

***ESMAP***

---

Joint UNDP / World Bank **Energy Sector Management Assistance Programme**

---

c/o The World Bank • 1818 H Street, N.W. • Washington, D.C. 20433 • U.S.A.

48182

**Kenya: Development and Testing of Financing Mechanisms  
for Solar Electric Equipment in Rural Villages**

February 7, 1996

## **Introduction**

This project brief outlines the proposed activity to test financing mechanisms for solar electric equipment for low/middle income households in Kenya. The project will be managed by the World Bank through its ESMAP program and implemented through two local Kenyan organizations, Energy Alternatives for Africa (EAA) and the Kenya Rural Enterprise Programme (K-REP). EAA is one of the leading NGO's (or not-for-profit organizations) with solar energy experience in rural and peri-urban Kenya. K-REP is in the process of creating a Grameen-type bank in Kenya, for which it is very much interested to develop credit mechanisms for solar electric equipment. The project will be cofinanced by the Ashden Trust and ESMAP. The project will start in March 1996.

## **Objectives**

- Immediate: at village level, test realistic and practical financing mechanisms to provide electricity to individual households using solar energy.
- Medium-term: develop a commercial package to provide village power using solar energy for use by local and international financial institutions.

## **Background**

Less than 0.5 percent of rural households have access to grid electricity. This number is even expected to fall as population growth exceeds rural connections rate, despite major investments in the rural electrification program. Rural households have understood the implications, and have started to invest in solar electric equipment. As a result, today more rural households have solar electricity than grid electricity, despite the fact that grid electricity is subsidized and solar equipment is taxed. Households that purchased a solar electric system are relatively well to do (upper-middle class) as they have bought it "cash". Therefore, household income clearly limits the size of the market.

Access to sources of finance may alleviate this constraint, resulting in an acceleration of the use of solar electricity. Rural households currently cannot get a loan to purchase solar electric equipment, and even rural business men will encounter difficulties in attracting financial assistance to help set up shop in rural areas. Although many households would be able to afford and are willing to make weekly or monthly payments for solar electric services, they are not able to purchase a system right off the shelf as is the case now with virtually all transactions. There clearly is an interest in low voltage DC electricity as many households now run a few fluorescent lamps, radio and/or tv from a car (or lorry) battery that they regularly have to bring into a neighboring town for recharging. However, equipment is often of poor quality (particularly locally made lamps and batteries), and in the absence of load controllers, batteries are often abused by too deeply discharging. Better knowledge of system components and their performance is required, and this will be major focal point under the project.

Financing mechanisms have often failed, particularly in Africa and among poor households. People are known to move to other towns before having paid back the loan for the purchase of their new equipment even if it consists of e.g. improved stoves of \$10 - \$25. The proposed project will internalize the key lessons from past rural credit efforts by using a community level approach, and working only with existing groups, some of which are informal ones. In this way, there is previous knowledge about behavior of individuals, and careful selection of participants will be possible, enhancing the chances of reaching a success.

### **The Project**

The project will invest in solar electric equipment and transfer this to households while testing a number of financing mechanisms. Poly crystalline panels of 20 Watt are selected as they may best correspond to households' initial needs for electricity. Households that can afford it, can always opt for more panels at the same time, or later. An energy service company, villagers' association, or cooperative will be established in each of these villages to manage the project locally (to be referred to as: ESC) This simply means that there will be a formal agreement either with a group of villagers, or with a more commercially oriented group or individual(s) to implement the project. Although different financing mechanisms will be tested in each of these villages, the underlying principle is the same:

- (i) ESC will be responsible for collecting the payments and providing technical assistance to households, and a specific person may be designated. This person will be responsible for the day to day (week to week) monitoring and is likely to be someone from the immediate surroundings of the village: a shop owner (or from the neighboring town), someone from the energy service company or villagers association or cooperative, someone subcontracted by the project such as a PV outlet owner for a Nairobi-based company, etc. The final selection will be based on discussions with participants, and will be tailor made for that particular village. There are budgetary provisions (small) to provide some logistic help to the ESC in each village. A technician is available to install systems, wire houses, and provide technical backup for the normally applied fees.
- (ii) A system will be set up for participating households to finance or lease solar equipment. Target households are in the low and medium income class, who are neither accustomed to having loans nor to owning expensive equipment. If households already own some of the equipment (such as lamps, batteries, etc.), these will be tested. Only if this equipment is of sufficient quality can it be used. The project will strongly advocate knowledge about quality, performance, and maintenance. The terms and conditions will be discussed with potential participants and may vary from village to village, depending on households needs and abilities. Although different financing options will be tested, users will need to make regular payments until they have fully paid for their solar equipment, except in case of leasing. In case of default, equipment will be relocated to another household.

- (iii). The selection of participating households will be done in close collaboration with the villagers' association, cooperation (whether this exists in a formal or informal setup).

The three different financing options that will be tested are: leasing, a loan, or a special arrangement that is designed to minimize socioeconomic problems. In this latter case, a solar battery charging station will be built in a central place (such as the marketplace) to provide electricity to surrounding businesses (through a small low-voltage DC network) and households (who bring their batteries for charging). The charging station comprises panels of individual households who can only take their panel home after they have completed their payment schedule. In this way the panels generate revenues to help defray costs. The advantages of this special setup are the following: equipment is placed in a central location that is frequented by all villagers, who receive the benefits of it (shops are open longer), batteries can be charged locally (for the poorer segments of the population), technical expertise will be built in this location to provide assistance when this is required (repair & maintenance), and an outlet for spares and additional equipment is created. In addition the charging station is a demonstration unit and thus creates awareness. It also gives feedback to households that bring their batteries for charging, e.g., when batteries are too deeply discharged they will not be allowed to be charged at the station anymore. This setup will provide more benefits to a wider selection of households.

The medium term objective of the project is to design and test an investment and credit package to bring solar electricity to remote, non-grid connected villages. Instead of waiting until grid extension takes place, one can try to design packages that are of potential interest to donors and private investors. For such a package to be adopted on a large-scale, it needs to be financially attractive. For it to become financially viable, it needs to be economically and socially acceptable in the village, and this can only be found out by testing it under real life conditions. This project will thus take a different approach than usual, by starting with the end-user and see how financial assistance should be designed to help him/her meet his goals, rather than the conventional approach whereby clients are sought for existing programs with financial institutions.

### Scope of Work

First, an Implementation Manual will be designed. K-REP will do this work in the first phase of the project. A socio-economic household survey will be organized in the project areas, in two villages to start with. The organizational structure and the most promising forms of financing mechanisms that should be established in these villages will be identified. Based on this information, energy service companies, associations, or groups (ESC) will be created, and arrangements for maintaining and operating equipment will be made. Business plans will be developed to that effect, and signed (by the coordinator or responsible of each ESC and the overall project coordinator). An input from a lawyer will be required to make sure that these are in conformity with Kenyan laws, and to make sure that legal recourse exist when households default and refuse to give the equipment back. K-REP will be responsible for all this work, and the outcome will be both the actual organizational structures created and financing mechanisms identified, and an implementation manual that can be used in different villages to repeat the same process. Terms of Reference are attached as Annex I.

The second phase starts upon completion of the implementation manual. Once an ESC is in place and a business contract signed, the equipment can be installed in the village. Equipment will be procured while the design work for the implementation manual is in progress. The equipment can be considered as a revolving fund: once panels are fully reimbursed by users, new ones can be procured and put back into the system. Or if there is a market for even smaller panels, e.g., to charge nickel-cadmium batteries, smaller panels could be purchased to that effect. By placing bulk orders, the ESC can obtain better prices for equipment and spare parts. It is envisaged to encourage the business of spare parts, additional equipment, etc. in the participating villages. Draft Terms of Reference are attached as Annex II.

Once the different financing mechanisms are operational, they should be monitored. An evaluation should take place after about one year to determine the prospects for replication. The implementation manual should be adjusted to reflect any lessons learnt. The third phase will start after the evaluation, and will consist of starting operations in one or more additional villages. At this point, financing has only been secured for one additional village, but a proposal for further donor involvement will be written if this is deemed appropriate.

The project will need substantial supervision on a day-to-day as well as week-to-week basis. It will depend for much of the supervision on local capacity in the area of the charging station. As mentioned earlier, local technicians will be available in the villages; they should become self supporting once the project is fully operational. During the first year more supervision from the overall project staff in Nairobi is needed than in subsequent years to ensure proper institutional functioning. They will also document progress so that lessons can be learnt from mistakes and failures as well as successes.

### **Organizational Structure of the Project**

The project will be initiated by Energy Alternatives for Africa (EAA), a local organization that came up with the original idea of the battery charging station. EAA has a lot of experience with promoting photovoltaics and setting up training schemes in rural Africa. EAA will be responsible for overall project coordination within Kenya, for monitoring and documenting progress, and for attesting that the different actors stick to their respective roles in a timely fashion.

Kenya Rural Enterprise Programme (KREP) will be responsible for developing business plans and designing credit management schemes in each of the villages, and finalizing the implementation manual. It will also be asked to audit the projects from time to time to finetune some of the details of the financing mechanisms. KREP has expertise in Kenya to develop business plans and has in addition experience with rural and community credit management. In addition, KREP has a network of entrepreneurs that can be interested in the project at a later point in time. KREP is respected by a variety of local and foreign organizations, and it has expressed a keen interest in the subject.

### **Preliminary Financial Analysis**

This analysis determines the financial return on an investment package for the installation and operation of solar electric equipment consisting of 20 Watt panels and charge controllers. During the project different financing mechanisms will be tested and the financial internal rate of return and the payback time of the US\$16,000 to US\$35,000 needed are calculated (see Table 1 below). All costs are included, both for equipment, and for maintaining and operating it (if applicable). The equipment lifetime was assumed to be fifteen years<sup>1</sup>. Preliminary analysis shows a rate of return that ranges from about 20% to 40% and the payback time that ranges between two and four years. If this performance can be achieved in practice, the private sector might indeed be interested in pursuing it on a larger scale. Note that the total investment costs are higher than they would be under normal circumstances, as there is more allocated for equipment and provisions for monitoring and trouble shooting because this is a pilot project.

**Table 1: Projected Financial Performance of the Different Financing Mechanisms**

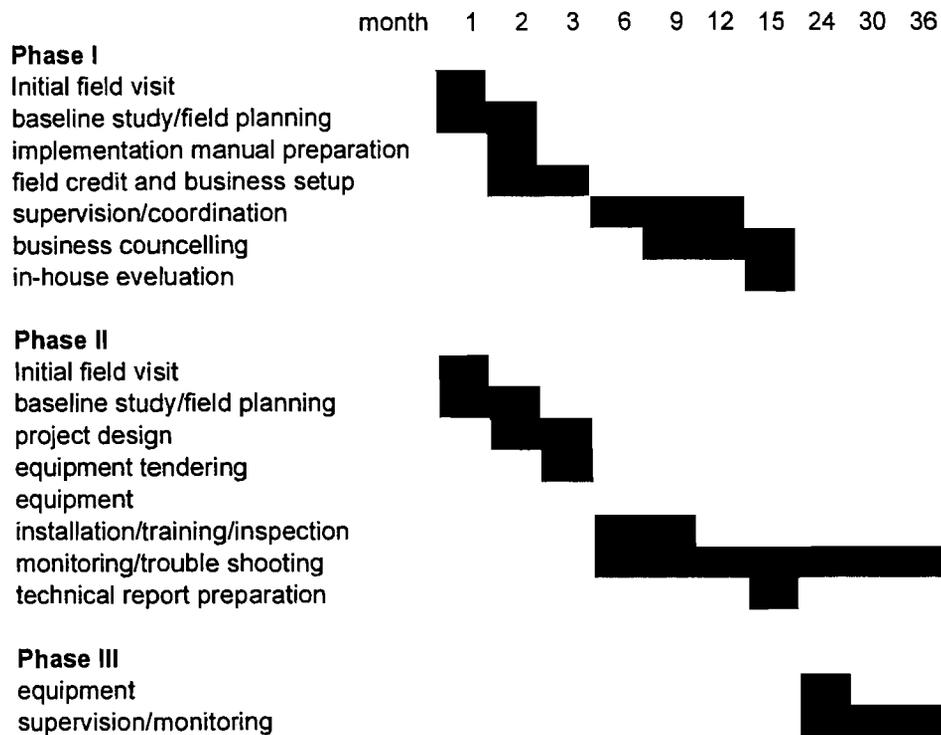
Mechanism	IRR	Payback time (yr)
Battery charging station		21.4 4.3
Lease	39	2.4
Loan	35	1.7

### **Timetable and Budget**

The project will last about three and a half years, allowing for some slack time for households to repay their debts. The first phase is the preparation of an implementation manual, which will last about three months. The second phase will last approximately one and a half years, and will include an interim evaluation. The third phase will be an extension of the project into different villages. At that time it should be clear whether the project has achieved its objectives.

---

<sup>1</sup> This is conservative as certain panel manufacturers currently guarantee their equipment for 20 years.



The budget amounts to \$172,000, which includes a large allocation for local supervision of the activities in the field. A breakdown of the budget is as follows:

	K US\$
Development business plans	22.0
Equipment	90.0
Local project management	60.0
<b>Total</b>	<b>172</b>

~~A detailed budget is attached in Annex III~~

Phase I (\$22,000) includes the preparation of an implementation manual and monitoring and evaluation of the financing mechanisms. This part will be financed by the Ashden Trust. Arrangements for financing of this part will be made directly between K-REP and Ashden. Phase II (US\$100,000) will be financed by ESMAP, and includes training, installation of equipment, monitoring and technical trouble shooting. For Phase III, a minimum of \$50,000 will be available in 1997.

There will be one issue to be solved when the project is successful in recovering the initial investments for equipment: What to do with those funds. No decision will be taken at this time how it should be spent, rather this will be deferred to when it actually occurs. It is clear,

however, that any recovered funds should continue to be used for the intended purpose, the best way to do that will depend on the prevailing circumstances at that time.

### **Risks**

The main risk is the selection of participating households who are all of the low/medium income levels. If they are not able to repay their loans, the project will be a failure. The higher the rate of intervention in the village, the lower the anticipated risk. With the loan schedule, the risk is the highest as intervention only takes place when collecting payments. With the battery charging station, there is contact every day as it is located at the central marketplace. The leasing schedule is in between as the manager needs to be in more frequent contact with his clients as it is (and remains) his equipment. Even with the loan schedule, the risk is small as (i) participating households are selected after discussion with village authorities; and (ii) monitoring is an important part of the project, and sufficient funds are allocated to finance this. This risk can be mitigated by working closely with local authorities to determine who can participate and who not. The project intends to give a high level of responsibility to the local scene, i.e., either local authorities or private entrepreneurs.

The cohesion of village community groups (or associations) and the competence of an energy service company will therefore be an important factor to determine the success of the project. Any weaknesses here will pose risks to the project. However, these risks will be minimized by designing a solid business plan, using local consultants.

## **Annex I - Terms Of Reference Phase I**

The financing part of the project will be handled by K-REP, as outlined in this document. The specific tasks are the following:

- (i) carry out a baseline socio-economic study in the two project zones, in Meru District in Kenya; you will determine among others income levels, expenditure patterns, existing service delivery for lighting and information services, existing sociological groups and structures, existing businesses, and existing use of financing (for other purposes);
- (ii) develop business plans for the actors in the project (ESC);
- (iii) design most appropriate financing mechanisms for each of the villages, and make arrangements to operationalize them (including training for operators);
- (iv) prepare an implementation manual, outlining the results of the above, providing guidelines for duplicating the efforts elsewhere.

Once the financing mechanisms are operational, you will monitor their performance. To that effect, you will agree on reporting arrangements with the ESCs, and you will carry out field visits. You will also provide business counselling on demand to the ESCs and business entrepreneurs who intend to become involved in providing solar electric services to the rural population.

After about one year of operations, you will carry out an evaluation, and you will fine tune both the financing mechanisms and the operational manual.

## **Annex II - Terms of Reference Phase II**

Energy Alternatives for Africa will be responsible for coordination in the field and for the technical parts of the project. The specific tasks will be the following:

- (i) Assist K-REP in developing business plans and the implementation manual;
- (ii) identify the equipment requirements for the two villages, and design the technical outlays its installation;
- (iii) identify training needs in each of the project villages;
- (iv) procure equipment;
- (v) monitor installation of the equipment in the villages, train operators and technicians;
- (vi) monitor operation of the equipment, provide technical back stopping, and trouble shooting if needed; provide assistance to ESC's to expand their business operations, by suggesting alternative and additional avenues for business opportunities;
- (vii) agreeing on monitoring arrangements with ESCs;
- (viii) prepare a technical evaluation after about one year of operations; and
- (ix) propose a plan for Phase III, an extension of the project to other areas.

EAA will keep ESMAP informed of progress and problems on a regular basis, preferably by e-mail. At the end of the project, you may be asked to provide a financial audit report.

## Annex III - Detailed Budget

<b>Phase I</b>	days	US\$
Initial field visit	4	500
baseline study/field planning	20	4000
implementation manual preparation	20	5250
field credit and business setup	13	3250
supervision/coordination	10	2500
business counselling	8	2000
in-house evaluation	7	3500
travel allowances	40	1000
subtotal		22000
<b>Phase II</b>		
Initial field visit	4	950
baseline study/field planning	12	2850
project design	18	5600
equipment tendering	5	1250
equipment		55000
installation/training/inspection	40	8000
monitoring/trouble shooting	50	8000
technical report preparation	2	600
administration		3000
travel allowances+ travel costs		10000
miscellaneous		4750
subtotal		100000
<b>Phase III</b>		
equipment		35000
supervision/monitoring		15000
subtotal		50000
total		172000