Solar Energy

A Reference Guide for Users

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scode

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Technology challenging poverty

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PREFACE

The only source of energy for many rural communities, besides diesel power and grid electricity has been kerosene, candles, dry-cell batteries and centrally recharged lead-acid batteries. Therefore, there is a constant demand for power to light small amenities.

Solar energy technology has played a significant role in filling up this gap. The technology is appropriate for use in the rural areas where there is no conventional electrical power or the supply is erratic. Studies have shown that where energy requirements are below 500-watt hours per day, solar electricity is often the most economical source of electric power. In addition, low voltage solar energy is relatively simple and can be adapted to the needs of individual applications such as electric calculators, small radios, television, lights or electric pumps.

Solar electric systems can easily be expanded by adding more modules and batteries. The technology is environmentally friendly because it does not cause global warming or destroy the ozone layer. Solar devices have long life spans since they have no movable parts that wear out and maintenance is low since no fuel is used.

MANUAL GUIDE

SECTION A

Part I gives basic information on various solar components required to produce solar energy.
Part II provides tips to owners of solar modules

SECTION B

Part I focuses on project experiences
Part II provides personal experiences from project beneficiaries
Part III covers lessons learned

SECTION A
PART I

SOLAR ENERGY PRODUCTION

Solar Energy

Solar energy comes from the sun. It can be direct or indirect. Most energy sources on earth are forms of indirect solar energy. F or instance, energy in foodstuffs and wood comes from the sun, the movement of the wind (causing waves in oceans) and the evaporation of water to form rainfall which accumulates in rivers are also powered by the sun. Therefore, hydroelectric power and wind power are forms of indirect solar energy.

Direct solar energy is what is usually referred to when speaking of solar power - it is the use of sunlight for heating or generating electricity. This solar energy can also be used to run radio and television sets.

Obtaining energy from the sun is referred to as "tapping". This means that it is captured, stored and used as electricity. This is done using a solar energy system or kit.

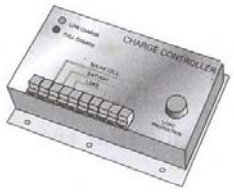
The solar energy kit

The solar energy kit comprises a solar module or panel, a charge regulator, a solar battery, cables, switches and sockets and lights or lamps.

Solar panel (or module)

This consists of a number of cells that store the sun's energy and produce electricity. The energy contained in sunlight is converted into electrical energy by photovoltaic (PV) modules. A PV module consists of a number of individual solar cells wired together to provide the required amount of voltage and current. PV is measured in units of what is referred to as peak watts (Wp). A peak watt figure applies to the power output of the module under what is seen as "peak sun" conditions, considered to be 1000 watts per square metre.

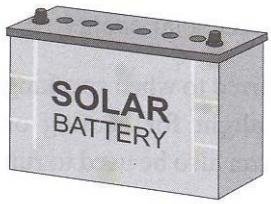
Charge regulator



It is also referred to as a charge controller. This is an electronic device which regulates the solar system. It controls the amount of power entering and leaving the battery. The charge regulator prevents the solar panel from overcharging the battery and protects the battery from deep discharge. It is easy to understand its operation by observing the light emitting diodes present. That is, load on, load off and load high. The charge regulator is an important part of the solar kit.

Main switch
The main switch is an electrical device used to protect the solar system from short circuit current emerging from a user's fault or faulty component. It contains fuses which act as a bridge between the loads and the rest of the system.

Solar battery
The solar battery stores electricity derived from the solar module and then distributes it for use, through the charge regulator, to the light switches and socket. If the battery is overcharged or over discharged, it will be damaged.



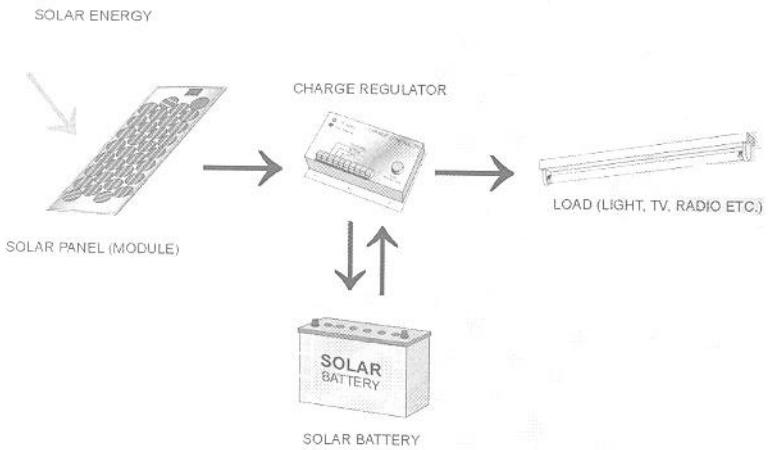
During the day, electricity from the module charges the battery. During the evening, the battery is discharged to power lights and other applications.

Cables
Cables connect all the parts of the solar system together. They transmit electric energy. Thick gauge cables are preferred in solar installation because they allow less electric energy to be lost along the way. Generally, cables of2.5mm sq., 4.0 mm sq. and 6.0mm sq. are used.

Sizing: Solar systems must be properly sized to avoid damage and ensure that they function well over a long time. Sizing of a solar system refers to the process of matching the power output capacity of a solar module with the storage capacity of a solar battery, the current handling capacity of a charge regulator and the cable thickness. Most solar installation failures can be attributed to wrong system sizing.

The Solar Energy Electric Cycle
When the sun's rays shine on the solar module, the cells produce electricity or energy. The electricity travels through the cables, to the charge regulator, the cables and up to the solar battery. The battery stores the energy until needed.

Whenever the sun's rays shine upon the solar module, electricity is produced. This process is referred to as the **solar energy electric cycle**.



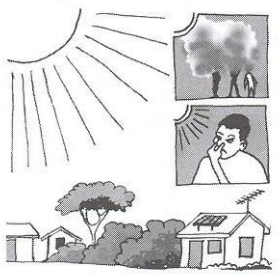
In this cycle, one can see the following steps:

- The sun provides the light
- The solar module generates electricity (energy) from the light
- The solar battery stores the electricity
- Solar energy is used for various purposes, including providing light at night or powering radios and televisions.

Benefits and Disadvantages of Solar Energy

Benefits

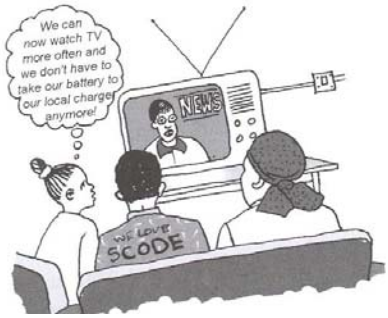
Solar electrical power has the following advantages:



1. It is convenient to use.
2. It is environmentally friendly-it does not emit fumes, smoke or soot, nor smell like kerosene or firewood. Therefore it does not pose a health hazard nor cause danger of fire.
3. Lighting at minimal cost: solar electric systems provide the most cost effective way of receiving high quality home lighting since no monthly costs are incurred.
4. Businesses selling solar energy components and technicians servicing solar systems are gainfully employed while families can work longer hours.
5. The PV systems, which convert sunlight into electricity without emitting toxic gases, can be used anywhere however isolated or remote. Therefore, poor households have the capacity to generate clean electric power by installing solar panels on their own rooftops.

6. Solar generated electric light helps to increase literacy especially since people can read after dark more easily than they can using kerosene lamps or candles. Children find it easier to do their homework and their eyesight, which could have been harmed by poor lighting is safeguarded.
7. Solar electricity is the most sustainable means of meeting the electric power needs of poor communities.
8. Greater access to radio and television, hence more information available to listeners and viewers leading to increased knowledge.

Disadvantages



1. Its operation and use is limited during cloudy days.
2. If poorly maintained or installed, it can become a great liability to the owner.
3. Initial capital can be costly.

PART II

LOOKING AFTER THE SOLAR ENERGY SYSTEM

The Solar Module

1. Shade

When the solar module is shaded in whole or part, for example, by tree branches, it captures less energy from the sun.

Do not position a panel where it will be wholly or partly shaded

Do:

- Make sure that all objects that may shade your module are removed.
- Make sure that only direct sunlight falls on your panel.

Do not:

- Concentrate artificial light on your solar module.

2. Cleaning

Your solar module must remain clean at all times.

Do:

- Inspect your solar module regularly for dirt such as dust or bird droppings.
- Clean your solar module once every three months (or when dirty) using clean water and a soft cloth.

Do not:

- Use soap or detergent.

3. Security

During installation, the solar module was firmly fixed to roof of the house.

Do not:

- Fix a wire mesh around it as it is already secure. This 'is because shadows cast by the wire mesh will make it produce less energy.

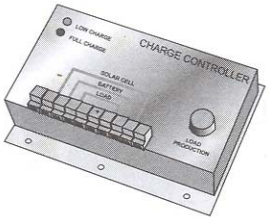
4. Safety

Your solar module consists of glass which can easily break.

Do not:

- Throw objects at the solar module.
- Stand or step on the module.
- Try to repair your solar module if it breaks because once the module is broken, it cannot be repaired.
- Carry out modifications on your system without technical guidance from your system supplier or a qualified technician.

The Charge Regulator



Do:

- Ensure connections are firm. In case of a problem, consult your solar installer or supplier.

Do not:

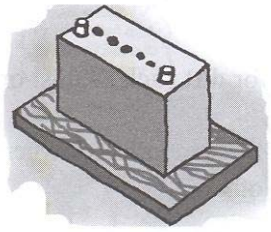
- Tamper with it.

Cable Network

Do:

- Inspect the cable network every three to five years to ensure there are no exposed wires.
- Protect your solar wiring from damage as this can result in the failure of your system.
- Avoid short circuiting your cables as this can lead to system damage.

Solar Battery



Do:

- Keep the solar battery in a clean environment.
- Place the solar battery on a stable surface to prevent it from falling or tilting.
- Keep the solar battery safely inside a well-ventilated wooden box.
- Always check the level of electrolyte in every cell of your battery. If the level has gone down, add some distilled (or de-ionized) water.
- Top the solar battery with distilled water from a good source, never use tap or rain water since they have impurities, which may damage your battery.
- Apply Vaseline, not grease or oil, on both battery terminals to prevent acid mist (a white substance) forming on them.
- Clean the terminals and battery's top surface regularly with hot water to prevent accumulation of acid mist which causes batteries to self discharge.

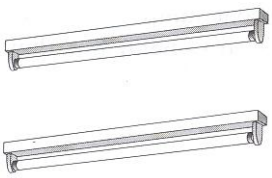
Do not:

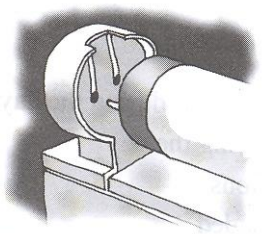
- Short -circuit the terminals of your solar battery. Your solar battery stores huge amounts of energy. If you connect the terminals directly, the stored energy will be released at one go causing the wires to melt or fire to occur. All power must be consumed through the installed regulator. This will protect your solar battery for a long time.
- Pour out the acid and fill with fresh acid as it damages the battery.
- Add acid to your solar battery at any time.

Do not short circuit your battery

- Accept advice on battery repairs from unauthorized persons. Rather, contact battery suppliers directly.
- Keep the solar battery near open flames as there is danger .of explosion.
- Take your old batteries for repair.

CAUTION: Unauthorized battery repair can invalidate the guarantee given by the battery supplier.





Replace a flourescent tube when it starts blackening

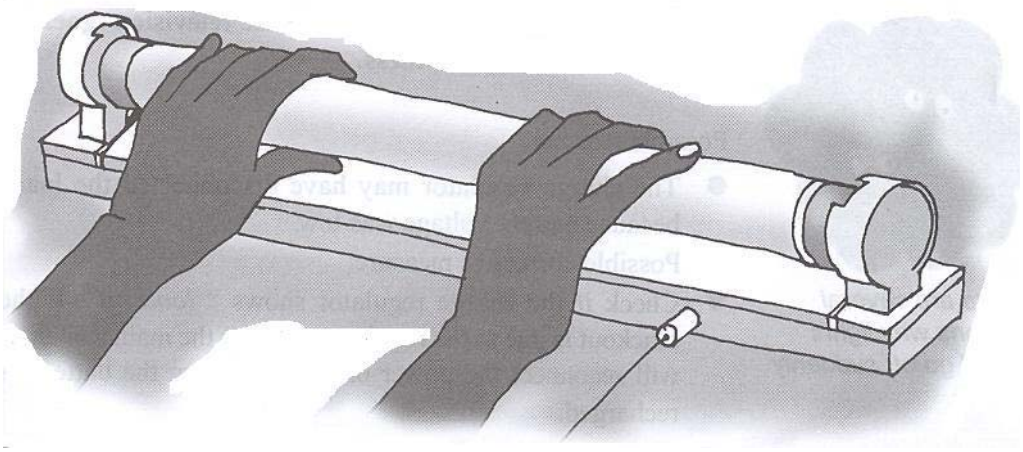
Fluorescent tubes

As fluorescent tubes age, they become black on one or both ends. As the blackening increases, the light from the tube will decrease. You need to replace it. In addition,

- Clean your fluorescent tubes when dust or soot covers them.
- Remove objects that block light from the tube

To remove a tube for replacement, follow the steps below:

- Turn off the light switch
- Hold the tube at both ends
- Turn the tube gently through 90 degrees or until the pins at both ends slide out of the holder
- Slide out the tube.

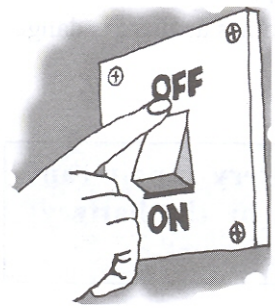


NB: Bright colours like white, cream or light blue for your walls reflect the light from your tubes and improve the lighting effect of the lamps.

How to save solar power

To save solar power:

- Switch off the main switch during the day to allow all energy captured from the sun to be saved in the solar battery.
- At night, switch off lights each time you leave a room that is not occupied. Do this even if you are leaving the room for a short while.
- Avoid overuse during the day.
- Preferably, use only solar fluorescent lamps and solar energy saving lamps. Solar bulbs are cheap but they consume more power.



Switch off lights whenever you leave a room

Trouble Shooting

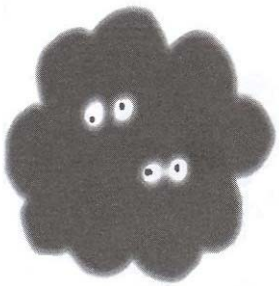
Problem: **It has been sunny all day but there is not enough power in your solar battery.**

Possible reasons:

- The television or radio may have been used during the day
- The lamps may have been left on during the day
- There could be some loose connections
- The panel may be faulty, dirty or shaded
- The battery may be old
- The electrolyte level in the battery could be low

Problem: **You were watching television and the rooms were well lit for several hours. Suddenly the television goes off and you are in total darkness.**

Possible reasons:



There are several reasons why lights would go off suddenly

- The charge regulator may have disconnected the loads because battery voltage was low.
  Possible corrective measure:
- Check if the charge regulator shows" load off'. If the blackout is due to the regulator, turn off the main switch. It will reconnect the power on its own when the battery is recharged.
- If the charge regulator is not responsible for the blackout and the lights and television do not function at all the next evening, contact your solar electric system supplier.

Problem: **There are frequent power blackouts.**

Possible reasons:

- Your solar electric system may be too small for your demands
- Your solar battery may be very old
- Your solar battery may be damaged
- There may be loose or corroded connections in your solar electric system
- The electrolyte level in your battery could be low

Possible corrective measures:

- Contact your solar electric system supplier
- Reduce the load demands on your system
- Upgrade your system
- Check the electrolyte level and top up if low

Problem: **During the cold and cloudy seasons the power supply is lower than usual**.

Possible corrective measure:

- Continue using the solar electric system but exercise greater conservation of power. The power supply will rise to normal when the sunny season resumes

Problem: **The solar battery acquires full charge earlier than normal and blackouts still occur.**

Possible corrective measures:

- Test the battery's state of self discharge and if high, replace with a new one
- If the problem occurs and the battery is in working order, the charge regulator could be faulty.
- Check battery terminals for a possible loose connection

SECTION B
PART I

PROJECT EXPERIENCES

Background

The implementation phase of the solar energy demonstration project began in August 1999. Prior to this, in 1996, a baseline survey and problem identification exercise had been carried out and community sensitization activities immediately followed.

The project, in Bahati and Mbogoine divisions of Nakuru district, began with the aim of improving residents' standard of living while reducing the emission of green house gases, which lead to global warming. This was to be achieved through adoption of solar photovoltaic systems.

SCODE technicians
Installing a solar panel

Before the project, children found it difficult to study at home during evenings because of poor lighting and smoke from kerosene or firewood, adversely affected their health and that of the women who spent large amounts of time in the kitchen. In addition, the cost of lighting for households came to approximately Ksh.7800 a year compared to Ksh.2400 billed to local households connected to grid electricity monthly. The SCODE project thus helped communities through provision of solar energy.

Creating awareness on the solar energy project

For most groups, solar energy was not a priority as a means of lighting as grid electricity was the choice that presented itself.

SCODE carried out rigorous sensitization campaigns through workshops, home visits and exhibitions aimed at changing people's attitudes towards solar energy, bridging existing information gaps among potential and current end users of solar PV systems and mobilizing local people to participate in the SCODE demonstration project.

Other issues of importance discussed while creating awareness about solar energy included:

- what a complete solar PV system comprises
- how a solar PV system works and what it is capable of doing
- how to operate and maintain it
- common problems experienced by solar users and how to solve or avoid them.

By the end of the campaign, the groups had started viewing solar energy as a viable option.

Working with community groups

SCODE worked with groups registered with the Ministry of Culture and Social Services. These were groups with good records of accomplishment, visionary and democratic leadership and the ability to finance solar systems either in part or in full.

Screening of groups included asking them to apply in writing to SCODE requesting participation in the project. A copy of their registration certificate, a brief account of the group's history, membership, activities and their future plans were also submitted. SCODE then sent solar technicians to visit the approved groups to discuss the project's purpose and mode of operation. The groups nominated members to participate in the project.

Some of the groups that participated in the project were:

1. Mwekuria Maili Tano Women's Group
2. Solai Mifugo Bora Self-Help Group
3. Kumenya Self-Help Group
4. Ndungiri Mutukanio 'C' Women's Water Project Group
5. Thimaku Self-Help Group
6. Jitegemea Youth Group
7. Umoja Youth Group
8. Bahati Kilimo Self-Help Group
9. Chania Catchment Self-Help Group
10. Ime Urumwe Solai Self-Help Group
11. Jasho Matangi Self-Help Group
12. Ukweli Self-Help Group
13. Kimuri Self-Help Group
14. Community-Based Health Care - Lower Subukia
15. Salkicheb Tank Self-Help Group
16. Kahuho Tree & Fruit Self-Help Group

Project set-up

SCODE carried out an energy audit of the households where the solar systems were to be installed. They requested household heads tor their energy demands and matched that with an appropriate solar kit. The majority settled for kits providing less energy than their requirements because they could not afford bigger systems. In such cases, the project team trained the user on how to cope with its limited power output. For

example, if a user was using a system designed to provide two hours of light yet wanted to run a radio and TV when fully charged, for a longer period, he or she was advised to switch off apy loads that were not in use.

Financial status of the group

The 100 beneficiary families targeted by the project were able to raise the required amount of between Ksh.12,500 and Ksh.22,500 within a period of six months. Half of the members who participated were farmers, 20% operated small businesses and 30% were employed wage-earners.

Fifty percent of the cost of the solar kits was paid directly to the solar supplier by UNDP's GEF/SGP as a grant to the project.

The project noted that over 50% of the farming families did not depend on their regular income and savings to purchase the solar systems. They obtained the financial boost from employed relatives, borrowed from friends or sold some assets and produce.

Fifty percent of the cost of the solar kits was paid directly to the solar supplier by UNDP's GEF /SGP as a grant to the project. The groups raised the other 50%, which they deposited in the group's bank account, while others paid their contribution to SCODE, who then paid the solar supplier.

Procurement of equipment

After the groups and SCODE decided on the number and sizes of solar systems required, each group agreed on:

- how much the members would contribute each month (or the interval agreed)
- how much would be used from the group account to purchase the solar kits
- when the group would pay the supplier and who would take charge of this.

They also agreed that SCODE would be responsible for acquiring the solar kits from the supplier, storage and delivery of the same to individual member's home. SCODE also took on the responsibility of inspecting the delivered goods to ensure they were acceptable.

Installation of the solar electric system

To ensure the project had competent technicians, SCODE requested the groups to identify two technicians who had installed grid electricity and solar systems locally so that they could be trained. The technicians participated in project implementation and later assisted the groups in undertaking simple repairs at a fee.

Training enabled users to fully understand their systems, operate them with confidence.

Training of users

Training enabled users to fully understand their systems, operate them with confidence and carry out routine maintenance practices. Out of this understanding, the users developed their own user-friendly management practices that helped add value to their systems.

The project trained users at three key stages:

1. **Before installation**: a series of workshops were held to expose potential users to the various technical, social and financial challenges faced by solar users and how to overcome them.
2. **During installation**: individual household members were trained by the technician on how the system works. This enabled the family to understand the various parts of their system, how they relate to each other and how to use the system to maximize benefits. They were also informed on the do's and don'ts associated with the system and when to seek the technician or supplier's assistance.
3. **After installation**: After using the system for a while, the solar energy users came together to share experiences with technicians and suppliers. This helped mainstream their views, observations and thinking with technically accepted practices.

Monitoring and evaluation activities

Before the start of the project, group members compiled information on their energy situation which was used to gauge the impact of the project by the individual groups. This included:

- the energy systems used in the house for lighting and running electrical appliances
- the amount of money spent on lighting and running these appliances
- the number and type of television sets and radios; how they were powered and how often they were used
- the number of homes with access to television sets and radios
- the seasons when television sets and radios were purchased and the mode of payment.

Using the above information, the following indicators were used to establish the impact of the project:

- the increase in the number of solar lighting appliances
- the increase in the number of hours in which television sets and radios were in use
- the reduction in the amount of kerosene used for lighting
- the increase in the number of television sets and radios.

PART II

PERSONAL EXPERIENCES

Location of project beneficiaries' households

Beneficiary households are residents of Bahati and Mbogoine divisions of Nakuru district. SCODE worked with 100 households through cost sharing efforts aimed at producing energy for lighting and operating radios and televisions.

Mr. and Mrs. Kamau from Bahati, recipients of SCODE/UN initiative for solar panels

Mrs Maina says the system is convenient for her in the kitchen

The Maina household

Mrs Maina, a mother of seven, had seen people in her neighborhood with solar energy. Her pastor, who uses solar energy, told her husband about the SCODE project. In December 2000, they bought a 20-watt system but after a few months realized that it did not satisfy their needs, so they bought a 50-watt system which has proved very useful to them. Mrs Maina says the system is convenient for her in the kitchen. Her school-going children are also benefiting as they have adequate light to do their homework.

The Mungai household

Benson Mungai is a farmer and a father of three. He says: "I first saw a solar energy demonstration at the Nairobi Show and it impressed me a lot. I also have a few friends who use it and saw its advantages. Then I heard about the SCODE project but this was after the first phase when the solar kits were no longer being sold at half price. However, I still decided to buy one. Before solar, I used kerosene which was expensive and had a strong, bad smell.

Once I used solar energy. I realized its convenience – lighting was better, there was no smell and I could also use it for radio and TV.

But once I used solar energy, I realized its convenience lighting was better, there was no smell and I could also use it for radio and TV. The only problem was when there was no sun, the system did not charge fully, so we had less electricity. But I learned what to prioritize during the day so as to ensure maximum usage in the evening. I also

believe that solar has no side effects -my eyes don't itch after using it for long periods as they used to with kerosene.

This solar energy project with SCODE has been extremely helpful in not only installing the solar panels and maintaining the panels but also in educating me. I am happy with the partnership and have greatly benefited from it. I plan to buy a bigger panel in future when I can afford it.

Solar energy is the best investment one can make because it is convenient and once you have it, it is yours for life - you only pay for it once and that's it."

The Gathu household

Charles Gathu, a farmer and father of four, had been using kerosene pressure lamps until early 2000. He used four pressure lamps, which was quite expensive because of the amount of kerosene needed.

Although the initial capital was high, it is cheaper to use solar energy in the long run

He learned about SCODE from a neighbor and bought a 20watt system. However, the panel developed a crack so it didn't work. He called the technicians, it was replaced and since then he has encountered no problems.

F or him, the only inconvenience was that the system couldn't store as much energy during the cold weather and would light for only three hours in the evening. But with time he learned how to use less energy during the day so as to have more energy during the night.

He observes that although the initial capital was high, it is cheaper to use solar energy in the long run. He has other plans for the future -to buy a bigger solar system to cater for his radio, television, security lights and poultry.

The Nyaikaba household

Catherine Nyaikaba is the chairperson of Mwekuria Women's Group, formed in 1986, with about 100 members. In 1999, group members saw a demonstration of solar energy through the SCODE project. Unfortunately, by the time the project began, there was famine in the area so many had no alternative but to invest all their money in feeding their families and paying school fees thus missing out on the solar project. However, a few like Mrs Nyaikaba were fortunate to have saved some money so they benefited from the project.

I no longer have to worry about lighting as my four-light system meets our needs perfectly.

Mrs Nyaikaba says that she used to spend almost Ksh.40 per week on kerosene but now uses that money on other things. She adds that she no longer has to worry about lighting as her four-light system meets their needs perfectly.'

She adds that the solar technology has satisfied her energy needs -for lighting my kitchen, bedroom, security light and sitting room. She also uses it for her radio and television set. She observes: "SCODE has done a wonderful job - they have educated me through workshops on how the system works and also- how to maintain it and in turn I have educated my whole household".

The Gakunyi household

Mr and Mrs Gakunyi are farmers and parents of five children. Mr Gakunyi says: "I first heard about solar energy when living in Timboroa but was not impressed by it because the person using it always experienced blackouts. 1 had also told my wife that people were now using electricity from the sun but she didn't believe me - she thought 1 was making up stories to entertain her."

It was expensive, unsafe because the children knocked over the lamps and we also had to keep taking the battery for the TV for recharging.

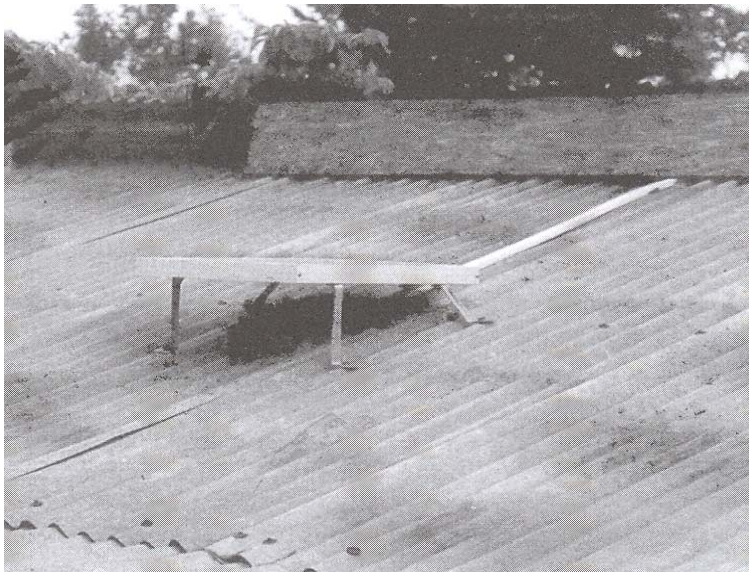
Later they moved to Bahati in Nakuru and became members of the Kumenya Self-Help Group where he's the vice- secretary.

Early in 2000, the chairman of his group informed him that SCODE was conducting a solar energy project. After attending one of their meetings, he was convinced that it worked and decided, together with his wife, to buy a solar kit. After selling bags of maize, they got enough money to buy a 20-watt system.

Mrs. Gakunyi says that before solar, they used kerosene for lighting and batteries for the TV and radio. She observes: "It was expensive, unsafe because the children knocked over the lamps and we also had to keep taking the battery for the TV for recharging. Our lives have completely changed since we started using solar. We have bright lights in the kitchen, sitting room and in the bedrooms. The system is safe because the children can't play with the lights or battery. The radio and TV are protected because of the charge regulator and we don't have to take the battery to be re-charged. We have fewer expenses unlike when we used kerosene and batteries and we don't make monthly payments like those who use grid electricity. Because I am at home most of the time, I'm able to play my favorite music cassettes and sometimes watch TV during the day."

Moreover, many people are always curious about their solar system. Mr. Gakunyi relates a story of how a neighbor asked him why his house was always so bright at night and he told her about solar energy. She was very impressed but her main worry was incurring monthly bills like those who used grid electricity. But he assured her that this wouldn't happen so she is now planning to install solar energy in her home.

We have fewer expenses unlike when we used kerosene and batteries and we don't make monthly payments like those who use grid electricity.



PART III

LESSONS LEARNED

Organising community groups

It is advisable to work with registered groups because:

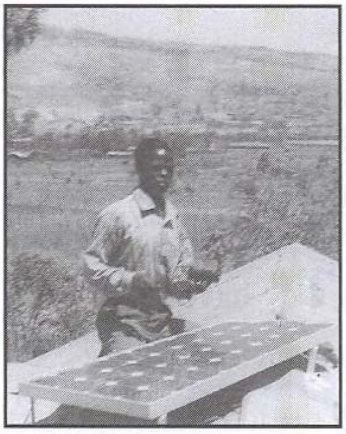
- they have well known, defined members
- they have an established management structure and procedures
- they are legal entities
- they have well defined objectives they have an existing motivation to work together for the benefit of all.

In addition, using groups enables a small demonstration project to spillover to larger numbers of people with minimal financial resources.

Project financing

Solar systems are not cheap. A complete solar kit cost the project Ksh.626 per watt for a 20-watt, system and Ksh.516 per watt for a 45-watt system. This high cost tends to persuade potential users to go for incomplete kits and the result is poor service. To avoid this, the group should agree on how to finance complete kits to ensure better energy services and guaranteed quality and security against fake products in the market. There are various ways a group can finance their solar systems:

1. Group lending - loans can be given to members to purchase solar systems. The terms and conditions of the loan must be clearly explained and agreed upon by group members.
2. Group financing - a group can use its own funds to buy solar systems for its members. In order to cater for the various levels of energy demands among its members, the members should agree on the amount of money the group will contribute. If a member wants a system that costs more than the groups' contribution, he/she should pay the additional cost.
3. External borrowing - a group can borrow funds to buy solar systems from a lending institution. The group needs to have a good plan and capacity to repay the loan because failure to do so will expose the group to problems in future.
4. Donor funding - a group can write a proposal to a donor organisation interested in funding solar projects. The group should propose to contribute a significant proportion of the cost while requesting the donor to provide grant funds to bridge the gap. The challenge is to find an interested donor and a proposal format easy enough for the group to use.



SCODE technician installing a solar panel in rural Nakuru Town

Technical assistance

1. Trained local technicians are preferred in order to avoid simple mistakes or damage, which result in poor performance of the solar electric system.
2. The group needs to identify and develop working partnerships with competent and reputable solar experts and a local electrical technician. The solar expert will train the technician on design, installation and maintenance of the solar system.
3. Procurement - the group should be assisted by solar experts to look for at least three quotations from credible suppliers with local outlets and reliable technical backup. After obtaining quotations, the group should meet, discuss and agree on which supplier to buy from based on price, quality, guarantee, after sales service, track record and accessibility.
4. The group should then ask each participating member to confirm the size of solar kits they require. Advice from the solar expert will be helpful to enable the group approach the right supplier. The group can then decide to enter into a written memorandum of understanding with the supplier, spelling out roles and responsibilities of each party, terms and conditions of purchase and supply, number of solar kits and the duration of the project.

Future Activities

1. Credit schemes - credit facilities for solar systems are nonexistent in the project area. SCODE will enable an increasing number of sensitized households to acquire solar systems and pay for them while enjoying the benefits of the service.
2. Training of local electrical technicians - to ensure the installed solar systems continue working well, it is important to train the *fundis* on sizes, installations and maintenance of solar systems. This reduces cases of tampering with installed systems and increases acceptance of solar technology by the community. SCODE will initiate a project to train *fundis* on design, installation, operation and maintenance of solar PV systems.
3. Income-generating activities - many rural trading centers in the project area are not connected to grid electricity, yet centers keep coming up due to increasing demand for goods and services. In such areas, people are unable to use simple electrical appliances to generate an income due to lack of electrical power. SCODE will carry out solar energy activities to demonstrate that solar can be used to generate income. Through the credit scheme, SCODE will support local people to acquire and use solar systems for such activities.

The Solar Energy Users Manual is a compilation of experience drawn form the Sustainable Community Development Service (SCODE) solar energy project. SCODE is a grassroots organization that seeks to improve the quality of life of poor people by accessing appropriate technologies which the can sustain,

The manual is organized as a reference guide for those who would like to know more about solar energy, its benefits and requirements for installation. The information and illustrations are designed to simplify the technology into an understandable and easy-to-read format.

The manual contains basic information on various solar components required to set up a solar electric system and produce solar energy. The second section focuses on the project experience and draws examples form beneficiaries of the project including lessons learned.

The solar technology described can easily be implemented in households providing power for families as it is appropriate technology integrating all aspects of self-sufficient living.

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