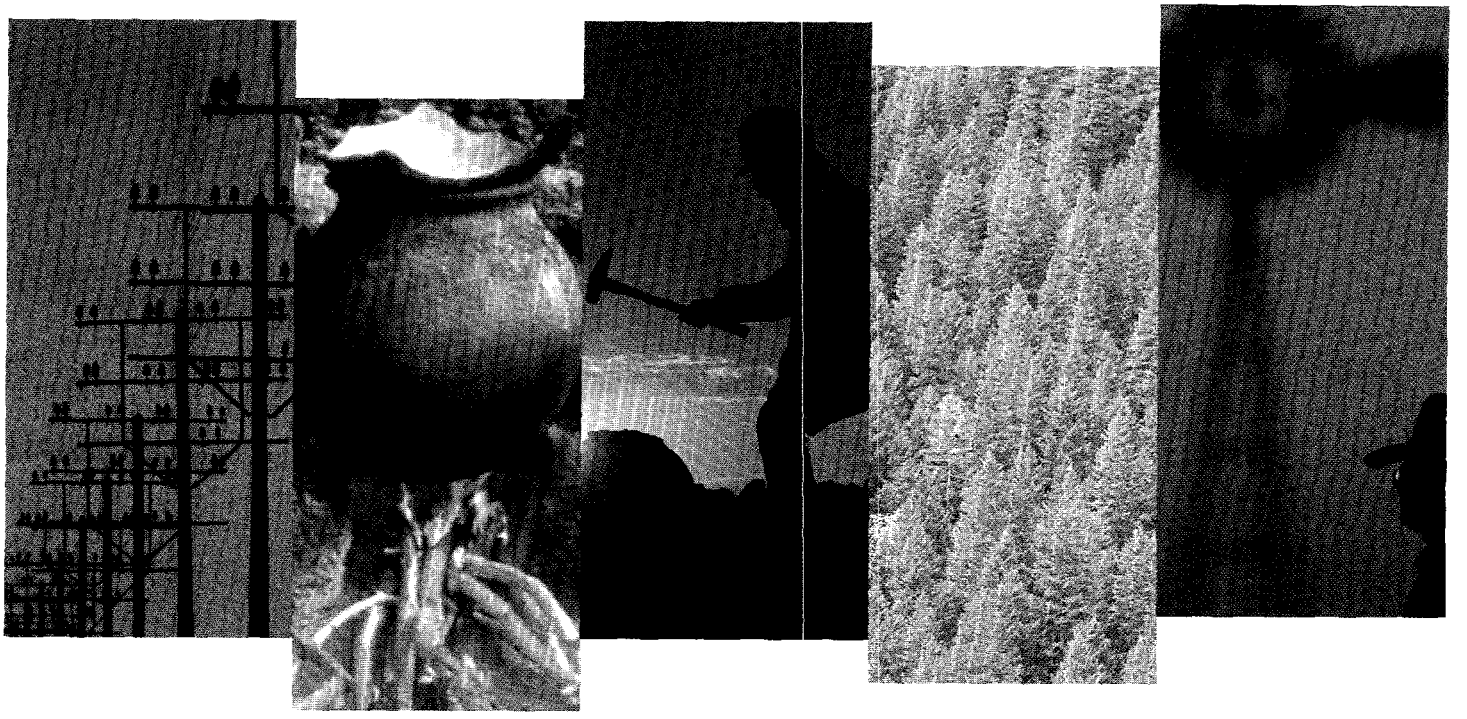
Lao PDR

Institutional Development for Off-grid Electrification

ESM215
June 1999



Energy

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JOINT UNDP / WORLD BANK

ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME (ESMAP)

PURPOSE

The Joint UNDP/World Bank Energy Sector Management Assistance Programme (ESMAP) is a special global technical assistance program run as part of the World Bank's Energy, Mining and Telecommunications Department. ESMAP provides advice to governments on sustainable energy development. Established with the support of UNDP and bilateral official donors in 1983, it focuses on the role of energy in the development process with the objective of contributing to poverty alleviation, improving living conditions and preserving the environment in developing countries and transition economies. ESMAP centers its interventions on three priority areas: sector reform and restructuring; access to modern energy for the poorest; and promotion of sustainable energy practices.

GOVERNANCE AND OPERATIONS

ESMAP is governed by a Consultative Group (ESMAP CG) composed of representatives of the UNDP and World Bank, other donors, and development experts from regions benefiting from ESMAP's assistance. The ESMAP CG is chaired by a World Bank Vice President, and advised by a Technical Advisory Group (TAG) of four independent energy experts that reviews the Programme's strategic agenda, its work plan, and its achievements. ESMAP relies on a cadre of engineers, energy planners, and economists from the World Bank to conduct its activities under the guidance of the Manager of ESMAP, responsible for administering the Programme.

FUNDING

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(ESMAP)

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Preface

This report is the result of a collaborative effort between Electricité du Laos and the Energy Sector Management Assistance Programme (ESMAP). The study was initiated to complement work on grid electrification that was being completed by the World Bank regional staff. The project was implemented by the ESMAP with resources from The World Bank and the Government of The Netherlands.

To our knowledge, this report represents the first attempt at addressing institutional issues linked to developing off-grid electricity in Laos. Many of the insights herein can be attributed to the growing literature on off-grid electrification in developing countries. However, this is a first time that the lessons of off-grid programs in many parts of the world are used to design a concrete pilot project component for a World Bank loan.

Acknowledgments

This report was prepared by Douglas Barnes and Willem Floor. Significant sections were contributed by consultants: Voravate Tuntivate, Allen Inversin, Malcolm Cosgrove-Davies, and Dean Girdis. The authors wish to thank Veronique Bishop for her support and many comments. The report also benefited greatly from a survey conducted by the staff of Electricité du Laos. Mr. Houmphone Bulyaphol, Director, Electricity Department and Mr. Somphone Simmalavong, Director of Transmission, Substation, and Distribution Projects, Electricité du Laos, have given to the ESMAP team their full cooperation and support during the field work conducted in Laos and greatly facilitated this study.

Abbreviations and Acronyms

kgoe	kilogram of oil equivalent
kWh	kilowatt hour
kW	kilowatt
km	kilometer
kV	kilovolt
LPG	liquefied petroleum gas
MWh	megawatt hour
MW	megawatt
TWh	terawatt hour

Energy Conversion Factors

Fuel Type	Energy content			Efficiency for cooking
	Megajoules	Kgoe	Kilo-calories	Percent
LPG (kg)	45.0	1.059	10,800	60
Electricity (kWh)	3.6	0.085	860	75
Kerosene (liter)	35.0	0.824	8,400	35
Charcoal (kg), 5% Moist. C. 4% Ash	30.0	0.706	7,200	22
Wood (kg), 15% Moist. C. 1% Ash	16.0	0.376	3,840	15
Coal (kg) (content can vary significantly)	23.0	0.541	5,520	NA
Dung (kg) 15% Moist. C. 20% Ash	14.5	0.341	3,480	NA
Straw (kg) 5% Moist. C. 4% Ash	13.5	0.318	3,240	NA

Hydropower Terms

Picohydro	= less than 1 kilowatt
Microhydro	= 1 kilowatt to 100 kilowatts
Minihydro	= 100 kilowatts to 1 megawatt
Small Hydro	= 1 megawatt to 50 megawatts

Notes on Currency

All dollar figures in the report refer to U.S. dollars ($)

Currency unit: 1,100 kip = US$1 as of April/May 1997, the period in which the survey on which this report is based was conducted

Executive Summary

1. Laos has lagged behind other Asian countries in extending electricity to rural areas. Part of the reason for this is that the country is the least-densely populated in Asia, with only 19 persons per square kilometer. At present, about 60 percent of the population in Vientiane, the capital city, has access to electricity, while only 8 percent of rural households are connected to the grid. Lao PDR is a country covering 236,800 square kilometers with a population estimated in 1995 to be 4.5 million, about 85 percent of which lives in rural areas. About 40 percent of the population lives in and much of the economic activity is centered around two geographic areas of development. These areas are along the Mekong River and in close proximity to the Thai border in the south, and in the Vientiane–Luang Prabang corridor in the north.

2. Due to the geographical setting and the pattern of human settlement in Lao PDR, it would prove technically difficult and financially unattractive to rely only on conventional, grid-based extension for providing electricity services to the rural population, particularly to those who live in the isolated and remote areas of the country. However, there are alternative systems that can be considered. These include small decentralized diesel generation, isolated pico- and microhydro generation, photovoltaic home systems, and solar lanterns. The problem is that the institutions that currently exist in Laos are not geared to providing electricity to remote villages, even though there appears to be significant electricity demand in rural communities. Currently, people not connected to the grid are meeting their demand for electricity through a variety of ways, including batteries, picohydro, and small diesel generators. However, even in rural areas that are grid-connected, not all people can afford electricity, especially when they have to pay for the very high up-front capital costs of generation and distribution. The costs of such systems puts them beyond the reach of all but the most well off-rural households.

Can Rural Areas Pay for Electricity Services?

3. To determine if there is an ability to pay for electricity services in rural Laos, ESMAP conducted a market survey regarding present patterns of energy use for lighting and other uses of electricity. The survey was carried out in April and May of 1997. A total of 1,580 households were interviewed, including 720 households with electricity (grid-connected) and 860 households without. The survey of households without electricity was conducted in larger villages in rural areas consisting of about 100 households or more. The villages with electricity were selected on a random basis.

4. The survey indicates that there is significant demand for electricity services in rural areas that is currently being met with a variety of energy types, but that there is considerable regional variation within this. The somewhat surprising finding is that people in areas without grid electricity are spending more on electricity and its alternatives compared to their counterparts in towns and villages that have access to

national or provincial grids. All of the off-grid households in the survey were spending about 10 percent of their income, or just less that 5,000 kip per month (approximately $5 at the time of the survey) on electricity, while households with electricity from the grid were spending about 2,200 kip per month (approximately $2) on electricity services. The main reason for this disparity is that the present array of off-grid services is both unorganized and unsubsidized, whereas the electricity supplied from the national grid is heavily subsidized. Table 1 summarizes the monthly energy costs for households connected and not connected to the Lao PDR's provincial and national grids.

5. The expenditures shown in the lower half of Table 1 for both batteries and other fuels indicate that people are willing to pay more for higher-quality energy services rather than rely just on combustible fuels and their poor-quality lighting and other liabilities. However, the demand for higher-quality energy services is mainly for very low-cost systems. The survey demonstrates that, on average, rural people are willing to spend about 10 percent of their income on energy services provided by batteries and generators, but not much more than that level. However, there are some significant regional variations in the use of such alternative energy devices, and programs to promote off-grid electricity should be targeted to those regions with significant use of batteries and generators. In Savannakhet Province, for example, over 90 percent of the households use some form of car or motorcycle battery. In contrast, the figure is only 2 percent for the province of Phongsaly.

6. The survey also shows that there is a substantial ability to pay for electricity in some parts of rural Laos, estimated by the survey to be at least 5,000 kip per month, and as high as 10,000 kip per month for some households. An average of 5,000 kip per month is enough to pay for very low-cost renewable energy services (solar lanterns, for example) that could provide even better lighting for people located in villages such as those in the survey. (As a reminder, the survey's non-grid-connected households involved mainly larger villages with over 100 households). It should not be overlooked, however, that many households are paying even higher amounts per month, reaching levels above 10,000 kip. The figures in Table 1 are for the entire sample; they do not represent just the users of particular energy technologies.

Experience to Date in Developing Off-grid Services

7. International experience with the development of off-grid rural electricity services —such as microgrids and household photovoltaic systems—indicates that such enterprises often fail without the necessary institutional support. This support includes financial institutions willing to lend money, technical assistance to help operators in developing appropriate business plans, non-governmental organizations to assist with loan applications, and other support systems (see Figure 1). System operators should have a reasonable business plan that includes cost recovery and run a profitable enterprise that is financially sustainable. Other criteria for success, experience demonstrates,

include local ownership and accountability for such systems and the use of appropriate technology.

Table 1: Energy Expenditures for Households Connected/not Connected to Provincial/Local and National Grids

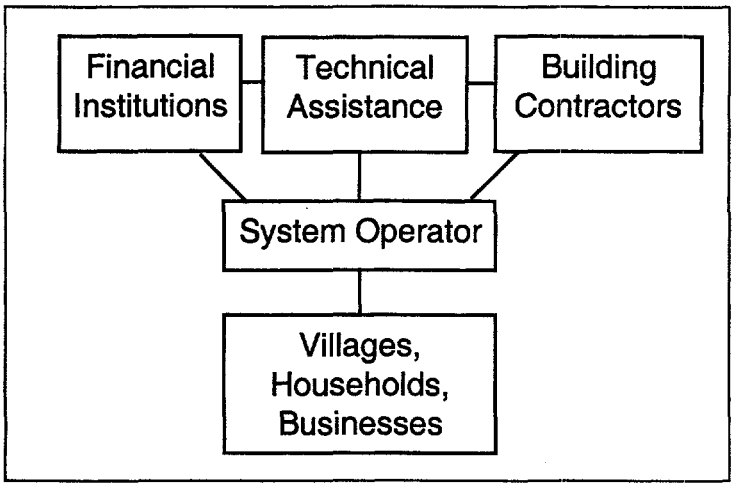
	Energy expenditures				
Province	*Grid electricity (kip/mo.)*	*Other electricity services (kip/mo.)*	*Total (kip/mo.)*	*Percent of income*	*Average price per kWh*
Households served by national grid					
Bokeo	693	413	1,106	1.0	13
Khammouane	893	396	1,289	2.8	15
Savannakhet	700	90	790	1.4	16
Salavane	787	169	955	1.4	14
Households served by provincial/local grids					
Phongsaly	2,361	1,274	3,635	6.5	380
Luang Namtha	1,486	849	2,335	3.5	209
Xiengkhoung	6,600	1,513	8,114	6.3	320
Attapeau	3,358	611	3,969	3.7	235
Total	1,672	557	2,230	3.0	121
Households not served by large grid					
Phongsaly	0	3,918	3,918	10.4	NA
Luang Namtha	0	3,997	3,997	14.3	NA
Bokeo	0	9,430	9,430	13.6	NA
Xiengkhoung	0	5,182	5,182	7.4	NA
Khammouane	0	3,235	3,235	10.7	NA
Savannakhet	0	4,376	4,376	9.9	NA
Salavane	0	4,408	4,408	6.7	NA
Attapeau	0	4,197	4,197	7.0	NA
Total	0	4,936	4,936	10.4	NA

Notes: The figures in this table reflect the exchange rate at the time of the ESMAP survey in spring 1997; that is, US$1=1,100 kip. The recent currency crisis in Asia has resulted in a devaluation of the kip since then. As of July 1, 1998, the exchange rate was US$1=3,393 kip. Electricity prices have changed accordingly. Table figures reflect entire sample; hence, "other electricity" includes batteries and all other expenses for lighting (candles, etc.).

Source: ESMAP Laos Energy Use Survey, 1997.

8. Of course, the success of any business begins with customers willing and able to pay for electric services. Thus, one key to the development of a microgrid system involves the identification of significant demand centers where there is a desire to have electricity and an ability and willingness to pay for it. Depending on the level of demand in rural areas, the electricity provided from a microgrid is likely to be more costly than grid electricity, but much less expensive on a kilowatt per hour basis than electricity provided from batteries and some other alternative sources.

Figure 1: Support Model for Off-grid Electrification



Application of Off-grid Development to Lao PDR

9. Large segments of the rural population in Lao PDR are without electricity from national or provincial grids and they will not be connected even in the distant future. As a consequence, in parallel with the development of grid electrification in Laos, there is a great need to provide institutional support for local microgrids and other small electricity systems. Few local microgrids have been developed in the past, however, and without the proper regulatory framework and adequate institutional and financial support, it is unlikely that many more will develop on their own. At present, there are few institutions in Laos to support the development of microgrids for rural electrification.

10. To support sustainable off-grid power service, the government of Lao PDR has directed Electricité du Laos to undertake an off-grid pilot program as a component of the World Bank's Southern Provinces Rural Electrification Project. The development of off-grid electrification in the Laos project would require a decision by rural communities and entrepreneurs to develop local enterprises to distribute electricity. The key functions and institutions that would be involved in the implementation of such programs are summarized in Box 1. This should be considered as an initial blueprint for institutional

support and for the distribution of functions in the development of off-grid electrification in Laos; one which is anticipated to change and evolve over time.

11. Responsibility for providing technical assistance should lie with an off-grid electricity unit within Electricité du Laos. This unit will promote the pilot program in various regions of the country. Prospective system operators should have a choice of technologies ranging from a microgrid, to battery charging, to photovoltaic household systems. To obtain a loan or the lease of equipment, prospective local operators would have to submit their business plans to a committee for off-grid rural electrification composed of representatives from government, the electric power industry, and non-profit groups. Once approved, the loans would be supervised by the Electricité du Laos off-grid electrification unit (current law prohibits Electricité du Laos from assuming another role). Entities within this off-grid unit would be available to provide technical support to projects, particularly in cases of problems or difficulties. However, the operation of the enterprises and the repayment of their loans would be entirely the responsibility of the local system operators.

12. For the construction of microgrid systems, either Electricité du Laos company or private contractors will supply the materials and carry out system construction. Many failures of similar programs in the past can be traced to retailers and private contractors out of touch with local markets making deals with donors and "installing" equipment in rural areas which ultimately provided insufficient demand, or which found the installed technology unacceptable. However, contractors and manufacturers will be more likely to adapt and adjust their products to meet real needs if they must sell their services and equipment to local system operators who are more knowledgeable about local customers and their preferences. This skewing of incentives toward bona fide local requirements and ability to pay will be especially important in helping local operators to keep their costs low.

Conclusion

13. The off-grid component of the Bank's Southern Provinces Rural Electrification Project will require a very different approach compared to the extension of existing grids. The former will rely on organizing efforts by local community groups or measured risk-taking by local entrepreneurs to develop systems for supplying rural consumers with electricity. These off-grid, local systems will have to develop their own business plans to gain access to financing or lease agreements to serve rural consumers. The responsibility of the government and of the Laos PDR power company will be to make credit available to local community groups and entrepreneurs; to inform them of grants, financing, training, and other options available for such enterprises; and to provide technical support after the systems have been established. However, it will be the responsibility of the off-grid system operators to provide rural people with access to electricity at a reasonable price based on their costs. Through decentralized, off-grid

systems, the Bank's rural electrification project would reach even those who are distant from the grid, as long as they have the desire and the ability to pay for electricity.

Box 1: Key Institutions and Functions for Development of Off-grid Electrification, Laos PDR

1. *Electricité du Laos Off-grid Unit.* Promotes and seeks business plan proposals to provide off-grid electrification to villages and households in rural areas.
2. *Village committees, entrepreneurs, and non-governmental organizations.* Develop business plans and submit applications for loans to off-grid rural electrification committee.
3. *Committee for Off-grid Rural Electrification.* The committee reviews and approves applications for loans or leases to provide off-grid electricity to rural consumers.
4. *Financial institutions and Electricité du Laos.* The financial institutions implement loan agreements or Electricité du Laos executes the leasing arrangements.
5. *Private or independent contractors.* Community or private entrepreneurs utilize financing to select contractors to construct systems according to planned designs.
6. *Electricité du Laos Off-grid Unit.* Supervises loans or leases and reports findings to lending and leasing agencies. Results in identification of best practices that feeds into off-grid promotion.

1

Introduction

1.1 Laos has lagged behind other Asian countries in extending electricity to rural areas. Part of the reason for this is that the country is the least-densely populated in Asia, with only 19 persons per square kilometer. At present, about 60 percent of the population in Vientiane, the capital city, has access to electricity, while only 8 percent of rural households are connected to the grid. Lao PDR is a country covering 236,800 square kilometers with a population estimated in 1995 to be 4.5 million, about 85 percent of which lives in rural areas. About 40 percent of the population lives in and much of the economic activity is centered around two geographic areas of development. These areas are along the Mekong River and in close proximity to the Thai border in the south, and in the Vientiane-Luang Prabang corridor in the north.

1.2 The reason for the lack of rural electrification has nothing to do with electricity generation, as is common in other developing countries. Electricity is a leading export of Laos. About 790 GWh, representing approximately 72 percent of production, was exported, earning around $25 million in revenue. In the past decade, Electricité du Laos (EdL), the national power utility, has increased rural connections as part of the World Bank's Provincial Grid Integration Project, the second phase of which envisions continued extension of coverage to rural areas.

1.3 Due to the geographical setting and the pattern of human settlement in Lao PDR, it is technically difficult and financially unattractive to rely only on conventional, grid-based extension for providing electricity services to the rural population, particularly to those who live in the isolated and remote areas of the country. However, there are alternative systems that can be considered. These include small decentralized diesel generation, isolated pico- and microhydro generation, solar PV home systems, and solar lanterns. The problem is that current institutions in Laos are not geared to providing electricity to remote villages, even though there appears to be significant electricity demand in rural communities. Currently, people unconnected to the grid are meeting their demand for electricity in a variety of ways, including batteries, picohydro, and small diesel generators. However, not all people in rural areas who have access to the grid can afford electricity, especially when they have to pay for the very high up-front capital costs

of generation and distribution. The costs of such systems put them beyond the reach of all but the most well-off rural households.

1.4 Rural electrification is an important priority for Laos because it can contribute to the long-term development of rural areas. Although it is clear from past studies that rural electrification in isolation does not cause economic development, the evidence suggests that it is a necessary condition for development in economically active regions. Although electricity is important for economic development, it is equally important that the supply of electricity be self-sustaining financially. Thus, the price of electricity should allow the supplier to extend, improve, maintain, and operate the supply and distribution facilities.

1.5 The purpose of this report is to suggest institutions, approaches, and regulations that will assist in the development of small, off-grid electrification systems for rural people in Laos who will not have access to grid electricity for at least the next ten years. Such systems include small diesel systems, microhydro, individual household photovoltaic systems, and other innovative sources of supply. The work for this report was initiated to support the development of an off-grid component for the World Bank's Laos Southern Provinces Electrification Project.

2

Present Electricity Demand in Rural Areas

2.1 This section examines the types of fuels or energy sources that households surveyed in rural Laos choose for lighting and other needs (i.e., all non-cooking energy uses), along with some of the factors which seem to influence these choices. In addition, an assessment is made concerning whether current expenditures by rural households on energy and rural household incomes are enough to sustain a program for off-grid electrification.

2.2 The findings presented in this section and in this paper as a whole are based on a survey of larger villages completed in April and May of 1997. A sample of about 1,500 rural households—including those connected and not connected to national or provincial grids—were interviewed regarding energy use and expenditures for energy-consuming activities other than cooking. The survey was conducted in eight of Lao PDR's 18 provinces. The sample households that did not have electricity were in relatively large villages (100 or more households) that were also reasonably accessible to transport. These criteria were selected because such villages were assumed to be more likely candidates for off-grid power systems than very small villages. (See Appendix D for survey details).

2.3 The survey revealed that more people than expected already pay for off-grid electric services of various kinds and that there is potential for better serving these populations. This does not mean that all people in rural areas are able to afford electricity services provided by small grids. However, the survey reveals that there are many rural areas in which people could afford such services.

Paying, and Paying More

2.4 The majority of all rural households in Laos are in villages with no access to grid electricity (see Table 2-1). However, this does not mean that these households spend nothing for household lighting and other energy-dependent activities. In fact, people commonly purchase and use diesel and kerosene for lighting and dry cell batteries as a source of electricity. In recent years, there has been an increased demand in rural areas not connected to the grid for more and better-quality lighting. Rural households

with higher incomes use car, truck, or motorcycle batteries, and a few households even use small electricity generating systems, such as diesel and picohydro.

Table 2-1: Extent of Grid Electrification in Laos

Provinces	*No. of Districts*	*Villages*		*Households*	
		Total	*Percent with electricity*	*Total*	*Percent with electricity*
Vientiane Prefecture	9	486	62.3	85,422	61.0
Phongsaly	7	664	0.8	25,862	1.9
Luang Namtha	5	484	1.0	20,620	2.4
Oudomxai	7	813	0.4	32,474	0.9
Bokeo	5	399	1.5	18,758	4.3
Luang Prabang	11	1,213	3.6	58,590	7.3
Houaphan	6	937		34,614	0.6
Xaignabouly	5	360	1.4	35,395	3.4
Xiengkhouang	8	516	1.0	28,912	1.6
Vientiane	9	575	13.7	51,955	25.1
Bolikhamxai	6	482	1.7	27,280	1.8
Khammouane	9	911	16.2	49,538	14.5
Savannakhet	13	1,574	5.4	108,455	15.5
Saravane	8	742	4.4	41,627	5.2
Xekong	4	337	NA	10,092	1.0
Champasak	10	900	13.9	84,395	13.1
Attapeau	5	188	2.7	14,619	3.4
Special Zone	4	214	0.0	12,503	0.0
Total	131	11,795	7.3	741,111	15.1

Note: Vientiane Prefecture refers to the city of Vientiane, while Vientiane refers to the province of Vientiane, not including the city.

Source: Ministry of Industry and Handicraft, September 1995.

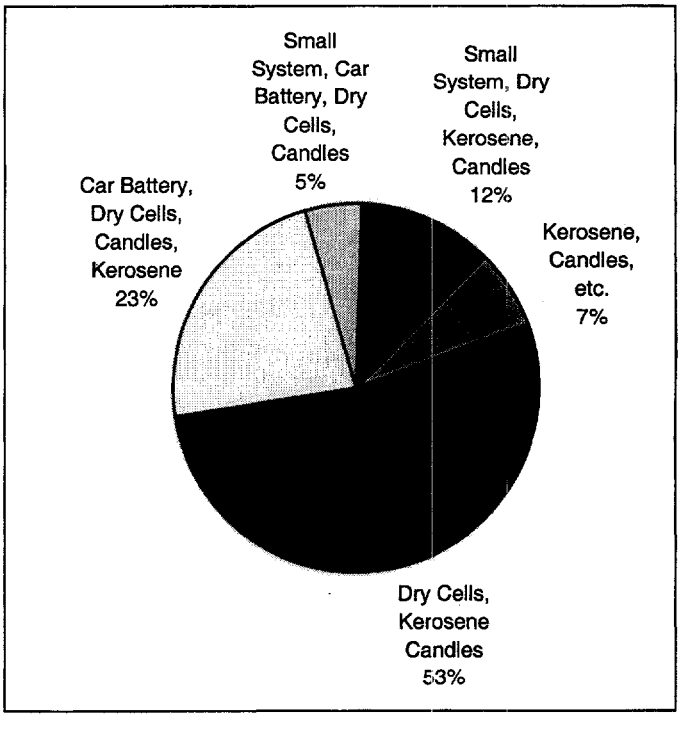
2.5 People in areas unconnected to a grid are also spending more on electricity or on alternatives compared to their counterparts in towns and villages with access to a grid. Among all non-grid households interviewed in the survey, people were spending about 10 percent of their income, or just less than 5,000 kip per month (approximately $5 at the time of the survey). In contrast, households connected to the grid were spending about 2,200 kip per month (approximately $2) on electricity services. The main reason for this disparity is that the present array of off-grid services is both unorganized and unsubsidized, whereas electricity supplied from the national grid is heavily subsidized.

Electricity and Other Energy Sources

2.6 This section investigates patterns of electrification based on combinations of four energy sources chosen by households, related expenditure patterns, and socioeconomic profiles.

2.7 There are four main but overlapping sources of energy used for lighting in rural Laos (see Figure 2-1). These are similar to those in other developing countries with little grid electrification in rural areas. The most basic energy used for lighting involves candles, as well as kerosene and other petroleum products. A second energy source, the dry cell battery—provides a very limited supply of electricity for flashlights, small radios, and tape cassettes. A third and increasingly popular energy source car and motorcycle batteries, is much more versatile, but still has limitations. These batteries supply sufficient electricity for lighting and small appliances such as television sets. A fourth source of electricity for households, which is increasing but still not very prevalent, includes small electricity generating systems based on small diesel (approximately 3 kilowatts) or picohydro generation (approximately 300 watts or less).

Figure 2-1: Combinations of Off-grid Energy Sources in Use in Rural Laos, 1997



Source: ESMAP Laos Energy Use Survey, 1997.

2.8 Only a small portion of surveyed households use combustibles—kerosene, candles, or diesel for lighting and other non-cooking uses—exclusively. For the most part, households using only these fuels are among the poorest. Overall monthly expenditures on non-electricity energy for these households is the lowest among all of the five energy source groups identified in the survey (see Table 2-2). Most of the people in this group are from three of the eight provinces included in the survey: Attapue (32 percent), Phongsaly (28 percent), and Saravane (21 percent). Because of their remote location and a greater number of poor households, energy options are limited in these provinces.

2.9 The majority of households in the survey, accounting for 53 percent of the total, are able to purchase dry cell batteries in addition to fuels such as kerosene, candles, and others (group 2 in Table 2-2), enabling them to use radios, tape players, and flash-lights. The average monthly income of households in this group (61,000 kip) is slightly higher than households that use non-electric energy only (49,654 kip), but still significantly lower than the respective provincial averages. However, their average monthly expenditures for both energy sources is about twice that of those who do not use batteries. Among households in this group, about three-quarters of them live in the provinces of Phongsaly (26 percent), Luang Namtha (31 percent), and Attapeau (17 percent). The lower incomes and remoteness of these regions mean that the use of car and other types of large batteries is not as prevalent.

Table 2-2: Energy Source Combinations and Associated Expenditures in Large, Off-grid Villages

Energy Source Combinations	*Households (percent)*	*Average energy expenses (kip/mo/HH)*	*Average income (kip/mo/HH)*	*Energy expenses (percent of income)*
1. Combustibles (diesel/ kerosene/ candle/ wood torch)	7	1,702	49,654	6
2. Combustibles & dry-cell battery	53	3,441	61,009	11
3. Automotive battery, combustibles, & dry cell-battery	23	6,011	96,666	11
4. Small system, combustibles, & dry-cell battery	12	6,443	85,664	9
5. Automotive battery, small system dry cell-battery & combustibles	5	16,481	215,808	14
All households (860)	100	4,936	79,209	10

Source: ESMAP Laos Energy Use Survey, 1997.

2.10 Quite a few households in villages without access to grid electricity use car or motorcycle batteries for lighting and other household purposes. About 23 percent of these households use electricity from car batteries combined with kerosene, candles, and other energy sources. Due to the costs of automotive batteries or generators, people in groups 3, 4, and 5 in Table 2-2 have higher average monthly energy expenses than those in groups 1 and 2. Most of the people using car batteries (groups 3 and 5) are concentrated in four provinces. Approximately 24 percent of all households in these groups live in Bokeo, 29 percent in Savannakhet, 23 percent in Saravane, and 14 percent in Khammouane. The concentration of automobile battery users in these geographical areas suggests that households in provinces where automotive batteries are available at affordable cost are substituting this source for dry cell batteries.

2.11 Seventeen percent of households in the survey area receive their electricity from small generators. This is particularly interesting, because in most developing countries, generators are not very commonly used in rural areas. In this group of households, families either own a generator or purchase electricity from a neighbor or community or private entrepreneur who generates from either a small diesel or picohydro generator. Sometimes the diesel motors used by higher-income households serve a dual purpose. During the day they are used for agricultural and productive activities such as rice milling, grinding coffee, transport, and pumping water. In the evenings, they generate electricity for household uses. In addition to diesel generators, the use of picohydro generators for at least part of the year is becoming more prevalent in some parts of Laos.

Ability to Pay for Electricity Services

2.12 The notion that people in rural areas spend very little on energy for lighting and other energy services was found to be incorrect, especially for the accessible rural markets involved in the survey. Although it is true that extremely poor provinces with both low incomes and low access to energy do not spend very much on energy, in other regions, as noted, rural people are paying significant amounts of money for lighting and other needs.

2.13 The percentage of all households in Laos that have access to either the national or local grids is around 16 percent. Households with electricity from the national grid pay a very low charge and the percentage of their income spent on electricity is also very low. The amount that they paid in 1996 is commensurate with the national rate—between 14 and 16 kip (1.5 cents) per kilowatt hour. This is well below the long-run marginal cost of generation and distribution, which is about 90 kip per kilowatt hour. By contrast, households connected to local and provincial networks pay between 200 and 380 kip (20 to 35 cents) per kilowatt hour. The proportion of income spent on electricity service in these instances ranges between about 3 and 6.5 percent. In terms of their socioeconomic status, those households that have access to national grid service are not that much different from households that must rely on the local networks. It can be

assumed, then, that the former could afford to pay higher prices—prices that are more in line with generation and distribution costs—than are currently being charged.

Table 2-3: Energy Expenditures for Rural Households Connected to Provincial/Local and National Grids

Province	*Energy Expenditures*				*Average price per kWh*
	Grid electricity (kip/mo.)	*Other electricity (kip/mo.)*	*Total (kip/mo.)*	*Percentage of income*	
National grid					
Bokeo	693	413	1,106	1.0%	13
Khammouane	893	396	1,289	2.8%	15
Savannakhet	700	90	790	1.4%	16
Salavane	787	169	955	1.4%	14
Provincial/local grid					
Phongsaly	2,361	1,274	3,635	6.5%	380
Luang Namtha	1,486	849	2,335	3.5%	209
Xiengkhoung	6,600	1,513	8,114	6.3%	320
Attapeau	3,358	611	3,969	3.7%	235
Total	1,672	557	2,230	3.0%	121

Notes: The figures in this table reflect the exchange rate at the time of the ESMAP survey in spring 1997; that is, US$1=1,100 kip. The recent currency crisis in Asia has resulted in a devaluation of the kip since then. As of July 1, 1998, the exchange rate was US$1=3,393 kip. Electricity prices have change accordingly. Also, "other electricity" includes batteries and other expenses for lighting (candles, etc.).

Source: ESMAP Laos Energy Use Survey, 1997.

2.14 Households that are in villages not served by a grid are paying higher prices and a higher percentage of their income for lighting or other electricity services in many cases. The survey revealed that people without access to national or provincial grid service are on average spending between 1,700 kip per month on kerosene, candles, and other combustible sources of lighting; about 2,400 kip on different types of batteries; and about 700 kip on electricity from small generators (see Table 2-4). This amounts to equivalent kilowatt hour charges that are far greater than those charged by either the national or provincial grids. The total of these average expenditures, around 5,000 kip (about $5) per month, is about 10 percent of a typical family's income. This amount is considerably higher than typical household spending for either the national or provincial electricity service, which is just above 2,200 kip per month (about $2).

2.15 It can be concluded that there is a substantial ability to pay for electricity in some parts of rural Laos, estimated by the survey to be at least 5,000 kip per month, and as much as 10,000 kip per month for some households. An average of 5,000 kip per month is enough to pay for very low-cost renewable energy services (such as solar lanterns) that could provide even better lighting for people located in larger villages unconnected to a grid.

Paying for Off-grid Electricity Services

2.16 The amount of money households in rural Laos pay for off-grid services indicates the extent to which people are willing to pay for electricity in rural areas, depending on income and access to various appliances. In this section, expenditures on lighting and other electricity services by households are detailed for those using particular types of energy appliances.

Table 2-4: Energy Expenditures for Households in Villages without Access to Provincial or National Grids

Province	*Combustion (kerosene, diesel, candles) (kip/mo.)*	*Batteries (car and dry cell) (kip/mo.)*	*Small generators (kip/mo.)*	*Total (kip/mo.)*	*Expenses as percentage of income*
Phongsaly	1,606	1,376	936	3,918	10.4
Luang Namtha	1,695	1,993	309	3,997	14.3
Bokeo	1,641	5,648	2,141	9,430	13.6
Xiengkhoung	2,430	2,045	707	5,182	7.4
Khammouane	1,610	1,505	120	3,235	10.7
Savannakhet	478	3,898	—	4,376	9.9
Salavane	1,691	2,717	—	4,408	6.7
Attapeau	2,344	1,269	583	4,197	7.0
Total	1,773	2,443	719	4,936	10.4

Note: Exchange rate US$1 = 1,100 kip. Figures are for the entire sample, not just for the users of a particular energy technology.

Source: ESMAP Laos Energy Use Survey, 1997.

2.17 As might be expected, kerosene, diesel, dry cell batteries, and candles are the most common forms of energy used for household lighting (see Table 2-5). More than 80 percent of the households in the survey either use dry cell batteries or kerosene as

a fuel. However, these households also are not spending much for lighting (see Table 2-6). Although combustible fuels (kerosene, candles, torches, etc.) are very popular for lighting in areas without electricity, the use of dry cell batteries also is very prevalent in Laos. The survey demonstrates that, as households move toward the use of car and motorcycle batteries and electricity from small generating systems, total expenditures on energy for lighting and other services increase. In addition, as households move toward these sources, there is a significant decrease in the number of them using kerosene, diesel, etc. for lighting. However, as can be seen from Table 2-5, there are significant regional differences in the use of car batteries and other methods of generating electricity. The percentage of households using car batteries in large, off-grid villages is close to 50 percent and above in four of the eight provinces in the survey. By contrast, the use of small systems is virtually non-existent in provinces such as Savannakhet, Saravane, and Attapeau, and has reached levels of only 10 to 30 percent in Bokeo and Xiengkhoung.

Table 2-5: Lighting Fuels and Alternative Electricity Services Used by Non-Grid-Connected Households

(percent of households)

	Combustibles			*Batteries*		*Small System*		
Province	*Kerosene /diesel*	*Candles*	*Wood torches*	*Dry cell*	*Car or cycle*	*Buy from others*	*Own diesel gen-set*	*Own pico-hydro*
Phongsaly	82	41	--	87	2	--	1	14
Luang Namtha	97	31	1	99	3	7	2	--
Bokeo	91	60	--	97	67	23	10	--
Xiengkhoung	97	71	--	100	2	18	2	30
Khammouane	98	25	37	82	48	--	2	--
Savannakhet	65	12	12	28	95	--	--	--
Saravane	62	10	88	37	75	2	--	--
Attapeau	92	4	91	82	16	--	6	--
Total	88	35	22	84	28	7	3	7

Source: ESMAP Laos Energy Use Survey, 1997.

2.18 People with small generating systems are spending the most on energy, followed by households using car batteries. Rural households that own a small generator are spending approximately $11 to $12 per month on electricity services (excluding

capital costs). These households generally have higher incomes than others. Car and motorcycle battery users are spending between $3 and $6 per month. These households make up about 28 percent of all non-grid-connected households in the survey, with some very wide regional variations (2 percent to 95 percent). These figures represent actual expenditures for households that use a particular fuel or energy device (see Table 2-6). This means that households that do not use kerosene or batteries are not averaged into the results, rendering a more accurate profile of expenditures on specific types of energy or energy appliances.

Table 2-6: Energy Expenditures for Non-Grid-Connected Households

	Energy Source or Technology (kip per household per month)								*Total*
	Combustibles			*Batteries*		*Small Generation*			
Province	*Kero-sene & diesel*	*Candles*	*Wood torches*	*Dry cell*	*Car or cycle*	*Buy from others*	*Own diesel gen-set*	*Own pico-hydro*	*Income (percent of)*
Phongsaly	1,097	1,252	—	1,493	4,250	—	14,000	5,531	10.4
Luang Namtha	1,417	1,017	300	1,809	6,250	1,204	9,050	—	14.3
Bokeo	1,199	919	—	2,026	5,510	2,928	14,575	—	13.6
Xiengkhoung	1,819	948	—	1,945	6,000	2,981	3,750	328	7.4
Khammouane	1,241	333	836	766	1,820	—	7,200	—	10.7
Savannakhet	518	678	536	650	3,909	—	—	—	9.9
Salavane	1,415	533	892	928	3,120	—	—	—	6.7
Attapeau	1,463	660	973	963	2,995	—	10,000	—	7.0
Total	1,380	968	973	1,566	4,037	2,594	11,564	2,302	10.4
Percentage of sample	88	35	22	84	28	7	3	7	100

Note: Exchange rate US$1=1,100 kip.

Source: ESMAP Laos Energy Use Survey, 1997.

2.19 The expenses shown for both batteries and small generation systems in Table 2-6 indicate that people are willing to pay more for higher-quality energy services rather than rely just on combustible fuels and their poor-quality lighting and other liabilities. Even so, this willingness to pay is still restricted mainly to very low-cost systems. On average, people are willing to spend about 10 percent of their income on energy services provided by batteries and generators, but not much more than that. In addition, as previously noted, there are some significant regional variations in the use of

such alternative energy devices. Programs to promote off-grid electricity should thus be targeted to regions with significant numbers of batteries and generators. In Savannakhet for instance, over 90 percent of the households in the region use some form of car or motorcycle battery, but for the province of Phongsaly, the figure is only 2 percent.

2.20 Given there is a willingness to pay for improved energy services, potential consumers must still confront the capital cost barrier of such systems and the required downpayment. Often consumers have the monthly income to finance such systems but, for a number of reasons, are unable to pay for the necessary downpayment. Mechanisms, such as those reviewed in this project, can be used to overcome this barrier by providing assistance to reduce the upfront costs associated with some off-grid electrification systems.

2.2.1 Once financing is arranged, with the requisite downpayment as security, the lending group or institutions needs to develop a formal repayment and collection system. Standard practices already applied by such entities in the areas of lending should be applied for rural electrification. Ideally, the downpayment on the equipment will serve to secure the loan and reduce the risk of non-payment and default. If non-payment results, the financial entity should apply normal lending practices to first encourage resumption of debt and interest repayment, and in the case that the borrower is unable to pay, the financial entity may need to terminate the loan and repossess the system.

2.22 In the next sections, this report examines institutional and other approaches that will make it possible to better serve rural markets that will not receive grid electricity for many years to come.

3

Development of an Institutional Model

3.1 Before turning to the specific institutions recommended for the support of off-grid electrification in Laos, this paper examines some of the successes and problems from relevant international experience with off-grid development.

Some Background on International Experience

3.2 The experience with off-grid systems from other parts of the developing world demonstrates both successes and failures. In Nepal, following some early failures, there have been successful experiences with microgrids based on microhydro generation. The program was developed as the result of cooperation between a church-based development organization and a manufacturer. Early on, the main focus of the program was milling. In this instance, a turbine was adapted to local conditions in Nepal and sold primarily to substitute for diesel-powered grain mills. However, it became apparent that a dual purpose could be served by providing motive power during the day for milling and electricity for household use in the evening. The result would be a greater use of existing equipment, resulting in lower power costs. The development of these systems was often the result of extensive collaboration between local communities, non-governmental organizations, equipment manufacturers, and regulatory reforms instituted by the government. Many innovations have emerged during the course of the development of the systems, including low-cost system designs, development of new end uses, low-cost house wiring, and others. Today, the amount of electricity generated from microhydro systems in Nepal is substantial.

3.3 The largest microhydro program in the world is in China, where local grids still provide much of the electricity for rural areas and provincial towns. The number of small hydropower plants in China is now over 48,000, with a combined power capacity of over 15,000 megawatts. The program is based on the principle of local responsibility for operations with strong technical support from the central government. Local electricity companies were formed to serve towns and rural areas during the period in which the government stressed local self-reliance. The source of electricity for these companies is based on both hydropower and small, coal-fired power plants. The Chinese government

also provides support and financing for the development of small hydropower systems. An electricity company can apply to develop such systems to provide electricity to the local grid. The application is forwarded to the Ministry of Water Resources and Power Development, and if it appears promising, a team of technical specialists is sent to the region to assess the project's potential. After working with the local company, a plan is developed and submitted for loan approval. Once the loan is approved, the project is constructed. China is now in the process of connecting many of these small generators into regional grids. This is raising other problems however, because of the many different system designs and standards.

3.4 All of the experience in the development of microhydro and local renewable energy systems has not been positive, however. There are many instances in which small systems have been set up with little thought as to institutional support or maintenance, and many now sit in varying stages of disrepair. These systems often involved donor equipment that was provided to local communities through grants. The systems were typically installed without much local participation in design or system management. The result was that after a few years of operation, the systems often broke down, with little prospect of local communities being able to repair the equipment.

3.5 In many cases, diesel systems with microgrids that serve rural communities are run by national power companies, but such systems invariably involve large subsidies and are rarely financially sustainable. This is the case in Indonesia, where cross-subsidies are used to finance systems on remote islands. The national power company charges customers about the same price for electricity in the small systems as for customers that receive electricity from the national grid. To a lesser degree, diesel systems in Bolivia also require cross-subsidies, but the power company does charge higher prices to customers in the microgrid systems.

3.6 A lesson from this is that power pricing that fails to recover the financial costs of service actually is a detriment to expansion of electricity to rural areas, since it is viewed as leading to company losses. Although it is possible to successfully apply cross-subsidies that finance rural electrification, such cross-subsidies should not be excessive. Regardless of cross-subsidies, each independent institution in the electricity sector must be financially viable, with cost-recovering tariffs.

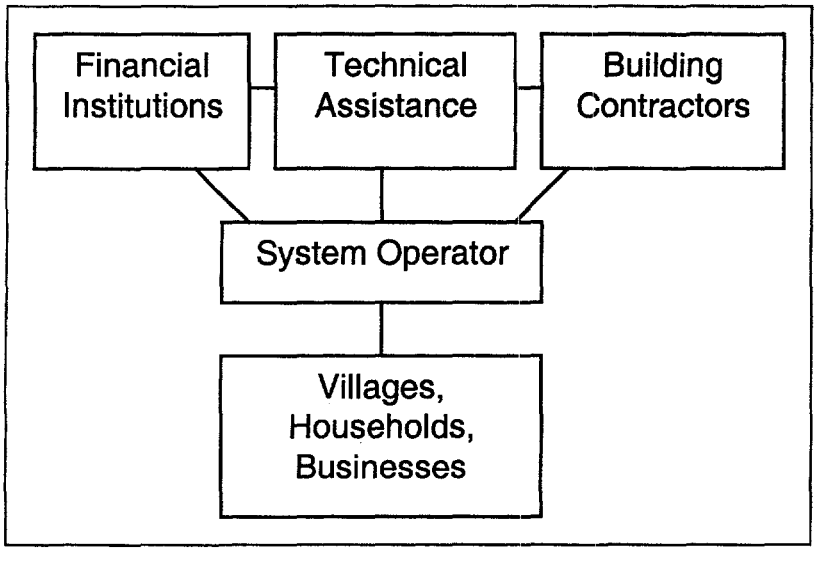
A General Off-grid Model

3.7 In this section, a general model is described for the development of off-grid electrification. The institutional model for successful off-grid systems that appears to work best involves a combination of local involvement, financial support and supervision, and continuing institutional support. Institutional support appears to be necessary to assist in site selection, to assist independent operators over the long term, and to provide financial and technical support and supervision. Table 3-1 lists the specific institutions and their roles pertinent to this model. Figure 3-1 illustrates schematically the relationships among the institutions detailed in Table 3-1.

Table 3-1: Institutions Necessary for Off-grid Development

Institutions	*Activities and Roles*
Financial institutions	Make loans to system operators and supervise loans
Technical assistance: contract facilitators (NGOs, private groups, others)	Assist operators in developing business plan, loan application, and identification of contractors.
Building contractors	Contracted to construct system
System operators	Develop business plan for serving villages, households and businesses; borrow money to set up system; contract to have system constructed; organize and run the electricity service.
Villages, households, and businesses	Pay for off-grid services to system operators

Figure 3-1: Organization of Institutional Support for Off-grid Electrification



The Beneficiaries: Households, Businesses, and Villages

3.8 One key to the development of a viable microgrid involves the identification of significant demand centers where there is a desire to have electricity and an ability and willingness to pay for it. The success of any decentralized system begins with customer demand. As indicated in the previous section, many people in rural areas already use electricity. They have already devised their own individual solutions to obtain electric power. For instance, over 90 percent of the households surveyed in Savannakhet Province use car or motor scooter batteries for lighting and perhaps a

television, and over 80 percent of all households in the larger villages without electricity purchase dry cell batteries. Rural people also use kerosene and candles for lighting. In other words, there is significant demand for power in many rural areas that do not have access to any form of grid electricity. Depending on the level of demand in rural areas, the electricity provided from a microgrid is likely to be more costly than that from a regular grid, though much less expensive on a per kilowatt hour basis than electricity provided from batteries and other sources. Thus, it may be easier to initiate a program for off-grid electrification in areas that already have a high penetration of car and motorcycle batteries used for lighting and electric appliances.

3.9 The type of electricity demand in a rural area may also determine the feasibility of implementing a microgrid system. Typically, small grid systems based on diesel generating sets are run only in the evening, mainly because of the significant costs involved in operating the systems during the day when there is low demand for electricity. Similarly, it is often difficult to justify a microgrid system based on microhydro if there is no significant demand for electricity during the day from grain mills or other small industries. Very light evening demand for lighting may be better met through small household photovoltaic systems. In addition to different demand levels for electricity, each of the above system types involves different costs. Therefore, any assessment of the potential demand for electricity must also involve a determination of the ability to pay by local consumers. In extremely poor areas, such as some areas in Phongsaly Province, the ability to pay for services may be extremely low. In contrast, in more wealthy areas such as Bokeo, people may have significant resources to invest in and pay for electricity service once institutional barriers are removed to setting up local distribution companies. The point is that none of these systems is superior or inferior, but rather, must be adapted to the local demand for electricity and the ability to pay. (See Annex C for details regarding development of low-cost distribution systems).

System Operators: Meeting The Demand

3.10 Local microgrids can be run either by the national power company or by local system operators. Local operators can be private entrepreneurs, community groups, or other groups with a local constituency. As indicated, local micro-grids run by national power companies generally involve low charges to customers and heavy subsidies or cross-subsidies within the larger power system. National pricing policies for electricity usually figure as part of the reason for the subsidies. By contrast, small systems run by local entrepreneurs generally are characterized by cost recovery, higher prices, and some profits.

3.11 Even in regions with significant demand for electricity, there are often barriers that may prevent the development of a microgrid system. There may not be sufficient cash or capital to finance a system. This may be the case for either local or outside entrepreneurs, who may feel that the development of a system involves too much risk.

3.12 Financial viability is absolutely a necessity for the development of successful microgrid systems. Unfortunately, local system operators typically do not have much capital and sometimes are pressured by the community to keep prices as low as possible. In many cases, the result is that the charges for electricity often only cover the operating costs of the system and provide no financial cushion to cover any major repairs. Local operators often overlook the cash reserves necessary for future system repairs. The result is that any problem with the system often results in a collapse of the ability to continue offering reliable service.

3.13 The greatest challenge is to organize local grids so that they are run like a business, whether the operators are private or community groups. As a prerequisite to financing such projects, the development of a sound business plan is recommended so operators may not only meet their operating and maintenance costs, but are also able to pay off their capital loans and extend the system to new customers as necessary (see Box 4-2 in next section and sample business plans in Appendix C). The business plan must be both flexible enough to allow for adjustments as necessary and yet meet the needs of its customers. In this regard, the responsibilities of the operators are to provide the level of service that is appropriate for the community; maintain the system, including making major repairs; charge prices that will cover costs over the long term; collect on bills in a timely fashion; and pay off any loans for the capital costs of the system.

3.14 As previously noted, the institutional form of a local operator can be a local community group, a private entrepreneur from within or outside of the community, a municipal organization, a non-governmental organization, or some other group. Regardless, the key to success lies in serving the community, gaining the trust of customers, and running the operation as a business. In all likelihood, local groups will require support from outside of the communities they serve. Without such support, the typical experience is that local operators bend to local pressures to continue serving consumers who are not paying their bills, and to not charge prices that cover the long-term maintenance and capital replacements costs that are necessary for running and maintaining an off-grid system. In the next few sections, the institutions that can provide such support are described.

Financing Institutions: Financing the Grids

3.15 The existence of locally-operated microgrids is likely to depend on borrowing funds to develop a local electricity distribution business. The typical costs of setting up a small microgrid can be between $5,000 and $20,000, depending on the size of the system. It is very unlikely that any community, community group, or entrepreneur will have the cash available to make such an investment.

3.16 The role of the lending (or equipment-leasing) institution in ensuring that local operators can pay back their loans is extremely important. After all, if the local operator fails, then the financing institution will not recover its investment. In many

cases, the financing institution is the primary organization that provides oversight to the generation and distribution company.

3.17 An example of the strong role that a financial institution can play in the development of rural electrification can be found in the United States. The rural electrification program there is based on a partnership between the lender and the borrower. The Rural Electrification Administration (REA), an agency of the U.S. government, is not only a lender, but also provides supervisory guidance and planning. Even today, decades after final completion of the U.S. rural electric system, the financial ratios of the U.S. rural electric cooperatives are still tracked for all borrowers. The reason is that the Administration (REA) must ensure that cooperatives continue to properly manage their investments to generate expected loan repayments. At the time the first rural electric cooperatives were established in the 1930s, it was necessary to set up a significant budget for loan supervision. Loan supervision which basically entails keeping track of the cooperatives' operations to ensure that they are viable businesses, ensuring that technical standards are met, and assisting borrowers in the operation and maintenance management of their systems. Without this significant supervisory role on the part of the lender, it may be difficult to ensure the long-term viability of rural distribution companies. As noted, this has been a problem for many microgrids in developing countries.

3.18 Clearly, lending money or leasing equipment without intensive supervision and technical support for rural system operators carries the risk of defaults and business failures. Supervision and technical support are thus an administrative cost that should be absorbed as part of the project overhead. A lending organization should not stifle innovative power delivery systems, but rather, should encourage and promote innovative business development to provide different types of energy sources in rural areas. These businesses can be financed by loans from an appropriate bank or their equipment leased from a leasing institution. They can be supervised by either the bank or the leasing company, with technical support and guidance being provided by non-governmental organizations and other institutions. However, it is absolutely necessary to coordinate the lending or leasing, financial supervision, and technical assistance functions. A lack of such coordination could lead to business failure. But even with supervision and coordination, there should also be protection against loan defaults in the form of significant down payments and legal provisions for possible foreclosure.

The Contractors: Building the Systems

3.19 Typically, either the local or national electricity company or private contractors will supply the materials and construct microgrid systems. Various options should be considered to ensure that the systems are low cost. In too many cases, there is a built-in incentive for contractors to develop and sell systems that are acceptable to the national government or to donors. However, contractors and manufacturers will be more likely to adapt and adjust their products to local circumstances and sell systems that will

keep cost low if the direct customer is the rural community itself or the operator of a community microgrid.

3.20 The lender or leasing company must also ensure that the goods and services being purchased through the loan are sound from a technical point of view and meet certain minimum design and other standards. Small, local systems in some instances are based on very poor standards of design and provide very unreliable service. Only when the contractor has finished the installation of the system and it has met certain standards according to the contract should the contractor be paid. It is then up to the operator to pay off the loan or lease for the system within a reasonable period of time.

Technical Assistance: Business Plans, Contract Development, and Promotion

3.21 The process described above would not be possible without arrangements for contracts and loans and without the delivery and installation of equipment. Although it is possible for a community or a private entrepreneur to perform such technical tasks, it is more likely that a specialized agency or other entity that knows how to make such arrangements will be required to assist the community or entrepreneur with these functions. The entity could be a private company, a non-governmental organization, a private voluntary organization, or some other organization that is familiar with the needs and capabilities of people in rural areas. In fact, such organizations may serve as the focal point for coordination of all facets of getting rural microgrids installed and operating. This includes designing the systems, getting loans approved, arranging for contractors to construct the systems, and ensuring systems are maintained.

3.22 The need for working with such organizations lies with the fact that rural communities are rarely capable of undertaking all these functions on their own, including developing a sustainable business plan. Likewise, it is often impossible for a financial organization to identify the markets where successful systems can be developed. This is not always the case, but often there is a need for a group to act as a catalyst for a small, off-grid, project. The responsibility of such a group would be to act as a liaison between all parties. Local communities could contract with the group to develop a least-cost plan for the micro-grid, to develop a business plan that could be presented to a lender, and even arrange for contractors to undertake construction of the initial system. The contract could even be incorporated as part of the loan. However, once the system is in the hands of the local operators, the role of the liaison group either terminate or would become one of providing advisory services.

3.23 For the successful development of local systems, it is extremely important to identify the types of households and communities that have the potential to become customers. Some of the traditional indicators used include household income and community size and density. To a certain extent, the communities or companies that participate in developing off-grid programs will likely be those that are willing to take the initiative and assume the financial risk to set up and operate systems themselves. A

combination of technical support to identify and monitor rural demand for electricity services, along with incentives to encourage local initiatives to deliver such services is therefore central to the success of most off-grid programs.

Roles of Government and Donors

Government as a Facilitator

3.24 For the development of microgrid systems, the role of government is to create an enabling environment. Without strong government support, it is unlikely that the institutions to support the growth of microgrid systems in Laos can be developed.

3.25 Before discussing specifically what the government should do, it is important to understand what it should *not* do and why. At the policy level, it should not penalize diesel or microhydro-based grid systems through import barriers and taxes. The government should also not monopolize electricity generation and distribution through the existing public electricity company, but rather, eliminate barriers to entry to the electric power business. It should not establish universal electricity pricing or set nationwide pricing schemes that are below the cost of production. For decentralized grid projects, the government should avoid supporting model or demonstration programs that supply equipment free of charge to demonstrate that technologies work. Likewise, it should not have "target-based" approaches to the development of decentralized grid systems.

3.26 That said, there are many legitimate activities for the government of Laos PDR to encourage, the market-based development of microgrid systems. For example, it should provide various types of support for the development of low-cost systems. The government should support a resource assessment of local potential hydro sites, as well as assess the potential market niches for small systems. It should also support ongoing monitoring and evaluation of projects that work, or "best practices," and should have an effective means of disseminating them. It should develop a coherent regulatory framework within which small grid systems can flourish. This would include encouraging local communities or groups to organize to serve local needs, setting prices that encourage the development of local electricity business to serve rural people, and encouraging cooperation between broader rural development programs and those who are interested in developing local electricity markets. In general, the government should support technical assistance, training, and innovative product development and not get involved in actual project implementation.

Donor Agencies as Sources of Innovation, Technical Support, and Funding

3.27 Donor agencies can play an extremely important role in the development of local grid systems. Similar to the role of government, donors can be involved in innovative, low-cost system design, the technical support for such systems, the training of local system operators, and even limited support in key areas for the capital costs of the systems themselves. Donors can provide funding to local non-governmental

organizations or other groups that are interested in the development of microgrids in rural areas. However, it is imperative that local people or entrepreneurs be able to select the types of systems that best suit their needs.

3.28 The government should ensure that any bilateral assistance for rural electrification be channeled through an existing program, which has its own set of design, technical, and other standards. This is because bilateral donors typically promote the use of their own design and equipment standards. Although these standards or designs will produce functional systems, there is a risk of installation of too many different standards and systems that often are not compatible with one another. Equipment and standards also change over time. In addition, systems implemented in rural areas by donors are often replicas of ones that have been developed for urban markets, which require higher standards and reliability than is necessary for the low demand typical in rural communities. These problems lead to costs that are higher than necessary in terms of materials, construction, and maintenance. Although donor programs that provide equipment free of charge to communities might appear to benefit rural people, in most such instances, problems arise immediately because such efforts typically make little attempt to develop market infrastructure or support for technical and other problems that arise after installation.

The Importance of a National Policy

3.29 In many developing countries, various government agencies pursue independent rural electrification programs supported by different foreign donors. The lack of a uniform, coherent policy and set of guidelines this demonstrates has resulted in conflicts, duplication of efforts, a multiplicity of technical standards and universal tariffs, and other problems which have constrained rather than helped the extension of electric power to rural areas.

3.30 One of the obstacles to extending power to rural populations is the high cost of conventional grid systems. In Laos, as in most other developing areas of the world, these conventional systems use designs based on Western urban standards. At the other end of the spectrum are very small informal, private electricity supply systems being installed by local entrepreneurs. These systems typically are powered by a small diesel motors (5-10 kW) and include an inadequately fused distribution system strung informally between houses using any available support, including trees, bamboo poles, etc. These non-standard distribution systems have the benefit of extremely low cost, but pay little or no attention to safety, efficiency, reliability, or long-term maintainability. (This situation points to an important gap in current knowledge of well-designed, safe, low-cost distribution systems specifically geared toward village-sized loads. While there has been experience in some developing countries with the design and execution of appropriate, low-cost distribution systems, this knowledge is scattered, unpublished, and largely unavailable. But see Appendix B.)

3.31 There is a clear need for the Laos government to formulate national policy and standards for off-grid power development, to monitor the implementation of off-grid rural electrification programs, to facilitate policy adjustments, and to provide financial and technical assistance to the private sector and/or public sector involved in commercially-managed off-grid rural electrification. For instance, the government needs to develop and agree on equipment standards for off-grid rural electrification. This will be done under a Policy and Human Resources Development (PHRD) grant from the Government of Japan, the results of which are expected to be published in a future World Bank technical paper (see Appendix B for details of terms of reference for low-cost distribution work). This will facilitate cost reduction in system development through bulk purchases, in manufacturing, etc.

3.32 Donor-financed projects should be subject to established technical and other standards to avoid efforts that largely benefit the donors' national manufacturers and/or contractors. Donors would thus be asked to provide consultant assistance to help ensure the compatibility of equipment they furnish with existing equipment and with equipment that might be connected to the grid in the future. Uniform policy and standards will also make it easier to capitalize on national capabilities to manufacture parts and equipment components. However, the standards should be flexible enough to allow cost reductions in system design. As mentioned, many rural electrification programs have in the past enforced urban standards in rural areas, which has increased systems costs and reduced the number of people who could afford to have electric services.

3.33 Regarding the extension of the grid to rural areas, the Laos government should rely on the national power company to develop rural electrification plans which will provide guidance as to the timing and the level of resources necessary. Such decisions should not be driven by supply and political considerations, but only where demand for electricity can be justified based on financial and technical considerations. This means that grid extension will be a slow but financially sustainable process. Moreover, if communities realize that they will remain unconnected to the grid for many years to come, they are more likely to invest in their own generation and distribution microgrids and other sources of electric power.

3.34 The question as to whether the Laos government should leave off-grid rural electrification completely to the private sector is a valid one. The answer is that this would limit extension of electric power only to the wealthiest households. It would also lead to quite disparate, uncoordinated, and disjointed efforts by private entrepreneurs. Having a coherent national policy will provide a framework for coordination and greater efficiency. Also, small entrepreneurs often have little capital and may not be able to make large investments in the equipment necessary to develop a microgrid. With the availability of financial assistance, they might be willing to make the necessary investments and provide the needed management for the operation of viable systems.

4

Proposed Institutional Support and Development Approaches for Off-grid Systems

4.1 The underlying premise of this report is that, with the development of grid electrification in Laos, there is a great need to encourage the development of local microgrids and other small, off-grid electricity systems in rural areas. This section describes a proposed pattern for institutional support and participation in off-grid power development and possible approaches to the development of off-grid systems. These are offered as an initial set of suggestions for improving the climate for development of viable decentralized grids and other forms of off-grid electrification for rural communities.

4.2 Few local microgrids have been developed in Laos to date, and without the proper regulatory framework and adequate institutional and other support, it is unlikely that many will develop on their own. At present, most microgrids and other forms of decentralized electrification in developing countries are very small and weakly capitalized. They also charge fairly high prices for electricity. These are pitfalls that can be avoided with the proper support and incentives to prospective off-grid enterprises. As previously noted, however, there are few institutions at present in Laos to support the development of microgrids.

Overview of Suggested Institutional and Other Participants

4.3 The institutions and groups that it is assumed will be centrally involved in off-grid development include the local operators or enterprises that propose to serve rural communities; a unit within Electricité du Laos dedicated to off-grid programs; an appropriately staffed committee for contract and loan approval; and organizations which can facilitate the development of community proposals or business plans for developing microgrids. (See Table 4-1 for a complete list of proposed participants).

Table 4-1: Off-grid Rural Electrification: Potential Participating Agencies and Organizations in Laos

Participating Agencies	Responsibilities or Activities
Financing Institutions	
Electricité du Laos	Leasing
Banks	Lending
Ministry of Industry and Handicrafts	Special accounts
Project Implementation and Technical Assistance	
Committee for Off-grid Rural Electrification (composed of Ministry of Industry and Handicraft, Electricité du Laos, non-governmental organizations, lending institutions, etc.)	Approval of business plans and Electricité du Laos-supported leasing program
EdL Off-grid Unit	Promotion, technical support, monitoring and evaluation, and loan supervision
Market Development	
Contractors and service providers	System design and construction
Wholesalers and retailers	Sale of renewable, microgrid systems and system components to entrepreneurs, villages, etc.
Project Beneficiaries	
Cooperatives	Represent consumers and households in the village
Village committees	Represent consumers and household in the village
Private entrepreneurs	Create rural electricity distribution business
Non-governmental organizations	Represent households and consumer groups

Financing Institutions

4.4 The heart of any effort to develop rural off-grid systems are mechanisms for village committees, entrepreneurs, and other implementing entities to spread out the capital costs of systems. The two main types of financing for this purpose involve loans and leases. In provinces, etc. with appropriate financial institutions—for example, local or provincial banks—loan funds can be made available to support the development of electricity service businesses. In addition, Electricité du Laos can provide equipment to rural businesses through a leasing program (current law prohibits EdL from playing

another role). In either case, technical support and lending supervision for projects will be necessary.

Developing a Business Plan

4.5 To qualify for a system development loan, a would-be operator would have to submit a business plan for perusal by such entities as—presumably—the proposed off-grid rural electrification committee (see Table 4-1) and by prospective lenders or lessors. The development of a realistic, viable business plan will be the critical first step in any proposal to serve rural communities (see Box 4-1). In the beginning, several model business plans for the establishment of a microgrid based on diesel, microhydro, or other technologies could be drawn up. However, these pre-existing plans would serve only as models that could be modified as needed to fit the specific circumstances of community groups, entrepreneurs, and others.

4.6 The business plan should obviously incorporate the proposed technology, and the choice of which one to use should be left up to the prospective operator(s). There are a number of options, all of which represent well-developed technological approaches to providing decentralized power. These range from diesel- or hydro-based microgrids, to battery charging systems, to household photovoltaic systems. The last of these would involve a business to either sell or lease the equipment.

4.7 The business plan should contain a financial plan that includes an analysis of estimated cash flows. The financial plan should also include details of local investment, loans, and grant elements for the capital costs of the system. (Capital costs typically include the generation equipment, the wires, and other infrastructure necessary for power delivery). In addition, the financial plan should include estimates for operating and maintaining the system, as well as a pricing plan that reflects recovery of all costs based on reasonable estimates of electricity demand. There should also be plans for long-term system maintenance, overhauls, and replacement; would-be system operators often fail to incorporate such costs into the proposed pricing schemes of many small grid projects. The proposed price of electricity in the business plan can vary significantly, depending on the real or estimated demand for energy in the service area the proposed hours of system operation, and the anticipated uses of electric power.

4.8 Business plans could be developed with the assistance of Electricité du Laos, non-governmental organizations, or other groups active in promoting off-grid electrification. Several non-governmental organizations in Laos have already been involved in the development of microhydro systems, and these would be ideal groups to provide such assistance. In fact, in the initial stages of off-grid development, the availability of grant funds to local communities, etc. to hire such outside expertise for the preparation of their business plans is greatly encouraged. Publicity campaigns could be launched by the government through provincial authorities to make rural communities aware of the availability of grant and other funding, as well as of technical assistance for development of off-grid projects.

Project Implementation and Technical Assistance

Evaluating Proposals for Off-grid Projects

4.9 A formal committee for off-grid rural electrification could be established to evaluate proposals from rural communities, local groups, and entrepreneurs. The committee could be composed of representatives from the Ministry of Industry and Handicraft, Electricité du Laos, lending institutions, and non-profit groups promoting off-grid electrification. As mentioned, several non-governmental organizations in Laos have already been involved in the development of microhydro systems and these groups should also have representation. The committee would initially meet about four times per year to evaluate loan applications (accompanied by business plans). The applications would be judged based on financial soundness, extent of local investment in the project, adequacy of demand analysis, and competence of the prospective local operator. The committee also would receive annual reports from the economic analysis unit of EdL concerning the progress of already-funded projects, to assist in the process of evaluating new applications for loans.

4.10 Although the committee would approve lending to be supervised by EdL, it should not stand in the way of private entrepreneurs developing local systems with their own capital or with loans from local banks. A well-designed off-grid electrification program should actively encourage such efforts.

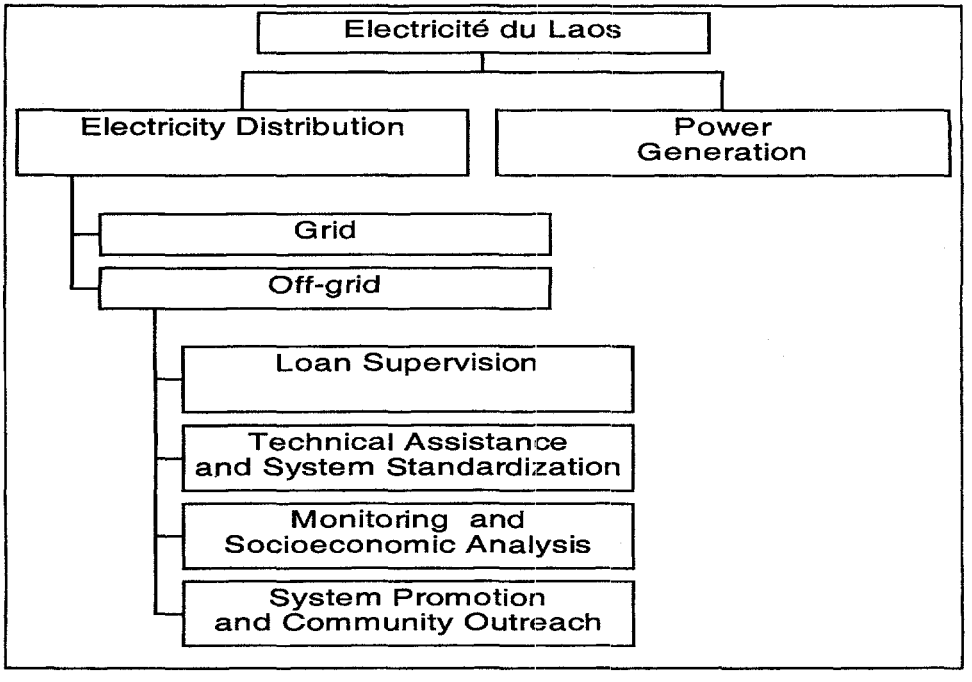
Financial Supervision and Technical Assistance: Electricité du Laos

4.11 Once a loan is approved, a prospective local operator will be able to contract for the construction of the system. However, the experience with most successful microgrid systems is that construction is not the most difficult part of the project. The areas in which small system operators are typically weak are in both management and financial skills. The unfortunate result is that without some supervision and support, they typically may operate a few years while the systems are new and then experience difficulties when equipment begins to age and maintenance expenses start to increase.

4.12 To forestall such problems, a financially and managerially autonomous rural electrification branch within EdL could be established to provide such supervision and support to both grid-based and off-grid rural electrification programs. The unit of this branch dealing with off-grid programs would have an independent budget. This would enable it to provide loan and lease supervision, technical support, monitoring and evaluation, training for local system operators, and promotion of the country's larger off-grid rural program. In the initial stages, the unit could work directly with village system operators. In essence, it would be responsible for ensuring that system loans are paid back to the lender. The unit would also be responsible for ensuring that system operators maintain healthy and financially sustainable businesses. The unit would work very closely with operators to ensure that financial benchmarks are met and that system

operation and maintenance are adequate. (See Figure 4-1 for a schematic demonstrating the proposed structure for involvement of EdL in off-grid development).

Figure 4-1: Proposed Structure for Involvement of EdL in Off-grid Development



4.13 To help ensure financial sustainability, the EdL off-grid programs unit could maintain a record of financial indicators that are updated quarterly. Such indicators could include operator revenues, the operator's monthly expenses, the depreciation value of capital equipment, and other relevant financial ratios. The unit could develop a monitoring and evaluation methodology to keep track of finances and other important information of off-grid systems. This could include a monitoring of connected households, the type of load development experienced during the system's build-up, consumers' willingness to pay for service, and customer satisfaction. The unit should be able to monitor and make recommendations for changes in the development of future systems. It would also evaluate and report the lessons learned for new systems.

4.14 Another key advisory service of the unit could be training and technical assistance. The function of this could be to instruct local groups on how to set up off-grid systems, how to maintain financial records, how to conduct periodic system maintenance, and other important technical and administrative tasks. It could also provide a venue for system operators to meet and discuss their problems and successes on a periodic basis.

4.15 The EdF off-grid unit also could be responsible for promotion and load development. For the development of new off-grid systems, establishment of an outreach program is essential to inform rural people and non-governmental organizations about the availability of funding, the costs of systems, and the prospects for the development of viable power enterprises to serve rural people. Such an outreach program would inform consumers about the various choices of system design, from microhydro, to diesel, to battery charging systems. The program would also explain how system financing works and the types of problems typically associated with off-grid development. It also would advise rural communities about the variety of services available for developing a business plan for microsystems, including appropriate technical design, the development of a contract and loan package, and other facets of business development.

Contracting for System Construction

4.16 Rural operators will be responsible for hiring contractors for system construction. A preferred procedure would be for the contract to be bid out after the loan agreement is reached. The people living in the future service area could assist in keeping costs low by providing local labor during construction where appropriate. All the arrangements for the construction contract could be part of the loan documentation package. It is important that the group or other entity that will operate the system hire and supervise the work of the system contractor themselves. However, the prospective operator(s) should be able to seek the assistance of qualified non-governmental organizations or EdL in this critical function.

Equipment

4.17 The equipment for producing electricity for small systems is not readily available in volume in Laos at the present time. It is anticipated that the development of systems should increase demand for such equipment. The cooperation and support of equipment wholesalers and retailers in Laos will be necessary for success in the broader development of off-grid rural systems.

Conclusion

4.18 Development of off-grid electrification in the Laos program would involve decisions by rural communities and individuals to develop local enterprises to distribute electricity.

Box 4-1: Elements of a Typical Business Plan

Identification of Electricity Demand

Number of customers, estimated electricity demand, density of consumers

System Technical Design

Proposed generation including housing, design of distribution system, etc.

Business Management Plan

Business or community organizations responsible for business

Pricing of electricity, including variable and fixed charges

Description of bill collection system

Description of hours of operation and management of load (if applicable)

Description of system operation and maintenance

Financial Analysis of Project

Expected revenues, capital costs, operational costs, energy costs, other costs

Analysis of revenues, costs, and loan repayment flows

Equipment Procurement and Construction Plans

System procurement costs

System construction costs

Vendors or vendor list that will provide materials and services

Loan/Leasing Terms and Conditions

Loan or lease role in project

Loan or lease disbursement schedule

Loan or lease repayment schedule

4.19 System operators should have a choice of technologies ranging from microgrid to battery charging to photovoltaic household systems. Operators should be able to obtain loans or leases after submitting a viable business plan to a specialized committee for off-grid rural electrification composed of representatives from government, the Laos electric power industry, and appropriate non-profit groups. Once approved, the loans would be supervised by a unit within EdL specializing in off-grid electrification. Sub-units within the larger EdL off-grid unit would be available to provide technical support to projects, particularly in instances in which problems or difficulties arise. However, system operation and the repayment of any loans would be entirely the responsibility of the local operator(s).

5

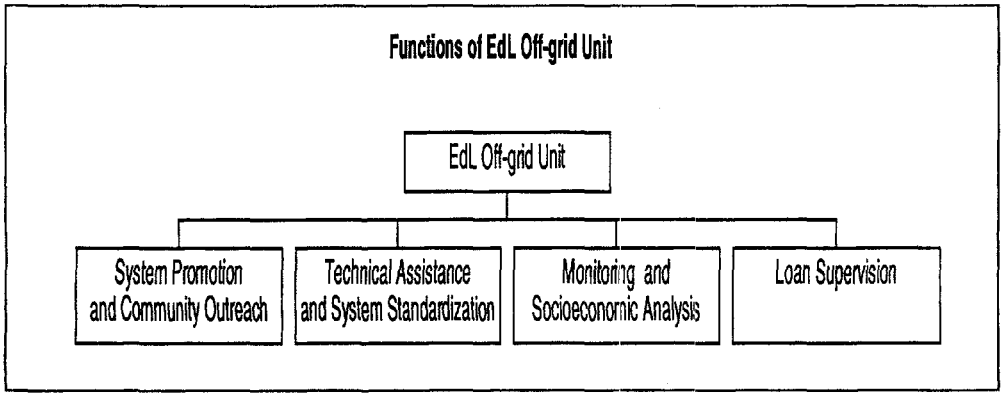
Summary

5.1 In spite of the fact that Laos PDR has significant generation capacity and even exports electricity to Thailand, only a very small percentage of the rural population in Laos has electricity. This means that in a country with abundant electric power, only about 16 percent of all people have access to it. However, serving rural populations is complicated by the low population densities and the difficult geography of the county. Laos has a very spread-out population along with a very rugged terrain, all of which make grid extension expensive, especially for regions which are very distant from the grid.

5.2 Compared to extension of existing national and provincial grids, an off-grid component of rural electrification requires a very different set of approaches. Off-grid systems should rely on the organization of local community groups or the risk-taking of local entrepreneurs to develop enterprises for supplying rural consumers with electricity using microhydro and other appropriate technologies. These local enterprises must develop their own business plans to serve rural consumers. The responsibility of the government and of the power company is to make credit available to prospective system operators, inform them of grants, financing, training, and other available options, and provide technical support after the enterprise is established. However, it is the responsibility of individual entrepreneurs, community groups, etc. to provide rural people with access to electricity at a reasonable price based on its cost. Through off-grid solutions, the World Bank's rural electrification effort in Laos would make it possible to reach even those who are distant from the grid as long as they have the desire and ability to pay for electric service.

Appendix A: Organization and Responsibilities of EdL Off-grid Unit

1. The proposed EdL off-grid electricity unit will have many responsibilities. Given that most off-grid electricity in Laos is at present based entirely on market mechanisms, the unit would have to work through existing private avenues to achieve off-grid electrification. In the process, it might also alleviate some of the existing barriers to commercial development of off-grid rural electricity service. As indicated in Section 4 of this study, the responsibilities of the off-grid unit fall into four categories (see schematic below). These are system promotion and outreach, technical support, monitoring and evaluation of ongoing projects (including identification of best practices), and loan and lease supervision. Details of these responsibilities are provided below.



System Promotion and Community Outreach

2. Given that many of the communities that will be served by an off-grid program are remote and often do not have access to information or financing, one of the first, efforts of an off-grid electrification unit should be to "advertise" the possibilities for power service access to rural communities. Specific activities in this vein could include the following:

- Work with consumers, NGOs, local private entrepreneurs, and provincial governments (energy and industry offices, for example) to promote off-grid electrification and productive use options.
- Help organize local consumers.
- Identify and screen local private entrepreneurs.
- Assist prospective users/operators to prepare and develop business plans.

- Provide assistance to prospective users/operators to gain approval for plans from committee for off-grid rural electrification (proposed in this study) and EdL.
- Act as a liaison among local users/operators and EdL and committee for off-grid rural electrification.
- Provide training to local users/operators in business practices and management; e.g., bill collection, bookkeeping, and customer services.
- Provide recommendations to committee for off-grid rural electrification and EdL regarding applicant eligibility for the program.
- Evaluate financial standing of cooperative, prospective investors.
- Work with prospective customers and EdL's technical support sub-unit to determine the total and detailed investment requirement for the selected system.

Technical Support

3. Technical support for off-grid electrification is very important because people in rural areas often do not know the relative strengths and weaknesses of different types of technologies and system designs. The technical support function could assist communities in a variety of ways, as follows:

- Provide recommendations to local consumers regarding which off-grid options are the most appropriate.
- Provide technical assistance to consumers and other organizations at the local level regarding the use of off-grid electrification options.
- Assist prospective users/operators to develop specifications for equipment and distribution systems.
- Work with prospective consumers to identify types and quantities of in-kind contributions from consumers or, in the case of private investors, identify required levels of capital investment.
- Provide training to local users/operators in the operation and maintenance of electricity generation sets and distribution systems.
- Create lists of equipment with brand name models and specifications that meet technical standards set by EdL.
- Set standards for all equipment that can be used for the program.
- Assist EdL's system promotion sub-unit and prospective customers to determine the total and detailed investment requirement for the selected system.

Monitoring and Socioeconomic Analysis

4. Monitoring and evaluation of the progress of the development of off-grid electrification is not just for keeping track of ongoing projects. The responsibilities of the relevant specialists would be to assess regional potential for off-grid electrification through implementation of surveys, to keep track of the progress of existing projects, to assess the impact of rural electrification, and to evaluate best practices as they emerge from the program. Specific responsibilities would include the following:

- Conduct and analyze market and electricity demand surveys.
- Monitor and evaluate performance of community operators, including key indicators which may include, for example, number of kWh sold, number of customers, total revenue, detailed operation and maintenance costs, cash reserves for all items, loan/lease payments made, outstanding debt.
- Evaluate and monitor electricity sales and usage, appliance ownership, and new connections.
- Monitor and evaluate customer satisfaction.
- Develop best practices for the new program and assist in incorporating them into packages for "typical" business development plans.

Loan/Leasing Supervision

5. The responsibilities of this function would be to draft contracts or agreements between the prospective local electricity businesses and EdL. Contracts must lay out respective responsibilities, financial obligations, any in-kind contributions, and obligations of both parties. Terms of contracts might vary from one client to another, but standard contracts must be drafted as models. In addition, the supervision unit would be responsible for collecting the leasing fee, reviewing electricity sales and revenue, and overseeing contract execution.

Appendix B: Preparation of Specifications for Low-cost Distribution Networks

Background

1. Pressure to broaden electricity coverage in rural areas of Laos continues unabated, driven by both the government of Lao PDR (GoL) and the rural populations themselves. Rural electrification has been afforded a high priority by the GoL, and this is reflected in the World Bank's Country Assistance Strategy for Laos. The Bank has supported the GoL's rural electrification efforts through the Southern Provinces Rural Electrification Project, as well as the ongoing Provincial Grid Integration Project. The proposed Southern Provinces Rural Electrification Project, which is in an advanced preparation stage, would continue this support.

2. One of the obstacles to extending rural electrification to rural populations without electricity is the high cost of conventional grid systems. In Laos, as in most other areas of the developing world, existing grid systems use designs based on Western urban standards. At the other end of the spectrum, very small, private electricity supply systems are being installed by local entrepreneurs on their own initiative in developing countries. These systems typically are powered by a small diesel motor (5-10 kW) and include an inadequately fused distribution system strung informally between houses using any available support, including trees, bamboo poles, etc. These informal distribution systems have the benefit of extremely low cost, but pay little or no attention to safety, efficiency, reliability, or long-term maintainability. This situation points to an important gap in current knowledge of well designed, safe, low-cost distribution systems that are specifically geared to isolated village loads. While there has been some experience in other countries with the design and execution of appropriate, low-cost distribution systems, this knowledge is scattered, unpublished, and largely unavailable.

3. The GoL has received a grant from the Policy and Human Resources Development (PHRD) Fund of the Government of Japan for the preparation of specifications for safe, reliable, and low-cost distribution systems, including house wiring, for isolated rural demand centers dominated by household loads. The specifications would focus on secondary (low voltage) distribution systems and consider a range of options for application in Laos. These would also be relevant for developing countries worldwide. The GoL has requested Electricité du Laos (EdL) to retain a consultant to complete this task.

Objective of Specifications Preparation Effort

4. The objective of this effort is the preparation of a manual for isolated village electricity distribution systems to provide guidance in design, construction, and operation of safe, reliable, and low-cost distribution systems, including house wiring, for isolated rural demand centers dominated by household loads. The specifications would focus on secondary (low voltage) distribution systems and consider a range of options for application in developing countries worldwide.

5. The manual would be used in the implementation of microhydro and diesel mini-grids in the Southern Provinces Rural Electrification Project. In addition, it could be issued as a best practices guide for rural electrification projects generally, including those supported by the World Bank.

Scope of Work

6. The consultant will prepare a manual for isolated village electricity distribution systems (the Manual) for design, construction, operation, and maintenance of isolated rural systems. The manual will include the basic criteria for a low-cost distribution system such as minimum safety requirements, efficiency, reliability, maintainability, longevity, etc. The consultant will provide all logistical support, translation, etc. to prepare the manual. The consultant may provide honoraria and/or travel support to experts selected to make significant contributions either in the preparation of draft sections or in peer review.

7. A range of options will be presented in the manual, from the most basic system which meets the minimal performance, safety, and other criteria, to improvements which are either necessary under certain circumstances or which are desirable to exceed more advanced criteria (e.g., to incur system losses lower than those called for in the basic criteria). The manual will include sufficient drawings and sample specifications to enable an engineer to design, construct, operate, and maintain a low-cost distribution system.

8. In particular, the manual will include: detailed guidelines for system design; sample engineering specifications and drawings suitable for direct use in bidding documents; suggested procurement procedures and practices; recommended construction practices and techniques; guidelines for equipment testing prior to acceptance, system testing, and commissioning; operation and maintenance procedures.

9. Since the experience with low-cost grid networks is dispersed, this task will require a collaborative approach which taps the knowledge of a number of identified resource persons who have hands-on experience in designing and executing such systems. These will include practitioners in developed and developing countries. The consultant will provide substantive inputs to the manual, and will also incorporate inputs from at least five qualified resource persons. For this purpose, the consultant shall submit a list

of recommended resource persons, representing the widest possible scope of international experience, for review and approval by EdL and the World Bank.

10. Manual preparation is expected to require extensive international consultation via phone, fax, mail, and/or the Internet. Through this collaborative process, the consultant will prepare a draft manual which he will then submit for international peer review and for review by EdL and the World Bank. Once the reviewers' comments have been incorporated into a revised draft, the consultant will convene a workshop at a location selected in consultation with EdL to address unresolved issues and to finalize the report. Representatives from multilateral agencies including the World Bank, Asian Development Bank, Inter-American Development Bank, and African Development Bank will also be invited to comment on the draft and participate in the workshop.

11. The final draft manual incorporating the results of the workshop will be submitted to EdL and the World Bank for review and approval. The approved manual will then be translated by the consultant into French and Spanish and also submitted to the World Bank for publication as a technical paper.

Appendix C:
How to Write a Business Plan for Rural Electricity Service in Laos

Introduction

1. The business plan is the document that will be required by communities, entrepreneurs, and others attempting to establish off-grid rural electricity systems to obtain loans and/or leases for the development of these enterprises. This appendix provides an explanation of a typical business plan, several examples, and blank forms which can be used for describing a prospective off-grid enterprise and its associated financial requirements.

2. This document describes how to prepare a business plan (BP) for rural electricity service. It is for use by rural development workers or consultants with some business training or experience. This document will enable these and other rural development specialists to assist either an individual or community group in: (1) preparing a business plan, (2) presenting the business plan for financing to a bank or government agency, and (3) assisting in the implementation of the business plan.

3. This "how-to" guide to writing business plans presents a detailed description of how rural development specialists and consultants should work with the entrepreneur and what they should discuss with the entrepreneur, be it either an individual or cooperative. Many of the concepts and terms presented may be new to many rural residents, so it is very important that the consultant or other individual providing guidance takes time to explain the ideas and concepts. If the target audience fails to understand the purpose, principles, and approach of writing a business plan, then it is unlikely that they will be able to prepare a successful one. Simplifying many of the concepts by referencing examples within their communities is one approach that may be helpful in explaining these concepts and ideas.

Why Write a Business Plan?

4. Writing a business plan will help to better define and assess a business opportunity for the entrepreneur (business person or community group/organization). After it is complete, either a strong, well-planned approach to developing the enterprise will result, or the idea will be discarded as being unfeasible. A BP will help the entrepreneur to:

- define the product they will sell,
- determine how they will sell it and at what price,

- estimate how much it will cost to establish the enterprise, and make the product,
- identify competing products, and
- identify the potential customers.

5. A BP can be used for any type of product or service; the general methodology is the same. In the rural energy sector, a BP can be used to determine how to generate and sell electricity to potential customers.

6. In Laos, electricity can be produced and sold in several ways to rural consumers. A decentralized microgrid system can be developed to sell electricity to a group of consumers living close together; for example, in a small village or town. Each consumer would be connected to the microgrid and pay a monthly fee for electricity. An alternative could be a solar charging business that charges batteries for individuals and families for a service fee. Lastly, a farmer could use an agricultural engine used during the day to generate electricity for households at night. A BP should be completed for each of these options to establish whether or not the business can be successful for each specific location noted.

7. This section illustrates how to prepare a simple business plan for an electricity service business. More specifically, it is aimed at those who wish to provide electricity for themselves and for sale to others in rural areas. A sample outline is presented in Box C-1. Accompanying the general approach outline below are two sample business plans: one for microgrid electricity which is sold to village households and one for household photovoltaic systems rented to households.

Box C-1: Components of a Typical Business Plan for a Rural Energy Enterprise

1. Business Description
2. Market Analysis and Electricity Demand
3. Marketing Plan
4. Technical Design, Equipment Procurement and Construction Plan
5. Operating Plan
6. Organization Plan
7. Financial Analysis
8. Summary and Conclusion

Required Preparation for Writing a Business Plan

8. It is very important to have completed certain steps prior to writing a business plan. Failure to do so will result in a poor plan and will only necessitate

additional and supplementary work during the plan preparation. Key steps that must be undertaken in advance include:

- Defining the business: What is the goal of the business? What will it sell? Where will it be located? Who are the customers?
- Assessing the market for energy products: What are people using now?
- Assessing potential customers: Would they use your product?
- Developing a marketing approach: How would you sell your product?
- Defining the production process: How will you generate electricity or distribute your product?
- Operating the business: Who will run the business? How will the product be produced?
- Identifying the owners: Who will the owners be?
- Assessing the financial structure: How will the business make money? Is it fully appreciated it must be profitable?

9. If the potential entrepreneur has not thought about these questions, then they should not proceed. They probably will not have detailed answers to any of these questions, but they should have thought about them and they should be able to give an answer indicating that they have completed some basic work and/or thought about the subject. Lastly, it is important that the entrepreneur—whether individual or cooperative— understands the need to run the business profitability.

Preparing a Business Plan

Phase 1: Preparing the Business Plan

Business Description

10. The BP should introduce the business concept and the entrepreneur, giving a realistic impression of the business, its objectives, and merits. The business description will define the basic type of business and its purpose. The entrepreneur should be able to briefly answer the following questions before proceeding to the next phase—preparing operating plans. The questions to answer include:

- What is the exact business of the venture?
- What product or service does it sell?
- Where is the market for this product or service?
- What is the target market or specific customer group?
- How will the business be operated?

- Who will manage/run the business?
- How will it be financed? Or, what are the potential sources of finance?
- Why will it succeed?

11. By focusing on these questions, the entrepreneur(s) will first be able to determine their understanding of the prospective business and the factors that will lead to its success or cause its failure. Second, the business description will meet the expectations of the reader/financier. Typically, the business description would be drafted before the other phases, but updated after the entire BP is complete.

How to prepare a business description

1. ***Identify the location of the business.*** This will include contact information such as name of business, name of contact person, and address.
2. ***Define the history of the entrepreneur.*** Prior business experience should be briefly outlined for individuals and community groups alike. Does the entrepreneur have any energy experience and if so, what is it?
3. ***Identify the mission statement or goal of the business.*** Why is the business going to be established? Is it to make money or to provide a service?
4. ***Define the history of the market for electricity/energy services and identify the target market geographically and demographically.***
5. ***Describe the operations of the business.*** This will include what product/service will be sold, how it will be sold, and how it will be produced or procured.
6. ***Develop profiles of managers.*** This should include past experience managing projects and people.
7. ***Develop a financial summary.*** This will describe key points of the financial plan.

Market Analysis and Electricity Demand

12. The entrepreneur will need to complete an analysis of the market for electricity which should clearly identify the opportunity and potential sales. The term "market" refers to the geographic boundaries within which the firm will operate and its target market—the group of potential customers, their characteristics, and needs—to whom they will directly market energy services.

13. There are two steps that need to be undertaken to fully assess the market. First, an analysis of competing products or services needs to be completed. Second, a marketing plan needs to be developed. Competition can come in either two forms. Direct competition refers to substitute products or services, such as car batteries versus

microgrid lighting, and indirect competition, including other forms of energy and lighting such as candles, kerosene, lanterns, or flashlights.

14. A marketing analysis includes a study of the basic factors that define the market for the firm's product or service and how the firm will take advantage of the market opportunity. Specific components of a marketing analysis include:

- geographic boundaries of the market for energy services,
- economic, competitive, and social factors that influence the market,
- specific market niche, the potential customers, and their buying characteristics, such as consumer density,
- estimated demand for electricity or battery charging, and potential sales, and
- competing energy products or services.

How to prepare a market analysis and sales forecast

15. A market survey of the target market will need to be completed, taking into account the following:

- ***Define the firm's market location.*** This refers to geographic boundaries. Will electricity be sold only in the village? Is there potential to expand its sales at a later date (either in the village, adjacent villages, or to others)? Will batteries be leased to customers outside the immediate surroundings; e.g., village?
- ***Understand customer buying forces.*** This includes determining consumers; income level, current expenditures on energy services/products, seasonality and/or variability of income, customer occupation (farmer or government worker, for example), and ability to pay for new energy services. What do they use energy for? What service or use will your product have for them?
- ***Identify the target market.*** Within the larger market of the village or community there is a specific customer group that will be the focus of marketing efforts. The entrepreneur must match their abilities and skills to meet these potential customers' needs. The target market will be the customers most likely to purchase the product. The entrepreneur should develop a customer profile that will define their key characteristics, such as where they live, their occupation, income, family size, social class, and buying habits. In other countries for example, many microgrids and grid-connected power customers are government employees with stable incomes who can afford the initial connection fee or capital investment. Farmers may be very interested in the service as well, though poorer farmers may not have enough income to buy the product and would therefore not be a target market for the firm.
- ***Identify competing products or services.*** The success of the business will be strongly influenced by the level of competition it will confront. Competing electrical/energy services need to be evaluated, including direct competition provided by grid-based

power and car batteries for lighting, and indirect competition from the use of dry cell batteries, kerosene, and candles. Competing energy products should be evaluated based on quality, price, customer service, credit availability, accessibility, and reliability.

- ***Estimate electricity demand and sales.*** The ultimate aim of market research is to determine the potential sales, and by doing so, the entrepreneur can judge the feasibility of the business and prepare other parts of the business plan. The business will need to identify the potential sales of electricity or batteries based on their target market including: (1) number of customers, (2) estimated electricity demand (either kWh consumption monthly or battery charges monthly), and (3) demand profile (low demand or only evening demand). The electricity demand forecast can be based on several factors: existing energy consumption (quantity), existing energy expenditures, and ability to pay for energy services. A survey should be completed by the entrepreneur or community group to determine this information. Sales forecasts can then be based on existing energy use patterns, taking into account potentially higher energy consumption for better lighting service provided by microgrids or other prospective energy services.

Marketing Plan

16. Planning involves deciding what must be done, how it will be done, when it needs to be done, and by whom it will be done. A marketing plan will establish basic plans, policies, and procedures to delivery electricity in the right form to the customer at the right time and price. A marketing plan will:

- describe how the business' target customers will be motivated to purchase energy services,
- identify the method of selling the energy service, and
- convince lenders as to the commercial success of the business.

How to prepare a marketing plan

- ***Identify marketing goals.*** These should be concise and serve as the basis for providing incentives to management and a means of measuring the business' success. For example, the marketing plan might indicate that the electricity enterprise or cooperative will have 20 customers by the end of the first year or it might show that the business will lease 15 batteries in the first four months.
- ***Describe the marketing strategy.*** The marketing strategy is the business' plan for reaching the targeted consumers and for presenting the product/service to them. There are several components.
  - ♦ First, product positioning must be identified. Will electricity be sold/presented as a basic service, to replace other energy forms, or will it be sold as a luxury good?

Depending upon the target market, either option may work, though it is likely that it will serve as a new and improved basic service to the consumer.

- Second, price will need to be established with consideration for the product cost, consumer ability to pay, and anticipated profit margin. The price must be greater than the total cost if the business is going to succeed.
- Third, how the product will be distributed must be identified. For microgrids, this will be with electrical lines to homes, but for the businessmen selling batteries, the entrepreneur will need to determine how to delivery the product to the customer.
- Last, how the product will be promoted should be defined and may include promotion in public places such as a weekly market, visits to homes, or advertising with signs. When payment for service will be collected must also be defined.

- ***Prepare a marketing budget.*** The budget should include all the costs for promoting the product, such as printing expenses, sign rentals, etc. Monitoring and evaluation of the marketing effort can be measured either by total sales or the cost of making sales.

Technical Design, Equipment Procurement, and Construction Plan

17. Selecting the right equipment and installing it correctly is very important. For a microgrid, if too large a generator is chosen, then the cost of capital and electricity will be high in relation to potential sales. For battery charging stations, using too many solar panels to charge batteries will raise capital costs and the cost of charging a battery. In each case, the result may be fewer customers, lower profit, and a lower probability of the business succeeding. Once the equipment is purchased, it must be installed and serviced correctly. If it is not, then the quality of electricity service may be low or may not work at all.

18. The business needs to chose equipment that meets its needs, with access to the right technical capacity to make it work properly.

How to prepare a procurement and construction plan

- ***Select generation source.*** The source of generation will depend on the availability of natural resources and technical capabilities. For a microgrid, hydropower may be an option depending upon site availability. If no sites are available, then diesel may be the only option. Even if a suitable hydro site is available, the business must have the skills or assistance to develop the site. For a solar battery charging station, the site will need to have good isolation and be free of shade.
- ***Define the equipment needed.*** After electricity demand has been estimated and market research completed, then the business can determine what type of equipment it will need. For a microgrid, estimated demand will assist in choosing the right size

generator (see technical standards section later in this appendix). A battery charging station will require estimation of the potential demand and choice of the right size battery and solar panels necessary to charge the batteries.

- ***Estimate construction costs.*** The business will need to estimate the costs of building the place of operation, the production site, and installing the equipment. For microgrids, the costs for installing distribution lines must be determined.
- ***Determine vendors' list.*** The business will need to select from what vendors they will purchase goods and choose the criteria for evaluating the products, such as cost and service support.
- ***Assess the building contractor.*** Are they well qualified to complete the installation of the equipment? Have they done this work before? Will they provide a guarantee and servicing for the equipment?

Operating Plan

19. The operating plan describes the production process or how the electricity or energy service will be produced and sold. The inputs included are the energy source (such as diesel), labor to manage its production, sales skills, and the final output.

How to prepare an operating plan

- ***Defining operating procedures.*** The day-to-day operations of the business must be defined. This includes how the product/service will be produced or procured, such as maintenance and operation of generator and solar panels; how the electricity will be sold; whether or not the batteries will be leased; how the production process will be managed.
- ***Describe the operating facilities.*** How much and what type of space is required to sell the product? From where will the product be produced or sold? What resources are needed to produce the product?
- ***Describe how the product will be purchased.*** Where will the generator or solar panels be bought: from a supplier in the capital or abroad? Will it be paid for with credit? How often will it be purchased?
- ***Describe how electricity will be sold.*** Pricing of electricity must include variable and fixed charges. There are likely differences between the cost of electricity service and batteries and they must be priced differently if necessary.
- ***Describe the service/product delivery.*** How will the bill collection system work? What are the hours of operation and how will the system load be managed? Describe the system operation and maintenance.
- ***Establish an inventory control system.*** Where will the goods be stored? When will the business know to buy new products, such as batteries? How will the products be

protected against theft? What are the storage facilities for the business and what is the protection against the resale of electricity by consumers?

- ***Establish a quality control system.*** It is important to ensure that electricity service is reliable and that solar panels are of high quality. The business will need to create a system to monitor the service provided to households by surveying them on a periodic basis. Basic customer service expectations and product standards will need to be established.

Organization Plan

20. The organization plan discusses the management of people, physical assets, and financial aspects of the business and will lay the groundwork on how to manage the business successfully. It will include the form of ownership, organization structure, organization of staffing, and functions and responsibilities of staff.

How to prepare an organizational plan

- ***Identify the form of ownership.*** Will the business be owned by the community, will only customers be shareholders, or will it be owned by a private person or group? The advantages of the type of ownership selected should be described.
- ***Define the management philosophy.*** What are the values, beliefs, and goals of the organization? What are the principles that will govern the business? Is it being established to only make money or to provide a service or both? A business may have a very different approach than a community organization would have. For both approaches, it is critical that the management philosophy recognize the need to be profitable, as this is the underlying principle of any business, even a community/cooperative-based business providing services to the community.
- ***Create an organizational structure.*** This defines what the roles and responsibilities are for the business operator and employees, including the owner of the business or members of the cooperative.
- ***Personnel and compensation.*** Key personnel need to be identified with required qualifications and compensation defined, if any. Who will be the manager(s) and what is their experience?

Financial Analysis

21. The financial plan will establish if the business is profitable and what the financing requirements are. Key questions that it will answer include:

- What amount of financing is needed to start the business?
- When will the financing be needed and in what form?
- Who will provide it?

How to complete the financial analysis

- ***Determine the business cashflow.*** This requires estimating the potential revenue based on the electricity demand forecast and the price of the electricity or number of battery charges. Costs must then be estimated, including capital costs to purchase equipment, operating costs for managing the business, operation and maintenance expenses, and fuel costs. After both revenue and costs have been identified, a cashflow over a five-year period should be created to demonstrate if the business will make or lose money over a specific period of operations.
- ***Define the capital structure and financial conditions.*** The use of either a loan to fund a microgrid or leases for solar PV systems/batteries should be described. A disbursement schedule of the financing and a repayment schedule should be described.
- ***Determine the financing of capital costs for consumers.*** Based on the quantity of electricity sold and the consumers' ability to pay for electricity, financing costs should be estimated and how they will impact customers must be determined.
- ***Financial controls.*** A mechanism will need to be established to monitor the inflows of payments, repayment of debt, and the profitability or return of the business.

Summary and Conclusion

22. The business plan should be summarized, with key points of key sections presented. It is important that the overall concept be highlighted and why the business will be successful described in detail, with supporting facts from the main text of the BP presented.

Phase 2: Getting Financing

Presenting the Plan

23. Once the business plan has been completed, the entrepreneur or group must present the plan for financing. When doing so, the key personnel involved in the plan's preparation and future management of the business should present the plan to the financing group. The representatives of the future enterprise must demonstrate their knowledge and commitment to the business if they expect to receive financing.

Financing Sources

24. The major principle financing sources includes Electricité du Laos for leasing and commercial banks for lending assistance.

Phase 3: Implementing the Business Plan

25. Once financing is secured, the BP can be implemented. First though, the market and product should be reviewed to determine if the business plan needs to be

adjusted for any conditions that make have changed. Major changes should not be necessary if the BP was properly prepared. Once any necessary changes are taken into consideration, then the implementation process may begin. The consultant or other specialist should work with the entrepreneur(s) in initiating the process, with periodic visits every other month to assess progress and provide any additional assistance that may be needed.

Example 1: Business Plan for Bam Nadee Microgrid

Business Description

26. The proposed business, Bam Nadee Microgrid (BNM), will generate and sell electricity to a group of families in the village of Bam Nadee in Vientiane Province. BNM will form a cooperative to provide electricity to families in the village.

27. BNM is a community-sponsored project, organized and managed by the residents of the village. Prior to this venture, the members of this project successfully established a rice cooperative, selling the produce at a 50 percent profit for several consecutive years. We propose to buy a generator and to use some of the profit from the rice cooperative, borrowing the remainder. We believe that our positive experience with the rice cooperative taught us good business skills that we can use in this new business.

28. The goal of the business is to provide a service to its members. BNM expects to make some money from the sale of electricity, but we propose to invest the money in the business for maintenance and as a cash reserve.

29. The village of Bam Nadee has about 150 families, though BNM does not expect initially to sell electricity to all the families. We have estimated that about 30 families will join the BNM, paying an initial fee of $35 and an additional monthly fee of $10. Most of these families earn a good income as farmers, skilled artisans, and government workers. Poorer families appear unwilling to join at this time. The monthly fee charged is about the same amount a village family now spends on energy services.

30. The business will be operated by a committee of cooperative members who will be responsible for managing the daily operations of the business and for collecting the monthly fees. A generator will be bought and installed in a community hut. BNM will hire a contractor to install the equipment, including the poles, wires, and wiring into each home.

31. There will be two key managers for the cooperative. Mr. Kham was manager of the rice farm and is a village leader. He has experience managing people, basic accounting skills, works hard, and is honest. Ms. Phiuphon is the local bar manager and has strong experience in working with and motivating people.

32. BNM expects to obtain financing from Electricité du Laos, with assistance from local NGOs in filing the necessary paperwork.

33. BNM believes that the business will succeed because of the following:

- a good market has been identified,
- additional members will join once the business is operating successfully,
- many village families currently spend as much as $9/month on energy services, mainly for lighting, and
- members of the cooperative are very committed to making the business succeed.

Market Analysis and Electricity Demand

Business location

34. BNM will operate only in the village of Bam Nadee. After the business is operating, BNM expects that it will expand within the village as families recognize the benefits of electricity and demand service. Once the village market is fully met, BNM could expand to the neighboring village, a distance of 200 meters, by constructing a distribution line or by installing an additional generator. BNM has not evaluated this option.

Customer characteristics

35. The average income level of villagers surveyed is about $45 per month, with current average expenditures on energy services/products of about $9/month. BNM expects its customers will be in the higher range of income and energy expenditures. Most village household income is seasonal, as the economy is agriculture-based. Government workers will use the service as well and do not have seasonal income. Based on our survey, most potential consumers have the ability to pay for electricity service.

Target market

36. Within the village, BNM has identified a specific target customer on whom to focus its marketing efforts. These customers would most likely be able to purchase the product based on a customer profile. Key characteristics include living in the center of the village, a non-farm based occupation, an income above $85 a month, an average of six family members, a higher social class, current users of car batteries for energy, and ownership of electrical appliances such as a stereo and TV.

Competition

37. The primary competing energy service is car batteries charged at the neighboring village. (Bam Nadee is too far from grid-based power to be connected within the next ten years). Indirect competition from other energy sources includes dry cell batteries used for radios and stereos and kerosene used for evening lighting. It is expected that electric lighting and power will replace most of these fuels because: 1) the quality is higher, 2) the prices of electricity and current energy sources are equivalent, 3)

credit will be made available, and 4) the reliability of electric lighting and power is higher.

Electricity demand

38. Based on BNM's survey of 50 families, we expect that 30 families initially will purchase an estimated 200 watts of electricity daily. This electricity demand forecast was based on: 1) existing energy consumed with car batteries, disposable batteries, and kerosene, and 2) the current income level of target families ($85 month or more). Electricity sales would represent less than 20 percent of total customer income. The survey was completed by the cooperative members.

Marketing Plan

Marketing goals

39. The marketing goals for BNM include:

- 30 paying customers connected by the end of the third month of business,
- 20 additional customers connected by the end of the first year, and
- high-quality electricity service between 7 PM and 10 PM, seven nights a week.

Marketing strategy

40. The strategy for reaching the targeted consumers is based on replacing other sources of lighting and energy. BNM expects that the improved quality of electricity provided will convince them to join BNM to obtain access to the service. Based on capital, marketing, and maintenance costs, we expect to charge $10 month, a sufficient amount to cover loan repayment costs and generate a good profit. Electricity will be distributed through a microgrid with electrical lines directly to homes and businesses. Product promotion will include displays in the weekly village market, community meetings, and visits to prospective consumers at their homes. Advertising will be used, but meetings and visits are expected to play the most important role in attracting customers.

Marketing budget

41. The estimated marketing budget is $50 and includes all promotion costs, including printing expenses and display materials.

Technical Design, Equipment Procurement, and Construction Plan

Generation source and equipment

42. The microgrid will use a 15-horsepower diesel generator to generate power. It is expected that this type of generator will be sufficient to generate power for a

total of about 50 families within the village. Total demand for the initial 30 customers, based on a consumption of 200 watts each, is about 6 kW. The generator to be purchased can produce about 10 kWh, with sufficient capacity for expansion to 50 customers.

Construction costs

The following table summarizes construction costs:

Construction Costs: Bam Nadee Microgrid

	Capital	Labor
Building and site	$500	coop members
Generator	$2500	n/a
Installation of equipment	$500	n/a
Distribution lines/ other equipment	$2000	coop members
Other	$200	n/a
TOTAL	*$5700*	-

Vendors' list

43. The generator and equipment will be purchased in the regional capital based quotes from a variety of suppliers. The vendor will provide a warranty and service for the generator free of charge for the first year. Thereafter, a service fee will be required.

Operating Plan

Operating procedures

44. The generator will be run from 7 PM to 10 PM daily by the generator operator. A cooperative member will be trained and hired by the cooperative to run and maintain the generator. Each consumer will receive electricity during this period of time for a fixed monthly fee. Maximum demand will be limited to 600 watts/day per customer, sufficient to power two incandescent lights and a radio or TV.

Operating facilities

45. The generator will be located in the village in a secure building that will be built by BNM. Diesel fuel will stored in the same building as the generator.

Product purchase

46. The generator will be bought from Laotian Diesels, located in the regional capital, with credit obtained from the financing source. Diesel fuel will be purchased weekly from the village market.

Electricity sales

47. Electricity will not be sold per watt. Instead, a fixed fee will be charged per month for unlimited consumption up to an estimated 600 watts daily. Consumption above this amount will be restricted by a circuit cutoff switch. Total monthly sales are estimated to be about 6 kWh.

Service delivery

48. BNM will collect payments on the first day of each month. In case of non-payment, power will not be cut off until the third month of non-payment. All fees collected will be deposited in a local bank account and will be used to pay bills. Hours of operation will be from 7 PM to 10 PM. Maintenance will be performed on a weekly basis.

Quality control system

49. The quality of electricity service will be maintained through periodic formal or informal surveys of households to assess their level of satisfaction with the service. Basic customer service expectations have already been established through a market survey, with consumers expecting reliable power on a daily basis.

Organization Plan

Form of ownership

50. The business is to be owned by cooperative members, each of whom will contribute to the equity by depositing $35 per family. Additional members, (a total of 50 families), who will join must give the same amount to be members. Only customers will be shareholders The advantage of this system is that it will encourage complete commitment to BNM.

Management philosophy

51. The goal of BNM is to provide electricity to cooperative members and earn sufficient profit to maintain reliable service and reinvest in the business.

Organizational structure

52. The managers will be responsible for operating the business, with members of the cooperatives participating in semi-annual meetings to discuss its operation and other issues of importance.

Personnel and compensation

53. Key managers with responsibility for managing and running the cooperative will be Mr. Kham and Ms. Phiuphon. Each will receive a monthly salary of $5.

- Mr. Kham was manager of the rice cooperative and is a village leader who organized the village to establish the cooperative. He has experience managing people, possesses basic accounting skills, works hard, and is honest. With his leadership we expect to be equally successful with this new business.
- Ms. Phiuphon runs a local bar. Her experience is wide and shows that she can do anything asked of her quite well. She is now managing the cash collection of the bar and is directing employees.

Financial Analysis and Plan

Business cashflow

54. The first-year revenue based on the electricity demand forecast is $3,800, with a positive cash balance of $2,810 at the end of the year. Net profit for the year is $1,460. We expect to make $3,540 in the second year.

55. Capital costs include the purchase of a generator and other equipment, construction of a building, and installation for $5,700. Operating costs are $540 for the first year. An annual cashflow has been prepared and is attached and demonstrates that the business will make $105 monthly by the fourth month.

Capital structure and financial conditions

56. A loan of $5,250, (75% leverage with a downpayment of $1,750), is necessary for the purchase of the generator and for installation of equipment. BNM expects to begin repayment after the third month of operation and will continue until the entire loan is repaid.

Financing of capital costs for consumers

57. Each family is expected to invest equity in BNM from their savings. No credit will be provided initially for them to join the cooperative, though after one year, BNM may consider providing some type of credit financing.

Financial controls

58. The managers of BNM will monitor the inflows of payments, record them in a ledger, deposit them in the bank account, repay debt on a monthly basis, and assess the profits on a yearly basis. This is presented in the attached cashflow. Income statements are presented below for Years 1 and 2.

Income Statement, Year 1

	US$
Monthly fees collected	3800
Operating costs	540
Net profit	*3260*
Loan repayment	1800
Net profit/loss	***1460***

Income Statement, Year 2

	US$
Monthly fees collected	6000
Operating costs	660
Net profit	*5340*
Loan repayment	1800
Net profit/loss	***3540***

Summary and Conclusion

59 BNM believes the business will be successful because we have completed good market research, discussed the business and service issues with prospective cooperative members, identified a good market for electricity, and are committed to the business and its success.

Bam Nadee Microgrid: Cashflow Projection for Year 1, US$

	Month												
	1	2	3	4	5	6	7	8	9	10	11	12	Total
REVENUE													
Capital	1050								700				1750
Loan	5250												5250
Monthly fees			300	300	300	300	300	300	500	500	500	500	3800
Total Cash	*6300*	*0*	*300*	*300*	*300*	*300*	*300*	*300*	*1200*	*500*	*500*	*500*	*10800*
COSTS													
Capital Costs													
Generator		2500											2500
Building	500												500
Equipment		2000											2000
Installation Cost		500											500
Other			150										150
Operating Costs													
Marketing	20	20	10										50
Fuel Cost			20	20	20	20	20	20	30	30	30	30	240
Managers' Salaries			10	10	10	10	10	10	10	10	10	10	100
Operator Salary			5	5	5	5	5	5	5	5	5	5	50
Maintenance Cost			10	10	10	10	10	10	10	10	10	10	100
Total Costs	*520*	*5020*	*205*	*45*	*45*	*45*	*45*	*45*	*55*	*55*	*55*	*55*	*6190*
Cashflow (Profit/Loss)	*5780*	*-5020*	*95*	*255*	*255*	*255*	*255*	*255*	*1145*	*445*	*445*	*445*	*4610*
Loan repayment (less)	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(1800)
Net Cashflow (Profit/Loss)	*5630*	*-5170*	*-55*	*105*	*105*	*105*	*105*	*105*	*995*	*295*	*295*	*295*	*2,810*
Cash Balance	5630	460	405	510	615	720	825	930	1925	2220	2515	2810	2810

Example 2: Business Plan for Laotian PV Systems

Business Description

60. The proposed business, *Laotian PV (LPV)*, will lease complete solar systems to families in the village of Laksoa in Vientiane Province. LPV will be owned by Mr. Phonphan and his sons, businessmen in the village and owners of a shop charging batteries with a small generator.

61. Mr. Phonphan has been a successful shop owner, with 20 years of experience in the community. LPV will buy the generating system distributor in the capital, investing $600 equity and borrowing the remainder. We believe that our experience with the current shop taught us good business skills that we can use in this new business.

62. The goal of the business is to lease solar systems to consumers in the village and surrounding community. Profits will be used to expand the business by buying more PV systems to lease to more consumers, perform maintenance on existing equipment, and as a cash reserve.

63. The village and surrounding communities of Laksoa have about 500 families. LPV does not expect that all households will be interested in leasing a PV system, but has estimated that about 50 systems will be leased after three months. Each customer will pay an initial security fee of $20 and an additional monthly fee of $10 for a 15-watt system, or $15 for a 50-watt system. Most of these families earn a good income as farmers, skilled artisans, and government workers. Some poorer families appear uninterested at this time, but probably some will join later when they understand the benefits. The monthly fee charged is only slightly higher than the average amount a village family now spends on energy services.

64. The business will be operated by Mr. Phonphan and his two sons, who will be responsible for managing the daily operations of the business and collecting the monthly fees. The PV systems will be installed at each home by a contractor licensed to install the equipment.

65. LPV expects to obtain financing from the local bank, with assistance from local NGOs in filing the necessary paperwork. After the monthly repayment fee is paid each month, LPV expects to make between $100 and $200 per month by the fourth month of operations.

66. LPV believes that the business will succeed because of the following:

- there is large market,
- many village families currently spend as much as $7 per month on energy services, mainly for lighting, and
- the owner is very committed to making the business succeed.

Market Analysis and Electricity Demand

Business location

67. LPV will operate in the village of Laksoa. After the business is operating, LPV expects that it will expand and lease systems outside the village as families recognize the benefits of electricity. Once the village demand is fully met, LPV could expand its services to as many as five neighboring villages.

Customer characteristics

68. The income level of villagers surveyed is about $75 per month on average, with current average expenditures on energy services/products of about $10 per month. LPV expects its customers will be in the middle range of this figure. Most household income is seasonal, as the economy is agriculture-based. Government workers will probably be more likely to lease batteries as they have a stable income. Based on our survey, many consumers have the ability to lease a PV system.

Target market

69. Within the community, LPV has identified a specific target customer on whom to focus its marketing efforts. These customers would most likely be able to lease a PV system based on the following customer profile: non-farm based occupation, income of about $75 a month, an average of six family members, diverse social class, current users of car batteries and disposable batteries for energy and lighting, and ownership of a stereo.

Competition

70. Competing energy services are primarily car batteries charged at the trading town, 10 kilometers from the village. (Laksoa is too far from grid-based power to be connected within the next 10 years). Indirect competition from other energy sources includes dry cell batteries used for radios and stereos and kerosene used for evening lighting. It is expected that solar PV systems will displace currently used car batteries because: 1) higher-quality batteries will be used, 2) leasing will be the same price for better service than is charged in the neighboring town, 3) reliability is higher, and 4) batteries will be guaranteed.

Electricity demand

71. LPV's survey demonstrates that 50 families will lease PV systems on a monthly basis. This demand forecast was based on: 1) existing energy consumed with car batteries, disposable batteries, and kerosene, and 2) a current income level of target families of $75 month. PV systems would represent only 13 percent to 20 percent of total income. My sons completed the survey of families in the community.

Marketing Plan

Marketing goals

72. The marketing goals for LPV include:

- 30 paying customers leasing PV systems by the end of the third month of business,
- 20 additional customers by the end of the first year, and
- a profitable business after one year of operations.

Marketing strategy

73. The strategy for reaching the targeted consumers is based on replacing other currently used energy sources. LPV expects that the improved quality of electricity provided through the leasing of PV systems will encourage targeted households to switch. Based on capital, marketing, and maintenance costs, we expect to charge $10-15 per month, sufficient to cover loan repayment costs and generate a good profit. PV systems will be leased from the entrepreneur's existing business location where customers will make lease payments and receive service assistance. PV systems will be promoted with displays in the weekly village market, community meetings, and visits to prospective consumer's homes.

Marketing budget

74. The estimated marketing budget is $100 and includes all promotion costs, including printing expenses and display material.

Technical Design, Equipment Procurement, and Construction Plan

Charging source and equipment

75. The solar PV equipment will include two models: a 15-watt model and a 50-watt model, each of which will include a solar panel, inverter, and battery. It is expected that the 15-watt system will be able to generate enough electricity to power one to two lights, and the larger system sufficient to power one light and a radio, depending upon wattage of the lights and hours of use.

Capital costs

76. The following summarizes equipment and construction costs:

Capital Costs: Laotian PV

	Capital
Storage Building	$250
10 50-watt systems	$6,000
40 15-watt systems	$9,000
Installation of equipment	
TOTAL	*$16,500*

Vendors' list

77. The solar systems will be purchased in the capital through an approved dealer. The vendor will provide a warranty and service free of charge for the first five years. Thereafter, a service fee will be paid.

Operating Plan

Operating procedures

78. My two sons will be trained to run and complete basic maintenance to the PV systems.

Operating facilities

79. The systems will be leased from my existing business and will be kept in a building located next to my shop in the village. The batteries and other equipment will be stored in my locked storehouse.

Product purchasing

80. The batteries and solar panels will be bought from ACME Solar Panels located in the capital, with the entrepreneur's equity and credit obtained from the financing source.

Service delivery

81. LPV will collect monthly payments on the first charge of the month. In case of non-payment, the systems will be taken back after one month of non-payment. All fees collected will be deposited in the local bank account and used to pay back the bank loan and other expenses.

Quality control systems

82. Battery quality will be monitored and batteries replaced if necessary. It is expected that we will replace batteries on a yearly basis. If customers are overusing batteries, they will be charged an additional fee. If a battery is bad, then a new battery will be given to the customer. Quality will be judged through periodic surveys of households to assess their level of satisfaction with the service. Basic customer service expectations have been established through a market survey, with prospective consumers expecting reliable batteries and systems.

Organization Plan

Form of ownership

83. The business be owned by Mr. Phonphan and his two sons who will contribute $600 in equity.

Management philosophy

84. The goal of LPV is to earn a good profit through PV system leasing and to create a sustainable business.

Organizational structure

85. Mr. Phonphan will be the manager of the business and will be directly responsible for the operations of the business. His sons will be in charge of PV system leasing and marketing.

Personnel and compensation

86. Mr. Phonphan has considerable experience in managing and running a business, with over 20 years of experience. His two sons have been working with him for five years and have both studied business at the regional capital. Compensation will be through ownership of the business: Mr. Phonphan will have 50 percent and his sons will each have 25 percent.

Financial Analysis and Plan

Business cashflow

87. The first-year revenue based on the electricity demand forecast is $6,080, with a positive cash balance of $1,780 at the end of the year. Net profit for the year is $80, but we expect to make $2,600 in the second year.

88. Capital costs include the purchase of PV systems, construction of a building, and installation for equipment, for a total cost of $16,500. Operating costs are $400 for the first year. An annual cashflow has been prepared and is attached and demonstrates that the business will have a positive cashflow by the third month of operation.

Capital structure and financial conditions

89. A loan of $12,450 is necessary for the purchase of the solar systems and for installation of equipment. LPV expects to begin repayment immediately and to continue until the entire loan is repaid. The owners will invest $4,150 of their own savings, (25% downpayment).

Financial controls

90. The managers of LPV will monitor the inflows of payments, record them in a ledger, deposit them in the bank, repay debt on a monthly basis, and assess the profits on a yearly basis. This is presented in the attached cashflow. Income statements are presented below for Year 1 and 2.

Income Statement, Year 1

	US$
Monthly fees collected	6080
Operating costs	400
Net profit	*5680*
Loan repayment	(5000)
Net profit/loss	***80***

Income Statement, Year 2

	US$
Monthly fees collected	9600
Operating costs	400
Net profit	*9200*
Loan repayment	(6600)
Net profit/loss	***2600***

Summary and Conclusion

91. LPV believes the business will be successful because we have completed good market research, discussed the business and service issues with potential customers, identified a good market for electricity, and are committed to the business and its success.

Laotian PV Systems: Cashflow Projection for Year 1, US$

	Month												
	1	2	3	4	5	6	7	8	9	10	11	12	Total
REVENUE													
Capital	4150												4150
Loan	6450								6000				12450
Battery Deposit			900						100				1000
Monthly fees			480	480	480	480	480	480	800	800	800	800	6080
Total Cash	*10600*	*0*	*1380*	*480*	*480*	*480*	*480*	*480*	*6900*	*800*	*800*	*800*	*23680*
COSTS													
Capital Costs													
Building	250												250
Solar Systems		9000							6000				15000
Installation Cost			750						500				1250
Operating Costs													
Marketing	40	40	20										100
Miscellaneous			20	20	20	20	20	20	20	20	20	20	200
Maintenance Cost			10	10	10	10	10	10	10	10	10	10	100
Total Costs	*290*	*9040*	*800*	*30*	*30*	*30*	*30*	*30*	*6530*	*30*	*30*	*30*	*16900*
Cashflow (Profit/Loss)	*10310*	*(9040)*	*580*	*450*	*450*	*450*	*450*	*450*	*370*	*770*	*770*	*770*	*6780*
Loan repayment (less)	(350)	(350)	(350)	(350)	(350)	(350)	(350)	(350)	(550)	(550)	(550)	(550)	(5000)
Net Cashflow (Profit/Loss)	*9,960*	*(9390)*	*230*	*100*	*100*	*100*	*100*	*100*	*(180)*	*220*	*220*	*220*	*1780*
Cash Balance	9,960	570	800	900	1000	1100	1200	1300	1120	1340	1560	1780	1780

Example No. 3

Business Plan Form

1 Business Description

The proposed business will:

The owner(s):

The goal:

The market:

The business will be operated by:

Financing will come from:

We believe that the business will succeed because of the following:

-
-
-
-

2 *Market Analysis and Electricity Demand*

Business location

Customer

Target market

Competition

Electricity demand.

3 Marketing Plan

Marketing goals

The marketing goals include:

-
-
-
-

Marketing strategy

Marketing budget

4 *Technical Design, Equipment Procurement and Construction Plan*

Charging source and equipment

Construction costs

Construction Costs

	Capital	Labor
Building and Site		
TOTAL		

Vendors' list

5 *Operating Plan*

Operating procedures

Operating facilities

Product purchasing

Service delivery

Quality control system

6 *Organization Plan*

Form of ownership

Management philosophy

Organizational structure

Personnel and compensation

7 *Financial Analysis and Plan*

Business cashflow

Capital structure and financial conditions

Financial controls

Income Statement, Year 1

	US$
Monthly fees collected	
Operating costs	
Net profit	
Loan repayment	
Net profit/loss	

Income Statement, Year 2

	US$
Monthly fees collected	
Operating costs	
Net profit	
Loan repayment	
Net profit/loss	

8 Summary and Conclusion

Cashflow Projection for Year 1, US$

	Month												
	1	2	3	4	5	6	7	8	9	10	11	12	Total
REVENUE													
Capital													
Loan													
Monthly fees													
Total Cash													
COSTS													
Capital Costs													
Generator													
Building													
Installation Cost													
Other Equipment													
Operating Costs													
Marketing													
Fuel Cost													
Miscellaneous													
Maintenance Cost													
Total Costs													
Cashflow (Profit/Loss)													
Loan repayment (less)													
Net Cashflow (Profit/Loss)													
Cash Balance													

Appendix D:
The Survey Sample Design and Questionnaire

1. The ESMAP survey of energy use in rural Laos was conducted utilizing a multi-stage random sampling design. The survey used two similar questionnaires, including one designed for households with electricity and another designed for households without electricity. The survey was carried out between April and May 1997. A total of 1,580 households were interviewed, including 720 households with electricity and 860 households without.

2. Lao PDR consists of 17 provinces and a Special Zone covering an area of 236,800 square kilometers (see Table 2-1 in main portion of this paper). A total of 752,102 households (4.58 million people) live in the country.[1] The vast majority (approximately 85-90 percent) of the population lives in the rural areas, including rural villages and towns.[2]

3. The population frame for rural households with electricity consisted of all households in villages that have electricity from either the central grids (EdL's grids) or small, provincial, government-owned grids serving provincial capitals and/or main towns. Only the provincial capitals or main towns of small provinces that still can be characterized as rural were included in the population frame. The population frame for the rural populations without electricity was comprised of all rural households living in villages with more than 100 households and which have no access to grid electricity (either EdL or provincial government grids). The reason that the survey focussed on the larger villages is that these are more likely to be the initial focus of the off-grid electricity program.

4. A four-stage sample selection process was employed for the survey. The first stage of the sample involved the selection of eight provinces. Of the eight provinces, six were randomly selected and two others were non-randomly selected. The two provinces from the Northern region that were non-randomly selected were Phongsaly and Luang Namtha. They were selected because they are under consideration for pilot off-grid electrification projects. Table D-1 lists all of the provinces in Laos PDR and provides the sample details of the provinces that were selected for the surveys.

---

[1] Committee for Planning and Cooperation, National Statistical Center, Lao Census March 1995, Preliminary Report.

[2] Only about six out of eight districts which form the Vientiane Municipality and a few major districts of larger provinces including Savannakhet, Champasak, and Luang Prabang could be considered urban areas.

Table D-1. Sample Selection for Rural Energy Survey

Provinces	*Total districts*	*Sample Selection*			
		Districts	*Villages*	*Households with electricity*	*Households without electricity*
Vientiane Prefecture	9	--	--	--	--
Phongsaly	7	3	15	90	160
Luang Namtha	5	3	15	90	160
Oudomxai	7	--	--	--	--
Bokeo	5	3	15	60	120
Luang Prabang	11	--	--	--	--
Houaphan	6	--	--	--	--
Xaignabouly	5	--	--	--	--
Xiengkhouang	8	3	15	60	120
Vientiane	9	--	--	--	--
Bolikhamxai	6	--	--	--	--
Khammouane	9	3	15	120	60
Savannakhet	13	3	15	120	60
Saravane	8	3	15	120	60
Xekong	4	--	--	--	--
Champasak	10	--	--	--	--
Attapeau	5	3	15	60	120
Special Zone	4	--	--	--	--
Total	131	24	120	720	860

Note: "--"not surveyed.

Source: Ministry of Industry and Handicraft, September 1995; ESMAP Laos Energy Use Survey, 1977.

5. For the second stage of the sample selection procedure, a total of 24 districts were selected. Of these districts, the survey for households with electricity was implemented in 11 districts, while the survey for households without electricity was implemented in 13 districts. Districts selected for both surveys were selected based on prior information regarding the number of districts and villages that have access and no access to grid electricity. For provinces with a low percentage of the population with electricity, only one district was selected for the survey of households with electricity and two districts were selected for the survey of households without electricity. The reverse

of the procedure was used for districts with a relatively high rate of grid-based rural electrification.

6. The third stage of the sampling process involved selecting villages at random from the sample districts. A master file for the 1995 census containing lists of villages and the number of households in each village for the whole country was utilized as the sample frame. For the survey of households without electricity, the villages included in the sampling frame were those with more than 100 households. A total of five villages were randomly selected from each selected district.

7. The justification for including only larger villages was that the project aimed to collect data to develop strategies for non-grid rural electrification in remote areas where EdL has no plans for electricity distribution in the near future, but whose households might want to have even a small amount of electricity and might also have means to pay for it. Furthermore, it is believed that households in larger villages are more likely to have a demand for a small amount of electricity and the willingness and ability to pay for it.

8. For electrified households, a survey list of all villages with electricity connections to either EdL or provincial government grids, regardless of their size, was used as a sampling frame for random selection of electrified villages.[3] A total of five villages was randomly selected from each district in the second sampling stage.

9. Because of the low population densities and remoteness of some regions, the survey team was given some flexibility in selecting villages. After beginning the survey, it was evident that some villages selected for the sample could not be located, had moved to the new location, or were not accessible by truck, boat, or foot in a reasonable amount of time. In these cases, the field managers were allowed to substitute the village with another, similar village. Although this has the potential to bias the sampling results, once again, the off-grid electricity program is likely to be concentrated in the types of villages sampled by this study. Thus, the sample is not necessarily representative of all villages in Laos, especially small villages in extremely remote areas.

10. In the final stage of both surveys, 12 households from each village were randomly picked for interviews. For the two non-randomly selected provinces in the north (Phongsaly and Luang Namtha), a total of 16 households were selected at random from each village for interviews. This was to ensure a reasonable number of cases representing these two provinces. However, in the case of the survey of electrified households, only electrified households were randomly picked for interviews.

---

[3] Electrified villages are usually large and have more than 100 households, because the village selection procedure for electrification adopted by EdL and provincial governments favors large villages over small ones.

Survey Schedule of Questions for Laos Off-grid Electricity Planning Project

Household ID No.: | | | | |

Non-Electrified and Electrified Household Survey Form

Rural Household Energy Survey
LAO PDR
Non-Grid Rural Electrification Planning Project

Date of interview: _____

Time Start: _____

Time End _____

Interviewer's Name: _____

Supervisor's Name: _____

1.2 House Number:	_____	Q1.2	
1.3 Village (Ban):	_____	Q1.3	
1.4 District (Muang):	_____	Q1.4	
1.5 Province (Kwaeng)	_____	Q1.5	

Coding:
[-7] = Do not apply
[-8] = No answer
[-9] = Missing value

Section 2: Socio-Economic Information

			Var. Name
	Name of respondent:		
2.1a	Sex of the respondent Code: [1] = Male [2] = Female	_____	Q2.1a
2.1b	Age of respondent:	_____	Q2.1b

			Var. Name	
2.1c	Educational level of respondent: [0] = Never attended school [1] = Primary school [2] = Middle school [3] = High school [4] = College education [5] = University education [6] = Post-graduate education	_____	Q2.1c	
2.2	Respondent's relationship to head of household [1] = Head of the household [2] = Head of household's wife or husband [3] = Daughter [4] = Son [5] = Daughter-in-law [6] = Son-in-law [7] = Other, specify	_____	Q2.2	
2.3	How many persons usually eat or sleep in the household ? (Fill in according to age)			
2.3a	Less than 6 years	_____	Q2.3a	
2.3b	7-17 years	_____	Q2.3b	
2.3c	18-60 years	_____	Q2.3c	
2.3d	61 years and over	_____	Q2.3d	
2.3e	Total	_____	Q2.3e	
2.4	What is the highest educational level of immediate adult family member of the household ? (regardless of where he/she lives) [0] = Never attended school [1] = Primary school (1-7 years) [2] = Middle school (S1 to S4) [3] = High school (S5 to S6) [4] = College education [5] = University education [6] = Post-graduate education	_____	Q2.4	
2.5	How many persons in your household earn income? (include all types of income earned)	_____	Q2.5	

Section 3: Housing Unit

			Var. Name	
3.1	Main type of dwelling unit [1] = Wood construction [2] = Brick construction (bricks)/concrete block [3] = Brick and wood construction [4] = Bamboo construction wall [5] = Other specify.....	_____	Q3.1	
3.2	Main roofing materials of the dwelling unit [1] = Metal sheet roof [2] = Bamboo/straw fiber/leaves [3] = Bake brick [4] = Other specify	_____	Q3.2	
3.3	Is any part of your house used for business activity or commercial purposes or home industry, i.e., business owned and operated by you or a member of your household? [1] = Yes; [0] = No, If "No," go to Q3.5	_____	Q3.3	
3.4	If part of your house is used for business activity, please indicate type [1] = Hair salon or barber shop [2] = Food and beverage shop (i.e., restaurant) [3] = Grocery and beverage shop [4] = Beverage shop [5] = Retail store [6] = Making handicraft or handicraft shop [7] = Tailor/Dress maker [8] = Repair/tool shop (e.g., agricultural tool) [9] = Rice mill [10] = Small saw mill/furniture factory [11] = Other, specify	_____	Q3.4	
3.5	Does your household own or rent this house? [1] = Own; [0] = Rent	_____	Q3.5	

Section 4: Sources of Energy for Lighting

What is your usual sources of energy for lighting in the household?

Code: Yes = [1]; No = [0]

		Yes	No	Var. Name	
4.1	Electricity from the grid			Q4.1	
4.2	Kerosene.			Q4.2	
4.3	Diesel			Q4.3	
4.4	Car battery			Q4.4	
4.5	Electricity from privately/community owned generator			Q4.5	
4.6	Dry cell battery			Q4.6	
4.7	Candles			Q4.7	
4.8	Torch			Q4.8	
4.9	Electricity from the household own solar PV panel			Q4.9	
4.10	Other specify			Q4.10	

Sources of Energy for Cooking and Boiling & Heating of Water and Frequency of Usage

How often does your household use the following fuels for cooking?

Code: [0] = Do not use
[1] = Use some of the time
[2] = Use most of the time
[3] = Always

			Var. Name	
4.11	Charcoal		Q4.11	
4.12	Firewood		Q4.12	
4.13	Twigs or small tree branches		Q4.13	
4.14	Scrap wood		Q4.14	
4.15	Agricultural residue including straw & stalk		Q4.15	
4.16	Electricity		Q4.16	
4.17	Sawdust		Q4.17	
4.18	LPG		Q4.18	

	Section 5: Electricity			Var. Name	
5.0	Does your household use electricity generated from electric generator is connected to the grid? Code: [0] = Do not use [1] = Use electricity		_____	Q5.0	
5.1	What is the source of your household electricity connection? Code: Yes = [1]; No = [0]	**Yes**	**No**		
5.1	Electricit© du Laos (EDL's central grid)	_____	_____	Q5.1	
5.2	Neighbor/relative who connected from Electricit© du Laos (EDL)	_____	_____	Q5.2	
5.3	Provincial electricity services (local grid)	_____	_____	Q5.3	
5.4	Neighbor/relative who connect to Provincial electricity services	_____	_____	Q5.4	
5.5	Neighbor who has generator	_____	_____	Q5.5	
5.6	Private entrepreneur who has generator	_____	_____	Q5.6	
5.7	Owned electric generator home	_____	_____	Q5.7	
5.8	Cooperative	_____	_____	Q5.8	
5.9	Other, specify	_____	_____	Q5.9	
5.10	How many years has your household had electricity? _____ Years.		_____	Q5.10	
5.11	Is the electricity used by your household only? [1] = Only my household; (If [1] go to Q4.3) [2] = We share with other household(s)		_____	Q5.11	
5.11a	If share electricity with other household, please indicate the total number of households including your households who are sharing electricity with yours? _____ households.		_____	Q5.11a	

			Var. Name	
5.12	Who do you pay electricity services to: [1] = EDL [2] = Neighbor/relative who pays to EDL [3] = Provincial Electricity services [4] = Neighbor/relative who pays to Provincial electricity services [5] = Neighbor who has generator [6] = Private entrepreneur who has generator [7] = Does not pay [8] = Cooperative [9] = Other, specify	_____	Q5.12	
5.13	On the average, how much does your household pay for electricity for each billing period? _____ Kips	_____	Q5.13	
5.14	How many days do each bill cover? _____days	_____	Q5.14	
5.15	How does your household pay your monthly electricity bill? [1] = Pay by kWh used [2] = Pay by number of light bulbs/tubes & appliance [3] = Fixed monthly cost (If answer [2] or [3] go to Q5.17a)	_____	Q5.15	
5.16	If pay by kWh used, how much does your household pay per kWh _____ Kips/kWh	_____	Q5.16	
5.17	If pay by number of light bulbs/tubes & appliances or fixed monthly cost:			
5.17a	How many light bulbs and tubes do you have? _____ Bulbs/tubes	_____	Q5.17a	
5.17b	What is the average wattage of all light bulbs/tubes? _____ Watts		Q5.17	
5.18	Does your household use electricity to cook rice? [1] = Yes; [2] = No		Q5.18	
5.19	Does your household use electricity to boil water? [1] = Yes; [2] = No		Q5.19	
5.20	Does your household use electricity for radio/tape? [1] = Yes; [2] = No		Q5.20	
5.21	Does your household use electricity for TV? [1] = Yes; [2] = No		Q5.21	
5.22	How many hours during the day time do you have electricity services? _____ Hours during the day		Q5.22	
5.23	How many hours during the evening & night time do you have electricity services? _____ hours during the evening and night time		Q5.23	

				Var. Name	
5.24	Do you have to use any of the following sources of energy to supplement electricity for lighting ? Code: [1] = Yes; [0] = No	YES	NO		
5.24a	Candle			Q5.24a	
5.24b	Kerosene/diesel lamp			Q5.24b	
5.24c	Pressurized lamp			Q5.24c	
5.24d	Car Battery			Q5.24d	
5.25	On the average, how much does your household have to spend per month to supplement electric light?		Kip	Q5.25	

Ask the respondent to show you most recent electric bills (at least 2 consecutive bills for each meter will be needed). Then copy information from the bills in the questionnaire form.

Electricity Bills

____/____/____ Billing date: (Enter date/mo/yr)

_____ Meter Number

_____ Billing Number

Last meter reading	Current meter reading	Total kWh	Total Costs	____/____/___(dd/mo/yr) date current meter reading

____/____/____ Billing date: (Enter date/mo/yr)

_____ Meter Number

Last meter reading	Current meter reading	Total kWh	Total Costs	____/____/___(dd/mo/yr) date current meter reading

____/____/____ Billing date: (Enter date/mo/yr)

_____ Meter Number

Last meter reading	Current meter reading	Total kWh	Total Costs	____/____/___(dd/mo/yr) date current meter reading

____/____/____
Billing date: Meter Number
(Enter date/mo/yr)

Last meter reading	Current meter reading	Total kWh	Total Costs	____/____/___(dd/mo/yr) date current meter reading

Interviewer must calculate number of days, kWh and kips from the bills and fill in the following sections after the interview, prior to submit this form to the field supervisor.

Calculation of electric bills for kWh consumed and expenditure

Meter number: _____	No. of days bill cover:	_____	days	**Q5.26a**	
	kWh consumed	_____	kWh	**Q5.26b**	
	Amount due/owed:	_____	Kips	**Q5.26c**	
Meter number: _____	No. of days bill cover:	_____	days	**Q5.27a**	
	kWh consumed	_____	kWh	**Q5.27b**	
	Amount due/owed:	_____	Kips	**Q5.27c**	
Meter number: _____	No. of days bill cover:	_____	days	**Q5.28a**	
	kWh consumed	_____	kWh	**Q5.28b**	
	Amount due/owed:	_____	Kips	**Q5.28c**	
Meter number: _____	No. of days bill cover:	_____	days	**Q5.29a**	
	kWh consumed	_____	kWh	**Q5.29b**	
	Amount due/owed:	_____	Kips	**Q5.29c**	

Section 5.1: Electric Appliances Ownership

	How many of the following appliances does your household have? (Enter "0" for do not have)	Number Have	Var. Name	
5.30	Rice Cooker	_____	Q5.30	
5.31	Electric hot plate and/or Stove	_____	Q5.31	
5.32	Electric kettle	_____	Q5.32	
5.33	Electric power drill/saw	_____	Q5.33	
5.34	Electric motor	_____	Q5.34	
5.35	Fan	_____	Q5.35	
5.36	Ironing	_____	Q5.36	
5.37	Refrigerator	_____	Q5.37	
5.38	Color Television	_____	Q5.38	
5.39	Washing machine	_____	Q5.39	
5.40	Black and White Television	_____	Q5.40	
5.41	Radio/tape cassette	_____	Q5.41	
5.42	Large stereo system	_____	Q5.42	
5.43	VCR	_____	Q5.43	

	Section 5.1: Electric Appliance Ownership (Cont.)		**Var. Name**	
5.43	Electric Pump (water)	_____	**Q5.44**	
5.44	Electric sewing machine	_____	**Q5.45**	

	Section 6: Use Electricity for Business and/or Productive Purposes		**Var. Name**	
6.1	Does your household use electricity to conduct your business or productive purposes? [1] = Yes; [0] = No (If answer [0] go to Q7.1 Do you use electricity for lighting or anything else in your home business/industry/agricultural activity? If Yes, for which of the following purposes do you use electric energy sources in your home business/industry/ agricultural activity?	_____	**Q6.1**	
6.3	Lighting **to protect your home business/industry** from burglary or alike OR to **protect your livestock and/or crops.** [1] = Yes; [0] = No; if "NO" go to Q6.5	_____	**Q6.3**	
6.4	If yes, generally how many hrs/evening do you keep light on to protect your home business or industry or livestock or crops? _____ hrs/evening	_____	**Q6.4**	
6.5	Area lighting **to conduct business** (i.e., lighting to keep store/shop open in the evening, or do handicraft, or etc.). [1] = Yes; [0] = No; if "NO" go to Q6.7	_____	**Q6.5**	
6.6	Generally, how many hours/evening do you have area lighting on to conduct business. (i.e., keep store/shop open, or do handicraft, or etc.) _____hours/evening	_____	**Q6.6**	
6.7	Lighting to **do more work** in the evening Code: [1] = Yes; [0] = No;	_____	**Q6.7**	
6.8	Lighting to **repair equipment/tools** used for production. Code: [1] = Yes; [0] = No	_____	**Q6.8**	

	Uses Electricity for Productive Purposes (Cont.)		**Var. name**	
6.9	**To power tool/motor/machine/pump/refrigerator** Code: [1] = Yes; [0] = No	_____	**Q6.9**	
6.10	**Radio/tape** for music to entertain customers in the business premises. [1] = Yes; [0] = No	_____	**Q6.10**	
6.11	**TV/Video** to entertain customers [1] = Yes; [0] = No		**Q6.11**	
6.12	Any other use [1] = Yes, specify..... [0] = No	_____	**Q6.12**	

Lighting

Can you please tell me how many light bulbs are used each day in your household, as well as the capacity of each and the number of hours used?

Incandescent light bulb

Capacity (watts)	Number of bulbs	Total hours each bulb is used during a 24-hour period	Number of bulbs	Total hours
			B5W	**B5H**
5				
			B10W	**B10H**
10				
			B25W	**B25H**
25				
			B40W	**B40H**
40				
			B60W	**B60H**
60				
			B75W	**B75H**
75				
			B100W	**B100H**
100				

First, for each capacity listed in Column 1, the interviewer enters in Column 2 the number of bulbs the household has for each.
Second, the interviewer enters in Column 3 the total number of hours each bulb is used during a 24-hour period, using the addition sign between entries (e.g., 3 + 4 + 2).
Third, add the numbers from Column 3 and records the total number of hours in Column 5, and copy the number of bulbs from column 2 into column 4.

Lighting (cont.)

Could you tell me how many lamps are used daily in your household for lighting, as well as their capacity and number of hours used per day?
Fluorescent Tube

Capacity (watts)	Number of tubes	Total hours each lamp is used during a 24-hour period	Number of tubes	Total hours
			F10W	**F10H**
10				
			F18W	**F18H**
18				
			F20W	**F20H**
20				
			F36W	**F36H**
36				
			F40W	**F40H**
40				

First, the interviewer enters in Column 2 the number of lamps the household has for each capacity.
Second, the interviewer enters in Column 3 the total number of hours each lamp is used in a 24-hour period, using the addition sign between entries (e.g., 3 + 4 + 2).
Third, adds the entries from Column 3 and records them in Column 5, then and copy the number of bulbs from column 2 into column 4.

Section 7: Kerosene

				Var. Name	
7.1	During the past 12 months how often did your household use kerosene for lighting? [0] = No, did not use; If "NO" go to Q8.1 [1] = Used sometimes [2] = Used most of the time [3] = Always	_____		Q7.1	
7.2	During the month that your household uses kerosene, what percentage is dedicated for the following purposes? (e.g., enter 5%, 10%, 15%, 20%, 25%, 30%, ...85%, 90%, 95%, 100%				
7.2a	Lighting	_____	%	Q7.2a	
7.2b	Refrigerator	_____	%	Q7.2b	
7.2c	Fire starter	_____	%	Q7.2c	
7.2d	Other, specify	_____	%	Q7.2d	
	Total	100	%	Total	100%
7.3	On the average, how much does your household spend on kerosene per month? _____Kips	_____		Q7.3	
7.4	In general, how many liters of kerosene and price per does your household usually purchase?				
	(Q7.4a) Number of liters usually by each time E.g., Small Pepsi bottle (0.25 liter) Beer bottle (0.65 liter) Whisky bottle (0.75 liter) Fish sauce bottle (0.65 liter) Big Pepsi Bottle) (1.00 liter)	_____		Q7.4a	
	(Q7.4b) Price per liter (in Kip)			Q7.4b	
7.5	Generally, how many <u>days</u> does the kerosene from your <u>usual purchase</u> last? _____ days	_____		Q7.5	
7.6	When your household uses kerosene, how many liter are usually used in a month?	_____		Q7.6	

Section 8: Diesel

				Var. Name	
8.1	During the past 12 months did your household use any diesel for lighting? [0] = No, did not use; If "NO" go to Q8.7 [1] = Used sometimes [2] = Used most of the time [3] = Always	_____		Q8.1	
8.2	During the month that your household uses diesel, what percentage are dedicated for each of the following purposes? (E.g., enter 5%, 10%, 15%, 20%, 25%, 30%, ...85%, 90%, 95%,.100%)				
8.2a	Lighting	_____	%	Q8.2a	
8.2b	Rice milling	_____	%	Q8.2b	
8.2c	Electric generator	_____		Q8.2c	
8.2d	Agricultural activities/Three wheeler transport)	_____		Q8.2d	
8.2e	Fire starter	_____		Q8.2e	
8.2f	Other specify	_____	%	Q8.2f	
	Total	100	%	Total	100%

			Var. Name	
8.3	On the average, how much does your household spend on diesel per month? (Kip)	_____	Q8.3	
8.4	In general, how many liters of diesel, and price per liter does your household usually purchase?			
	(8.4a)Number of liters usually buy each time E.g., Small Pepsi bottle (0.25 liter) Beer bottle (0.65 liter) Whisky bottle (0.75 liter) Fish sauce bottle (0.65 liter) Big Pepsi Bottle) (1.00 liter)	_____	Q8.4a	
	(8.4b) Price per liter		Q8.4b	
8.5	Generally, how many days does the diesel from your usual purchase last? _____ days	_____	Q8.5	
8.6	When your household uses diesel, how many liters if diesel are usually used in a month?	_____	Q8.6	

			Var. Name	
	Uses of kerosene &/or diesel for household activity Now I would like to ask you some questions about evening activities that require diesel lamp. Do any household members use diesel lamp in the evening for the following purposes?			
8.7	**Reading/writing/studying** (i.e., read newspaper, bible, novel, write letter, do homework for school, prepare for examination, and etc.). [1] = Yes; [0] = No; If "NO" go to Q8.9	_____	**Q8.7**	
8.8	Generally, how many <u>hours per evening</u> do household members usually use diesel lamp for reading/writing/studying? _____ hours/evening	_____	**Q8.8**	
8.9	**Area lighting** [1] = Yes; [0] = No; If "NO" go to Q8.11	_____	**Q8.9**	
8.10	Generally, how many <u>hours per evening</u> does your household usually use diesel lamp for area lighting? _____hours per evening	_____	**Q8.10**	
8.11	**Security** [1] = Yes; [0] = No; If "NO" go to Q8.13	_____	**Q8.11**	
8.12	Generally, how many <u>hours per evening</u> does your household usually use diesel lamp for security purpose? _____hours per evening	_____	**Q8.12**	
8.13	**Social activities** such as, meeting [1] = Yes; [0] = No; If "NO" go to Q9.1	_____	**Q8.13**	
8.14	Generally, how many <u>hours per **WEEK**</u> do household members usually use diesel lamp for these social activities? _____hours per <u>**WEEK**</u>	_____	**Q8.14**	

Section 9: Electricity from Car Battery

			Var. Name	
9.1	During the past 12 months did your household use car battery to supply electricity? [1] = Yes; [0] = No, if "NO" go to Q9.16	_____	Q9.1	
9.2	During the past 30 days did your household use car battery to supply electricity? [0] = No, did not use [1] = Used as supplementary source of electricity [2] = Used as the main source of electricity If "USED AS THE SUPPLEMENTARY [1] OR MAIN SOURCE [2]" go to Q9.4a	_____	Q9.2	
9.3	Please give me reasons, why your household has not used your car battery during the past 30 days? [1] = Out of order [2] = Being serviced [3] = Recharge is too costly [4] = No transportation [5] = Other specify, ...	_____	Q9.3	
	Does your household use car battery for the following end-uses? [1] = Yes; [0] = No			
9.4a	Television	_____	Q9.4a	
9.4b	Lighting	_____	Q9.4b	
9.4c	Radio & cassette tape player	_____	Q9.4c	
9.5	How many batteries does your household have? _____ Battery(ies)	_____	Q9.5	
9.6a	What is the Voltage of your **First** car battery _____ Volts.	_____	Q9.6a	
9.6b	What is the Amps hours of your **First** car battery _____ Amp-hrs	_____	Q9.6b	
9.7a	How much does the first car battery cost? (kips	_____	Q9.7a	
9.7b	What is the Voltage of your **Second** car battery _____ Volts.	_____	Q9.7b	
9.8a	What is the Amps hours of your **Second** car battery _____ Amp-hrs	_____	Q9.8a	
9.8b	How much did your household pay for your **Second** battery? _____ Kip	_____	Q9.8b	
9.9	On the average how much do you spend on recharging battery each month? _____ Kip	_____	Q9.9	
9.10	How much does each recharge cost? _____ Kip	_____	Q9.10	

	Section 9: Electricity from Car Battery (Cont.)		**Var. Name**	
9.11	How many month did your previous battery last? (Enter "0" if you did not own any battery before)		**Q9.11**	
9.12a	How long does the battery give you services before the next recharge? _____ days		**Q9.12**	
9.13	What is the distance from your home to the recharge station? _____ kilometers	_____	**Q9.13**	
9.14	Which mode of transport does your household use to the recharge station? [1] = Bicycle [2] = Motorcycle [3] = Bus/truck/car [4] = Cart [5] = Other, specify	_____	**Q9.14**	
9.15	What is the average cost of transport to and from the recharge station? __ Kip. (Cost/round trip)	_____	**Q9.15**	
	Electricity Connected from Neighbor or Private generators			
9.16	What is the source of your household electricity services? [0] = Do not have electricity from any sources [1] = Connected from neighbor [2] = Own generator [3] = Own mini micro hydro generator [4] = Electric generator owned by community or neighbor [5] = Own car battery Amount of electricity service your household receive in a month?		**Q9.16**	
9.17	Number of light bulbs_____		**Q9.17**	
9.18	What is the average capacity of the light bulb _____ watts		**Q9.18**	
9.19a	Do you also use electricity for: Radio/tape cassette? [0] = No; [1] = Yes		**Q9.19**	
9.19b	Do you also use electricity for: Television? [0] = No; [1] = Yes		**Q9.20**	
9.20	Milling rice or other productive purposes [0] = No; [1] = Yes			
9.21a	Based on the amount of money you pay, how many hours of services you receive in a day? _____ Hrs/day		**Q9.21a**	

			Var. Name	
9.21b	In general, how many days in a month does your household have electric services? _____ days/mo		Q9.21b	
9.22	On the average how do you spend in a month for such electricity services? _____Kips/month (don't have to pay enter "0"; if have your own generator enter total fuel and maintenance costs)		Q9.22	

			Var. Name	
	Uses of car battery & electricity from neighbor & private generator for household activity Now I would like to ask you some questions about evening activities that require car battery to supply electric energy for lighting. Do any household member use car battery or electricity connect from neighbor to supply electric energy in the evening for the following purposes?			
9.23	**Reading/writing/studying** (i.e., read newspaper, bible, novel, write letter, do homework for school, prepare for examination, etc.) [1] = Yes; [0] = No; If "NO" go to Q9.25	_____	Q9.23	
9.24	Generally, how many hours per evening do household members usually use either sources of electricity for lights to read/write/study? _____ hours/evening	_____	Q9.24	
9.25	**Area lighting** [1] = Yes; [0] = No; If "NO" go to Q9.27	_____	Q9.25	
9.26	Generally, how many hours per evening does your household usually use the above sources to supply electric energy for area lighting? _____hrs/evening	_____	Q9.26	
9.27	**Security** [1] = Yes; [0] = No; If "NO" go to Q9.29	_____	Q9.27	
9.28	Generally, how many hours per evening does your household usually use electric lights for security purposes? _____hrs/evening	_____	Q9.28	
9.29	**Social activities** such as, meeting [1] = Yes; [0] = No; If "NO" go to Q9.31	_____	Q9.29	
9.30	Generally, how many hours per **WEEK** do household members usually use electric lights for these social activities? _____hours/**WEEK**	_____	Q9.30	
9.31	**Entertainment** such as TV, radio, tape, stereo [1] = Yes; [0] = No		Q9.31	
9.32	Television _____ Hours/day		Q9.32	

Section 10: Dry Cell Battery

				Var. Name	
10.1	During the past 12 months did your household use dry cell battery? [1] = Yes; [0] = No, if "NO" go to Q11.1		_____	Q10.1	
	Which of the following purposes does your household use dry cell batteries for: Code: [1] = Yes; [0] = No	Yes	No		
10.2	Flashlight	_____	_____	Q10.2	
10.3	Lantern	_____	_____	Q10.3	
10.4	Combine flash light and lantern	_____	_____	Q10.4	
10.5	Radio and/or tape cassette	_____	_____	Q10.5	
10.6	Other, specify	_____	_____	Q10.6	

			Var. Name	
10.7	On the average, how much does your household spend on dry cell batteries per month? _____ Ush	_____	Q10.7	
10.8a	On the average how much does your household spend on dry cell battery for **each purchase?** _____Ush/purchase		Q10.8a	
10.8b	Generally, for how long do the batteries from each of those purchase last? _____ days	_____	Q10.8b	

Section 11: Candle

			Var. Name	
11.1	During the past 12 months how often did your household use candle for lighting? [0] = Do not use candle for lighting If "NOT USE CANDLE" go to Q12.1 [1] = Used sometimes [2] = Used candle most of the time [3] = Always	_____	Q11.1	
11.2	On the average, how much does your household spend on candle each month? _____Ush/month	_____	Q11.2	
11.3a	On the average, how much does you household spend on candle for each purchase? _____ Ush.	_____	11.3a	
11.3b	Generally, for how long do the candles from each purchase last? _____days	_____	Q11.3b	
	Uses of candle light for household activity Now I would like to ask you some questions about evening activities that require candle light Do any household member use candle light in the evening for the following purposes.			
11.4	**Reading/writing/studying** (i.e., read newspaper, bible, novel, write letter, do homework for school, prepare for examination) [1] = Yes; [0] = No; If "NO" go to Q11.6	_____	Q11.4	
11.5	Generally, how many <u>hrs per evening</u> do household members usually use candle light for reading or writing or studying	_____	Q11.5	
11.6	**Area lighting** [1] = Yes; [0] = No; If "NO" go to Q11.18	_____	Q11.6	
11.7	Generally, how many <u>hours per evening</u> does your household usually use candle for area lighting? _____hours per evening	_____	Q11.7	

			Var. Name	
11.8	**Social activities** such as, meeting [1] = Yes; [0] = No; If "NO" go to Q11.10	_____	**Q11.8**	
11.9	Generally, how many hours per **WEEK** do household members usually use candle for lighting for social activities? ____hours/**WEEK**		**Q10.9**	
	Torch			
11.10	During the past 12 months how often did your household use torch for lighting? [0] = Do not use torch for lighting If "NOT USE TORCH" go to Q12.1 [1] = Used sometimes [2] = Used candle most of the time [3] = Always		**Q11.10**	
11.11	On the average, how much does your household spend on torch each month? _____Ush/month		**Q11.11**	
11.12	**Area lighting** [1] = Yes; [0] = No; If "NO" go to Q11.10		**Q11.12**	
11.13	Generally, how many hours per evening does your household usually use torch for area lighting? _____hours per evening		**Q11.13**	

Section 12: Non-Electric Lighting Equipment

			Var. Name	
12.1	How does your household use non-electric lighting equipment? [0] = Does not use; If "Does not use" go to Q13.1 [1] = Supplementary to electric sources [2] = Main source of lighting	_____	**Q12.1**	
12.2a	How many **kerosene/diesel wick lamps** does your household have? _____ lamps (Enter "0" for none, if "NONE" go to Q12.3a)	_____	**Q12.2a**	
12.2b	How often does your household use **kerosene/diesel wick lamp**? [0] = Never; [1] = Some of the time; [2] = Most of the time; [3] = Always	_____	**Q12.2b**	

			Var. Name	
12.3a	How many **pressurized kerosene lamps** does your household have? _____ lamps (Enter "0" for none, if "NONE" go to Q12.4a)		Q12.3a	
12.3b	How often does your household use **Pressurized kerosene lamp**? [0] = Never; [1] = Some of the time; [2] = Most of the time; [3] = Always		Q12.3b	
12.4a	How many **hurricane lanterns** does your household have? _____ lamps (Enter "0" for none, if "NONE" go to Q12.5a)		Q12.4a	
12.4b	How often does your household use **hurricane lantern** ? [0] = Never; [1] = Some of the time; [2] = Most of the times [3] = Always		Q12.4b	
12.5a	How many other non-electric lighting equipment does your household have? Please specify and enter the number owned		Q12.5a	
12.5b	How often does your household use **other non-electric lighting equipment**? [0] = Never; [1] = Rarely; [2] = Sometime; [3] = Always		Q12.5b	

Section 13: Uses of energy for productive purposes

Do you use any of the following fuels or energy sources for lighting or anything else in your home business/industry/agricultural activity?
[1] = Yes; [0] = No; If "NO" to all 5 questions (Q3.1, Q13.2, Q13.3, Q13.4, Q13.5 go to Q14.1)

		Yes	No	Var. Name	
13.1	Kerosene			Q13.1	
13.2	Diesel			Q13.2	
13.3	Car battery			Q13.3	
13.4	Electricity from private or community owned generator			Q13.4	
13.5	Electricity from the grid (including local & central grid)			Q13.5	

	Section 13: Uses of energy for productive purposes (cont.)		**Var. Name**	
	If Yes to any of the above 4 questions, for which of the following purposes do you use the above fuels or energy sources in your home business/industry/ agricultural activity?			
13.6	Lighting **to protect your home business/industry** from burglary or alike OR to **protect your livestock and/or crops.** [1] = Yes; [0] = No; if "NO" go to Q13.8	_____	**Q13.6**	
13.7	If yes, generally how many hrs/evening do you keep light on to protect your home business or industry or livestock or crops? _____ hrs/evening	_____	**Q13.7**	
13.8a	Area lighting **to conduct business** (i.e., lighting to keep store/shop open in the evening, or do handicraft, or etc.). [1] = Yes; [0] = No; if "NO" go to Q13.10	_____	**Q13.8**	
13.9	Generally, how many hours/evening do you have area lighting on to conduct business. (i.e., keep store/shop open, or do handicraft, or etc.) _____hours/evening	_____	**Q13.9**	
13.10	Lighting to **do more work** in the evening Code: [1] = Yes; [0] = No;	_____	**Q13.10**	
13.11	Lighting to **repair equipment/tools** used for production. Code: [1] = Yes; [0] = No	_____	**Q13.11**	
13.12	**To power tool or motor or machine or pump or refrigerator** Code: [1] = Yes; [0] = No	_____	**Q13.12**	
13.13	**Radio/tape** for music to entertain customers in the business premises. [1] = Yes; [0] = No	_____	**Q13.13**	
13.14	**TV/Video** to entertain customers [1] = Yes; [0] = No	_____	**Q12.14**	
13.15	Rice milling or grind coffee [1] = Yes; [0] = No	_____	**Q13.15**	

Section 14: Cash Income

Var. Name	
Q14.1	

14.1 What was your household's **total non-agricultural** cash income over the past 12 months?
Include all cash income such as, cash income from sales of livestock/fowl (including their products)/fish, worker wages, bonuses, pension, veteran benefits, remittances from relatives, rent income, interest, and others income _____

Section 14.1: Agricultural activities and income from agriculture

Please tell me about all of the crops that generate income for your household during the past 12 months. (Do not enter losses or crops grown for your own household consumption.)

Type of Crops	Total gross income from sales of crops	Total production expenses	Net income from sales of crops
	Q14.11	Q14.12	Q14.13
	Q14.21	Q14.22	Q14.23
	Q14.31	Q14.32	Q14.33
	Q14.41	Q14.42	Q14.43
	Q14.51	Q14.52	Q14.53

Note: Total expenses must include the expenses incurred, such as land rental fees, fertilizer, and workers' wages. The number of crops in the questionnaire must reflect the variety of crops grown in the survey area.

Section 15: Non-Agricultural Expenditures

			Var. Name	
15.1	What was your household's total non-agricultural expenditure last year? (include all expenditure such as, food, foodstuff, medicine, schooling, and any others) Food and foodstuff (i.e., meat, sugar, and etc.)	_____	Q15.1	

Section 16: Agricultural land

			Var. Name	
	Please describe your land that was under cultivation last year (in Hectares).			
16.1	Total Land owned (Enter "0" for do not own land)	_____	Q16.1	
16.2	Total land under cultivation (Even if not owned, enter number of Hectares under cultivation)	_____	Q16.2	
16.3	Cultivated portions of land that were irrigated	_____	Q16.3	
16.4	Slash & burn (Even if not owned, enter number of Hectares under cultivation)	_____	Q16.4	

Section 17: Livestock Holdings

			Var. Name	
17.1a	How many **goats and sheep** does your household have? (enter "0" for do not have)	_____	Q17.1a	
17.2a	How many **pigs** does your household have? (enter "0" for do not have)	_____	Q17.2a	
17.3a	How many **Cattle** does your household have? (enter "0" for do not have)	_____	Q17.3a	
17.4a	How many **domestic fowls** does your household have? (enter "0" for do not have)	_____	Q17.4a	
17.5a	How many other livestock/fowls does your household have? Please, specify..... (enter "0" for do not have)	_____	Q17.5a	

Section 18: Electrical appliance acquisition

Var. Name	

Code: [1] = Cooker [2] = Black & White Television [3] = Refrigerator [4] = Fan
[5] = Color Television [6] = Washing Machine [7] = Radio [8] = iron
[9] = Hot Plate [10] = Stereo [11] = Milling machine
[12] = Electric machinery and/or tools for productive purposes
[13] = Other specify,.....

Use the coding above for the following questions

Q18.1 **First Appliance Would Like to Acquire**
If electricity were to become available to your household use, in addition to lighting which of the above electric appliance would you like to acquire for your family/business as the **First Appliance**? _____ **Q18.1**

Q18.2 **Second Appliance Would Like to Acquire**
If electricity were to become available to your household use, in addition to lighting which of the above electric appliance would you like to acquire for your family/business as the **Second Appliance**? _____ **Q18.2**

Q18.3 **Third Appliance Would Like to Acquire**
If electricity were to become available to your household use, in addition to lighting which of the above electric appliance would you like to acquire for your family/business as the **Third Appliance**? _____ **Q18.3**

Section: 19 Household Attitude Towards Electricity

Var. Name	

The following statements I am about to read to you concern energy use and other issues. Please tell me if you agree or disagree with these statements and how strong your feelings are.

Use the following coding for answer:
[1] = strongly agree; [2] = agree; [3] = no opinion
[4] = disagree; [5] = strongly disagree

19.1 It is true that electricity is the most convenient source of energy. _____ **Q19.1**

			Var. Name
	Use the following coding for the answer. [1] = strongly agree; [2] = agree; [3] = no opinion [4] = disagree; [5] = strongly disagree		
19.2	Electricity is very expensive fuel.	_____	Q19.2
19.3	Electricity will improve my family's way of living.	_____	Q19.3
19.4	Electricity is a very reliable source of energy for the family	_____	Q19.4
19.5	Electricity is a clean source of energy for my family	_____	Q19.5
19.6	Electricity can supply more lighting for my family	_____	Q19.6
19.7	Electricity is cheaper than other fuels	_____	Q19.7
19.8	Electricity is energy for the rich family	_____	Q19.8
19.9	Electricity is dangerous	_____	Q19.9
19.10	Electricity is the way of the future.	_____	Q19.10
19.11	Electricity must be used sparingly.	_____	Q19.11
19.12	Electricity is convenient to use.	_____	Q19.12
19.13	Electricity is a luxury.	_____	Q19.13
19.14	Electricity is affordable	_____	Q19.14
19.15	Electricity improves security at night	_____	Q19.15
19.16	Electricity is the key to have productive business	_____	Q19.16
19.17	Electricity allows me to do more work in my business	_____	Q19.17
19.18	Car battery is the best way to provide light for me and my family	_____	Q19.18
19.19	Car battery is the best source of energy for my household entertainment equipment. (i.e., radio & TV)	_____	Q19.19
19.20	My family is very happy with the source of energy that we are using for lighting	_____	Q19.20

Section 20: Household desires to use electricity

			Var. Name	
20.1	Would your household like to have access to electricity, or would you prefer to continue using your present energy sources? (exclude energy for cooking) [1] = Electricity (If answer "ELECTRICITY" go to Q20.3 [0] = Prefer present energy sources	_____	Q20.1	
20.2	Please give me reasons why you prefer present energy sources? [1] = Can't afford to pay for the costs associated with connection and usage of electricity [2] = Can't afford to buy electrical equipment [3] = See no applications [4] = Satisfied with present energy sources [5] = Other, specify	_____	Q20.2	
20.3	Which of the following services you would like to have first, second and third? (enter the rank number (1, 2, or 3) you like to have first, second and third)	Rank _____		
20.3a	Clean water	_____	Q20.3a	
20.3b	Electricity	_____	Q20.3b	
20.3c	Irrigation		Q20.3c	
20.3d	Road	_____	Q20.3d	

Joint UNDP/World Bank

ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME (ESMAP)

LIST OF REPORTS ON COMPLETED ACTIVITIES

Region/Country	*Activity/Report Title*	*Date*	*Number*
	SUB-SAHARAN AFRICA (AFR)		
Africa Regional	Anglophone Africa Household Energy Workshop (English)	07/88	085/88
	Regional Power Seminar on Reducing Electric Power System Losses in Africa (English)	08/88	087/88
	Institutional Evaluation of EGL (English)	02/89	098/89
	Biomass Mapping Regional Workshops (English)	05/89	--
	Francophone Household Energy Workshop (French)	08/89	--
	Interafrican Electrical Engineering College: Proposals for Short- and Long-Term Development (English)	03/90	112/90
	Biomass Assessment and Mapping (English)	03/90	--
	Symposium on Power Sector Reform and Efficiency Improvement in Sub-Saharan Africa (English)	06/96	182/96
	Commercialization of Marginal Gas Fields (English)	12/97	201/97
Angola	Energy Assessment (English and Portuguese)	05/89	4708-ANG
	Power Rehabilitation and Technical Assistance (English)	10/91	142/91
Benin	Energy Assessment (English and French)	06/85	5222-BEN
Botswana	Energy Assessment (English)	09/84	4998-BT
	Pump Electrification Prefeasibility Study (English)	01/86	047/86
	Review of Electricity Service Connection Policy (English)	07/87	071/87
	Tuli Block Farms Electrification Study (English)	07/87	072/87
	Household Energy Issues Study (English)	02/88	--
	Urban Household Energy Strategy Study (English)	05/91	132/91
Burkina Faso	Energy Assessment (English and French)	01/86	5730-BUR
	Technical Assistance Program (English)	03/86	052/86
	Urban Household Energy Strategy Study (English and French)	06/91	134/91
Burundi	Energy Assessment (English)	06/82	3778-BU
	Petroleum Supply Management (English)	01/84	012/84
	Status Report (English and French)	02/84	011/84
	Presentation of Energy Projects for the Fourth Five-Year Plan (1983-1987) (English and French)	05/85	036/85
	Improved Charcoal Cookstove Strategy (English and French)	09/85	042/85
	Peat Utilization Project (English)	11/85	046/85
	Energy Assessment (English and French)	01/92	9215-BU
Cape Verde	Energy Assessment (English and Portuguese)	08/84	5073-CV
	Household Energy Strategy Study (English)	02/90	110/90
Central African Republic	Energy Assessement (French)	08/92	9898-CAR
Chad	Elements of Strategy for Urban Household Energy The Case of N'djamena (French)	12/93	160/94
Comoros	Energy Assessment (English and French)	01/88	7104-COM
Congo	Energy Assessment (English)	01/88	6420-COB
	Power Development Plan (English and French)	03/90	106/90
Côte d'Ivoire	Energy Assessment (English and French)	04/85	5250-IVC
	Improved Biomass Utilization (English and French)	04/87	069/87
	Power System Efficiency Study (English)	12/87	--
	Power Sector Efficiency Study (French)	02/92	140/91
	Project of Energy Efficiency in Buildings (English)	09/95	175/95

Region/Country	*Activity/Report Title*	*Date*	*Number*
Ethiopia	Energy Assessment (English)	07/84	4741-ET
	Power System Efficiency Study (English)	10/85	045/85
	Agricultural Residue Briquetting Pilot Project (English)	12/86	062/86
	Bagasse Study (English)	12/86	063/86
	Cooking Efficiency Project (English)	12/87	--
	Energy Assessment (English)	02/96	179/96
Gabon	Energy Assessment (English)	07/88	6915-GA
The Gambia	Energy Assessment (English)	11/83	4743-GM
	Solar Water Heating Retrofit Project (English)	02/85	030/85
	Solar Photovoltaic Applications (English)	03/85	032/85
	Petroleum Supply Management Assistance (English)	04/85	035/85
Ghana	Energy Assessment (English)	11/86	6234-GH
	Energy Rationalization in the Industrial Sector (English)	06/88	084/88
	Sawmill Residues Utilization Study (English)	11/88	074/87
	Industrial Energy Efficiency (English)	11/92	148/92
Guinea	Energy Assessment (English)	11/86	6137-GUI
	Household Energy Strategy (English and French)	01/94	163/94
Guinea-Bissau	Energy Assessment (English and Portuguese)	08/84	5083-GUB
	Recommended Technical Assistance Projects (English & Portuguese)	04/85	033/85
	Management Options for the Electric Power and Water Supply Subsectors (English)	02/90	100/90
	Power and Water Institutional Restructuring (French)	04/91	118/91
Kenya	Energy Assessment (English)	05/82	3800-KE
	Power System Efficiency Study (English)	03/84	014/84
	Status Report (English)	05/84	016/84
	Coal Conversion Action Plan (English)	02/87	--
	Solar Water Heating Study (English)	02/87	066/87
	Peri-Urban Woodfuel Development (English)	10/87	076/87
	Power Master Plan (English)	11/87	--
	Power Loss Reduction Study (English)	09/96	186/96
Lesotho	Energy Assessment (English)	01/84	4676-LSO
Liberia	Energy Assessment (English)	12/84	5279-LBR
	Recommended Technical Assistance Projects (English)	06/85	038/85
	Power System Efficiency Study (English)	12/87	081/87
Madagascar	Energy Assessment (English)	01/87	5700-MAG
	Power System Efficiency Study (English and French)	12/87	075/87
	Environmental Impact of Woodfuels (French)	10/95	176/95
Malawi	Energy Assessment (English)	08/82	3903-MAL
	Technical Assistance to Improve the Efficiency of Fuelwood Use in the Tobacco Industry (English)	11/83	009/83
	Status Report (English)	01/84	013/84
Mali	Energy Assessment (English and French)	11/91	8423-MLI
	Household Energy Strategy (English and French)	03/92	147/92
Islamic Republic of Mauritania	Energy Assessment (English and French)	04/85	5224-MAU
	Household Energy Strategy Study (English and French)	07/90	123/90
Mauritius	Energy Assessment (English)	12/81	3510-MAS
	Status Report (English)	10/83	008/83
	Power System Efficiency Audit (English)	05/87	070/87

Region/Country	*Activity/Report Title*	*Date*	*Number*
Mauritius	Bagasse Power Potential (English)	10/87	077/87
	Energy Sector Review (English)	12/94	3643-MAS
Mozambique	Energy Assessment (English)	01/87	6128-MOZ
	Household Electricity Utilization Study (English)	03/90	113/90
	Electricity Tariffs Study (English)	06/96	181/96
	Sample Survey of Low Voltage Electricity Customers	06/97	195/97
Namibia	Energy Assessment (English)	03/93	11320-NAM
Niger	Energy Assessment (French)	05/84	4642-NIR
	Status Report (English and French)	02/86	051/86
	Improved Stoves Project (English and French)	12/87	080/87
	Household Energy Conservation and Substitution (English and French)	01/88	082/88
Nigeria	Energy Assessment (English)	08/83	4440-UNI
	Energy Assessment (English)	07/93	11672-UNI
Rwanda	Energy Assessment (English)	06/82	3779-RW
	Status Report (English and French)	05/84	017/84
	Improved Charcoal Cookstove Strategy (English and French)	08/86	059/86
	Improved Charcoal Production Techniques (English and French)	02/87	065/87
	Energy Assessment (English and French)	07/91	8017-RW
	Commercialization of Improved Charcoal Stoves and Carbonization Techniques Mid-Term Progress Report (English and French)	12/91	141/91
SADC	SADC Regional Power Interconnection Study, Vols. I-IV (English)	12/93	--
SADCC	SADCC Regional Sector: Regional Capacity-Building Program for Energy Surveys and Policy Analysis (English)	11/91	--
Sao Tome and Principe	Energy Assessment (English)	10/85	5803-STP
Senegal	Energy Assessment (English)	07/83	4182-SE
	Status Report (English and French)	10/84	025/84
	Industrial Energy Conservation Study (English)	05/85	037/85
	Preparatory Assistance for Donor Meeting (English and French)	04/86	056/86
	Urban Household Energy Strategy (English)	02/89	096/89
	Industrial Energy Conservation Program (English)	05/94	165/94
Seychelles	Energy Assessment (English)	01/84	4693-SEY
	Electric Power System Efficiency Study (English)	08/84	021/84
Sierra Leone	Energy Assessment (English)	10/87	6597-SL
Somalia	Energy Assessment (English)	12/85	5796-SO
South Africa Republic of	Options for the Structure and Regulation of Natural Gas Industry (English)	05/95	172/95
Sudan	Management Assistance to the Ministry of Energy and Mining	05/83	003/83
	Energy Assessment (English)	07/83	4511-SU
	Power System Efficiency Study (English)	06/84	018/84
	Status Report (English)	11/84	026/84
	Wood Energy/Forestry Feasibility (English)	07/87	073/87
Swaziland	Energy Assessment (English)	02/87	6262-SW
	Household Energy Strategy Study	10/97	198/97
Tanzania	Energy Assessment (English)	11/84	4969-TA
	Peri-Urban Woodfuels Feasibility Study (English)	08/88	086/88
	Tobacco Curing Efficiency Study (English)	05/89	102/89
	Remote Sensing and Mapping of Woodlands (English)	06/90	--
	Industrial Energy Efficiency Technical Assistance (English)	08/90	122/90

Region/Country	*Activity/Report Title*	*Date*	*Number*
Tanzania	Power Loss Reduction Volume 1: Transmission and Distribution SystemTechnical Loss Reduction and Network Development (English)	06/98	204A/98
	Power Loss Reduction Volume 2: Reduction of Non-Technical Losses (English)	06/98	204B/98
Togo	Energy Assessment (English)	06/85	5221-TO
	Wood Recovery in the Nangbeto Lake (English and French)	04/86	055/86
	Power Efficiency Improvement (English and French)	12/87	078/87
Uganda	Energy Assessment (English)	07/83	4453-UG
	Status Report (English)	08/84	020/84
	Institutional Review of the Energy Sector (English)	01/85	029/85
	Energy Efficiency in Tobacco Curing Industry (English)	02/86	049/86
	Fuelwood/Forestry Feasibility Study (English)	03/86	053/86
	Power System Efficiency Study (English)	12/88	092/88
	Energy Efficiency Improvement in the Brick and Tile Industry (English)	02/89	097/89
	Tobacco Curing Pilot Project (English)	03/89	UNDP Terminal Report
	Energy Assessment (English)	12/96	193/96
Zaire	Energy Assessment (English)	05/86	5837-ZR
Zambia	Energy Assessment (English)	01/83	4110-ZA
	Status Report (English)	08/85	039/85
	Energy Sector Institutional Review (English)	11/86	060/86
	Power Subsector Efficiency Study (English)	02/89	093/88
	Energy Strategy Study (English)	02/89	094/88
	Urban Household Energy Strategy Study (English)	08/90	121/90
Zimbabwe	Energy Assessment (English)	06/82	3765-ZIM
	Power System Efficiency Study (English)	06/83	005/83
	Status Report (English)	08/84	019/84
	Power Sector Management Assistance Project (English)	04/85	034/85
	Power Sector Management Institution Building (English)	09/89	--
	Petroleum Management Assistance (English)	12/89	109/89
	Charcoal Utilization Prefeasibility Study (English)	06/90	119/90
	Integrated Energy Strategy Evaluation (English)	01/92	8768-ZIM
	Energy Efficiency Technical Assistance Project: Strategic Framework for a National Energy Efficiency Improvement Program (English)	04/94	--
	Capacity Building for the National Energy Efficiency Improvement Programme (NEEIP) (English)	12/94	--
	EAST ASIA AND PACIFIC (EAP)		
Asia Regional	Pacific Household and Rural Energy Seminar (English)	11/90	--
China	County-Level Rural Energy Assessments (English)	05/89	101/89
	Fuelwood Forestry Preinvestment Study (English)	12/89	105/89
	Strategic Options for Power Sector Reform in China (English)	07/93	156/93
	Energy Efficiency and Pollution Control in Township and Village Enterprises (TVE) Industry (English)	11/94	168/94
	Energy for Rural Development in China: An Assessment Based on a Joint Chinese/ESMAP Study in Six Counties (English)	06/96	183/96
Fiji	Energy Assessment (English)	06/83	4462-FIJ

Region/Country	*Activity/Report Title*	*Date*	*Number*
Indonesia	Energy Assessment (English)	11/81	3543-IND
	Status Report (English)	09/84	022/84
	Power Generation Efficiency Study (English)	02/86	050/86
	Energy Efficiency in the Brick, Tile and Lime Industries (English)	04/87	067/87
	Diesel Generating Plant Efficiency Study (English)	12/88	095/88
	Urban Household Energy Strategy Study (English)	02/90	107/90
	Biomass Gasifier Preinvestment Study Vols. I & II (English)	12/90	124/90
	Prospects for Biomass Power Generation with Emphasis on Palm Oil, Sugar, Rubberwood and Plywood Residues (English)	11/94	167/94
Lao PDR	Urban Electricity Demand Assessment Study (English)	03/93	154/93
	Institutional Development for Off-Grid Electrification	06/99	215/99
Malaysia	Sabah Power System Efficiency Study (English)	03/87	068/87
	Gas Utilization Study (English)	09/91	9645-MA
Myanmar	Energy Assessment (English)	06/85	5416-BA
Papua New Guinea	Energy Assessment (English)	06/82	3882-PNG
	Status Report (English)	07/83	006/83
	Energy Strategy Paper (English)	--	--
	Institutional Review in the Energy Sector (English)	10/84	023/84
	Power Tariff Study (English)	10/84	024/84
Philippines	Commercial Potential for Power Production from Agricultural Residues (English)	12/93	157/93
	Energy Conservation Study (English)	08/94	--
Solomon Islands	Energy Assessment (English)	06/83	4404-SOL
	Energy Assessment (English)	01/92	979-SOL
South Pacific	Petroleum Transport in the South Pacific (English)	05/86	--
Thailand	Energy Assessment (English)	09/85	5793-TH
	Rural Energy Issues and Options (English)	09/85	044/85
	Accelerated Dissemination of Improved Stoves and Charcoal Kilns (English)	09/87	079/87
	Northeast Region Village Forestry and Woodfuels Preinvestment Study (English)	02/88	083/88
	Impact of Lower Oil Prices (English)	08/88	--
	Coal Development and Utilization Study (English)	10/89	--
Tonga	Energy Assessment (English)	06/85	5498-TON
Vanuatu	Energy Assessment (English)	06/85	5577-VA
Vietnam	Rural and Household Energy-Issues and Options (English)	01/94	161/94
	Power Sector Reform and Restructuring in Vietnam: Final Report to the Steering Committee (English and Vietnamese)	09/95	174/95
	Household Energy Technical Assistance: Improved Coal Briquetting and Commercialized Dissemination of Higher Efficiency Biomass and Coal Stoves (English)	01/96	178/96
Western Samoa	Energy Assessment (English)	06/85	5497-WSO
	SOUTH ASIA (SAS)		
Bangladesh	Energy Assessment (English)	10/82	3873-BD
	Priority Investment Program (English)	05/83	002/83
	Status Report (English)	04/84	015/84

Region/Country	*Activity/Report Title*	*Date*	*Number*
Bangladesh	Power System Efficiency Study (English)	02/85	031/85
	Small Scale Uses of Gas Prefeasibility Study (English)	12/88	--
India	Opportunities for Commercialization of Nonconventional Energy Systems (English)	11/88	091/88
	Maharashtra Bagasse Energy Efficiency Project (English)	07/90	120/90
	Mini-Hydro Development on Irrigation Dams and Canal Drops Vols. I, II and III (English)	07/91	139/91
	WindFarm Pre-Investment Study (English)	12/92	150/92
	Power Sector Reform Seminar (English)	04/94	166/94
	Environmental Issues in the Power Sector (English)	06/98	205/98
	Environmental Issues in the Power Sector: Manual for Environmental Decision Making (English)	06/99	213/99
	Household Energy Strategies for Urban India: The Case of Hyderabad	06/99	214/99
Nepal	Energy Assessment (English)	08/83	4474-NEP
	Status Report (English)	01/85	028/84
	Energy Efficiency & Fuel Substitution in Industries (English)	06/93	158/93
Pakistan	Household Energy Assessment (English)	05/88	--
	Assessment of Photovoltaic Programs, Applications, and Markets (English)	10/89	103/89
	National Household Energy Survey and Strategy Formulation Study: Project Terminal Report (English)	03/94	--
	Managing the Energy Transition (English)	10/94	--
	Lighting Efficiency Improvement Program Phase 1: Commercial Buildings Five Year Plan (English)	10/94	--
Sri Lanka	Energy Assessment (English)	05/82	3792-CE
	Power System Loss Reduction Study (English)	07/83	007/83
	Status Report (English)	01/84	010/84
	Industrial Energy Conservation Study (English)	03/86	054/86

EUROPE AND CENTRAL ASIA (ECA)

Bulgaria	Natural Gas Policies and Issues (English)	10/96	188/96
Central and Eastern Europe	Power Sector Reform in Selected Countries	07/97	196/97
Eastern Europe	The Future of Natural Gas in Eastern Europe (English)	08/92	149/92
Kazakhstan	Natural Gas Investment Study, Volumes 1, 2 & 3	12/97	199/97
Kazakhstan & Kyrgyzstan	Opportunities for Renewable Energy Development	11/97	16855-KAZ
Poland	Energy Sector Restructuring Program Vols. I-V (English)	01/93	153/93
	Natural Gas Upstream Pricing (English and Polish)	08/98	206/98
	Energy Sector Restructuring Program: Establishing the Energy Regulation Authority	10/98	208/98
Portugal	Energy Assessment (English)	04/84	4824-PO
Romania	Natural Gas Development Strategy (English)	12/96	192/96
Slovenia	Workshop on Private Participation in the Power Sector (English)	02/99	211/99
Turkey	Energy Assessment (English)	03/83	3877-TU

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	MIDDLE EAST AND NORTH AFRICA (MNA)		
Arab Republic of Egypt	Energy Assessment (English)	10/96	189/96
Morocco	Energy Assessment (English and French)	03/84	4157-MOR
	Status Report (English and French)	01/86	048/86
	Energy Sector Institutional Development Study (English and French)	07/95	173/95
	Natural Gas Pricing Study (French)	10/98	209/98
	Gas Development Plan Phase II (French)	02/99	210/99
Syria	Energy Assessment (English)	05/86	5822-SYR
	Electric Power Efficiency Study (English)	09/88	089/88
	Energy Efficiency Improvement in the Cement Sector (English)	04/89	099/89
	Energy Efficiency Improvement in the Fertilizer Sector (English)	06/90	115/90
Tunisia	Fuel Substitution (English and French)	03/90	--
	Power Efficiency Study (English and French)	02/92	136/91
	Energy Management Strategy in the Residential and Tertiary Sectors (English)	04/92	146/92
	Renewable Energy Strategy Study, Volume I (French)	11/96	190A/96
	Renewable Energy Strategy Study, Volume II (French)	11/96	190B/96
Yemen	Energy Assessment (English)	12/84	4892-YAR
	Energy Investment Priorities (English)	02/87	6376-YAR
	Household Energy Strategy Study Phase I (English)	03/91	126/91
	LATIN AMERICA AND THE CARIBBEAN (LAC)		
LAC Regional	Regional Seminar on Electric Power System Loss Reduction in the Caribbean (English)	07/89	--
	Elimination of Lead in Gasoline in Latin America and the Caribbean (English and Spanish)	04/97	194/97
	Elimination of Lead in Gasoline in Latin America and the Caribbean - Status Report (English and Spanish)	12/97	200/97
	Harmonization of Fuels Specifications in Latin America and the Caribbean (English and Spanish)	06/98	203/98
Bolivia	Energy Assessment (English)	04/83	4213-BO
	National Energy Plan (English)	12/87	--
	La Paz Private Power Technical Assistance (English)	11/90	111/90
	Prefeasibility Evaluation Rural Electrification and Demand Assessment (English and Spanish)	04/91	129/91
	National Energy Plan (Spanish)	08/91	131/91
	Private Power Generation and Transmission (English)	01/92	137/91
	Natural Gas Distribution: Economics and Regulation (English)	03/92	125/92
	Natural Gas Sector Policies and Issues (English and Spanish)	12/93	164/93
	Household Rural Energy Strategy (English and Spanish)	01/94	162/94
	Preparation of Capitalization of the Hydrocarbon Sector	12/96	191/96
Brazil	Energy Efficiency & Conservation: Strategic Partnership for Energy Efficiency in Brazil (English)	01/95	170/95
	Hydro and Thermal Power Sector Study	09/97	197/97
Chile	Energy Sector Review (English)	08/88	7129-CH

Region/Country	*Activity/Report Title*	*Date*	*Number*
Colombia	Energy Strategy Paper (English)	12/86	--
	Power Sector Restructuring (English)	11/94	169/94
	Energy Efficiency Report for the Commercial and Public Sector (English)	06/96	184/96
Costa Rica	Energy Assessment (English and Spanish)	01/84	4655-CR
	Recommended Technical Assistance Projects (English)	11/84	027/84
	Forest Residues Utilization Study (English and Spanish)	02/90	108/90
Dominican Republic	Energy Assessment (English)	05/91	8234-DO
Ecuador	Energy Assessment (Spanish)	12/85	5865-EC
	Energy Strategy Phase I (Spanish)	07/88	--
	Energy Strategy (English)	04/91	--
	Private Minihydropower Development Study (English)	11/92	--
	Energy Pricing Subsidies and Interfuel Substitution (English)	08/94	11798-EC
	Energy Pricing, Poverty and Social Mitigation (English)	08/94	12831-EC
Guatemala	Issues and Options in the Energy Sector (English)	09/93	12160-GU
Haiti	Energy Assessment (English and French)	06/82	3672-HA
	Status Report (English and French)	08/85	041/85
	Household Energy Strategy (English and French)	12/91	143/91
Honduras	Energy Assessment (English)	08/87	6476-HO
	Petroleum Supply Management (English)	03/91	128/91
Jamaica	Energy Assessment (English)	04/85	5466-JM
	Petroleum Procurement, Refining, and Distribution Study (English)	11/86	061/86
	Energy Efficiency Building Code Phase I (English)	03/88	--
	Energy Efficiency Standards and Labels Phase I (English)	03/88	--
	Management Information System Phase I (English)	03/88	--
	Charcoal Production Project (English)	09/88	090/88
	FIDCO Sawmill Residues Utilization Study (English)	09/88	088/88
	Energy Sector Strategy and Investment Planning Study (English)	07/92	135/92
Mexico	Improved Charcoal Production Within Forest Management for the State of Veracruz (English and Spanish)	08/91	138/91
	Energy Efficiency Management Technical Assistance to the Comision Nacional para el Ahorro de Energia (CONAE) (English)	04/96	180/96
Panama	Power System Efficiency Study (English)	06/83	004/83
Paraguay	Energy Assessment (English)	10/84	5145-PA
	Recommended Technical Assistance Projects (English)	09/85	--
	Status Report (English and Spanish)	09/85	043/85
Peru	Energy Assessment (English)	01/84	4677-PE
	Status Report (English)	08/85	040/85
	Proposal for a Stove Dissemination Program in the Sierra (English and Spanish)	02/87	064/87
	Energy Strategy (English and Spanish)	12/90	--
	Study of Energy Taxation and Liberalization of the Hydrocarbons Sector (English and Spanish)	120/93	159/93
Saint Lucia	Energy Assessment (English)	09/84	5111-SLU
St. Vincent and the Grenadines	Energy Assessment (English)	09/84	5103-STV
Trinidad and Tobago	Energy Assessment (English)	12/85	5930-TR

Region/Country	*Activity/Report Title*	*Date*	*Number*
	GLOBAL		
	Energy End Use Efficiency: Research and Strategy (English)	11/89	--
	Women and Energy--A Resource Guide		
	The International Network: Policies and Experience (English)	04/90	--
	Guidelines for Utility Customer Management and		
	Metering (English and Spanish)	07/91	--
	Assessment of Personal Computer Models for Energy		
	Planning in Developing Countries (English)	10/91	--
	Long-Term Gas Contracts Principles and Applications (English)	02/93	152/93
	Comparative Behavior of Firms Under Public and Private		
	Ownership (English)	05/93	155/93
	Development of Regional Electric Power Networks (English)	10/94	--
	Roundtable on Energy Efficiency (English)	02/95	171/95
	Assessing Pollution Abatement Policies with a Case Study		
	of Ankara (English)	11/95	177/95
	A Synopsis of the Third Annual Roundtable on Independent Power		
	Projects: Rhetoric and Reality (English)	08/96	187/96
	Rural Energy and Development Roundtable (English)	05/98	202/98
	A Synopsis of the Second Roundtable on Energy Efficiency:		
	Institutional and Financial Delivery Mechanisms (English)	09/98	207/98
	The Effect of a Shadow Price on Carbon Emission in the		
	Energy Portfolio of the World Bank: A Carbon		
	Backcasting Exercise (English)	02/99	212/99

06/29/99

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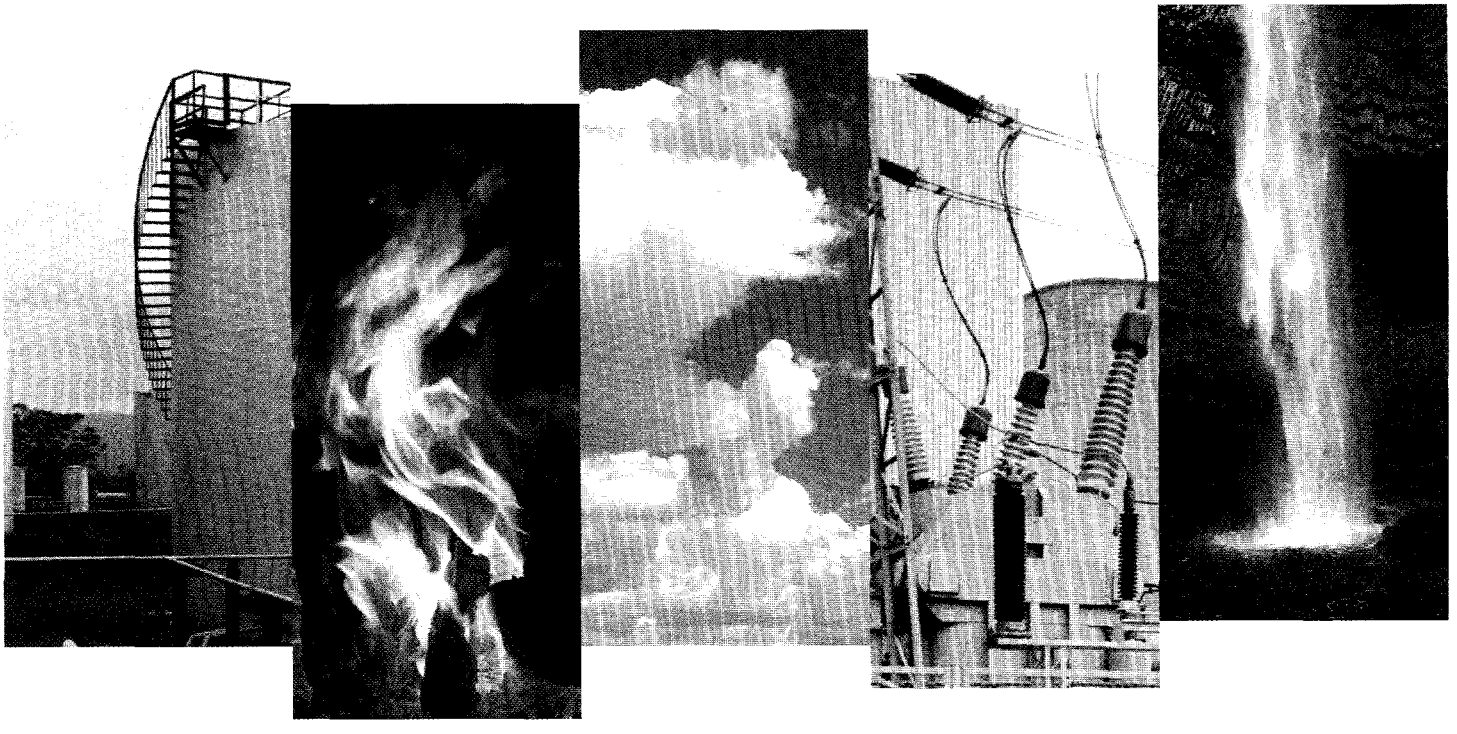

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