.

Electrification:

2.35 This project works with local mayors, and investments are usually made in high-visibility, public places—for instance, solar panels on schools, health stations, or community centers. About US$150,000 has been used for these purposes.

Contact:

Project Coordinator: Augustin Moscoso (pobrezar@orbi.net).

Expert: Manuel Castillo (Santiago de Veraguas).

Task Manager: Maurizio Guadagni

Issues:

Sustainability:

2.36 Have any of the systems needed maintenance? Are they still functioning? Who pays for repairs and replacement of parts?

Effectiveness:

2.37 Is there demand for the services provided through electricity?

Efficiency:

2.38 How does this provision of electricity compare with alternative sources? Are these systems more or less expensive than comparable systems in pure-play rural electrification projects?

Panama – Social Investment Fund

Report:

Project Appraisal Document (click on link for report)

Total Project Cost: US$28 million

2.39 Early evidence from this project indicates that due to demand that is sometimes isolated or low, economies of scale are lost that could be realized by supply-driven projects. For example, if only a few communities decide that electrification is their top priority, and the technology required is more sophisticated than extending the grid, there are only a few systems with relatively large overhead costs.

Abstract:

2.40 The Social Investment Fund Project aims at poverty alleviation by addressing the demand of the poor for priority infrastructure and services and support for productive activities. This will be achieved by helping to improve the policies and expand and strengthen the operations of the Panamanian Social Emergency Fund (FES). The project has two components. The first provides beneficiaries in the poorest districts with high-priority, small-scale infrastructure, based on community-driven proposals; and trains ministries, municipalities, and nongovernmental organizations in participatory planning, subproject maintenance, social management, operations, and environmental concerns. The second supports three pilot programs designed to provide disadvantaged population

groups nationwide with priority social services; contribute nationwide to microenterprise development by providing credit channeled through intermediary organizations and training of their staffs; and meet the nutritional needs of extremely poor children, and thereby increase school attendance in selected underserved districts through an experimental program.

Rural Electrification:

2.41 The rural electrification component started only recently (2001).

Contact:

Jonathan D. Halpern

Issues:

Sustainability:

2.42 Do the beneficiaries pay for the service? Are there arrangements for operation and maintenance in place?

Effectiveness:

2.43 Was there political interference from local power holders? Did the systems meet actual demand?

Efficiency:

2.44 Does decentralized deployment hinder effective monitoring?

3

Conclusions

3.1 The following conclusions are based on the projects described above. Most of these are small-scale, decentralized, integrated projects. The results of these projects are compared with large-scale, centralized, pure-play rural electrification projects. These two kinds of projects represent the two extremes of the range of possible projects, with many options in between.

3.2 No data has been collected on the potential difficulties of coordinating different departments, both on the Bank side and the government side. This is due to the fact that the analyzed projects integrated on a subproject level in the field, without much involvement of other sectors on either the Bank or government side. For example, a social fund project may be composed of subprojects in different sectors (such as water and electricity) that are implemented without involving a multidisciplinary team.

3.3 The experience with integrated rural electrification in LCR is limited. Most of the projects were demand driven as part of a social fund, which increased effectiveness because the beneficiaries had to opt –in, as opposed to a more regional approach to electrification. It is assumed that the target group is able to identify and communicate its most pressing developmental needs, and that the social funds can assist in meeting these needs. If a community chooses to invest in access to electricity, it is assumed that electricity is the most pressing need, and that access to it can decrease the incidence of poverty. In addition, the observed focus on social and productive applications is likely to increase the positive impact on poverty alleviation.

3.4 In terms of efficiency, the small size and number of projects reduces the possibility to capture economies of scale. However, it should be noted that this reduction in efficiency is not due to the integrated character of the projects per se, but the resulting smaller size of the electrification component. Moreover, a small pure-play electrification project would incur higher per-system cost than a large pure-play electrification project. One way to reach more meaningful conclusions on this aspect would be to compare the rural electrification component of an integrated project with a similarly sized pure-play rural electrification project.

3.5 Sustainability has been identified as a problem in some of the projects, because of nonpayment for service and lack of attention to this issue in project

preparation and implementation. From the preliminary information of this small sample of integrated electrification projects, it seems that pure-play rural electrification projects are more aware of sustainability issues and put more emphasis on designing sustainable projects, including provisions regarding maintenance and operation of the systems once they are installed than do integrated projects.

3.6 It is recommended to center further analysis of the identified projects on the issues of efficiency, effectiveness, and sustainability. Specifically, it would be interesting to find out how to combine the advantages of the two types of projects (integrated and pure-play) to come up with better rural electrification projects or components. That would require the analysis of the trade-off between effectiveness (demand-driven projects meet target group's needs), efficiency (per-system cost decrease in larger projects) and sustainability (incorporating best practices in system design).

Annex 1

Projects without Significant Rural Electrification (RE) Activities

A1.1 The following Bank operations (mostly social funds) have been identified as not warranting further review. To indicate that they were surveyed, they are listed below:

Project	*Country*	*Comment*
Fourth Social Protection Project – FOPAR	Argentina	Very few RE subprojects
Provincial Agricultural Development Project	Argentina	No RE subprojects
Social Protection	Argentina	Very few RE subprojects
Emergency Social Fund	Bolivia	No RE subprojects
Participatory Rural Investment Project	Bolivia	No electrification due to overlap with ESMAP Bolivia
Renewable Energy in the Rural Market Project	Brazil	Dropped
Third Social Development Fund: Emergency (FISEI)	Ecuador	No RE subprojects
Social Fund (FISDL)	El Salvador	No RE subprojects
Social Investment Fund II	Guatemala	Very few RE subprojects
Reconstruction and Local Development Project	Guatemala	No RE subproject implemented
Health, Nutrition, and Water Project	Guyana	No RE subprojects
Economic & Social Fund	Haiti	No RE subprojects
Economic & Social Fund II	Haiti	Project has been dropped
Social Investment Fund	Honduras	No RE subprojects
Social Investment Fund	Jamaica	No RE subprojects
Decentralization and Regional Development	Mexico	Mostly urban, <1% rural electr.
FISE	Nicaragua	No RE subprojects
Poverty Reduction Fund	St. Lucia	No RE subprojects

Annex 2

Results of Literature Search

A2.1 A list of literature of other agencies yielded the following results:

Wasserman, Gary and Alice Davenport, Power to the people: Rural electrification sector summary report, 1983. U.S. Agency for International Development.

Pearce, David and Michael Webb, Rural electrification in developing countries: A Reappraisal.

FAO (Food and Agriculture Organization). 2000. Solar Photovoltaics for Sustainable Agriculture and Rural Development.

The full text of the articles listed can be requested by email from the Sectoral and IT Resource Center.

General Rural Electrification:

A2.2 Barnes, D. F., 1988. Electric power for rural growth: How electricity affects rural life in developing countries. Boulder, Colorado, U.S.: Westview Press.

A2.3 ABSTRACT: Is rural electrification a catalyst for development or does it accentuate rural inequality, since it first goes to wealthy households? This study examined the effects of rural electrification on rural industries, communities and households in relation to agricultural development, small-scale industry and commerce, social change, and poverty. The data were provided by reports concerning Colombia, India, and Indonesia. It is concluded that rural electrification offers substantial opportunities for agricultural development by way of electrical pumps for irrigation; it may contribute to the establishment and survival of rural businesses; although higher income households are the first to be connected, rural households in general benefit, women and children more directly than men; and its (variable) positive impacts may be determined more by government policies and unique regional characteristics than by the technology itself.

A2.4 Bala, B. K.,1998. Energy and environment: Modeling and simulation.

A2.5 ABSTRACT: A systems approach was used for modeling agricultural energy use in Bangladesh. The current energy use pattern in agriculture, including the use of animal draught power and cow dung, is described. The local, regional, and global environmental aspects of energy use are analyzed using Long-range Energy Alternatives

Planning (LEAP). The simulation of an integrated rural energy system in Bangladesh is illustrated with the example of Langulia, a village provided with electricity. A general method to explore integrated rural energy for farming systems or agriculture-related issues in a developing country is developed to understand the behavior of different income categories. The model can be applied to optimize the cropping and energy-use patterns at microlevel and macrolevel. The parameters of the model are: available crop land; cropping pattern; available crop residue; available animal feed; available animal dung; applied fertilizers; energy supply; household energy use; irrigation requirements; animal and tractor power requirements; and human labor.

A2.6 Development-in-Practice (World Bank). 1996. Rural energy and development: Improving energy supplies for two billion people.

A2.7 ABSTRACT: A study of the energy supply situation of the rural poor in developing countries, in the wake of reform and liberalization of the energy sector, is presented. The impact of biofuel use by the poor, in terms of pollution, health, ecological damage, and energy efficiency, as well as the importance of biofuels in relation to modern fuels across the world, is assessed. The five general principles that experience has shown to be relevant to the provision of both traditional and modern fuels are described: (1) enabling people to choose alternative forms of energy; (2) avoiding unnecessary subsidies; (3) addressing market failures; (4) emphasizing participation and institutional development; and (5) recognizing the central role of enabling conditions. The main options for rural electrification, and various innovations in renewable energy in India and China, such as biogas and photovoltaic systems, are indicated. The World Bank's experience in rural energy programs is reviewed. Some of the policies that are discussed are often equally applicable to unserved urban populations, for whom the costs of service extension are much lower.

A2.8 Financial Times Information Limited. December 22, 2000. POTENTIAL OF PV SYSTEMS IN THIRD WORLD STILL UNTAPPED, SAYS FAO.

A2.9 ABSTRACT: The FAO is urging governments to promote solar systems in rural areas. Private sector investments should be attracted for financing solar energy electrification programs. International donor funds could be used as a leverage for such private sector investments. Integrated photovoltaic electrification programs should simultaneously address electricity needs in different sectors of rural society by offering solar systems for drinking water, irrigation, health care, education, and communication. The energy, agriculture, education, and health sectors should work closer together to ensure that solar systems are used for delivering these basic needs and services to the rural poor. Such an integrated approach could also help to promote solar technology, improve maintenance and servicing of infrastructure. and create sustainable markets. Moreover, solar energy systems would also serve the environment and concerns about climate change.

A2.10 FULL TEXT: Selective use of solar energy could significantly improve the livelihood of millions of people in rural areas in developing countries, according to a

recently released report from the United Nations Food and Agriculture Organization (FAO), entitled "Solar Photovoltaics for Sustainable Agriculture and Rural Development". Solar photovoltaic technology is currently mainly used for lighting, radio, and television in households in the Third World, but the FAO feels the time is ripe now to advance towards a new phase of solar energy beyond the light bulb: "We should not only use solar systems for household lighting, but also for pumping drinking water, irrigation, cattle watering, small cottage and agro-industries, facilitating educational radio and TV programs and health services".

A2.11 Almost two billion people in developing countries are still without access to electricity. Their energy problems will not be resolved by solar home electrification alone, FAO said. "It is realized that the most disadvantaged, subsistence farmers will generally not be able to afford solar systems. Solar systems do, however, provide some particular advantages that make them interesting for basic social services such as water supply and vaccine refrigeration, as well as for several niche applications. With lower prices, the size and number of niches will grow," the Rome- based FAO predicts.

A2.12 The report cites many examples of growing solar energy application in agriculture. Solar pumping is suitable for drip irrigation of horticultural and other high value crops. Solar systems are also often the most economic solutions to supply water for people and their livestock in remote, unelectrified areas. Water pumping is one of the major rural photovoltaic markets in developing countries, while solar electric-powered fences are also widely sold.

A2.13 Small solar systems also help develop other productive activities in many countries, such as restaurants, bars, cinemas, telephone shops, and technical and artesian workshops by providing light and powering small tools such as drills, blenders, mobile phones, and television sets. Installing and maintaining solar systems and selling photovoltaic electricity helps to create jobs in rural areas. However, the introduction of photovoltaics still faces several barriers, such as high investment costs, lack of financing and infrastructure, low volumes of sales, and lack of political commitment and policies, the FAO said. Innovative financial schemes such as revolving funds, soft loans to farmer cooperatives ,and equipment leasing arrangements are opening new opportunities for the application of solar technologies.

A2.14 The FAO is urging governments to promote solar systems in rural areas. Private sector investments should be attracted for financing solar energy electrification programs. International donor funds could be used as a leverage for such private sector investments. Integrated photovoltaic electrification programs should simultaneously address electricity needs in different sectors of rural society by offering solar systems for drinking water, irrigation, health care, education, and communication. The energy, agriculture, education, and health sectors should work closer together to ensure that solar systems are used for delivering these basic needs and services to the rural poor. Such an integrated approach could also help to promote solar technology, improve maintenance and servicing of infrastructure, and create sustainable markets. Moreover, solar energy systems would also serve the environment and concerns about climate change.

Case Studies:

A2.15 Testino, M. G., 1988. Luz es progreso? Electrificación rural en Junin y Apurimac. Lima, Perú: Tecnología Intermedia.

A2.16 ABSTRACT: This paper outlines the potential of hydroelectricity as a source of energy in the Andes and considers in detail why two micro hydroelectric schemes in Juin and Apurimac in Peru had little effect on rural development. The population distribution, hydrological systems, and public electricity programs for each region were examined, together with the agricultural and industrial production and regional markets for the goods produced. The conclusion drawn is that rural electrification is ineffective where there is no or little demand for energy as a productive factor. The main problems with regard to small hydroelectric schemes are operational costs and preference for an alternative use of water, both of which may be partly overcome by combining the schemes with irrigation projects. The provision of energy is insufficient; credit programs, technical assistance, and the promotion of small-scale industries are also required.

A2.17 Pascall, M., 1988. Integrated rural development in St. Lucia: A participatory approach. Canada: Convergence.

A2.18 ABSTRACT: In Des Barras, Fond St. Jacques, and Oleon in St. Lucia, the West Indies, an integrated rural development project focusing on strong community participation was initiated. Its general aim was to increase access to extension services, enhance women's participation, and improve the position of farm families. More specifically, it aimed to promote confidence in the community by building up leadership, providing skills training and field experience for community extension agents, and opening up avenues for change at the policymaking level. The project commenced with meetings to identify needs and problems and related research questions; then data was collected by community members and external researchers. Finally, subcommittees were formed which each searched for a solution to a specific problem. The project's results in two communities are described. Electricity, employment, and a community center were the needs of Des Barras, whereas in Fond St. Jacques the lack of land, infrastructure, and a community center were problematic. It is concluded that participatory research contributed to the project's success.

A2.19 Oubrecht, J. and O. Abdulshekur, 1994. Opportunities to use wind energy to pump water in the rural settlements of Ethiopia. Prague, Czechoslovakia:

A2.20 Institute of Tropical and Subtropical Agriculture, Prague Agricultural University.

A2.21 ABSTRACT: The majority of rural settlements in Ethiopia are in remote places, access to which is difficult. To extend the electricity grid to such locations would not be remunerative because of the low populations and the long distances. To use diesel motors to pump water is several times more expensive than to use wind power. The wind speed must be at least 2.4 m/s for the wind engine to work. All the six stations tested

meet this requirement during the course of the growing season of the crops. The pumping station has a simple design to transmit the torque straight to the reciprocating movement of the piston of the pump (no gearbox required). The efficiency of the transmission is very high. A wind pump with a wind wheel of about six meters across enables the farmer to provide supplemental irrigation for one to seven hectares of land to support at least two crops in one calendar year. Because it is impossible to extend wires to the remote areas and because it is too costly to use diesel oil to generate electricity, it is necessary to find suitable places where wind-driven pumps can be installed to provide water for irrigation, for the farmer's family, and livestock. In the evenings the wind power can generate electricity for lighting and enable the use of radio and TV sets and other appliances with a low electricity demand. From authors' summary.

A2.22 Sokari,-George, E., J. O. Emereum and H. H. Dimkpa-Harry, 1991. Rural electrification: A study of socio-economic and fertility change in Rivers State, Nigeria. Japan: Rivers State University of Science and Technology, Department of Architecture and Town Planning, Nigeria-African-Study Monographs.

A2.23 ABSTRACT: Rural areas in Nigeria are currently undergoing rapid economic and socio-cultural transformations, as well as fertility decline. Many communities have benefited from various development inputs, including electrification. It is stated that rural electrification is a major factor contributing to these changes, especially in relation to health services, contraceptives use and fertility decline. Two villages in Rivers State, one fully electrified since 1974 (Bonny) and another (Kula) with a four-hour electricity service, were selected as case studies. Data reveal that family planning was more practiced and subsequently fertility decline was more significant in Bonny than in Kula. There is a need for model building and research on electrification as a modernization process. From author's summary.

A2.24 Siwar, C. and N. H. Mustapha, 1989. Integrated rural development: Malaysia. Bangladesh and New Delhi, India: State-of-the-Art-Series – CIRDAP.

A2.25 ABSTRACT: Many Asian governments have adopted integrated rural development (IRD) strategies to alleviate rural poverty. This report reviews the organizational and financial inputs, the socioeconomic impacts, and the drawbacks of IRD in Malaysia. It is shown that some successes have been achieved in improving the socioeconomic well-being of the rural population in terms of increased education, calorie intake, and access to electricity, water supply, and health services. The impact of IRD on poverty alleviation, however, has been minimal. The gains seem to be unequally distributed, with the larger farmers benefiting more than the smaller ones. Noting the bad economic situation, IRD strategies are unlikely to promote rural development and eradicate poverty. It is expected that the agricultural component will continue to be the main feature of rural development programs.

WEB SITES:

IDB Policy Statement on Electric Energy
http://www.iadb.org/cont/poli/OP-733-1E.htm
" Pertaining to rural electrification, are consistent with and complement an acceptable rural development program as an element of infrastructure"

Asian Development Bank Policy Statement "Bank Policy Initiatives for the Energy Sector" - Section on Rural Energy
http://www.adb.org/Documents/Policies/Energy_Initiatives/energy_ini350.asp

Sustainable Energy
http://www.fao.org/sd/epdirect/EPre0036.htm

African Rural Energy Enterprise Development (AREED)
http://www.uccee.org/AREED/index.htm

To generate a list of projects dealing with Rural Electrification:
Go to **Global Development Gateway AIDA Database** (**Accessible Information on Development Activities**) http://www.developmentgateway.org/node/100647/
Set Topic drop box to "energy", set Text in Fields to "rural electrification"

Annex 3

Terms of Reference

A3.1 Regional Evaluation of Bank Experience with Integrated Rural Electrification Projects in LCR Countries

Purpose of ESMAP seed money

A3.2 The seed money will be used to compile existing data and information on past Bank operations on integrated rural development in LAC countries. Many of these operations involve rural electrification. This initial task is expected to provide a clearer view of whether there is sufficient past experience to conduct more detailed country-level investigations and to determine more precisely what specific issues should be evaluated in such investigations. As previously articulated in the preliminary proposal to ESMAP, the ultimate objective is to enable the design of more effective rural electrification projects integrated with other sector operations, by learning form the lessons of past integrated rural development projects in the LAC region.

A3.3 Specifically, the following tasks will be undertaken. The study will identify past Bank operations in the LCR region where rural energy development is combined with at least one other sector (for instance, rural electrification as part of a social investment fund project). It will collect documents concerning the identified integrated operations, such as staff appraisal reports, project completion reports, and OED reports. It will review the reports and summarize the operations' results. It then will identify former task managers and other Bank staff involved in the design, implementation, and evaluation of the projects for future consultations. The study will conduct a literature search of all relevant papers and materials dealing with the experience by other agencies, such as UNDP and bilateral donors, on integrated rural electrification projects. Finally, it will prepare a detailed plan of follow-up activities for fuller ESMAP study.