Sunlabob
Renewable Energy

Solar recharging stations - selling hours of solar lighting in the evenings

The solar lantern service of Sunlabob using commercial charging stations in the villages

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Summary

Village entrepreneurs rent large solar charging stations that are set up at a central place in the village. They use them to recharge portable and exchangeable lanterns and other equipment (mobile phones, radios, laptops, etc). The village households pay a charging fee that covers all costs.

This configuration allows to take advantage of economies of scale on the charging and control equipment. The resulting recharging fee for the lanterns is comparable to kerosene costs of households for lighting.

Each lantern has an integrated microprocessor that gives the lantern a unique identity and monitors and safeguards its battery. During each recharging the charging station collects data on the use and status of the lantern. The data is analyzed for ensuring high efficiency of all equipment, and for trustworthy and reliable carbon trading.

Investments are through private channels for the charging stations, and public grants into revolving funds for purchasing the first batch of lamps for launching the village entrepreneurs. This results in a PPP for providing electric lighting among poor households in remote rural villages.

Challenge

Solar lanterns are now being widely propagated as a solution for lighting in remote villages away from the grid. However, experience shows that the lanterns fail much earlier than would be expected from the life expectancy of solar equipment. This is due to cheap low quality components being used in order to cut costs for the lanterns and thereby make them affordable for rural households. Furthermore batteries are irregularly charged, and households engage in "hotwiring", ie. try to use the charge for operating other equipment. Because of this the batteries fail too early.

Independent solar lanterns with own panels therefore are still uneconomical for rural households in the long run. This has resulted in solar lighting still not making a broad breakthrough in poor rural areas. Kerosene still rules the lighting market away from the grids.

The challenge therefore is to achieve an operational system for solar lanterns that can….

1. ..use state-of-the-art charging equipment and tamper proof units to exploit the full life expectancy of the components
2. ..tightly control the use of and charge status of the lanterns and monitor the life cycle of their components, thereby increasing their real on site efficiency, and
3. ..thereby reduce costs per hour of light and thus to be able to commercially compete with kerosene lanterns at household level.

With such innovations solar lighting can make a breakthrough in the vast numbers of low income poor rural households.

Sunlabobs response

Sunlabob has responded to this challenge by developing a package whereby a village entrepreneur operates a large solar charging station rented from Sunlabob. The entrepreneur then charges portable lamps belonging to him/her, which can circulate in the households of the villages. For each recharging the entrepreneur collects a fee. All collected fees together cover all the costs of operating the whole system on a commercial basis. For the households the recharging fee is a regular small expense just like buying kerosene at the village shop. But with these rechargeable solar lanterns they get more and safer light at lower costs than from kerosene.

A fully operational system in a village comprises of:

- one large solar array
- one battery charging station
- 24-144 lanterns (depending on size of solar array and battery charging station)
- an electronic system control unit

Technical details

The Lantern Unit:

The Lantern Unit is a light bulb with its battery. It is portable and can be taken home, hung up, or stood on a table, etc. It is sealed in a robust and tamper-proof casing.

The Lantern Unit's internal microprocessor adds up the time the lantern has been in use. After 9 hours of lighting operation have elapsed, a slowly flashing LED warning light informs the user that one hour of operation is left. After another 30 minutes, the LED starts flashing at a higher frequency to indicate the upcoming shutdown. After a total usage of 10 hours, the Lantern Unit shuts off and cannot be turned on again by the customer.

If the Lantern Unit is used as a power supply, e.g. to charge a cellphone, and a low voltage condition is detected (flat battery), the integrated low voltage protection

feature disconnects the power outlet and switches off the lamp.

During the entire period between chargings, the Lantern Unit's power receptacle cannot be used for charging the unit's battery. This ensures that no unauthorized charging may occur.

In order to prepare for charging, the Lantern Unit is connected to the System Control Unit. Once it's connected to the SCU, the Lantern Unit can be unlocked by choosing the respective option on the SCU's display. At the same time, the SCU reads the number of hours the Lantern Unit has been used since the last charging and writes it to the charging log, along with the Lantern Unit's unique ID and the current date and time.

The Lantern Unit can now be connected to the Battery Charging Unit until its battery is fully charged. While in charging mode, the Lantern Unit's internal controller prevents switching on the lamp, and also interferes with any attempt of power extraction through the receptacle that exceeds a certain period of time. This approach ensures that only fully charged Lantern Units are handed out, but does not interfere with the operation of modern charge regulators that may probe the battery by discharging it for short periods of time.

Once the battery is fully charged, the Lantern Unit can be prepared for handing out to the next household that wants to exchange it with a spent one. Before the Lantern Unit can be given to a household, the SCU needs to be plugged in again to activate the Lantern Unit for lighting operation. At the same time, the SCU records the Lantern Unit's unique ID and writes it to the activation log, along with the current date and time.

The System Control Unit

The SCU is located at the charging station. It is used to activate the Lantern Units for either charging mode or for lighting mode by the households, and it is also used to collect any data acquired since the last recharging.

The SCU currently uses an integrated SD storage module to store the log files and firmware updates of the associated Lantern Units. It is also used to store the SCU's firmware updates and configuration data.

The size of this storage module can be increased to accommodate the needs of system setups with large numbers of Lantern Units per SCU.

Management Software

To facilitate the handling of data collected by many System Control Units (SCU) in many villages, the Sunlabob Lantern Recharging System comes with a graphical Management Software. The software can be installed on a PC or Notebook computer running either Linux or Microsoft Windows (Windows 2000, XP, Vista or later) operating systems. To connect the computer with the System Control Units in each village, a USB Port is required.

For easy processing of the acquired data, e.g. with the help of spreadsheet software or accounting systems, the rental and activation log files can be displayed, copied to the PCs clipboard or saved as text files.

With the help of the Management Software, firmware updates for the Lantern Units

and the SCUs can be transferred to the SCUs. The software is also used to modify configuration settings of the System Control Units.

The scenarios can always be modified, if necessary. Operating times could be changed if a different battery or lamp is used, warning modes can be adjusted or the protection scheme may be altered to accommodate different power supply modes. All this can be done by simply uploading a new lantern firmware with the help of the SCU.

The management software can collect data from a large number of lamps distributed over a very large area. This data can be analyzed in many different ways, ie. number of charges and their fluctuations in time, distribution of lamps, diverse intensity of usage in various areas, frequency of switching on and off, average time of switched on light, etc. etc.

Operational details

The village entrepreneurs who rent the charging stations from Sunlabob are in a franchise agreement with Sunlabob. This franchise encompasses:

1. The installation of the charging station, including the SCU.
2. The regular servicing of the charging station
3. Sale of Lantern Units, and of replacements for their components
4. Regular trainings for maintaining quality and implementing emerging technical advances
5. Operational advice
6. Business advice
7. Assistance in local marketing, through PR materials, demonstrations and campaigns
8. Assistance in accessing soft loans etc.

Normally the rent pays for these services. Various programs funded by public agencies may pick up some of the costs, eg. the trainings, etc.

Market

Benefits for Households

Village households are the final clients of this product and its services. They will always compare solar lanterns with the kerosene lanterns they know. The small but regular payments of households for kerosene add up over a year to one of their major cash expenditures. The solar lanterns should achieve a reduction of this budget item for a typical poor household.

In effect the operations result in the sale of hours of light as opposed to the sale of equipment. This is the same as when a household is connected to the grid.

Households report that they very much prefer lights that avoid the stink and smoke of kerosene. They also say that with kerosene there is the constant concern with the fire hazard.

The operational procedures with paying recharging fees is very near to the established behaviour of regularly buying small amounts of kerosene from the village shop. The financial flows in the households are the same too. This allows for easy adoption.

This direct competition with kerosene-based lighting is the challenge that the solar lanterns are picking up. After being able to demonstrate this in an area, the resulting demand can be huge as there are very many households using kerosene for lighting.

Benefits for Village Entrepreneurs

Renting and operating a recharging station is a sustainable village based enterprise, technically and operationally safeguarded by a franchise arrangement with Sunlabob.

The village entrepreneur may not make a living just from operating a charging station, but it will be a regular and reliable income that can fit with other income streams.

The village entrepreneur will be linked into the franchise network of Sunlabob and through that have exposure to other technologies and services that s/he may want to explore and develop in the village, eg. operating a TV/Video or even projector with screen, operating coolers, operating a laptop with GPRS internet connection, producing bottles of UV-sterilized water for drinking, etc…

Carbon

The software allows to unambiguously attribute each single solar recharging to a particular replacement of kerosene. This is a breakthrough for such highly dispersed usage of kerosene. It provides a possibility to bulk all these minor uses of kerosene into deals for saving carbon, thereby further reducing the charging fees and therefore letting households benefit directly from the carbon savings they achieve.

Risks

The most serious risk are programs and projects that subsidize solar lighting or provide it free of cost to communities. Experience shows that after the agency leaves the equipment sooner or later begins to fail, with villagers then saying that solar technology doesn't work. Convincing such villagers to try it again on a rental basis of for a fee has been difficult in the past.

Kerosene sellers will lose business and may retaliate. However this has so far not been experienced. Often the kerosene selling village shop ends up renting the charging station.

A further risk is that a village gets access to the grid, at which time the households may want to switch. This risk is mitigated by the fact that a) often the installation fees for a household connection are too high for the poorest households who are the ones targeted with this service, and b) the whole equipment can be dismantled and set up in another village.

Global potential

The presented operational procedures and technical solutions are replicable worldwide anywhere where…:

- there is sufficient sunlight
- there is a population organized in villages or if dispersed throughout the landscape regularly comes to certain points, eg. schools, market, etc.
- kerosene is expensive at the household doorstep (ie. about 1.5 usd per liter or more)

The potential market in rural areas worldwide is therefore vast.

Investment opportunities

When exploring the financing of ventures with charging stations and solar lanterns the strong public interest in rural electrification must be taken into account, particularly in remote areas and particularly for poor households. While the objective must always be to launch and sustain commercially viable village enterprises and the backup franchised services by private companies, there is also a strong case to be made for public involvement in launching such ventures.

However, public financial involvement must be designed to encourage private investments into commercial operations. Subsidies, if badly designed, can be counterproductive.

Public and private investments can mutually leverage each other, where each one on its own may not achieve the intended effect. It is suggested that private investors (eg. social investment funds, eco-investment funds, carbon investment funds, etc.) can invest in the charging stations to be rented out, whereas publicly launched revolving funds can provide the first batch of lanterns to start up the businesses of the village entrepreneurs. See figure.

Note that after the initial investment by the public, the launched village enterprises are expected to generate enough income to expand and continue their operations through the revolving fund without any further investments by the public.

Of course private investment funds can also invest into lanterns and the public can also invest in charging stations to be rented out. This is sometimes required to balance out the investments on both sides (to be later evened out again).

In effect this leads to a Public Private Partnership in providing solar lighting to poor households in remote villages.

Private-Public interaction for mutual leverage of resources and operations for providing lighting in remote villages