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Course Info



Living with Solar Course

These courses are held regularly.

Next course is on the weekend 24th-25th March. 2007

Registration by Friday 16th March. 2007



Solar Lighting Kits in Developing Countries

Please visit our online shop

- [Summary of Models for the Implementation of Solar Home Systems in Developing Countries \(IEA Report IEA PVPS T9-02:200338 pages 390k pdf\)](#)
- [The Role of Quality Management, Hardware Certification and Accredited Training in PV Programmes in Developing Countries \(IEA PVPS REPORT T9-04:2003 31 pages 1meg pdf\)](#)



The Need for Well Designed Solar Lighting Kits

There are some 2 billion people without access to grid electricity. A World Bank study some years ago concluded that it would never be cost effective to extend the grid to most of these areas. This is due to rugged terrain, lack of finance for infrastructure, and dispersed local villages with low power demand. For example the cost of grid extension in most areas of PNG is in the region of US \$15,000 / m. (Chris Cheatham PEDP).

On the other hand, people do require lighting for house activities, social interaction, study etc. Generally, kerosene lanterns have provided this. These lanterns are not satisfactory. Most of their light is directed sideways where it is not wanted. They produce indoor air pollution including particulates, carbon monoxide and carcinogenic gases (WHO). Kerosene smoke causes respiratory infections, lung and throat cancers and cataracts (WHO-SELF Newsletter, 2002). The World Bank estimates 780 million women and children breathe kerosene fumes equivalent to two packs of cigarettes a day (SELF 2002). Kerosene lanterns are a leading cause of burns in underdeveloped countries. In India alone, 2.5 million people suffer burns from overturned lanterns every year (SELF 2002).

Prices for kerosene have increased dramatically in the past couple of years with increasing oil prices. A kerosene pressure lamp uses about 80 ml an hour of kerosene.

Solar lighting generally pays for itself in a few years compared with the cost of kerosene lighting. Crystalline type solar panels have a 20 – 40 year design life. However, here is one proviso to this statement – the solar lighting system needs to be well designed in several respects.

Many studies have been carried out over the years to evaluate the success of solar lighting kits in developing countries. (Reliability of PV Stand Alone Systems for Rural Electrification – by Universidad Politecnica de Madrid et al - 2004). It is fair to say that not all the programs have been entirely successful. We are confident that the Rainbow Sundaya Solar Kits overcome the problems which have been identified with some solar kit failures in the past.

• There have been occasions of 'fly-by-night' opportunists selling cheap undersized solar systems with undersized components – e.g. a 10W plastic solar panel to run a television.

Sundaya and Rainbow Power Company both have over a decade of on the ground experience in developing countries. Over 300,000 solar lighting kits around the world make use of Sundaya components. Rainbow Power Company staff have traveled and worked in most Pacific countries. Our staff just don't fly in and out of the capital city – for example we have worked in most provinces in Papua New Guinea from Western Province to the

Highlands and East New Britain.

- Many solar kit failures have been a result of poor installation, e.g. connections made by 'twisted wires' etc.

Rainbow Sundaya kits are designed, as much as possible, to be 'plug and play'. The cables in a solar lighting kit are a bit like the veins and the arteries in your body. They are carrying electricity to and from your battery. They need to be big enough to not cause resistance.

The various connections need to be well made to resist corrosion, which is a particular problem in warm tropical climates. The Sundaya DCS Cabling System has a number of unique features. The positive and negative cables are a different shape so T-con and S-con connectors for making cable branches and switch connections cannot be placed incorrectly. These connections can be installed with a screwdriver only using insulation displacement. No cable strippers or crimpers are needed. The plugs and sockets are shaped so that incorrect connections cannot be made.

- Another common failure is caused by unplanned or 'unauthorised' additions and connections made to the solar lighting kit. One reliability study found that over 50% of homeowners left a light on all night for 'orientation lighting' e.g. for children to find the toilet etc. Cultural and security reasons are also often cited for the desire for an 'all night' light.

The Rainbow Sundaya lighting kits seek to discourage the addition of poor quality (and poorly installed) lights by including a generous selection of lights. Some kits have a one or two watt night light for all night use.

- Problems have been caused by poor quality components. This leads to premature failure of the solar kit causing customer dissatisfaction.

The Rainbow Sundaya kits use only the highest quality components. Our combined philosophy is that poor people cannot afford low quality products that fail prematurely. All the major components in our kits have been independently tested for safety and quality to meet World Bank, Underwriters Laboratories (UL) and CE specifications.

The Rainbow Sundaya solar lighting kits make use of very reliable, highly efficient fluoros, which have been tested to World Bank specifications. The A-lights and Multi (Ulux) lights used in the kits have been tested for a variety of parameters, including light output efficiency, reverse polarity protection, over voltage, (15V for 4 hours) and high temperatures (6 hours at 40 °C). The tubes are specified for very long life and are economically replaceable. The Multilights used in our smallest kits are submersible to 25m and are rated for at least 10,000 hours of use! Most solar lighting kit failures center around battery failure which is costly to replace (typically 33% of the solar kit price).

Battery quality is one issue; however no matter how good the battery is, early failure will occur if it is frequently deeply cycled (discharged) and rarely allowed to reach full charge.

The study referred to earlier identified that commonly 18% of users bypass the charge controller due to frustration. In some countries 80% of the batteries were found to be 50% discharged.

The battery is used to store power, which is needed at night and on cloudy days when the solar panel is not generating power. Many solar system failures are the result of 'not looking after the battery'. Batteries that are discharged deeply and frequently will have a very shortened life span. Similarly, batteries, which are not fully charged at least once every 7-10 days, will not last very long. These potential problems need to be addressed by customer education and by the 'intelligence' of the electronic controller. The Sundaya Solar Lighting Kits come with a sealed maintenance

free battery except for the largest kit, which has a conventional wet lead acid battery. Sundaya S3 and S4 storage systems come with a battery box and bracket so it can be mounted away from small children etc.

The Sundaya Energy Management system is the 'brain' of this system. It protects the cables from electrical faults and overloads. One common cause of electrical faults is caused by the positive negative cables shorting against each other when rodents eat the insulation. The Energy Management system monitors the battery and prevents it being damaged by overcharging from the solar panel. It also prevents the battery being damaged by discharging it too deeply. It will first sound an alarm to give the homeowner an hour's warning that the lights will be turned off to prevent battery damage. This alarm helps to reduce customer frustration caused by a low voltage disconnection of the lights without any warning. The Sundaya Apple, S3 and S4 Energy Management system includes a display to give the homeowner a continual indication of their battery state of charge in easy to read 10% increments.

The patented Forced Health Improvement System ensures that the battery is fully charged at least once every 10 days.

To conclude, the Sundaya Energy Management System is designed to keep the homeowner informed in order to maximise battery life and if necessary to control the loads with a minimum of frustration to the homeowner!

Sundaya Solar Lighting Kits are the result of several years of continual research and development. The end product, at a very attractive price, is only possible with mass production. Rainbow Power Company is pleased to offer these high quality kits to our Pacific neighbours. We are certain that they will provide you with excellent value for many years to come.

Dave Lambert
Export Sales Manager

5 October 2005

Solar Lanterns

Over the years we have looked at many 'rechargeable lanterns' for use in rural villages. There is a large selection available from very cheap ones in camping shops for under US\$50 to fairly expensive ones (up to US\$250) for use in rural villages. Generally, they look nice - quite similar to the hurricane kerosene lantern. They often work well for a few weeks before all the inherent weaknesses start manifesting themselves.

Generally, the weaknesses relate to the general low quality and the inherent limitations of the design concept. More specifically some of the problems include: 1) Cheap basic electronics to look after the battery - e.g. protection from deep discharges and overcharging. The electronics driving the fluoro tube are poorly designed.

2) The battery and solar panel are usually too small to allow the lantern to be run for 3-4 hours a night after 2-3 days of cloudy weather. Otherwise the lantern becomes too heavy and bulky if a suitably large battery is used.

3) Low quality switches and connections which soon corrode, particularly in tropical and marine environments. Their 'portable' design often encourages their use outdoors in the rain and even on small boats for fishing.

4) The general 'packaging' is for appearance and often is not UV resistant, waterproof or impact resistant. They tend to break the first time they are dropped or knocked over.

5) The solar panel is often a cheap plastic amorphous type which is not

designed for long term use in the sun. Good quality solar panels will come with a 10-25 year warranty!

To conclude, I think the overall concept fails from the size and design limitations. If you equip it with an 8-12kg battery, it becomes too heavy to market as a 'portable' lantern. It is not cost effective to make good electronics to look after the battery and the tube for a single light. A larger system to run a couple of lights is more cost effective than a single lighting package.

As a company, we have not found a solar lantern which we feel would be completely suitable for use in rural villages. We feel one is better off buying a small Sundaya lighting kit. The small kit includes a 14W solar panel, a sealed battery (20-40Ah) in an enclosure with a sophisticated charge controller, a couple of lights with 15-30m of heavy duty cable. The kits are largely 'plug & play' and can be installed with limited tools and knowledge. Their cost is similar to the more expensive solar lanterns on the market.

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RAINBOW POWER COMPANY LTD

Manufacture, Sales and Installation of Renewable Energy Systems

1 Alternative Way, Nimbin NSW 2480, Australia.

Phone: (02) 6689 1430 - Fax: (02) 6689 1109

intn'l: +61 2 6689 1088 - Fax: +61 2 6689 1109

email: info@rpc.com.au

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