Lighting for rural homes using a solar lantern

Supplying the market with a locally-assembled solar light

The Solar Lantern developed by ITC (the consulting subsidiary of ITDG) has been designed as a low-cost alternative to solar home systems. Sunlight falling onto a photovoltaic panel charges the lantern battery so that the lamp can provide light. The battery can also power a small radio. It is ideal for any application where there is no local connection to grid electricity. It also has important applications where there is inconsistent or unreliable supply.

Technical details:

Charge input
The lamp can accommodate inputs from either a 12V Photo-Voltaic panel or a suitable mains adaptor. The input is protected from accidental reverse polarity connection and over current.

Rechargeable battery
The lantern uses a 6.5 Ah sealed lead acid rechargeable battery to store charge. This gives a good service life, high energy density and good performance in cyclic applications.

Power output
The lantern is fitted with an auxiliary power output supplying 12V DC – sufficient to power a small radio or incandescent extension lamp. Output is limited via a self-resetting thermal fuse to 200 mA.

Performance
With a fully charged battery and the 5W lamp option, the lantern will provide light for $5^1/_2$ hours. With a 6W panel full charge time is around 8 hours. Charge time using an AC adaptor is around seven hours.

Light source
Light is provided by a high efficiency, compact fluorescent tube. The lantern design can accommodate the 5, 7 or 9 watt sizes. These lamps are six times more efficient than standard incandescent bulbs and have an operating life which is eight times as long.

Lantern materials
In order to withstand harsh environments and outdoor use in Africa, the lantern body is moulded from tough glass-filled Polypropylene, the lamp diffuser is moulded from clear and scratch resistant Acrylic (PMMA).

Dimensions
Height 420mm; Plan diameter 135mm;
Weight 3.3 Kg

Many solar applications are on the market in developing countries. Yet that market remains highly limited. Few current solar technologies can pass the test of being affordable, accessible and appropriate. They have mainly been designed, developed and manufactured in industrialised countries and then exported.

As a result they simply cannot meet the needs of ordinary people, who continue using kerosene, candles and dry cell torches, at considerable cost to their budget, danger to their homes and health, and with a poor lighting result.

ITDG's solar lantern aimed to break new ground, not in solar technology, but in its application, and to do so through the market. This has involved working closely with the intended beneficiaries to achieve a product which truly meets their needs, including their economic constraints.

▲ **Cooking the family supper, Rift Valley, Kenya.**

Marketing the ITDG solar lantern

This lantern is targeted at those households who currently use kerosene or candles and would like to upgrade to a more efficient form of lighting, but for whom a stand-alone solar home system is too expensive.

The unit cost of the lantern has to be set at a level which is affordable on average incomes, and compares favourably over time with the cost of the kerosene and other lighting expenditure of the household.

ITDG therefore carried out market research:

- To determine which aspects of existing solar lantern designs were favourable to potential customers.
- To use working prototypes to gauge customers' reactions to the new design.

The most important features were identified as follows:

Price

- the maximum price of the lantern and solar panel should be $100
- people are willing to pay this price for a light with the right service characteristics

‘I’ve fallen in love with the lantern already, and don’t want to lose it’

Service characteristics

- the lantern should provide light for up to 4 hours each evening
- customers should have access to affordable and readily available spares
- customers expect an overall lifetime of the lantern of 6 years
- customers expect a 12 months warranty

Design characteristics

- a 360 degree spread of light
- the bulb enclosure should allow maximum transmission of light with minimum dispersion
- the carry handle should be sturdy and comfortable
- the preferred choice of bulb was 7W CFL type
- the lamp should be portable and weigh no more than 2.5 kg
- the lantern should be stable with a good base

Some use the lantern for group meetings like family gatherings, church, following the progress of African Nations Cup football matches on the radio and for checking animals in their compounds.

The findings of this initial survey were used to produce a new design for an injection moulded lamp which incorporates all of these features.

Rapid Prototyping

Computer-aided design (CAD), combined with rapid prototyping techniques and soft-tooling allowed the designers to make a single copy of their new design in a matter of hours. Potential customers could then give their opinions before any significant costs were incurred.

Fully working test lanterns meeting all the service and design characteristics specified by potential users were then distributed to sample households. A simple questionnaire was used to measure customer reaction.

“This thing is very good when big groups of people come together, like on the 25th [December].”

Reaction has been very positive, with more people wanting to try lanterns than there are prototype units to test – even when they have to buy the prototype lanterns at the intended retail price

Local manufacture

A key test for the accessibility and affordability of renewable energy technologies is whether their manufacture can be transferred to local partners. This also contributes to sustainability, as back-up services must be made available locally.

This remains difficult in the case of solar, where production has only spread to a few developing countries. The approach of ITDG is to locate the manufacture of as many components as possible – the plastic mouldings, the batteries, etc – in developing countries. It will then appoint local Kenyan companies to assemble, distribute and provide after sales care for the lanterns, thus creating local employment opportunities.

Finance

Finance is a major issue for average households in developing countries who want access to any energy option above the traditional and basic level. The ITDG solar lantern is aiming, through close research with end users normally barred from the market, to insert a new intermediate energy option into the market which reduces the cost barriers.

Following the market research, the design process set out to drive down cost factors while maintaining a robust and reliable product. Plastics have been used for the body and lamp, rather than metal or glass, and the design kept simple to allow injection-moulding. The most cost-effective batteries and panels were located. A microprocessor is used to control the charging/discharging of the lantern, extending the battery life in order to save users’ money over time.

At our target price, customers would be willing to pay for the improved quality of light which the lantern provides. They can recoup their outlay within a year, and thereafter profit from the durability designed into the lantern.

The first estimates show a potential market for over one million units in Kenya alone, if cost can be kept low.

The experience gained in Kenya will be used to assess the size of the demand for low-cost solar lanterns in other developing countries.

One older couple said they could only manage to read one or two pages using kerosene lights before their eyes began to hurt. With the lantern, they can read for much longer without straining their eyes.

“I used to buy kerosene more frequently than now, so my costs have gone down. Unless I use my small lamp for the kitchen, I don’t have any need for kerosene any more. In a month we would spend 120 Ksh on around five litres of kerosene. Now I spend only about 40 Ksh per month”