# How Solar is Transforming Rural India:

ENERGETICA INDIA

The article discusses two case studies showing the use of solar in India's rural areas, helping the common man.

CASE STUDY I

## Solar energy for lighting and mobile in Bihar - Initiative from Naturetech Infrastructure

In India, rural electrification has been an important policy agenda for the central as well as the state government since independence. Electrification at the village level is an issue in only few states where the rate of village electrification remains low. The rate of village electrification in Bihar declined to 30.2% from 61.3% under the new definition.

The Bhagalpur district is located in the eastern part of Bihar with a population of 24.23 lakh and 4.12 lakh households. There are three villages in the Jagdishpur Block, Bhagalpur District, about 15 km from the 'city' Bhagalpur. One village has access to grid electricity supply, with erratic power supply for two to three hours per day. The other two villages are unelectrified with no access to electricity.

Naturetech Infrastructure Pvt. Ltd has provided lighting and mobile charging service to 51 households in these three villages, supplying electricity to about 80% households in two unelectrified villages and about 40% households in the village with limited access to grid electricity.

### The Business Model

Solar energy is generated at one centrally located place through PV (photovoltaic) panels in the village and stored in batteries, which is distributed through 24-V DC mini-grid covering all the households in the village.

Each village is powered with two PV panels of 75 W each on a 20-feet street pole. Power is generated at 24 V and two 40-Ah lead-acid tubular batteries connected in series are charged through a charger controller with LCD display and embedded digital timer. The mini-grid is switched on and off through a timer setting available in the charge controller itself. Power is distributed to the households through 24-V DC 2/3 distribution lines, with 1–2 A MCB for overload/fault protection. To minimize transmission and distribution losses and achieve better tail-end voltage, the distribution circuit length has been kept at a distance of less than 200 m from the battery bank that covers about 30 households.

The services offered are home lighting during evening hours (five hours) and daytime mobile charging (eight hours) for the villagers from semi and unelectrified without compromising on the quality and cost.

Naturetech Infra deputes its own trained personnel to erect the PV panels, and lays a distribution network and internal household wiring. The villagers help Naturetech personnel to install PV panels and to lay distribution network within the village. They have identified a person within the village and trained him to operate the PV-based mini-grid system, troubleshoot in distribution network, and collect monthly charges.

### Economics of Service

The installation cost of the PV-based mini-grid system is about Rs 2500 per household. Naturetech Infra has financed the installing of the PV-based mini-grid system in three villages and intends to take forth the learning from the installation and operation. For future projects, the organization intends to tap finance from commercial and avail grants from various agencies.

As the above model is decentralized, it can be replicated anywhere in the country and has tremendous scale-up potential, which shall reduce the operating and installation cost.

**Impact of the Project**

With the implementation of the project, the villagers have now stopped using kerosene lantern, as also moving around to charge their mobile phone. Besides home lighting, community lighting service is provided free of cost at community places (like temples and other religious places, places of social gathering, and on the streets). The villagers are happy with the services as they get to spend their evening time more productively than ever before.

**Sustainability Aspect**

The project has improved the social life of the villagers as male members are mostly available in the evening hours at community places. The project has no operating cost towards feedstock, does not cause any carbon dioxide emissions, and replaces a highly subsidized fuel like kerosene. The business model comprises simple and straightforward arrangements/features using standard products. This can be taken up in an organized and professional manner to ensure scale-up and channelize funds for such projects. The barriers to the project are non-availability of commercial loan at reasonable interest rate and higher replacement cost of lead–acid tubular batteries.

## CASE STUDY II

# Fresh vegetables in Ladakh; Use of Solar Green House

Situated at an altitude of more than 3500 m above sea level, the Ladakh district of Jammu and Kashmir is one of the famous cold deserts of the world characterized by cold breeze and blazing sun. Ladakh receives very low rainfall. In winters, the temperature can be as low as –25 °C.

The climate makes it difficult to grow fresh vegetables and other crops in the open for almost nine months in a year as plants die because of freezing cold. Airlifting the vegetables from the plains in winter and bringing them by road in summer is a normal practice for the people living in Ladakh, making these fresh vegetables expensive and their availability limited. Most of the locals rarely get to eat fresh vegetables and hence, many suffer from malnutrition. Being a rainshadow area means the sky is mainly devoid of clouds. Ladakh experiences clear sunny days for almost 300 days in a year.

Exploiting this sunny climate of Ladakh, GERES (Groupe Energies Renouvelables,

Environment et Solidarités) started developing improved passive solar greenhouses

to grow fresh vegetables and other crops indoors even during the winter season. For the

last 10 years, GERES is working in this area in collaboration with LEHO (Ladakh Environmental Health Organization), LEDEG (Ladakh Ecological Development Group), the Leh Nutrition Project, and STAG (SKARCHEN and SPITI Trans-Himalayan Action Group/Ecosphere) .

GERES developed an IGH (improved greenhouse) to maximize the capture of solar energy during the day, minimize the heat loss at night, and thus prevent plants from dying due to freezing.

The greenhouses are designed in such a way that they are sufficiently heated using only solar energy and do not require any supplementary heating. Some of the salient features of the improved greenhouses are as follows:

- The greenhouse is oriented along an east–west axis with a long south-facing side
- This long south side has a transparent cover made of heavy duty polythene with an extra stabilizer to withstand the intense UV rays present in the sunlight
- The polythene is built to last for a period of more than five years. A double

layer of polythene is used in severely cold places

- The north, east, and west side walls of the greenhouse are constructed using mud bricks in low and medium snow fall areas and with stone or rock in heavy snow fall areas to enable the green house to absorb maximum heat from the sun during the day and release the stored heat at night to maintain a temperature suitable for healthy growth of plants inside the greenhouse.

The walls on the north, east, and west sides are constructed as cavity walls to help in minimizing heat loss from the greenhouse. The 100-mm cavity in these walls is filled with insulating material such as sawdust or straw. The roof is slanted at an angle of 35° to allow maximum direct sunlight during the winter season. At night, the roof is covered with thatch and the polythene on the south side is covered with a cloth or tarpaulin to prevent heat loss.

- Vents are provided on the walls and on the roof to avoid excess humidity and heat and also to allow controlled natural ventilation
- The inner side of the north- and west-facing walls are painted black to improve heat absorption and the east-facing wall is painted white to reflect the morning sunlight on to the crops. There is a door in the wall at one end.

Except the polythene used for covering the south side, the entire greenhouse is constructed using locally available material. The main frame of the roof is made using local poplar wood, willows are used for struts, and straw or water-resistant local grass is used for the thatch. Rock, stone, mud bricks or rammed earth are used in the construction of walls. The polythene sheet has to be procured from places like Mumbai. Local masons were employed to construct the greenhouse by providing them with special training wherever required.

The greenhouse comes in two sizes. A smaller greenhouse with 4.5 m breadth and 9.7 m length for domestic use and a bigger greenhouse with 4.8 m breadth and 27.3 m length for commercial use. The construction cost of a domestic use IGH is approximately Rs 30,000. The owner of the domestic IGH has to either pay or

collect all the locally available material like wood for the roof frame, straw for thatch, mud bricks, and the material used for insulation. He has to provide the labour or pay for the labour required for construction. The NGO pays and provides the doors, vents, and the special UV stabilized polythene, which comes to about 25% of the total cost. Some subsidy is given for domestic IGH.

Construction of the greenhouses is timed in such a way that it matches the agricultural cycle of Ladakh.

GERES monitors the IGH construction by providing the methodology and design. LEHO and other local NGOs coordinate in selecting the prospective owners, training them on greenhouse maintenance and operation, and providing other support needed for constructing the greenhouse to local owners.

Local NGOs have set up certain criteria to select the prospective owners of a domestic IGH.

- Families should belong to the BPL (below the poverty line) category
- They should have a site suitable for greenhouse construction
- The family must be keen to use the greenhouse successfully and also willing to share the products with the community at large

A wide variety of vegetables including spinach, coriander, garlic, radish, onions, lettuce, and strawberries are grown in winter. Tomatoes, cucumbers, and grapes are grown in autumn and in spring seedlings are grown in the greenhouses. Some families have even started growing flower plants and potted plants.

Improved greenhouses have benefited the people of Ladakh, especially in terms of health. Prior to introduction of IGH, during winter people used to consume fresh vegetables only once or twice in a month. However, since the time IGHs were introduced, the consumption has increased to two to three times in a week. On an average one IGH owner provides fresh vegetables to nine other families and barters with six other families, resulting in an improvement in their health. On an average, the villagers are able to save Rs 500 to Rs 1000 on vegetable purchases as locally grown fresh vegetables cost less when compared to imported vegetables.

Production of fresh vegetables locally reduces dependency on imports from plains, thus saving the expenditure on transportation. According to some estimates of GERES, the 560 greenhouses presently in operation are able to save about 460 tonnes of carbon emissions per year.

The IGH has also brought employment opportunities to locals. About 220 masons and 15 carpenters have received training and got livelihood through constructing greenhouses.

The IGHs have increased income generation for their owners, as now they can earn additional income by selling vegetables and seedlings for cash. Surveys conducted have revealed that on an average an IGH owner earns Rs 8250 per year by selling their excess produce providing a 30% increase in their income levels.

The scale-up potential for IGHs in the high-altitude Himalayan states is very large.

In Ladakh, alone the potential demand for IGH to produce fresh vegetables for civilian consumption is about 3000 units. It may double up to 6000 units, if military requirement for fresh vegetables is included. At present, replacement of UV-resistant polythene sheet every five years and also lack of awareness among agricultural/horticulture departments at the state level is proving to be a barrier in the promotion of IGHs. The solar passive concepts of south-facing glazings, high thermal mass, and insulation can also be used in other constructions like individual houses, public buildings, schools, hospitals, and government offices.