

Noble Energy Solar Technologies (NEST) Ltd, India 2005



the **Ashden Awards**
for sustainable energy

Affordable solar lanterns to replace kerosene lamps

Summary

NEST is a private company based in Hyderabad, India, which was set up to develop a very small solar lantern, the 'Aishwarya®', as a safe substitute for the kerosene wick lamp. Over 65,000 lanterns have been produced and distributed during the past five years.

It is estimated that in India alone, about 100 million households use kerosene wick lamps as their main source of light. Such lamps produce poor quality light and unhealthy fumes, and present a serious fire risk particularly when used in thatched homes. Fluorescent lamps with batteries recharged using solar photovoltaics (PV), can provide much better quality and safer light, but the cost of such a lantern can be prohibitive.

NEST have brought down this cost, by making a PV lantern which is small and light-weight, with strict attention to quality of manufacture. By working closely with a network of dealers and sub-dealers, through whom they provide credit, spares and support, they have enabled very poor people in the most remote villages to buy PV lanterns without subsidies. Over 75% of the Aishwarya lanterns produced by NEST have been sold in this way, throughout the states of Andhra Pradesh and Maharashtra.

The Ashden judges commended NEST for developing an attractive and high-quality lantern specifically for the poorest households, and setting up a financial and service structure which enables such households to purchase without subsidy and receive proper after-sales support. These achievements were made possible by effective management within NEST and their active links with subcontractors and their dealership network

The organisation

NEST (Noble Energy Solar Technologies Ltd) is a private company which was set up by the current Managing Director, Mr DT Barki, in 1998. Mr Barki had previously followed a successful career in the PV industry in India but, having seen a baby die in a house fire caused by a kerosene lamp when he was a child, he had a longstanding wish to use his expertise to eliminate the need for kerosene lamps in poor households. The lantern design and manufacturing systems were developed over a period of three years, and commercial production started in 2001. Production has grown steadily from a total of 2001-02 to a current production of over 5,000 per month. NEST is managed by a board of directors, and currently employs fifteen people at its office and workshop in Secunderabad. A dedicated solar module manufacturing plant in Bangalore runs with about 7 employees. The annual turnover in 2004-5 was about £0.25 million, mostly (about 85%) from the sale of Aishwarya PV lanterns.

Contact name: DT Barki, NEST, India

Email: dtbarki@usa.net, info@solarnest.net

Website: www.solarnest.net

Technology and use

NEST set out to develop a PV-powered lantern of a similar size to a simple kerosene lamp. It is lightweight so that it can easily be carried even by children, affordable by the poorest households who have no other alternative but kerosene and attractive as a consumer product. They designed the lantern to allow for easy replacement of key parts, rather than repair.

The basic components of the lantern are common to all PV lighting systems: a PV module to supply the electrical power, a rechargeable battery for energy storage, a lamp and an electronic controller. NEST chose to use 3 W high-efficiency compact fluorescent lamps (CFLs), which produce about 60 lumens of light output - five times as much as a kerosene lamp. This small size CFL is manufactured specially for them, by Osram. NEST make the polycrystalline PV modules at their own factory in Bangalore, using 3 Wp modules to provide for 3 to 4 hours of light per night. The PV module is mounted with an angled bracket on the roof or outside wall of a house, and plugged into the lantern to charge it during the day. The lead-acid battery (rated 4 Ah at 6 V) is the heaviest part of the lantern and is therefore mounted in the base to give stability. The lantern base also has a socket to power a small fan or radio if desired. NEST design their own electronic controllers, and purchase the components for them to ensure quality, but outsource the manufacture to a small electronics business in Hyderabad. Manufacture of the plastic housing is outsourced to another small business.

The lanterns are assembled at the NEST workshop in Secunderabad. Rigorous attention is paid to quality, with checks on all individual components and on the finished lanterns. The lantern is packed as a single item in a box, so that it can be sold like any other consumer product. The name 'Aishwarya®' is that of an Indian Miss World, and was chosen to emphasise both the intelligence and aesthetic appeal of the lantern! In Sanskrit 'Aishwarya' means 'fortune'.

NEST are fully aware that people would like access to electricity for more than lighting, and they also produce larger PV lanterns (for street vendors and street lighting) and solar-home systems.

There are many ongoing developments in the global markets for PV and lighting products, and NEST are keenly aware of these. One global concern is the shortage of silicon which is the main material for making PV cells and modules. NEST are taking part in joint ventures to process silicon, and also to produce amorphous silicon PV modules which require much less silicon than their current multicrystalline modules. NEST has already signed a Memorandum of Understanding with a Japanese silicon company to work jointly on breakthrough poly-silicon technology to overcome the silicon feedstock problem the world is facing today. Light-emitting-diodes (LEDs) are increasingly used for small scale lighting, and NEST are keeping a watching brief on this technology to judge when it might be more appropriate than CFLs.

How users pay

NEST specifically intended the Aishwarya to be sold as an unsubsidised, commercial product in very remote, poor villages, and about 75% of their production to date has been sold in this way. In order to achieve this, they have established a network of dealers based in small towns. Dealers are independent businesses, sometimes selling other goods or services as well as lanterns, and are provided with training, stock, spare parts and support by the NEST head office. Each dealer recruits a number of sub-dealers who work on commission at village level. Dealerships vary in size, but typically sell between 500 and 1000 lanterns per year.

Most customers cannot afford the purchase price of about 1,500 rupees (£19) for an Aishwarya lamp, but are able to buy on credit from the dealers. Typically they will be asked to pay 200 rupees per month for 8 months, or 100 rupees per month for 16 months. NEST will sometimes reduce their own profit in order to allow the dealers to give free credit, but this is the only form of subsidy offered. Because the sub-dealers know their individual customers, they are able to collect regular payments, even from people who do not have a formal address. Customers often need to extend

their repayment period, but the overall track record of repayment is very good, with only about 3-4% defaulting on payments.

A kerosene wick lamp used in a home for 3 hours per night would burn about 7 litres of kerosene per month, at a cost of 10 rupees per litre, with government subsidy. But kerosene is seldom available at this subsidised rate to the poor; they often buy it at a very high black market rate of around 20-25 rupees per litre or 70 rupees per month. Thus the lamp pays for itself from savings on kerosene in less than two years. After that the cost of replacement batteries and CFLs is only 200 rupees every 3 years (see below) and the lantern should last for more than ten years as the designed life of solar panels is 25 years.

Some lanterns have been bought and distributed by NGOs in social programmes. They have also been given away in promotions and high-profile events, for instance as prizes to high-achieving school students, in order to emphasise the value of good quality light. NEST have provided PV street lights for some government programmes, and have also donated them to some of the slum communities around Hyderabad. Within this thriving, modern city there are still many people without access to the benefits of electricity.

Training and support

The dealership network which provides an effective route for sales is also crucial for training, replacement parts, after-sales service and recycling.

Sub-dealers have to make sure that each user knows they must recharge their lantern every day, otherwise it will not provide the intended 3 to 4 hours of light each evening. It is an advantage for sub-dealers to recruit a number of customers in a given village, so that several people can share experience of using lanterns.

Each dealer is provided with a full set of spare components. Sub-dealers carry a few spare controllers, batteries and CFLs which can be swapped in if needed during the one year guarantee period. In practice there is little need for this, but it is important that people have the confidence that their lantern will go on working.

The overall experience is that very few lanterns give problems, and when they do it is usually because the battery has not been regularly charged. The lifetime of the battery is typically 3 years if it is used carefully (about 1000 daily cycles of discharge and recharge) after which it is exchanged by the NEST dealer at a cost of about 150 rupees. The CFLs have a similar lifetime and are replaced at a cost of about 60 rupees. Both CFLs and batteries are returned to their manufacturers for recycling.

Benefits of the project

The reason for developing the Aishwarya lantern was to avoid the dangers of kerosene wick lamps. The continuous problem of kerosene is the inhalation of fumes, and eye irritation, but the risk of lamps being knocked over and setting fire to homes is very real. Aishwarya lanterns avoid all these problems.

Poor villagers often go without light at night if they run out of kerosene or simply cannot afford it. There are great benefits to having the Aishwarya lantern available whenever it is needed, particularly for urgent matters like delivering babies or dealing with accidents. Villagers told the visiting Ashden judge that they really appreciated being able to see the food that they were eating, and not end up eating bugs! They also enjoyed the increased security from having light around the village, and felt that it deterred wild pigs and other animals.

The light from an Aishwarya lamp is about five times brighter than a single kerosene lamp, with better spectral quality, and it is therefore much better for reading, thus enabling children to study in the evenings. Some people have also been able to carry out income-generating work in the evenings. Most lamps provide the sole source of light to a family of typically five people -

sometimes two families share one Aishwarya - so the 40,000 sold in poor villages are benefiting over 200,000 people on a daily basis.

Combustion of kerosene in a wick lamp is very inefficient at producing light, and emits significant amounts of carbon dioxide. A single wick lamp which burns 80 litres of kerosene produces about 250 kg of carbon dioxide per year, which is avoided by using the Aishwarya.

NEST has generated employment for a growing number of people. There are currently 15 direct employees (12 men and 3 women) at their head office and workshop in Hyderabad, and 7 at their factory in Bangalore. There are also about 50 dealers, 5 of whom are women, working full or part-time selling Aishwarya lanterns, and each of these provides part-time employment for around five or ten sub-dealers. The small businesses which manufacture charge controllers and plastic parts work exclusively for NEST and employ a further 60 people.

Aishwarya lanterns are popular: new orders come from villages where people already own them. There is a huge potential for widespread sales, in India and beyond. In India alone there are 100 million families using kerosene wick lamps. The publicity from the Ashden Awards produced worldwide interest in the Aishwarya lantern, and NEST currently have enquiries from over 40 countries for Aishwarya solar lamps.

Management, finance and partnerships

NEST was established as a profit-making business with a very clear social focus, and this is evident in the day-to-day operation of the business, and in the commitment of the staff - many of whom have been with NEST since it started.

NEST works very effectively with other businesses, including the suppliers of outsourced components. The dealership network, with the detailed local knowledge that it provides, has been crucial in enabling the lanterns to be sold successfully in really remote areas. NEST have been able to motivate their dealers to follow their approach of providing a high quality product and service to poor people, while at the same time allowing the dealers to function as independent businesses.

NEST works with a number of NGOs who supply lanterns for social programmes. They have also worked with affluent non-resident villagers and non-resident Indians, to promote lanterns in their native regions.

Most of finance for NEST has been on a straight commercial basis, through private investors and banks. A loan from Winrock International underpinned the rapid expansion of the business in 2004.

Use of the Ashden Award

NEST wanted to expand their successful programme of replacing kerosene lamps with low-cost solar powered lanterns. To achieve this they knew they would need to look at new technologies to further reduce the cost, and have made progress in the following areas:

- **Energy storage:** NEST has entered into a joint venture with a Japanese company to use Electric Double Layer Capacitors to replace lead-acid batteries in their lanterns. This will hopefully reduce cost and eliminate the use of some potentially hazardous chemicals.
- **Lighting technology:** NEST is investigating the use of LEDs in place of fluorescent bulbs in their lanterns. LEDs can last longer than fluorescent tubes.
- **Solar PV cells:** NEST has signed an agreement with a Japanese company to investigate using high-grade silica deposits in India for the production of solar PV cells. They hope that this will help them work around the current global shortage of silicon for solar PV.

One impact of NEST winning an Ashden Award is that their dealers are stepping up their efforts and have a new enthusiasm to sell the solar powered lanterns. Publicity gained due to the Award has also been instrumental in making contacts overseas that are proving useful in the technical advances NEST desires to make. Several foreign companies have funded the distribution of NEST lanterns in poor areas of India after hearing about them through the short films that were made about the winners and show on international television.

This report is based on information provided to the Ashden Awards judges by NEST, findings from a two-day visit by one of the judges to see their work in the Andhra Pradesh; and presentations by DT Barki at the Ashden Awards seminars in London.

Dr Anne Wheldon, Technical Director of the Ashden Awards, March 2006.

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