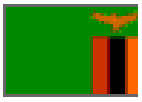

Issues and Options for Rural Electrification in Zambia

(Contract No. LAG–I-98-00010-00)

Submitted to
Energy and Environment Training Program
(EETP)
Global Bureau
The U.S. Agency for International Development
(USAID)
Ronald Reagan Building
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Washington, D.C. 20523

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March 28, 2002

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ACKNOWLEDGEMENTS

This report entitled "Issues and Options for Rural Electrification in Zambia" has been prepared by CORE International, Inc. under its Energy and Environment Training Project - Indefinite Quantity Contract (EETP-IQC) with the U.S. Agency for International Development (USAID). The Office of Energy, Environment, & Technology within the Bureau of Economic Growth, Agriculture, & Trade and the USAID Mission, Lusaka, Zambia directed all work performed by CORE International.

The preparation of this study required extensive deskwork and research as well as field work in Zambia. CORE's experts worked closely with officials from a number of Zambian Government agencies, various consumer and other associations, and donor agencies. The officials from these entities and many others provided valuable insights that significantly added to the quality and substance of this report. CORE International would like to make a special mention of the following officials from Zambia who supported the process of the preparation of this report:

Ms. Josephine Mapoma	Ministry of Energy and Water Development	Permanent Secretary
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Tim Ashworth	CMR Farm	Commercial farmer
Wayne Mikutowicz	Nexant	Principal
John Downie	Tobacco Association of Zambia	Executive Director

CORE International would like to specifically acknowledge the technical guidance provided by Ms. Susan Gale, USAID Mission, Zambia; and Mr. Mark Murray, Team Leader; Dr. Kevin Warr, Program Analyst; Ms. Davida Wood, USAID-AAAS Fellow, and Mr. Eric Streed, Program Analyst, all from USAID/EGAT/EIT; Washington, D.C.

EXECUTIVE SUMMARY

Power Sector Status and Performance

One of the principle objectives of the Zambian government (GRZ) is to increase access to electricity for its people through a program encouraging participation by the private sector. In fact, the Government has a set a target to achieve 50% access of electricity to its population by the year 2010. In order to support this ambitious goal, the GRZ has already taken a number of concrete actions.

The National Energy Policy (NEP), 1994, and the Electricity Act, 1995, were drawn up by the Ministry of Energy and Water Development (MEWD). The common goals of both documents included aims to increase access to electricity to households, and to develop cost effective electricity generating sites for domestic as well as export markets. In order to achieve these goals, the Government of Zambia allows Independent Power Producers (IPPs) to generate and transmit electricity using the national grid. Through the NEP, the electricity is sold in domestic and export markets.

In May 1999, the Government published “Framework and Package of Incentives for "Private Sector Participation in Hydropower Generation and Transmission Development”. An Office for Promoting Private Power Investment (OPPPI) has been set up under MEWD to implement the framework. OPPPI has recently completed a study on the solicitation strategy and documents for a number of projects have been prepared. These projects include two projects directly related to rural electrification: (i) electrification of Mkushi Farm Block through grid connection, and (ii) development of northwest small hydropower. Pre-qualification for the Mkushi Farm Block electrification project is underway. These projects are envisaged to be developed by the private sector on a Build-Own-Operate (BOO) basis.

In June 2001, a Cabinet decision was made on the steps to be taken for the divestiture of Government’s interest in ZESCO. The steps include (i) that Zambia Privatization Agency (ZPA) would undertake the necessary studies to enable the operations and management of ZESCO to be carried out by a private sector operator, (ii) identification and establishment of suitable modalities for peri-urban and rural electrification, and (iii) regulatory capacity building.

According to the World Bank, the government has made considerable progress in a number of areas as part of its power sector strategy reform. Some of the noteworthy reform indicators are as follows:

- The MEWD will begin the preparation of a Sector Reform Implementation Plan. This program, undertaken In agreement with the World Bank, will include all of the issues related to regulation, tariff, restructuring of ZESCO, and privatization.

- The collection rates by ZESCO have gone up to 84% over the year 2000 level (69%).
- A new wholesale tariff structure has been implemented by ZESCO, which takes the Kariba North Bank Corporation (KNBC) out side of ZESCO operations.
- Rural electricity tariffs were increased effective February 2001. Also, some improvement is made in ZESCO's cash flow situation; more is needed.

In addition, during October 2001, the World Bank and the government officials also discussed a concept paper -- Increased Access to Electricity with Renewable Energy -- developed by the Global Environment Facility (GEF). The concept developed by GEF could lead to IDA assistance in increasing electricity access to rural and peri-urban population throughout the country through increased private sector participation. In addition to officials from MEWD, both OPPPI and the Energy Regulatory Board (ERB) agreed to pursue aggressively this project, as it would directly advance the government's sector strategy.

Rural Electrification

The Ministry of Energy and Water Development (MEWD) is the Government's principal entity charged with national energy planning and policy development. The Government has stated that increasing access of electricity to rural areas and the provision of all forms of energy to promote rural economic development are two of its key priorities. To this end, the MEWD is in discussions with SIDA of Sweden to obtain technical assistance for the preparation of a Rural Electrification Master Plan. As part of this plan, the Government is also looking at the utilization of applicable renewable energy technologies including solar photovoltaic systems, micro hydro schemes, domestic production of ethanol from sugar cane, and a viable fuel wood program.

The Government has established a Rural Electrification Fund, financed by putting a levy on electricity supplied by ZESCO. This Fund provides limited resources for addressing rural electricity requirements of the country. The capitalization and management of the Fund needs further review. The Fund has not been as effective as expected to support the overall Government policy for increasing RE applications due to a variety of institutional reasons.

The overall objective of the Fund is to focus on extending the main national grid to rural areas currently not served, which represents almost 80% of the Zambian population. The extension of the national grid as a vehicle to expanding RE has proven to be very costly in most predominantly rural developing countries. When grid extension programs are introduced into systems with low collection rates, a limited ability of rural consumers to pay, illegal connections, theft, and other non-technical losses, most grid extension projects become financially unviable.

Accordingly, similar to other countries, Zambia is unable to attract the private sector to participate in the Fund for any RE projects without extensive incentives to the industry.

Barriers and Constraints to Rural Electrification

A number of challenges and constraints need to be addressed through designing a targeted and effective RE Model based on lessons learned elsewhere. These proposed programs need to be targeted specifically to the circumstances of Zambia. Preliminary assessments by the Government and several donors indicate that Zambia faces most of the major barriers to increasing rural energy access. These include limited financial resources, low tariffs, institutional weakness, high transaction costs, cumbersome commercial procedures, low educational attainment, limited in-house training for ZESCO employees, and little awareness of renewable energy technologies. There is a need for a more in-depth identification of barriers and development of approaches to addressing these barriers through a comprehensive RE strategy.

Lessons Learned in RE in Other countries

The following are some of the key lessons learned based on the RE experience in other countries:

- **Adopt a Broader View of Rural Electrification**
  A broader view of RE needs to be adopted by rural energy planners. Rural electrification should be viewed in terms of its criticality to rural development -- better education; modern health care; agriculture sector development; creation of rural industry; employment; income; retention of qualified students and workers through achieving lower levels of migration to urban areas; and building the capacity of village leaders. One means for adopting this approach is to link rural energy programs with rural development in the government budget process.

- **Develop RE Policies and Programs at the Local Level**
  Rural energy programs and policies solely designed at the national level without the active involvement of rural consumers, village and municipality officials and elected leaders, village farmers, and other industry leaders have not resulted in measurable success and sustainability. Active involvement of local consumers can be achieved by two concrete actions: (i) design and delivery of consumer education and consumer participation programs, including workshops on achieving political acceptance at the village/district levels; and (ii) requiring, as a matter of government policy, that all RE projects include a local value added component.

- **Develop Creative Approaches to RE Program Implementation**
  In order to draw upon private sector efficiency and achieve transparency, the government ministries should consider involving private energy service providers, development banks, local commercial banks, and local and internationally known and experienced NGOs in the implementation of the programs. NGOs are not-for-profit entities that are sealed away from the day-to-day government institutional complexities; they are also closer to the consumers. Therefore, they generally have greater capacity and credibility to achieve success. Private banks and energy companies have a vested interest in the success of the projects. Therefore, they can make excellent stakeholders to promote successful RE schemes.

- **Focus Government Resources on Acting as a Broker not an Implementer of RE Programs**
  The governments should consider revising their roles from the owners of RE programs to brokers, bringing the energy companies, local and international banks, energy equipment and technology providers, and donors into the project in order to facilitate development and implement market driven solutions to rural energy needs. This can be achieved only after the government puts in place an enabling environment that would encourage private sector investment in RE programs. In the absence of an enabling environment specifically designed for rural electrification, it is unlikely that the private sector will ever focus on non-commercial RE projects, given the perceived and real risks and the institutional difficulties.

- **Design and Implement Targeted Research and Development, Training and Information/Communications Programs**
  The most proper function for the government policy and role in RE is to devote its resources to assessing the applicability of RE technologies to its rural sector. Through such applied research and fact-finding, the government can prioritize the applicable technologies in terms of their costs and benefits and devise incentives to influence consumer choices and market behavior. In addition, the importance of consumer education and political acceptance in implementing RE cannot be overestimated. Experience in many countries has confirmed repeatedly that properly designed programs in these areas can be very effective in technology acceptance, consumer participation, and market entry, all of which are critical to the success of even the best designed RE programs.

- **Adopt Regional Approaches to Solving Rural Electrification Problems**
  There are significant economies of scale that can be achieved through adopting regional approaches to infrastructure planning. It is no different for RE. Many countries, such as those in the Southern Africa Region, the

South Asia Region, and other regions, share common problems related to designing and implementing RE programs. Common problems, if addressed regionally, have the best chance to lead to common solutions, which can be shared by the countries in the region.

- **Capitalize on Good Corporate Citizenship to Facilitate RE**
  A somewhat unorthodox approach used by some governments (Thailand, the Philippines) is to capitalize on good corporate citizenship of large foreign companies interested in making investments in their countries. This typically works when governments negotiate a premium for some value added to rural electrification projects on other sector projects, which it awards concessions or franchises to foreign businesses and investors. An example of this in the case of Zambia may be for the government to require some rural electrification premium as part of any new IPPs or investors in ZESCO's assets, as they are put up for privatization.

Rural Electrification Options for Zambia

There are three distinct types of rural demand needs that the Zambian planners need to address in designing a rural electrification plan:

1. Villages well away from existing infrastructure and where RE is used primarily to improve the quality of life in households;

2. Areas that are more or less proximate to existing network and will be electrified eventually. However, the total increase in economic activity is not expected to outweigh the costs of electrification; and

3. Areas where greater supplies of electricity could result in significant value added in agriculture – pumping, cold rooms, processing, mixing of feed, etc.

The typical approaches used by most developing country governments are based on using international bilateral grants to address the demand for 1 above, loans from International financial Institutions (World Bank, Asian Development Bank, African Development Bank, etc.) for 2 above, and energy service companies with some form of concessional financing for 3 above.

The lessons learned in other countries offer key insights that may be helpful for Zambia to design its own rural electrification strategy. Leadership for both the collection of lessons from abroad and for formulating an appropriate rural electrification model will need to start with the government. The following questions are pertinent to the formulation of RE policy:

- What is the Government's long-term rural development policy?

- How does the Government view the role of rural electrification in facilitating rural economic development?

- What are the main development issues that require separate development policies for urban and rural development?

- What are the key energy demand characteristics and demographic patterns in Zambia that need to be explicitly incorporated in RE planning?

- What are the key elements of an enabling environment that the Government needs to put in place to encourage market participation in the RE program?

- What should be the role of the donors?

- How should the participation of the various RE stakeholders be maximized in order to boost rural electrification?

- What is the role of the regulator to protect the consumer on the one hand and to facilitate investor viability on the other?

These are just a few of the planning challenges that the Government of Zambia needs to face as it prepares to develop its aggressive RE strategy. This Desk Study provides a review of the different RE models used in other countries and outlines a key criterion that should be considered by the Government of Zambia as it embarks upon the development of a Rural Electrification Master Plan with assistance from SIDA and moves forward with the design of the GEF concept paper -- Increased Access to Electricity with Renewable Energy.

Annex I provides an extensive bibliography on the subject of rural electrification.

I. COUNTRY BACKGROUND

A. THE ECONOMY

1. Background

Zambia is a landlocked country with an approximate land area of 740 thousand sq. kms. The population of the country is approximately 11 million. Exhibit I-1 provides a map of Zambia. Zambia's neighbors in the South are Botswana, Namibia and Zimbabwe. Tanzania and the Democratic Republic of Congo are in the North; Angola is in the West; and Mozambique and Malawi are in the East.

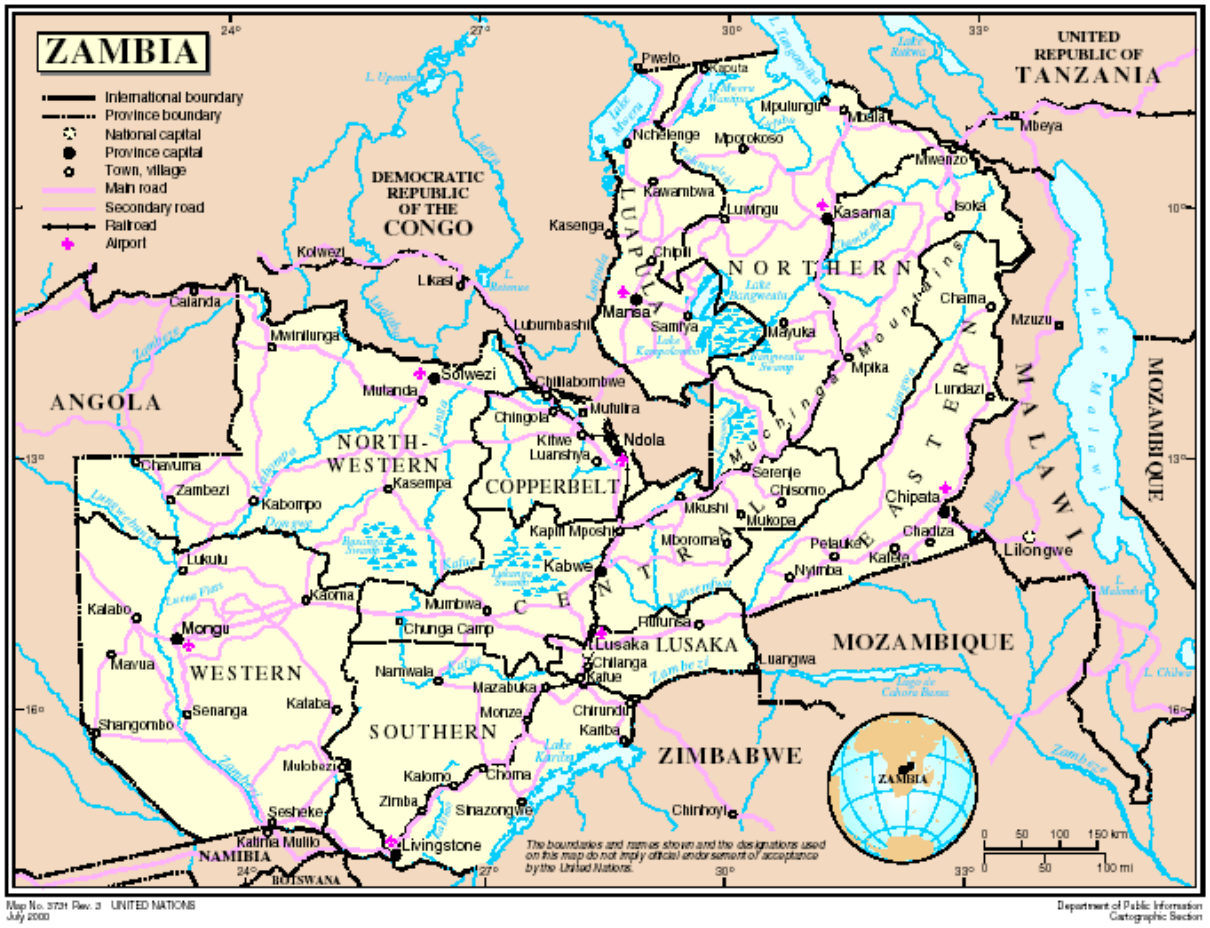
Zambia's economy has two main poles – agriculture and mining. There is a significant and growing commercial agricultural sector, as well as more traditional forms of small farm holdings. Foreign exchange earnings are still heavily dependent on the exports of copper, cobalt and zinc, which together account for about 85 percent of the country's export earnings. Zambia's tropical upland geography, with a range of moderately high elevation microclimates, offers nearly unlimited possibilities for mixed agriculture. Increasingly, commercial agro-industrial operations are starting up in Zambia. New export crops include flowers, fresh vegetables, coffee, tobacco, and herbs. The country's resources also include woodlands and various non-copper minerals. Tourism, to view African wildlife and the Victoria Falls, is another sector that may offer potential opportunities for growth.

In spite of the significant potential in both minerals extraction and agriculture, poverty remains widespread and the country has faced difficulties in mobilizing the resources necessary to take full advantage of this resource potential. Electricity and other infrastructure tend to follow the rail lines, excluding many parts of the country from modern roads, telecoms, and electricity. The government has attempted to mitigate some of the impacts of a limited grid system by using distributed generation, mostly diesel engines at a score of locations throughout the country.

At the present time, just under 20% of the population receives electricity at home. In rural areas this electrification figure is less than 2%. Clearly a tremendous scope exists for increasing the use of electricity throughout the country.

Zambia, assisted by its donors in the international community, has implemented a program of structural adjustment, which focuses on both macroeconomic management and restructuring of specific sectors of the country's economy. Many of Zambia's neighbors have political or military problems, some of which have resulted in a steady influx of refugees over the past decade. This influx further strains the country's infrastructure and, realistically, must be accounted for in future expansion plans for electricity, roads and telecom.

EXHIBIT I-1: MAP OF ZAMBIA



The government recognizes that Zambia needs to diversify and expand its economic base and mobilize critically needed investment in non-traditional sectors of the economy. To this end, the Government began to introduce a number of market-oriented economic reforms during the 1990s. These reforms, some of which are also part of the Structural Adjustment Program, were aimed at reducing state participation in and control of economic activity. Specifically, the Government initiated the following policies:

- Decontrol of prices and elimination of most subsidies;
- Market principles for the determination of interest rates and exchange rates;
- Elimination of import restrictions and a reduction in import tariffs; and

- A systematic privatization of state-owned enterprises and liberalization of crop marketing.

As a result of these policies, and aided by good weather and a relatively stable exchange rate in 1999 the country's economy reversed its previous trends. Problems in the privatization of the copper industry reduced the growth of the economy, along with export earnings. Nevertheless, Zambia's GDP in 1999 managed to grow by 2.4 percent, mostly through improved agricultural output. With increased investment as a result of the ZCCM privatization, and continued growth in the agriculture sector, GDP growth for 2000 was close to the target of 3.5 percent.

In order to continue recovery, the Bank of Zambia embarked on a new, tighter, monetary policy and almost doubled banks' cash reserve requirement to fifteen percent. The Bank of Zambia continued to adjust the reserve requirement until the Kwacha began to stabilize.

At the end of 2000, the World Bank, the IMF and Zambia agreed on a significant reduction in Zambia's international debt obligations – about US $2.5 billion in present value terms or about 60 percent – under the enhanced Highly Indebted Poor Country (HIPC) initiative. This initiative is ongoing and represents one of the most important elements of the Government's economic recovery and adjustment programs.

2. Zambia's Recent Economic Performance

Real Zambian GDP closed the decade at close to, its 1990 level. GDP per capita remains below 1990 levels, given population growth.[1]

Zambia's privatization program has had mixed results over the past several years. The largest company, Zambia Consolidated Copper Mines (ZCCM), was privatized to a subsidiary of Anglo American Corp. in the first half of 2000. It is possible that Anglo American may give up its share of ZCCM before this report is completed due to a deteriorating international market for copper. The Government is currently seeking potential bidders, possibly including those who were unsuccessful in purchasing ZCCM shares the first time around. The schedule for privatizing the country's main electricity provider, ZESCO, is expected to be finalized in the next 3 months, with the selection of a privatization financial advisor. The Government has decided to concession its interest in ZESCO rather than selling the assets outright and hopes for completion of the transaction this year (2002).

[1] In terms of global ratings on key economic indicators, Zambia was placed 126 out of 191 countries in terms of GDP and 175th out of 191 countries in terms of GDP per capita.

A continuing problem for Zambia's macroeconomic policy is the deficit in its balance of trade on goods and services, now nearly 10 percent of GDP. The trade deficit requires external financing and competes with infrastructure for foreign funds.

Zambia possesses many attributes that should make it attractive to investors as long as it can show continued progress in its economic restructuring. A stable regional political environment, while beyond the control of the Zambian Government, is also an important element in attracting investment.

A regional tariff-free zone, the Common Market for Eastern and Southern Africa (COMESA), has started up. Although the free trade area may negatively affect local industry initially, Zambia's manufacturers have already seen some positive results from COMESA. The possibility of heightened competition for Zambia's manufacturers remains, but the overall effects seem to have been positive. Without effective regional integration Zambia has little prospect of modernizing its infrastructure, a precondition for it to begin realizing its untapped potential.

B. KEY DEVELOPMENT POLICY ISSUES

The Government has started along the path of a major economic reform program. The following policies have emerged as key to its overall development strategy:

- Stability-oriented macroeconomic policy, which will result in lower interest rates, slowing inflation, and a stable Kwacha;
- Institutional realignment and reorganization to provide an investor-friendly environment;
- Pricing reforms to align prices and costs with regional levels;
- Aggressive privatization of state enterprises including the energy and telecommunications sectors;
- Liberalization of trade and import policies and a focus towards regional markets and competition; and
- An overall private-sector-led growth strategy.

Zambia has already begun showing progress in each of these areas. In the privatization area, the Government has already created the Copperbelt Energy Corporation and Kariba North Bank Power as separate companies. The latter remains a parastatal. The rest of the power sector assets are under the management of the national utility, ZESCO. The Government has already

approved private sector participation in ZESCO through concessioning, and currently the government is looking for a transaction advisor that would help in the process of identifying a concessionaire. This will prepare the energy sector for external investments in a more market-oriented environment, with competition driving efficiency gains and consumer benefits.

The Government is also entering into regional dialogues with its neighbors on regional development policies in the agriculture sector and is part of the Southern Africa Power Pool (SAPP) in order to participate in the regional electricity market.

II. ENERGY SECTOR OVERVIEW

A. OVERALL ENERGY SECTOR

1. Overview

Zambia's energy situation is reasonably balanced. While Zambia is a net oil importer, importing an estimated 12,000 barrels per day in 1998, it is also a net exporter of hydroelectricity. The country's domestic energy resources include coal and hydroelectric power. Zambia has an installed generating capacity of 1,776 MW of which 1,690 MW is hydroelectric and approximately 86 MW is thermal.

Biomass energy still represents more than 70% of final energy demand in the country. Of the country's 1999 total of 4.6 million TOE of final demand, about 3.6 million TOE was firewood or charcoal. Households used the vast majority of biomass energy, some 80% of the firewood and about 99% of the charcoal. Exhibit II-1 breaks out energy use by sector.

EXHIBIT II-1: ENERGY DEMAND BY USER (1998)

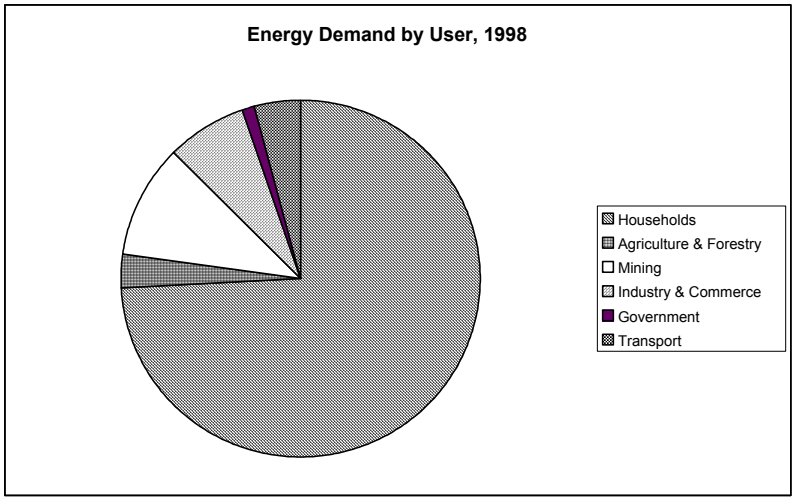
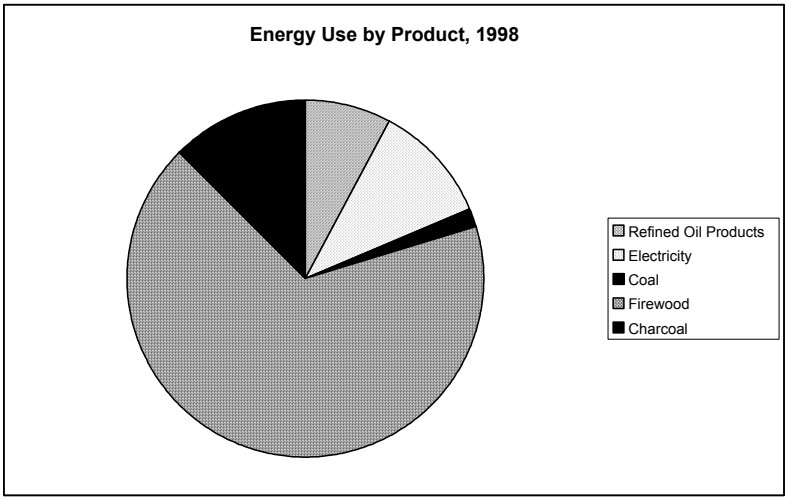


Exhibit II-2 shows final energy demand by product.

EXHIBIT II-2: ENERGY USE BY PRODUCT (1998)

Refined oil products accounted for just 8% of the country's final energy demand



and all oil is imported. Indeni, a small refinery, was recently rehabilitated and is now operating. However, most products are imported through Tanzania and terminaled at that site.

The share of oil in overall energy demand has been declining since the 1980s. Oil demand, once more than 500,000 tonnes annually, has fallen to 350,000 tonnes in 1999. Both mining and transport demand are well below their earlier levels. Oil use in the mining industry was as much as 180,000 tonnes annually in the early 1990s. In the last few years the mining industry has used less than 120,000 tonnes.

A decline in mining demand has affected the transport of goods in the country, and transportation energy demand, in the 280,000-300,000 tonne/year range in the early 1990s, has fallen to less than 200,000 tonnes in 1999.

Oil product prices are relatively high in Zambia, especially given the overland transport for distributing refined products to the rest of the country from Ndola. A recent effort to introduce competition in retail oil product sales has resulted in four major international firms (Caltex, BP, Shell, ExxonMobil), already active at the wholesale level, establishing an expanded presence at the retail level.

Zambia has reserves of coal and was once producing more than 500,000 tonnes annually (about equivalent in energy terms to current oil use). Production has fallen, largely due to the closing of a coal-fired power plant and reductions in certain smelting operations. Current coal production is about 186,000 tonnes annually.

Electricity remains the prevalent form of commercial energy, with consumption equivalent to more than 500,000 TOE per year (7,773 GWh). Two power plants, Kafue Gorge and Kariba North, account for more than 90% of total generation. Virtually all generation is on the ZESCO network, with isolated supplies well under 1% of total generation.[2]

Electricity tariffs remain low by world standards. The highest tariff block for residential users is less than $0.03/kWh, while several categories of users pay just $0.01-0.02/kWh. In addition to low tariffs, technical losses in transmission and distribution exceed 15% and non-technical losses are estimated to fall into the 18-20% range. The Government of Zambia owes significant arrearages to ZESCO. The revenues received by ZESCO are not sufficient to maintain the network infrastructure and extend the grid to new service areas. Consequently, internal cash generation for system expansion and rural electrification is almost nil. Both users and donors provide the bulk of the funds for such system extension.

Zambia is a net exporter of electricity. In 1999 more than 545 GWh were exported, mostly to Eskom and BPC. In the past Zimbabwe has been a significant purchaser of Zambia's electricity exports. However, the country's recent economic slowdown has reduced those exports to small levels since the mid 1990s. As recently as 1994, Zimbabwe was purchasing about 2,000 GWh annually. More than 70% of electricity sold in Zambia is used by the mining industry. With the current slowdown in mining industry demand for electricity, there is a growing surplus available for export. Zambia's membership in the Southern Africa Power Pool (SAPP) should enable the country to make better use of its abundant hydroelectric resources (see below).

The Southern Africa Power Pool

Zambia is a member of the Southern African Power Pool (SAPP), under which the member States will be linked into a single electricity grid. The SAPP offers a regional marketing mechanism for electricity among member countries. It covers an area of 9 million sq. km. and connects 200 million people in Southern Africa. The northern system is primarily composed of ZESA, ZESCO and SNEL, and the southern system is primarily Eskom, BPC and NamPower. These interconnections have resulted in an increased ability of the SAPP members to trade electricity and redistribute it to the various demand centers. Other interconnections, including the Tanzania, are currently underway or planned. A new link under construction is a transmission line between South Africa and Zambia through Botswana. Botswana began use of the line in 1998. A 720-kilometer transmission line connecting South Africa and Namibia should be fully operational soon, permitting, for example, Zambia to wheel power to Namibia.

Zambia's unique location makes it an important link in the SAPP. A major transmission link between the Democratic Republic of Congo and South Africa through Zambia, Zimbabwe and Botswana is being considered.

A number of donors have been active in financing transmission interconnections in order to increase the coverage of the pool and accelerate electricity market development in the Southern Africa Region. Ongoing projects to rehabilitate and upgrade Zambia's transmission system include a Government of Norway grant for $13 million (out of a project total of $40 million). The World Bank also approved a $75 million financing for the rehabilitation of Zambia's electricity infrastructure. Sweden is also supporting the Pool's efforts.

[2] Of the total generation by isolated grids, 55 GWh per year, more than 75% comes from small hydro plants. The remainder consists of diesel gensets

In spite of the country's ongoing economic restructuring and adjustment, non-mining electricity demand continues to grow. Current demand by households is about twice the level of 1990, a growth rate of about twice the current GDP rate of increase.

In the face of growing demand for electricity both in the urban and rural areas, the Government has developed a set of national energy policy objectives. The key policy objectives of the Government are as follows:

- To increase the access of reliable and affordable electricity to all consumers, both urban and rural, through a targeted set of programs to both increase domestic generating capacity and participating in the regional electricity market as a member of the SAPP;

- To increase the efficiency of utilization of imported petroleum and to reduce imports in order to maintain control on foreign exchange reserves in the country;

- To promote the use of domestic coal by utilizing clean energy technologies;

- To manage the supply and consumption of fuel wood in the households by both controlling use and increasing reforestation; and

- To develop and implement a program for effective use of applicable renewable technologies both connected to grid and off-grid systems for remote and isolated rural areas.

As Exhibit II-1, above, indicated, biomass energy is roughly four times greater than the commercial energy totals, at about 3.6 million TOE.

2. Potential Energy Resources

Zambia has considerable energy resources and technical potential exists to increase its energy supply to various end-use consumers.

Hydropower

The most abundant source of energy in Zambia is hydropower with the main river catchment areas developed at the Zambezi and Kafue rivers. The Zambezi River has the Kariba North Bank power station and Victoria Falls power stations; on the Kafue River, the Kafue Gorge Hydroelectric Scheme. The main power stations are connected into the national grid by way of a 220 and 330 kV network. Mini-hydro stations serve the rural areas in the northeast: Lusiwasi (12 MW), Musonda Falls (5 MW), Chishimba Falls (6 MW), and Lunzua (0.75 MW).

However, the distribution of electricity is mainly concentrated in Livingstone near Victoria Falls, the Capital of Lusaka, and the Copperbelt towns. Zambia also has the potential to develop more small and micro hydro sites to serve isolated mini-grids. A number of small hydro sites have been identified, which offer potential to towns presently being served by small diesel generators.

Coal

There is an estimated 30 million tons of coal in Zambia. Due to a shortage of investment funds and constraints on coal production, the output has dropped over the last few years. It contributes only about 6 percent of the energy needs of Zambia, mainly to the mining sector and industry. There has been some research done to examine the possible use of coal briquettes for cooking in specially designed cooking stoves. However, this is not consistent with promoting clean rural energy and neither the government nor private sector want to promote widespread use of this rural technology.

Peat

Peat is a potential source that has not been systematically examined, nor are there any statistics of its use in Zambia. There are known areas of peat along the Zambezi and Kafue River valleys.

Solar

Because of the bountiful sunshine throughout Zambia, solar power is a possible substitute for other energy sources. Its use is competitive in rural areas especially for electrifying villages, pumping water, and refrigeration in health clinics. The main problem with solar energy is the very high initial investment costs, which can be quite prohibitive. The other renewable energy source is wind power, which currently is used primarily for pumping water.

Since Zambia faces high costs of grid extension services, it is attempting to speed up off-grid rural electrification by developing a program of electrification by solar energy.

Wood

There are an estimated 50 million hectares of woodlands in Zambia. That is equivalent to 66 percent of the total land area. The standing volume of timber is estimated to be approximately 2,700 to 4,700 Billion tons. Annual yields vary according to region--higher in the north to lower in the south--and range from $0.3m^3$/ha to over $0.8m^3$/ha. Wood fuel and charcoal meet the needs of about 70 percent of both rural and urban consumers. However, the government's policy is to curtail rampant use of wood fuel both because of deforestation and pollution.

B. CURRENT STATUS OF RURAL ELECTRIFICATION

1. Overview

The rural energy situation in African countries is not much different from that in other developing countries in that rural areas are typically dependent on off-grid electricity systems, especially in areas that are remote and have a low density of demand. For large rural areas, close to the main urban areas, the typical approach used by developing countries to provide electricity is extension of the national or regional grid. While in most developed countries over 90 percent of the rural population has access to electricity, such access in developing countries ranges only from 20-35 percent. Also, given the nature of demand, the delivery cost of electricity is generally higher than that in high-density urban areas. Most developing country governments, therefore, routinely subsidize rural energy, which has a direct impact on rural development.

Despite the demonstrated linkage between access to electricity and rural development, most governments and analysts feel that the added cost of providing electricity to rural areas has not yielded commensurate economic benefits. Often the argument is that access to electricity has not produced economic development and industrial growth that was envisioned at the start of the rural electrification (RE) initiative. Actual experience in most developing countries is different, however. In fact, rural economies have shown both economic benefits as well as associated industrial development directly resulting from RE initiatives.

It is not that the provision of electricity to rural areas that has not resulted in the expected economic benefits. Rather, it is the lack of sustainability of RE programs after the donors and donor-funded contractors leave. Too often, the system breaks down due to poor or non-existent maintenance and a lack of spare parts. Most donor-supported programs in the past in many developing countries, especially in Africa and Asia have generally not been sustainable. The newer approaches to RE are beginning to encourage private sector led initiatives and introduce market mechanisms in order to achieve sustainability.

In most Southern African countries, land areas are generally ample and the rural population is dispersed in individual villages or clusters of villages. This leads to a pattern of remotely located low-density electricity demand, which is not amenable to the grid extension model of providing RE. Therefore, the role of off-grid decentralized electricity systems is becoming increasingly important. Grid extension in such situations is prohibitively costly and not financially viable. Although in many countries diesel generators, micro hydro, solar, and biomass technologies have been utilized to increase rural electricity access, in most countries in Africa, solar and biomass technologies are most commonly used. The delivery mechanisms are typically NGOs, private contractors and energy

service delivery companies. However, there has not been an appreciable application of these technologies. Despite their technical feasibility and gradually reducing cost factors, there are widespread constraints to their applications. Some of the main constraints are as follows:

- A lack of government support and commitment, toward policies to encourage renewable energy technology based RE systems;
- Cost disparities between grid connected and off-grid RE applications;
- Insufficient incentives for private companies and investors to participate in the development and delivery of RE;
- Inadequacy of regulatory functions applicable specifically to grid-connected and off-grid systems;
- Undefined and ill-targeted subsidies and an absence of mechanisms to remove subsidies once the programs are sustainable;
- A lack of creative public and private sector alliances to develop market-based solutions to RE;
- Difficulties for central government ministries and planners to actively involve local leaders, village chiefs, and town officials in RE planning in order to facilitate locally driven strategies rather than centrally imposed policies and programs;
- Low regard for the explicit recognition of the value of linkages between rural electrification and rural development at the central planning level; and
- Inadequate programs for consumer education, public participation and acceptance, and political acceptance of the role of rural electrification in economic development.

Most developing country governments worldwide, and many African countries, face these barriers to planning and implementing effective and sustainable RE programs.

2. Status of RE in Zambia

The Ministry of Energy and Water Development (MEWD) is the Government's principal entity charged with national energy planning and policy development. The Government has stated that increasing access of electricity to rural areas and the provision of all forms of energy to promote rural economic development

are two of its key priorities. To this end, the MEWD is in discussions with SIDA of Sweden to obtain technical assistance for the preparation of a Rural Electrification Master Plan. As part of this plan, the Government is also looking at the utilization of applicable renewable energy technologies including solar photovoltaic systems, micro hydro schemes, domestic production of ethanol from sugar cane, and a viable fuel wood program.

For the most part, people in rural and peri-urban areas use kerosene for lighting and most of commercial farmers use diesel-powered irrigation. Because of the lack of electricity, inhabitants in the rural areas are not able to increase their productivity levels and their incomes. Social services are also seriously hindered at schools and health clinics. At current electricity connection rates (less than 10,000 customers per year), and assuming zero population growth, it will take 100 years to provide universal access.

One of the principle objectives of the Zambian government is to increase access to electricity for its people through a program encouraging participation by the private sector.

The National Energy Policy (NEP), 1994, and the Electricity Act, 1995, were drawn up by the Ministry of Energy and Water Development (MEWD). The common goals of both documents included aims to increase access to electricity to households, and to develop cost effective electricity generating sites for domestic as well as export markets. In order to achieve these goals, the Government of Zambia allows Independent Power Producers (IPPs) to generate and transmit electricity using the national grid. Through the NEP, the electricity is sold in domestic and export markets. A large scale Power Sector Reform Project was initiated in 1999 to rehabilitate and expand the existing system.

In 1998, a framework of incentives for private sector investors was developed by the Ministry of Energy and Water Development (MEWD). The framework allowed IPPs to both generate electricity and to export it the national grid. Fiscal incentives for hydropower project investments include provisions concerning transmission lines. Government licenses are granted to investors on the basis of "build, own, operate and transfer" (BOOT) for generation, and "build, own and maintain" (BOM) for transmission. The private sector investing in rural areas is given better incentives than in urban areas, and the bigger the investments, the bigger the incentives.

In 2000, seven projects were funded to extend electricity to seven provinces in Zambia: Chisamba Farm Block; Central Province; Gwembe-Tonga, Southern Province; Chembe, Luapula Province; Lukulu Farm Block, Northern Province; Tapo-Lukona, Western Province; Manyinga Sub-Boma, Northern Province; and areas in Katete, Eastern Province. These projects were funded by the Zambian Government under financing from several bilateral donors.

The Government has established a Rural Electrification Fund, financed by putting a levy on electricity supplied by ZESCO. This Fund provides limited resources, approximately $5 million annually, for addressing rural electricity requirements of the country. The capitalization and management of the Fund needs further review. The Fund has not been as effective as expected to support the overall Government policy for increasing RE applications due to a variety of institutional reasons.

The overall objective of the Fund is to focus on extending the main national grid to rural areas currently not served, which represents almost 80% of the Zambian population. The extension of the national grid as a vehicle to expanding RE has proven to be very costly in most countries. When grid extension programs are introduced into systems with low collection rates, an inability of rural consumers to pay, illegal connections, theft, and other non-technical losses, most grid extension projects become financially unviable. Accordingly, similar to other countries, Zambia is unable to attract the private sector to participate in the Fund for any RE projects without extensive incentives to the industry.

Therefore, Zambia is taking a careful look at how the impact of the Fund can be enhanced by promoting off-grid decentralized RE projects utilizing alternative renewable electricity sources such as solar, biomass, micro hydro schemes, etc. The most visible evidence in Zambia is for solar energy applications for RE.

Twenty-three rural electrification projects had been completed by 2000; of which sixteen projects involved extending the national electricity grid, primarily under funding from the World Bank. Seven projects, funded by the government, supported the installation of solar photovoltaic equipment in remote rural areas at schools and rural health centers.

The Swedish Government is helping Zambia implement a project to offer solar electricity services to 400 homes through Energy Services Companies (ESCOs) in Chipata, Lundazi and Nyimba Districts of Eastern Province.

The Ministry of Energy and Water Development (MEWD) and the Swedish International Development Agency (SIDA) have implemented a sizeable pilot solar PV project in the Nyimba, Chipata and Lundazi districts in the Eastern Province. A number of energy service delivery companies are being utilized to implement the projects. The project, since 1998, has provided electricity services to rural areas for lighting, water pumping, and refrigeration. The sector of application included medical facilities, households, NGOs, schools, small businesses, and tourism. A total of 350 solar PV installations have been completed. The largest number (230) of applications has been in refrigeration systems.

This is a pilot project and is being implemented entirely by grant funds. The project offers the following interesting lessons that could be useful in the design of future projects:

1. The project supported private sector Electricity Service Companies (ESCOs) to be set up under the project through a bidding process. The mechanism used was to provide physical capital and training to the ESCOs in project implementation. In addition, the Ministry carried out awareness campaigns in the project areas to increase the acceptance of solar PV technology. As a result of this model, the Ministry feels that there is sufficient scope to develop a much larger ESCO industry for wider applications of the technology for RE systems in other provinces.

2. The project has attracted in large measure the interest of the self-employed, farmers, teachers and small businesses in the provinces. The success has been sporadic and it is not clear how a project like this would fare if expanded, and what the role of the regulator, ERB, should be in ensuring equity between grid-connected and off-grid electricity providers.

3. There is a widespread belief among the planners that if the subsidies are removed, such projects will not survive, as rural consumers will simply be unwilling to pay the full price. This belief is rather rampant. However, a number of rural electrification projects have not only survived but have also grown even after the government has removed the subsidy and left to the private sector to develop RE applications. Examples in Sri Lanka, Bangladesh, Peru, and Bolivia have confirmed that most rural consumers, having tasted the fruits of access to electricity, are willing to pay unsubsidized prices for electricity when faced with the choice of losing access.

4. Without a doubt, however, subsidies are needed to develop a market for rural electricity. There are different approaches to providing subsidy -- (i) to the electricity provider, or (ii) directly to the consumer. In the case of the SIDA pilot project in Zambia, the Government provided the subsidy to the energy service delivery companies to keep them engaged rather than to the consumer. The appropriate approach may need to be tested through more projects in the future.

5. Another issue that will need to be addressed is the nature of mechanisms for funding future projects. There are many options: (i) Fund managed by the Government, (ii) Fund managed by a development bank or even a local commercial bank that already has a rural clientele through other banking business and thus has the needed credibility, or (iii) non-profit fund managers such as NGOs. Once again, the Government will need to make decisions on financing approaches and the management of the flow of funds in the case of public sector projects.

6. Consumer acceptance of RE systems and their benefits need to be assessed in order to design future programs. The success of RE programs is greatly linked to political acceptance at the local levels. The local politicians can be great champions with greater access and credibility to make a significant difference in the success and expansion of the RE programs that may initially be implemented as pilot projects.

7. Energy programs driven solely by donors in the rural sector without the participation of the private sector have a well-documented history of disappearing in many countries once the donor funds are gone. In fact, continuous dependence on donors for RE projects creates a conditioning that makes it much harder to start private sector led RE projects. In its planning process, Zambia will need to explicitly define and encourage the role of the private sector.

8. Finally, the regulator needs to begin thinking about its role as off-grid RE systems begin to take off. It is a challenging process as subsidy and tariff issues have to be addressed without being unfair either to the energy providers or the rural consumer.

In addition to the solar PV RE systems in rural areas, Zambia has also initiated RE programs utilizing biomass-based RE applications in rural areas. The National Institute for Scientific and Industrial Research (NISIR), with NORAD support, is involved in RE programs to meet both lighting and cooking needs. The specific RE applications being assessed include the production of methanol using animal dung for lighting and cooking. This technology is low-cost and simple and can be implemented by the communities. In a larger market, local entrepreneurs can be brought in to commercialize the local industry. The NISIR needs more funds to study a more widespread application of this technology.

Other potential RE opportunities in Zambia that need to be studied include (i) micro hydro applications at the village level where possible, (ii) biomass energy generation from excess bagasse (sugar cane residue), and (iii) possible wind energy. These and other RE options, need to be assessed by the Government as part of an integrated rural energy development planning process.

In addition to the ongoing Zambia - Power Rehabilitation Project funded by the World Bank, a new project - Increased Access to Electricity with Renewable Energy - is being developed by the World Bank and Global Environment Facility (GEF). The objective of the project is to expand access to electricity in large scale in the rural and peri-urban areas through creation of an enabling policy and institutional environment with increased private sector participation and community participation to promote sustainable economic growth and reduce poverty. The total project costs are estimated to be US $120 million, tentatively including Government (electricity levy) US $25 million, Private US $25 million,

GEF US $5 million, SIDA US$ 5 million, and IDA US$ 60 million. The World Bank is in discussions with GEF for assistance in starting project development.

The project includes two major components: (i) technical assistance (TA) and capacity building component, and (ii) co-financing in investment projects to be undertaken by the competitively selected project entities. The investment projects can be grouped into four categories: (a) grid connection, (b) isolated small grid supply using RET such as small and mini hydropower, (c) solar home systems such as photovoltaic systems, and (d) more efficient biomass energy utilization. It is expected that GEF will be used to co-finance component 1 and component 2(b) and 2(c).

The first component will provide TA support aimed at the enhancement of the legislative and regulatory framework and capacity building, establishment and initial operations of the rural electrification institutions (e.g., a Rural Electrification Agency responsible for administration of the Rural Electrification Fund), including the preparation of indicative subsidy standard for different type of investment projects, project/project entity selection criteria and process including standard application form (project proposal) and model contracts. It will also include training and capacity building for fund administration, review of project proposals, and evaluation and monitoring of project performance, training and capacity building program on renewable energy related technologies such as maintenance of batteries for photovoltaic systems, and operation and maintenance of small/mini hydropower.

In addition, the TA part of the project will focus on the improvement of business models for private service providers involved in marketing, developing, installation and operation of RET based projects

Other parts of the TA will include the following components:

- Updating of indicative master plan covering whole country for expanded access including feasibility studies for small and mini hydropower;

- Management of forest resources and improvement of charcoal production and utilization technology;

- Financial and legal advisory services for private power transactions for large scale hydropower development; and

- Financial and legal advisory services to complete ZESCO restructuring and concessioning as undertaken by ZPA.

The second component of the project will focus on the following:

- Grid extension projects for peri-urban and rural electrification;
- Development of mini grids using RET such as small/mini hydropower (GEF co-financing);
- Solar home systems such as photovoltaic systems of different size (GEF co-financing);
- More efficient biomass energy utilization such as efficient stoves to burn fuel wood.

Both the scope of the project and its cost estimate are considered preliminary at this early stage and need to be firmed up in further project preparation.

Finally, The Government is in discussions with SIDA to launch a project for the development of a Rural Electrification Master Plan for the country.

3. Energy and Development in the Rural Sector

The rural population in most of Africa generally does not participate in the mainstream formal economy. Subsistence agriculture is the main economic activity open to this population. Therefore, the village population does not have access to economic opportunities available to urban dwellers. One reason for this disparity in economic opportunities is the lack of reliable and affordable energy. Most energy systems are designed based on conventional technology and at scales that are too large for rural populations. Conventional modern systems based on technologies producing high quality and lower cost electricity are prohibitively "costly" in rural settings, given the higher costs of distribution. In the absence of plentiful modern energy, rural areas are either left without access to electricity or must depend upon more costly and small-scale renewable energy technologies that do not offer the economies of scale of larger systems.

Without commercial energy, economic development in the rural areas in Africa is mostly restricted to basic agriculture. Raw materials that could otherwise be developed to provide a "value added", remain undeveloped in the absence of commercial energy. Typically, therefore, rural development includes (i) agriculture extension, (ii) basic health care services such as hygiene and drinking water, (iii) education, and (iv) basic cottage industry such as basket weaving, pottery, etc. Upgrading the social needs of rural communities and making the rural population an important element of the development process cannot be achieved without the availability of commercial energy.

Generally, in rural areas, there are few mechanisms for the development and growth of the enterprise sector and industry. Therefore, the energy needs in the rural sector are basically social energy needs such as lighting, cooking, water heating and pumping.

Small-scale applications of solar technology for such applications as crop drying in the farm sector have proven unsuccessful, as the farmers are unable to pay for such systems. A broader impediment to RE application in African villages is the consumer perception that energy is "not that important" when compared to other needs such as money, food, water, and medicine. A number of surveys done by various donors and NGOs indicate that the rural consumer needs to be educated in the very direct linkage between the development of the rural sector and the availability of commercial energy.

In addition to the technology barrier, a number of other barriers limit the application of RE systems in Southern Africa. These have their roots in the institutional capacity of village level management institutions. For example, there is a lack of an enabling environment that is needed to promote economic development as a policy and mobilize the energy needed to foster the planned development. The local leaders need to be committed to a sustained development of the enterprise sector, creating new jobs, and proceeding towards a more equitable income distribution. Only such commitment to development will open ways for more wide spread application of rural energy systems. An added and most commonly observed problem facing villages in Southern Africa is the constant migration of skilled students and workers to the urban areas. Targeted programs are needed to open up job opportunities in the rural sector itself to reduce such large and constant migration toward urban areas. In other words, some level of industrial activity is needed to retain skills within the villages. Education sector policies of the governments, therefore, need to focus on this approach.

Specifically, in the case of Zambia, a number of challenges and constraints need to be addressed through designing a targeted and effective RE Model based on lessons learned elsewhere. Preliminary assessments by the Government and several donors indicate that Zambia faces most of the major barriers to increasing rural energy access. These include financial, tariffs, institutional, transaction costs, commercial, education, training and awareness on renewable energy technologies. There is a need for a more in-depth identification of barriers and development of approaches to addressing these barriers through a comprehensive RE strategy. The following is a summary of the key barriers:

Lack of a Structure to Foster and Leverage Public-Private Financing of Rural Electrification Schemes

As part of its national energy strategy, the government has set a target to increase electricity access to 50% of the country's population by 2010. This is an

ambitious target and even by conservative estimates would require massive investments in the sector Total investment needed for new generation capacity and a transmission/distribution system could easily exceed US $1 billion. Given the public sector budget constraints, much of this investment will have to come from the private sector. Therefore, availability of attractive private sector financing will continue to be a major constraint, even though the government has announced various incentives to potential investors. Apart from the lack of public/private funds, there is a lack of a structure that could efficiently channel funds needed for such large investment needs. The Rural Electrification Fund is simply too small to have much impact. The government may need to develop a public/private investment structure operating along commercial lines that would serve as the vehicle to generate and disburse investments needed for the power sector. Under such an arrangement, the private investors may feel more assured of getting a return on their investments.

Lack of Proper Tariff Levels and Structures

The absence of a cost-based tariff structure is a common problem in most developing countries. As mentioned earlier, the current electricity tariff level in Zambia is below the long run marginal cost and the government continues to subsidize tariffs heavily even to consumers located near or with easy access to grid. This has resulted in an inequitable access of electricity to the country's population.

The problem becomes even more complicated when the government has to focus on those consumers that do not have access to the main grid and can only be served through mini grids and off-grid energy systems. This raises the complex issue of "who should be subsidized and to what extent". In other words, the government faces the challenge of introducing market-based operation of the sector on one hand and targeting and providing subsidies to some consumers on the other hand. Nonetheless, some tariff rationalization to reflect costs is critically needed in order to generate any appreciable private sector investment in the sector.

Need for Institutional Capacity Building

There is a need to strengthen all key institutions involved in the energy sector. This includes strengthening of the management of the REF through both additional capitalization and a more corporate governance approach to its operations. Moreover, as reported by the World Bank in October 2001, ZESCO's revenue collection has improved only recently after the privatized copper mines started to pay their current bills. For the last several years, ZESCO's collection rate has been less than 50% of its bills. Other areas that the government needs to address are (i) a cumbersome process in transferring the collected levy from ZESCO to MEWD which leads to long delays, (ii) absence of a systematic approach and transparent procedure in selection and financing of projects, and (iii) a lack of sufficient number of trained managers and staff responsible for the management of the energy sector.

Lack of Data and Information Needed for Effective Energy Planning

There is a lack of data on geographical distribution of renewable energy sources, which can be used for project planning. There is also a lack of information on the applicability of various renewable energy technologies in different settings in Zambia. In addition, there is a need to establish a structure based on successful RE models elsewhere in the world. Also, given the population distribution in Zambia, there is a need for developing creative mechanisms to widely disseminate information on the benefits of renewable energy technologies, particularly with respect to rural development, increased business opportunities, and job creation. Institutional mechanisms need to be put in place to actively involve the rural and remote consumer in the RE planning and delivery process. This task is not easy in general and is even more complicated because of communication difficulties, language problems, and illiteracy.

High Cost of Renewable Energy Technologies (RET)

Most of the RETs have not achieved successful deployment in rural areas because of their high costs. Both the consumer and the private providers believe that given the high cost of RETs, there is really not a big market for such technologies. As a result, only those RETs generally survive that are initiated by the governments and are backed by a sizable subsidy. This long-held view is being proven wrong in many cases. In fact, analysts and private energy providers in many countries are discovering that the consumers' willingness to pay is very high if the quality and reliability of the electricity supply is acceptable. Indeed, the consumer is willing to pay if the continuity of energy supply can be assured. As a result, a number of technology vendor based delivery systems are becoming popular. Currently, in Zambia, only 7-8 entrepreneurs are licensed for supply and installation of photovoltaic systems. This number could be significantly increased if the vendors can be convinced of the market size and consumer willingness to pay.

Undoubtedly, the Government of Zambia would need to aggressively design and implement an institutional structure for rural electrification if it were to make the progress necessary to meet its strategic goal of 50% electricity access by the year 2010.

III. POTENTIAL RURAL ELECTRIFICATION OPTIONS

Typically, there are three types of rural demand centers that any planners must address in designing a rural electrification plan:

1. Villages well away from existing infrastructure and where RE is used primarily to improve the quality of life in households;

2. Areas that are more or less proximate to existing network and will be electrified eventually. However, the total increase in economic activity is not expected to outweigh the costs of electrification; and

3. Areas where greater supplies of electricity could result in significant value added in agriculture – pumping, cold rooms, processing, mixing of feed, etc.

The typical approaches used by most developing country governments are based on using international bilateral grants to address the demand for 1 above, loans from International financial Institutions (World Bank, Asian Development Bank, African Development Bank, etc.) for 2 above, and energy service companies with some form of concessional financing for 3 above.

This section provides a summary of the most widely adopted technical, institutional, and financial options for RE development in selected countries.

A. TECHNICAL OPTIONS

The basic technical options available to government planners for developing rural electrification programs and providing rural electricity are classified in two categories (i) grid-connected systems and (ii) off-grid decentralized systems. These approaches are suitable for different demand patterns and have different economic and financial performance.

1. Isolated Off-Grid Systems

Off-grid systems are typically decentralized and isolated and meet rural electricity demand at the individual household level or at the village level. Essentially this involves the use of one or more renewable technologies. In some cases, village level off-grid systems for locations away from the main grid are being planned. They involve small independent power producers (IPPs). Off-grid small IPPs in rural areas are viewed by most investors and energy developers as financially risky as they are not governed and protected by a power purchase agreement (PPA) between the producer and the utility.

The most common off-grid systems continue to be very small, utilizing one or more renewable technologies. This means extraction and delivery of energy from solar, biomass, mini hydro, wind, etc. With increasing environmental considerations, these technologies find relatively easy acceptance among both producers and consumers. Renewable energy technology has a number of advantages including (i) less environmental impacts, (ii) reduced reliance on fossil fuels, (iii) modular design permitting scheduled implementation, (iv) well demonstrated safety, and (v) smaller scale applications providing economic opportunities to a larger number of market players.

Biomass Systems

Fuel derived from biological sources (e.g. wood, animal waste, farm by-products) are termed as biomass based systems. These are very popular in many countries and are widely used both at the individual household level by the consumer and in more organized manner by the community, NGOs and private providers. In 1995, close to 70% of the population in Zambia was dependent upon biomass energy. In many countries in Africa, biomass is very commonly used in rural areas at the individual household level. However, its utilization has yet to be systematically organized. Some of the benefits of non-wood biomass energy systems are (i) reduction in greenhouse gas emissions, (ii) reduction in agricultural & forestry residue waste disposal, (iii) a decrease in reliance on importing petroleum products, and (iv) greater community acceptance as a feasible source of technology for small rural communities. This is not the case with wood fuel, which is not sustainable and is environmentally unacceptable.

Micro Hydro Schemes

In some cases, isolated micro hydro schemes for the provision of electricity to populations located in the vicinity of river systems have proved very useful as isolated off-grid rural electrification systems. In Sri Lanka, for example, the Ceylon Electricity Board (CEB), through local NGOs, have implemented several micro hydro facilities with local communities. These facilities are managed outside of the CEB system.

Micro Hydropower facilities plants can be designed as multipurpose projects – flood control, irrigation etc. - in order to improve their economic performance. The advantages of hydropower are well known and accepted as a clean, domestic and renewable resource, which provides inexpensive electricity, that is absent of environmental pollution and maintains the potential for recycling of water for other uses, etc.

Methane from Landfills at the Municipal Level

Landfill gas is produced from the decomposition of municipal waste and is approximately 50% methane. It is typically collected through wells drilled into the landfill, which are connected by a plastic piping system. The gas can then be used for a variety of applications. This option for off-grid energy systems is applicable only at the municipal level, as large landfills are needed in order to

produce sufficient landfill gas. Therefore, this RE approach is not applicable to remotely located small villages.

Solar Photovoltaic Systems

Essentially solar PV systems capture energy from the sun and convert it to electricity through photovoltaic cells or thermal process. This is a very practical alternative to extending power distribution lines to remote and low-density populations. It has been widely used in rural areas around the world. It has also been used in many urban areas because of its environmental benefits and its potential to reduce demand for fossil fuels.

Solar energy can be used for lighting, refrigeration, and water pumping. In addition to these individual applications, larger scale projects can provide power for centralized grid systems. Solar energy systems are easy to operate and require low maintenance. It is a free and abundant resource and batteries store energy during night and cloudy periods.

Wind Energy

Wind energy is available as a result of uneven heating of the earth, which provides for energy to run wind turbines and produces electricity. Small wind turbines have proven to be an appropriate technology for off-grid electricity generation for rural areas located with access to sufficient wind.

Renewable energy technologies offer a viable source for off-grid rural electrification systems. The basic advantages of these systems include (i) safety and reliability, (ii) environmental benefits, (iii) cost effectiveness, (iv) low maintenance, and (v) entrepreneurial business opportunities. They are proven to be excellent means for meeting social energy needs. The next development step is to expand the scale of these applications to the commercial level and institute an enabling environment whereby the private sector can be encouraged to see these RE opportunities as businesses.

2. Distributed Power and Micro-Grids

A variety of both conventional and renewable technologies are in use in many rural areas. The primary factor that has dictated the acceptability of distributed and modular generation systems has been the unit cost of delivered electricity. These systems should be considered as potential options for rural loads in Zambia that have cost-effective access to the national or local grid. Exhibit III-1 below provides a cost comparison of various technologies for rural applications to put the potential of these technologies into context.

As this exhibit shows, costs per kWh vary widely by orders of magnitude. These costs, and the institutional infrastructure available for the application of these distributed systems, are the primary factors that determine the extent of success

of any rural electrification program that needs to increase the access of electricity to rural populations.

EXHIBIT III-1: COST COMPARISON OF DISTRIBUTED AND MODULAR GENERATION TECHNOLOGIES

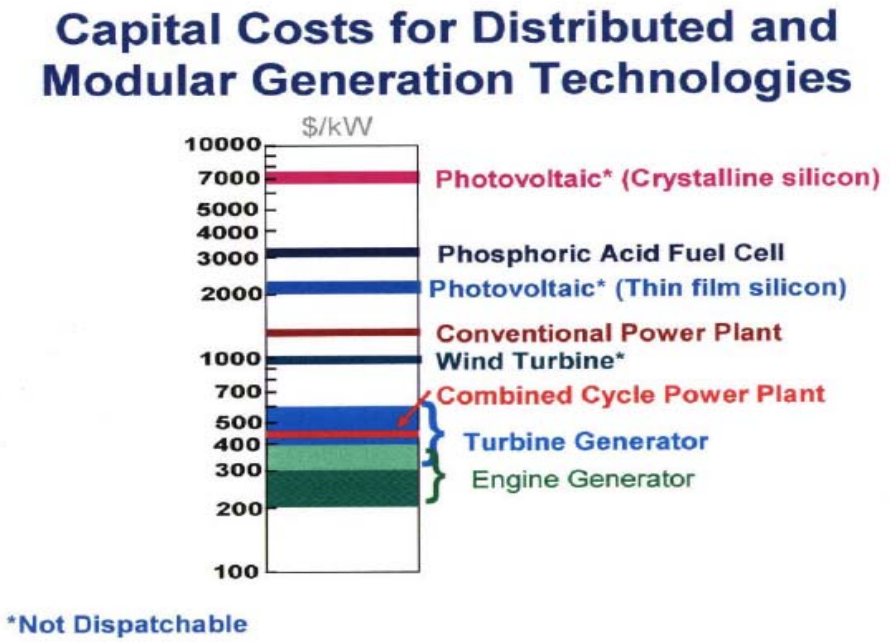


Exhibit III-2 provides typical system efficiencies and their dispatchability, which are also important in decision-making.

EXHIBIT III-2: SUMMARY OF DISTRIBUTED GENERATION TECHNOLOGIES

	Dispatch-Ability	Capacity Range	Efficiency
Engine Generator	Yes	500 kW to 5 MW	35%
Turbine Generator	Yes	500 kW to 25 MW	29 - 42%
Photovoltaics	----	1kW - 1MW	6 - 19%
Wind Turbine	----	10 kW - 1MW	25%
Fuel Cells	Yes	200 kW - 2MW	40 - 57%

Source: Wan Adelman, 1995

Note: Efficiencies of renewable energy technologies should not be compared directly with those of fossil technologies, since the fuel is unlimited.

There are a few examples of medium size RE systems (500 kW to 1.5 MW) that have been developed using diesel and wind power. Typically, these systems require a grid connection or a micro grid. A few projects in this range are being developed in Cape Verde, Mauritania, and Morocco utilizing wind energy resources.

Considerable interest is developing in other micro grid projects based on hydropower. Mini hydro schemes (500 kW to 10 MW) and micro hydro (less than 100 kW) are being looked at for specific sites for both micro grid and stand-alone applications. The most inhibiting factor for wide scale implementation of such RE schemes continues to be cost and not the technology.

In the context of this Desk Study and the pattern of energy demand and density in the rural sector in Zambia, these RE systems should be considered in the mid to long term. In the near term, off-grid systems have the best potential to meet the social energy needs of the rural populations.

3. Grid Extension

Although, traditionally, rural electricity has been provided by an extension of the national grid, it has invariably required some form of sustained subsidy in order to increase access to rural consumers. In some cases, mini or micro grids have been used for small diesel-fired power plants and mini and micro hydro schemes. However, these systems too have required subsidies from the government. Experience worldwide has confirmed that grid-based RE systems have not been economical in most rural applications, primarily because of low demand density and a lack of collections of revenues due to inability of the consumers to pay.

As a general policy, most governments are looking to off-grid decentralized RE systems, which invariably makes the renewable energy technology based systems the most attractive options. Such systems can be scaled to the size of the demand; are mobile; require low maintenance; and have less risk. The capital costs are also scaled, as these schemes can be implemented at a schedule to correspond to the availability of capital.

In the case of Zambia, initially, renewable energy based off-grid systems may offer the best option for remotely located rural populations. At the same time, planning should begin, on a pilot basis initially, for small-scale grid connected systems for rural areas adjacent to the national grid. The role of IPPs will need to be developed to provide them the needed incentives and guarantees in order to shift the financing burden away from government budgets.

B. INSTITUTIONAL OPTIONS

A variety of institutional models are in application in different countries for designing and implementing rural electrification. Each has its own strengths and weaknesses. While no single model can be lifted and applied on a wholesale basis to any country including Zambia, these models offer food for thought and provide attractive elements that can be incorporated into an eventual RE model for Zambia.

The most talked about and the oldest model for rural electrification is the Rural Electrification Administration (REA) model used in the U.S. since the 1930s. The underlying principle and the driver for this approach was the belief that rural communities in the U.S. could only be economically developed if they were able to receive reliable and affordable electricity. The REA model is based on the extension of the grid for rural electricity loads.

The REA program was funded by the U.S. Department of Agriculture (USDA). The same agency funded a program for increasing agricultural productivity. Both of these programs were aggressively funded and offer the most glaring testimony to the linkage between rural electrification and rural development. In 50 years of existence, the REA program has yielded impressive results; less than 10 percent of the loans ever defaulted. It has developed over 3,000 rural electric utilities (REUs) that serve over 30 million rural residents across the U.S. Collectively, they provide approximately 18 percent of the total electricity in the U.S. to customers in almost every state.

Although initially funded by the U.S. government, the program is now funded also by the Cooperative Finance Corporation (CFC) which has assets over $7 billion and continues to serve the need of rural customers. A number of countries have adopted this model, most notably, Thailand and Costa Rica.

A number of new institutional models have emerged during the last 20 years. A few of them that offer some relevance to Zambia are briefly discussed below. Annex II: *Selected Reference Material* includes a number of papers that describe many models in detail and provides a critique of several case studies.

Investor Owned Utilities (IOUs)

An investor-owned utility (IOU) is owned by stockholders who may or may not be the customers of the utility, and who may or may not live in the service area. The IOU is a for-profit enterprise, which is designed in a manner to provide the investors a return on their investment.

Municipal Utilities (MUs)
Municipal systems are owned by a unit of the government, like a city, that purchases electricity at wholesale prices and distributes it to customers. Along similar lines, a local rural government or village body can own a utility that purchases electricity at wholesale prices and distributes it to rural customers.

Rural Electric Cooperatives (RECs)
A rural electric cooperative (REC) is a type of electric utility that is owned by the members it serves. Its profits, or margins, are put back into the cooperative to help run the business efficiently, or are returned to the customer-owner. A co-op exists solely to provide high-quality service at the lowest possible price for its customers and owners. The RECs offer membership on a voluntary basis with a democratic member control on management and operation. They enjoy autonomy and independence. Key features of successful cooperatives include a targeted education, training, and public information program; cooperation among cooperatives; and a concern for the community they serve.

The most basic difference between an electric cooperative and an investor-owned utility is the REC's membership structure and management approach. In a business corporation, the number of shares of stock each investor holds determines control. Electric cooperatives (co-ops) are owned and controlled by the consumers they serve. Members participate in the operation of the co-op by electing a board of directors to determine the rates and type of service(s) they receive. The co-op's board of directors is responsible for establishing the cooperative's basic policies, goals, and strategies. The board also hires a manager to execute those policies.

Another fundamental difference is that co-ops are not-for-profit organizations. The not-for-profit status of RECs provides greater facility to their operation and enhances their ability to pass on the savings from taxes to their customers through reduced electricity prices.

The "universal service" concept also separates not-for-profit REUs and public utilities. Public utilities are required to provide electricity to its service area on demand for a price. This leads to a basic difference in the manner the RECs and IOUs set tariffs. In the case of the RECs, the board of directors of the co-op set rates, although government can and may exercise some form of control.

NRECA International, the most experienced entity in the U.S. on U.S. RECs, has recommended the following key factors that guide the operations of any cooperative. They are quoted here:

> *1. Voluntary and Open Membership - Cooperatives are voluntary organizations, open to all persons able to use their services and willing to*

accept the responsibilities of membership, without gender, social, racial, political, or religious discrimination.

2. Democratic Member Control - Cooperatives are democratic organizations controlled by their members, who actively participate in setting policies and making decisions. The elected representatives are accountable to the membership. In primary cooperatives, members have equal voting rights (one member, one vote) and cooperatives at other levels are organized in a democratic manner.

3. Members' Economic Participation - Members contribute equitably to, and democratically control, the capital of their cooperative. At least part of that capital is usually the common property of the cooperative. Members usually receive limited compensation, if any, on capital subscribed as a condition of membership. Members allocate surpluses for any or all of the following purposes: developing the cooperative, possibly by setting up reserves, part of which at least would be indivisible; benefiting members in proportion to their transactions with the cooperative; and supporting other activities approved by the membership.

4. Autonomy and Independence - Cooperatives are autonomous, self-help organizations controlled by their members. If they enter into agreements with other organizations, including governments, or raise capital from external sources, they do so on terms that ensure democratic control by their members and maintain their cooperative autonomy.

5. Education, Training, and Information - Cooperatives provide education and training for their members, elected representatives, managers, and employees so they can contribute effectively to the development of their cooperatives. They inform the general public, particularly young people and opinion leaders, about the nature and benefits of cooperation.

6. Cooperation Among Cooperatives - Cooperatives serve their members most effectively and strengthen the cooperative movement by working together through local, national, regional, and international structures.

7. Concern for Community - While focusing on member needs, cooperatives work for the sustainable development of their communities through policies accepted by their members

If Zambia considers some form of a cooperative model as the institutional approach for RE development, these guiding principles will be important in designing the RECs.

Concessions

Another model, with limited success, is for the government to offer franchises to local and international NGOs or businesses to design and implement off-grid utility systems for specified RE applications. In principle, the government can divide the various rural load areas into discrete areas/packages and offer concessions to private parties either to generate and distribute or to buy electricity from the national utility and distribute it to the consumers. Consideration of this approach requires a major regulatory reform to address issues of subsidy and competition in the electricity market. Some countries are considering this approach. However, given the fact that electric utilities in most developing countries are national, vertically integrated monopolies, introduction of private power generators would require an unbundling and restructuring of the national utility and the promulgation of a transparent privatization policy.

Franchises

Another model that has received some consideration is for the governments to move the management of RE programs outside of the government by offering franchises to private companies, financial institutions, or private contractors through a competitive selection process. Typically, this approach requires governments to allocate funds, either from the national budget or from international donor aid, and to provide contracts to franchisees to implement the RE program with the government overseeing the progress and linking performance to any subsequent renewal of the franchise. This approach has not been very successful as the franchisee and consumer often are not able to come to an agreement on risk sharing for financial risks associated with nonpayment of electricity equipment by the consumers. In fact, in the case of donor-financed RE programs, in recent years, the donors have gone directly to the NGOs and local development banks to implement rural energy programs. An interesting example of this approach is the World Bank/Global Environment Facility $30 million Energy Services delivery Project in Sri Lanka. This project is further discussed in the next section.

Micro-Enterprises

Another option for governments is to develop a policy and investment climate that would induce micro-enterprises and local distributors of energy equipment (solar PV systems, batteries, etc.) to take on off-grid renewable energy applications in remote villages. Bangladesh, Sri Lanka, Peru, and Indonesia are a few of the countries that have sporadically used this model.

C. FINANCING APPROACHES

As rural electrification continues to assume global proportions in developing countries, the demand for creative financing schemes to fund RE programs will also increase. Given constrained government budgets, much of the future RE development will need to involve the private sector. In other words, rural energy

has to become a profitable business. Furthermore, the energy sectors in developing countries are undergoing restructuring and fresh approaches for sector management are relying more and more on market led energy sector development. Therefore, any source of electricity must compete economically in the energy market, with delivery technologies designed to match the local demand characteristics and local conditions.

There are a number of approaches to financing REUs and off-grid electricity providers. These include the following:

1. Public Sector - Government Budget

Rural electrification and renewable energy programs must compete with other programs such as education, health care, agricultural sector development, etc. for government funds from an already constrained public budget in most developing countries. The situation in Zambia is no different. Therefore, apart from some grid-connected rural electrification for rural populations located near the national grid, virtually any other RE initiative is left to the mercy of grants and credits from bilateral and multilateral donors. The lack of funding commitment to RE from the governments has been the main reason why the access of electricity to rural consumers continues to be well below 25 percent in most developing countries.

Therefore, any rural electrification program that is designed in a manner that it depends on the public sector budget is likely doomed to fail even before its start. The private sector has to be brought in and that is possible only if governments can establish an enabling environment in which RE becomes a commercial undertaking and contains elements that are attractive to private investors. This offers a pressing opportunity for the governments to put RE on the main policy agenda and work diligently to develop an enabling policy and regulatory environment to foster private sector participation. Most developing countries have not addressed this issue. There are, however, many success stories where the countries have achieved impressive successes.

2. Public Sector - Multilateral and Bilateral Donors

In the past, most developing countries have benefited from loans and credits from bilateral and multilateral donors some of which have been used for rural electrification and renewable energy based off-grid electricity systems. However, only a fraction of the total rural energy needs have received any attention and many of the RE programs have been pilot projects. Another complicating factor continues to be the absence of any value added contribution by the governments to the donor support and funding for RE programs. In fact, a significant portion of the donors' funds for the development programs go into administrative costs, salaries and expenses, with the net result that only a fraction of the funds allocated ever directly impact to RE programs and projects.

The history of donor-supported RE programs implemented by government ministries is that once the donor funds dry up, the programs disappear. This has led to a lack of consumer confidence in any government-sponsored RE program. Village communities, farmers, individual consumers, and village leaders, all, have difficulty in accepting the benefit of RE programs as they have witnessed too many failures. Both the donors and the governments have recognized this, and there is an emerging trend whereby, donors are insisting on the involvement of private NGOs, development banks, and micro-enterprises in the development and management of RE programs as a precondition to financial support.

In addition, one is witnessing creative government-NGO-donor partnerships, which are sending positive messages to rural consumers, farmers, workers, and village leaders, and the consumer confidence is increasing. While this is encouraging, it must be noted that even donor funds can meet only a fraction of the commercial energy requirements of the rural sector. It needs to be further stressed that private capital is key to any measurable penetration of the rural electricity market.

3. Private Sector

A number of options exist for mobilizing private sector investment in RE applications -- (i) commercial banks, (ii) cooperatives, (iii) “Sweat equity” and; (iv) suppliers' credits.

Commercial Finance

Straight commercial financing is provided by commercial banks operating in the open market, which tend to be very tight in developing countries. They offer no project financing. Most of the loan instruments are short term, require high collateral, and are available at relatively high interest rates. Therefore, they are generally not suitable for grid-based RE systems that often need project financing. However, these banks can play an important role in financing off-grid small projects, where the bulk of the funds needed are for equipment such as solar cells, batteries, etc.

Commercial financing would become an attractive source for funding RE programs when two conditions are met. First, the project developer and /or the energy service delivery company should be able to convince itself that such RE projects are commercial ventures providing a return on investment. Secondly, the governments must be able to provide financial and fiscal incentives to the project implementers in recognition of the importance of rural energy for rural development and that it, the government, does not have the financial means to undertake these programs on a commercial basis.

The clear advantages of commercially financed RE initiatives are as follows:

- faster, more efficient, and greater possibility of sustainability as long as market conditions remain stable;
- greater acceptability from the private sector and donors; and
- potential for building upon initial success, thereby increasing the prospects for greater capital mobilization and larger rural energy access.

The biggest obvious drawback, of course, is that the private RE developers and implementers must pay high interest rates to commercial banks and both the investors and the banks must face regulatory risks, consumer default rates, and foreign exchange risks.

Cooperative Finance

Another approach to RE financing involves the establishment of consumer-owned cooperatives similar to RECs discussed earlier. Alternatively, producers' cooperatives, similar to those in some sectors in Scandinavian countries, can be established. The producers' cooperatives are similar to business partnerships, except they operate as not-for-profit enterprises. For this to happen, however, a legal and regulatory climate needs to be developed with specific regulations and rules to protect both the producers' financial viability and the consumer interest. Given the structure of rural electrification, this model may be very attractive. However, this decision should be contrasted with its impact on the overall electricity market, which must operate commercially with profit and competition at its core.

The advantages of a cooperative approach, briefly stated, are that they are equity based and can move quickly, once consensus has been reached among the members of the governing body. However, cooperatives need government support to protect them from competition, foreign exchange risks, and market failures.

“Sweat Equity” Finance

Sweat equity simply implies that the local residents and firms (consumers) implement RE programs and system expansion. This may involve local companies, engineers, equipment suppliers, etc. In a sense, the consumer takes on a broader role than just being the buyer of a product or a service. The consumer contributes time and human resources to the implementation of RE programs, thereby, reducing the cost and at the same time increasing confidence of others in the program. This is similar to concessions or franchises except that consumers participate with businesses in the decision making process. This

approach for RE is only at the conceptual stage. There is some attraction in this option in that it protects the consumer and provides the consumer a choice on decisions. However, practical issues such as long gestation periods, financial risks, and competition from private providers may make the option unviable.

Supplier Credits

Suppliers' credits is a widely practiced approach to project financing for large projects. Essentially, this approach works on the premise that the equipment supplier provides financing for equipment at competitive rates in order to reduce the need for the project sponsor to raise large upfront capital. It has now also become a relatively common practice for the introduction of new technologies to an otherwise un-served market. There are numerous examples where the manufacturers of equipment, say pre-designed solar PV systems, offer suppliers' credits in order to make a market entry. This option should clearly be explored for expanding the use of RE systems. The main disadvantage of this approach is that the consumer loses some choice as the producer locks into a specific equipment or technology. The advantage, obviously, is that the technology is usually tested and well demonstrated; the interest rates are favorable, and the RE application allows for a modular expansion.

A number of financing mechanisms to develop and implement RE programs were discussed above. While they are different in characteristics, all of them require or are connected with some form of subsidy in order to be viable. With respect to subsidy, it is not enough just to ask what amount of the subsidy should be provided and to whom. One also needs to define conditions that should trigger the withdrawal and the ultimate elimination of any subsidies. Other factors that dictate any type of RE financing of RE systems are (i) the government's tariff policy, and (ii) the process of collections of revenues from the consumers in order for the utilities to be viable.

Subsidy Requirements and Methods of Gradual Withdrawal

Subsidies are needed for RE systems for the following reasons:

- High cost of providing electric service to rural areas because of low density

- Low purchasing power of rural population, making the provision of electric service to rural areas generally not commercially viable

The following are a few of the most common forms of subsidy that most governments provide to promote and accelerate RE:

- Corporate tax holiday for a pre-defined period;

- Other tax benefits such as sales tax on equipment used for providing electric service;
- Electricity generation tax;
- Tax on sale of electricity;
- Custom duty relief on imported equipment;
- Low interest and/or moratorium on interest for some period by domestic development banks on loans to rural electricity providers under a government scheme for rural electric service companies;
- Subsidy by multilateral and bilateral donors in the form of grant and low interest loans;
- Suppliers credits at low or no interest for equipment and engineering;
- One-time grant based on the equipment purchased; and
- One-time grant for setting up the utility or the provider.

The problem with government subsidies is that no one usually plans a withdrawal strategy. Once the subsidy is put in place, it typically remains there and the governments find it politically very difficult to remove the subsidies. No matter how the subsidy is designed and targeted it does have an impact on the performance of the market. Governments, therefore, find themselves in a dilemma -- how to design subsidies without affecting the market. The World Bank has done considerable work in this area and offers approaches for subsidy design without distorting the market. The grid or off-grid electricity providers cannot remain commercially viable if they provide subsidized power and the electric service would deteriorate over a period. Some of the findings of the Bank's work should be considered by Zambia in designing its RE subsidy. The following offer a few options for consideration:

- Initiate other rural development programs for poverty alleviation of rural population
- Train and employ rural populations in the activities of rural electricity providers
- Create an environment for rural industries that can employ rural populations and encourage rural cottage industries
- Improve educational and health facilities in rural areas

- Involve local NGOs in all aspects and activities for poverty alleviation programs

- Involve local rural populations in decision making in developing and implementing rural development programs

- Develop a targeted Rural Consumer Education Strategy to emphasize that (i) electricity cannot be provided to them on subsidized rates forever, (ii) the subsidy would be withdrawn over a period in a gradual manner, and (iii) they have to increase their economic condition to afford electricity after the subsidy is completely withdrawn

- Tariff policy should allow the regulator to set the tariff so that it protects consumer interests while protecting the utility/provider's financial viability

Revenue Collections

The governments can initiate a number of rules and actions to affect adequate levels of revenue collection from the rural consumer. Some of the mechanisms could include the following:

- Develop and implement a mechanism for consumer participation, disclosure and procedures for addressing consumer complaints regarding metering and billing

- The meter reading and billing frequency should be designed to suit the consumer and the electricity provider (preferably monthly or bi-monthly)

- The working route of meter reading and bill serving group must change regularly

- The sale of technology such as solar home systems (SHSs) may be tied with a maintenance contract, which stipulates inspection of the system at a regular interval. The maintenance crew may tie up the collection of the due payments during the inspection visit

- Loan collection may be tied to the income cycle of the communities (e.g. Bi-monthly, quarterly, or six-monthly)

In conclusion, the choice of RE financing schemes should be closely tied to a government's plans for subsidy and the common procedures for revenue collections. Often financing schemes are promoted by governments without regard to the interaction between financing approaches, subsidy, and collections problems. This results in a slow pace of RE penetration and, in some cases, provides disappointing results.

IV. INSTITUTIONAL APPROACHES

This section includes several case studies of selected RE systems in many countries in Africa, Asia and Latin America and provides an assessment of the lessons learned and the factors that influence the design of most optimum custom-made approaches in different settings.

A. SELECTED RE CASE STUDIES

1. Bangladesh

One of the most successful private sector led RE projects is a solar project being implemented by Grameen Shakti (GS), a Renewable Energy Company in Bangladesh. The company was established in 1996 as a non-profit and is an affiliated company of the Grameen Bank. The company's objectives are as follows:

- To popularize and deliver renewable energy to rural households.
- To market solar, biogas and wind energy on a commercial basis, focusing on rural areas, particularly the clientele of Grameen Bank.
- To provide services that alleviate poverty and protect the environment through applied research and development of renewable energy based technologies.
- To undertake a project to progressively manufacture and market efficient and affordable household-based photovoltaic systems.
- To implement projects to generate electricity from wind in the coastal belts and offshore islands; and operate mini and micro hydro-plants in the hilly areas.
- To develop and implement special credit, savings and investment programs for generation, storage, and utilization of renewable energy for the benefit of the rural people.
- To test the new and appropriate technologies to provide more cost effective energy services at affordable price to the non-electrified areas.
- To provide capital, technology and management services to energy enterprises, including individuals, communities, businesses, non-government organizations (NGOs), private voluntary organizations (PVOs), which promote, produce and finance enterprises based on renewable energy sources.

The company has the following main programs:

- Solar Program: marketing solar home systems through a network of branch offices with a soft loan program
- Wind Program: distributing electricity through micro-enterprises in cyclone shelters in coastal areas of Bangladesh
- Bio-gas Program: promoting bio digester to produce cooking fuel and fertilizer
- Bio-mass Gasification Program: producing electricity from bio-mass and marketing the power in rural markets
- Training Program: creating employment for rural people and a base of necessary skills
- Research and Development Program: exploring appropriate technologies, marketing and financing mechanisms, local manufacturer of components
- RICT Program: Introducing Rural Information and Communication Technology
- Solar Powered Computer Education Program: providing computer education at remote places

Solar Program Review
For the solar program, the company offers the following terms to rural consumers:

Option I

- 25 % down payment
- 75 % in 24 installments. (It has an 8% service charge)

Option II

- 15 % down payment
- 85 % in 36 installments. (It has a 12% service charge)

One of the keys to the success of the company is its excellent consumer service provided through 43 branch units, located in difficult-to-access areas, consisting of one engineer and one technician based at each of the branch units that not only market the program but also provide full on-site service and maintenance of all systems. The units take care of the following activities:

- Engineers visit the customers each month to collect the installments. During the visit he checks the systems and takes corrective measures if necessary.

- Each system has a "Maintenance Card" to record problems and actions taken. Technicians regularly attend the maintenance call.

- Customers are given orientation training on minor maintenance issues.

- Engineers and technicians train the local technicians who are expected to gradually take over the maintenance of PV systems.

GS has marketed and installed 5206 Solar PV systems as of July 2001 with a total capacity of 259.4 kWp. GS is installing, on an average, 300 solar systems pre month. GS has trained 300 local technicians (young men and women) on installation, operation, and maintenance of PV systems. These trained technicians are expected to take over after the sales service period expires. In addition, it has trained 2100 customers on minor maintenance of their systems. Gradually all customers will be brought under the training program.

Wind Program Review
GS has installed 6 wind turbines in coastal areas. Four of them are hybrid systems with diesel backup. One system is of 10 kW and the rest are 1.5 kW each. Power is being supplied to cyclone shelters of Grameen Bank and some customers.

Solar Powered Computer Education Program
GS has started four computer education centers.

Future Plan

- GS has planned to install 10841 solar home systems within the next 5 years

- 18 small battery-charging stations, powered by solar PV, will be installed within the next 2 years

- 16 computer-training centers, powered by solar PV, will be installed within the next 2 years

- 20 multi service centers, powered by solar PV, will be installed within the next 2 years

This program offers a number of lessons learned including the value of customer service and training of customers, coupled with a highly trained and motivated sales and maintenance staff.

2. Botswana

The Manayana PV Home Systems Project was started in 1992 as the first phase of a program to introduce renewable energy technologies into rural Botswana. The Government of Botswana asked Renewable Energy for African Development (REFAD), a U.S. based technical assistance organization, to evaluate the project and to use the results to provide additional input for the establishment of a wide spread commercially driven PV rural electrification program.

The project had overwhelmingly positive impacts on the lifestyles and economy of the rural community with nearly universal interest by non-electrified households in purchasing the solar PV systems. The photovoltaic home systems reduced energy cost for the users and provided a significant number of end-users with money-making opportunities. The PV home systems also increased the amount of reading done by the users. This increased level of reading had corresponding positive impacts on education. Also, the home PV systems resulted in increased socializing and entertaining in the household, drawing the community closer together. The street lights also had substantial benefits to the community. They increased security and freedom of movement, reduced criminal activity, and facilitated socializing and participating in the political process. Finally, there are very strong perceptions of improved health care in Manyana stemming from the availability of hot water and faster medical service. All the technologies in this pilot project together have created a conducive environment for more socializing, meeting, learning and greater village development. Despite technical problems, the technologies have proven themselves viable and desirable by the residents of Manyana. These types of systems offer potential for replication in other communities as well.

3. Brazil

A hybrid village level project involving wind and solar technologies implemented in the Community of Joanes demonstrates the role of communities in expanding RE implementation. The project is a 59 kW hybrid system with a 228 kW battery. It includes (i) four 10 kW wind turbines, and (ii) one 10 kW photovoltaic array to

feed to the grid directly. Essentially the batteries are charged and dispatched to the power to the grid.

The project created a stable and cost effective solution to power shortages in Joanes, which already had a 1 MW Diesel Plant. Several other communities have since replicated the project with different hybrid schemes suitable to their pattern of electricity demand.

The government is currently studying various models for RE including cooperatives, concessions and franchises, etc. The key issue is whether the government considers it important for the consumer to have a choice of systems and technology and to introduce competition to provide for this choice. The government can accomplish this through awarding several concessions and requiring concessionaires to provide service to all rural customers in the concession area. Brazil wants to ensure that it chooses a model that is sustainable with high cost recovery.

4. China

One of the most successful RE programs in China has been the small hydro schemes program. The major achievements of this national/local project(s) are as follows:

- 4300 hydropower stations have been built and are operational.
- 23 million kW installed capacity averaging around 5 MW per station.
- One-third of counties receive power and one-fourth of the population of the country is serviced under this project.

This project was planned at the community level and the community takes an active role in planning and management of the individual plants.

5. Costa Rica

The rural electrification program in Costa Rica is one of the most successful RE programs, with a 95% access of electricity to the rural population, virtually reaching the access rates in developed countries. It provides high quality and affordable electricity to its rural population and enjoys a 98% collection rate. The Costa Rica model was based on the U.S. REA model, which allowed for the national utility and the municipalities to operate a large transmission/distribution network throughout the country. A number of cooperative are involved at the distribution end. The program has been largely financed by the IFIs based on guarantees of the national utility, which is financially sound.

6. India

In India, steps for formation of Rural Electric Cooperatives for distribution of Power in rural areas were taken for the first time only in the later half of the 1960s when the Government of India sponsored an investigation by an expert team from the National Rural Electric Cooperatives Association (NRECA), USA for identifying a few areas with adequate potential for the establishment of Rural Electric Cooperatives. As a result, 5 areas were identified, one each in the States of Andhra Pradesh (Sircilla), Gujarat (Kodinar), Karnataka (Hukeri), Maharashtra (Rahuri & Shrirampur) and Uttar Pradesh (Lucknow) and five pilot rural electric cooperatives were established in 1969. Since, by coincidence, Rural Electrification Corporation (REC) had also come to be established by that time, it took the responsibility of funding and promoting these pilot societies. Inclusive of these five pilot societies, REC has so far sanctioned 41 RE Cooperatives in the country spread over 12 States. As of now, 33 of them are in operation and 8 cooperatives societies (3 in Rajasthan and one each in the States of Bihar, Gujarat, Jammu & Kashmir, Uttar Pradesh and Orissa) have since been taken over by the respective State Electricity Boards (SEBs).

The broad objectives of the rural electric cooperatives are to:

- Extend the electrical network in their areas quickly and economically;
- Provide proper service to the consumers taking into account local conditions;
- Support the wider program of development of the area for increasing agricultural production and stimulating the growth of rural industries, and
- To ensure local participation in the management of rural distribution of electricity.

While a few of the existing RE Cooperatives are doing well, most of them are in very difficult situation and/or organizationally and financially weak. The primary reasons for the failure of these cooperatives are as follows:

- Lack of freedom to set tariffs on commercial basis for different types of consumers in their area of operation.
- Unfavorable load mix that is often forced on them because of SEBs proximity and influence with the State Governments.
- Constant political interference.

As a result, what one often sees is narrow political compulsions giving rise to subjectivity and irresponsibility within these organizations, very often matched only by similar subjectivity and irresponsibility by authorities overseeing and regulating functioning of these bodies.

Notwithstanding, there are a number of independent and small RE programs that are showing great promise. The following program is an excellent example of an integrated rural energy program designed by India, which combines both national planning and rural level leadership to enhance program sustainability. The Ministry of Non-conventional Energy Resources (MNES) administers this program.

The program is named as the Integrated Rural Energy Program (IREP) and was conceptualized during the Sixth Five Year Plan and launched during the Seventh Five Year Plan (1985-90) with the objective to meet the basic needs of cooking, heating and lighting in the rural sector. The focus was on utilizing locally available resources to the extent possible.

The program has two components: (i) a central Sector Component, as grants-in-aid for professionals and supporting staff in the IREP project cells at the State and District/Block levels, training of the staff and extension work, and (ii) a state Sector Component, which funds IREP Block energy projects at the state, district, and block levels. Specific management components of the program include the following:

- 19 State Level Technical Back Up Units (STBU) for technical support to IREP State, District and Block Cells
- 171 District Level Technical Back Up Units (DTBU) for technical support to IREP District and Block Cells
- 6 Regional IREP Training Centers set up, but only two centers at Delhi and Lucknow are fully functional
- 860 Blocks covered

Some examples of the successful RE projects implemented by IREP are briefly discussed below:

a. Solan District, Himachal Pradesh (Agro-climatic zone: Western Himalayan)

Project Area:	5 villages
Energy plan focus:	Water heating and cooking

Devices installed:	3 community solar water heaters (750 lpd each) 116 Improved Chulhas (Cooking Stoves) 51 Solar cookers with electric back-up
Local institutions Involved:	Mahila Mandals and Panchayats Local NGOs – DEEP and Development Promoter

b. Sultanpur District, Uttar Pradesh (Agro-climatic zone: Upper Gangetic)

Project Area:	3 villages
Energy plan focus:	Cooking and lighting
Devices installed:	24 Biogas plants (2 cubic meter each) 250 Improved Chulhas 65 Solar lanterns
Local institutions Involved:	Village Panchayats Local technicians

c. Solar Photovoltaic Project in Sagardeep Island, West Bengal

- Set up by West Bengal Renewable Energy Development Agency (WBREDA)
- Soft loan by Indian Renewable Energy Development Agency (IREDA)
- Project cost Rs 42.7 million
- Five power stations of 25 kWp each
- 120 consumers in one or two villages connected to each power station
- 100 W (maximum) to each consumer
- Rs. 1000 as deposit by each consumer
- Rs. 120 per month paid by each consumer
- Rs. 80 per month was already spent by each consumer on kerosene for lighting
- 9 metric tonne subsidized kerosene saved per annum
- Project funded by Ministry of Non-Conventional Energy Sources (MNES) and DOE's National Renewable Energy Laboratory, USA

7. Mozambique

Following the passage of the Electricity Law in 1997 which de-monopolized EDM, the national utility, and allowed private sector participation in the industry, the World Bank Urban Household Energy Project funded a pilot isolated grid electrification project in two coastal towns in Mozambique. Low-cost electricity services were extended to the two isolated areas after an enabling framework had been created for private sector participation.

Major project impacts in 2001 consisted of the following:

- cost recovery tariffs were introduced,
- more than 60 new jobs were created during construction,
- about 400 households / industries now enjoy 24-hour electricity supply,
- the grids were extended to the Vilankulo airport which has become a main hub to bring in an increasing number of tourists,
- a number of streetlights have been built along the main roads and around the public places,
- better lighting improved health clinic services and extended their operating time, and
- the power sector reforms that permitted the creation of independent grids with cost-based tariffs were rated as a "significant achievement" by the World Bank's internal independent review.

This project demonstrates that private sector can be attracted to participate in rural electrification schemes, even in a poor country with a non fully-reformed distribution sector, if the appropriate legal framework and risk management options are in place. These include the ability to charge full cost-recovery competitive tariffs. Furthermore, the project illustrates that under certain conditions, it is possible to significantly reduce rural electrification costs through the development of independent grids rather than having to invest in costly transmission extensions. A very important lesson from this project is that the consumers are able and willing to pay higher tariffs in return for improved and reliable quality of electricity.

8. Nepal

The percent of Nepalese population with access to the national electricity grid has remained 15%. Furthermore, mostly the urban areas have been electrified, and only 4% of the rural population has access to the national electricity grid. This implies that the extension of the electricity grid has only been able to keep pace with the population growth and hence the percentage has remained at 15 despite the annual increase in the distribution system.
The government's target is to double the access of the rural population to the grid in the next five years. With the recent commissioning of new hydropower plants

(such as the 60 MW Khimti, and the 36 MW Bhote Koshi) and with others in the construction phase (e.g. 144 MW Kali Gandaki) there will be excess generation capacity for the first time in recent history, especially during the wet seasons. Nepal Electricity Authority (NEA), in 1998, announced a policy to support the private sector small hydropower developers. As a result of this policy, a number of small-scale hydropower projects (less than 10 MW) are currently in the development phase.

It is evident that as more power plants are connected to the grid and the grid is further expanded, it will be logistically and financially difficult for NEA to manage the entire grid system. Furthermore, in the present context the loss of revenue due to pilferage and leakage of electricity within the national electricity grid system is also significant (25% including technical and non-technical losses).
To date, the private sector has only been involved in the electricity generation sector. In the above backdrop, involvement of a non-government electricity institution may provide the momentum in the distribution sector. These institutions could purchase bulk power from NEA or private generators (IPPs) and distribute it within a pre-defined area.

Therefore, the government is aggressively promoting private industry's participation in both generation and distribution, with transmission remaining the government monopoly. A number of institutional arrangements are being considered: private or public companies, electric cooperatives, users' associations, and municipalities. The legal regime for the establishment of these types of electricity providers already exists.

The following is an interesting example of a users' association, which buys bulk power from the NEA and then distributes it to a variety of consumers.

Lamjung Electricity Users' Association (EUA) in Nepal
The following are key characteristics of this association:

- A users' association under the Nepal Electricity Authority (NEA), started with a grant from the Nordic Development Agency for the construction of distribution lines and substations

- NEA sells bulk power to the association and the association is responsible for distribution, metering and collection, etc.

- The association has a thirteen member executive committee (eleven elected from the users and 2 nominated)

- Five-member 'Transfer Committee' responsible for providing electricity to the users

- Electricity tariff based on the cost of the project was NR 5.3/kWh. NEA tariff was NR 3.5/kWh. Given this difference, NEA and the association agreed to a tariff of NR 3.88/kWh

- Achievements: (i) 3,500 consumers in 1997 and now 6,100, (ii) 1443 MWh sold in 1997 and now 3294 MWh, (iii) NEA is now collecting NR. 9 million/year, and (iv) Distribution loss is just 9% as compared to 22% at the national level

The consumer has a high level of confidence in this approach as the consumer participates in its management. Other measures that have made this project a success include the following:

- Locally placed technicians for operation and maintenance, and repair have increased consumer confidence and public acceptance of the association

- Accounts are audited regularly and are available to any member of the public

- Quick recovery of revenues

Given the enormous success of the Lamjung Users' Association, NEA is planning several new small-scale hydropower projects for remote locations in rural areas throughout Nepal. This approach may be quite applicable in Zambia as a way to increase access of electricity to rural consumers in both grid-connected and off-grid modes.

9. Peru

Peru has made significant progress in increasing the access of electricity to rural communities, many of which are remotely located in the Andes Mountains. The basic approach used by the government has been to expand off-grid micro hydro facilities throughout the country. The program began with the establishment of a revolving fund for rural electrification, similar to the concept of the Rural Electrification Fund in Zambia. The following are the key features of this successful program:

- Revolving fund started with an initial funding from the Inter-American Development Bank and replenished regularly by the revenues from the sale of electricity

- 15 micro-hydro schemes took loans from the scheme initially

- 6400 families benefited from the first stage project

- Rates of repayment met expectations (over 90 percent)

- Enabled more communities to receive loans from the fund

This project, because of its success, built confidence in the viability of Credit Programs for energy services in isolated rural and un-electrified areas. Several similar projects have been implemented in other rural communities throughout the rural areas in Peru. They are mostly off-grid micro schemes and pay for themselves without putting a burden on the government budget.

10. Sri Lanka

The Government of Sri Lanka manages its electricity sector through the authority of Ceylon Electricity Board (CEB), the national utility. CEB suffers from all of the typical problems plaguing most developing countries -- high losses, inefficient systems, lack of investment capital, etc., and a very low access of electricity to rural consumers. The government has taken a number of steps to address the low level of rural electricity access.

It started an Energy Services Delivery Project (ESDP) with a focus on the rural sector. The project was started by a credit provided by the World Bank and Global Environment Facility (GEF). The total initial grant for Phase I was $30 million. Instead of putting the management of this project inside the national utility (CEB) or a government ministry, the Bank/GEF team set up an alternate institutional and administrative structure for the project. The overall responsibility for management and fund disbursement was placed under the Development Finance Credit Corporation (DFCC) in order to give the project a commercial character and to keep it away from institutional inefficiencies in CEB and the government ministries.

The DFCC used a number of 'Participating Credit Institutions' (PCIs) such as the National Development Bank, Hatton National Bank, Sampath Bank, Commercial Bank, and Sarvodaya Economic Enterprises Development Services (SEEDS).

Two major programs were implemented under the ESD project: (i) Solar Home Systems (SHSs), and (ii) Off-Grid Village Hydro Schemes (VHSs).

The SHS component of the program had the following features: (i) typically 30 Wp, 45 Wp, or 50 Wp systems, and over 1,000 such systems were installed by the end of June 2000. By the end of June 2001, this number rose to 4,236 SHS, a remarkable example of market penetration by any standards. To date around 6,400 have been installed and an additional 1000 units are being processed. DFCC has a pipeline of an additional 10,000 units to be installed by December 2002.

The GEF grant is co-financing an average of $100 per SHS, the rest comes from the World Bank line of credit to the DFCC.

The DFCC uses four dealers in the industry: Shell Renewables Lanka Ltd., Selco Solar Power Lanka Ltd., Access Int. (Pvt.) Ltd., and Alpha Thermal Systems Ltd., which provide sales and maintenance services. The financing mechanism provides around Rs.5,000 down payment and the rest is on commercial rates. DFCC has a 97% recovery rate.

The second component of the ESD project is the installation of off-Grid village hydro schemes (VHSs). These systems are typically 10 kW in capacity and serve one village. Currently, the following is the status of this program:

- Originally catered as 100 W per household, but now it averages 250 W per household.

- A total of 19 projects have been implemented as of June 2001, and DFCC has a pipeline of 61 additional projects for December 2002. A total of 600 households in three key villages now receive electricity from these off-grid projects.

The GEF Grant co-finances US $400 / kW with a cap of US $20,000 per project. Villagers form a consumer society (Electricity Consumers Society) provide pool equity and local labor for the project, which is an excellent way to involve the consumer and provide local value added through new jobs in the villages. An actual use basis tariff system is applied to recover revenues. This component of the ESD project is also very successful due to both local capacity building and a comprehensive awareness program implemented by the DFCC and participating credit institutions.

After years of mixed reviews on many rural energy projects financed by the international finance institutions (IFIs), the ESD project has emerged as a real showcase project. The success of the project is so overwhelming that DFCC is currently in discussions with the WB/GEF for a follow on phase of the project, which will almost be twice the size of the initial project.

The main reason attributed to the success of the project is the implementation structure of the project, which utilized banking and finance institutions to manage all disbursements. By assigning the disbursement and management of the project to parties with a vested interest in its success, the WB/GEF team was able to buy a built-in insurance that the project will be implemented successfully. An added benefit of the project was the participation by consumers, which added consumer confidence in, and political acceptance of, such RE schemes.

11. Swaziland

UNESCO, in cooperation with the Ministry of Natural Resources and the community of Mphaphati, has established a solar village in Swaziland. Additional solar villages have been are set up in Namibia, Malawi, Mozambique, Lesotho and Angola. The key objective of this UNESCO initiative is to establish a sustainable demonstration project and to fulfill basic electricity requirements using the solar PV technology. The project started in 1998 and has since been completed. In Mphaphati four systems have been installed: for classrooms, eight staff houses, street lightning/security systems, and a water pumping system.

All systems are operating well and no theft has been experienced so far. Preliminary evaluation rates this project as a success. This success has been attributed to the involvement and participation of the community since the commencement of project. At the start of the project, the community formed a Solar Committee to manage the systems and the revenues generated by charging users a monthly rental fee. Additionally, system users and Solar Committee have been trained in basic maintenance and the use of the systems in order to provide prompt service and maintain consumer confidence.

12. Thailand

The power sector in Thailand is managed by the national utility (EGAT), responsible for generation and transmission functions; the Metropolitan Electricity (MEA), responsible for distribution in metropolitan areas; and the Provincial Electricity Authority (PEA), responsible for rural areas. Over the past 25 years, Thailand has achieved a remarkable success in increasing rural electricity access, now over 90%. The fundamental approach used by the Thais has been a strong distribution company and a cross subsidy from urban consumers to rural consumers. The Thai model is perhaps the best model that demonstrates the linkage between electricity availability and rural economic and industrial development. The value added of the rural sector to the national GDP has been continuously increasing at rates more than twice that of the national economic growth rate.

13. Vietnam

An interesting project was implemented in Vietnam that demonstrates the importance of including women who are an important element in RE projects as they are the primary users of the RE technology. The Vietnam Women's Union (VWU) is an NGO comprising 11 million women members. With an $ 87,000 grant from the Solar Electric Light Fund (SELF) and Rockefeller Brothers Fund, the VWU established a Revolving Fund. The fund also received a grant of US $35,000 from the Sandia National Laboratories (funded by DOE, USA). The fund was managed by the VWU.

A total of 135 solar household PV systems were installed in 5 communities spread over 3 provinces. Each community system was of 225 Wp each, and 2 outdoor lighting systems were of 75 Wp each. The repayment was received over a three-year period in monthly or bi-monthly installments, with a 95 percent on time repayment rate.

Additional case studies for rural and renewable energy applications and models in Africa can be found in a comprehensive review of "Experience with PV Systems in Africa", which included a number of countries. The main finding of this project is that there is considerable potential for RE applications throughout the continent. The biggest barrier continues to be a lack of commitment by the governments to finance rural energy as a rural development program. Also, there is a lack of market participation in RE programs, which depends upon the governments to develop an enabling environment for market entry. In the absence of an enabling environment, most RE programs depend upon donor grants and shrinking government budgets; and disappear when such funding dries out. Analysts have conducted numerous analyses on mechanisms to achieve RE program sustainability. Many of these papers are included as references in the bibliography in Annex III. Regardless of how the problem of sustainability is approached, the conclusion continues to be the same -- RE models that involve markets, and are backed by a strong government program for consumer education and participation and political acceptance -- are the only ones that have a chance of sustainability.

14. Zambia

An ESCO-Model energy delivery project is being implemented by the Zambian Government through the Department of Energy in the Ministry of Energy and Water Development. The main outputs of the project are expected to be three operational privately-owned ESCOs. Since the project started in 1998, three ESCOs have been established. The first, Nyimba ESCO is operational with 100 PV systems installed at the customers' premises. The other two, Chipata ESCO and Lundazi ESCO were to be supplied with 150 PV systems each during the first months of 2001 for installation.

The cost of setting up the ESCOs has been shared between the government, SIDA and the companies themselves. The ESCOs have five to eight employees each. Private contractors install the systems, although the ESCO technicians also participate in the process. At present, the ESCOs are subsidized during the project as no interest or amortization is paid on the investments in the PV equipment. The issue of capital and running cost coverage is under discussion. Various models are being considered and probably a mix of public and private ownership model will be implemented. At present, the projects combine public ownership with private supply of maintenance.

B. LESSONS LEARNED

Section A provided a brief review a few selected technical and institutional approaches employed in a number of countries. The case studies were selected because (i) they provide a combination of attractive public-private approaches and mechanisms for consumer participation, and (ii) they are significantly different yet attractive, and are filled with lessons for future planning of RE programs. This review is by no means "all inclusive". It does, however, provide a window to a wealth of experience in the RE program development area and illustrates several lessons that may form the basis for an approach that Zambia may wish to adapt for designing its RE program.

The following key lessons can be drawn from the case studies provided earlier:

1. Adopt a Broader View of Rural Electrification

Given the barriers to successful RE -- such as low density demand, high cost of transmission and distribution systems, consumer acceptance, low levels of cost recovery, a lack of finance, and a frail institutional infrastructure in most rural communities -- RE programs designed along traditional lines of urban energy programs cannot be sustainable. A broader view of RE needs to be adopted by rural energy planners. Rural electrification should be viewed in terms of its criticality to rural development -- better education; modern health care; agriculture sector development; creation of rural industry; employment; income; retention of qualified students and workers through achieving lower levels of migration to urban areas; and building the capacity of village leaders. One means for adopting this approach is to link rural energy programs with rural development in the government budget process. Similarly, when preparing rural development projects for funding by the IFIs, rural energy, as a critical component of the project, should be included in the project and loan/credit design.

2. Develop RE Policies and Programs at the Local Level

Rural energy programs and policies solely designed at the national level without the active involvement of rural consumers, village and municipality officials and elected leaders, village farmers, and other industry leaders have not resulted in measurable success and sustainability. This is due to the fact that unless the RE policies and programs achieve acceptance by those that they affect, one cannot have their active participation and commitment. In addition, all RE programs and projects should be designed in a manner that provides a local economic value added such as local jobs and income during project implementation. This can be achieved by two concrete actions: (i) design and delivery of consumer

education and consumer participation programs, including workshops on achieving political acceptance at the village/district levels; and (ii) require, as a matter of government policy, that all RE projects include a local value added component.

3. Develop Creative Approaches to RE Program Implementation

In order to draw upon private sector efficiency and achieve transparency, the government ministries should consider involving private energy service providers, development banks, local commercial banks, and local and internationally known and experienced NGOs in the implementation of the programs. NGOs are not-for-profit entities that are sealed away from the day-to-day government institutional complexities; they are also closer to the consumers. Therefore, they generally have greater capacity and credibility to achieve success. Private banks and energy companies have a vested interest in the success of the projects. Therefore, they can make excellent stakeholders to promote successful RE schemes.

For grid-connected RE systems as well, the government and the national utility should involve private banks and energy companies through transparent concession and franchise processes. In some cases, the government can advance its RE expansion objectives by requiring franchisees and IPPs to allocate a portion of their project to meeting rural electricity demand.

4. Focus Government Resources on Acting as a Broker not an Implementer of RE Programs

Governments should consider revising their roles from the owners of RE programs to brokers, whereby the role of the government should be to act as a broker to bring the energy companies, local and international banks, energy equipment and technology providers, and donors into the project in order to facilitate development and implement market driven solutions to rural energy needs. This can be achieved only after the government puts in place an enabling environment that would encourage private sector investment in RE programs. In the absence of an enabling environment specifically designed for rural electrification, it is unlikely that the private sector will ever focus on RE projects, given the perceived and real risks and the institutional difficulties. In this regard, governments also have an obligation to develop RE programs that are based on a participatory dialogue between the donors and the government rather than simply signing off on donor driven programs.

5. Design and Implement Targeted Research and Development, Training and Information/Communications Programs

The most proper function for the government policy and role in RE is to devote its resources to assessing the applicability of RE technologies to its rural sector. Through such R&D, the government can prioritize the applicable technologies in terms their cost and benefit and orient the consumer choice and market behavior to influence the utilization of the best technologies.

In addition, the importance of consumer education and political acceptance in implementing RE cannot be overestimated. Experience in many countries has confirmed repeatedly that properly designed programs in these areas can be very effective in technology acceptance, consumer participation, and market entry, all of which are critical to the success of even the best designed RE programs.

6. Adopt Regional Approaches to Solving Rural Electrification Problems

There are tremendous economies of scale that can be achieved through adopting regional approaches to infrastructure planning. It is no different for RE. Many countries, such as those in the Southern Africa Region, the South Asia Region, and other regions, share common problems related to designing and implementing RE programs. Common problems, if addressed regionally, have the best chance to lead to common solutions, which can be shared by the countries in the region. The approaches used in South Asia between India and Bhutan and those being contemplated among other South Asian countries offer examples of regional approaches. The interconnections between Albania, Macedonia, and Montenegro are another example of a regional approach to power transmission and distribution planning.

7. Capitalize on Good Corporate Citizenship to Facilitate RE

A somewhat unorthodox approach used by some governments (Thailand, the Philippines) is to capitalize on good corporate citizenship of large foreign companies interested in making investments in their countries. This typically works when governments negotiate a premium for some value added to rural electrification projects on other sector projects, which it awards concessions or franchises to foreign businesses and investors. An example of this in the case of Zambia may be for the government to require some rural electrification premium as part of any new IPPs or investors in ZESCO's assets, as they are put up for privatization.

The above lessons learned offer key insights that may be helpful for Zambia to design its own rural electrification strategy. Clearly, the exercise for designing the most appropriate rural electrification model for Zambia has to start with a leadership role by the government. Many questions are very pertinent:

- What is the Government's long-term rural development policy?
- How does the Government view the role of rural electrification in facilitating rural economic development?
- What are the main development issues that require separate development policies for urban and rural development?
- What are the key energy demand characteristics and demographic patterns in Zambia that need to be explicitly incorporated in RE planning?
- What are the key elements of an enabling environment that the Government needs to put in place to encourage market participation in the RE program?
- What should be the role of the donors?
- How should the participation of the various RE stakeholders be maximized in order to boost rural electrification?
- What is the role of the regulator to protect the consumer on the one hand and to facilitate investor viability on the other?

These are just a few of the planning challenges that the Government of Zambia needs to face as it prepares to develop its aggressive RE strategy.

V. RURAL ELECTRIFICATION OPTIONS IN ZAMBIA

The previous sections of the report focused on a description of Zambia's energy sector, the rural energy issues, rural development issues, potential options for RE programs, case studies of several RE models, and the lessons learned internationally that are very pertinent to the choices that Zambia needs to make for its own rural electrification strategy.

The basic question is -- How does the Government of Zambia decide on which RE model is the best model for Zambia and how does it develop and implement the selected model? The main determinant of this is the Government's overall development policy. Different RE models are selected for different national development objectives. For example, the Thai RE Model was to support the government's overall policy to accelerate rural economic development and to shift industry away from Bangkok to rural areas. Therefore, RE acquired a very prominent role in the Thai development approach. Indonesia, on the other hand, did not adopt this model. As a result, Java is overcrowded and rural Indonesia continues to have a low rural electricity access.

Other successful models of RE have different government policy objectives as their drivers. For example, the PROMISE and PER in Mexico and Chile were designed to support the governments' strategy to provide infrastructure in rural areas. Therefore, a fundamental question to be addressed is what the Zambian government's overall economic development policy and what role does rural development play in that process.

The following discussions provides an outline of the key issues that the Government of Zambia would need to consider in designing and adopting an RE model.

A. TECHNICAL OPTIONS

Given the geography, demography, and energy consumption and demand characteristics in the urban and rural areas in Zambia, the government needs to complete its assessment of the technical options that are most suitable to the conditions in Zambia. Specifically, the following issues should be addressed:

1. Grid-connected Rural Electrification

For rural population clusters and villages with easy access to the grid, the Government needs to focus on developing more capacity and upgrading of the transmission and distribution systems. The main constraint to this is a lack of available financing -- more projects than there are available funds -- from the budget or the donors. Therefore, in order to accelerate the access of grid-based electricity to rural areas, the government needs to create conditions that would

involve the private sector. This requires an unbundling and restructuring of the national utility, ZESCO, coupled with a privatization of some of the electricity assets. Through this process, already begun by the government, private capital can be generated to funnel the needed capital to meet electricity sector requirements. A portion of the privatization proceeds could, for example, be allocated to RE programs. Alternatively, and perhaps simultaneously, the government could accelerate the process of attracting IPPs to bring on new generating capacity. However, the transmission and distribution systems may need to be simultaneously upgraded and expanded to accommodate new capacity.

In the absence of an aggressive commitment to accelerating rural electrification, the Government will continue at its current pace, which will not result in greater rural electricity access no matter what the objectives are of the Government's Rural Electrification Plan.

2. Off-Grid Electricity Systems

For remotely located rural populations with low demand density, the only available option is the application of decentralized electricity systems -- in other words, small diesel generators, solar home systems, biomass energy, wind energy, micro hydro, etc. These systems tend to be expensive and the institutional constraints to the rural application of renewable technologies go well beyond technological constraints. The best role for the government in this area is to restrict itself to assessing and prioritizing various technologies and focusing on consumer education, information dissemination, pilot project demonstrations, and building an overall political acceptance of these technologies at the village/district level with extensive involvement of village leaders, farmers' unions, community leaders, and local industry groups.

Simultaneously, the government should institute an enabling environment to involve local banks, energy companies, equipment suppliers, and NGOs to participate in these types of projects. This will require specific economic and financial incentives (discussed later).

B. ECONOMIC AND POLICY ISSUES

As mentioned earlier, without a slate of fiscal and financial incentives, it is unlikely that private sector will play a significant role in this market. Many governments have recognized the need for such incentives. The best approach is to (i) design a series of limited time fiscal and financial incentives for private investors and technology/equipment vendors, (ii) put in place a simplified structure for the provision of these incentives such as a "one-stop shopping" or a single entity empowered to grant the incentives, and (iii) implement an aggressive public campaign to advertise the incentive program. At the same time an aggressive campaign should be launched to create the market by

educating the rural consumer by involving local leaders and consumer groups. Through such a two-prong approach, the government can virtually eliminate any direct subsidies to the consumers and focus on helping the market become mature.

Some of the policy options available to the Government of Zambia are as follows:

- Electricity projects (where the total outlay does not exceed a pre-determined amount) do not have to be submitted to the full review and approval process of the Government. Rather, they could be provided a fast-track approval. For example, many governments have established a "Board of Investment for promoted Projects" and qualified all RE projects as "promoted project".

- Private sector companies may be allowed to set up enterprises to operate either as licensees or as generating companies.

- Private companies entering the electricity sector may be allowed higher debt-equity ratios than typically required for such projects.

- The condition of dividend balancing by export earnings and equity, requirements, which are normally applied to foreign investment, may be relaxed for any investments in the power sector.

- The customs duty for import of power equipment may be reduced for all equipment for electricity generation and distribution projects.

- A five to ten year tax holiday may be allowed for foreign investors.

- The excise duty on a large number of capital goods and instruments in the power sector may be reduced.

C. INSTITUTIONAL ISSUES

As mentioned earlier, most of the challenge in designing successful rural electrification programs comes from institutional issues. The institutional challenges facing Zambia to put in place a sustainable rural electrification strategy are formidable. Currently, the RE planning functions are placed within the Ministry of Energy and Water Development (MEWD). The Government has developed a Rural Electrification Plan (REP) as the instrument to guide its RE policy. In addition, a Rural Electrification Fund (REF) has been established and it is capitalized by a levy on the revenues of the national utility, ZESCO. These are all steps in the right direction. The implementation of both the REP and REF is a key step.

In this context, the government's initiative to seek assistance from SIDA to develop a comprehensive Master Plan for Rural Electrification is an urgent need and should be considered as soon as possible. As the process for this Plan begins, the upcoming project being prepared by the World Bank -- Increased Access to Electricity with Renewable Energy—would add further momentum in that the proposed loan includes a number of TAs that focus on strengthening the institutional structure for RE design and implementation. Together, these initiatives will go a long way for the government to implement its strategy successfully.

1. Role of the Government

As a general rule, the government should stay away from the management and implementation of RE programs except for implementing pilot projects, as Zambia has already done. Pilot projects should be monitored and relevant information publicized to the consumer and markets. Other proper and effective roles for the government could include the following:

- Develop overall RE policy linked with the government's rural development policy. The policy goals should be clearly specified and widely publicized and opportunities should be provided to the public to participate in the process.

- Define and implement a process to recognize the institutional importance of local stakeholders (village chiefs, farmers' unions, industry groups, and consumer societies) in advancing rural electrification. Develop a mechanism to cultivate these relationships that are critical to acceptance of any RE program.

- Develop approaches to encourage the participation of energy service providers, local banks and investors, and energy equipment providers in rural electrification. Bring their views into the new policy for RE and make recommendations for policy reform reflecting these views.

- Influence the donors through constructive dialogue to include RE as an explicit component in rural development credits/loans. Also, act as a broker between donors and energy service providers to mobilize soft credits that would encourage rural electricity market development.

- Work with the Zambian Privatization Agency (ZPA) and the OPPPI and explore the prospects for introducing a premium for rural electricity in all franchises, concessions, and IPP projects.

- Take initiatives to affect locally driven RE solutions rather than RE programs driven by the central government and the donors.

- Many NGOs such as ITDG, Winrock, and NRECA have extensive experience in designing and implementing rural electrification programs, many of which are sustainable. The government could develop instruments to mobilize the participation of these NGOs. The RE programs will be more transparent, closer to the consumer, and more efficient and successful.

- Consider mechanisms to mobilize more financing to capitalize the Rural Electrification Fund. Also, consider moving the management of the Fund outside the government with an adequate level of oversight.

The above list offers just a few factors that could guide the design of the ultimate role of the government in developing and implementing its Rural Electrification Plan.

2. Local Leaders, Institutions and Consumer

The basic principles that should guide the process for extensive involvement by the consumer, local leaders, and industry groups have already been defined earlier. The active involvement of local leaders and consumers is critical to the success of Zambia's rural electrification strategy. Some of the successful approaches that the government could consider include the following:

- Develop working groups that include the central government and urban representatives as well as rural chiefs, village- or province-based NGOs, farmers, and consumer leaders and begin the process of periodic dialogues on the importance of rural energy for rural development. These dialogues should be in a format that facilitates recommendations from these groups to the central RE policy makers.

- Periodically share successful RE stories not only in Zambia, but also in other countries with rural consumers by designing and widely disseminating posters, fact sheets, and other printed material in local language.

- Hold village meetings or "town hall meetings" with rural citizens and explain the government's strategy to increase the availability of electricity to rural consumers. Use rural entities that have gained consumer confidence to provide support in promoting rural energy.

- Develop a local level culture that would formalize lobbying with local leaders and legislatures to push for policies that would promote rural electrification and rural development. Work closely with rural development officials at the local level to gain their support in educating the consumer.

- Develop "road shows" as part of a national rural electrification campaign and take the campaign to the villages and remote areas. This could be done in coordination with technology vendors. They may even be willing to sponsor these "road shows" as would view them as beneficial to their commercial interests.

- To the extent possible, enhance capacity at the local level for appreciating the benefits of RE. Local schools could be good mechanisms to spread this concept.

- Design and conduct local demonstration programs for RE technology in collaboration with local participants.

3. Encouragement of Private Sector Participation

In addition to educating and rural consumer and emphasizing local initiatives for RE, the government should simultaneously encourage the supply side -- the energy suppliers and the financial institutions and/or investors. As mentioned earlier, mere existence of financial and fiscal incentives, while necessary, is not a sufficient condition for the private sector to promote and pursue RE. The government also has the burden and challenge to educate the investor and technology vendor. This should be accomplished through routine informal and formal dialogues between the parties.

The criteria for eligibility and the process for receiving the incentives should be made easier and simpler. Perhaps, a one-stop shopping concept should be considered, whereby any investor with a viable RE project should be given all clearances quickly and in a single location.

One of the major inhibitors to private sector investments in developing countries is the perception of the investors with respect to risks. Often, despite attractive fiscal and financial investments, the private sector is reluctant to invest in rural electrification because of a high degree of risk perceived by the investor. For example, the investor is not guaranteed of the continued ability of the rural consumer to pay. Also, there is no guarantee that a rural consumer will commit to supply of electricity; the consumer, in fact, may chose not to have electricity as the consumer's perception may be that it is too costly. These and other factors cause a level of uncertainty that the investor is simply not prepared to deal with as long as there are other opportunities for more attractive investments. Therefore, the developing country governments have a much harder challenge.

The availability of incentives may not be enough. The governments have to find a way to actually encourage private investors to consider RE more favorably. According, the Government of Zambia may need to institute a program that would focus on methods to create a climate that would provide investors a greater degree of comfort with rural energy projects. Some of the mechanisms used by developing countries (e.g., Thailand, Korea, Brazil, etc.) are as follows:

- Joint public-private projects to demonstrate the viability of rural and renewable energy projects;
- Business roundtables, investor workshops, and other approaches to increase public-private dialogue;
- Promotion of foreign and domestic investor partnerships;
- Implementation of a risk insurance policy for investors for a limited time;
- Investor-friendly business licensing and incentives policy including expedited services; and
- Full repatriation of capital and profits for a fixed number of years to promote foreign investors.

These are just some of the ideas that could help promote private sector investment in the rural energy sector. The GRZ could consider these and other approaches to encourage private investment as part of its development of the Master Plan for Rural Electrification that it is about to launch with the assistance of SIDA. At the same time, the TA and capacity building components of the upcoming World Bank project should also focus on this important barrier to RE.

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