

PROPOSAL FOR REVIEW

Project Title: Uganda: Photovoltaic (PV) Pilot Project for Rural Electrification

GEF Focal Area: Climate Change

Country Eligibility: Convention Ratified 8 September, 1993

Total Project Costs: US \$ 2.8 million

GEF Financing: US \$ 1,756 million

Country Contribution: US \$ 200,000

Cofinancing/Parallel Financing: US \$ 1 million (UNDP IPF)

GEF Implementing Agency: UNDP

Executing Agency: Ministry of Natural Resources

Estimated Approval Date: January 1996

Project Duration: 3 years

GEF Preparation Costs: US \$ 45,000 (Government of Uganda: US \$ 15,000; UNDP: US \$ 30,000)

UGANDA: PHOTOVOLTAICS (PV) PILOT PROJECT FOR RURAL ELECTRIFICATION

COUNTRY AND SECTOR BACKGROUND CONTEXT

1. The Government of Uganda is committed to addressing the energy needs of the majority of its citizens who live in the rural areas. Approximately 90% of the population lives in rural areas and depends on traditional fuels (woodfuel and crop residues) for cooking and water heating and kerosene for lighting. In the past, Government emphasis has been on the development of the electric power sector, which serves less than 5% of the total population (2% in the rural areas) and the supply of petroleum products. The supply of these modern conventional sources of energy entails substantial capital investment and foreign exchange requirements, which contribute to the nation's high debt burden. Yet, the direct beneficiaries of this heavy investment are mainly the urban dwellers who use electricity and own vehicles, and constitute a small proportion of the population. Therefore, the Government has realised that some change in emphasis in energy planning, to reflect more of the rural energy needs than before, is the only way that the majority of the citizens can move towards attaining energy security and social welfare. This project represents one important element of a larger programme to meet rural energy needs. Other elements of that programme include conventional rural electrification, the dissemination of fuel-efficient stoves, collection of wind-energy data, and improved woodfuel management.

2. Although the Government's macro-economic policies emphasize rural electrification as a means of improving the quality of life of the rural population and promoting rural economic development, it has become apparent that the fulfillment of this goal cannot be achieved through the extension of the national electric grid due to the people's inability to afford either the connection fee or the energy consumption charges. It is unlikely that the populations living even a few kilometers from the grid will be connected to the grid in the near future, even where the Uganda Electricity Board (UEB) identifies a particular economic activity warranting grid extension.

3. Recognizing the problem of grid extension into rural areas, the Government of Uganda is now focussing on the promotion of solar PV systems for rural electrification or pre-electrification. In 1992/93, The Governments removed duties and sales tax on solar energy equipment. Despite this measure, solar PV system up-front costs have continued to be too high for the rural people. In response to this situation, the Government requested UNDP/GEF assistance in establishing a pilot project to promote the potential use of solar PV systems for rural electrification on a sustainable basis.

4. The Government intends to use this pilot project to establish the necessary conditions for expansion of pre-electrification of remote areas using PV's in solar home systems. This will include developing training packages to increase the number of personnel qualified to install, maintain, and finance these systems. It will involve developing public information to inform the public about how to avail themselves of the benefits of these systems. It will involve working with Uganda Bureau of Standards to develop standards for the systems being installed, and using

skilled technicians to certify that the installations made by private entrepreneurs conform to those standards. This project will also utilise co-financing to develop a small revolving fund on a pilot basis, to help households and businesses defray the high up-front costs of the systems.

5. A consultant mission was fielded in March 1995 to prepare the project. This consultancy was supported by the Ugandan Ministry of Natural Resources and the Office of the President for in-country costs and international travel costs. UNDP/GEF paid the consultant's fees.

6. The major needs for electricity in the rural households in Uganda are: lighting, radio and, to a lesser extent, refrigeration. For community purposes, priority uses include lighting for community centres and institutions, vaccine refrigeration in health centres, and water pumping. These end-use needs can all be met using solar electricity. (Cooking, the most important end-use for households, will still be met through biomass resources.) The technical viability and cost-effectiveness on a life-cycle basis of these applications have been demonstrated in other developing countries, including Kenya, Indonesia, the Pacific Islands, the Philippines, the SADCC countries (Southern Africa), and the Dominican Republic. It should also be noted that Uganda's geographical position ensures sunshine throughout the year, therefore enhancing the potential for PV applications (average insolation is in the country about 5 KWh/m²/day).

7. The use of photovoltaics (PV) systems began in Uganda in the early 1980's for communication purposes, and their use has spread to lighting and refrigeration in donor-financed projects. But their dissemination has been very slow, due to a number of transactions barriers. It is estimated that there are only about 600 PV installations in Uganda today. Six companies handle PV systems on a part-time basis, but none of them can generate a significant volume of business to expand due to the suppressed nature of the market. The suppression of the market arises from a number of factors. First, the Government's pronouncements of support to the development of renewable energy technologies have not been followed with meaningful demonstrations. Second, the high up-front cost of PV technology and the absence of credit for end-users and local suppliers who have minimal resources for purchasing and marketing solar equipment have been barriers to market expansion. Third, there is an insufficient number of adequately trained manpower in both the public and private sectors to correctly size, install and maintain PV systems. This shortcoming has resulted in customer wariness with respect to the technology. Fourth, the lack of familiarity with the uses of this important renewable energy technology has hindered applications for installations.

8. There are no hard statistics on the number of householders that are willing and able to pay for PV systems. Assuming that PV systems will be used only for "pre-electrification" of domestic consumers in new areas, an estimate of 3,800 new PV-system customers/year has been targeted as part of the government's rural electrification programme. This estimate corresponds to the wealthiest section of the rural (or peri-urban) population: i.e., those householders with the greatest willingness and ability to pay. Connecting these householders can only be met if this programme is effective in eradicating the transactions barriers inhibiting widespread dissemination of PV's. If each household is assumed to use a 50Wp solar panel, the annual market in Uganda will be in the order of 190KWp (approximately 30 times the present market), which would constitute a reasonable size medium-scale market.

9. Interviews with some rural residents, banking institutions, NGO's, government officials indicate that there is a substantial unmet demand for electric power in rural areas which could be provided by household and community-based PV systems. These systems would be affordable to a substantial portion of the population (estimates ranged up to 40% depending on the region) if the cost of the systems was approximately \$750; and credit made available to permit a 20% down payment (\$150) the remainder of the loan payable over time. The banking institutions suggested repayment periods for the balances of between 9 months to 2 years while cooperatives and NGO's prefer periods of up to 5 years. The length of the payback period is one of the factors to be clarified and tested through this Pilot Phase, in anticipation of a scaling-up of this activity with expanded future financing.

10. There are presently other conditions in Uganda that favour the increased use of solar PV and other renewable energy systems. First, Government has removed subsidies on conventional sources of energy, thus levelling the ground for competition from renewables. Second, the recently concluded National Environment Action Plan (NEAP) has strongly recommended the increased use of renewable energy as one of the means of conserving the environment. Third, being a signatory to the Framework Convention on Climate Change (FCCC), Uganda has shown its seriousness in subscribing to international efforts in curbing global warming by carrying out an inventory of greenhouse gases and sinks in the country. The solar PV strategy to reduce the use of kerosene and diesel engines in rural areas would be a continuing process in addressing this environmental issue. Fourth, the banking sector has stabilized, interest rates have decreased, and inflation is low. At least four banking institutions (Uganda Commercial Bank, the Cooperative Bank Ltd., Centenary Rural Development Bank Ltd., and the Uganda Women's Finance and Credit Trust) expressed strong interest to participate in PV system financing. Fifth, the services provided by the UEB in a number of areas have been very poor, and people are looking for alternative or supplementary sources of electricity.

11. The Government of Uganda is committed to the policy of fostering market-driven, private sector-oriented economic development. In this regard, therefore, the supply of the PV systems will be the role of the private sector. A favourable investment code is also in place which encourages local manufacture of PV system components.

12. The envisaged pilot project is meant, therefore, to address these barriers, nurture the existing favourable conditions, and assist the Government to create a favourable environment for market expansion and for the private sector to sustain the use of solar PV technology. The superiority of PV lighting to kerosene wick candles and lanterns in terms of luminescence, the elimination of toxic emissions, and the ability to utilise radios, televisions and eventually refrigerators will greatly improve the quality of life of the rural population, while opening and expanding a new market for these important renewable energy technologies.

PROJECT OBJECTIVES

13. The long-term objective of the pilot project is to lay a firm foundation for the sustainable dissemination and use of solar PV systems in those rural areas that cannot be accessed by the national electric grid. At the same time, this will contribute to the curbing of greenhouse gas emissions from the use of kerosene and diesel generators.

The specific objectives are to:

- evaluate the potential for increased use of solar PV technology to provide electricity in rural areas of the country through the expanded involvement of the private sector in providing energy services;

determine the necessary policy, technical, financial, social, and institutional requirements to expand the market for PV systems on a demand-driven, full cost-recovery basis;

strengthen the capacity of the private sector to design, install, service and, eventually, manufacture PV systems, and of the public sector to promote, monitor and evaluate the performance of these systems, and to provide the policy framework for expanded use of solar PV systems;

- provide electricity to at least 840 households and 4 communities in 4 districts not presently served by the grid;
- enable the preparation of an investment plan for the use of PV technology on a national scale in Uganda using one or more proven implementation strategies;
- subscribe to the global efforts in combatting the build up of CO₂ in the atmosphere;
- design and find ways to disseminate smaller systems (i.e., solar lanterns) for the poorer households as well as larger systems for wealthier households and economically and productive applications.

14. The 1000 household systems and the four community-based systems will be purchased using the \$1 million revolving fund. The revolving fund will initially be kept small (on the order of \$1 million) to ensure that the financial institutions are capable of managing a programme of this kind. Once the validity of the approach has been demonstrated and the institutional capability proven, the size of the revolving fund can be increased as part of future bilateral and multilateral financing.

PROJECT DESCRIPTION

15. In order to achieve the project objectives, the project strategy will be to establish programmatic and/or commercial linkages between local industry/importers, banking institutions, NGOs/cooperatives, training institutions, and Government agencies through the financing, design, installation and maintenance of at least 840 household and 4 community-based PV systems in 4 trading centres on a pilot basis. The project will test the effectiveness of several models of financing mechanisms which have succeeded in other countries to induce demand for PV technology. In particular, two models - the consumer financing and the leasing mechanisms - will be tested. Consumer financing will involve either commercial/ development/ cooperative banks giving loans to the consumers to purchase the systems or suppliers extending hire-purchase terms to the consumers. The suppliers that would be involved in the hire-purchase scheme could also be induced by benefiting from a credit facility to procure equipment. The leasing programme will use

cooperatives or NGOs as intermediaries between the financier and the consumer, as manager and guarantor of the funds. The money in this case will be used to seed a revolving fund to facilitate system purchase. The other method which has been used elsewhere, i.e. the use of an energy service company (e.g. UEB), will not be used for this pilot project because UEB does not wish to expand its programme at this time.

16. The Government is aware that in order to fully integrate any renewable energy technology into people's daily lives, the people themselves must get involved in its deployment and understand its strengths, limitations and the associated costs. Therefore, the selection of the 4 sites for the pilot project will be carried out with the active involvement and support of the local communities. To this end, the pilot project staff, local authorities and NGOs will carry out a public education program to the target end-users at the outset, and throughout the course of the project. Emphasis will also be placed on technical training that will ensure technology sustainability. The Government also realizes that this pilot activity is valuable only insofar as it leads to a larger upscaling using greater funds. They have expressed a willingness to finance these activities as part of a future MDB loans. The project implementation will consist of the following activities:

- Selection of the pilot sites:- Using the UEB plan for rural electrification, potential sites will be selected. These population centres, which must be unlikely to receive grid power in the next 5-10 years, will be mapped out. Then, a survey to select the four pilot sites, depending on need, willingness to pay, ability to pay and potential to sustain the technology, will be conducted. It is important that these selected sites contain a sufficient number of households able to afford the payments so that each district will provide a threshold size of at least 20 systems.
- Establishment of financing mechanisms for household and community-based PV systems:- This will involve the selection and commitment of banks to administer the loan scheme using either their own or donor funds. It will also involve training financial institution staff to be able to appraise loans and administer funds for the PV systems. The mechanism for the creation and administration of revolving funds by NGOs and/or cooperatives will also be established.
- Collection of information and visits to similar projects in other countries:- Information and lessons learned will be necessary from other countries and agencies that have been successful in using solar PV technology, including Zimbabwe, the Dominican Republic, and Mexico.
- Ensuring quality of systems:- This will involve the establishment of equipment standards and codes of practice that meet either local or internationally recognised requirements, and a balance of system (BOS) test facility. The Uganda Bureau of Standards will be strengthened through this process. Project staff will ensure that the systems are well designed with quality components, and can be assembled and installed to meet consistent standards. Incentives and arrangements for battery recycling will also be put in place in order to avoid environmental damage will also be put in place.
- Selection of PV system suppliers/installers:- Credible commercial agents for supplying and installing the PV systems will be identified. Project staff will develop criteria for bid qualifications and assist with the review of the bids and the award of contracts to local private firms.

- **System installation and supervision:-** Once the consumers have signed contracts with the banks/financial institutions, the project staff (in conjunction with the National Bureau of Standards) will monitor system installations to ensure conformity to contract specifications and installation codes of practice. This will also involve overseeing and inspecting initial system installation.
- **Strengthening data collection and processing capability:-** Solar radiation equipment will be procured to train technicians. The project coordination unit will also need to link up with the existing GIS in the Directorate of Environment to map the information relevant to the pilot and future projects (i.e. existing PV installations, UEB grid and future expansion, population densities, economic resources, NGO operations, solar radiation data, etc.).
- **Capacity building and public awareness:-** The project will provide training to technicians in both the public and the private sectors in PV system design, installation, normal maintenance and trouble shooting, through polytechnics, colleges and workshops. Consumer education will also be carried out to make them understand and accept the service available from a PV system and how to optimise it.

Evaluation of pilot project performance, including 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 Government, the UNDP, co-financiers, and other interested organisations at the mid point and end of the project. This will also be one of the inputs to a loan application for upsizing the project following on the Pilot Phase.

- **Assisting the establishment of a Uganda Solar Energy Industry Association.** The association will help in consolidating common industry interests, forming linkages among agencies/institutions involved in solar energy activities by circulating information, and improving the solar energy business environment.

RATIONALE FOR GEF FINANCING

17. This project is a Government priority in the energy sector because it will provide a working model of a viable way of meeting the objective of rural electrification in the near and medium term. 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 stabilise carbon emissions to the atmosphere.

18. The Government's move to promote the use of solar PV systems was expressed in the 1992/93 fiscal budget when the 58% tax on solar energy systems and devices was lifted. However, a smaller tax (32%) was re-imposed in the 1993/94 budget when it was apparent that the move had not increased the use of the technology due to the high initial costs of the systems and the limited technical and financial capacity to disseminate those systems. It was therefore apparent that removal of tax may be a necessary, but not a sufficient condition for widespread dissemination of solar PV systems. There are definitely other barriers that must also be removed to open and expand the market. The import tax on PV modules and system components will be removed as part of project implementation. On re-examination of the situation and the experiences of other countries, it was realised that more positive actions would be required to open and expand the market for renewable

PV technologies. Without opening a larger market, the bulk importation and sale of solar systems, which could help reduce prices, was impossible. The realization was made that financing was needed to help the consumers and suppliers to increase their capacity to purchase the systems. Technical assistance funds would also be required to ensure adequate institutional capacity for the sustainability of the technology. Because of the Government's financial constraints, these funds have to be sought elsewhere. The GEF support is requested to pay for technical assistance requirements for the project while other donors cofinance the loan fund (several donors are currently considering providing the cofinancing). Local NGO's will also be involved in this project. This pilot project will be followed by a sizeable loan application to multilateral sources.

SUSTAINABILITY AND PARTICIPATION

19. The project will involve the coordination of activities between various groups which singly and collectively will contribute to its sustainability. The Government will provide the necessary policy environment and coordination for the project and ensure that the initiatives undertaken by the project are consistent with the overall national objectives and priorities. It will also remove the import duty on PV components

20. The project will demonstrate to Ugandans the technical and economic viability as well as the environmental benefits of PV solar home and community systems for rural electrification. By requiring full-cost recovery, it will represent a sustainable model of PV dissemination. By educating the consumer to understand and accept the service available from a solar home system, he will be able to use it properly and not abuse it, and also pay his installments promptly. The project will ensure the local availability of trained technicians to be at hand to assist the consumer in case of trouble. Such training can be offered by the Faculty of Technology at Makerere University and/or the Uganda Polytechnic.

21. The project's private sector approach is of particular significance. Its sustainability will depend on the opportunity for some of the participating entities to profit from it in monetary terms. The private commercial suppliers of systems and the manufacturers of components will be looking forward to an expanded market for their wares, which can only be achieved through the success and sustainability of the pilot project. At present, the PV industry supplies mostly hotels and tourist installations. Establishing a market for solar home systems will increase their range and viability. The commercial banks and other lending institutions will benefit from an expanded market as they would earn from interest payments. Considering that the repayment period for the home systems will be relatively short (between one and four years), a large market ensures a large and fast monetary turn-over for the banks. The PV systems, with their life-time projected at 15 and 20 years, will normally act as collateral for the short-term loans in case of payment default and in the absence of another security asset.

22. The current political organisation in Uganda has created a very effective grassroots management system of "resistance councils". A village resistance council is headed by an executive committee whose members are charged with various functions for the development and social harmony of their community. Regular meetings are held by the village members, who constitute the council, to discuss development and social issues. Resistance councils, make it easy to mobilise and educate community members for development projects, like the provision of PV community-based systems. The council would be the best evaluator of the needs to which the PV systems should be put for community services.

23. NGOs are increasingly recognised as important to Uganda since they represent constituencies that have been neglected or unattended in the past. They also fill the gaps in the provision of social services and development support that cannot be provided by Government. They already control resources estimated at approximately US \$125 million, and are increasingly involved in projects for environmental sustainability, including solar energy and biogas. Therefore, they are considered credible agents for community mobilisation, public education, and management of revolving funds.

LESSONS LEARNED AND TECHNICAL REVIEW

24. The traditional energy planning method that concentrates on the expansion of the electricity sector through increased hydropower supply and the procurement of more petroleum products to meet rising energy demand has not only continued to increase the nation's indebtedness, but also failed to improve the quality of life for the majority of the population. The scarcity of fuelwood resources in many parts of the country, the limitations on the extension of grid electricity to the rural areas, and the poor distribution of kerosene in some areas, have threatened energy security in the rural areas. The PV pilot project is an integral part of a larger rural energy planning program that will address the issues of energy security, environmental conservation and quality of life.

25. In recent years, the Government has liberalised the energy market in order to make it more efficient. Power supply is no longer a monopoly of the Government controlled utility company, while the utility now prices its energy output at the long-run-marginal-cost. Price control on petroleum products has been abolished. This has created a niche market for renewable energy technologies for certain end-of-line applications, and also opened the door for private sector participation in the provision of energy services. As long as the Government maintains a conducive policy environment, the ensuing competition for serving this market is bound to result in the provision of relatively cheap energy services to the rural population.

26. The use of solar home systems in rural areas has been successful in a number of developing countries, some of them in the African region. These projects will give the Ugandan project valuable input that will be necessary for its sustainability. Therefore, contacts will be established with these and other on-going donor funded projects to share information on host country energy and environment policies, capacity-building experiences, and institutional participation, and to encourage networking. Project staff will pay visits to some of the projects early-on in the execution of the project to gain first-hand experience. It will be necessary to take stock of, and learn lessons from, the successful and failed local installations.

27. Many lessons learned from the GEF/UNDP project in Zimbabwe (Zimbabwe's Photovoltaics for Household and Community Use - ZIM/92/G31) will be of relevance to this project. The experience from the Zimbabwe project would dictate that future PV-based projects for rural electrification should consider the following elements:

When establishing a credit window for the purchase of such systems, a number of local financial institutions with outreach facilities into the rural areas (and charging market-based fees) should be involved. Under such arrangements, end-users must pay for the actual (unsubsidized) costs of PV systems over a reasonable period of time and the financial institutions must realize revenues to compensate for their services. It is preferable to establish these arrangements on a pilot basis using a small amount of money prior to endowing a larger revolving fund;

- A regulatory environment must be created in which the quality of PV equipment and installation is ensured and new products are inspected and tested before they are allowed on the market;
- An expanded and virile private sector that is fully capable of designing, installing and maintaining high-quality PV systems on a commercial basis must be involved in project implementation from the beginning; and
- The provision of public information and education efforts is essential to sensitize the public about environmental issues and positive impacts of renewable energy systems.

28. In response to the STAP reviewer's comments, the proposal has been changed to address the main points raised. First, the likely saturation level of PV systems in the rural sector (between 5 and 40%) has been clarified in the proposal. Second, over the course of twenty years, one household using 15 liters of kerosene for lighting per month (baseline use required to operate three lamps) will emit 9.36 tonnes of CO₂. Third, the focus of the solar home systems on lighting has been strengthened as there is little likelihood for rural households to utilize television in Uganda. Finally, the discount rate used in the analysis is 10%, and at that discount rate, with the prices utilized, the PV systems represent a least-cost solution.

ISSUES, ACTIONS AND RISKS

29. The major issues to be addressed during the project life-time shall include: technical deficiencies in system components, loan administration and repayment, battery hazards, and the need for public information. The project design has included the necessary safe-guards against these problems. In particular, the development of equipment standards, codes of practice, maintenance regimes and technical training are pivotal elements of the project.

30. The major risk in the project concerns the defaulting by consumers on loan repayments. In particular, a number of the consumers may have no collateral which the lending institution could place a lien against. However, the PV system itself could be regarded as collateral. This is because a PV panel's (single crystal cell) life-time is approximated at around 20 years and, therefore, the panel has a very small depreciation rate compared to the loan repayment period of one to four years. Therefore, in case of defaulting on repayment during this period, the lending institution or loan administrator can repossess the system.

PROJECT IMPLEMENTATION

31. UNDP shall be the implementing agency for this project. The Government of Uganda, through the Ministry of Natural Resources, shall be the executing agency. The Ministry of Natural Resources (MNR), in collaboration with the UNDP/GEF, will establish a project advisory committee which will be charged with reviewing the progress of the project from time to time. A project management unit (PMU) will be established with an office in Kampala. The PMU will be independent of the MNR but will function within the policy framework established by the MNR. The day-to-day responsibility for the project will rest with a national project manager (possibly an energy professional from the MNR staff seconded to the project for the duration of the pilot project). There will also be an expatriate Chief Technical Advisor (CTA) who will be supported by an established international technical assistance agency with prior experience in the use of renewable energy technologies for rural electrification.

PROJECT MANAGEMENT UNIT (PMU)

32. A separate Programme Management Unit will be established that will be independent of the Ministry of Natural Resources but will function within the policy framework established by the Ministry.

The PMU will carry out and coordinate the management, administrative and financial functions related to project implementation including the coordination of the participating agencies, the hiring of support personnel, work scheduling, information collection dissemination, and the provision of technical assistance and technical/financial reporting.

PROJECT ADVISORY COMMITTEE (PAC)

33. A project advisory committee will be established. Members of the Committee will be drawn from key institutions actively involved in energy-related activities from both governmental and non-governmental sectors. Some of these institutions will include: Uganda Electric Board, Uganda National Bureau of Standards, Makerere University Faculty of Technology, SEFA (NGO-Solar Energy for Africa), PRIDE (an NGO), Uganda Institute of Bankers, DENIVA (an umbrella NGO), UNDP and other bilateral donors. Banks and other financial institutions that will be participating in the project will form a revolving fund that will continue to be used for solar PV system purchases within each bank on an ongoing basis. The same applies to the NGOs and cooperatives. Other NGOs will also work alongside the PMU staff and local authorities to educate/inform the rural population regarding the use of PV technologies and also to monitor the performance of the installed systems.

ANNEX 1

PROJECT FINANCING AND BUDGET

1. A. GEF Contribution

Expenditure Category	Year 1	Year 2	Year 3	Total
1. Personnel	265,000	265,000	265,000	795,000
2. Sub-Contracts	45,000	45,000	45,000	135,000
3. Training	120,000	120,000	120,000	360,000
4. Equipment	80,000	60,000	60,000	200,000
5. International Travel	20,000	20,000	20,000	60,000
6. Contingency	53,000	51,000	51,000	155,000
Subtotal	583,000	561,000	561,000	1,705,000
7. Project Support Services (Including Exec. Agency Support Costs)	17,490	16,830	16,830	51,150
TOTAL GEF Budget	600,490	577,830	577,830	1,756,150

B. Cofinancing required for the revolving fund \$1,000,000

C. Government contribution \$213,000
(office rent, office supplies, vehicle maintenance etc.)

Annex 2

**A Technical Review of GEF proposal on
Uganda PV pilot project for Rural Electrification**

1. Relevance to GEF

This is a technically sound proposal. However, more work is needed on the economic and demographic implications of scale up of the proposed effort, before strong relevance to GEF can be claimed. Clearer justification needs to be presented explaining why this proposal may have an impact on CO₂ emissions from Uganda even in the long run (see below).

The proposed general approach is appropriate for the technical and institutional infrastructure in Uganda. PV technology is indeed a possible viable option for rural household lighting in Uganda. This project aims to develop local technical trained manpower which will be necessary for success of PV rural electrification in the long run. The project will also help determine appropriate financing mechanisms for PV powered homes. On the other hand, the following points are either not addressed in the project or are presented in insufficient detail. These points, when explored in more detail, may lead to the conclusion that the project requires reformulation for GEF support.

(i) How many Ugandan rural households can afford (and are willing) to pay back within one year the approximately US\$1000 that the PV system will cost them? This number must be rather a small fraction of the rural households. What fraction is it?

(ii) What are the current CO₂ emissions from these households that could be legitimately claimed to be reduced with the use of PV system? Note that cooking will remain biomass based. Entertainment (radio and TV) with PV power will not reduce any existing CO₂ emissions. So, the only CO₂ emissions saved are those from lighting.

(iii) If the PV panels considered are 60 W_p, (presumably meaning 60 Watts peak) per household, then the panel will each provide about a quarter of a kWh of daily electricity to the house. This equals a power consumption of about 50 watts for 5 hours. If lighting consumes some 36 watts out of this (two 18 watt compact fluorescent lamps), it is difficult to do much by way of TV entertainment in the remaining power. The authors of the proposal should present their technical calculations in more detail to make their case that TV viewing will also be possible.

(iv) The Net Present Value (NPV) calculations given on page 11 of the proposal do not cite the discount rate used in the calculations. It is evident that since the PV system cost is almost all up-front (with only the periodic replacement of the battery as a recurring cost), the PV system will cost close to US\$ 1000 including BOS. The kerosene and the dry cells for the next 20 years are valued at an NPV of \$1,557 for each household. However, the discount rates for future savings for households are not stated. Households commonly use discount rates of between 30% and 90% for future expenses/savings. Did the proposal authors use such high discount rates? If not, then the savings may appear significant from societal viewpoint (discount rates of 10% or 12%), but may be altogether absent when viewed from the household viewpoint. If this is

true, then the systems will be difficult to market. This issue needs to be elaborated clearly in the proposal.

2. Objectives

The project objectives are to develop a method to promote and mature a market for household PV systems. However, this objective needs to be demonstrated to be relevant to GEF objectives by appropriate demographic data for Uganda (see question (i) above).

If the objectives can be justified, then the project is well formulated to address them. If the objectives cannot be justified, the project should be reoriented, focusing only on PV-lanterns and on community PV lighting systems. Individual household PV electrification may have to be removed from the project objectives.

3. Approach

The approach is clearly defined in the project brief. The approach is appropriate and technically sound for the stated project objectives (but see 2 above). No obvious environmental opportunities or problems have been overlooked. Uganda is an appropriate country for the proposed project.

4. Background Information

The project proposal provides much useful background information. However, some crucial pieces are still missing. These are defined in the questions (i-iv) raised in item 1 above. These need to be supplied.

5. Funding Level

The project asks for about US\$ 2.9 million to set up PV installations in 870 homes and 4 community systems. The NPV of these systems will be about half of the budget. This is not too high considering that there are start-up costs, and the costs of building up the expertise and the knowledge base.

6. Innovation

The proposal is innovative in terms of planning program to introduce PV powered lighting to replace kerosene lighting in rural households. This is a potential success story waiting to happen. The proposal addresses the necessity of building up the technical and institutional infrastructure for the success of this approach. Also, the proposal aims to recover costs fully from this effort. It is known that rural households in unelectrified regions are commonly willing to pay up to 30 US ¢ per kWh for electricity for lighting. This can be supplied with conventional PV technology. The problem is how the technical and institutional arrangements will be put in place to supply the PV-powered lighting. This proposal aims to address precisely these issues.

7. Strengths / Weaknesses

As discussed above, the strengths of the proposal are the attention it gives to the problem of building up the necessary institutional and technical infrastructure to make the technology successful in the market. The proposal also does not rely on expectations of continued handouts: the PV lighting systems are supposed to be sold with full cost recovery, so that this effort, if successful, can expand vastly. The main weakness of the proposal is that it lacks adequate detail in the four areas mentioned in section 1 (see parts i-iv). On exploring these issues in detail, the proposal may have to be reoriented to focus on PV-lanterns which will have a much larger market. PV-lanterns costing only US\$ 25 to 50 each, and capable of giving 3 hours of light per day, can be fabricated today. These will reach into a much larger number of households and replace kerosene lighting. The potential impact could be great.

ANNEX 4

INCREMENTAL COSTS

1. This project is designed to expand the market for PV-based electrification in rural Uganda. As part of the project, the Government will revoke import duties on PV modules and components. The project focuses particularly on building capacity to overcome several transaction barriers. First is the lack of trained manpower. 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 NGO's 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 through a revolving fund administered by existing financial institutions. The beneficiaries 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 programmatic costs which are largely unrecoverable.

Broad Development Goals

2. 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.

Baseline

3. 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. Most of these are installed at hotels and tourist facilities. Limited national capacity to permit the dissemination of a larger number of systems. 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.

Global environmental objectives

4. The global environmental objective being pursued through 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 increase 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.

GEF alternatives

5. 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, providing support to private entrepreneurs for sales and servicing of solar home systems, and arranging 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. Depending upon the selected sites between 5 and 40% of rural households will be willing and able to afford the payments for a solar home system. 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 multilateral 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 loans. This plan will assist Uganda in examining different ways of meeting rural power needs, not just the needs for PV-based systems.

6. For a rural household using solar electric lighting instead of three kerosene lamps, the amount of CO₂ to be avoided will amount to about 9.36 tonnes per household over the twenty year lifespan of the project. If one thousand systems are installed as part of this project, the project will have accounted for 9,000 tonnes of CO₂ avoided over twenty years. However, since the goal of this project is to open the Ugandan market for PV systems, CO₂ avoidance is not the relevant goal--rather it is the number of systems sold in Uganda both directly and indirectly attributable to the project.

System boundary

7. For the purposes 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 which might include peri-urban and even unelectrified urban areas.

Additional domestic benefits

8. The additional domestic benefits are twofold. First, the project will provide a vastly superior quality of lighting for rural households when compared to the baseline. This improved lighting quality can be measured in lumens, but is not quantified in the analysis. Second, for those households purchasing solar home systems, the indoor air quality of their homes will improve as kerosene will no longer need to be burnt for lighting.

Costs

9. 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 1000 solar home systems. As these small loans are paid back, the financing agencies will be able to provide loans for additional systems, between 5000 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.

Incremental cost matrix: Barriers to Implementation and Their Removal

COMPONENT	STAFF COSTS	TRAINING COSTS	EQUIPMENT COSTS	TRAVEL COSTS	TOTAL COSTS	TRANSACTION BARRIER	INCREMENTAL COSTS	HOW WILL FUTURE PROJECTS PROCEED ONCE BARRIERS ARE REMOVED
1. PREPARATION OF DETAILED WORKPLAN (including selection of Districts & Inst.) Total Funds Needed (Requested from GEF)	80 50	50 50	0 0	50 20	180 120	Lack of PV component for national renewable energy policy	Positive	Project will be implemented as part of an effective national policy for promoting renewable energy system.
2. GENERAL INFORMATION DISSEMINATION Total Funds Needed (Requested from GEF)	100 100	150 150	80 50	70 50	400 350	Inadequate information and awareness of renewable energy systems	Positive	Public information campaigns and personnel and equipment for information dissemination
3. TRAINING OF TECHNICIANS Total Funds Needed (Requested from GEF)	100 100	250 220	150 150	40 40	540 510	Lack of skilled personnel to maintain and properly install solar equipment	Positive	Highly skilled staff will be trained and permanent training facilities established
4. TRAINING OF FINANCIAL INSTITUTIONS PERSONNEL Total Funds Needed (Requested from GEF)	100 100	150 150	80 50	70 50	400 350	Financial institutions have no ability to appraise and operate PV-based loan accounts	Positive	Trained staff will be available to manage revolving fund for up-front costs of renewable systems
5. PREPARATION OF SOLAR ENERGY EQUIPMENT STANDARDS Total Funds Needed (Requested from GEF)	80 80	50 50	0 0	20 20	180 150	Lack of standards and inspections leaves consumers with little confidence and no protection	Positive	Codes on PV equipment and installation maintained and inspections carried out to ensure satisfactory installation and maintenance
6. PROJECT MANAGEMENT Total Funds Needed (Requested from GEF)	250 250	0 0	0 0	50 50	300 300	Lack of project management capability	Positive	Skilled staff available to ensure project success
7. REVOLVING FUND Total funds needed (Requested from GEF)	0 0	1,000 0	0 0	0 0	1,000 0	Lack of financing for small-scale rural energy	Negative	Revolving fund will allow dissemination throughout rural Uganda
TOTAL PROJECT BUDGET					3,000*			
TOTAL GEF BUDGET					1,800			

* Uganda Government Contribution (in kind): \$200,000.