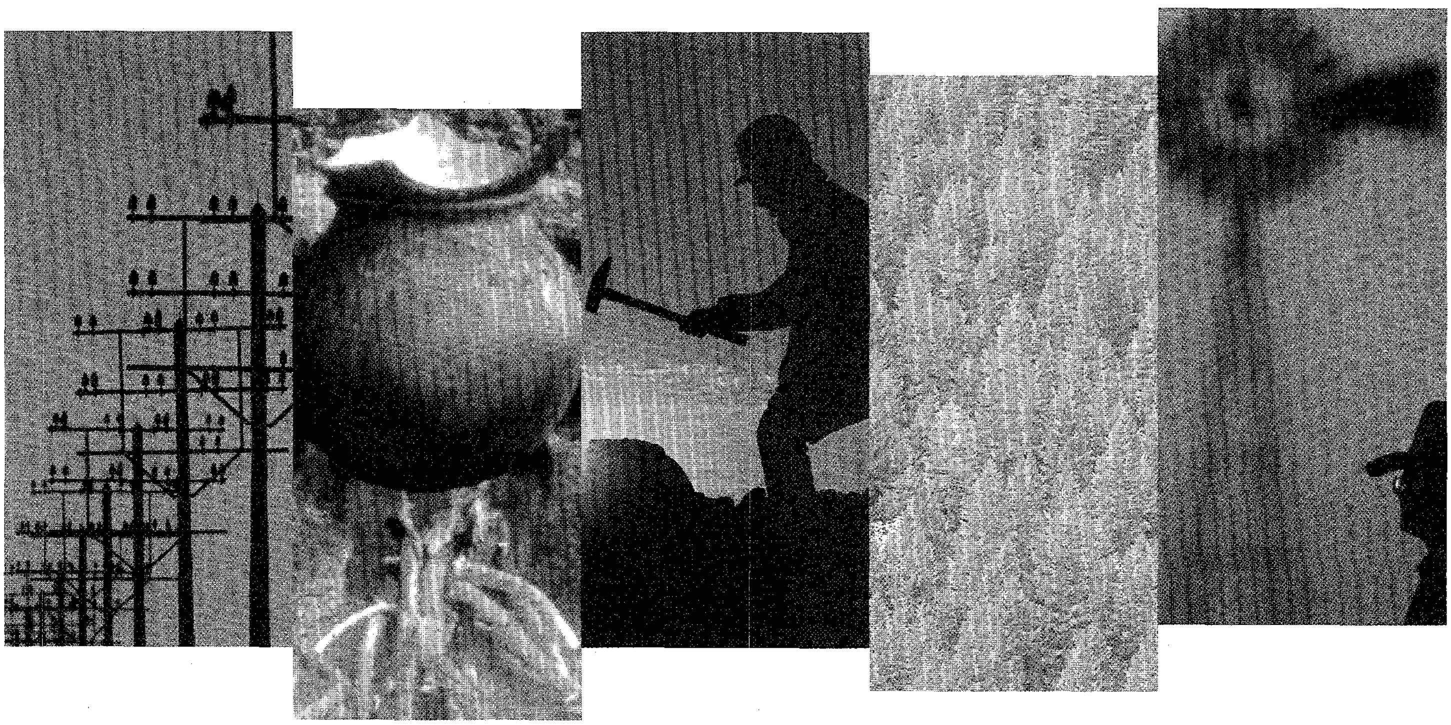
Kenya

Implementation Manual: Financing Mechanisms for Solar Electric Equipment

ESM231



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(ESMAP)

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Contents

Annexes

Figure, Tables, and Boxes

Preface

The Financing Mechanisms for Solar Electric Equipment project was initiated to obtain experience in developing sustainable finance approaches to SHS dissemination in Africa. Worldwide, under numerous projects, hundreds of photovoltaic (PV) systems have been installed using donor-driven approaches. However, few if any of these projects have grown beyond the pilot stage. A primary reason for this is that not enough attention is paid to developing sustainable financing mechanisms.

In this effort, it proved more difficult and time consuming than expected to gain experience. First, the financial partners had no knowledge at all about solar home systems (SHSs). Second, SHSs are a consumer item and are generally not used for productive purposes, whereas most rural financing mechanisms are for productive purposes only. In addition, consumer loan mechanisms are not well developed in rural areas. Third, long-term assistance capacity building is required to develop the capability of such mechanisms.

Two financial institutions participated in the project. One, the Kenya Rural Enterprise Programme (K-REP), used two approaches: (1) a participatory approach to creating credit groups from scratch, which proved difficult; and (2) "dealer" credit, whereby the local dealer (or installer) identified the beneficiaries/end-users but the financial institution still had contracts with the end-users. The second financial institution was the Cooperative Bank of Kenya, Ltd.; which used existing loan groups and management structures.

About US$55,000 of grant financing to create loan funds was provided by The Ashden Trust directly to the financial institutions. However, one institution used the loan money as a guarantee funds and used its own funds to create the loan fund, and the other institution matched the Ashden Trust funds to double the loan fund. Through Swedish and Dutch funds, ESMAP contracted a technical company for the quality control, training, and awareness-raising aspects as well as the description of the solar market.

Acknowledgments

Project staff of Energy Alternatives for Africa (EAA), the technical partner in the project, are grateful to the customers who purchased solar home systems through loans and who provided crucial feedback on their experiences with the new product. Special gratitude is extended to the Kenya Rural Enterprise Programme and the Cooperative Bank of Kenya, Ltd. (CBK).

This report was written by Mark Hankins of Energy Alternatives for Africa and Robert van der Plas of the Energy Unit in the Energy, Mining and Telecommunications Department of the World Bank, with contributions by Bernard Osawa (EAA), Aleke Dondo (General Manager, K-REP), Geoffrey Nasubo (Senior Project Officer, K-REP), Alex Malla (Manager, Small and Micro-Credit Unit, CBK Ltd.), and Ms. Muturi (CBK Ltd.).

A vote of appreciation is offered to the installers who helped install the systems during the test marketing exercise: Henry Watitwa, Bright Home Solar Services (Western Kenya); Nyagah Thagichu (Muranga & Nyanzarua); and Charles Muchumuti, Pemamu (Bungoma).

Abbreviations and Acronyms

a-Si	Amorphous silicon (module)
The Ashden Trust	A trust of the Sainsbury Family
BOS	balance of system
CBK, Ltd.	The Cooperative Bank of Kenya, Ltd.
EAA	Energy Alternatives Africa, Ltd.
ESMAP	Energy Sector Management Assistance Programme
KSh	Kenyan shilling
K-REP	Kenya Rural Enterprise Programme
NGO	nongovernmental organization
PV	photovoltaic
SACCO	savings and cooperative credit organization
SHS	solar home system
VAT	value-added tax (Currently 16 percent in Kenya; rose to 17 percent for a while during project implementation)

Units of Measurement

DC	direct current
W	watt
Wp	Watts-peak. Used to measure peak power output of solar modules.

Currency Equivalents

60 Kenyan shillings = \$1[1]
KSh 1 = \$0.0167[2]

1 All dollar amounts are U.S. dollars.

2 As of late 1998. The Kenyan shilling varied from 60 to 67 to the dollar during the project.

Executive Summary

Where grid-based rural electrification is constrained, PV-powered solar home systems (SHSs) provide a cost-effective, viable alternative for limited household and business power requirements. This implementation manual is designed to serve as a clear, step-by-step guide for the planning and execution of solar electric system investment and credit packages in African countries. This manual is based on more than two years' worth of field experience in Kenya during which about 120 solar home systems (SHS) were installed through different financing mechanisms. It outlines two different finance approaches that address lighting and power needs of (a) rural households with regular cash income and (b) small businesses with the potential to increase their productivity with PV electricity.

Financing mechanisms for SHS do not currently exist in Kenya. Some dealers provide lay-away service, whereby clients reserve their equipment and can take it home when their accumulated deposits equal the agreed purchase price. This is applied mainly to solar modules only; the end-user has the responsibility for installing the system. End-users often cut corners to save money; for example, charge controllers are seldom purchased because they are deemed unnecessary, or because systems are under-designed, with poorly matching components. This affects the quality of the installations, and end-users are likely to experience performance problems much earlier than necessary. The same problems are valid for cash-purchased systems.

The justification for developing a financing mechanism is to address these problems. People who find it difficult to pay a large sum of cash up-front will often be able to pay a monthly fee over a certain period to purchase a properly designed system. The financing mechanisms pursued in this project will ultimately allow for (1) a better control of the quality of the solar systems, thereby reducing the chances of early equipment failure; (2) a spread-out payment that makes it more affordable for the end-user to purchase this higher quality equipment; (3) an increase in the number of people who can enjoy services by SHS; and (4) scale-economies through bundled procurement and installation, which will also offset some of the costs of the loan and the costs of quality control.

The approach adopted is based on the cooperation of a finance partner and a technical partner with communities that desire solar electric systems. The finance company makes loans available to qualifying households and small businesses that desire lighting and small power systems. The technical partner insures that all systems are well designed, installed, inspected, and maintained. Loan agreements stipulate that the borrower follow technical guidelines set up by the technical partner to insure maximum system life (i.e., battery life). Rural-based service companies install and service the systems, while local artisans fabricate battery boxes and module mounts.

This manual has been developed based on "on-the-ground" field experience. Some of the issues and the manner in which they are addressed may be specific and may need to be adjusted to suit the local conditions/situations on a case-by-case basis. The manual does not provide a ready-made recipe for future programs, but merely provides feedback on an actual experience that could be taken into account when developing financing mechanisms for solar equipment elsewhere.

The work done in this project involved two different types of finance institutions that are already active in rural areas. In fact, both are recognized as leaders in their field. One is oriented towards giving business loans to small, well-organized rural groups and small businesses. Members of such groups are to guarantee each other and lower defaulting risks (i.e., peer pressure as collateral). The second type of finance group is an organized cooperative bank with experience loaning to individuals through rural-based savings and cooperative credit organizations (SACCOs). Described throughout this manual are the actual experiences of both institutions in adapting their existing financing mechanisms to the purchase and sale of solar equipment.

Identifying and Organizing the Rural Loan Groups

Several ways exist to identify target groups and cooperating technical and financing partners. If the initiative is starting at the community level, then interested groups must organize themselves and identify finance organizations. The groups must be legally recognized. If the initiative is starting from the financing institution, then target communities should be identified though outreach and promotional meetings.

The target group is informed of the benefits and disadvantages of solar electricity during awareness meetings. Minimum data on energy requirements are collected to determine the needs of the group in the target region. In areas where people lack an understanding of PV technology, demonstrations should be held to show how solar electricity works, and to discuss the costs and benefits. Groups or cooperative societies discuss the particulars of the loan program with the financing institution, and ensure that there are no further questions lingering. By the end of this process, the complete chain of players involved is identified, and clear guidelines of their roles and responsibilities should be in place.

The Loan Package

Group members apply collectively for loans from the finance partner. Loan application procedures should be those already established and tested by the financing institution and the credit group. With advice from a technical partner or selected local technicians, applicants choose a system size that best fits their needs. A limited number of standardized system packages is preferred for logistical reasons.[3]

For each applicant, the credit group approves a loan amount equivalent to the desired systems as per the technical partner's standard designs and the applicant's credit rating. Vetting and approval procedures should be those established by the individual groups. The

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[3] In this project three sizes of systems were offered, ranging from 20 to 60 watts.

group submits a single request to the finance partner once it has established its total loan requirements.

Each group collects deposits and payments from individual members using established procedures and makes regular payments to the finance partner. If repayment for the group as a whole is sound, the finance partner could recommend a further series of installations. Individuals with good credit history can apply for follow-up loans if they so desire (i.e., if they want a non-standard solar system, they can build it up over time with follow-up loans), or new applicants/members can join the group. The cycle of installations and repayment continues. When individuals complete repayment on a system, they become eligible for system expansion.

The Technical Package

Equipment is bid for by the finance partner or the loan group, with support from the technical partner. Who organizes the tender process is a decision to be taken by the finance partner; quality control is easier when the finance partner keeps this in-house, although the process may be more sustainable if it is done directly by the credit group. After evaluating the tendered bids, the successful supplier(s) delivers equipment directly to the group. The finance partner in turn directly pays the supplier(s) for the goods delivered. Minor components or accessories are procured by the installer at a budget recommended by the technical partner and agreed on by the finance partner.

The solar electric systems are installed by technicians selected by the credit groups and approved by the technical partner. In case the group cannot nominate a technician, the technical partner identifies and trains technicians based within the project area. During the installation, technicians are further trained on minimum installation code and standards.[4] Inspections are held on completion to confirm system compliance with minimum standards. The group should be fully involved and where possible a nominee from the group trained as inspector. Monitoring, repairs, and maintenance should be built-in into the technical packages, and provided for at least the duration of the loan repayment period. After this, clients can buy additional coverage.

Conclusions

It was indeed feasible, albeit difficult and laborious to organize, to establish financing mechanisms for solar electric systems for use in households and small businesses—once the right partners were identified and clear procedures were established indicating each partner's responsibilities. This is so despite the fact that solar systems are consumer goods that do not generate income in a short time period. The desire to have access to some electricity is so deeply rooted that households that have a chance to obtain a loan to acquire a solar electric system will do so. In order to get these financing mechanisms off the

4 Minimum installation code and standards cover issues from installation practice to user training.

ground, a certain amount of technical assistance for training and quality control is necessary, as is a limited financial assistance to slightly reduce the costs of the loans offered.

The financial institutions had no prior experience with solar loans. It took the research-oriented units that carried out the projects quite a while to convince their management that solar loans are worth pursuing. The two institutions now have sufficient experience to scale up the effort, although some support will be required to help them do this properly. The first 35 systems took 1.5 years to be installed properly. The next 50 took about half a year. During a next phase the two institutions should be able to install 500 systems in less than six months. In fact, under the IFC/GEF-financed Photovoltaic Market Transformation Initiative, it is expected that 1500 systems will be installed by the end of 2000 using the general methodology set forth in this manual.

Lessons Learned

1. **End-users** appreciated the opportunity to buy into a scheme to finance a SHS; they were able to acquire better-quality and larger systems than they if they had been on their own.

2. The **credit mechanisms** tested here all deal with groups of individuals, instead of directly with individuals. The bulk purchase of equipment offset most of the cost of financing the loans.

3. The **financial institutions** found it more difficult than expected to implement the financing mechanisms for solar equipment, even though these were based on existing mechanisms that they regularly apply for other purposes.

4. **Technical assistance** proved indispensable, and it should be available over a longer period.

5. **Maintenance** of SHSs was often a problem; however, it was built into the project and functioned well.

6. The Kenya Rural Enterprise Programme (K-REP) **solar business loans** are fully "mainstreamed" now. There appears to be a substantial demand for small loans (US$1,000–10,000) in the energy enterprise business.

7. **Interference** beyond control of the partners can play havoc with the process, and this is a real problem.

8. **Private companies** are eager to cooperate with this type of effort.

9. **Village-level installers** played a key role.

1

Background

1.1 Availability of electricity for lighting, radios, televisions, water pumps, tools, office, and other applications is essential to the infrastructure and development of any modern day community. When electricity is available, contact between remote areas and the rest of the world becomes possible, business opportunities are created, and efficiency is vastly improved in the delivery of health, education, water, and other services to the community. Unfortunately, options for rural electrification are limited by their cost and applicability. For very basic lighting and amenity power, kerosene and dry cell and SLI batteries are the only options available and affordable to most rural households, even though over time they are expensive, inconvenient, and environmentally costly. This holds for Kenya as well as for many other (African) countries.

1.2 In Kenya, a connection to grid electricity in the near or medium term is not feasible for a vast majority of rural households. This is because there has been (1) a notable reduction of investment in the energy sector in the last decade, (2) a slowing of growth in the national power generating capacity, and (3) a reduction in the effectiveness of the Rural Electrification Program compared to population growth.

1.3 For homes and small businesses, conventional petrol or diesel generators are too expensive in terms of purchase price, operation, and maintenance. Recognizing their limited chances of being connected to the grid, many rural households opt to buy solar electric lighting systems. They often buy their equipment piecemeal, one component at the time—e.g., first a battery and a television; later, a first small solar module to avoid frequent recharging of the battery; and so on. This requires good skills on the part of the users, as the systems are technically imperfect.

1.4 Still, despite the favorable conditions created by a strong middle class and a high demand for PV technology, the great majority of rural households in Kenya (see Box 1-1) and other countries have not installed solar systems for a variety of reasons including the following:

- **High incremental costs of solar home systems.** These costs cannot be met by most households, making income the most important constraint in uptake. Duties and taxes on imported PV equipment, high dealer margins, and high costs of doing business contribute to relatively high prices for PV electricity system installations.
- **Poor reputation of PV technology**. Often PV is seen as an inferior technology, not because of its functionality but because of a lack of enforced installation and design standards, mixed quality of balance of system (BOS) components available locally, and a lack of full awareness among end-users on operation and maintenance of solar electric systems. About one-third of the existing systems in Kenyan rural areas are not fully operational because of poor installation, customer misuse, and poor design practices.
- **Lack of access to finance.** This prevents end-users from investing in suitably sized and installed systems. Financed solar electric systems are an attractive option for rural households and small businesses because financing allows end-users to buy properly designed, high-quality systems—larger systems than would be possible to purchase with cash. Regular monthly payments for PV systems (which are not much larger than current energy expenditures) should suffice, over time, for loan repayments. Furthermore, the cost of financing systems can be offset by bulk purchases, which allow higher economies of scale.

Box 1-1. The Kenya Situation

In Kenya less than 0.5% of rural households have access to grid electricity while population growth exceeds the rate of rural connections despite major investments in the rural electrification program. Kenya has been an active market for solar home systems for almost a decade, during which more than 150,000 units have been installed on a commercial basis and an estimated 15 -25,000 new systems being installed yearly. Whereas the figures are based on module sales, it is important to note that not every system is 'complete' (i.e., uses a charge controller). The private sector has responded quickly to this growing consumer need, offering an increased and diversified supply of solar energy components and technologies on the market. Currently there are more than ten solar module distributors and at least five companies manufacturing balance of system components (BOS). Scores of agents market, install and service solar electric equipment in rural areas.

Presently the estimated size of the Kenya solar PV market is valued at about US$5 million and has been growing at more than 25 % per year for the last 7 years. Today, there are more rural Kenyan households with solar electric systems than the government's Rural Electrification Programme customers, despite the fact that PV equipment is taxed and REP equipment is subsidized!. This demand has created and sustained a growing market for solar products and services, mainly from households with ability to meet initial costs of purchase and installation. Most of these relatively well to do households have acquired systems on a cash basis, indicating that affordability, among other considerations, is an important factor in the solar energy technologies uptake among rural households.

1.5 The work in this manual is based on the premise that solar home systems (SHS) are a mature technology and that, with some effort, they can become products offered routinely by financial institutions, in much the same way cars are financed through loan packages in industrialized countries. However, finance efforts in Africa have often failed because not enough attention is paid to details of the finance process or the sustainability thereof. The difficulties involved in setting up a loan program should not be underestimated. Indeed, despite the involvement of two professional finance institutions, this pilot effort suffered many of the pitfalls associated with rural finance. Managing loan programs with dispersed groups of beneficiaries is a risky and complicated business if not done correctly. The three key obstacles faced during this initiative were as follows:

- Banks were not familiar with SHS technology, and although they immediately saw the potential for large-scale application and the impact it could have on rural development, they were hesitant to make a full commitment and required outside funding to start addressing the issues.
- Rural groups had very high, often unrealistically high, expectations of the project.
- Despite the large number of solar systems in use in Kenya, technical capacity for installation and maintenance is very limited in rural areas, and substantial training was required.

2

Objectives of the Implementation Manual

2.1 This manual presents a method for using commercial finance to provide basic rural electric services using solar electricity. It is designed primarily to supply solar home systems, whose high demand in rural Kenya is due to the priority rural people give lighting, TV, and radio services. This approach—refined through actual pilot experience—employs technical and finance partners that cooperate with rural groups in specified target areas.

2.2 Specifically, this manual seeks to:

- provide an integrated package that links rural finance mechanisms with the provision of properly designed, installed, inspected, and serviced high quality solar electric systems at the local level. Technical specifications insure that the systems last longer than the length of the loan repayment period;
- establish credit procedures for lending to rural households through local savings or credit groups. This manual describes two schemes for providing SHS loans. Both loan methods specified maximum payback periods of 18 to 24 months. Interest was fixed by the finance institution as per normal prevailing rural rates, possibly slightly reduced through external financial assistance;
- establish credit procedures for rural-based enterprises with potential to increase productivity with access to electricity. Such enterprises can sell equipment (PV systems, components, appliances), electricity (i.e., for lights/radio power in market centers, battery charging), or services that electric power enables (electric workshops, video cinemas, etc.);
- provide guidelines for use by locally based solar and rural electrification (RE) establishments and/or companies for design, installation and service of systems. In the package described herein, local technicians are trained and certified to install and service solar electric systems. Individuals from loan

groups can also be trained as inspectors,[5] and to know when to call for a technician or have the owner do the repair himself;

- provide assistance to borrowers (end-users) in the form of energy management, maintenance, training, etc. to properly operate their systems and/or business planning (when applicable);
- provide technical support services to local technicians in solar systems design, installation, quality control, systems sizing, component procurement, technician training, etc.; and
- provide sustainable methods for monitoring, evaluating, and documenting the performance of systems and the effectiveness of the financing mechanisms.

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[5] Inspectors will examine systems to verify that they are installed to standards.

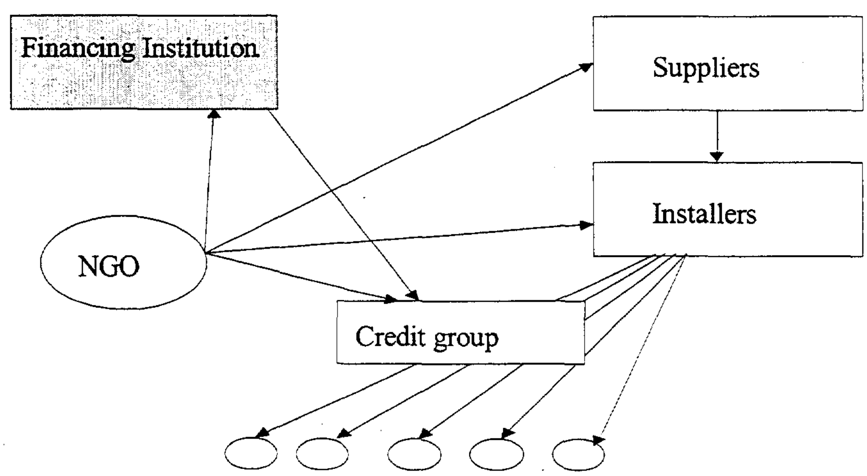
3

SHS Finance Methodology and Player Roles

3.1 In the system outlined herein, a finance group advances loans and earns income from interest and fees. The technical partner provides, for a fee, a defined number of technical services, including supply of components and the design, installation, and maintenance of solar systems at market prices. Rural groups are the beneficiaries of the project, and are active participants in the project through their loan organizations. Figure 3-1 shows the envisaged project operational schematic.

The Solar Home System Finance Process

Figure 3-1. Envisaged Project Structure, with an NGO Managing



3.2 Essentially, there are three parts to a SHSs finance initiative. The initiative must:

- find and organize one or more groups of loan customers;
- provide customers with loans that are continuously offered; and

- insure that the PV systems work properly, at the minimum for the duration of the loan.

These three steps are outlined here and discussed in detail in their respective sections.

- Step 1: Identifying and Organizing the Rural Loan Groups
  - ➢ Outreach and promotion
  - ➢ Market survey and customer screening
  - ➢ Group identification
  - ➢ Group formation
- Step 2: The Loan Package
  - ➢ Loan package design
  - ➢ Screening and acceptance of loans
  - ➢ Loan disbursement
  - ➢ Loan repayment
- Step 3: The Technical Package (designing, packaging, delivering and maintaining the PV product)
  - ➢ System design and sizing (packages)
  - ➢ System tendering, procurement and payment
  - ➢ Delivery, installation, certification, end-user training and inspection
  - ➢ Maintenance and service of systems

The Groups Involved in the Process

3.3 Two keys to the success of a SHS financing mechanism are (1) to keep it as simple as possible and (2) to satisfy the interests of all parties. Depending on the location and needs of the beneficiaries, different players may be involved in different circumstances. For example, the loan groups might be locally based NGOs, credit groups, cooperatives, etc. The technical partner could be a dedicated solar company, a technical consultant, a power company, etc.

3.4 There must be a clear understanding of the specific roles among the project partners for smooth and sustainable operation of the project. A **memorandum of understanding** or **contract** should be drawn up between the finance partner and the technical partner, and between the finance partner and the rural loan groups, and duly signed by all parties. These documents should specify each partner's responsibilities and obligations to the project. There should be clear terms of reference for the above partners and any subcontracted parties.

3.5 Finance groups, rural loan groups, and technical partners must agree on timetables, record-keeping methods, and key milestones to be completed during the project. In order for the project to retain momentum, and to remain interesting to the groups involved, the timetable should be realistically drawn up, and carried out. Partners must agree on fund transfer methodologies (i.e., LPOs, payment on delivery, etc.) well in advance of project execution.

The Finance Partner

3.6 The finance partner oversees the loan process, ideally on-loaning to a number of rural credit groups and developing a package that can be used in a number of locations. Its work involves design, implementation, and management of the credit scheme, and may include loan collection. The finance partner should work within the protocols of its network of rural loan groups.

3.7 With the support of the technical partner, the finance partner may also be responsible for tendering bids for and procuring project equipment, and payment to suppliers and technicians for equipment and services rendered.

Rural Loan Groups

3.8 Rural loan groups should be structured groups of individuals with a common desire to obtain services that PV can provide. Preferably, they should have experience with participating in or managing credit schemes. The group should at the minimum:

- have a defined leadership,
- be a legal entity, and
- have an established bank account and lending system.

3.9 Individuals and small businesses outside of loans groups should only be considered if they can individually guarantee their loans and if such loans will benefit the overall program.

3.10 The rural loan group's main duties are:

- ensuring that loans are repaid promptly using existing mechanisms, and
- repaying these funds to the finance group.

3.11 In addition, rural groups may be responsible (often with the technical partner) for:

- conducting demonstrations of SHS in new areas,
- pre-screening beneficiaries ability to repay loans,
- assessing energy requirements and types of houses,

- selecting and hiring technicians,
- storing equipment and preparing sites before installation, and
- ensuring that the systems are inspected and maintained.

3.12 With regard to this last goal, the loan group may nominate able persons to be trained by the technical partner In the long term, loan groups may desire to take on contracting of system installation and inspection activities to reduce costs.

The Technical Partner

3.13 The technical partner insures that solar electric systems are properly designed, installed, and maintained. The technical partner may also:

- develop a tender and procurement process of equipment to insure quality of components and price competitiveness.
- develop (or set) a minimum installation code to be observed by all participating teams.
- be responsible for training of installation technicians and endeavor to ensure end-users are adequately trained on minimum system maintenance by the installation technicians
- ensure that systems all installed systems are inspected in line with the minimum installation code.

Other Project Players

3.14 In this initiative, the technical partner subcontracted supply and installation of equipment to local companies. Central PV suppliers were asked to bid competitively for equipment. Local technicians installed the equipment to acceptable standards.

3.15 **Private sector agents/dealers (suppliers)** supply major system components (modules, batteries, charge controllers, lights and fixtures, and DC sockets) through a tender process. This project bought systems in batches of 25–30 units, thereby obtaining significant cost reductions for systems.

3.16 Rural-based **technicians** install systems and offer service subcontracts to system users under a contract developed by the technical partner. They will also be required to supply minor system components (e.g., cables, switches, clips, and junction boxes). Funds for the purchase of these components may be provided by the finance partner (through the group) before commencement of work (due to their small size). As the loan scheme grows, they play a larger role in equipment supply.

3.17 To insure that systems work for the loan period (two years), they must be installed to acceptable standards. There is therefore a need for independent, trustworthy **inspectors** to visit systems to verify that installation standards are met.

4

Identifying and Organizing the Rural Loan Groups

4.1 The loan process for SHSs depends on the complete involvement of community loan groups in project planning and execution. Group identification is thus a crucial step, as only strong, self-reliant credit groups will be successful. Ideally, the finance partner should select groups to participate in the scheme. However, because the technical partner (or solar company) is more likely to be motivated to identify potential markets for its product, its input may be required. During this stage, a number of activities need to be undertaken simultaneously, including awareness raising, loan group sensitization, user identification, and market surveys.

Surveying the Market

4.2 The target market for SHSs must be viable. To insure that it is, a profile of the market should be drawn up to establish whether the target group

- has sufficient knowledge about solar equipment,
- views solar equipment to be a priority,
- can afford solar equipment systems, and
- is willing to pay for solar equipment systems and installation and maintenance, plus finance charges.

4.3 This can be done through market surveys that analyze data from target individuals and groups. In areas where solar PV is well known, it may not be necessary to conduct surveys. Advertising the program and asking potential buyers fill out application forms for systems may be sufficient to gauge demand.

4.4 If a survey is carried out, it should be short and simple enough to be completed quickly (see Annex L). Lengthy surveys add much time to the data collection process, and thus to the costs. An adequate sample size should be used (i.e., more than 50 respondents) that is properly weighted from each of the target groups. The survey group should not be a random sample, because not all rural individuals will be able to afford even financed systems (in Kenya less than 40 percent of the rural population can afford "standard" SHSs, even if financed). Effort should be made to make sure that the sample group is representative of the target group.

4.5 The data gathered should include current expenditures on energy (kerosene, dry cells), incomes, and previous loan history. The data should be analyzed in such a way as to enable the finance partner to make a decision to invest in solar electric equipment for this community. Other information from the survey will be used to design the finance package and solar electric systems.

4.6 For the finance partner, the survey should answer the following:

- What are regular incomes and ability to pay?
- What is the maximum size of loan that can be offered to the target group?
- Are the loan groups sufficiently organized?
- What repayment periods, interest rates, and monthly payments are individuals expecting?
- Do individuals in the group have a history of receiving loans and/or saving?
- What is the community's record in terms of repaying or defaulting on loans?

4.7 For the technical partner, the survey should answer the following:

- What are current energy use and expenditure patterns?
- What are the energy need priorities?
- How are households dispersed, and what are the types of houses?
- What size(s) system can best meet the needs of this group?
- What is the history of PV systems in the target area?
- Are the end-users expecting more power than PV can economically deliver?
- Are the end-users likely to follow guidelines recommended by the project?
- To what degree must end-users be educated about PV systems?
- Is there a capability to install, service, and maintain, or must this be developed?
- Is there likely to be a grid extension to the target area?

K-REP Mt. Kenya Pilot Survey

4.8 During the pilot initiative, a needs assessment survey was conducted among 60 community members in two target communities in the Mt. Kenya area. The surveyed group included individuals who had an interest in obtaining PV systems and who were also members of informal solar groups. Individuals from the survey areas were informed well in advance that a survey would be conducted.

4.9 The survey found that the target groups selected were good risks for solar lighting systems credit. Specifically, it found that:

- Most could afford a solar loan, with the average requested loan amount at KSh 40,000 ($700).
- Average monthly expenditure on energy (excluding heating and cooking) was KSh 570 (about $9), spread equally between kerosene and dry cells.
- 25 percent had experience with PV systems.
- More than 80 percent had received loans before.

Cooperative Bank Group Identification Experiences

4.10 The Co-operative Bank of Kenya, Ltd. (CBK), identified two loan group partners without conducting formal market surveys. Because the bank has a large network of partner SACCOs (more than 2000), it simply contacted a number of its most successful SACCO partners and asked if the members were interested in solar lighting systems. Several SACCOs responded immediately. They were located in high-income, off-grid, tea-growing areas and had members that were already familiar with PV systems. They invited the project team to come to make presentations to their groups.

4.11 CBK and Energy Alternatives for Africa Ltd. (EAA) sent teams to meet with SACCO groups; the first meeting took place with the Muranga Tea Society in March 1998, the second with Ol Kalou Dairy Cooperative in October 1998. These meetings were held during ordinary SACCO membership meetings. Systems were demonstrated and discussions about the technology were held with the groups. The prices for systems to be offered by the project—which were much lower than typical commercial prices—were advertised. In both cases, there was a high interest among group members and sign-up lists were immediately filled up. Consumer demand was so high that all of the available systems were immediately booked.

Identifying and Forming Loan Groups

4.12 Efficient, organized, honest loan groups are the cornerstone of any rural finance program. The finance partner must organize the loan groups and fund recovery method. A good solar finance program therefore needs *well-run loan groups*. Organizing *new* loan groups based on potential solar home system loans is relatively complex process. Rural customers for SHS are very widely distributed, and communicating between and arranging meetings for such groups, particularly when they are self-funded, is logistically difficult. As explained below, although this project expended significant resources helping several groups organize themselves, the groups did not stay together for a number of reasons.[6] If new group formation is attempted, it should not be taken lightly, and it should be done by skilled finance groups. The K-REP case study below may help others avoid the pitfalls of setting up new groups from scratch.

4.13 Working with *existing* rural credit groups is, in this initiative's experience, the most effective way to develop SHS loan packages. Established credit groups have (1) a history that the finance partner can review and (2) screening methodologies that are more impersonal and objective than they are for "informal" groups.

4.14 In this project, two types of rural loan groups were used:

- **K-REP Informal Loan Groups**. These groups were formed for the expressed purpose of getting solar loans. K-REP guided the organization of the groups through its field offices.
- **CBK Rural SACCOs.** These are established tea and dairy societies that handle payments for rural tea farmers. They give farmers loans based on their tea/cash crop income. Because of the poor likelihood that the grid would be extended to their location, many of the households prioritize solar-powered lighting and TV systems. The tea SACCOs are relatively rich, and maintain a dollar account for their foreign exchange earnings. CBK Ltd. also worked with dairy SACCOs that are generally less well to do than the tea SACCOs.

Group Formation Experiences

4.15 It was crucial to K-REP that they get groups that had the right attitude toward the loans, so the initial group screening process took longer than anticipated. K-REP engaged in preliminary discussions with several groups—two in Mt. Kenya Region and two in Western Kenya—before actually offering loans. The initial two informal loan groups around Mt. Kenya did not work out (after a six-month group identification and formation effort). K-REP then took the finance package to Western Kenya, from where they had received applications from several groups of secondary school teachers. These groups did accept the terms, and ended up receiving loans for 35 systems. Coop Bank selected Muranga to work, based on its experience with the SACCOs in that area. It discussed the project with a few selected SACCOs, and started working with the tea cooperative that reacted the quickest. It later started to work with a dairy cooperative as well.

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6 Other projects in East Africa (Uganda, Tanzania) have been unsuccessful in their attempts to create solar PV loan groups.

4.16 **Approach 1: Self-Selected K-REP Groups (Mt. Kenya).** These groups had earlier approached the technical partner (EAA) for assistance in developing a solar loan program,[7] and therefore had some knowledge of solar equipment. The project staff felt that this awareness would be of benefit to the project. K-REP and EAA conducted outreach and promotion campaigns to sensitize the community on the project and the loan delivery processes. However, the close links between the technical partner and the loan groups proved to be a handicap, not an aide, to project implementation, as the end-users expected the project to subsidize finance and system costs. One village loan group expected the project to cover group formation costs and to greatly lower interest rates on their behalf. This very first step of the project ran into so much trouble that the partners had to threaten withdrawal of the proposed services.

4.17 The two Mt. Kenya groups were unsuccessful because of poor leadership and lack of focus on a specific activity that could hold the members together beyond the solar energy loans. However, the finance partner, K-REP, did not effectively coordinate loan group formation activities, and there was a breakdown in communication between the two parties. The reason for this low performance can be explained on two levels:

4.18 The field staff had not been adequately sensitized to the importance of the project as part of K-REP's research efforts to develop new products for micro finance services; and

4.19 Because the credit officers were already "overloaded" with their normal credit-supervision portfolio and with the small solar business loans, they found it difficult to create adequate time to attend to the new initiative, which by and large was considered risky.

4.20 **Approach 2: K-REP–Selected Loan Group (Western Kenya).** In Western Kenya, K-REP used a different approach to identify loan groups. K-REP field office staff, installation technicians,[8] and solar companies were briefed on the project, and were requested to seek potential partner groups. This approach generated a favorable response as groups from different parts of the country put in applications for assistance to install solar systems in their homes. Due to fund limitations, it was decided that an area with a high concentration of interest should be chosen. Five groups with 60 members were selected from among the many that applied from Bungoma District of Western Kenya.

4.21 In this stage, three groups were registered self-help groups composed of locally based teachers. These groups were well organized, with regular savings contributions and bank accounts, but without the rigid savings rules described in the project processes above. Two of the groups came together solely for the purpose of accessing solar loans and were unstructured, unregistered, and lacking in savings activities.

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7 In fact, they had approached the technical partner to help them design a finance project.

8 These technicians approached the technical partner looking for credit schemes for PV systems.

4.22 **Approach 3: CBK Pre-Formed Groups (Muranga and Ol Kalou).** An advantage of the CBK program is that their loan groups are fully organized *before* the project begins. They are fully formed tea societies and dairy cooperatives (i.e., savings and cooperative credit organizations, or SACCOs) with memberships numbering in the thousands that have established management structures, constitutions, meeting schedules and bank accounts. They also have buildings and other assets.

4.23 In this case, there was no loan group formation process. The finance and technical partner spent several person-days with the SACCO leadership, and in general meetings. There was general enthusiasm for the product and the prices offered, and the groups quickly incorporated SHS loans into the package of loans that they already offered to their clients (the loan process is described in the next chapter). As mentioned before, a sign-up list was circulated that included a pre-qualification and SHS sizing sheet, and the available systems from the finance group were quickly applied for by SACCO members. This worked well for one SACCO.

4.24 For the other SACCO, local politics clouded the process and created delays. Maintaining group interest in the solar equipment package presented some difficulties:

- Timing: Rural people prefer to buy SHSs during the last quarter of the year. In other quarters, they have heavy financial loads (school fees, agricultural investments, etc.).
- Agriculture: A collapse in the Kenyan dairy market and Kenya Creameries Company caused immediate problems with the Ol Kalau group, a dairy cooperative.
- Personal politics: One of the more influential SACCO managers of the first SACCO was able to steer the project team away from the SACCO he manages after a number of systems were installed, to a SACCO in his home area.

5

The Loan Package

5.1 For the finance approach to work, loan recipients must be capable of taking on PV electricity system loans to be paid in 12–24 months. Loans for solar electric systems should be provided using existing the methodologies of finance institutions or loan groups. This manual outlines two finance approaches for PV systems that address the lighting and power needs of

- rural households with regular cash income, and
- small businesses with the potential to increase productivity with PV electricity.

5.2 The finance system design should adopt an acceptable set of credit (and, if necessary, savings) policies and procedures. These should govern finance operations and management while at the same time safeguarding the interests of the group members, the group, and the finance partner by incorporating the principles of equity, sound economic practice, and flexibility. The system design should be regularly reviewed to take into account experience.

5.3 One financing method involved a participatory self-organized loan group guided by a successful micro-credit NGO, K-REP,[9] whose approach has been shown to be successful in poverty alleviation on a wide scale. The other method used established savings and credit cooperatives (SACCOs, which provide loans to their members based on income from cash crop earnings) organized by a national cooperative bank, the Cooperative Bank of Kenya, Ltd. (CBK). In both cases, the project approached the financial institution with limited grant funds and requested them to on-loan funds to the rural loan groups using established practices. As described below, both approaches have their relative merits and disadvantages (see Table 5-1).

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[9] K-REP's objective is to develop appropriate financial products, services, and systems for the poor. Its capital stands at KSh 600 million and its rural portfolio at KSh 165 million; it has 8 rural branches and 159 employees.

5.4 Note that both rural loan groups and finance institutions must be fully involved and interested in the activity from the start. There is always the danger of the international "PV agenda" or "donor agenda" involving finance institutions in loans they would not ordinarily service or handle.

5.5 Neither K-REP nor CBK had previous experience funding PV technology. Initially this lack of awareness of PV technology among their management and field staff was a major hurdle to the project; often, rural customers were much more knowledgeable and interested in PV than the banks. This meant that there was a relatively long "gearing-up" process during which time the finance groups familiarized themselves with the technology and developed the confidence needed to put their resources behind it.

Table 5-1. The Two Types of Loan Packages

	K-REP	*Cooperative Bank & SACCOs*
Down payment	No	25% of loan
Interest rate	18.5%	About 12%; exact rate to be decided by SACCO
Fees	0.5% insurance fee 1% set up fee passbook (KSh 100) membership (KSh 150)	None. SACCO members are already registered.
Loan term	Max. two years	Max. two years
Loan amount	Three types were offered (20, 40, and 60 Watt), ranging from KSh 32,000 to 68,000. This included installation costs and pre-paid maintenance costs for 2 years.	The same types were offered, but only the 60-watt was selected.
Requirements	Savings: min. KSh 100/month > 10% of loan	Must be registered SACCO member.

The K-REP Program

5.6 The K-REP model combines provision of credit and loans with savings mobilization, in a system similar to the Grameen Bank in Bangladesh. Organized rural groups guarantee one another when taking loans, and their combined savings become a hedge against default. Credit policies provide directives for implementing and administering finance operations. The savings policies relate to group members savings obligations, while group policies outline the conditions and provisions for group membership.

5.7 The K-REP group-lending methodology has been applied to microenterprise development in many poverty-alleviation programs around the region. The approach accesses credit and other services to individuals through community groups. It has been successful because it reaches large numbers, realizes high loan collection rates, empowers the target group to actively take decisions that affect them, and generally contributes to an improvement in the living standard of the beneficiaries. It should be mentioned that, K-REP, up until the time of this work, had extended loans for businesses only and did not have a consumer loan portfolio, so the SHS work was a completely new type of loan for them.

5.8 Ultimately, however, K-REP was convinced that PV could offer an alternative to stalled rural electrification programs, and agreed to participate in the project to gain experience with a new type of consumer loan using their standard participatory loan techniques.

5.9 K-REP used the following credit guidelines for solar loans:

- **Eligibility**: Eligibility for assistance is limited to the registered members only, through their groups that will have been approved by the finance partner. The members will be required to conform to the rules and regulations governing the activities of the registered group. For groups to be eligible to draw funding from the finance partner, they must have been registered with the finance partner for at least six months. The groups' financial status must also be sound and its savings account must have a balance of at least 10 percent of the requested loan amount.
- **Loan application**: Individual loan applications are submitted through their respective groups, which are responsible for assessing and approving applications. The groups subsequently apply for funding from the finance partner.
- **Loan assessment and approval**: Loan requirements for each member will be determined by the group's constitution. The amount to be borrowed will be based on the cost of the system as determined in the design by the technical partner. The group will assess and approve all individual loans. Before approving any loan to a group the finance partner shall use its own method to verify the group's financial status, history, and reliability. Loan approval shall be subject to the fulfillment of the finance partner's requirements.
- **Loan collateral**: The group members' shares or savings within the group shall be used as collateral. The groups in turn should also have savings with the finance partner to be used as collateral.
- **Loan disbursements**: On approval, loans will be disbursed to the loan groups only after a loan agreement between the loan group and the finance partner has been duly executed. The finance partner will turn prepare payment checks to equipment suppliers/installers so that bulk supply arrangements can be effected.
- **Loan size**: The loan amount provided will depend on the size of the desired "standardized" system and the user's actual and proven ability to repay the required loan, as decided by the group.
- **Service charges and fees**: Loans to group members will attract a service charge or interest rate agreed on by the group but should reflect the interest

rates normally charged by the finance partner. For this project the rate was a flat 18.5 percent; after charging an insurance fee of 0.5 percent and an application fee of 1.0 percent, the total charge was 20 percent. (By comparison, commercial rates in Kenya range from 25 to 30 percent.) The finance partner will charge the loan group a reasonable interest rate, which should be reviewed from time to time to reflect cost recovery and project sustainability requirements.

- **Loan repayment**: Loan repayment will be remitted directly to the finance partner by the loan group. In cases where group members' payments come through the groups account (as in the pilot case), members' repayments are deducted and the lump sum amount submitted directly to the finance partner. Early repayment is allowed without penalties.

- **Type and purpose of loan**: In this scheme, loans will be exclusively be short-term (1–2 years) and will be provided to households and small businesses for the purpose of purchasing and installing solar electric systems for lighting, TV, radio and other possible applications related to the promotion of usage of solar technologies.

- **Defaults**: Defaults will be defined according to the finance partner's and the individual group's constitutions. In case of default in payment by the group, or if the group becomes insolvent before completion of loan repayment, the finance partner shall hold the individual members responsible. However, the loan group will be responsible as long as it exists and should deal with any defaulting individual according to the group's policy on defaults. Group members who fail to pay the default amount in full are required to repay the outstanding amount from their group savings.

- **Bad debts**: Loan amounts that cannot be covered by members' savings may be considered bad debts by finance partner. The finance partner will then have to consider and discuss alternative means of recovering the debt, which will include repossessing the solar electric system as a last resort.

- **Subsequent loans**: Once a group member has successfully completed repaying a loan, she/he will qualify for a second loan for a system upgrade if so desired. (This will also depend on the number of group members interested in the upgrade). In all cases, the loan granting process will be repeated subject to availability of funds. Only those groups that maintain a 100 percent repayment rate throughout the loan period will qualify for second and subsequent loans.

Box 5-1 (on the following two pages) describes K-REP's loan experience during the project.

The Cooperative Bank of Kenya Program

5.10 The Cooperative Bank of Kenya, Ltd., (CBK) adopted the following procedure for assessing and approving loans:

- The Cooperative Bank identifies a potential SACCO partner, based on its credit history, total number of members, and potential interest in participating in the solar pilot scheme
- A joint awareness meeting follows in which the technical partner, Cooperative Bank, and the SACCO members discuss the possibility of solar loans. In practice, these meetings were held to coincide with the annual general meetings of the SACCO. During these meetings, SHSs were demonstrated and explained to members, and system prices and options were given.
- If SACCO members agree that the SACCO should participate, the SACCO management pre-selects qualified applicants and forwards this list with an application for a solar loan from Cooperative Bank at the nearest Cooperative branch. The application is a short form that provides the necessary elements to determine the size of the solar system
- The Cooperative Bank branch appraises the SACCO after the application letter is received. If the SACCO qualifies, a letter of offer is sent to them detailing terms and conditions of loan.
- The SACCO collects deposits (25 percent) from its members and forwards the check to the Cooperative Bank.

5.11 The SACCO signs a letter of offer and equipment is ordered and delivered. The Cooperative Bank procures the equipment and pays the suppliers. Installation procedures follow.

Box 5-1. The K-REP Loan Experience

Approach 1: Self-Selected K-REP Groups (Mt. Kenya)

In the Mt. Kenya region, two groups were organized and registered between December 1996 and February 1997. One of them, however (the Tharaka-Nithii group), dropped out of the project after failing to come to an agreement with K-REP on loan terms. The second group (the Ukuu Village Group) initially accepted the K-REP terms, and loans (KSh 423,547) for 14 systems were disbursed to the group account. The group leaders were supposed to coordinate further disbursements to equipment suppliers and installation technicians, based on competitive quotations that the technical partner had organized.

Unfortunately, once the funds were under their jurisdiction, the Ukuu Village Group reverted to earlier demands, and pressed for concessions on the loans from K-REP. These demands were that the financier (K-REP) should

- waive the requirements on savings contributions and monthly group meetings;
- reduce the interest rate on loans from the proposed 18.5 percent per annum to less than 10 percent p.a.;

- allow a loan to be given to each individual borrower, who would then choose the component supplier and installer without EAA intervention; and
- give an assurance that the loans would be written off in the event of drought or famine.

K-REP management rejected these conditions and recalled the loan in May 1997. K-REP policy is quite clear on negotiating loan terms with client groups, and there were a number of reasons why renegotiating was unacceptable, including the following:

- A prospective borrower should not be allowed to set his/her own set of terms and conditions under which to borrow from a prospective lender.
- There was an ongoing micro-enterprise development program in the area whose clients were already borrowing under the same terms and conditions, having fully accepted them as being fair enough.
- To accept the demands from the prospective solar energy clients would have set a dangerous precedent for future lending operations.

In fact, both of the above groups knew that the funds being disbursed were from a donor for a pilot solar project. Based on this knowledge, they tried to negotiate better terms for themselves. In addition, they were not sure how well the solar PV technologies worked and thought that they should get better terms because they were "guinea pigs."

K-REP acted properly in rejecting the clients' changed demands. Acceding to the demands could have encouraged cheating, including diversion of funds to unrelated activities or taking shortcuts to avoid meeting the required quality standards in solar components and system installations and maintenance that were being promoted in the project.

Clearly, for the Mt. Kenya farmers and teachers with access to other loan sources, 20 percent interest rates were too high.

However, K-REP's failure to exercise flexibility in the initial stages of the effort proved quite costly in terms of wasted time and effort. When introducing new loan packages, there is a need for flexibility to determine what works and what does not, and to encourage local groups to feel local ownership of the project.

Approach 2: K-REP-Selected Loan Group (Western Kenya)

Five groups of teachers approached K-REP in Western Kenya to have solar lighting systems installed. These groups were less well organized than the Mt. Kenya group, and had also come together chiefly for the purpose of getting a solar lighting system. The first wave of 35 loan applicants from five groups were processed and loans were disbursed direct to equipment suppliers and the technical partner (the latter for provision of technical services) in December 1997, three months after reception of applications. System installations began between February and April 1998 and were subcontracted to two local installer companies.

Upon delivery and pre-inspection of the equipment of the 35 systems, irregularities began to occur. The two companies were assigned different target groups for which to install and maintain systems. One company installed about 17 systems correctly. The other company started to install systems before contracts were signed between K-REP and the end-user. In addition, the latter company's systems were almost all installed incorrectly. In all, 26 systems were installed before the process was stopped. It took the two installer companies several months to sort out the differences between themselves, K-REP, and the customers. In the end (April 1999), K-REP gave the job of installing the nine remaining systems to the first installer.

As of December 31, 1999, 50 percent of the outstanding loan value had been repaid. Some 17 percent of the households had paid off early; 17 percent were on time with repayments; 17 percent were somewhat behind; 46 percent are in default; and 3 percent had their equipment repossessed. All loans were to be cleared by June 2000, but there is some doubt that this will happen.

Problems encountered were the following: people refused to pay when their system malfunctioned; technicians failed to honor their commitment to provide maintenance services over the two years of the loan repayment; and technicians failed to respond to customer requests for assistance. Finally, loan repayment seemed to be taken less seriously over time.

Observations

Developing Financing Mechanisms

5.12 Adapting the loan packages required significant resources that had to be budgeted for. This was so despite the fact that the financial institution had considerable experience in applying such loan packages for other purposes. Training of field officers, management, and technicians needs to be taken into account and factored into cost calculations (be they project or commercial).

Coordination between Technical Partner, Finance Partner, and Loan Groups

5.13 Each partner has different organizational priorities and different levels of bureaucracy. Finance partners usually have a fairly large internal bureaucratic system in place, which means that they cannot always react quickly to demands from other project partners. The loan groups have their daily tasks to worry about for survival, and cannot always schedule a general meeting during the working hours of the financing partner. In reality, much of the coordination was born by the technical partner.

Scale Economies from Bulk Purchase

5.14 The procurement of SHSs for a group of 40 beneficiaries took some time to organize because of the tendering process, but the resulting savings were considerable (See Annex A for more details) and could reach 20 percent or more. These savings can be used to offset the cost of finance, and to purchase higher quality equipment than would have been possible without a loan.

Business Loans for Solar Enterprises

5.15 A lack of modern energy is seen as a barrier to development, and the productive use of energy is often considered a priority for rural development. However, loans to "solar" businesses that use the energy for productive purposes are perceived as risky by conventional banks. The project attempted, as did several parallel efforts financed by the same donors, to develop a line of solar business loans in conjunction with local finance groups. Note that solar electricity is not economically viable for energy-intensive tasks such as milling and welding. The loans successfully disseminated in this effort were provided to enterprises that use electricity for such non-intensive uses as rural entertainment, battery charging, and lighting, or to enterprises that sold PV products themselves (see Table 5-1). The objective of this activity is to assess whether such loans are indeed sustainable, and whether they could have a positive impact on the micro enterprises involved in solar business.

5.16 During the course of this project, eight loans were issued to businesses engaged in solar activities (see Table 5-2). Two of these loans were issued by EAA as part of an overall ESMAP/Ashden Trust–funded activity; five others were issued by Kenya Rural Enterprise Programme using funds provided for this purpose by the Ashden Trust; and one was issued as part of the Cooperative Bank SHS loans (the bank was unaware that the loan was not for a SHS but for a business). All of the loan recipients required constant technical back-up from EAA.

5.17 The five K-REP business loans were issued within the organization's normal loan procedures (18-20–percent interest rates, security, full assessment process). By the time five loans (valued at about $21,000) were issued, a further eight applicants had applied for loans (worth $50,000; see Table 5-2). Of the first five loans, four were paid on time and one paid late. Since K-REP split into a bank and an NGO, it featured solar loans as a regular item in its lending program.

5.18 The two EAA loans were non-commercial in nature, as they were offered for rural ventures that were new, untested, and risky. The loan offered in Kenya was tendered to about 15 organizations working in PV, and was awarded to the organization with the best proposal (Bright Home Solar Energy in the Kisumu district). Bright Home Solar Energy set up a solar service center that served as a PV sales outlet, a solar battery charging station, and a video-cinema (in addition to a pre-existing photo studio). The loan proved that a PV-powered enterprise in a rural area can be a commercial success; despite the fact that loan repayments to EAA have been temporarily behind schedule, the loan is being fully paid back.

5.19 The second loan was offered in Kasese, Uganda, to an enterprise to start a battery-charging station and to sell and install PV systems. Due to the deteriorating security situation in Kasese, the enterprise stopped operating and can no longer service the loan.

Table 5-2. Business Loans for Solar Enterprises

Borrower	*Details of Loan*	*Loan Description*	*Loan Impact*
Birdsnest Intercontinental Agencies, Ltd. (Nairobi)	K-REP Amount: Ksh 150,000 Date: August 1996 Term: 12 months Interest rate:18.5% p.a.	Manufacturer of 12V DC fluorescent ballasts. Requested loan for improving production line.	Completed loan Nov 1997. Applied for follow-up loan and is now on 3rd follow-up loan. Company still in business.
Fence Electrics, Ltd. (Kajiado)	K-REP Amount: Ksh 200,000 Date: Sept 1996 Term: 27 months Interest rate:18.5% p.a.	To set up solar marketing and promotion activities. Develop increased market for solar equipment and appliances.	Business was not successful. Entrepreneur concentrated on other business interests. Loan had not been repaid as of October 1997.
Windmills and Solar Energy (Nairobi)	K-REP Amount: Ksh 250,000 Date: October 1996 Term: 27 months Interest rate:18.5% p.a.	Manufacturer of 12VDC fluorescent lamp ballasts and fixture. Requested loan for improving production line.	Payment completed by November 1997. Business split into 2 companies soon after repayment
Kiru Electric and Solar Services (Tharaka-Nithii)	K-REP Amount: Ksh 200,000 Date: October 1996 Term: 27 months Interest rate:18.5% p.a.	Rural supplier of SHS requested loan to intensify marketing of PV through stocking of quality PV accessories.	Payments up-to-date as of October 1997. Repayments of loan put strain on business during poor harvest.
Solagen, Ltd. (Nairobi)	K-REP Amount: Ksh 500,000 Date: July 1997 Term: 15 months Interest rate:20% p.a.	Retail distributor of PV equipment requested loan to consolidate market network.	Payments up to date; has expanded the range of equipment in his shops.
Bright Home Solar Energy (Bungoma)	EAA Amount: KSh 600,000 Date: January 1998 Term: 12 months Interest rate: 0%	Experimental non-commercial loan to set up solar business and battery-charging station in rural village.	Solar business and charging station in operation. Business 5 months behind on repayments due to slow sales activities.
Bwera Solar Services Kasese Uganda	EAA/Ashden Trust Amount: US$8000 Date: June 1997 Term: 12 months Interest rate: 10%	Loan to set up a solar business and battery-charging station in rural village.	Loan repayments stopped. Loan defaulted due to war in market area (rebel activity caused total cessation of business)
??? Muranga	Cooperative Bank Amount: KSh 60,000 Date: May 1998 Term: 24 months Interest rate: 12%	Loan for PV system to power lights, TV, and music system for rural bar and shop. Loan was applied for as part of SHS package from Muranga.	Loan repaid on time. Business wants to expand system with second loan.

5.20 A $5 million IFC/GEF project (Photovoltaic Market Transformation Initiative, or PVMTI) has been under preparation for the past three years. Several project proposals have been received and are being reviewed. Three of the approved first-track projects are moving forward, all with the finance model outlined in this manual. One consortium, Muramati/ASP Solar, is in fact using one of the communities that benefited from ESMAP assistance. The BP/Solagen consortium has used the implementation manual in its development, and Marathon Marketing is using the implementation manual as a blueprint for a program it is developing with a South African company (Total Solar). The concept of solar electricity is now well known within the SACCO community in Kenya. In short, the ESMAP pilot activity prepared the way for PVMTI. Although PVMTI will take time to become operational, it is expected that more than 500 solar home systems will be financed using mechanisms developed under the ESMAP activity.

6

The Technical Package

6.1 This chapter discusses the lessons learned from designing and implementing the technical packages that were dealt with under the financing mechanisms.

6.2 Solar electricity systems need to be designed to meet the needs of the end-users, be they lights, radio, TV, for lighting, other possible applications. Several "standard" packages should be prepared to cover a range of would-be user's needs and to simplify procurement. System upgrade and expansion packages should also be offered. The focus should be on quality and functionality. Systems should not be user-serviceable, and the battery and control should be enclosed and locked to prevent user bypass of the charge regulator (a common occurrence in Kenya). Preventive maintenance and monitoring of the systems should be built-in during at least the first two years, before the loans have been fully repaid. This will raise awareness among the users, who may opt to buy additional maintenance contracts later on. A selected group of suppliers and installers should be identified through a tender to introduce and implement the equipment that will be financed through the financing mechanism.

6.3 Financing will leverage better design, installation, and maintenance practices because it will allow users to procure higher-quality service without necessarily straining their budgets. Loans will only be extended to those individuals who agree to abide by the standards incorporated in the financing package.

6.4 The technical package provided here, combined with end-users' education, will address the technical problems raised previously. Further, inspections and service contracts will ensure that quality is maintained. In addition, all systems will be installed according to the minimum installation code in Annex D.

Systems Design

6.5 If systems fail, it is probably for the following reasons: non-use of charge regulators, poor design and installation, poor component and BOS quality, or poor-quality batteries. This section briefly clarifies these issues and outlines the technical solutions to be used.

Non-use of Charge Regulators

6.6 This causes chronic deep-discharge of batteries, which shortens battery life significantly, decreasing financial viability of PV home systems. The main reason end-users do not use charge regulators is the high prices of units and lack of understanding of their function. Charge controllers shall be used in all systems installed under the loan scheme.

Poor Design and Installation

6.7 Uninformed customers and untrained technicians commonly install systems that have been undersized (i.e., the daily load is higher than the capacity of the module to generate energy), poorly designed, and/or badly installed (many systems are installed with improper wire sizing, poor module placement, and poor electrical connections). This compounds the problems caused by non-use of charge regulators and shortens the life of fluorescent lights. The technical partner will ensure better design, installation, and maintenance practice under the loan scheme, and the costs for this will be factored in the price of the systems and included in the loans.

Poor Component and BOS Quality

6.8 Because end-users cannot afford cash for quality equipment, they buy the cheapest possible, and this is often of poor quality. For the same reason they often leave out charge controllers. Component mismatch is a common occurrence, as are poor quality (cheap locally assembled lights). Only quality equipment will be procured and used in the project. Component mismatch will be adequately addressed.

Batteries

6.9 Batteries are often blamed for the technical problems of SHS. More often than not, this is a symptom instead of the cause. The aforementioned four reasons could all result in premature battery failure. However, poor quality batteries can be a reason for system failure in itself, in particular if non-modified car batteries are used. Systems to be used within this effort will optimize the cycle life of batteries by making sure they remain in a state of charge above 50 percent. The battery and charge regulator are to be isolated in a locked box to prevent user access. Until the user has completed payment, only the contracted service person(s), or an appointed service technician of the credit group, will have keys to the box. This will prevent the end-user from bypassing the low-voltage disconnect of the charge regulator.

6.10 For the 12-volt systems (the most common), the charge regulator will have its low-voltage disconnect set at about 50 percent state of charge (11.8 volts). This is to economically optimize the life of the battery that should have a cycling life of about 600–1200 cycles, or 2–4 years. Charge regulators chosen should have some system indication, such as LED (light emitting diode) warning lights that enable the end-user to gauge when the system is low on energy and when it is about to disconnect.

Mounting

6.11 Improper mounting of PV modules is also a common problem. All PV modules within the scheme will be mounted properly (with the tilt in a North-South orientation). The technical partner will recommend several types of mounts and provide designs and prototypes, as well as standard mounting orientation advice.

Wiring

6.12 Self-installed systems and those installed by untrained technicians usually result in the use of improper wire sizes and types compounded with long wire runs. Proper wire sizes will be used in the project. The technical partner will provide guidelines for all systems.

Guarantees on Components

6.13 Over-the-counter sales do not always carry guarantees. The tender will specify reasonable warrantees on all components to ensure that the equipment lasts beyond the period of the loan. Users will be provided with guidelines within which all system packages are designed to work.

Equipment Approval and Selection

6.14 Major system components (batteries, lamps, charge regulators and modules) will be accepted based on prepared criteria such as those presented in Annex D. These criteria will be circulated to companies before equipment is bid for. The project will have minimum warranties of two years on all equipment, except batteries. Criteria will be loosely based on established guidelines as laid out by the "Universal Technical Standards for Solar Home Systems." Other standards may be used; see Annex B for standards applied during a UNDP/GEF-financed project in Zimbabwe.

6.15 To encourage local involvement and job creation, battery boxes and module mounts will be made within the project areas. The technical partner, with support of the loan group, will select artisans and ensure that they are trained to meet the quality requirements of the project.

Suppliers and Installer Selection

6.16 For the project to be successful, two things must happen. First, **the supplier** will be required to have the capacity to supply (including delivery to the loan group) the equipment bid for. The equipment will be expected to "perform as advertised" and must meet all conditions established in the tender document.

6.17 Second, **the installer**, who usually is a local technician, will be required to correctly install the systems according to the minimum standards (see Annex D) while exhibiting a high degree of competence. If awarded the maintenance contract, he/she will be required to further maintain the systems in the best state possible following the maintenance schedule applied under the project. The installer(s) must be technically qualified to do the work—i.e., must be trained and certified. In addition, she/he must have proper equipment and tools; based reasonably close to the community receiving the systems, and have the means to make regular visits; and accepted by the customers.

Systems Installation

6.18 The installation phase needs to be properly organized. The following procedure is recommended.

Delivery

6.19 Delivery of project equipment will be to the loan group, which will be responsible for making prior arrangements to store the equipment in a secure place.

6.20 On delivery, an official of the loan group, together with the installer and/or a person nominated by the technical partner, will inspect the equipment to verify that the correct equipment has been supplied. The group officials will then acknowledge delivery in writing for purposes of payment. Payment to suppliers will be done as agreed by the finance partner and quoted on the invoice(s).

6.21 Minor system components will be supplied by the installer and shall be inspected before installation.

Pre-installation Inspection

6.22 Pre-installation inspection will be carried out before systems are installed in "waves" of between 10 and 20 or larger numbers, depending on the capacity of the installation team. Before commencing installations, the technical partner will conduct a pre-installation inspection to ensure that only the correct equipment is used. The following will be examined:

- The installation team's quality and type of tools to be used for installation;
- The quality and type of cables, switches, sockets etc. supplied by the installer; and
- The installation team's knowledge and ability to carry out the work.

Installation

6.23 Installation will only be carried out by qualified technicians. With the very first installation, training will be conducted by the technical partner to familiarize the installers with the special needs of the financed systems. A thorough drill on the minimum installation code and practice will be conducted at the time. The installers will also be trained in end-user education, among other things. Loan group members will be included in the installer training. A training fee will be levied on all systems installed to cover the training costs.

6.24 Only those trainees who successfully complete the training and pass the course will be certified to install and service systems within the project. Once the technical partner establishes that the installers can carry out the job satisfactorily, they will be left on their own to carry out the installations and educate the end-users on basic the operation of their system.

6.25 On completion of each installation, the installer is required to fill out a job completion or system certification form (See Annex G). The form must be countersigned by the system owner.

6.26 Installation fees to technicians will be paid in two 50-percent installments, the first before installation and the second on passing inspection.

User Training

6.27 User training will involve basic lessons in charge control indicators, availability of power according to system size, energy management, and maintenance of system components. The training will also cover the "do's and don'ts" and will be adequately tied to the end-user contract (see Annex E). Leaflets will be provided, preferably in the local dialect, the national language, and English (French, Spanish, etc. may also be used depending on the region). The training will be conducted by the installer.

Inspection

6.28 Every installed system will be inspected according to criteria established within the project standards and according to the format of the system inspection sheet (see Annex H). All systems will be inspected before the final payment is made to the installer. The inspection will be conducted by the technical partner, although it is expected that at some point the loan group will nominate a capable individual to be trained by the technical partner as an inspector.

6.29 In the event of a system failing to pass the inspection, the installer will be asked to rectify all installation faults before payment can be made.

Maintenance

6.30 To prevent non-payment or abuse of the system by customers, systems will be maintained by service contractors over the period of the loan. End-users will be obligated to adhere to the terms of the users maintenance contract. Priority in awarding service contracts will be given to the installation companies that installed the systems.

6.31 The maintenance service contract will include the following:

- Three mandatory service visits in two years, one in the first and two in the second (see Annex G, the sample user service contract, for details);

- One bonus service trip; and
- Call maintenance trip(s) to be paid for by the end-user.

6.32 Service dates will be arranged between the companies and the loan groups, and a copy of the service schedule provided to the technical partner. A service form (Annex I) will be completed and signed by household and service provider on each service trip. Payment for maintenance service will be made to the technician by the loan group or financial partner (whichever is appropriate) on presentation of signed service forms.

Security

6.33 Security of the system will be the sole responsibility of the system owner. It should be suggested that a nominal amount in the member's or group's savings be allocated to pay for insurance against theft.

Repairs

6.34 Any user-caused problem will be rectified by the service company at the end-user's expense and at a price agreed on by the company and customer. Complaints will be handled by the loan group together with the project technical partner as referee if necessary.

Monitoring

6.35 For the purposes of evaluation and recommendation, the technical partner will from time to time monitor the performance of the systems. A random sample of the systems will be monitored and recommendations made to equipment manufacturers, installers, and end-users. Experiences arising from this will be documented to provide "good practice" information for those wishing to replicate the scheme.

Hand-over

6.36 After all loan payments are made, the end-user will be given the keys to the battery box and will henceforth be directly responsible for maintaining the system. At their own disposition, they can extend the service contract.

Disclaimer

6.37 Neither the loan group, the installer, nor the technical partner will in any way whatsoever be liable for damage to property and/or injury to health of persons arising from improper use of the solar electric system.

7

Lessons Learned

7.1 **End-users** appreciated the opportunity of buying into a scheme to finance a SHS, as most cannot currently afford to buy one with cash. Their early involvement in the process was crucial. Overall, they were satisfied with the process, even though it was not always easy (the path to a final agreement between credit groups and the financial institutions was particularly slow. Clearly, the benefits of having electricity made them forget the difficulties during the start-up period of the project.

7.2 They are willing to pay interest charges, although the level is limited to what they have access to for other purposes. For example, they find unacceptable the prevailing commercial market interest rates of 25–30 percent per annum. K-REP, which was able to offer loans at 20 percent, found takers. However, in areas where cooperatives or SACCOs exist, people do not want to pay much more than what these offer, usually around 12–14 percent. It is clear that some sort of supported loan scheme is required if one wants to finance SHSs, but the level of support should not create large differences with existing opportunities available to clients (for other purposes, such as agricultural loans, housing loans, etc).

7.3 The **credit mechanisms** tested here all deal with groups of individuals, instead of directly with individuals. It was demonstrated that procurement of equipment for groups of about 30 could lower SHS cost (installed cost, including maintenance contract) by as much as 20 percent, thus offsetting the costs of borrowing money. The experience shows that it is easier to deal with existing credit groups (such as through cooperatives/SACCOs) than with the credit groups created for this purpose. However, concentrating only on cooperatives would severely limit the replicability: not all households are members of such organizations. Using Teacher Associations (etc.) is a variation on the same theme; they would also be relatively easy to use, particularly if they would allow automatic loan payments through salary deductions. Dealer (or installer) credit schemes took somewhat longer to realize, but once the practices were established, the dealer wanted to launch new operations.

7.4 One option that was not pursued is hire-purchase, which is just a slightly different version from the dealer credit. Fee-for-service was rejected because: (1) no ESCO or financing group was willing to take the risk of supplying systems that could be stolen, (2) fee-for-service costs were too high for the small number of systems to be provided, and (3) customers prefer to own their systems.

7.5 Selection of the credit groups to work with should, to the extent possible, be disconnected from local politics. This can be done by providing clear and transparent guidelines and by issuing pre-selection criteria.

7.6 The **financial institutions** found it more difficult than expected to implement the financing mechanisms for solar equipment, even though these were based on existing mechanisms that they regularly apply for other purposes. One reason was that the loans for SHS are consumer loans; they are not the loans for productive purposes that the institutions normally offer. Another reason was that interaction with the groups was somewhat cumbersome: beneficiaries also are not used to consumer loans, and this needed some reinforcement. Both institutions eventually fully subscribed to the concept of rural electrification through SHS to improve rural living conditions, although the managers of the research units initially found some difficulties to convince their management to launch the pilot activities and gain more experience. Finding resources to properly support the pilot activities during the testing period proved to be somewhat difficult. The current experience clearly demonstrates the value of pilot projects. Both institutions would have found great difficulties to successfully offer solar financing mechanisms on a large scale without the pilot phase made possible through the ESMAP project.

7.7 The fact is that both financing institutions are leaders in their fields, and have considerable donor funds—on a grant basis—to develop new initiatives. It stretches their capacity to carry out many activities simultaneously. Although the ESMAP project provided a total of about $65,000 in two tranches to the two institutions, this was fairly small in comparison to their normal level of operations, which may have reduced their effectiveness. This was compounded by the fact that ESMAP did not provide many resources for the functioning of the financial institutions, in view of addressing sustainability from the start.

7.8 **Technical assistance** (TA) proved indispensable, and it should be made available over a longer period. It was the "glue" that kept the different actors together and more or less on the agreed track. The TA was helpful in selecting the beneficiaries and holding early discussions with them; in developing standard packages acceptable for the beneficiaries' needs and payment ability; in procuring the equipment on behalf of the credit groups; in training of the local installers; in inspecting the installed SHSs; and in creating a mechanism and capacity to maintain and service the systems. The financial institutions expected too much from the TA, and relied heavily on it even for carrying out some of their own responsibilities. It is possible that this practice is a spillover from the easy access to many donor-funded activities that rely heavily on outside consultants.

7.9 **Maintenance** of SHSs has often been a problem. Even though not much maintenance is required, a certain number of checks need to be carried out at certain times. In the pilot project, this was built in: the purchase price of the SHS included the cost of three scheduled maintenance visits and one unscheduled visit over a two-year period. So far, most equipment functions as designed, and the most frequent problem is the blackening of lamps due to the relatively low quality of the locally produced ballasts as well as quality control problems with the international supplier. Beneficiaries have accepted the fact that they cannot access their batteries (these are in an enclosed box), and less than five percent have tried to temper with the locks.

7.10 K-REP's **solar business** loans are fully "mainstreamed" now. There appears to be a substantial demand for small loans ($1,000–10,000) in the energy enterprise business. Repayment of the few business loans that were provided under the pilot activities was satisfactory. These companies are all still in business (except one), and most have benefited from the loans in the sense that they are now more productive. Some also requested (and obtained) follow-up loans. Once K-REP split into a commercial bank and an NGO, the commercial bank included solar loans in its regular loan portfolio. K-REP intends to pursue the idea of creating a "solar bank" as soon as it is confident that the consumer loans can be handled adequately.

7.11 The solar-loan learning curve for K-REP and CBK has been steep. Both feel they still need some technical and financial assistance before the loan handling is given over from the research department to the regular operational department.

7.12 7. **Interference** beyond control of the partners can wreak havoc with the process, and there are quite a few events that may undermine households' ability to meet their payments: a serious draught; a recession or collapse of an industry; unforeseen insecurity in an area (rebel activities or a war); local politics, etc. In addition, interference from anticipated large donor-financed projects also upsets the players. This was the case in Kenya, where a $5 million solar project has been under preparation for more than years.

7.13 8. **Private companies** have been eager to cooperate with this type of effort. Despite delays and constant communication problems, the companies maintained their interest in the effort and happily sorted out small problems to do with product quality control. They also used the project to monitor and adapt their product to customer needs.

7.14 **Village-level installers** played a key role. Because wholesale prices were handed over to customers, the installers were able to charge fair installation and maintenance fees and to maintain a steady cash flow over a long period.

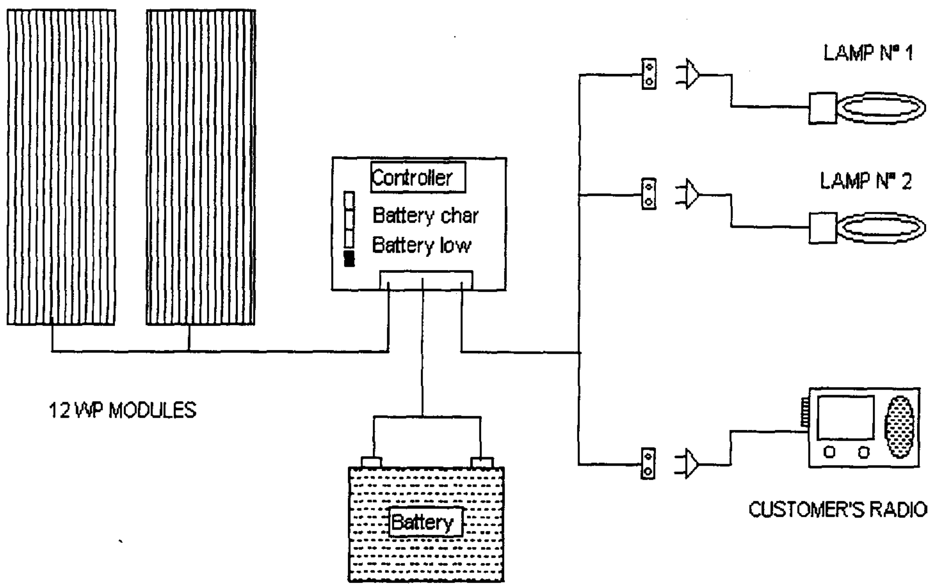
Annex A

Sample Solar System Packages

System 1: Two-light system and a radio socket

Item	*Type/Size*	*Qty*
Module monocrystalline	12Wp	2
Charge controller	SPCC 10	1
Lamp	PL 9	2
Spare tubes		1
Battery	6EL70 70AH	1
Cable & Accessories	2.5mm	30m
Cable	4.0mm	10m
Battery Box & Lock	1	1
Voltage Converter	1	1
Battery Terminals	Ordinary	1 pair
Wire clips & tacks		1
Switches		2
Sockets & Plug		1
Fuses	Fuse Card	1
Connector strips		1
Junction box		2
Main switch	15A	1
Module mount		1
Distilled water		1
Installation/Transport		1
Inspection & Maintenance	2 years	3
TOTAL		

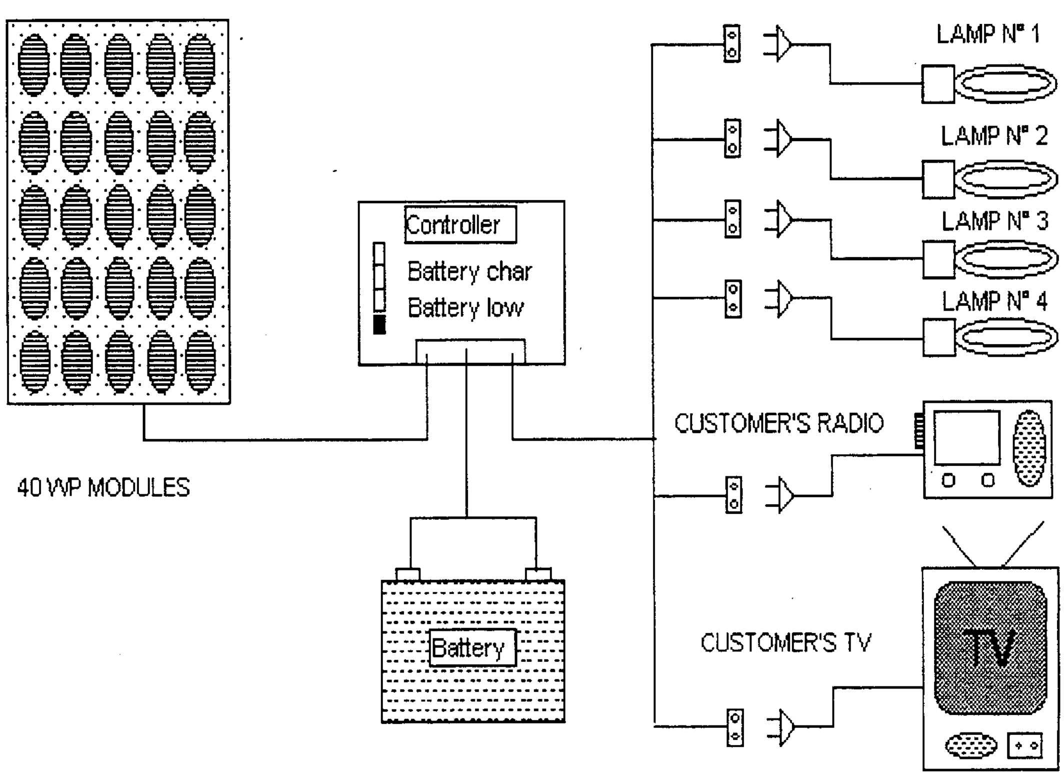
Graphic Presentation of System 1



System 2: Four--light system, a radio, and TV socket

Item	*Type/Size*	*Qty*
Module	MSX 40	1
Battery	6EL100 100AH	1
Charge controller	SPCC 10	1
Lamp	PL 9	4
Spare tubes		2
Cable & Accessories	2.5mm	60m
Cable	4.0mm	10m
Battery Box & Lock	for one	1
Voltage Converter DC		1
Battery Terminals	Ordinary	1 pair
Wire clips & tacks		1
Switches		4
Sockets & Plug		2
Fuses	Fuse Card	1
Connector strips	15A/30A	2
Junction box		3
Main switch	30A	1
Module mount		1
Distilled water		1
Installation/Transport		1
Inspection & Maintenance	2 years	3
TOTAL		

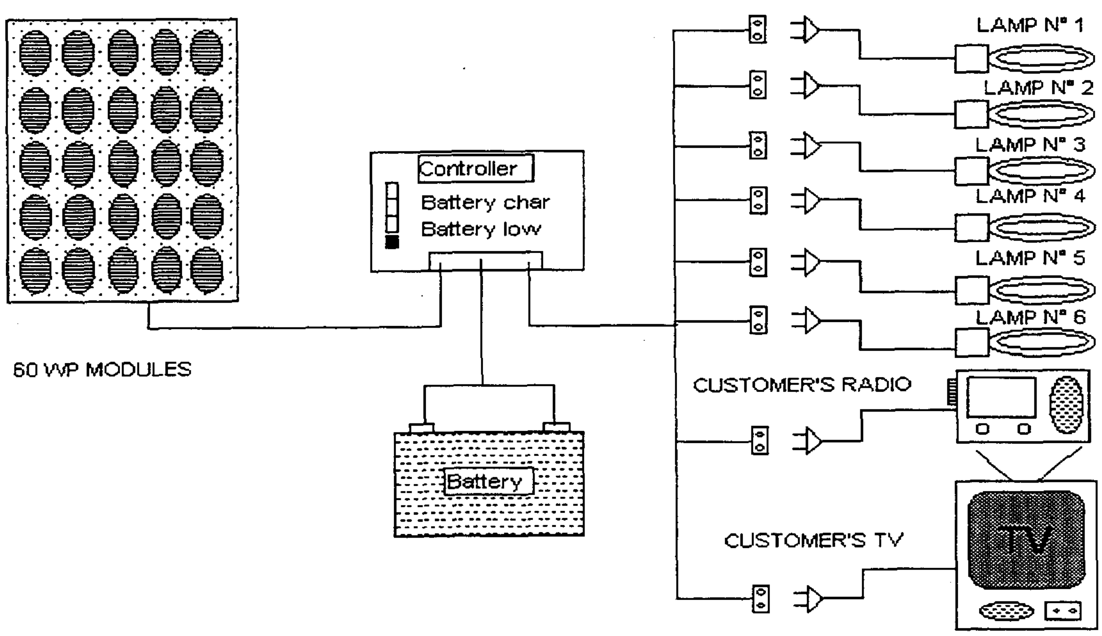
Graphic Presentation of System 2



System 3: Six-light system, radio, and TV socket

Item	*Type/Size*	*Qty*
Module	MSX 60	1
Battery	6EL100 100AH	1
Charge controller	SPCC 16	1
Lamp	PL 9	6
Spare tubes		2
Cable & Accessories	2.5mm	100m
Cable	4.0mm	10m
Battery Box & Lock	for one	1
Voltage Converter DC		1
Battery Terminals	Ordinary	1 pair
Wire clips & tacks		1
Switches		6
Sockets & Plug		2
Fuses	Fuse Card	1
Connector strips	15A/30A	3
Junction box		4
Main switch	30A	1
Module mount		1
Distilled water		1
Installation/Transport		1
Inspection & Maintenance	2 years	3
TOTAL		

Graphic Presentation of System 3



Annex B

Draft Component Standards

(Adapted from the Zimbabwe GEF Solar Home Lighting Project and Botswana Technology Centre Standards)

The following specifications have been developed for small domestic (60 Wp and less) lighting systems with an expected load current of 8 amps or less during operation. The standards are designed to enable users to get high quality, reliable solar systems at the lowest possible cost, and to insure that their systems batteries and appliances last well with small lighting systems similar to the ones being offered by this project.

The component standards will be enforced through agreements with equipment suppliers. Installation standards will be enforced through strict inspections by the technical partner. The installation inspection and service visit forms are attached.

1. Solar Cell Modules

Modules 20 Wp and above: All modules must be guaranteed for at least 10 years against faulty workmanship, factory defects and power losses of more than 10 percent of their original rating. Modules rated at 20 Wp and above must meet the ISPRA CEC 503 specification (or its equivalent).

Modules below 20 Wp: All modules must be guaranteed for at least 5 years against faulty workmanship, factory defects and power losses of more than 10 percent of the original rating.

All crystalline modules must have **32** or more cells.

All modules must be clearly marked with the manufacturers, model number, serial number and peak watt rating.

2. Batteries

All batteries shall have a warranty against factory defects of at least one year.

Battery capacity must be rated at the 20-hour rate, discharge to 1.75 volts per cell at 25°C

Batteries must be clearly labeled with the manufacturers name, model number, and date of manufacture. Manufacturers hall, if possible provide discharge curves and cycle life data on batteries supplied within the project.

Solar-designed batteries are to be used wherever possible. Automotive batteries will not be acceptable, as they are likely to have a low life in PV systems. The technical partner shall be provided with details of all batteries to be used in the project.

3. Charge Controllers

A charge controller is required on all systems.

All charge controllers shall have warranty of at least two (2) years and shall provide the warranty in writing to the customer.

Low voltage discount should be set at 11.9–12.0 volts (open circuit battery voltage).

Voltage reconnect on charge controllers is to be set at 12.7V (on charge)

Over-voltage protection shall disconnect charge controllers at a minimum of 14.2 volts (on charge)

User interface. Regulators shall have LEDs to notify the user when the battery voltage is low (i.e., disconnection).

Charge controllers shall have a self-consumption of more than 10 percent (including on standby mode) of the total energy produced by the module.

4. Lamps

Only fluorescent-type lamps—or other efficient light fixtures recommended by the technical partner—shall be used.

All lamps shall have a warranty of at least two (2) year and shall provide the warranty in writing to the customer.

All lamps shall be reverse- polarity protected

All lamps shall be protected against insect intrusion into the inverter housing.

Lamps designs shall minimize radio reference.

Annex C

Sample Installation & Service Contract Between Installer and Loan Group/Finance Partner

This contract is entered into between installer of P.O Box .... (henceforth known as the installer) and Loan group /finance partner, of P.O Box .... (henceforth called the contractor).

1. The installer shall carry out all installation work according to standards and within the time limit set by the contractor. Only the recommended system components shall be installed according to the installation code in Annex D.
2. The installer shall carry out three (3) maintenance service visits over the contract period (two years) to maintain the system and make sure that it is in good working order and will be obliged to fill in the maintenance service forms which will in turn be submitted to the contractor. The visits shall be scheduled in advance with the system owner. The installer has the right to charge for unscheduled service calls.
3. Payments for installation shall be made in two (2) equal installments. The first at the start and the second on successful completion of the installation work as found satisfactory by the client. Further payments for maintenance shall be made to the installers on presentation of completed service form duly signed by the system owners. In case of any doubts, the contractor has the right to seek confirmation.
4. Payment for maintenance service shall be made on presentation of signed service forms.
5. All payments shall be made by the contractor to the installer by bankers cheque.
6. In the event of the installer failing to fulfil the terms and conditions of the installation contract according to the installation standards agreed on, the remaining payment shall be withheld until satisfactory remedies will have been made. Part of the down payment may also be recalled.
7. If the installer sees evidence of the system tampering with the system he shall report in writing to the contractor.
8. If any component of the system under warranty fails, the installer shall contact the contractor to assist in the replacement of the unit.

I hereby enter into this agreement with the full knowledge of the obligations and responsibilities it entails, and agree to honour this binding contract to the best of my abilities.

____

Installer, Date

____

Loan Group, Date

Annex D

Sample Solar Electric Systems: Minimum Installation Code

1. **Cables:** All cables shall be multi-stranded copper conductors. The minimum acceptable cross-section of wire in all sub-circuits shall be 2.5 mm^2. Single stranded wires shall not be accepted.

2. **Current capacity:** The maximum rated current of a circuit shall not exceed the capacity of the over-current protection device in that circuit.

3. **Voltage drop:** The voltage drop in cables between the PV array and the regulator shall not exceed 0.24 V (2 percent of the nominal voltage) at maximum rated array current. The voltage drop between the charge regulator and all the loads shall not exceed 0.6 V (5 percent of the nominal battery voltage). The voltages and voltage drops shall be measured with all loads in the circuit switched on.

4. **Colour code:** The following conventions shall be used for two-conductor DC wiring. positive: red, negative: black

5. **Connections and junction boxes:** Cables shall be joined using junction boxes or block connectors. All cable joints shall be contained within a suitable junction box or enclosure, which is drip and dust proof and electrically insulated. Electrical tape shall not be accepted. All electrical connections shall be tight and properly insulated.

6. **Fuses:** Fuses shall be selected so that the maximum current does not exceed 80 percent of the rated capacity of the fuse. The fuses shall be installed in the positive line. In addition, the fuses shall be of a widely available type. Spare fuses shall be provided.

7. **Switches:** The number of switches shall be equal to the number of lights as indicated in the design circuits. All switches shall be surface mounted and secured to the walls at a height of 1.5 m above the finished floor. All switches shall indicate their ON/OFF state clearly and should be specifically adapted for dc current or rated at not less than 10A if conventional 240 VAC products are used. In mud walls switches shall be mounted on wooden boards.

8. **Sockets:** Only standard DC sockets shall be used in all installations. No other sockets will be acceptable.

9. **Wiring and cabling:** Surface mounted cabling shall be installed using appropriate fasteners at suitable intervals to prevent sagging (25 cm for clips). Visible interior cabling shall be aesthetically tidy, and shall not slant from the vertical or horizontal unless unavoidable. In mud-walled houses, cables lights and sockets shall be fastened to secure and firm timber works. Holes through roofing materials shall be avoided wherever possible. If any, then such holes shall be sealed with a weatherproof seal to prevent leakage. Wires running through holes in the roof shall be protected by grommets against possible damage from sharp edges.

10. **Batteries:** Battery interconnections shall be made using appropriate terminal blocks. Wiring on the terminals shall be secure. If possible soldering should be used to fasten the wires to the terminal blocks. The terminals shall be clean and tightly fastened.

11. **Battery box:** The solar battery and the charge controller shall be locked inside a wooden box, which shall be accessible, by the installer(s). This is to insure that the battery is not misused. The battery box shall in turn be located in a well ventilated and access restricted place. However, the charge regulator indicators shall still be made visible.

12. **PV array mount:** The module mount shall be made of steel, painted with a rustproof coating and roof mounted. The mounting shall be such that minimum damage will be done to the roof. All holes resulting from this exercise shall be appropriately sealed with a weatherproof seal to prevent leakage. The panels shall be mounted at an elevation of between 10 and 15° facing either north or south only depending on the location.

13. **Spares:** Spare parts shall be provided by the installation company to customer. These shall include at least one (1) spare bulb, fuses or fuse wire and distilled water.

14. **End user education:** The end user shall be adequately trained on the minimum basic working and maintenance of the installed system during or immediately after the installation exercise.

Annex E

Sample User Service Contract (U 1)

This contract is entered into between the appointed solar installation and maintenance company, herein referred to as the "installer," and the recipient of the solar loan, herein referred to as the "client." This Contract is entered into between the above parties for the purpose of ensuring the solar lighting system will have a long and useful life.

1. The solar battery and charge controller shall be locked inside a wooden box which shall only be accessible by the service company and, in the case of emergency or loss of keys, by the cooperative society. This is to insure that the battery is not misused and to lengthen the life of the system.

2. The client shall be responsible for (a) cleaning the module, (b) changing the lamps when they wear out, and (c) operating the system in a responsible manner.

3. The service company shall have the responsibility of maintaining and servicing the client's solar lighting system for an initial period of two (2) years. If the client so desires, he/she can extend the period of the contract.

4. Over the contract period, the service company shall visit the client a minimum of 3 times (at least once every six months from the time of installation) to maintain the system and make sure that it is in good working order. These visits shall be scheduled in advance with the cooperative society and/or client.

5. In addition to the above three service visits, the service company shall visit the system one (1) time, in response to a customer service request. On any other visit, the service company has the right to charge for unscheduled service calls.

6. A system service form will be filled in triplicate (copy to loan group, company and technical partner) by the service company on each service trip, and signed by the end-user. This form (copy attached) shall be used by the technical partner to evaluate system performance. During the trips the service company shall: (a) clean and top the battery, (b) check for bad cells, (c) clean and check output of the module, (d) check the status of the charge controller and appliances, (e) check the wiring and fuses, and (f) review the system performance with the client.

7. Payments to the service company will be made by the loan group for all of the systems. The first shall be upon installation of the system. Subsequent payments will be made after each round of maintenance.

8. If the service company sees evidence of client tampering with the system, he/she shall report this in writing to the loan group and the technical partner.

9. If any component of the system under warranty fails, the service company shall contact the technical partner to assist in the replacement of the unit.

10. At the end of the loan period (two years), the service company shall hand over the keys of the battery box to the client upon instruction by the loan group.

11. In the event of unresolved disputes between the client and the service company, the matter will be handed over to the loan group. In such cases, the decision of loan group will be final and not subject to further litigation.

____

Loan recipient, Date

____

Installer, Date

Annex F

Sample System Delivery Sheets

System Delivery Sheet (D S1)

This form should be completed by the system owner in triplicate. Copies should be given to the installer and technical partner.

Customers details

Name: ______________________________ Date: _________________

Address: ___________________________ Tel: ____________________

Group: _____________________________ Village: _________________________

District: _________________________ Nearest Town: ______________

Please check **Yes** or **No** for the items delivered to your house.

Item	Specification	Qty	Delivered
Module	12Wp	2	
Charge controller	SPCC 10	1	
Lamp	PL 9	2	
Spare tubes		1	
Battery	6EL70 70AH	1	
Cables	2.5 & 4.0 mm	40 m	
Battery Box & Lock	1	1	
DC/DC Voltage Converter	1	1	
Battery Terminals	Ordinary	1 set	
Wire clips & tacks		1	

Switches		2	
Sockets & Plug		1	
Fuses	Fuse Card	1	
Connector strips		1	
Junction box		2	
Main switch	15A	1	
Module mount		1	
Distilled water		1	

Comments:

____

____

____

____

____

Customer's signature: ____

Technician's signature: ____

System Delivery Sheet (D S2)

This form should be completed by the system owner in triplicate. Copies should be given to the installer and technical partner.

Customers details

Name: ______________________________ Date: _________________

Address: ___________________________ Tel: ____________________

Group: _________________________ Village: _________________________

District: _________________________ Nearest Town: ______________

Please check **Yes** or **No** for the items delivered to your house.

Item	Specification	Qty	Delivered
Module	MSX 40	1	
Battery	6EL100 100AH	1	
Charge controller	SPCC 10	1	
Lamp	PL 9	4	
Spare tubes		2	
Cables	2.5 & 4.0 mm		
Battery Box & Lock	for one	1	
DC/DC voltage Converter		1	
Battery Terminals	Ordinary	1 set	
Wire clips & tacks		1	
Switches		4	
DC sockets & Plug		2	
Fuses	Fuse Card	1	

Connector strips	15A/30A	2	
Junction box		3	
Main switch	30A	1	
Module mount		1	
Distilled water		1	

Comments:

____
____
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____
____

Customer's signature: ____

Technician's signature: ____

System Delivery Sheet (D S3)

This form should be completed by the system owner in triplicate. Copies should be given to the installer and technical partner.

Customers details

Name: ______________________________ Date: __________________

Address: ___________________________ Tel: _____________________

Group: ___________________________ Village: ___________________________

District: __________________________ Nearest Town: _______________

Please check **Yes** or **No** for the items delivered to your house.

Item	**Specification**	**Qty**	**Delivered**
Module	MSX 60	1	
Battery	6EL100 100AH	1	
Charge controller	SPCC 16	1	
Lamp	PL 9	6	
Spare tubes		2	
Cables	2.5& 4.0 mm	100m	
Cable		10m	
Battery Box & Lock		1	
DC/DC Converter		1	
Battery Terminals	Ordinary	1 set	
Wire clips & tacks		1	
Switches		6	
Sockets & Plug		2	
Fuses	Fuse Card	1	

Connector strips	15A/30A	3	
Junction box		4	
Main switch	30A	1	
Module mount		1	
Distilled water		1	

Comments:

____
____
____
____
____

Customer's signature: ____

Technician's signature: ____

Annex G

Sample Job Completion Sheet

This form should be completed by the technician in triplicate and countersigned by the system owner. Copies should be given to system owner, installer, and technical partner.

Technicians Name: ______________________________

Customers details

Name: ______________________ Date: ______________________

Address: ______________________________

Group: ______________________ Sub-location: ______________________

Village: ______________________ Location: ______________________

District: ______________________ Nearest Town: ______________________

Technical info:

System voltage:

Solar Modules	Manufacturer	Model	Wattage	Serial No.
Lights	Manufacturer	Type	Wattage	Quantity
Charge controller	Manufacturer	Model	Current IN	Current OUT

Battery	Manufacturer	Model	Capacity(Ah)	Quantity
Other Loads	Manufacturer	Model	Wattage	Serial No.

System Tests

Module(s) Isc: _______ Amps

Continuity: __________

Module(s) polarity: __________

Battery voltage: ___________ VDC

Battery polarity: _____________

Module(s) Voc: ______ VDC

Polarity of outlets: _______

Voltage drop: _______ VDC

Final visual inspection: _______

Spares

Item	Type /model	Quantity
CFL (lights)		
Battery water		
Fuses		

Guarantee card(s) signed: Yes / No.

System explained: Yes / No.

Comments:____

____

____

____

____

____

____

____

____

____

Technician's signature: ____

Customer's signature: ____

Annex H

Sample System Inspection Sheet (I 1)

This form should be completed in triplicate and copies retained by the technical partner, loan group and the installation company.

Customer: ______________________________

District: ______________________________

Solar Company: ______________________________

Technician name (s): ______________________________

	ACCEPT	REJECT
1. Solar Module	________	______

Manufacturer: ____________________

Model No: ____________________

Serial No: ______________ Voc _____

Peak Watts: ____________________

	ACCEPT	REJECT
2. Battery:	________	______

Manufacturer: ____________________

Model: ____________________

Manufacture Date: ______________

Amp Hours: ____________________

3. Battery Box and box clipping: _______ _______

4. Charge Regulator _______ _______

Manufacturer: ____________________

Model No: ____________________

Serial No: ____________________

5. Lamps (ALL LAMPS FLUORESCENT) _______ _______

Manufacturer: ____________________

Model: ____________________

Watts: __________ Number ________

Watts: __________ Number ________

TV Interference: ____________________

Radio Interference: ________________

Insect Proof: ____________________

6. Other loads. (List loads and wattage)		ACCEPT	REJECT
____________________	______W	_______	_______
____________________	______W	_______	_______
____________________	______W	_______	_______

7. Wiring and Voltage Drops

Load Cabling _____ mm2 _____ Vdc _______ _______

Solar Cable _______ mm2 _____ Vdc _______ _______

Battery Cable ______ mm2 _____ Vdc _______ _______

Cable Properly Secured to Walls _______ _______

Cable through wall or roof _______ _______

Mount through roof _______ _______

All Connections in boxes _______ _______

Switches working & well installed _______ _______

Sockets working /Properly installed _______ _______

Voltage droppers working _______ _______

Battery wiring _______ _______

7. Solar Array mounting _______ _______

Types of: ______________________

Module facing North/ South _______ _______

8. Spares on site _______ _______

Distilled Water ____________________

Fluorescent tubes ________________

Fuses ___________________________

9. FUSES _______ _______

10. SYSTEM OVERALL APPROVAL RATING ACCEPT REJECT

General Comments and Changes Required:

Inspector Name: ______________________________

Signature: ____________________ Date: ____________________

Customer Signature: ____________________ Date: ____________________

Annex I

Sample System Maintenance/ Service Sheet (M 1)

This form should be completed by the technician in triplicate and countersigned by the system owner. A copy should be submitted to EAA.

Customer: ____

Group: ____

District: ____

Technician's Name: ____

Company: ____

Is this a scheduled visit? Yes/ No.   Date: ____________________

System Check list (see next page)

Battery Voltage (when arriving)	VDC			
Sun conditions:	Bright		Cloudy	
Time: 7 8 9 10 11 12 1 2 3 4 5				
Controller Battery low Light High	Low		Cut-off	
Load fuse	OK		Blown	
Battery voltage(with solar disconnected and loads OFF)	VDC			
Sun conditions:	Bright		Cloudy	
Time: 7 8 9 10 11 12 1 2 3 4 5				
Battery voltage(with solar disconnected and loads ON)	VDC			
Sun conditions:	Bright		Cloudy	
Time: 7 8 9 10 11 12 1 2 3 4 5				
Battery Acid Level	OK		Low	
Battery Terminals	Clean		Corroded	
Top of Battery	Clean		Dirty	
Solar Module (s)	Clean		Dirty	
Solar Module voltage (Voc)	VDC			
Solar Module Current (Isc)	Amps			
Sun conditions:	Bright		Cloudy	
Time: 7 8 9 10 11 12 1 2 3 4 5				
Fluorescent Lights	# OK		# Black	
DC/DC Converter	OK		Faulty	
Switches	# OK		# Faulty	
Sockets	OK		Faulty	
Battery Voltage (when leaving)	VDC			
Sun conditions:	Bright		Cloudy	
Time: 7 8 9 10 11 12 1 2 3 4 5				
Controller Battery low Light	ON		OFF	

Has system disconnected ? Yes/ No.

Work performed and Comments.

Please indicate if any part of the system has been tampered with.

____
____
____
____
____
____

Next service is due on: ____________________________

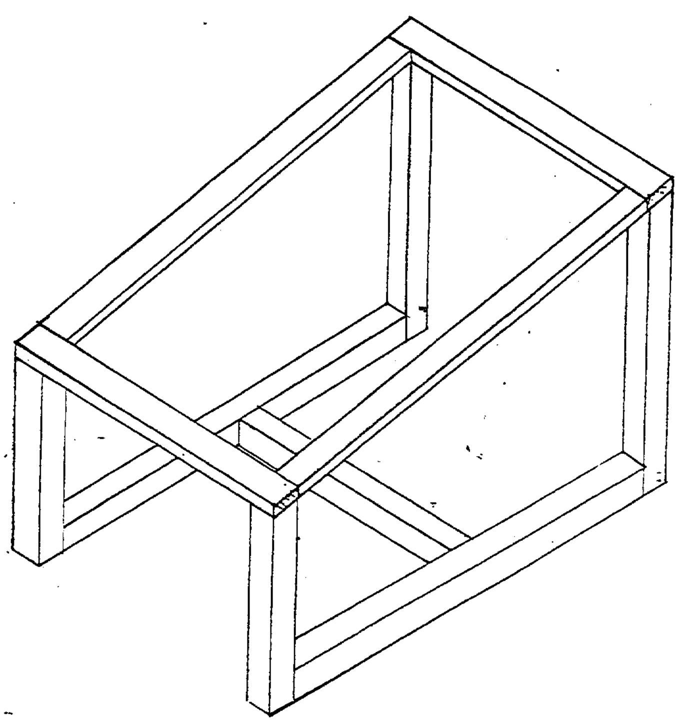
Technician's Signature: ____________________________

Customer Signature: ______________________________

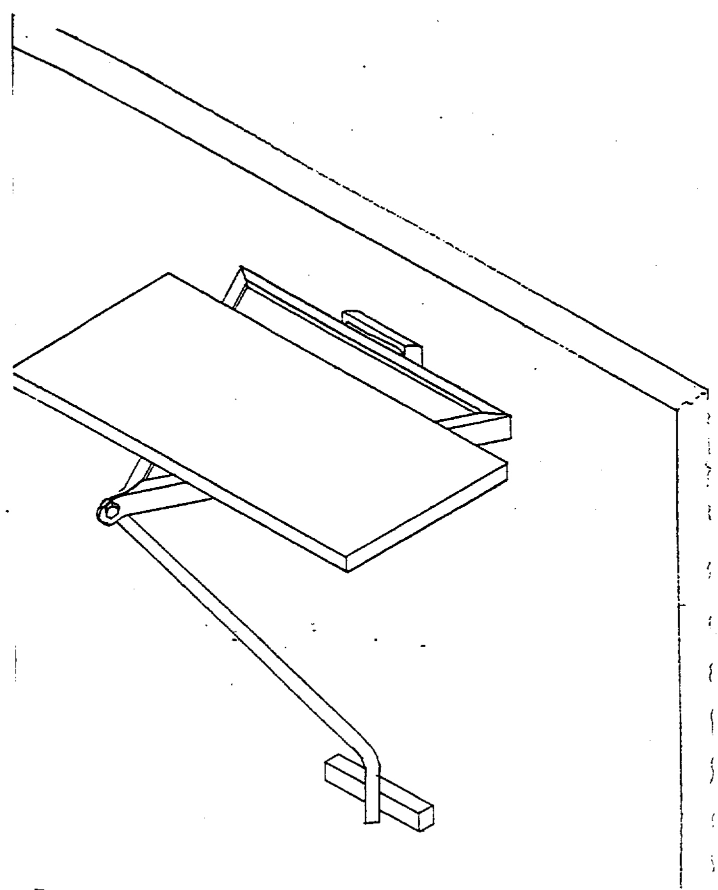
Annex J

Technical Drawings

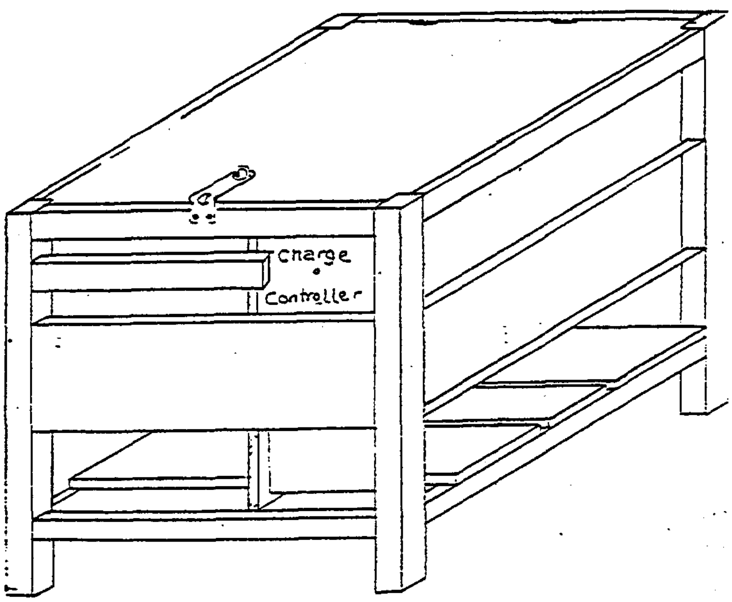
Wooden or metal (flat) roof mount



Metal triangular wall mount



Wooden battery box with lock and built-in charge controller.



Annex K

Sample Survey and Loan Contract

Individual Details and Loan Application

1. Name: ______________________________

2. Postal Address: ______________________________

   Telephone: ______________________________

   Fax No: ______________________________

3. I.D. Card No: ______________________________

4. Age: __________

5. Marital Status: __________

6. Education: ______________________________

7. Employed- Yes (__) No (__)

8. Type of Employment: ______________________________

9. Monthly Income (salary) Kshs. __________

10. Other Sources

    I. Farming __________ Income Kshs. __________

    II. Business __________ Income Kshs. __________

    III. Others __________ Income Kshs. __________

11. Solar System details

(a) Do you have a solar electric system (or part of a system) already?

Yes (__) No (__)

If yes, give details. How can it be up-graded?

____

____

____

____

(b) How many rooms do you wish to provide lights for? Please list in order of importance and number of hours.

Room	Importance	No. of Hours
Sittting room		
Bedroom 1		
Bedroom 2		
Bedroom 3		
Bedroom 4		
Kitchen		
Bathroom		
Toilet		
Corridor		
Others		

(c) What electric appliances do you have now?

Cassette player? Give number of cells. __________

Television? (black and white or Colour?) ________

How many hours do you wish to use them? _______

(d) What other electric appliances do you intend to buy when you when you get PV system? ________________________________

12. Amount of loan requested: Kshs. __________

FOR OFFICIAL USE ONLY

Approval by Group ____________________________

Approval by K-REP ____________________________

Date and Stamp: ____________________________

Loan Agreement

Memorandum of Agreement for Loan made this __________ day of ____

______ One thousand Nine Hundred and Ninety __________ Between ________ self-help Group, P.O. Box __________(hereinafter called the Borrower on the one Part) and Kenya Rural Enterprise Programme ______

____ (hereinafter called the lender on the other part).

WHEREBY IT IS AGREED THAT:

1. Kenya rural Enterprise Programme lends Kenya Shillings ______

   in the form of a loan repayable within __________ years/months.

2. The loan will attract a service charge at the rate of 32.5% p.a on reducing balance equivalent to 18.5 p.a flat rate.

3. The loan will be repaid in a period of 24 months through a banker's order recorded in the Group account in favor of SOLAR account.

4. The total repayment amount will be as follows:-

   Principal __________ Kshs.

   Service Charge _______ Kshs.

   Total _______________ Kshs.

Total amount in words: Kenya Shillings ______________ only.

5. The principal pls service charge will be paid in equal monthly

   installments of Kshs. __________ as per the attached repayment

   schedule.

6. The date of the first installment will be ___________

7. The date of the last installment will be ___________

8. The loan will be used for on-lending to the Group members for installation of their household Solar systems.

9. The loan will be used only for the purpose stated in No. 8 above.

10. Security for the loan willb e a Group Guarantee executed by all the members undertaking to be jointly and severally liable for repaying the loan in full.

11. If the borrower is unable to repay the loan, K-REP will have the right to institute legal action to recover the debt in full. This will only be done on the approval of the K-REP Projects Review Committee.

12. This agreement will remain in force as long as there is outstanding balances of the loan.

Declaration

We the Borrowers (Group) and the Lender (K-REP) certify that we have read and understood the terms and conditions of this Loan Agreement and do hereby confirm that we shall abide by them.

SIGNED on the behalf of the borrower in the presence of

Name: ________________________

Signature: ______________________

Signed by All Group members on their behalf and on behalf of

1. Name: ______________________

   ID. No.: ______________________

   Signature: ____________________

2. Name: ______________________

   ID. No.: ______________________

   Signature: ____________________

3. Name: ______________________

   ID. No.: ______________________

   Signature: ____________________

4. Name: ______________________

   ID. No.: ______________________

   Signature: ____________________

5. Name: ______________________

   ID. No.: ______________________

   Signature: ____________________

6. Name: ______________________

   ID. No.: ______________________

   Signature: ____________________

On behalf of Kenya Rural Enterprise Programme (The Lender) below:

In the presence of:

Name: ______________________________

Signature: ___________________________

Date: ______________________________

CREDIT OFFICER MONTHLY MONITIORING FORM

1. Name of group ____

2. Number of members ___________________________________

3. Attendance at meetings _________________________________

   Date of meeting _____ No. who attended _____

4. Number of loan made by groups to individual members _______

Loan Status

i. Total amount loaned Ksh. __________

ii. Amount due Kshs. _______________

iii. Amount paid Kshs. _______________

iv. No. of loans

30 days overdue __________ Amount __________

60 days overdue __________ Amount __________

over 60 days overdue ______ Amount __________

v. Loan repayment rate _______ %

6. Savings

Current savings as per latest bank balance Kshs. _________

Saved this month __________

Amount withdrawn this month Kshs. _________________

Field Officer's Signature ___________________________

Date __________

Months	SAVINGS TRANSACTIONS					LOAN APPLICATION						
	Date	Deposit	Interest	Forfeiture	and	Date	Amount	Loan	Interest	Total	Loan	Signature
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												

Joint UNDP/World Bank
ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME (ESMAP)

LIST OF REPORTS ON COMPLETED ACTIVITIES

Region/Country	*Activity/Report Title*	*Date*	*Number*
	SUB-SAHARAN AFRICA (AFR)		
Africa Regional	Anglophone Africa Household Energy Workshop (English)	07/88	085/88
	Regional Power Seminar on Reducing Electric Power System Losses in Africa (English)	08/88	087/88
	Institutional Evaluation of EGL (English)	02/89	098/89
	Biomass Mapping Regional Workshops (English)	05/89	--
	Francophone Household Energy Workshop (French)	08/89	--
	Interafrican Electrical Engineering College: Proposals for Short- and Long-Term Development (English)	03/90	112/90
	Biomass Assessment and Mapping (English)	03/90	--
	Symposium on Power Sector Reform and Efficiency Improvement in Sub-Saharan Africa (English)	06/96	182/96
	Commercialization of Marginal Gas Fields (English)	12/97	201/97
	Commercilizing Natural Gas: Lessons from the Seminar in Nairobi for Sub-Saharan Africa and Beyond	01/00	225/00
Angola	Energy Assessment (English and Portuguese)	05/89	4708-ANG
	Power Rehabilitation and Technical Assistance (English)	10/91	142/91
Benin	Energy Assessment (English and French)	06/85	5222-BEN
Botswana	Energy Assessment (English)	09/84	4998-BT
	Pump Electrification Prefeasibility Study (English)	01/86	047/86
	Review of Electricity Service Connection Policy (English)	07/87	071/87
	Tuli Block Farms Electrification Study (English)	07/87	072/87
	Household Energy Issues Study (English)	02/88	--
	Urban Household Energy Strategy Study (English)	05/91	132/91
Burkina Faso	Energy Assessment (English and French)	01/86	5730-BUR
	Technical Assistance Program (English)	03/86	052/86
	Urban Household Energy Strategy Study (English and French)	06/91	134/91
Burundi	Energy Assessment (English)	06/82	3778-BU
	Petroleum Supply Management (English)	01/84	012/84
	Status Report (English and French)	02/84	011/84
	Presentation of Energy Projects for the Fourth Five-Year Plan (1983-1987) (English and French)	05/85	036/85
	Improved Charcoal Cookstove Strategy (English and French)	09/85	042/85
	Peat Utilization Project (English)	11/85	046/85
	Energy Assessment (English and French)	01/92	9215-BU
Cape Verde	Energy Assessment (English and Portuguese)	08/84	5073-CV
	Household Energy Strategy Study (English)	02/90	110/90
Central African Republic	Energy Assessement (French)	08/92	9898-CAR
Chad	Elements of Strategy for Urban Household Energy The Case of N'djamena (French)	12/93	160/94
Comoros	Energy Assessment (English and French)	01/88	7104-COM
	In Search of Better Ways to Develop Solar Markets: The Case of Comoros	05/00	230/00
Congo	Energy Assessment (English)	01/88	6420-COB
	Power Development Plan (English and French)	03/90	106/90
Côte d'Ivoire	Energy Assessment (English and French)	04/85	5250-IVC
	Improved Biomass Utilization (English and French)	04/87	069/87

Region/Country	*Activity/Report Title*	*Date*	*Number*
Côte d'Ivoire	Power System Efficiency Study (English)	12/87	--
	Power Sector Efficiency Study (French)	02/92	140/91
	Project of Energy Efficiency in Buildings (English)	09/95	175/95
Ethiopia	Energy Assessment (English)	07/84	4741-ET
	Power System Efficiency Study (English)	10/85	045/85
	Agricultural Residue Briquetting Pilot Project (English)	12/86	062/86
	Bagasse Study (English)	12/86	063/86
	Cooking Efficiency Project (English)	12/87	--
	Energy Assessment (English)	02/96	179/96
Gabon	Energy Assessment (English)	07/88	6915-GA
The Gambia	Energy Assessment (English)	11/83	4743-GM
	Solar Water Heating Retrofit Project (English)	02/85	030/85
	Solar Photovoltaic Applications (English)	03/85	032/85
	Petroleum Supply Management Assistance (English)	04/85	035/85
Ghana	Energy Assessment (English)	11/86	6234-GH
	Energy Rationalization in the Industrial Sector (English)	06/88	084/88
	Sawmill Residues Utilization Study (English)	11/88	074/87
	Industrial Energy Efficiency (English)	11/92	148/92
Guinea	Energy Assessment (English)	11/86	6137-GUI
	Household Energy Strategy (English and French)	01/94	163/94
Guinea-Bissau	Energy Assessment (English and Portuguese)	08/84	5083-GUB
	Recommended Technical Assistance Projects (English & Portuguese)	04/85	033/85
	Management Options for the Electric Power and Water Supply Subsectors (English)	02/90	100/90
	Power and Water Institutional Restructuring (French)	04/91	118/91
Kenya	Energy Assessment (English)	05/82	3800-KE
	Power System Efficiency Study (English)	03/84	014/84
	Status Report (English)	05/84	016/84
	Coal Conversion Action Plan (English)	02/87	--
	Solar Water Heating Study (English)	02/87	066/87
	Peri-Urban Woodfuel Development (English)	10/87	076/87
	Power Master Plan (English)	11/87	--
	Power Loss Reduction Study (English)	09/96	186/96
	Implementation Manual: Financing Mechanisms for Solar Electric Equipment	07/00	231/00
Lesotho	Energy Assessment (English)	01/84	4676-LSO
Liberia	Energy Assessment (English)	12/84	5279-LBR
	Recommended Technical Assistance Projects (English)	06/85	038/85
	Power System Efficiency Study (English)	12/87	081/87
Madagascar	Energy Assessment (English)	01/87	5700-MAG
	Power System Efficiency Study (English and French)	12/87	075/87
	Environmental Impact of Woodfuels (French)	10/95	176/95
Malawi	Energy Assessment (English)	08/82	3903-MAL
	Technical Assistance to Improve the Efficiency of Fuelwood Use in the Tobacco Industry (English)	11/83	009/83
	Status Report (English)	01/84	013/84
Mali	Energy Assessment (English and French)	11/91	8423-MLI
	Household Energy Strategy (English and French)	03/92	147/92
Islamic Republic of Mauritania	Energy Assessment (English and French)	04/85	5224-MAU
	Household Energy Strategy Study (English and French)	07/90	123/90

Region/Country	*Activity/Report Title*	*Date*	*Number*
Mauritius	Energy Assessment (English)	12/81	3510-MAS
	Status Report (English)	10/83	008/83
	Power System Efficiency Audit (English)	05/87	070/87
	Bagasse Power Potential (English)	10/87	077/87
	Energy Sector Review (English)	12/94	3643-MAS
Mozambique	Energy Assessment (English)	01/87	6128-MOZ
	Household Electricity Utilization Study (English)	03/90	113/90
	Electricity Tariffs Study (English)	06/96	181/96
	Sample Survey of Low Voltage Electricity Customers	06/97	195/97
Namibia	Energy Assessment (English)	03/93	11320-NAM
Niger	Energy Assessment (French)	05/84	4642-NIR
	Status Report (English and French)	02/86	051/86
	Improved Stoves Project (English and French)	12/87	080/87
	Household Energy Conservation and Substitution (English and French)	01/88	082/88
Nigeria	Energy Assessment (English)	08/83	4440-UNI
	Energy Assessment (English)	07/93	11672-UNI
Rwanda	Energy Assessment (English)	06/82	3779-RW
	Status Report (English and French)	05/84	017/84
	Improved Charcoal Cookstove Strategy (English and French)	08/86	059/86
	Improved Charcoal Production Techniques (English and French)	02/87	065/87
	Energy Assessment (English and French)	07/91	8017-RW
	Commercialization of Improved Charcoal Stoves and Carbonization Techniques Mid-Term Progress Report (English and French)	12/91	141/91
SADC	SADC Regional Power Interconnection Study, Vols. I-IV (English)	12/93	--
SADCC	SADCC Regional Sector: Regional Capacity-Building Program for Energy Surveys and Policy Analysis (English)	11/91	--
Sao Tome and Principe	Energy Assessment (English)	10/85	5803-STP
Senegal	Energy Assessment (English)	07/83	4182-SE
	Status Report (English and French)	10/84	025/84
	Industrial Energy Conservation Study (English)	05/85	037/85
	Preparatory Assistance for Donor Meeting (English and French)	04/86	056/86
	Urban Household Energy Strategy (English)	02/89	096/89
	Industrial Energy Conservation Program (English)	05/94	165/94
Seychelles	Energy Assessment (English)	01/84	4693-SEY
	Electric Power System Efficiency Study (English)	08/84	021/84
Sierra Leone	Energy Assessment (English)	10/87	6597-SL
Somalia	Energy Assessment (English)	12/85	5796-SO
South Africa Republic of	Options for the Structure and Regulation of Natural Gas Industry (English)	05/95	172/95
Sudan	Management Assistance to the Ministry of Energy and Mining	05/83	003/83
	Energy Assessment (English)	07/83	4511-SU
	Power System Efficiency Study (English)	06/84	018/84
	Status Report (English)	11/84	026/84
	Wood Energy/Forestry Feasibility (English)	07/87	073/87
Swaziland	Energy Assessment (English)	02/87	6262-SW
	Household Energy Strategy Study	10/97	198/97
Tanzania	Energy Assessment (English)	11/84	4969-TA
	Peri-Urban Woodfuels Feasibility Study (English)	08/88	086/88
	Tobacco Curing Efficiency Study (English)	05/89	102/89
	Remote Sensing and Mapping of Woodlands (English)	06/90	--

Region/Country	*Activity/Report Title*	*Date*	*Number*
Tanzania	Industrial Energy Efficiency Technical Assistance (English)	08/90	122/90
	Power Loss Reduction Volume 1: Transmission and Distribution SystemTechnical Loss Reduction and Network Development (English)	06/98	204A/98
	Power Loss Reduction Volume 2: Reduction of Non-Technical Losses (English)	06/98	204B/98
Togo	Energy Assessment (English)	06/85	5221-TO
	Wood Recovery in the Nangbeto Lake (English and French)	04/86	055/86
	Power Efficiency Improvement (English and French)	12/87	078/87
Uganda	Energy Assessment (English)	07/83	4453-UG
	Status Report (English)	08/84	020/84
	Institutional Review of the Energy Sector (English)	01/85	029/85
	Energy Efficiency in Tobacco Curing Industry (English)	02/86	049/86
	Fuelwood/Forestry Feasibility Study (English)	03/86	053/86
	Power System Efficiency Study (English)	12/88	092/88
	Energy Efficiency Improvement in the Brick and Tile Industry (English)	02/89	097/89
	Tobacco Curing Pilot Project (English)	03/89	UNDP Terminal Report
	Energy Assessment (English)	12/96	193/96
	Rural Electrification Strategy Study	09/99	221/99
Zaire	Energy Assessment (English)	05/86	5837-ZR
Zambia	Energy Assessment (English)	01/83	4110-ZA
	Status Report (English)	08/85	039/85
	Energy Sector Institutional Review (English)	11/86	060/86
	Power Subsector Efficiency Study (English)	02/89	093/88
	Energy Strategy Study (English)	02/89	094/88
	Urban Household Energy Strategy Study (English)	08/90	121/90
Zimbabwe	Energy Assessment (English)	06/82	3765-ZIM
	Power System Efficiency Study (English)	06/83	005/83
	Status Report (English)	08/84	019/84
	Power Sector Management Assistance Project (English)	04/85	034/85
	Power Sector Management Institution Building (English)	09/89	--
	Petroleum Management Assistance (English)	12/89	109/89
	Charcoal Utilization Prefeasibility Study (English)	06/90	119/90
	Integrated Energy Strategy Evaluation (English)	01/92	8768-ZIM
	Energy Efficiency Technical Assistance Project: Strategic Framework for a National Energy Efficiency Improvement Program (English)	04/94	--
	Capacity Building for the National Energy Efficiency Improvement Programme (NEEIP) (English)	12/94	--
	Rural Electrification Study	03/00	228/00

EAST ASIA AND PACIFIC (EAP)

Asia Regional	Pacific Household and Rural Energy Seminar (English)	11/90	--
China	County-Level Rural Energy Assessments (English)	05/89	101/89
	Fuelwood Forestry Preinvestment Study (English)	12/89	105/89
	Strategic Options for Power Sector Reform in China (English)	07/93	156/93
	Energy Efficiency and Pollution Control in Township and Village Enterprises (TVE) Industry (English)	11/94	168/94

Region/Country	*Activity/Report Title*	*Date*	*Number*
China	Energy for Rural Development in China: An Assessment Based on a Joint Chinese/ESMAP Study in Six Counties (English)	06/96	183/96
	Improving the Technical Efficiency of Decentralized Power Companies	09/99	222/999
Fiji	Energy Assessment (English)	06/83	4462-FIJ
Indonesia	Energy Assessment (English)	11/81	3543-IND
	Status Report (English)	09/84	022/84
	Power Generation Efficiency Study (English)	02/86	050/86
	Energy Efficiency in the Brick, Tile and Lime Industries (English)	04/87	067/87
	Diesel Generating Plant Efficiency Study (English)	12/88	095/88
	Urban Household Energy Strategy Study (English)	02/90	107/90
	Biomass Gasifier Preinvestment Study Vols. I & II (English)	12/90	124/90
	Prospects for Biomass Power Generation with Emphasis on Palm Oil, Sugar, Rubberwood and Plywood Residues (English)	11/94	167/94
Lao PDR	Urban Electricity Demand Assessment Study (English)	03/93	154/93
	Institutional Development for Off-Grid Electrification	06/99	215/99
Malaysia	Sabah Power System Efficiency Study (English)	03/87	068/87
	Gas Utilization Study (English)	09/91	9645-MA
Myanmar	Energy Assessment (English)	06/85	5416-BA
Papua New Guinea	Energy Assessment (English)	06/82	3882-PNG
	Status Report (English)	07/83	006/83
	Energy Strategy Paper (English)	--	--
	Institutional Review in the Energy Sector (English)	10/84	023/84
	Power Tariff Study (English)	10/84	024/84
Philippines	Commercial Potential for Power Production from Agricultural Residues (English)	12/93	157/93
	Energy Conservation Study (English)	08/94	--
Solomon Islands	Energy Assessment (English)	06/83	4404-SOL
	Energy Assessment (English)	01/92	979-SOL
South Pacific	Petroleum Transport in the South Pacific (English)	05/86	--
Thailand	Energy Assessment (English)	09/85	5793-TH
	Rural Energy Issues and Options (English)	09/85	044/85
	Accelerated Dissemination of Improved Stoves and Charcoal Kilns (English)	09/87	079/87
	Northeast Region Village Forestry and Woodfuels Preinvestment Study (English)	02/88	083/88
	Impact of Lower Oil Prices (English)	08/88	--
	Coal Development and Utilization Study (English)	10/89	--
Tonga	Energy Assessment (English)	06/85	5498-TON
Vanuatu	Energy Assessment (English)	06/85	5577-VA
Vietnam	Rural and Household Energy-Issues and Options (English)	01/94	161/94
	Power Sector Reform and Restructuring in Vietnam: Final Report to the Steering Committee (English and Vietnamese)	09/95	174/95
	Household Energy Technical Assistance: Improved Coal Briquetting and Commercialized Dissemination of Higher Efficiency Biomass and Coal Stoves (English)	01/96	178/96
Western Samoa	Energy Assessment (English)	06/85	5497-WSO

Region/Country	*Activity/Report Title*	*Date*	*Number*
	SOUTH ASIA (SAS)		
Bangladesh	Energy Assessment (English)	10/82	3873-BD
	Priority Investment Program (English)	05/83	002/83
	Status Report (English)	04/84	015/84
Bangladesh	Power System Efficiency Study (English)	02/85	031/85
	Small Scale Uses of Gas Prefeasibility Study (English)	12/88	--
India	Opportunities for Commercialization of Nonconventional Energy Systems (English)	11/88	091/88
	Maharashtra Bagasse Energy Efficiency Project (English)	07/90	120/90
	Mini-Hydro Development on Irrigation Dams and Canal Drops Vols. I, II and III (English)	07/91	139/91
	WindFarm Pre-Investment Study (English)	12/92	150/92
	Power Sector Reform Seminar (English)	04/94	166/94
	Environmental Issues in the Power Sector (English)	06/98	205/98
	Environmental Issues in the Power Sector: Manual for Environmental Decision Making (English)	06/99	213/99
	Household Energy Strategies for Urban India: The Case of Hyderabad	06/99	214/99
Nepal	Energy Assessment (English)	08/83	4474-NEP
	Status Report (English)	01/85	028/84
	Energy Efficiency & Fuel Substitution in Industries (English)	06/93	158/93
Pakistan	Household Energy Assessment (English)	05/88	--
	Assessment of Photovoltaic Programs, Applications, and Markets (English)	10/89	103/89
	National Household Energy Survey and Strategy Formulation Study: Project Terminal Report (English)	03/94	--
	Managing the Energy Transition (English)	10/94	--
	Lighting Efficiency Improvement Program Phase 1: Commercial Buildings Five Year Plan (English)	10/94	--
Sri Lanka	Energy Assessment (English)	05/82	3792-CE
	Power System Loss Reduction Study (English)	07/83	007/83
	Status Report (English)	01/84	010/84
	Industrial Energy Conservation Study (English)	03/86	054/86
	EUROPE AND CENTRAL ASIA (ECA)		
Bulgaria	Natural Gas Policies and Issues (English)	10/96	188/96
Central and Eastern Europe	Power Sector Reform in Selected Countries	07/97	196/97
Eastern Europe	The Future of Natural Gas in Eastern Europe (English)	08/92	149/92
Kazakhstan	Natural Gas Investment Study, Volumes 1, 2 & 3	12/97	199/97
Kazakhstan,& Kyrgyzstan	Opportunities for Renewable Energy Development	11/97	16855-KAZ
Poland	Energy Sector Restructuring Program Vols. I-V (English)	01/93	153/93
	Natural Gas Upstream Policy (English and Polish)	08/98	206/98
	Energy Sector Restructuring Program: Establishing the Energy Regulation Authority	10/98	208/98
Portugal	Energy Assessment (English)	04/84	4824-PO
Romania	Natural Gas Development Strategy (English)	12/96	192/96
Slovenia	Workshop on Private Participation in the Power Sector (English)	02/99	211/99

Region/Country	*Activity/Report Title*	*Date*	*Number*
Turkey	Energy Assessment (English)	03/83	3877-TU
	Energy and the Environment: Issues and Options Paper	04/00	229/00

MIDDLE EAST AND NORTH AFRICA (MNA)

Arab Republic of Egypt	Energy Assessment (English)	10/96	189/96
	Energy Assessment (English and French)	03/84	4157-MOR
	Status Report (English and French)	01/86	048/86
Morocco	Energy Sector Institutional Development Study (English and French)	07/95	173/95
	Natural Gas Pricing Study (French)	10/98	209/98
	Gas Development Plan Phase II (French)	02/99	210/99
Syria	Energy Assessment (English)	05/86	5822-SYR
	Electric Power Efficiency Study (English)	09/88	089/88
	Energy Efficiency Improvement in the Cement Sector (English)	04/89	099/89
Syria	Energy Efficiency Improvement in the Fertilizer Sector (English)	06/90	115/90
Tunisia	Fuel Substitution (English and French)	03/90	--
	Power Efficiency Study (English and French)	02/92	136/91
	Energy Management Strategy in the Residential and Tertiary Sectors (English)	04/92	146/92
	Renewable Energy Strategy Study, Volume I (French)	11/96	190A/96
	Renewable Energy Strategy Study, Volume II (French)	11/96	190B/96
Yemen	Energy Assessment (English)	12/84	4892-YAR
	Energy Investment Priorities (English)	02/87	6376-YAR
	Household Energy Strategy Study Phase I (English)	03/91	126/91

LATIN AMERICA AND THE CARIBBEAN (LAC)

LAC Regional	Regional Seminar on Electric Power System Loss Reduction in the Caribbean (English)	07/89	--
	Elimination of Lead in Gasoline in Latin America and the Caribbean (English and Spanish)	04/97	194/97
	Elimination of Lead in Gasoline in Latin America and the Caribbean - Status Report (English and Spanish)	12/97	200/97
	Harmonization of Fuels Specifications in Latin America and the Caribbean (English and Spanish)	06/98	203/98
Bolivia	Energy Assessment (English)	04/83	4213-BO
	National Energy Plan (English)	12/87	--
	La Paz Private Power Technical Assistance (English)	11/90	111/90
	Prefeasibility Evaluation Rural Electrification and Demand Assessment (English and Spanish)	04/91	129/91
	National Energy Plan (Spanish)	08/91	131/91
	Private Power Generation and Transmission (English)	01/92	137/91
	Natural Gas Distribution: Economics and Regulation (English)	03/92	125/92
	Natural Gas Sector Policies and Issues (English and Spanish)	12/93	164/93
	Household Rural Energy Strategy (English and Spanish)	01/94	162/94
	Preparation of Capitalization of the Hydrocarbon Sector	12/96	191/96
Brazil	Energy Efficiency & Conservation: Strategic Partnership for Energy Efficiency in Brazil (English)	01/95	170/95

Region/Country	*Activity/Report Title*	*Date*	*Number*
Brazil	Hydro and Thermal Power Sector Study	09/97	197/97
Chile	Energy Sector Review (English)	08/88	7129-CH
Colombia	Energy Strategy Paper (English)	12/86	--
	Power Sector Restructuring (English)	11/94	169/94
Colombia	Energy Efficiency Report for the Commercial and Public Sector (English)	06/96	184/96
Costa Rica	Energy Assessment (English and Spanish)	01/84	4655-CR
	Recommended Technical Assistance Projects (English)	11/84	027/84
	Forest Residues Utilization Study (English and Spanish)	02/90	108/90
Dominican Republic	Energy Assessment (English)	05/91	8234-DO
Ecuador	Energy Assessment (Spanish)	12/85	5865-EC
	Energy Strategy Phase I (Spanish)	07/88	--
	Energy Strategy (English)	04/91	--
	Private Minihydropower Development Study (English)	11/92	--
	Energy Pricing Subsidies and Interfuel Substitution (English)	08/94	11798-EC
	Energy Pricing, Poverty and Social Mitigation (English)	08/94	12831-EC
Guatemala	Issues and Options in the Energy Sector (English)	09/93	12160-GU
Haiti	Energy Assessment (English and French)	06/82	3672-HA
	Status Report (English and French)	08/85	041/85
	Household Energy Strategy (English and French)	12/91	143/91
Honduras	Energy Assessment (English)	08/87	6476-HO
	Petroleum Supply Management (English)	03/91	128/91
Jamaica	Energy Assessment (English)	04/85	5466-JM
	Petroleum Procurement, Refining, and Distribution Study (English)	11/86	061/86
	Energy Efficiency Building Code Phase I (English)	03/88	--
	Energy Efficiency Standards and Labels Phase I (English)	03/88	--
	Management Information System Phase I (English)	03/88	--
	Charcoal Production Project (English)	09/88	090/88
	FIDCO Sawmill Residues Utilization Study (English)	09/88	088/88
	Energy Sector Strategy and Investment Planning Study (English)	07/92	135/92
Mexico	Improved Charcoal Production Within Forest Management for the State of Veracruz (English and Spanish)	08/91	138/91
	Energy Efficiency Management Technical Assistance to the Comision Nacional para el Ahorro de Energia (CONAE) (English)	04/96	180/96
Panama	Power System Efficiency Study (English)	06/83	004/83
Paraguay	Energy Assessment (English)	10/84	5145-PA
	Recommended Technical Assistance Projects (English)	09/85	--
	Status Report (English and Spanish)	09/85	043/85
Peru	Energy Assessment (English)	01/84	4677-PE
	Status Report (English)	08/85	040/85
	Proposal for a Stove Dissemination Program in the Sierra (English and Spanish)	02/87	064/87
	Energy Strategy (English and Spanish)	12/90	--
	Study of Energy Taxation and Liberalization of the Hydrocarbons Sector (English and Spanish)	120/93	159/93
	Reform and Privatization in the Hydrocarbon Sector (English and Spanish)	07/99	216/99
Saint Lucia	Energy Assessment (English)	09/84	5111-SLU
St. Vincent and the Grenadines	Energy Assessment (English)	09/84	5103-STV

Region/Country	*Activity/Report Title*	*Date*	*Number*
Sub Andean	Environmental and Social Regulation of Oil and Gas Operations in Sensitive Areas of the Sub-Andean Basin (English and Spanish)	07/99	217/99
Trinidad and Tobago	Energy Assessment (English)	12/85	5930-TR

GLOBAL

	Energy End Use Efficiency: Research and Strategy (English)	11/89	--
	Women and Energy--A Resource Guide The International Network: Policies and Experience (English)	04/90	--
	Guidelines for Utility Customer Management and Metering (English and Spanish)	07/91	--
	Assessment of Personal Computer Models for Energy Planning in Developing Countries (English)	10/91	--
	Long-Term Gas Contracts Principles and Applications (English)	02/93	152/93
	Comparative Behavior of Firms Under Public and Private Ownership (English)	05/93	155/93
	Development of Regional Electric Power Networks (English)	10/94	--
	Roundtable on Energy Efficiency (English)	02/95	171/95
	Assessing Pollution Abatement Policies with a Case Study of Ankara (English)	11/95	177/95
	A Synopsis of the Third Annual Roundtable on Independent Power Projects: Rhetoric and Reality (English)	08/96	187/96
	Rural Energy and Development Roundtable (English)	05/98	202/98
	A Synopsis of the Second Roundtable on Energy Efficiency: Institutional and Financial Delivery Mechanisms (English)	09/98	207/98
	The Effect of a Shadow Price on Carbon Emission in the Energy Portfolio of the World Bank: A Carbon Backcasting Exercise (English)	02/99	212/99
	Increasing the Efficiency of Gas Distribution Phase 1: Case Studies and Thematic Data Sheets	07/99	218/99
	Global Energy Sector Reform in Developing Countries: A Scorecard	07/99	219/99
	Global Lighting Services for the Poor Phase II: Text Marketing of Small "Solar" Batteries for Rural Electrification Purposes	08/99	220/99
	A Review of the Renewable Energy Activities of the UNDP/ World Bank Energy Sector Management Assistance Programme 1993 to 1998	11/99	223/99
	Energy, Transportation and Environment: Policy Options for Environmental Improvement	12/99	224/99
	Privatization, Competition and Regulation in the British Electricity Industry, With Implications for Developing Countries	02/00	226/00
	Reducing the Cost of Grid Extension for Rural Electrification	02/00	227/00

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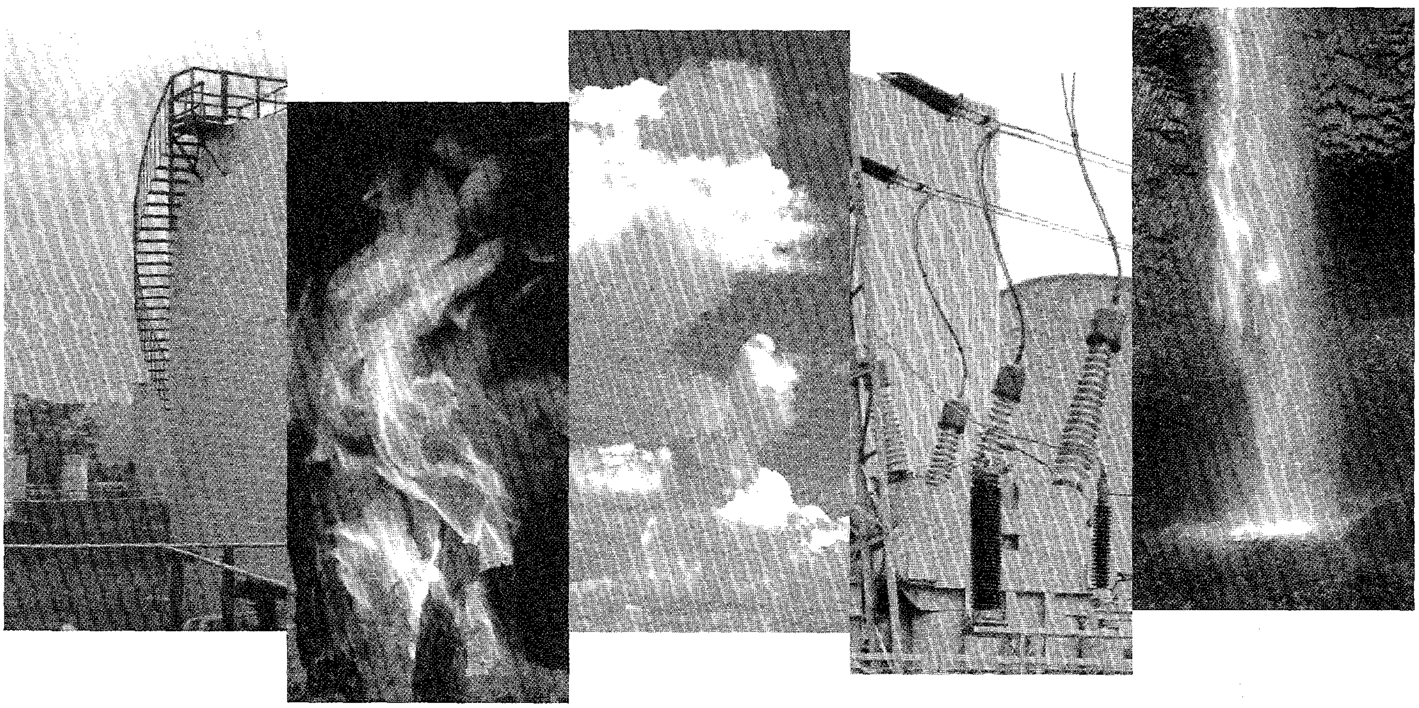

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