**UNITED NATIONS DEVELOPMENT PROGRAMME**
**GLOBAL ENVIRONMENT FACILITY**

# PROJECT DOCUMENT

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| Number: | UGA/97/G31/A/1G/99 |
| Title: | Uganda Photovoltaic Pilot Project for Rural Electrification |
| Country Eligibility: | UNFCCC ratified September 8, 1993 |
| Project Site: | Uganda |
| GEF Focal Area: | Climate Change |
| Executing Agency : | Government of Uganda |
| Implementing Agency: | Ministry of Natural Resources |
| GEF Budget: | $1,681,000 |
| Duration: | 3 years |
| Estimated Starting Date: | August 1997 |

| **UNDP and cost sharing Financing:** | |
|---|---|
| **GEF:** | |
| **Prep. Asst.** | **$75,000** |
| **Main Project** | **$1,681,000** |
| **TOTAL GEF:** | **$1,756,000** |
| **UNDP (TRAC)** | **$1,000,000** |
| **Gov. of Uganda** | **$200,000** |
| **Total** | **$2,956,000** |

**Brief Description**: The UPPPRE is a pilot project whose goal is to establish the foundation for the sustainable use of PV technology for rural electrification in areas which will not be accessed by the national electric grid in the foreseeable future. Its objective is to overcome the financial, social, and institutional barriers that presently exist to the widespread dissemination of the technology within Uganda. The targets of the project are individuals, communities and government services which have the ability/willingness to pay the real market cost of PV-based services. It is expected that a rapid scaling up of PV-based rural electrification activities will begin on or before the completion of the pilot project.

| On behalf of: | Signature | Date | Name/Title |
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| The Government: | _____ | _____ | _____ |
| UNDP: | _____ | _____ | _____ |

## TABLE OF CONTENTS

## A. CONTEXT

### 1. Description of the Subsector

Uganda is a landlocked country bordering Kenya, Tanzania, Zaire, Rwanda and Sudan. It covers 241,000 square km of which 20% is covered by water including the White Nile River and a portion of Lake Victoria. Due to its position on the equator and being at an altitude of 1000-1500 meters, temperatures are relatively constant year round and sunshine is abundant. Dry seasons are from December - February and from June - July. Annual rainfall averages 1400 mm in the southern part of the country and 500 mm in the northeast.

Uganda's population is approximately 19 million and is increasing at about 2.8% annually. Per capita income is estimated to be $170. Approximately 90% of the population live in rural areas. Due to the past economic and political problems, rural-urban migration has been relatively low. Kampala, the capital, has a population of approximately 800,000 people. The next largest town, Jinja, has a population of approximately 60,000 and is followed by 8 towns with between 30,000 - 60,000 people.

The energy sector can be divided into 4 subcategories: biomass, petroleum, electricity and renewable resources.

#### a. Biomass

Biomass accounts for 96% of total energy consumed in the country and includes firewood, charcoal, agricultural residues and animal dung. Firewood is the predominant form of biomass used in rural areas while charcoal use is greatest in urban areas. Woodfuel accounts for approximately 83% of the total biomass-based fuels used, with crop residues comprising 12% and animal dung 5%. It is estimated that Ugandans consume an average of one air-dry ton of woody biomass (fuelwood and charcoal) per capita per year (total approximately 17 million tons in 1992). Approximately 75% is consumed by households. Significant quantities of fuelwood are also used for tobacco curing, tea drying, fish smoking, brick-making, baking, and cooking in hotels. Men specialize in commercial fuelwood harvesting, while women and children collect fuelwood for domestic use.

In 1984, a World Bank report noted that, in 1983, fuelwood consumption exceeded production by approximately 25% (13.6 million tons vs 10.9 million tons). While measures to alter this trend have been initiated, fuelwood use is expected to dominate energy demand for the foreseeable future and will exert increasing pressure on the biomass resource base unless profound changes are made in the country's energy consumption pattern.

#### b. Petroleum-based products

Petroleum-based products provide about 4% of Uganda's energy needs, including 70% of the commercial energy supply. All petroleum-based products are imported through sea ports at

Mombasa and Dar es Salaam. Due to foreign currency constraints in the 1970's, many industries switched from petroleum to other products (particularly woodfuel and electricity). As prices of petroleum products have continued to rise, this tendency to switch to other fuels has continued and petroleum imports have decreased.

Importation and marketing are handled by six companies, the largest of which is Shell. Three companies supply 58% of Uganda's needs, purchasing crude oil from their overseas affiliates and having it processed at the refinery in Mombasa.

The transport sector consumes approximately 85% of petroleum imports with domestic and industrial uses accounting for 14% and 1% respectively. In rural areas, domestic use of kerosene is limited mainly to lighting.

Although some exploration work has been carried out in the Western Rift Valley area of Lake Albert, no commercially viable petroleum reserves have yet been identified.

### c. Electricity

Electricity provides approximately 1% of the total energy consumed in Uganda and 5% of commercial energy consumption. Most of this power is generated by the Owens Fall Dam (180 MW) at Jinja, which is managed by the Uganda Electricity Board (UEB). Diesel generators, also owned by UEB, generate an additional 3.8 MW in isolated areas. Two hydro plants in the western region supply local areas including (a) a 0.5 MW installation near Kabale, operated by UEB (currently being upgraded to 1 MW), and (b) a 5.4 MW installation operated by the Kalembe Copper Mine. There are also a few other privately owned micro-hydro installations in operation.

Total known hydropower reserves have been estimated at 3000 MW. This includes 21 mini hydro sites which have been identified as having the potential for development.

Approximately 4% of the population presently has access to electricity. Extension of the grid to rural areas has been carried out on a sporadic basis subject to the availability of funds. Additional impediments to a sustained rural electrification program include: (a) the dispersed nature of the population in Uganda, (b) UEB's difficulties in billing and collecting payments from consumers, (c) continuing capacity shortages (resulting in frequent brown-outs and black-outs) and (d) the high cost of electricity connections and consumption. These conditions are expected to continue for the near and medium-term.

### d. Renewable resources

Renewable resources (other than hydro) constitute a new field of interest in Uganda. The combined contribution of renewables is estimated at 1% although this sub-sector has a much greater potential than this figure suggests. Renewable resources include:

Biogas - Use of this technology has been limited to demonstrations. The major constraints have been the newness of the technology and the relatively high capital cost. Phase I of the National Biomass Study included a recommendation that, due to the minor role this technology is expected to play in Uganda's energy consumption in the foreseeable future, its development should be left to the private sector.

Wind - Uganda is thought to have a high wind energy potential although data to support this assumption was not available. Windmills have reportedly been used successfully in the Karamoja region. A wind generator was recently installed in the Sese Islands by a local entrepreneur to provide power for a private residence.

Crop Wastes - Include crop stalks, cobs, and domestic animal wastes. Currently some of these materials are used for fertilizer. Firewood is preferred as a fuel source over crop wastes owing to the time required for crop waste collection and its rapid rate of combustion. In 1993, crop residue production was estimated to be 5.3 million tons of which 1.0 million was consumed as fuel.

Industrial Biomass Residues - Include bagasse, coffee and rice husks, and sawdust. Most bagasse is used for energy as part of the sugar manufacturing process. The potential exists for sawdust to be transformed into charcoal briquettes and used as a source of fuel. The Sandu Sawmill at Mbale and the Kiira Sawmill in Jinja each produce 10,000 tons of sawdust annually although its use is presently negligible. Coffee is one of the most important crops grown in Uganda and a recent study indicates that coffee husks could become an important energy source for a variety of industrial activities (i.e. briquetting, ceramics, brick production, etc.). Rice production is increasing in Uganda and an estimated 8,200 tons of rice husks were available in 1994 for energy-related uses. Industrial biomass wastes are now recognized as potential sources of energy for a variety of uses. For example, it has been evaluated that each of the three sugar factories in Uganda could generate over 15 MW of electricity as well as sufficient quantities of biogas from molasses to cook food for all the workers on each estate.

Geothermal Energy - Uganda's resources, located in the Rift Valley region, are estimated at 450 MW. Three sites have been identified (Katwe field in the south, Buranga field near the Rwenzori Mountains and the Kibira field near Lake Albert). The Katwe field is considered the most promising due to the presence of subsurface steam at 230 deg. C and its location 35 km from a 132 KV transmission line at Kasese.

## 2. Host Country Strategy

At the time of independence in 1962, Uganda had one of the strongest economies in sub-saharan Africa including an excellent transport system comprised of road, railway and air transport facilities. Real GDP grew by 5.8% annually from 1962-70 with per capita GDP also increasing more than 2.8%/year.

The political instability which began in 1970 took a heavy toll on the economy. Skilled personnel fled the country, private industries were converted to parastatals and the public service degenerated. Additional problems were created by the breakup of the East African Community in 1977.

When the National Resistance Movement took control of the country in 1986, inflation was rampant, foreign exchange was scarce, roads and vehicles had deteriorated and many industries had been abandoned. The educational system and health services had degenerated, illiteracy had increased, and outbreaks of diseases were common.

In 1987, the Government introduced its Economic Recovery Program. As a result of a market-driven, private sector-oriented development strategy and Uganda's strong natural resource base, the economy has grown by an average of 5.7% per year since 1987 with most of this gain coming from the commercial sector. A number of policy initiatives undertaken recently by the Government, including the floating exchange rate of Uganda's currency, market determination of prices paid to coffee producers, and an improved investment climate have greatly boosted the economy. The Government has reduced the civil service and it is expected that economic growth will continue if political, economic and environmental factors remain favorable.

A presidential election was held on May 9, 1996 which resulted in a landslide victory for President Yoweri Museveni and his market-oriented policies. As a result, the Government has been able to continue its commitment to addressing the energy needs of the majority of its citizens who live in the rural areas and is continuing its efforts to identify private sector-based solutions to development problems.

## 3. Prior and Ongoing Assistance

A comprehensive study has not yet been carried out to establish the number of PV systems that exist in the country although it is estimated there are approximately 1,500 installations. Most have been financed by outside donor agencies and/or including approximately 300 community-based systems (primarily for clinic lighting and vaccine refrigeration implemented by the Ministry of Health).

A Ugandan NGO, Uganda Rural Development and Training (URDT), has established a solar village in Kagadi and has recently begun a solar lending program targeting rural peasants with approximately $60,000 of donor (Dutch/Hivos) funding.

Habitat for Humanity and the Solar Electric Light Fund, with the support of the U.S. Dept. of Energy, have installed 125 household systems (each 35 Wp) in Kasese. These systems are reportedly operating well and are greatly appreciated by the users. Habitat's market are lower income families and, as a result, the systems were heavily subsidized (50%).

Unsubsidized, private, household systems are becoming increasingly common in upperclass residences in rural areas but estimates are not available as to how many exist.

The tourism sector has been increasing its use of PV systems in and around game parks and reserves. Solar water heating systems are being produced by two local firms and are being used in tourist lodges with the support of USAID.

Uganda Railways Corporation (URC) a government-owned parastatal, has installed a total of 35 KWp at 39 remote locations for telecommunications and signaling. These systems were purchased with support from the European Union and Government of France.

Uganda Posts and Telecommunications (UPTC) has installed 30 KWp at 35 remote telecommunications sites throughout the country with funding from the World Bank.

It is noteworthy that, until recently, the above initiatives were carried out independently with little information exchange or coordination between them. As a result, minimum follow up and/or monitoring have taken place.

Uganda was recently accepted as a participant in the UNDP/GEF Small Grants Program. This program is designed to assist NGOs involved in activities which foster environmental benefits and can provide financial support of up to $50,000/project. It is anticipated that this program will act as a catalyst to encourage NGOs to participate in future renewable energy activities.

## 4. Institutional Framework

### a. Private Sector Companies

There are 9 private sector commercial companies selling and installing PV systems in Uganda in addition to two local battery manufacturers/assemblers. The PV vendor/suppliers are:

- Solar Energy for Africa
- Magric (U) Ltd.
- Sun Trade and Consulting International Co. Ltd.
- Incafex - Solar
- Agip (U) Ltd.
- Energie System Technik
- Afro-Kai
- Wilken Telecommunications Ltd.
- Entech (Africa) Ltd.

Most of the above are small enterprises with sales averaging 0.5-3 KWp/year. Some are also involved with the sale of other electro-mechanical equipment (i.e. for agriculture) and see PV as a related technology for which the market will expand in the near future. Others are traders who are marketing a range of commercial products, and would like to sell PV systems as off-the-shelf items similar to kerosene lanterns and transistor radios.

Uganda's two battery producers, Uganda Battery Ltd. and Battery Power Systems Uganda Ltd, have expressed interest in expanding their involvement with the use of batteries for PV systems and requested Project assistance in obtaining information and support related to the manufacture and sale of deep-discharge batteries for use in Uganda and the region.

Approximately 25 private Ugandan companies, training institutions, and consultants recently organized themselves into the Uganda Renewable Energy Association (UREA). While UREA is yet in its formative phase, its members are committed to strengthening and expanding the use of renewable energy technologies in Uganda through commercial channels and are an increasingly active group.

### b. The PV Credit Fund

When a consumer is connected to the grid, the individual pays a connection fee and for the consumption on a monthly (or bi-monthly) basis. As a result, the payments are affordable for people with modest but regular incomes. However, with a PV system, a consumer is obliged to pay most of the cost of 20 years-worth of electricity (the life of a solar panel) up-front. The establishment of financial mechanisms to spread this up-front cost over a reasonable period of time (and enable a significant portion of the population to afford the required payments) is a critical step in promoting large-scale PV-based rural electrification.

The demonstration of sustainable credit mechanisms to help both end-users and local PV vendor/installers spread the cost of household and community-based PV systems over time is an essential aspect of the Project UNDP/Kampala has made a grant of $ 1 million to the Government of Uganda to facilitate the development of such credit mechanisms in collaboration with existing local financial institutions. Using the PV Credit Fund (PCF), loans will be made available to credit-worthy PV vendor/installers, community-based organizations, individual end-users and public sector institutions to facilitate the purchase of household and PV systems and their repayment over time.

Between 3-5 local financial institutions will be identified to participate in the administration of the PV Credit Fund. These institutions will be selected from among existing commercial financial institutions and/or NGOs with experience in providing credit to small-scale enterprises and/or community based organizations.

The criteria to be used to select the local financial institutions which will participate in the use of the PV Credit Fund are:

- an interest to take part in an innovate credit program which targets a segment of the population which has both the willingness and ability to pay for PV-based electricity services.

- the creativity and flexibility to adapt, if necessary, certain traditional lending practices in order to develop and expand the market for private sector-based rural electrification services.

- a proven track record in the provision of short and medium-term financing to credit-worthy small-scale entrepreneurs, rural individuals and/or community-based organizations.

- the availability of branch offices in trading centers and communities in rural areas of the country which can service loans to individuals and groups of end-users.

- the availability of a technically-oriented person on staff who can be trained to evaluate PV-based loan requests.

### c. NGOs

In order to (a) inform/educate rural populations regarding the use of PV technologies for domestic and community-based uses, (b) help establish community-based user groups to facilitate the purchase and maintenance of household and community-based PV systems, and (c) establish pilot credit schemes, NGOs could play key roles.

There are between 300-400 NGOs in Uganda which are active in either development or relief efforts. NGOs are increasingly recognized as important since they (a) represent constituencies that tend to be neglected or unattended - the poorest of the poor, the disabled, and those living in remote areas, and (b) fill gaps in the provision of social services and development support that cannot be provided by government. In addition, the financial resources NGOs control in Uganda are estimated to be approximately $125 million annually.

DENIVA (The Development Network of Indigenous Voluntary Associations) is a Kampala-based umbrella organization established in 1988 to strengthen indigenous Ugandan NGOs through national and international networking, providing member services, facilitating training and research, information dissemination and influencing government policies. It presently has 400 member NGOs and publishes a quarterly newsletter with articles on member activities as well as technologies and projects of interest.

DENIVA has indicated that environmentally-friendly energy use as well as business management are issues currently receiving a great deal of attention in Uganda and, as a result, the Project will be well received by its member organizations.

As mentioned above, a local NGO, the Uganda Rural Development and Training Organization (URDT), has had extensive experience with PV systems and has established a solar village in Kagadi. A number of international NGOs, such as World Vision and Concern International (in Masaka and Rakai) are also using PV systems as part of their project activities and the number of such organizations (both Ugandan and international) using PV is growing.

As mentioned above, the UNDP/GEF Small Grant Program (SGP) has recently included Uganda among its participating countries. As a result, it is anticipated that the SGP will serve as a mechanism to promote/facilitate NGO involvement in the Project.

### d. Ministry of Natural Resources

The Project will take place within the framework of the Ministry of Natural Resources (MNR). The MNR is responsible for the assessment, maintenance, safeguarding and policy framework for the natural resources and environment of the country as well as the development, promotion and coordination of the efficient use of water, minerals, energy, forests, and climate. It includes Directorates of Water Development and Energy and Minerals Development.

The MNR employs over 2,000 people and is headed by a management team which includes the following:

- The Permanent Secretary acting as the Chief Executive of the Ministry
- The Director for Environmental Protection
- The Director for Minerals and Energy
- The Director for Water Development
- The Under Secretary (Finance and Administration)

New and renewable sources of energy are the responsibility of the Director for Minerals and Energy and the Commissioner for Energy.

### e. The Uganda National Bureau of Standards (UNBS)

The UNBS is a parastatal organization established in 1983 under the Ministry of Trade and Industry. It's objectives are to formulate, issue and promote the use of standards in commerce, health and safety in order to protect the public and the environment. In the past, the UNBS has worked closely with the Faculty of Technology at Makerere University to carry out materials testing.

### f. Local Authorities

When the present National Resistance Movement came to power in Uganda in 1986, it established a policy of decentralizing decision-making authority to the grass-roots level in order to create a system of local government that would be democratic, participatory, efficient and development-oriented. This led to the establishment of local committees which are the centers of planning, decision-making and development.

Local authorities are well suited to developing public awareness and interest in the use of PV systems at the village level for both individual household and community-based uses and their involvement will be important in mobilizing and educating community members. The Project staff will work closely with local authorities in the selected pilot areas.

### g. Additional Donor Financing

Discussions have taken place between UNDP/GEF personnel and representatives from:

(a) GTZ
(b) The European Development Fund
(c) The European Union
(d) The U.S. Export-Import Bank

Each of the above has expressed interest in providing additional support to the Project including the provision of credit to help establish pilot financing mechanisms and develop the market for PV household and community-based systems.

It is expected that, once project implementation has begun, additional public and/or private sector financing will be identified and additional innovative, financing schemes will be initiated.

## B. PROJECT JUSTIFICATION

### 1. Problems To Be Addressed; The Present Situation

Over 2 billion people in developing countries today do not have access to electricity. As populations increase, the level of demand for electricity will increase accordingly. If even a small portion of this demand were to be met through the use of conventional sources of energy, these non-renewable resources would be depleted at an even more rapid rate than is occurring today and greenhouse gas emissions (GHG) would increase dramatically. According to current projections, the greatest growth in GHG emissions during the next thirty years will occur in developing countries.

Increased energy efficiency can result in immediate energy savings and offset the need for future capacity expansion. This, however, would only address a small part of the real problem which is the future demand for basic electrical service by the rural population in developing countries and the ways in which that demand can be satisfied in a sustainable, environmentally-acceptable manner.

The Government of Uganda is committed to addressing both the environmental concerns and energy needs of the country's population, the majority of which live in rural areas. In the past, Government emphasis has been on the development of the electric power sector, which serves approximately 4% of the population (2% in the rural areas) and on ensuring the availability of petroleum-based products. The supply of conventional sources of energy, however, entails substantial capital investment and foreign exchange, which contribute to the nation's debt burden. The direct beneficiaries of these investments, however, are mainly the urban dwellers who use electricity and own vehicles, but constitute a small proportion of the population. Therefore, the Government has realized that some change in emphasis in energy planning is necessary to reflect the energy needs of rural areas and enable a larger portion of the population to move towards attaining energy security an improved standard of living.

Although the Government's macro-economic policies emphasize electrification as a means of improving the quality of life of the rural population, it has become apparent that this goal

cannot be achieved through the extension of the national electric grid due to the high cost as well as the low levels of electricity consumption that are generally found in rural areas. As a result, it is unlikely that the populations living even a few kilometers from the grid will be connected in the foreseeable future.

In addition, statistics compiled by the Uganda Electricity Board (as well as World Bank studies) confirm the existence of a substantial unserved market for electricity in rural areas where UEB-based grid power is presently unavailable.

As a result, UEB is supportive of a program to promote the increased use of PV systems for rural electrification and has asked that the Project coordinate its activities closely with those of UEB.

The use of renewable energy technologies has been slow to develop in Uganda for the following reasons:

- the absence of a policy environment which encourages the use of alternative energy systems and the production and delivery of energy services by the private sector;
- a lack of public education and information regarding the use, advantages and limitations of RETs,
- the high up-front cost of RETs and the absence of credit for end-users to spread the initial cost of PV systems over time and for local suppliers to enable them to purchase system components locally and from abroad and,
- a fragile private sector lacking the necessary human resources, information and linkages to RE equipment suppliers in industrialized countries.

Government import duties and sales taxes have been applied sporadically during the recent past. Prior to 1992, taxes on imported PV systems were at 58%. In 1992/93, they were removed but were again reinstated in 1992/93 (at 32%). The 1994/95 budget (Item # TC 101/1, Vol. IV, 20/7/94) again eliminated them.

On July 1, 1996, the Government established a nation-wide value added tax (VAT) of 17% on the sale of all goods and services. The VAT is presently being applied to both imported and locally-made PV systems and components. Discussions have taken place between personnel from the MNR and the Commissioner for Taxation regarding the exoneration of PV systems and components. This initiative will continue as part of the Project.

Ugandans in rural areas frequently use car batteries to power radios and TVS in their homes and, when discharged, carry the batteries to distant grid-powered charging stations. In addition to demonstrating an already-existing familiarity with the use of limited amounts of dc power, this implies a potential demand for PV systems as well as the possibility of establishing PV-powered battery charging businesses.

Lead acid batteries for cars and trucks have been manufactured in Uganda for 25 years by Uganda Batteries Ltd. UBL manufactures approximately 45,000 batteries/year with capacities

of between 36-225 AH. UBL has sold a number of batteries for use with TVS, radios and small PV systems. At one point, UBL itself was marketing PV systems but stopped due to the high cost of the import duties and sales taxes imposed at the time. UBL understands the limitations of standard lead-acid batteries when used with PV systems and is aware of the potential market for deep-cycle batteries in Uganda.

A favorable investment code exists in Uganda which could provide an incentive for local production of PV system components once a market has developed. The currency, the Ugandan shilling, is freely convertible.

Private power generation is allowed in Uganda. This power can be used by the producer but, if it is sold to a second party, the proposed rate schedule must be approved by the MNR.

## 2. Expected End-Of-Project Status

At the completion of the Project, the following conditions/resources will be in place:

- commercial and programmatic linkages established between local industry and financial institutions to ensure the sustainable design, purchase, installation, maintenance and financing of household and community-based PV systems.

- local financial institutions carrying out lending activities to Ugandan vendor/installers and end-users for PV lantern, household, and community-based systems.

- trained technicians employed by strengthened commercial PV suppliers in sufficient numbers to satisfy the demand for system installation and maintenance in many rural areas of the country.

- increased awareness in rural areas and of decision-makers regarding environmental issues, in general, and the availability, advantages, limitations and costs of household and community-based PV systems.

- adequate capacity within the Dept. of Energy of the Ministry of Natural Resources to promote, monitor and evaluate PV projects and review policies which encourage the development of the solar industry.

- appropriate national-level solar-based rural electrification policies established.

- national PV equipment standards and installation codes of professional practice in place enforced by staff from the Uganda National Bureau of Standards who have been trained in enforcement procedures.

- a basic PV component test facility in place to ensure the use of high quality PV equipment.

- a data base of renewable energy installations in Uganda established within the Ministry of Natural Resources using a geographic information system.

- adequate capacity within local institutions of higher learning to develop and implement a curriculum for solar/renewable energy training.

- local production of deep-discharge batteries by at least one of Uganda's two battery manufacturers/assemblers.

- procedures in place and monitoring to ensure battery recycling/disposal in an environmentally sound manner.

- an operational, self-sustaining Ugandan Renewable Energy Association.

- at least 2,000 households and a number of community-based PV systems installed in economically active districts of the country.

- an investment plan prepared, including identification of the institutional, human and financial resources, to expand commercially-based, nation-wide PV rural electrification activities using one or more proven implementation strategies.

As a result of Uganda's rapid economic growth, the increased availability of discretionary income in the rural areas, UEB's low, grid-based connection rate (4% of the population) and high level of suppressed demand for electricity, it is felt that followon commercial activities which provide PV-based electricity to an additional 4% of the population is feasible and would have important demonstration value for other countries in the region.

## 3. Target Beneficiaries

The beneficiaries of the Project will be the following:

- approximately 12,000 people and a range of Government services in rural areas of the country (which will have access to electricity through the use of commercially-provided PV lanterns, household systems and battery charging stations).

- Ugandan private PV system supplier/vendors (to be better able to market, install and maintain PV systems on a sustainable, profit-making basis).

- Ugandan financial institutions with branch offices in the target areas (to provide credit to both PV system end-users and suppliers on a sustainable, profit-making basis).

- NGOs, CBOs and cooperatives operating in the target areas (to become familiar with the "solar option" and develop ongoing roles as financiers, educators and trainers).

- rural population groups and national decision-makers who will have an increased awareness of the availability, advantages, limitations and costs of PV lanterns, household and community-based systems.

- the Ministry of Natural Resources (to establish the policy framework for the promotion of PV systems, propose safety measures, initiate equipment and installation standards, monitor and evaluate solar PV programs and design larger investment programs).

- Makerere University Faculty of Technology and other institutions of higher learning (to develop the in-house capability to train PV system designers, installers and maintenance personnel).

- the Uganda National Bureau of Standards (to develop their role in the enforcement of quality control standards for PV equipment and installation procedures).

- the Uganda Renewable Energy Association (UREA) (to organize the Ugandan private sector).

## 4. Comparative Costs, Ability/Willingness to Pay for PV Systems and Market Size

### a. Cost of Household PV Systems

At present, in western Uganda, a 44 Wp system which provides sufficient energy to operate 3 high efficiency fluorescent lights (6-10 watts each), a small black and white television and transistor radio for approximately 4 hours/day costs between $900-$1,000 installed. However, the cost of solar home systems in a number of developing countries in 1994 (where larger markets have already developed) averaged $650 for a 50Wp system. As a result, it is expected that, in the near future, a 44 Wp system in Uganda will cost between $550-570 as a result of increased commercial competition and local production of certain system components.

Assuming a household system cost of $570, a 40% ($228) down payment, and the remainder payable over an 18 month period at market (22%) rates, monthly payments of approximately $22 will be required.

### b. Comparative Cost of Kerosene, Dry Cells and Lead-Acid Batteries

The ability/willingness of people to pay for PV-based services can be evaluated by reviewing their present expenditures for lighting, TV and radio. Although it is generally recognized that substantial amounts of kerosene and batteries are used by non-grid-connected households, comprehensive survey information was not available. However, estimates were obtained during a 3 day field visit that quantified the use and cost of these energy sources.

Although not all families make use of car/truck batteries for lighting and/or radio/TV, many do. To this must be added the cost of dry cell batteries for flashlights, radios and cassettes.

Non-rechargeable dry cells are widely used and figures from other countries indicate that an average family consumes 100/year.

| | | | | |
|---|---|---|---|---|
| **Kerosene use** | | | | |
| liters/year/household | = | 40 | | |
| cost/liter | = | $ .78 | | |
| kerosene cost/year/household | | | = | $ 30 |
| | | | | |
| kerosene lamps/family/year | = | 3 | | |
| cost/lamp | = | $16 | | |
| kerosene lamp cost/year/household | | | = | $ 48 |
| | | | | |
| **Dry cell use** | | | | |
| dry cells/family/year | = | 100 | | |
| cost/dry cell | = | $ .35 | | |
| dry cell cost/year/household | = | | = | $ 33 |
| | | | | |
| **Lead acid battery use** | | | | |
| battery purchase price | = | $110 | | |
| battery lifetime | = | 2 years | | |
| battery cost/year/family | | | = | $ 55 |
| cost/recharge | = | $1 | | |
| recharge frequency | = | 1/week | | |
| charging cost/year/household | | | = | $ 52 |
| average cost/charging trip | = | $2 | | |
| travel cost/year/household | | | = | $104 |
| | | | | |
| Total cost/year | | | = | $322 |
| Cost/month | | | = | $ 27 |

### c. Comparative Cost of Grid Connection

Grid-based electricity demand in Uganda is composed of three major consumer groups which constitute 94% of total demand. These include:

domestic - approximately 4% of the households in the country are hooked to the grid including a total of approximately 680,000 people. Domestic consumption, predominantly from urban areas and trading centers, represents half of overall electricity consumption.

industrial- industry presently constitutes only a small percentage of electricity demand but is expected to increase as economic growth continues.

commercial- includes trading centers, shops and sales points and constitutes an important source of demand.

Additional users include craftsmen linked to service activities and other miscellaneous trades.

Hookup costs (in US dollars) for UEB grid-based power are as follows:

$90 (90,000 U Sh) for houses which are next to a low voltage connection point and for which no additional poles are required. This is a subsidized rate. The actual cost of the connection to UEB is approximately $200.

$276 (276,000 U Sh) for the installation of one pole and a low voltage household connection (including a meter). This is also a subsidized rate, the actual cost to UEB being, again, approximately double this amount. The maximum span allowed between poles is 60 m.

$800 (800,000 U Sh) for the addition of 2 poles and a low voltage household connection to the grid (including meter). This is the un-subsidized cost to UEB.

If a step-down transformer is required from an 11 KV line, this will cost the consumer an additional 6 million U Sh ($6,000).

Electricity tariffs (in U.S. cents) as of July 1, 1993 for low voltage consumers are as follows:

Code 1. Domestic

| | |
|---|---|
| 1-30 kwh/month | 2.0 cents/kwh |
| 31-200 | 7.0 cents/kwh |
| above 200 | 10.0 cents/kwh |

In addition, all domestic customers are billed an additional fixed service fee of $ 1.00 US/month.

According to UEB staff, monthly electric bills for consumers in Kampala average the equivalent of $60 US.

Code 2. Commercial/small industrial (less than 50 kVa installed capacity)

| | |
|---|---|
| all consumption | 11.5 cents/kwh |
| fixed service fee | $ 4.00 US/month |

As can be seen from the above figures, the combined cost of transformers, poles, electrical hookups and consumption is high in Uganda especially if one takes into account the low population densities (Ugandans tend to live in small family groups on widely dispersed farming plots (average 85 people/sq. km)). Only for consumers living less than 60m from an existing low voltage point will the cost of connecting to the grid be less than the down-payment for a

household PV system. In rural areas, the percentage of the population located this close to the grid is extremely small.

### d. Market Size

An estimation can be made of the annual market for PV systems in Uganda based on Uganda Electricity Board (UEB) projections.

The 1992 National Electrification Planning Study prepared by Electricite de France International projected UEB making 25,000 new connections between the year 2000 and 2005 in areas already served by the grid and an additional 38,000 connections in areas scheduled for electrification during the same period. If we assume that PV systems will be used only to provide power for domestic consumers in new areas, we can project an average of 3,800 new PV-system customers/year. If we assume each household system uses a 50 Wp solar panel, the annual market in Uganda will be on the order of 190 KWp (approximately 20-40 times the present market).

This projection is conservative as it does not take into account demand from (a) domestic and commercial customers in already-electrified areas who are not yet connected to the grid and who are situated more than 60m from an existing grid point, (b) people living in rural areas not yet scheduled to receive grid power which will now have the option of PV-based electricity, and (c) people living in urban areas who are connected to the grid but who require a more dependable electricity supply than is presently available from UEB.

## 5. Project Strategy and Implementation Arrangements

UNOPS will be the executing agency for the project and the Department of Energy of the Ministry of Natural Resources will be the implementing agency.

The project will overcome constraints to market development including (a) the high initial cost and lack of term financing, (b) lack of information at the household level and community levels, as well as among decision makers and government ministries, (c) undeveloped private sector-based supply and service networks and (d) a policy environment which is not conducive to PV market development.

The Government and UNDP/GEF expect the Project to lead to the expanded provision of sustainable, commercially-based, PV rural electrification services by the Ugandan private sector. All project initiatives have been planned from this perspective.

Project implementation will consist of the following activities:

### a. Promoting a Sustainable PV Market Structure

- Public awareness:- Consumer education will be organized by the Project Management Unit (PMU) and carried out by either the PMU, subcontractors and/or NGOs. The objective will

be to enable large segments of the population to become aware of the services and limitations of PV systems, their maintenance requirements, costs and where/how they may be purchased.

- Selection of pilot sites and market assessment for various PV equipment options:- Target sites will be selected according to agreed-upon criteria. Various size PV systems will be market tested in these areas in close collaboration with the Ugandan private sector vendor/installers. Micro-lights as well as solar home and community-based systems will be considered.

- System installation and final inspection:- Once groups of at least 60 consumers in an area have made down payments on either household or community-based PV systems, and a local vendor/installer has signed a loan agreement with a participating financial institution, the project staff (in conjunction with the Uganda National Bureau of Standards) will monitor system installation to ensure conformity to contract specifications and installation codes of practice. This will also include final system inspection and certification.

- Ensuring system quality:- This requires the establishment of (a) equipment standards and codes of practice that meet either locally established or internationally recognized requirements, and (b) a balance of system (BOS) test facility. Technical assistance will be provided to the Uganda National Bureau of Standards which will ensure that systems are well designed with quality components, and are assembled and installed to meet approved standards. Environmentally sound battery recycling/disposal procedures will also be put in place.

- Evaluation of pilot project performance;- This will include PV system performance, user satisfaction, loan repayment rates, and the establishment of plans for project expansion. Technical, financial, environmental and institutional aspects will be reviewed. Evaluation reports will be prepared and presented to the MNR, UNDP/Kampala, participating financial institutions, and other interested organizations at the mid point and at the end of the project. This will also be one of the inputs into plans for expanding the sale of PV-based energy services following completion of the Project.

- Strengthening of the Uganda Renewable Energy Association (UREA). UREA has already helped considerably in the design phase of the Project by consolidating common industry interests, forming linkages among agencies/institutions involved in solar energy activities, and by circulating information. Support will be provided to UREA to enable it to carry out standard association-related services at an accelerated rate and enable it to become self sufficient as rapidly as possible.

### b. Establishment and Management of Sustainable Credit Mechanisms

- Design and implementation of financing mechanisms for household and community-based PV systems:- This will involve the PMU working closely with participating financial institutions to define the procedures for each loan scheme(s), training financial institution

based on down payments from at least 60 solar system purchasers in a geographic area. The vendor/installers will then purchase system components locally and/or from abroad and will be responsible for loan repayments within a 12-18 month period.

Vendor/installers who wish to obtain credit from participating financial institutions to purchase PV system components from abroad prior to the receipt of 60 customer deposits will be able to use their homes or vehicles as collateral.

**Energy Service Companies (ESCOs)** - An ESCO sells energy services but retains ownership of the systems that provide them i.e. ownership of the SHS hardware is retained by the ESCO. UEB is an example of an ESCO. Working examples of solar-based ESCO's include Tuvalu Solar Electric Cooperative in the Pacific Islands and Soluz in the Dominican Republic.

An ESCO procures SHSs in bulk and installs and services them for a fixed monthly fee. It is also responsible for fee collections and financial management.

The principle advantages of an ESCO is that it can provide electricity-based services at a low cost to the consumer. However, it requires a technical and administrative infrastructure in the area to be served and access to long term credit at reasonable rates. A number of Ugandan private sector PV vendor/installer companies have expressed interest in establishing ESCO initiatives on a pilot scale within the framework of the Project.

The issue of borrower collateral has proven problematic in the past, especially for local vendor-installers who have sought commercial credit. The project will seek to modify collateral requirements for licensed local companies in order to facilitate their access to commercial sources of credit on a longterm basis.

As a result of preliminary discussions held with a number of financial institutions during the design of the project, it appears that collateral requirements may be eased for the following reasons:

- the vendor financing approach involves the establishment of a PV credit window with one or more participating financial institutions. Under this scheme, participating financial institutions will work closely with the ten or so local PV vendors and develop a familiarity with their management capabilities and assets. This familiarity should decrease the financial institutions' perceived risk factor and, as a result, ease collateral requirements.

- end-user financing will involve a group guarantee approach whereby borrowers will mutually guarantee their colleagues loan repayments. This approach should also decrease the financial institutions perceived risk factor and collateral requirements.

- the training provided by the project to financial institution representatives and the active involvement of the PMU staff in structuring and monitoring the operation of the loan schemes will also serve as a source of security for participating financial institutions.

staff to be able to appraise loans for PV systems and providing technical assistance in the field to rural bank managers. Mechanisms for the establishment, management and evaluation of credit schemes administered by NGOs, cooperatives and other community-based organizations will also be explored as additional loan capital becomes available.

### c. Capacity Building in the Private and Public Sectors

- Strengthening of local PV system vendor/installers: - Commercial agents to supply and install PV systems have already been identified and are well known to MNR staff. These vendor/installers will be provided with technical and management support to help strengthen their provision of PV-based energy services on a commercial basis.

- Training for private sector representatives will focus on PV system design, installation, maintenance and repair operations as well as business management procedures. The equipment provided under the project will include computers, software, communication tools (fax, Internet connections, etc.), mobile demonstration units, and audio and video material/equipment. Logistical support will also be provided to ensure sustainability following completion of the project.

- Qualification of local PV system vendor/installers: - Project staff will develop criteria for vendor/installer qualification and assist with the review of loan requests from approved vendor/installers (as well as CBOs). Loan approval criteria will include system quality, previous installation performance, price, spare parts availability, warranty/service arrangements and the commitment to establish a service center in the target area.

- Collection of information and organization of study tour visits for representatives of government, financial institutions and private sector companies to PV projects in other countries:- Candidate countries include the Dominican Republic, Bolivia, Colombia, Kenya, Zimbabwe, Botswana and Sri Lanka.

- Strengthening solar data collection and processing capability:- Solar radiation measurement equipment may be needed to add data to the country's insolation data bank. This will be evaluated by project staff in collaboration with the meteorology department of the MNR. Project staff will also establish a collaborative relationship with the National Environmental Management Authority's (NEMA) existing GIS capability to map relevant PV system information (i.e. existing PV installations, UEB grid and future expansion, population densities, economic resources, NGO operations, solar radiation data, etc.).

- Strengthening public sector support for PV-based rural electrification:- The Project will provide training and equipment to public sector departments to enable the Government to establish a policy environment which encourages and protects both small, private sector companies and consumers as the market for PV systems in Uganda develops. This could include, for example, organizing a dialogue between UREA members and Ministry of Finance officials concerning the rationale and impact of the recently established VAT and the possible exoneration of PV equipment. It could also include establishing the proper

legal context to enable local vendor-installers and/or financial institutions to repossess PV systems if loan repayments become seriously delinquent or for consumers to file complaints against vendor-installers if warranty or maintenance agreements are not honored. The establishment of safety measures, and equipment and installation standards will also be important Government inputs.

A preliminary workplan is included in Annex I. A detailed workplan, for project management purposes, will be prepared by the PMU, in collaboration with the stakeholders, at the outset of project implementation.

## 6. Reasons for Assistance from the UNDP/GEF

Uganda ratified the UNFCCC on September 8, 1993 and, as a result, is eligible to receive GEF support.

The Project is included under the "Removing Implementation Barriers for Technologies" component of the Climate Change GEF focal area. UNDP/GEF assistance is appropriate since the Project will provide a working model of a viable way of meeting the objective of electrifying rural areas of the country in the near and medium term future. As such, it will remove barriers to PV commercialization including those which relate to policy, information, human resource, and financing mechanisms.

Most PV-based rural electrification projects to date have been (a) donor or NGO-driven and/or (b) heavily subsidized. Both approaches have served to inform and sensitize individuals, community-based organizations, and decision makers about the potential roles PV can play in raising standards of living, creating local employment and promoting environmental conservation. However, these initiatives have not proven to be sustainable.

The Project is the first attempt in Africa to develop a market-driven, unsubsidized, private sector-oriented PV-based rural electrification program that involves local financial institutions using local capital on a profit-oriented basis. It is expected to serve as a catalyst to strengthen local industry and bring additional, large-scale private, bilateral and multilateral bank capital into the PV lending process to establish a truly sustainable, national-scale PV-based rural electrification initiative in Uganda.

In order to achieve the Project objectives, constraints to market development will be overcome including (a) the high initial cost and lack of term financing, (b) lack of information at the household and decisionmaker levels, (c) undeveloped supply and service networks and (d) a weak policy framework.

By replacing kerosene in the rural households, the Project is in line with the GEF's view of the development and use of non-carbon-emitting technologies to GHG emissions in the atmosphere.

## 7. Special Considerations

### a. Definition of a Solar Home System

A typical solar home system (SHS) consists of a 20 - 100 Wp solar array. a rechargeable battery for energy storage, a battery charge controller, one or more lights (usually fluorescent), outlets for a television, radio/cassette player or other low-power-consuming devices, switches, interconnecting wires, and mounting hardware. Both the array size and level of available sunlight determine the amount of electricity that will be available for daily use. In southwest Uganda, a 44 Wp system can provide sufficient energy to operate 3 high efficiency fluorescent lights (6-10 watts each), a small black and white television and transistor radio for approximately 4 hours/day. In areas of longer hours of sunlight (i.e. the northern regions), a similar level of service can be obtained from a smaller (and less costly) system.

### b. Environmental Considerations

It is planned that, as a result of this project, 2,000 households will begin using PV-based electricity, and, as a result, the amount of kerosene consumed each year/household will decrease significantly. This will prevent about 80 tons of carbon dioxide from being released into the atmosphere. Also, at a household usage rate of approximately 100 dry cells/year, the project will have prevented the haphazard disposal of nearly 3 million of these cells during a fifteen year period. In addition, hydrocarbon emissions from the use of as many as 3 million candles will have been avoided.

Uganda presently has two private companies manufacturing/assembling lead-acid batteries and certain battery components are already being recycled. The local production of deep cycle batteries by at least one of Uganda's two battery manufacturers will be encouraged under the project. Current practices of battery collection/removal, recycling and disposal will be reviewed and improvements identified.

### c. Private Sector Involvement

The strengthening of Ugandan private sector companies to design, market, install and maintain solar systems are primary objectives of the Project. This will be done through the provision of the following:

- training - to ensure that each company has a cadre of technicians who are qualified to size, install, maintain, troubleshoot and repair PV systems on an ongoing, profit-oriented basis. Commercial representatives from the districts where the PV systems will be installed will also be invited to participate in the project-sponsored training program(s).

- access to qualified technical assistance for the sizing and installation of more sophisticated PV-based systems (i.e. a complete hospital).

- credit - to facilitate the purchase (from both local and overseas sources) for sale and installation in Uganda.

- information - on the availability of PV equipment, the status of PV technology, potential markets, etc. from suppliers, associations and research institutions elsewhere in Africa, Europe, Asia and the US.

- support in strengthening the Uganda Renewable Energy Association.

### d. The Role of Women

Women will play a key role in the adoption of solar electricity in rural areas since they will benefit most. While men tend to migrate to the urban centers to seek employment, it is the women who usually remain in the villages carrying out domestic and micro-scale productive activities. After completing manual tasks during the daytime, they are usually confined to dark residences and neighborhoods in the evenings and are unable to use leisure time after dark. For this reason, women are often the first to show interest in solar home and community-based lighting systems.

In both Indonesia and the Dominican Republic, women account for about 25% of those signing for solar home system loans. This is due to the value women place on good quality lighting which allows them to perform domestic activities at night, leaving time for outside activities during the day. Ten percent of the women interviewed in the Dominican Republic indicated that improved lighting enabled them to carry out additional income generating activities. Women in the Philippines indicated that solar home systems helped them earn money by allowing them the time to manage local cooperative stores. Women also appreciate lighting when responding to infant needs at night. Children value the additional time available to study, listen to radio and watch TV.

Since women will be key benefactors, women's organizations at the national and local levels will be encouraged to participate in the Project. FINCA, an international NGO which provides credit to women-owners of small-scale businesses, has an active program in Uganda and will be considered as a possible participant in the Project.

### e. The Suitability of Uganda for the Project

In general, PV systems are economically and technically viable for small-scale power needs in regions where grid power is not available or unreliable and the following conditions exit:

- a positive perception on the part of the local private sector of the present and future markets for PV systems as well as their involvement in the marketing and maintenance of the equipment.

- individuals and communities which need and are able and willing to pay for electricity-based services and are located in regions with ample solar radiation.

- a general public awareness of the capabilities, costs, and maintenance requirements associated with the use of PV systems;

- public and private sector officials who understand the roles that PV can play in promoting social and economic development as well as environmental conservation;

- public policies that encourage the use of PV systems and the involvement of the private sector in the production and delivery of energy services;

- national plans which include the use of renewable energy technologies to address development issues such as health, education, agriculture, natural resource, and environmental management;

- financial institutions, with outreach capabilities in the rural areas, able to provide credit at reasonable interest rates to facilitate the purchase of PV systems by the local population;

- NGOs, or other community-based organizations which can organize individuals and communities into PV user groups. These groups can obtain credit, organize the purchase PV systems, and contract for maintenance services at lower cost and higher reliability due to economies of scale.

- the institutional capacity to train technicians locally to design, install, and maintain PV systems; and

- qualified personnel and spare parts located in close proximity to the users to ensure the proper use of the systems, the provision of maintenance and repair services in a timely manner, the availability of spare parts and the proper recycling or disposal of environmentally hazardous materials (i.e. used batteries and battery acid).

Since the introduction of the Economic Recovery Program in 1987, a number of changes have occurred in Uganda which strongly favor the increased use of PV systems including:

- economic growth has averaged 5.6% per annum since 1987, interest rates and inflation have dropped and the value of the Ugandan Shilling, which is freely convertible, has appreciated in value against the US dollar as well as other currencies[1].

- due to the need for rehabilitation of the Owen-Falls Dam and the aging of the national transmission and distribution network, UEB has been unable to meet current electricity demand. As a result, power outages, brownouts and consumer complaints have been common. UEB estimates there is a suppressed demand for an additional 60 MW of electrical power (one-third the present generating capacity). This has led to customer dissatisfaction and an increased interest on the part of both organizations and individuals to

[1]The exchange rate is approximately $1.00 U.S. = 1,000 USh.

identify affordable alternative sources of electricity in both grid-connected and non-connected areas.

- UEB began electrifying rural areas in 1989 and has not been able to recover the cost of these investments at the rate expected. As a result, UEB is supportive of a program to promote the increased use of PV systems for rural electrification and has asked that the UPPPRE coordinate its rural electrification activities closely with those of UEB.

- a National Environment Action Plan has been developed by the Ministry of Natural Resources which includes among its suggested actions "the increased dissemination of appropriate alternative energy technologies".

- the Ministry of Natural Resources realizes the importance of establishing a clear, up-to-date set of policies which recognize the increasing roles that can be filled by renewable energy technologies, in general, and solar energy, in particular, and has asked for assistance in this area.

- import duties and sales taxes on imported solar energy-based equipment have been eliminated. Discussions have been initiated with the Ministry of Finance to exonerate solar equipment from the recently-established V.A.T.

- power sector laws have been liberalized and now allow for private power generation.

- the banking sector has stabilized, interest rates have decreased, as has inflation (5-7% as of January 1997). The Cooperative Bank Ltd. has committed to providing credit-based financing for the project.

- both of Uganda's two battery manufacturers have expressed strong interest in obtaining information and support related to the manufacture of deep-discharge batteries for use in Uganda and in the region and in improving their present battery recycling and disposal procedures.

- the number of NGOs active in Uganda has increased dramatically in recent years.

### f. Technical Cooperation Between Developing Countries (TCDC)

Between 100,000 - 200,000 small-scale PV systems, in the range of 10-80 Wp each, have been installed in developing countries including China, the Dominican Republic, Honduras, Indonesia, Kenya, Mexico, Bolivia, South Africa and Zimbabwe. This growth is the result of both public and private sector initiatives and the pace appears to be accelerating.

A number of technical, economic, policy, social and environmental issues remain outstanding which will have important impacts on each country seeking to expand its use of the technology. The Project will seek to both learn from previous experiences in other countries as well as add to the international body of knowledge concerning this technology.

As part of the Project, communication links (e-mail, fax, phone and mail) will be established with key individuals and projects in a number of the countries listed above which are actively involved in the sustainable use of household and community-based PV systems. These links will lead to an ongoing dialogue between Ugandan practitioners (public and private sector) and similar personnel in other countries.

Study tours for selected public and private sector (including financial institution) personnel will be arranged to countries with private sector-oriented PV programs. In addition, as a result of the above communication links, priority will be given to the recruitment of outside consultants, when required, from other developing countries.

The above initiatives will be facilitated by the Chief Technical Advisor (CTA). Consideration will also be given to the engagement of an international technical assistance agency to provide support to the Project Management Unit (PMU).

### g. Sources/Structure of the Pilot Credit Mechanisms

One of the primary objectives of the UPPPRE is to establish one or more sustainable credit mechanisms which can be expanded, using local or venture capital at market rates, following completion of the project. This may involve local credit-based NGOs, community-based organizations or commercial financial institutions.

In order to identify the credit mechanism(s) most appropriate for Uganda, the project will include two separate credit tracks at the outset:

**Track #1 - The $1 Million UNDP PV Credit Fund -**

In order to bring credit-based NGOs, CBOs and commercial financial institutions into the business of lending to both local vendor/installers and consumers for the purchase and installation of PV systems, the $1 million UNDP Credit Fund will be used to establish between 1-4 different pilot lending schemes. These pilot schemes will be established with local financial institutions which are interested, but hesitant, in becoming involved in PV lending. In this way, a number of different private financial institutions and credit mechanisms will be evaluated on a pilot scale which serve communities, households, government institutions and low-income individuals. Financing mechanisms being considered include direct consumer group financing, vendor financing, and the establishment of energy service companies (ESCOs).

The PMU, in collaboration with Uganda Renewable Energy Association members and the local UNDP office, will identify appropriate local financial institutions with which to negotiate credit-based arrangements which will make use of a portion of the $1 million UNDP PV credit fund. The target groups of purchasers will include household owners, government institutions and communities.Consideration will also be given to the establishment of one or more centrally-based PV battery charging stations.

Although one of the objectives of the UPPPRE is to use commercial interest rates for PV lending, these rates (currently 22%) may inhibit market development at the outset. As a result, discussions have taken place with UREA members concerning the possible use of a sliding scale for interest rates. Under this arrangment, interest rates would be set at approximately 12% at the outset of the project, rising to, perhaps, 18% at the end of project year 1, and to 22% at the end of project year 2. In this manner, the markets for PV systems can be given time (and an incentive) to develop, financial institutions can become more familiar with PV lending issues and, market-based interest rates can be used during the final year of the project.

In order to select the financial institutions which will participate in the program, the PMU will prepare a tender and receive bids for the best terms under which the solar lending schemes will operate. Criteria for evaluating the bids will include (but not be limited to): (a) interest rates which will apply, (b) length of repayment periods, (c) use of the institutions own capital for a portion of each loan and (d) collateral requirements. Following selection of the participating financial institutions, Memoranda of Understanding will be negotiated with each including a disbursement schedule and the monitoring role of the PMU.

The PMU will be responsible for ensuring that participating financial institutions are monitored on a regular basis and that an accurate accounting/reporting system is established to avoid the diversion of project funds for other purposes.

Target areas for the UNDP PV Credit Fund will be determined in accordance with the geographic selection criteria provided in section 5(i) below.

**Track #2 - The Cooperative Bank Credit Facility**

As indicated above, the **Cooperative Bank** has agreed to provide the use of its loan capital, on a pilot basis, to qualified local vendor/installers, and primary cooperative societies to facilitate the purchase of household and community-based PV systems. Requests for credit from end-user primary societies, private sector vendor-suppliers and others will be evaluated by the CB in accordance with the CB's standard loan procedures.

The Cooperative Bank Limited was established in 1964, and has 24 branches throughout the country. In the near future, the CB management expects to add 10 branches and up to 200 rural offices. In general, the CB makes primarily short term (1-12 month) loans to farmers and small-scale businessmen.

The CB envisions its role in the Project as follows:

- the selection of loan candidates from among primary cooperative societies which need and can afford PV household and community-based systems and with which the CB has had a previously satisfactory credit-based relationship. Initially, these societes would be located in either the Bushenyi or Masaka Districts. The selected primary societies would be eligible to receive CB loans at market rates for solar systems based on down payments from at least

60 member/purchasers which will be deposited in a CB branch office. The primary society will be responsible for the repayment of the loan to the CB within a 12-18 month period. The primary society members will, as a group, guarantee the repayment of the loans made to each of their members.

- the selection of loan candidates from among local, private sector vendor/installers which have accounts at the CB as well as satisfactory credit ratings. These vendor/installers can receive CB loans based on down payments from at least 60 solar system purchasers in a geographic area which will be deposited in a CB branch office. The vendor/installers will then purchase system components locally or abroad and will be responsible to the CB for loan repayment within a 12-18 month period..

Vendor/installers who wish to obtain credit from the CB to purchase PV systems and/or components from abroad prior to the receipt of 60 customer deposits will be able to use their homes or vehicles as collateral.

Since the CB (a) has a network of branch offices in rural areas of the country, and (b) will be lending to groups of customers (primary societies) under a mutual guarantee scheme, it will not have to use an intermediary organization to service their PV loans.

CB officials are also interested in using solar systems to provide power to approximately 10 of their 24 rural branches offices. Most of these branches are already connected to the grid but, due to frequent and prolonged outages (sometimes lasting up to 2 weeks), are not able to provide sustained banking services. As part of a computerization program which the CB is initiating, they CB would like to have PV systems in the affected branch offices to provide power for 2 desk-top computers, 2 cash counters, 2 adding machines and 5 lights.

### h. Types of Credit Schemes and Collateral Considerations

Three basic types of financing mechanisms will be implemented as follows:

**Consumer Group Financing** - Loan candidates will be selected from among primary cooperative societies as well as other already-existing groups which need and can afford PV household and community-based systems. The selected groups will be eligible to receive loans from participating financial institutions for solar systems based on down payments from at least 60 member/purchasers.

The groups will then establish purchase agreements with local vendors who will install and provide maintenance for the systems. The groups will be responsible for the repayment of the loans within a 12-18 month period.

**Vendor Financing** - Loan candidates will be selected from among local, private sector vendor\installers which have satisfactory credit ratings and demonstrated interest/capability in the PV field. The vendor/installers will receive loans from participating financial institutions

- depending on the outcome of negotiations with local financial institutions, all (or a substantial part) of the capital lent by the financial institutions to either Ugandan PV vendors or groups of end-users will be provided by the UNDP Credit Fund. As a result, the participating financial institutions risk will be substantially reduced thus allowing them to ease their collateral requirements.

The structure and performance of each of the credit mechanisms will be carefully monitored by the PMU in collaboration with participating financial institutions and local private sector representatives. Assistance will be provided by the PMU to participating financial institutions, vendor/installers and community-based groups to ensure the efficient operation and monitoring of the credit mechanisms.

Once one or more of the credit mechanisms has proven successful, the PMU will seek to expand the scale of operation of the project to include geographical areas that appear to present additional market opportunities.

### i. Selection of Initial Target Areas

The target sites for the use of the UNDP PV Credit Fund (or for the Cooperative Bank participation) have not yet been selected. At the outset of the Project, the PMU will carry out a PV market survey in regions of the country which have not yet been electrified, are considered priority development areas by the GOU, and are considered promising markets by the private sector PV companies presently operating in Uganda. Consumer interest in solar microlights, solar lanterns, household and community-based PV systems will be evaluated. Once the survey results have been reviewed, representatives from the participating PV companies, the MNR, and the PMU will agree on the 4 trading centers selected as the pilot sites.

In selecting the initial 4 pilot sites, the following criteria will be considered:

- the level of need for electricity services that can economically be satisfied through the use of stand-alone PV systems in areas which will not be served by grid-based electricity in the forseeable future. This could include the use of households systems and solar lanterns by individuals, battery charging stations, and/or the use by community groups of PV-systems for health clinics, water pumps, schools, community centers and street lights.

- a consensus among the private sector institutions participating in the UPPPRE that approximately 60 customers/site will be interested/able to make a 30-40% down payment toward the installed price of a PV system as well as regular payments on the balance.

- Government development plans and priorities.

- a fair and representative geographic distribution of project benefits.

- the presence of local authorities (including National Assembly members) who are supportive of the program and willing to participate in public mobilization and education efforts.

- the presence of at least one community-based organization or NGO that has been working at the grassroots level and is interested and able to organize potential end-users into customer groups for purposes of education, loan procurement, equipment purchase, and maintenance.

- the potential for the establishment of micro-scale productive uses of electricity in the near term that could use PV power.

- the accessibility of the area year round by road or air to allow monitoring.

- the existence of lodging facilities for visitors.

- the availability of suitable sites for PV system installation (absence of tree-shading, available land, etc.).

### j. Addressing the Needs of Low Income People

The low income segment of the rural population in Uganda uses kerosene, candles and flashlights for lighting and may own a small radio which operates on dry cells. It is unlikely that this segment of Uganda's population will have access to electricity from either the grid or solar home systems in the foreseeable future. Solar lanterns, which sell for the equivalent of $150-in Uganda, may also be too expensive.

However, a small, PV-powered "microlamp" having a 100-200 lumen output could double or triple the current level of lighting used by this economic group. Such a microlamp is currently being field- tested under a World Bank (ESMAP) program in Kenya, is expected to cost between $25-$50 and have a three-year lifetime. It will make use of a 2-5 Wp solar charger and a rechargeable nicad battery. The availability of solar-charged nicads will also allow households to replace non-rechargeable dry-cell batteries in their already-existing radios and flashlights and provide a solution to an ongoing environmental problem.

When the Kenya microlamp field trials are completed and a viable prototype(s) is available, the PMU will integrate these systems into the Project and encourage local vendor/installers to market the microlamps on a commercial basis.

### k. Large-Scale Investment Potential

As part of the GEF evaluation process, the **World Bank** reviewed the UPPPRE Project Brief and indicated a preliminary willingness to provide loan capital on a long-term basis to Uganda for PV-based rural electrification once the Project has demonstrated the viability/sustainability of commercially-based PV lending for rural electrification.

The **U.S. Export-Import Bank** has its objective the provision of credit to facilitate U.S. exports to countries where it feels a secure banking climate and adequate infrastructure exist. Uganda is among the countries have been approved by the Ex-Im Bank and Ex-Im has tentatively agreed to provide low-interest financing to U.S. companies working in collaboration with Ugandan PV vendor/installers.

An initiative known as the **'The Solar Development Corporation'** is underway within the World Bank. The SDC will be wholesale loan window which will provide capital resources to local lending organizations, such as banks, credit unions and cooperatives in developing countries, which will apply the funds to long-term loans and leases for solar energy end-users. Preliminary discussions with World Bank representatives have resulted in an indication that Uganda could be a pilot country in Africa for the SDC following the completion of the Project.

Interest has been expressed by the German organization **GTZ**, the **European Union**, the Grants Management Unit of the **USAID-financed Action Program for the Environment (APE)**, and the **European Development Fund (EDF)** in providing additional grant-based funding for Project. If/when this funding/credit becomes available, additional, innovative financing schemes may be established in collaboration with other financial institutions.

### l. Promotion of Productive Uses of PV-based Electricity

Energy requirements for productive uses of electricity in rural areas usually follow a similar evolution to those of households as economic activity increases. Initially, artisan and micro-scale activities are carried out in people's homes and lighting usually has a high priority. Restaurant and bar owners are usually anxious to install TV's, cassette and video players, and fans to attract clients. Refrigerators enable the same owners to conserve food and cool drinks.

At the community level, water pumping may be considered an economically viable option for human and animal consumption or for agricultural production.

### m. Lessons Learned

Experience gained with the GEF project in Zimbabwe has shown that existing local entrepreneurs resent new entrepreneurs who establish businesses as a result of the project.

Through the active participation of the Uganda Renewable Energy Association in the design of the UPPPRE, UREA members have begun to understand the role they will be asked to play during project implementation as the body representing local private sector PV companies. This will include assessing new PV companies in Uganda and, if approved, integrating them as dues-paying members, into the Association. In this regard, the PMU will work closely with UREA to establish membership criteria and enable the Association to become a sustainable, self-sufficient entity prior to the completion of the project.

## 8. Coordination Arrangements

### a. Ministry of Natural Resources

The project will take place within the framework of the Ministry of Natural Resources (MNR), Dept. of Energy, which will provide overall policy guidance and monitoring. The Commissioner for Energy will be the National Project Manager and will be aided by a full-time Assistant Project Manager seconded from the MNR.

### b. Project Steering Committee (PSC)

In order to ensure that the Project makes appropriate progress toward the achievement of the project's goals, a Project Steering Committee (PSC) will be established. The PSC will be charged with overseeing and advising project execution and will have decision-making powers over all aspects of the project. All project reports will be prepared under the PSC's authority. The PSC will assist the Project Manager in formulating major project initiatives and will review and evaluate key project activities. The PSC will meet three times per year or however frequently required.

The PSC will be composed of representatives from the Ministry of Natural Resources, the Ministry of Finance, UNDP, the Uganda Renewable Energy Association, participating financial institutions and NGOs, the National Project Manager, and Chief Technical Advisor. The World Bank will also be requested to provide a representative. The PSC will be co-chaired by the Permanent Secretary of the Ministry of Natural Resources and the UNDP Resident Representative. The National Project Manager will act as the Secretary of the PSC.

The PSC will formally convene within three months of the initiation of the Project and will meet semi-annually (or more frequently, if required) during the course of the Project. On issues of urgent importance, the National Project Manager will act on behalf of the PSC after communicating with other members by fax or email.

The responsibilities of the PSC include:

- Ensuring good coordination of Project activities.
- Reviewing and approving annual workplans prepared by the Project Manager and PMU staff.
- Reviewing and approving annual reports prepared by the Project Manager and PMU staff.
- Deciding on adjustments to be made to the Project budget based on expenditures to date and current Project priorities.
- Participating in tripartite review meetings, midterm and final project evaluations.
- Periodically reviewing priority aspects of Project implementation and ensuring that activities are being funded and implemented according to plan.
- Ensuring that all recommendations and decisions of the PSC are reached through consensus and are accurately presented in the minutes of the meetings.

### c. Project Management Unit

Following the example of other projects which have been established by the Ministry of Natural Resources (i.e. The National Environmental Action Plan), and the UNDP/GEF (i.e. Zimbabwe Solar PV Project), a Project Management Unit (PMU) will be established. The PMU will exist for the duration of the Project and include the necessary technical and management expertise to ensure the carrying out planned project activities and the achievement of the project's goals.

The role of the PMU will consist of the following:

- Assisting with project document preparation, appraisal, establishing reviews and liaising with Government and other parties on program decisions.

- Participation in the establishment and organization of the Project Steering Committee (to monitor and review project progress).

- Initiation and carrying out of negotiations with project participants to establish operational structures including the credit arrangements with local and overseas financial institutions, the Uganda National Bureau of Standards, NGOs, Makerere University (for possible training activities), etc.

- Collection of renewable energy policy information from other African countries as well as elsewhere in the world as a means of beginning policy formulation in Uganda.

- Negotiations with government on policy issues pertaining to the project.

- Oversight, assistance and establishment of operational modes with key project participants to ensure operational success of the project.

- Identification and provision of information to private sector vendor/suppliers, financial institutions and NGOs concerning the experience of PV rural electrification projects elsewhere and the availability and cost of PV equipment from overseas and Africa-based suppliers.

- Preparation of scopes of work and qualifications required for short-term local and expatriate technical assistance.

- Management and monitoring of short-term local and expatriate technical assistants.

- In collaboration with local financial institutions, participation in financing decisions for PV procurement orders.

- Quarterly reporting and ongoing feedback to the MNR and UNDP/Kampala on the performance of various aspects of the project.

- Local procurement of equipment, supplies, vehicles and parts.
- Inventory, distribution, and reporting on equipment utilization and condition.
- Processing and payment of local staff salaries and benefits.
- Processing and payment of DSA and tickets for local and international travel.
- Processing and payment of DSA and other costs for incountry workshops.
- Establishment and ensuring replenishment of a project bank account and petty cash system.
- Clearance, registration and insurance of project vehicles.
- Recruitment, classification of posts, preparation of scopes of work and evaluation of for local project personnel, short term consultants and local subcontracts.
- Preparation of monthly financial reports.
- Organization and coordination of annual tripartite project reviews.

The PMU will function within the policy framework established by the MNR but be a separate, autonomous unit. The link between the MNR and the PMU will be provided by the National Project Manager.

The PMU will be composed of a number of host country professionals who will be responsible for the day-to-day operation and management of the project. See Annex V for the position descriptions.

A full-time expatriate Chief Technical Advisor (CTA) will be recruited by OPS/N.Y. for the first year of the project and will work as a member of the PMU. Thereafter, the CTA will work with the project on a consulting basis.

## 9. Counterpart Support Capacity

The counterpart support capacity that is required for the successful implementation of the project will come from within (1) the public sector, (2) the private, commercial vendor/installers, and (3) the financial/banking sector.

In order to strengthen the local capacity to design, manage and evaluate long-term commercialization projects, the Ministry of Natural Resources will provide the following long-term staff to the PMU:

- National Project Manager
- Assistant Project Manager/Solar Technology Specialist
- Awareness/Training Specialist
- Financial/administration Manager

The above staff will have capabilities in the areas of project design, management, monitoring, systems engineering, training, public education, and finance/administration as they apply to photovoltaic commercialization. These skills will be recruited either from the local market or from within the Ministry of Natural Resources. In the case of the latter, it has been agreed that selected MNR personnel will be seconded to the Project on a fulltime basis and will continue to be paid by the Government of Uganda. Their salaries and other benefits will be counted at host country contributions to the Project.

In the event the MNR is not able to identify suitable candidates from within the Ministry to staff the PMU, the project will recruit and hire national personnel from the local market using project resources.

The private, commercial vendor/installers and participating financial institutions are described above.

The necessary manpower in other areas (training, public awareness, standards enforcement, etc.) exists either within the local private sector, community-based organizations, NGO's or other government ministries.

## C. DEVELOPMENT OBJECTIVE

The development objective is to provide basic electrical services to those rural areas of the country which are not projected to have access to grid-based electricity in the foreseeable future through the use of affordable, environmentally benign solar PV technology which will reduce greenhouse gas emissions significantly. The project will serve as a demonstration of an innovative, sustainable alternative to grid-based electrification which will have applications elsewhere in Africa and in other developing countries.

## D. PROJECT GOAL, IMMEDIATE OBJECTIVES, OUTPUTS AND ACTIVITIES

The goal of the project is to develop the market and establish the foundation for the sustainable use of PV technologies for rural electrification on a commercial basis for those rural areas that will not be accessed by the national electric grid in the foreseeable future. This will be accomplished by overcoming the financial, social, institutional and policy barriers that presently exist to the widespread dissemination of PV systems. It is expected that the Project will lead to a large-scale commercial ventures which promote PV-based rural electrification using development bank and/or private venture capital.

**Immediate Objective 1**

Identify areas in Uganda with strong market demand for PV household and community-based systems. Market test various types of PV systems and develop strategies to overcome the financial, social and institutional constraints to the commercial sale of these systems on a demand-driven, full cost-recovery basis.

**Output 1.1**

Market/equipment surveys will be carried out in 7 areas from among which the initial 4 pilot sites will be selected.

**Activities for Output 1.1**

a) Selection of 7 candidate areas where market/equipment surveys will be carried out in collaboration with participating financial institutions and private sector vendor/installers.
b) Preparation and testing of market survey instrument.
c) Negotiation, signature of contract and orientation of CBO/NGO which will carry out the market/constraint survey in each of the 7 areas.
d) Survey implementation.
e) Survey monitoring and evaluation.
f) Review and presentation of survey results to MNR, financial institutions, and private sector.
g) Selection of pilot areas by MNR, financial institutions, and private sector

**Immediate Objective 2**

Strengthen the capacity of the private sector to provide PV-based electrification services on a commercial, demand-driven basis and of the public sector to promote, monitor, and provide the policy framework for the expanded use of PV systems;

**Output 2.1**

Private sector companies both larger and better able to provide PV-based electrification services using a range of PV systems in rural areas of the country.

**Activities for Output 2.1**

a) Establishment of an indigenous training capacity for PV system installers, technicians from both rural and urban areas, engineers and science-based university graduates in both the technical and business management aspects of PV-based system commercialization.
b) Training for local vendor/installers in preparing business plans and improved management procedures in anticipation of an expanded level of commercial PV activity.
c) Provision of operational support to the Uganda Renewable Energy Association (UREA) including publication subscriptions, journals and other forms of information concerning

PV-based electrification programs elsewhere in the world, establishment of a code of ethics, newsletter publication and a study tour.

d) Assistance to UREA members in organizing and participating in expositions, trade fairs, and other public events in Uganda to introduce, demonstrate and explain PV technology, emphasize its positive environmental impact and identify opportunities for its commercialization.
e) Provision of technical assistance and information to Uganda's two battery manufacturers to facilitate local production of deep-cycle batteries and encourage environmentally-improved mechanisms for battery recycling and disposal. As market demand increases, provide information and technical assistance to local industry to encourage the production of other PV system components for sale in Uganda and other countries in the region.

**Output 2.2**

Strengthened public sector institutions and government policies in place to promote, guide, and monitor private sector-based PV rural electrification. As a result, the framework will have been created for a significant increase in the use of PV systems throughout the country using public and private sector resources.

**Activities for Output 2.2**

a) Preparation of a draft set of national policies which encourage the private sector to provide PV-based electrification services, overcome policy-related constraints and promote environmental conservation.
b) Establishment, in collaboration with the Uganda National Bureau of Standards (UNBS), of a set of equipment and installation standards, as well as testing and enforcement procedures which will ensure safe, durable PV system service.
c) Establishment of procedures for vendor/installer licensing and technician certification as a pre-requisite for access to vendor/installer and/or end-user credit made available under the project.
d) Establishment of a modest PV equipment testing facility which will enable UNBS to evaluate the quality of PV systems and components proposed by private vendor/installers for installation under the project and thereafter.
e) Assessment, in collaboration with the Meteorological Department of the MNR, of the need for additional solar energy measurement equipment and data to allow accurate PV system design throughout the country.
f) Establishment, in collaboration with the National Environmental Management Agency (NEMA) of a geographic information system (GIS) data base and procedures to monitor and record the rate of expansion of PV-based rural electrification services in rural areas of the country.
g) Provision of training and study tour opportunities for key representatives of the MNR, participating financial institutions and the private sector in project design, monitoring and preparation of large-scale investment plans.

**Immediate Objective 3**

Provide high quality, sustainable PV-based electricity to at least 2,000 households and 4 communities in areas which will not be served by the grid in the foreseeable future and which have the ability and willingness to pay the full, unsubsidized cost of the PV systems.

**Output 3.1**

Establishment of one or more financing mechanisms involving local financial institutions, NGOs and vendor/installers to significantly increase the scale of PV lending in selected areas of the country which will pave the way for a substantial portion of the population to gain access to PV household and community-based electrification services.

**Activities for Output 3.1**

a) Establishment of marketing plans by the private sector for the sale of PV-based electrification services in the selected pilot areas.
b) Design and testing of pilot, commercially-based credit schemes involving local financial institutions, commercial vendor/installers, cooperatives, and individuals.
c) Design and testing of innovative financing schemes involving NGOs as well as other community-based organizations if additional grant-based donor funding can be identified.
d) Provision of technical and management assistance to financial institution/NGO rural-based managers to monitor/fine-tune PV-based lending schemes in the selected pilot areas.

**Output 3.2**

2,000 household and community-based systems in 4 districts installed by private vendor/installers with (a) private sector-based maintenance programs/infrastructure in place to ensure ongoing maintenance, availability of spare parts and sale of additional systems and (b) end-users trained in the basic "do's and don'ts" of PV systems operation/care.

**Activities for Output 3.2**

a) Facilitation of access of local vendor/installers to performance information and prices from PV equipment suppliers in Asia, Europe and the U.S.
b) Testing/inspection by the Uganda National Bureau of Standards of PV systems, components proposed by local vendor/installers and installation procedures.
c) Provision of on-site technical assistance to local vendor/installers to test innovative loan collection and maintenance contract schemes once additional grant-based funding for NGO/CBO-based revolving loan schemes has been obtained.
d) Development of special financial and commercial mechanisms to enable lower income segments of the population to gain access to PV systems (i.e. solar lanterns and/or micro-lights).
e) Promotion of economically productive applications using PV systems which generate employment and/or revenue.

f) Assistance to the private sector in training of end-users in PV system "do's and don'ts" and preparation of illustrative material.

**Immediate Objective 4**

Enable the Government and people of Uganda to understand and participate in global efforts to combat the build up of $CO_2$ in the atmosphere and curb greenhouse gas emissions resulting from the use of kerosene and diesel generators through the increased use of PV systems.

**Output 4.1**

An increased national public awareness of environmental issues and the impact that increased use of renewable energy (particularly PV) technologies can have as part of global efforts to combat the build up of $CO_2$ in the atmosphere and contribute to the curbing of greenhouse gas emissions from the use of kerosene and diesel generators.

**Activities for Output 4.1**

a) Establishment of a broad-based, ongoing public awareness campaign to educate both potential end-users and decision-makers about environmental issues and the uses, benefits, limitations and costs associated with PV systems and how/where to purchase one and have it installed. Develop and coordinate the distribution of PV/environmental materials through the media, community-based organizations, local councils, NGOs, the Ministry of Information, Post and Telecommunication services, etc.
b) Produce/present a video tape on the use of PV systems for rural electrification in order to assist rural Ugandans in understanding environmental issues and the potential impact of PV technology on their lives.
c) Hold three major workshops (at the beginning, middle and end of the project), including all participating agencies, to review and analyze the work carried out under the project and collect 'lessons learned' information for a draft final report.

**Immediate Objective 5**

Prepare a sustainable national program to provide private sector-based PV electrification services to a significant segment of the population that will not be served by the national electric grid in the foreseeable future.

**Output 5.1**

Establishment of an investment plan, including identification of the institutional, human and financial resources, to carry out a commercially-based, nation-wide PV rural electrification program using one or more proven implementation strategies.

**Activities for Output 5.1**

a) Continuation of coordination/communication with the Uganda Electricity Board regarding its planned grid-based rural electrification activities.
b) Continuation/expansion of information exchange with bilateral development agencies, NGOs, multilateral development banks, and private sources of investment capital, both in Uganda and overseas, during project implementation.
c) Preparation of business plans and/or proposals to attract additional capital during Project implementation and/or for follow on programs.

## E. INPUTS

### 1. Government of Uganda

| **Personnel** | **P/M** | **Shillings**[2] |
|---|---|---|
| National Project Manager (2/3 time) | 24 | 19,200,000 |
| 1 Assistant Project Manager / Solar Tech Specialist | 36 | 14,400,000 |
| 1 Awareness/Training Specialist | 36 | 14,400,400 |
| 1 Financial/Admin Manager | 36 | 14,400,400 |
| Monitoring/evaluation support | 12 | 4,800,000 |
| Policy formulation/implementation support | 6 | 2,400,000 |
| **Operating Expenses** | | |
| Office rent | | 72,000,000 |
| Office guard service | | 15,000,000 |
| Office water and electricity | | 7,400,000 |
| In-service training | | 33,200,000 |
| Sitting allowances for PSC members | | 3,000,000 |
| **Project Total** | **150** | **200,200,000** |

### 2. UNDP/GEF

| **Personnel** | **P/M** | **US $** |
|---|---|---|
| Chief Technical Advisor | 24 | 260,000 |
| Local Admin. Support | 132 | 55,800 |
| **Operating Costs** | | |
| Short term consultants (national) | 52 | 143,850 |
| Short term consultants (expat) | 5 | 75,000 |
| Incountry travel | | 70,000 |
| UNDP/GEF/RBA/evaluation missions | | 45,000 |
| Premises/communications | | 31,500 |
| **Subcontracts** | | |
| Publicity | | 39,000 |
| Surveys/testing | | 80,000 |
| **Training** | | |
| Study tours | | 85,000 |
| In-service training | | 180,000 |

[2]1,000 USh = 1.00 U.S.

| | | |
|---|---|---|
| PV training equipment | | 120,000 |
| **Equipment** | | |
| Office supplies | | 50,000 |
| Office equipment/furniture | | 116,000 |
| Vehicles (3) | | 90,000 |
| **Miscellaneous** | | |
| Vehicle/equipment maintenance | | 40,000 |
| Report preparation/final conference | | 9,000 |
| Insurance | | 9,000 |
| Publications/subscriptions | | 8,044 |
| Sundry | | 97,855 |
| Total | **213** | 1,605,049 |
| Project Support Services | | 31,471 |
| UNOPS Support Service | | 44,480 |
| **Total Main Budget:** | | **1,681,000** |
| **Total Previous Years (Prep. Assist.)** | | **75,000** |
| **UNDP/TRAC PV Credit Fund** | | 1,000,000 |
| **Total UNDP/GEF and TRAC PV Credit Fund Budgets** (See Annex vii for the incremental costs analysis) | | 2,756,000 |

## F. RISKS

The major risk issues to be addressed during the project life-time include (a) the strength of the purchasing power of people in the rural areas of the country , and (b) the establishment of viable loan administration and repayment mechanisms using commercial/financial institutions.

In view of the fact that the participating banks are insisting on relatively short loan repayment periods (12-18 months), the monthly payments for 40-50 Wp PV systems will be relatively high ($25-$40). This may limit the number of people who will initially have access to SHSs. However, it is expected that competition between Uganda's banking institutions (leading to lower interest rates), and between local PV vendor/suppliers (lowering system prices), as well as economies of scale, and increasing local production of BOS components will promote lower overall costs and, as a result, wider affordability.

If, as indicated above, additional grant-based funding is made available by the German organization GTZ, the European Union, the Grants Management Unit of the USAID-financed Action Program for the Environment (APE), or the European Development Fund (EDF),

additional, innovative financing schemes will be established in collaboration with local business-oriented NGOs such as FINCA, PRIDE/Africa and Centenary Rural Bank.

The second risk in the project involves the integration of PV-based lending into the ongoing operations of local financial institutions in Uganda. This integration is necessary in order to make the technology truly sustainable in the Ugandan context. However, the concept of private financial institution lending for rural electrification is new and the participating financial institutions will require time and experience in order to adopt it as part of their ongoing loan operations.

A related aspect is the provision of credit by the participating financial institutions to groups of individuals which have (or have not yet) established, positive credit records. The financial institutions will also be called upon to evaluate the creditworthiness of participating vendor-installers to enable them to market systems in areas where pre-existing groups with positive credit ratings may not be present.

## G. PRIOR OBLIGATIONS AND PREREQUISITES

Prior obligations: None

Prerequisites: The Government and UNDP/GEF will agree on the role(s) of each partner for the execution of the project. These will be defined in a separate document between the two parties.

## H. PROJECT REVIEWS, REPORTING AND EVALUATION

The project will be subject to tripartite review (joint review by representatives of the Government, executing agency and UNDP) at least once every 12 months, the first such meeting to be held within 12 months of the start of full implementation. The national project manager and/or senior project officer of the executing agency shall prepare and submit to each tripartite review meeting a Project Performance Evaluation Report (PER). Additional PPERs may be requested, if necessary, during the project.

A project terminal report will be prepared for consideration at the terminal tripartite review meeting. It shall be prepared in draft sufficiently in advance to allow review and technical clearance by the executing agency at least four months prior to the terminal tripartite review.

The project shall be subject to evaluation four months after the start of full implementation. The organization, terms of reference and timing will be decided after consultation between the parties to the project document. There will be evaluation missions at the middle and at the end of the project.

## I. LEGAL CONTEXT

This project document shall be the instrument referred to as such in Article 1 of the Standard Basic Assistance Agreement (SBAA) between the Government of Uganda and the United Nations Development Programme, signed by the parties on 29 April 1977. The host country implementing

agency shall, for the purpose of the Standard Basic Assistance Agreement, refer to the Government cooperating agency described in that agreement.

The following types of revisions may be made to this project document with the signature of the UNDP Resident Representative only, provided he or she is assured that the other signatories of the project document have no objections to the proposed changes:

a) Revisions in, or addition of, any of the annexes of the project document;

b) Revisions which do not involve significant changes in the immediate objectives, outputs or activities of a project, but are caused by the re-arrangement of inputs agreed to or by cost increases due to inflation; and

c) Mandatory annual revisions which rephrase the delivery of agreed project inputs or increased expert or other costs due to inflation or take into account agency expenditure flexibility.

d) The Government will provide the Resident Representative with certified periodic financial statements, and with an annual audit of the financial statements relating to the status of UNDP (including GEF) funds according to the procedures set out in Section 30503 of the UNDP Policies and Procedures Manual (PPM) and Section 10404 of the UNDP Finance Manual. The Audit will be conducted by the legally recognized auditor of the Government, or by a commercial auditor engaged by the Government.

## J. BUDGETS

**Annex I: Workplan Calendar**

# PRELIMINARY WORK PLAN

| OUTPUTS / ACTIVITIES | RESPONSIBLE PARTY | 3 | 6 | 9 | 12 | 15 | 18 | 21 | 24 | 27 | 30 | 33 | 36 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Staff appointments | MNR, UNDP | I | | | | | | | | | | | |
| Office setup | PMU | I I I | I I I | | | | | | | | | | |
| Workplan preparation / approval | PMU, PSC | I | | | | | | | | | | | |
| 1.1Pilot site candidate selection | PMU, LFI, LVI, UEB | I | | | | | | | | | | | |
| b. Prepare survey instrument | PMU, LFI, NGO | I | | | | | | | | | | | |
| c. Survey contract let | PMU, NGO | I | | | | | | | | | | | |
| d. Survey implemented | Contractor/ NGO | | I | | | | | | | | | | |
| e. Monitor survey implementation | PMU | | I | | | | | | | | | | |
| f. Review survey results | PMU, LFI, LVI, NGO | | E | | | | | | | | | | |
| g. Select pilot areas | PMU, LFI, LVI | | I | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.1 Training support | PMU, UREA, EC, EC | C | PIE | C | PIE | | PIE | | PIE | | PIE | | |
| b. Vendor/instal bus plans | PMU, LVI | P I | I I I | I I I | | | | | | | | | |
| c. UREA assistance | PMU, EC, | P | ST | I I I | I I I | I I I | I I I | I I I | I I I | | | | |
| d. Expo/fair planning | PMU, UREA | | | PIE | | | PIE | | | PIE | | | |
| e. Battery / component TA | PMU, EC | C | C | C | C | C | C | | | | | | |
| 2.2. Establish nat'l policies | PMU, MNR, EC | | C | IIII | E | C | | | | | | | |
| b. Equipment standards | PMU, UNBS, C | | | C | | | | | C | | | | |
| c. Licensing procedures | PMU, UNBS | P | I E | | | | | | | | | | |
| d. System test facility | PMU, EC, UNBS | | | | PIE | | | | | | | | |
| e. Meteorology assessment | PMU, MNR, EC | | | | P | | | | | | | | |
| f. GIS data base | PMU, MNR, NEMA | | P I | | | | | E | | | | | |
| g. Study tours | PMU, EC | P | IE | | | | | | | | | | |
| 3.1 Market plans | PMU, LFI, LVI | | PI | | E | | | | | | | | |
| b. Financing schemes | PMU, LFI | PI | | E | PI | | E | PI | | E | PI | | E |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| c. Add'l financing schemes | PMU, NGO | | PI | | | E | | | PI | | | E | |
| d. TA to financial institutions | PMU, LFI, NGO | P | I | E P | I | I | EP | I | I | EP | I | I | E |
| 3.2 Info to vendors | PMU, EC, UREA | I | I | I | I | I | I | I | I | I | I | I | I |
| b. System testing | PMU, EC, UNBS, C | | | | C | I | I | I | I | I | I | I | I |
| c. Field TA to LVI | PMU, NGO | | I | I | I | I | I | I | I | I | I | I | I |
| d. Low income mechanisms | PMU, EC, LVI | | | | | I | I | I | I | I | I | I | I |
| e. Productive uses applied research | PMU, LVI | P | I | E | | PIE | | PIE | | PIE | | PIE | |
| 4.1 Public aware campaign | PMU, UREA | CC | CII | CE | CII | CII | CII | CII | II | C | CII | I I I | E |
| b. PV video tape | PMU, UREA | | | | | P I | E | | | | | | |
| c. End project workshop | PMU | | | | | | | | | | | P | I E |
| 5.1 Coordination w/UEB | PMU | | I | | | | | | I | | | | I |
| b. Contacts w/capital sources | PMU | I | I | I | I | I | I | I | I | I | I | I | I |
| c. Business plan preparation | PMU | | | | | | | | | | PIE | | |

Key to abbreviations:

MNR = Ministry of Natural Resources
UNDP = United Nations Development Programme
PMU = Project Management Unit
NEMA = National Environmental Management Agency
PSC = Project Steering Committee
LFI = Local Financial Institutions
NGO = Non-Governmental Organization
LVI = Local Vendor/Installers
UREA = Uganda Renewable Energy Association
UNBS = Uganda National Bureau of Standards
EC = External Contractor
P = plan
I = implement
E = evaluate
C = consultant
ST = study tour

## Annex II: Schedule of Project Reviews, Reporting and Evaluation

Annex II is prepared by project management as an attachment to the project document at the outset of project operations.

## Annex III: Training Programs

Training will be an important aspect of strengthening local capacity under the Project. In-country human and technical resources will be used to plan, implement and evaluate training activities as much as possible.

Training initiatives will focus on the following aspects/approaches:

1. Technical and business management training

2. Short-term overseas training

3. Study tours

4. On-the-job training

### 1. Technical/Business Management Training

### A. Basic Technician Training

Basic technician training will target:

- Technicians with a certificate in any technical subject
- Technicians working with solar companies
- Technicians based in the rural areas of the target districts
- S6 or S4 leavers with good grades in physics or mathematics

Training will cover the following subject areas.

Introduction
- Basic electricity concepts
- Basic electrical wiring
- Home applications
- Comparison between PV power and grid power
- Justification for use of PV power

Solar Energy: The resource
- Solar radiation spectrum
- Regional and national distribution
- Seasonal and locational variations
- Use of meteorological records

Basic principles of the PV cell

PV Systems and Components
PV modules and arrays
PV system components and their operation

Overview of PV Use
Progress in PV technology over the last 20 years
World use of PV technology for different end-uses
Projected world demand for PV
Overview of past/present uses of photovoltaics in developing countries,

PV technology in Uganda
Background to PV use in Uganda
Major areas of PV application
The UNEPI PV refrigeration project, experiences and constraints
The HABITAT PV project, experiences and constraints
Experiences of any other PV projects in Uganda
Projected demand for PV in Uganda

Basic System Sizing
Daily energy requirements
Daily insolation
Peak power rating
Battery capacity
Daily energy consumption
System sizing tools (computerized and manual)

Batteries
Summary of battery characteristics
Selecting a battery (Ni-Cad, lead acid: solar vs car batteries)
Performance characteristics
Storage capacity
Charging, discharging, state of charge
Calculating capacity

Charge regulators
Role of charge regulators in load management
System connections
Power management
Choosing a charge regulator

Lamps and appliances
Lighting principles
Selecting type and size of lamps (florescent, incandescent, halogen, CFL's)

Appliances

Other components of PV systems
- Selecting wiring, switches, sockets and fuses.
- Making connections
- Earthling the system
- Voltage drop

Installing a Solar Electric System
- Tools and materials
- Safety
- Laying cables
- Mounting solar modules
- Battery and controller installation
- Testing and final connection
- Installation tips

User training
- Routine maintenance
- Trouble shooting
- When to call a technician

Maintenance and servicing PV systems
- Useful tools and materials for maintenance technicians tool box
- Maintenance procedure
- Checking the system to identify faults
- Trouble shooting guide

Marketing
- What does the customer want
- Ability to meet customers needs
- Causes of customer dissatisfaction
- Promoting PV technology

The courses will be conducted at Makerere University, Kyambogo Polytechnic or Global Energy Consult. Training materials will include papers prepared by resource persons, training kits, videos, slide shows, etc. Courses will last 3 weeks and be given three times per year. Each course will include 20 participants so that at the end of UPPPRE 180 technicians will have been trained.

## B: Advanced Technical/Business Management Course

Advanced training will target:

- Technicians with a higher diploma in a technical subject
- Managers and technicians working with solar companies
- Superior students from the basic technician course
- University graduates in a science field

Training will cover the following subject areas:

Overview of PV Use
- Progress in PV technology over the last 20 years
- World use of PV technology for different end-use
- Projected world demand for PV
- Overview of past/present uses of photovoltaics in developing countries,
- Comparison between PV power and grid power
- Justification for use of PV power

PV technology in Uganda
- Background to PV use in Uganda
- Major areas of PV application
- The UNEPI PV refrigeration project, experiences and constraints
- The HABITAT PV project, experiences and constraints
- Experiences of any other PV projects in Uganda
- Projected demand for PV in Uganda.

Solar Energy: The resource
- Solar radiation spectrum
- Global distribution
- Regional and national distribution
- Seasonal and geographic variations
- Resource estimation
- Use of meteorological records
- Effect of tilt angle
- Tracking and tilting solar panels

PV System sizing
- Large systems (AC and DC systems with high wattage appliances)
- PV water pumping systems
- PV refrigeration systems
- System sizing tools (computerized and manual)
- Hybrid systems
- Back-up systems

Commercial Applications
- Battery charging stations
- Repair of faulty components
- Batteries
- Charge regulators
- Inverters

System installation
- Tools and materials
- Safety
- Laying cables
- Mounting solar modules
- Lightening protection
- Battery, inverters and controller installation
- Testing and final connection
- Installation tips

System maintenance
- Useful tools and materials for maintenance technicians tool box
- Maintenance procedure
- Checking the system to identify faults
- Trouble shooting guide
- Setting up a maintenance or service point in rural areas and provision of PV spare parts.

**Marketing PV systems**

Business management techniques
- Qualities of a successful entrepreneur
- Identification of business opportunities
- Planning a business and preparing a marketing plan
- Recognition and use of business information
- Registering, licensing and other legal aspects of a business
- Financing the startup/expansion of a business - definitions and significance of capital costs, interest rates, inflation rates, principal, payback periods, etc.
- Procurement of material and products from abroad
- Maintaining (and costs associated with) an inventory
- Costing and pricing a product or service
- Maintaining business records
- Manpower management
- Customer relations
- Planning/management of credit schemes

Economic analyses

Life cycle cost
Cost benefit analysis
Comparison between PV and other options for provision of power

PV Codes of Practice

The courses will be conducted at Makerere University, Kyambogo Polytechnic or Global Energy Consult. Training materials will include papers prepared by resource persons, training kits, videos, slide shows, etc. Courses will last 3 weeks and be given three times per year. Each course will include 20 participants so that at the end of UPPPRE 180 technicians will have been trained.

**2. Short-term overseas training**

Training opportunities will be provided for key project personnel from the Ministry of Natural Resources in the promotion, design, implementation and evaluation of long-term renewable energy projects as well as the establishment of policies conducive to its development.

**3. Study Tours**

Study tours for selected public and private sector (including financial institution) personnel will be arranged to countries with private sector-oriented PV programs. Candidate countries could include Kenya, Botswana, South Africa, Zimbabwe, Bolivia and the Dominican Republic.

**4. On-the-Job Training**

On the job training will be provided to participating MNR, financial institution, NGO and UNBS personnel as part of project implementation activities. This will include association with short-term local and expatriate consultants as well as the experience gained through collaboration with the private sector vendor/installers, banking/financial institutions, NGOs and other donor agencies.

## Annex IV: Equipment Requirements

Most of the photovoltaic equipment purchased/installed under the project will be bought by local vendor/installers using end-user downpayments and commercial/NGO credit provided by non-UNDP/GEF sources.

The photovoltaic equipment purchased under the project using UNDP/GEF funds will be for public education/demonstration purchases and will not exceed a total value of $50,000.

Non-expendible equipment to be purchased using project funds are summarized as follows:

| Quantity | Item | Approx. Cost |
|---|---|---|
| 1 | PV mobile demonstration unit | $10,000 |
| 1 set | PV test equipment | $20,000 |
| 1 | 4 WD Vehicle | $40,000 |
| 1 | Towncar | $20,000 |
| 1 | Pickup truck | $30,000 |
| 5 | Desktop computers w/UPS | $20,000 |
| 1 | Laptop computer | $ 2,000 |
| 2 | Printers | $ 2,000 |
| 1 | Photocopier | $ 6,000 |
| 1 | Fax machine | $ 2,000 |
| 1 | Switchboard | $ 2,000 |
| 1 set | office furniture | $18,000 |

## Annex V: Job Descriptions

Five professional positions will be established which will have primary responsibility for the implementation of the Project. These include:

A. National Project Manager (NPM)
B. Assistant Project Manager / Solar Technology Specialist (APM/STS)
C. Public Education/Training Specialist (PETS)
D. Financial/Administration Manager (FAM)
E. Chief Technical Advisor (CTA)

It is planned that positions A-D will be recruited locally from within the Ministry of Natural Resources. MNR personnel selected to participate in the Project will be seconded to the project on a fulltime basis for its duration and their salaries will be paid by the Government of Uganda.

Job descriptions for each of the above positions and the information to be provided by short term consultants are as follows:

## A. NATIONAL PROJECT MANAGER (NPM)

### 1. General Description

Provision of overall management administration and supervision. Liaise with relevant Government, bilateral and multilateral donor/lending agencies,

### 2. Specific Duties

- Responsible to the MNR for overall program financial, administrative and technical activities.
- Coordination and liaison of Government, UNOPS, PSC, PMU and international agencies.
- Coordination and liaison of Government, donor, financial institution, NGO and industry activities.
- Responsible for project funds and equipment.
- Responsible for work plan management and field operations supervision.
- Coordinates all project activities.
- Prepare regular written reports to MNR on project implementation progress.
- Perform other project duties as requested by the MNR.

### 3. Qualifications

- university degree in a technical field.
- strong theoretical base in renewable energy technolgies.
- previous project management experience.
- ability to deal/negotiate with government ministries, private sector representatives, financial institutions and donor agencies.

## B. ASSISTANT PROJECT MANAGER / SOLAR TECHNOLOGY SPECIALIST (APM/STS)

### 1. General Description

Provision of administrative and technical support to the National Project Manager and PMU.

### 2. Specific Duties

- Reports to the NPM.
- Assist the NPM in administering project and supervising technical and field operations.
- Work collaboratively with the PMU staff members in planning and implementing technical activities, providing support to the Ugandan solar energy industry, participating financial institutions and end-users.
- Work collaboratively with the NPM and CTA in preparing monthly and quarterly technical reports for the MNR, UNOPS and PSC.
- Assist in the development of PV system standards and installation practices.
- Work collaboratively with PMU staff to coordinate expatriate technical assistance for the project.
- Participate in the evaluation and monitoring of systems installed in the field by local vendor/installers and in PV industry association deliberations.
- Prepare project and equipment lists/budgets as necessary.
- Perform other duties as requested by the NPM.

### 3. Qualifications

- university degree in a technical field..
- prior administrative experience.
- theoretical and/or practical experience with PV technologies.
- ability to relate well to industry representatives, local officials, financial institutions and end-users in the field.
- ability to prepare technical reports, scopes of work, evaluation documents and equipment specifications.
- willingness to spend extended periods of time working in the field with vendor installers, local officials, financial institution representatives and end-users.

## C. PUBLIC EDUCATION/TRAINING SPECIALIST (PETS)

### 1. General Description

Provision of outreach information and training support for the dissemination of PV systems in rural areas.

### 2. Specific Duties

- Reports to the National Project Manager.
- Mobilize environmental/PV public awareness, information collection/dissemination and training activities among the public, local leadership, end-users and private sector vendor/installers.
- Maintain contacts with local industry, rural leaders, financial institutions, NGOs and end-users as well as schools, health clinics, cooperatives and church groups regarding the design and implementation of public awareness and training programs.
- In collaboration with UREA, plan and monitor project-sponsored training programs.
- Coordinates environmental/PV publicity and public relations for project activities.
- Assist local industry in organizing/participating in rural fairs and/or agricultural shows.
- Coordinate planning for project-sponsored study tours.
- Assist local industry with the preparation of instruction manuals in local languages for end-users.
- In collaboration with the STS, help vendor/installers establish service centers in rural areas to stock spare parts, provide maintenance services and market additional systems.

### 3. Qualifications

- university degree in a media or training-related field.
- familiarity/interest in environmental/rural electrification/PV issues.
- previous experience in planning and implementing media and field-based public awareness programs in Uganda.
- ability to relate well to industry representatives, local officials, financial institutions and end-users in the field and translate their needs into practical training programs.
- ability to prepare technical reports, scopes of work, evaluation documents and equipment specifications.
- willingness to spend extended periods of time working in the field with vendor installers, local officials, financial institution representatives and end-users.

## D. FINANCIAL/ADMINISTRATION MANAGER (FAM)

### 1. General Description

Provision of professional administrative, accounting and financial support and reports to the National Project Manager

### 2. Specific Duties

- Provide administrative and accounting services to the project.
- Ensure financial monitoring and accounting for all aspects of the project.
- Prepare monthly and quarterly financial status reports and ensure availability of funds.
- Manage project petty cash fund.
- Monitor expendable materials required by the project and reorder when necessary.
- Ensure timely maintenance/repair of project vehicles.
- Provide personnel management support to the National Project Manager.
- Supervise the administrative staff of the project.
- Provide support to the business management training component of the project.
- Participate in the design, implementation and evaluation of the financing mechanisms carried out under the project.

### 3. Qualifications

- university degree in economics, finance or accounting.
- familiarity/interest in environmental/rural electrification/PV issues.
- previous experience in the financial management of development projects and/or small-scale businesses.
- previous experience with the preparation of business plans for small companies - highly desirable.
- previous experience with the design of business management training programs - highly desirable.
- willingness to spend extended periods of time working in the field with vendor installers, local officials, financial institution representatives and end-users to develop, monitor and refine financial management and credit systems.

## E. CHIEF TECHNICAL ADVISOR (CTA)

### 1. General Description

Provision of expert professional support to the NPM, PMU staff and PSC in areas related to project design, implementation, management, reporting and follow on planning.

### 2. Specific Duties

- Act as counterpart and provide management and technical support to the NPM for all project activities.
- Provide international perspective on PV-based rural electrification project design and implementation activities.
- Provide technical expertise in areas relating to PV components, standards, installation codes of practice, marketing, financing schemes, local assembly, and training.
- Provide technical assistance in the development of cost-effective PV systems for low income households.
- Assist with the design and implementation of in-country and overseas training programs.
- Assist with the preparation of terms of reference and review of CV's for expatriate short-term consultants.
- Assist with arranging of study tours for host country Government, project and financial institution personnel.
- Assist with the establishment of a draft set of renewable energy policies.
- Advise the PMU and local industry on the availability and performance of PV equipment from suppliers in Africa, Europe, Japan, elsewhere in Asia and the US.
- Assist with the establishment of a small PV test facility in Uganda.
- Assist with the establishment of a local capability to manufacture deep cycle batteries as well as environmentally sound battery recycling/disposal techniques.
- Perform other tasks as requested by the NPM, UNDP or PSC.

### 3. Qualifications

- university degree in engineering, physics or other technical area.
- at least 8 years previous experience in Africa, at least 5 of which were in senior positions of responsibility for project management.
- demonstrated experience with the design and implementation of renewable energy projects.
- prior enterprise development and/or financial management experience highly desirable.
- demonstrated ability to work collaboratively as a member of a Government/industry team.
- demonstrated familiarity/ability to work in close collaboration with international PV companies, bilateral, and multilateral development and international technical assistance agencies.

## F. SECRETARY/ACCOUNTANT

### 1. General Description

Provision of secretarial and accounting support to the Financial/Admin Manager and other project staff.

### 2. Specific Duties

- Receive and distribution of correspondence for the project (faxes, e-mails and letters).
- Send outgoing mail (faxes, e-mails and letters).
- Receive and make phone calls on behalf of project staff.
- Receive visitors and direct them to appropriate PMU staff.
- Maintain project files and a document database.
- Maintain a small project library with publications and reference books.
- Do wordprocessing and preparing document packages.
- Photocopying.
- Provide accounting support as requested by the Financial/Admin Manager.
- Other tasks as requested by PMU staff.

### 3. Qualifications

- Certificate of completion of studies from an approved secretarial or accounting training program.
- Five years previous experience in areas relating to secretarial and basic accounting practices.

## G. PROJECT DRIVER

### 1. General Description

Driving project vehicles for work-related activities and initiation/verification of timely vehicle maintenance.

### 2. Specific Duties

- Drive project vehicles both in town and to sites in rural areas of the country.
- Deliver mail.
- Keep project vehicles clean, in good repair and with fuel.
- Ensure vehicle maintenance is carried out on a timely basis.
- Other tasks as requested by the NPM and project staff.

### 3. Qualifications

- Valid Uganda drivers license for at least 10 years.
- Satisfactory references from at least two previous employers.
- Ability to carry out basic vehicle repairs in rural areas.

## H. UREA MANAGER (part-time)

### 1. General Description

Provision of overall management administration to the recently established renewable energy trade association UREA (Uganda Renewable Energy Association).

### 2. Specific Duties

- Responsible to the membership of the Uganda Renewable Energy Association and to the NPM. financial, administrative and technical activities.
- Carry out coordination, liaison and lobbying efforts with Government, donor agencies, NGOs, and financial institutions on behalf of UREA members.
- Circulate renewable energy and environmental information among UREA members, interested ministries, donor agencies and NGOs. Coordination and liaison of Government, donor, financial institution, NGO and industry activities.
- Prepare a quarterly newsletter including renewable energy and environmental articles of interest to Ugandan private and public sector individuals and organizations.
- Develop contacts and information exchange agreements with organizations such as the International Solar Energy Society, the U.S. Solar Energy Industry Association, international NGOs and other organizations active in relevant renewable energy and environmental fields.
- Help develop a long range industry association workplan, board of directors, staffing structure and budget.
- Fundraise among members and donor agencies in order to make UREA self-sustaining as rapidly as possible.

### 3. Qualifications

- university degree in a technical or management field.
- familiarity with a range of renewable energy and environmental issues.
- previous institutional management experience.
- proven ability to deal/negotiate/lobby with government ministries, private sector representatives, financial institutions and donor agencies.

## I. UREA SECRETARY (part-time)

### 1. General Description

Provision of secretarial support to the UREA Manager and membership.

### 2. Specific Duties

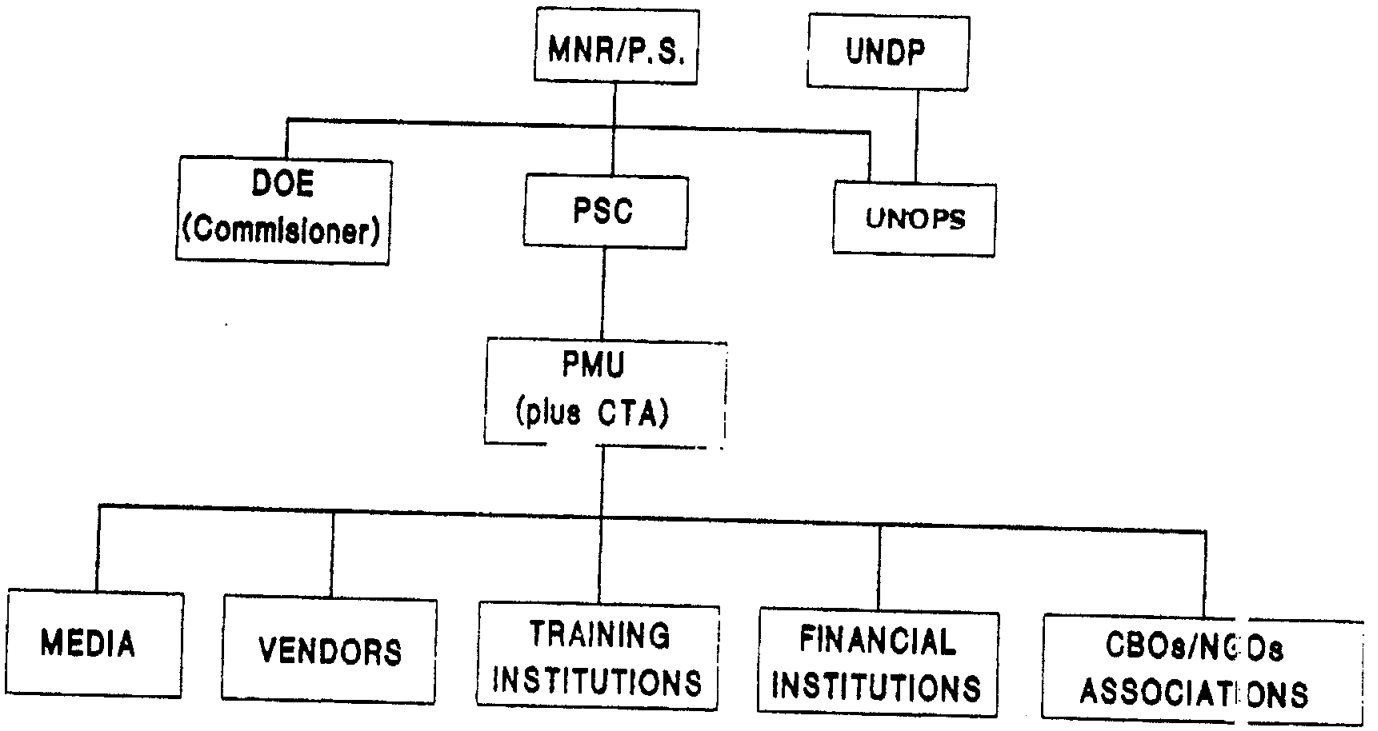
- Receive and distribute correspondence for the association.
- Send outgoing mail and correspondence.
- Receive and make phone calls on behalf of the UREA manager.
- Receive UREA visitors and directing them to appropriate members and/or the Manager.
- Maintain association files and establish/maintain a document database.
- Maintain a small library with publications from other renewable energy associations.
- Do wordprocessing and prepare document packages for the UREA manager and membership.
- Photocopying.
- Provide accounting support as requested by the UREA Manager.
- Other tasks as requested by UREA Manager.

### 3. Qualifications

- Certificate of completion of studies from an approved secretarial training program.
- 3 years previous experience in areas relating to secretarial practices.

## Annex VI: Organogram

# UPPPRE ORGANOGRAM




MNR – Ministry of Natural Resources
P.S. – Permanent Secretary
DOE – Department of Energy
PSC Project Steering Committee
UNOPS UN Office of Project Services
PMU – Project Management Unit
CTA – Chief Technical Advisor

## ANNEX VII : INCREMENTAL COST ANALYSIS

*Introduction*

This project is designed to expand the market for PV-based electrification in rural Uganda. It is targeted particularly on building capacity to overcome several transaction barriers. First is the lack of trained human power. As part of this project, a programme for training technicians to work in the private sector, the Bureau of Standards, and the educational institutions will be undertaken. Personnel from financial institutions will also be involved and trained in evaluating PV-based loans. The second is the lack of information. This project will work with communities and NGOs to disseminate information about the potential uses of PV's throughout Uganda. It will also provide a meaningful level of demonstration of the potential benefits of PV-based electrification. The third is the financing bottleneck. Potential PV users will be provided with financing to purchase the systems, and will have to pay back those loans. The co-financing element of this project is expected to serve as the endowment for the revolving fund. The GEF funds will be used for the start-up, programmatic costs which are largely unrecoverable.

*1. Broad Development Goals*

The broad development goal being pursued as part of this project is the meeting of local energy needs and the improvement of the quality of energy services available to rural Ugandans. This goal will be achieved through helping the Ugandan Government build capacity both within and outside the government to finance, implement and regulate rural "pre-electrification" through using Photovoltaic Home Systems and related PV-fueled electricity services for schools, clinics, hospitals and some businesses.

*2. Baseline*

On a national level, under the baseline, there will continue to be a very gradual and piecemeal dissemination of PV home systems throughout rural Uganda. At present, there are substantially fewer than 100 PV systems being installed per year throughout the country. As a result of these capacity limitations, most households in the targeted areas will have no access to electricity in the absence of this project. These households will continue to rely on kerosene for their lighting needs, batteries for radios and other lighting needs, and fuelwood for cooking.

On an individual household level, the average consumption of kerosene for lighting is approximately 4 litres per household per month. This amount of kerosene will fuel one sheltered wick lamp (hurricane type) for about 3 hours per night for one month. The

costs of meeting the individual baseline activities is approximately $3 per month per household for the average household. Costs of dry-cell batteries might run at an additional $1.50 per month. However, wealthier households utilize more kerosene to provide lighting. Their higher consumption reflects both the higher level of lighting needs satisfied and the relatively higher income and standard of living. Over a twenty-year period, a household using 4 litres of kerosene per month in 3 hurricane-type lamps would be expected to spend about $344 in current terms (at 15% discount rate). At a consumption level of 15 litres of kerosene per month and a 15% discount rate, the present value of rural lighting comes to $951 per household over twenty years.

*3. Global environmental objectives*

The global environmental objective being pursued though this project is the consolidation and expansion of the market for photovoltaics in Uganda. With a rural population of nearly 17 million or nearly 3 million households, there is a relatively significant potential market for photovoltaics which is not being met due to the limitations of information, institutional capacity and financing. This project seeks to raise the capacity of Uganda to manage and implement this type of project, and also to lay the foundation to substantially increased future investments in this area. Under the climate change operational programme, this project fits in under the long-term programme to open and expand the markets for renewable energy technologies.

*4. GEF alternatives*

Under the proposed project, there will be a major national programme to build capacity for carrying out rural-based PV projects. This project will seek to strengthen local capacity through providing training for assembling and installing solar home systems, building public institutions to finance and certify installations, provide support to private entrepreneurs providing for sales and servicing of solar home systems, and arrange a revolving-fund mechanism to defray the high up-front costs of these systems for consumers wishing to purchase them. Given the high costs of these systems, initially, only the wealthier households in rural areas will be able to afford them, even with the financial support from the revolving fund. As the costs of PV systems and components fall, a greater fraction of the rural population will be anticipated to participate in the programme. The establishment of a financing programme for this project will influence the ability of this project to expand beyond this pilot level to a more substantial level of financing with support under larger bilateral and loan-supported programmes. (The appropriate length of the payback period for such investments in some of the variables to be tested as part of this initial activity). In addition, a national plan for the expansion of the "pre-electrification" activities will be produced as part of a national rural electrification plan to be financed under future World Bank loans. This plan will look at all different forms of meeting rural power needs, not just the needs for PV-based systems.

From an individual household perspective, the present value of a solar home system with an initial cost of $750 (and recurrent costs for batteries which need replacement every 3 years) comes to about $882. However, this solar home system will result in a dramatically increased quality and quantity of lighting services to the household. The quality of lighting obtained from these systems is substantially better than can be obtained through kerosene given the lighting efficiency of kerosene lamps. The issue of "additional benefits" is addressed below.

*5 System boundary*

For the purpose of this analysis, the system boundary is designed as the Uganda rural sector. Although the project will initially focus on 4 districts, it is expected to lay the foundation for a larger national programme. Therefore, the entire Ugandan system is targeted.

*6. Additional domestic benefits*

In contrasting the baseline and the project situation in the above paragraphs, the estimates of costs are based upon likely actual expenditures in the baseline. However, under the project, households will obtain dramatically improved lighting benefits. Each solar home system is envisioned as providing sufficient power for three 11 W compact fluorescent bulbs, or their equivalent in lighting output terms. Each 11 W CFL is estimated to produce 250 lumens of light. According to Van Der plas ("Domestic Lighting", World Bank ESMAP, WPS 68, 1998), a kerosene wick lamp gives off between 40 and 50 lumens of light and has a consumption rate of between 34 and 39 grams/hour/ p.56). Thus, to obtain the quantity of light provided by one 11 W CFL, a household would have to utilize 5 wick lamps. If five wick lamps are utilized for 3 hours per night at a consumption rate of 35 g/hr, then the total monthly requirement for kerosene (specific gravity = 0.82) comes to 19.4 litres per month, approximately 5 times the average or typical consumption level. Since the solar home system provides three 11 W CFL's the required kerosene consumption to provide an equivalent level of lighting benefits would be about 60 litres per month. As virtually no households consume this quantity of kerosene, this points to the fact that obtaining an equivalent of domestic benefits requires an unrealistic estimated level of consumption. In the strictest sense, from an individual household perspective, solar home systems are much cheaper than utilizing massive quantities of kerosene. For an equal level of benefits, they represent a cheaper option than continuing to utilize kerosene. However, given the information obstacles, skill-levels, institutional weaknesses and financial limitations, the dissemination of solar home systems is liable to be a very slow undertaking without this project.

The break-even level at which households will find it cheaper (in net present value terms) to obtain lighting via solar home systems than through kerosene lamps is at approximately 14 litres of kerosene per month. Three lamps per household utilized for 4 hours per night come to an equivalent of 15 litres of kerosene consumed per month.

*7. Costs*

The costs of the country of achieving the baseline will be the costs of the continuing reliance upon kerosene and dry-cell battery lighting in the rural areas. On a per household basis at the average consumption level of 4 litres per month, this works out to about $344 per household over 20 years discounted at 15%. At the consumption level of 15 litres of kerosene per month, the present value of the lighting costs comes to $951 per household. At the consumption level providing an equivalent output as measured in lumens (60 litres/month), the baseline cost comes to $3334 over 20 years, discounted at 15%.

The cost to the country of this project is estimated to be $2.8 million, of which $1.8 is being requested from GEF as the information, training, and institutional capacity building elements. The remaining $1 million is being sought from other sources and will serve as the initial endowment for a revolving fund, which will provide front-end financing for up to 1,000 solar home systems. As these small loans are paid back, the financing agencies will be able to provide loans for additional systems, between 5,000 and 10,000 systems over 20 years, depending upon how quickly the cost of solar panel falls, the payback period settled upon, and the default level on the loans.

## 8 *Incremental cost matrix*

The incremental cost matrix is presented below:

| | Costs | National Benefits | Global Benefits |
|---|---|---|---|
| **Baseline** | **Per Household:**<br>**4 litres per month (average level): NPV over 20 years = $344**<br><br>**At 15 litres per month equal # lamps NPV over 20 years = $951**<br><br>**At 60 litres per month (equal lumen output level): NPV over 20 years = $3,334**<br><br>**Project level: no project costs** | **Rural households use kerosene lighting**<br><br>**Indoor air pollution from kerosene use** | **Per Household:**<br><br>**4 litres per month (average level): $CO_2$ emitted over 20 years = 2.5 tonnes/household**<br><br>**At 15 litres per month equal # lamps $CO_2$ emitted over 20 years = 9.36 tonnes/hh**<br><br>**At 60 litres per month (equal lumen output level): $CO_2$ emitted over 20 years = 37.44 tonnes/hh** |
| **Project case** | **Per Household**<br>**NPV of lighting using solar home systems = $882 over 20 years**<br><br>**Project level:**<br>**$1.8 million programme costs plus $1 million revolving fund endowment** | **Household involved in programme will obtain better quality lighting**<br><br>**Programme to build capacity to design, produce, disseminate and finance solar PV systems as part of national rural energy provision programme** | **Zero emissions from lighting in rural households** |
| **Increment** | **Per Household**<br><br>**4 litres per month (average level)= $538**<br><br>**At 15 litres per month (equal number of lamps) = $951-852 ($99)***<br><br>**At 60 litres per month (equal lumen level)= ($2,452)***<br><br>**Project level: no project costs** | **Increased use of solar home systems**<br><br>**Reduced indoor air pollution from kerosene** | **Reduce $CO_2$ emissions from kerosene use in rural households Reductions of 2.5, 8.7 or 37.4 tonnes per household over 20 years, depending upon assumptions**<br><br>**Expanded market for solar PVs and solar home systems** |
| | | | |

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