Solar Water-pumping Solutions

Lead Organisation: Claro Energy (www.claroenergy.in)

Geographic Spread: Bihar, India

Need

A consensus is building that India needs millions of more farmers who run their irrigation systems using solar power. The country is home to 25 million agricultural water pumps; this is one of the highest numbers in the world. Whether they draw their power from the country’s rickety power grid or from diesel-fueled generators, the pumps cause a host of problems. They are sucking aquifers dry, draining the government treasury and farmer’s pockets, and adding to the country’s burgeoning carbon emission levels. A growing number of government officials, aid workers and entrepreneurs believe that if any sector is ripe for solar power in India, it is the legion of agricultural irrigation pumps. About 18 million of the country’s 25 million pump sets are tied to the national electric grid. India’s Planning Commission estimates that farming accounts for about 15 percent of Gross Domestic Product (GDP) but the sector consumes some 25 percent of the nation’s electricity, mostly from powering irrigation pumps. Utilities provide this power at a huge loss; electricity for farmers is usually free, or nearly so, costing only a couple of pennies per kilowatt. This is taking its toll on the rest of the country. In July 2012, more than half of India’s population experienced the world’s largest blackout. Smaller, rolling blackouts are common. In some of India’s largest cities, blackouts are spurred on by outdated power grid, electricity theft, chronic shortages of fuel and the rising cost of imported coal and petroleum. Easing energy demand is a top priority.

The farmers who depend on short bursts of free electricity are not the best stewards of the nation’s diminishing supply of groundwater. The system incentivises a farmer to use as much water as he can when he has access to it. Thus, many farmers gravitate towards crops that require flooding, such as rice and wheat. But these commodities offer farmers the lowest profit margins. Global consulting firm KPMG estimates that solar pumps, which give a farmer the leisure to pump water only when he needs it, could increase agricultural income by 10 to 15 percent, since it would allow farmers to switch to profitable crops such as tomatoes and potatoes.

Solar-powered water pumps, which include a power source and expensive electronics, currently cost $6,000 or more, whereas a pump that runs on electricity or diesel can be purchased for as little as $500. That is an enormous gap for a country where the per capita income annually is approximately $1,200. 7 million diesel-using farmers, most of whom have no electricity connection, spend up to 40 percent of their incomes on diesel. That amount is rising because the country is phasing out its subsidy on the fuel.

Response

Claro Energy offers solar powered water pumping solutions to meet irrigation and drinking water needs in power deficit rural areas. Our solution replaces diesel-powered pumps, reducing carbon dioxide emissions by 25 tonnes annually. The newly constructed irrigation tube-well pumps have no operating cost, are pollution-free and have shorter payback periods as compared to diesel pumps. Claro Energy offers both AC and DC solar-pumping solutions that cover all types of irrigation needs. Claro Energy is currently focused on business models that explore ‘pay per use’ for customers, and their strategy includes partnering with local companies to
create ‘shared sales channels’. By replacing diesel-powered pumps, Claro Energy has managed to irrigate 1,580 acres of land till date, and generated 105 direct and indirect jobs. As pioneers in the Bihar market, Claro has 90% market presence with 75 installations. Their future strategies include deepening their penetration in Bihar, Jharkhand, Uttar Pradesh and Madhya Pradesh. They also aim to expand internationally to Bangladesh, South-East Asia and Africa through channel partners.

Drivers of the Initiative

Clean energy: The initiative encourages clean, renewable energy to meet agricultural needs.
Local economy: The initiative provides water pumping solutions for agriculture through a pay-per-use model.

Objectives

- To foster innovation to build trust, honesty, and social responsibility
- To provide water for irrigation in rural areas of India

Stakeholders Involved

Ministry of New and Renewable Energy (MNRE), Government of India: It is the nodal ministry of the Government of India for all matters relating to new and renewable energy. The broad aim of the ministry is to develop and deploy new and renewable energy to supplement the country’s energy requirements.

Claro Energy: Claro Energy is a solar water solutions company. It offers off-grid solar power irrigation solutions to power-deficit regions in India. It provides off-grid solar solutions to meet the irrigation and drinking water needs in remote and rural parts of India.

Angel Investors: They include accomplished entrepreneurs, technologists, investors and bankers who have invested in the project.

Innovative Features

Claro, so far, has been able to contribute to a reduction of about 511 tons of CO2 annually. Further, the installations have ensured a continuous supply of water to farmers over an area of more than 4000 acres for irrigation purposes. In addition, Claro has generated about 105 direct and indirect rural jobs over the last one year. Overall, more than 20,000 lives have been positively impacted in a short span.

The Process

The project began looking at off-grid, decentralised generation of power and then finalised a solar-based pumping system.

Claro energy produces a customised solar irrigation pump based on local groundwater table, solar insolation and irrigation water discharge conditions. The optimal solution is low cost and robust as it is appropriately integrated and sized.

Optimal design and engineering of an off-grid solar PV irrigation pump requires understanding of solar PV modules, centrifugal AC/DC pump and motor operation, and knowledge of middleware (inverters, variable frequency drives etc.).

Claro Energy has developed system integration expertise between solar modules and centrifugal pumps that is enabled through a power electronics middleware.

The target area was Bihar, as it had high power deficits and being on the Gangetic plains, the water table was high — five meters after monsoon, and ten meters during the rest of the year. Claro Energy believes that the state of Bihar combines three fundamental factors that will drive the long-term adoption of solar irrigation pumps. First, Bihar is primarily an agrarian based economy, with one third of the state GDP coming from agriculture. Second, there is severe shortage and non-availability of grid power in the region, which necessitates expensive diesel operated pumps. Third, low water tables in Bihar and high solar insolation allows system sizes to be smaller which in turn reduces the total cost and also increases engineering reliability.

Overcoming Barriers

Lack of information: Farmers are hesitant to try new technology until they see examples of its success. Even though bankers are keen to provide credit to renewable, green energy projects, the solar pump market still remains unregulated. Today, with a total of 15 ground teams, Claro Energy is able to rapidly deploy and service its pump installations, engage in brand building and business development efforts in Bihar. Claro Energy’s ability to put together a good management and motivated operational team is a decisive factor in its success.

No government support: Educating the government and creating market awareness on feasibility of solar power to run agriculture pumps was a big challenge for Claro Energy. Claro Energy demonstrated a 7.5 HP pump to run on solar power. Till today, it is the largest solar operated pump in Bihar. Such successes in solar
energy in Bihar led Claro Energy to become one of the trusted advisors to the state government. In one such instance, Claro Energy represented the Government of Bihar in discussions with the World Bank. 

**Limited availability of loans:** Banks would much rather provide credit in large volumes for solar lamps and lanterns - each costing as little as 1,500 rupees (30 dollars) a piece - than provide loans for solar pumps. With prices of photovoltaic film falling since 2008, the banks are worried that even if they seize the solar pumps of farmers defaulting on their loans, not much can actually be recovered. The solar pump has an unusual cost structure with very high capital investment and near-zero pumping costs. Experts believe the cost of installation makes solar pumps unattractive to small farmers who want to irrigate their own plots or farms. Claro Energy is actively trying to spread awareness on the long term economic and environmental benefits of solar pumps to persuade farmers to make the initial investment needed. 

**Supply Chain:** Setting up a robust supply chain in rural areas is a tough challenge and gives Claro Energy an advantage over many others. From material procurement at low costs to mechanical structure fabrication close to point of installation, Claro Energy has attained a higher level of operational effectiveness.

**Economic Benefits**
- The installations have ensured a continuous supply of water to farmers over an area of more than 4000 acres for irrigation purposes.
- Claro has created about 105 direct and indirect rural jobs over the last one year. Overall, more than 20000 lives have been positively impacted in a short span.
- Distributed solar power infrastructure development will generate local employment and prevent mass migration of villagers to urban areas.
- Since 40% of farmers in Bihar have a land holding of less than 2 acres, agriculture productivity from existing land is doubled by daily availability of reliable irrigation water (World Institute of Sustainable Energy, Pune). Further, crops can be grown during summer and precision farming techniques such as greenhouse agriculture and micro-irrigation can now be practiced.

**Unresolved Bottlenecks**
The lack of government support is still a limitation.

**Social Benefits**
- By having irrigation during the daytime, farmers are prevented from the drudgery of irrigation in the night, which led to exposure to other random risks such as snake bites or tripping in the dark.
- Farmers are becoming more water-efficient, as they have reliable daily water supply and they therefore don’t need to flood their fields whenever they get water.

**Environmental Benefits**
- Claro Energy has been able to contribute to a reduction of about 511 tons of CO₂ annually so far.
- Solar powered irrigation pump-sets prevent air pollution and emission of greenhouse gases due to diesel combustion.