# EMPOWERING RURAL ENTREPRENEURS IN INDIA

## PROJECT'S AIM: TO INSTALL A HYBRID PV-HYDRO MICRO-GRID FOR POWERING PRODUCTIVE AND RESIDENTIAL USES

**Location:**
Bhamane community, Uttar Kannad district, Karnataka, India

**Technology:**
Micro Hydro
Solar Photovoltaic

**Costs:**
Total: € 80,350
WISIONS financial support: € 40,000

**Partners Involved:**
Smart Hydro Power GmbH (www.smart-hydro.de)
Gram Oorja Solutions Pvt. Ltd. (www.gramoorja.in)
Sanjeevani Seva Trust

**Duration:**
Nov 2015 – Mar 2016

Picture: WISIONS

This project was implemented in the region of Karnataka, where farming is the main source of income for rural households. However, these remote areas have little access to agricultural processing facilities. The project aimed to provide basic electricity access while supporting the productive use of electricity. It did so by demonstrating the viability of a hybrid PV-hydro system to power a local rice mill and provide electricity for household lighting.

### TECHNOLOGY, OPERATIONS & MAINTENANCE

The project was implemented by the developers of the technology, Smart Hydro Power GmbH, in collaboration with local partners Gram Oorja and Sanjeevani Seva Trust. The Bhamane community lies in a mountainous, forested area which is suitable for hybrid solar PV-hydro. The main crop is rice, but the villagers in Bhamane and surrounding hamlets have to travel 20 km to 30 km to the nearest rice mill to process the grains.

The hardware installed comprises a 5 kVA hybrid system (hydro-kinetic turbine, photovoltaic panels, storage system and a backup generator), an energy management system and micro-grid, and a rice mill.

The turbine used in this project harnesses the kinetic energy from the river's water flow, rather than the potential energy from a differential in water head. Also called "zero-head" or "in-stream", these turbines require no dams or other cost-intensive infrastructure. Moreover, the course of the river remains in its natural state. The turbine can be anchored to the bottom of the river, to a bridge support, or to a block on the side of the river. The speed of the water flow can vary from river to river and from season to season, which affects the power output.

The installation of the system and micro-grid was completed in March 2016 and the project, including a second phase of training, was fully implemented by the beginning of the Monsoon season.

### DELIVERY MODEL & FINANCIAL MANAGEMENT

The delivery approach is based on the BOOT (build-own-operate-transfer) model. To ensure the long-term sustainability of the project, a management committee was formed, trained and tasked with operating the system and managing the funds from the electricity payments. The committee is made up of six members of the community. In addition, two local entrepreneurs are tasked with running the rice mill.

The project supported the linking of the Bahmane community to the "Sanjeevani Seva Trust", a local social service organisation already active in electrification in the region, with the goal of ensuring replication and knowledge sharing.

The maintenance of the system is supported by a tariff structure that reflects the operation and maintenance costs. The tariff structure was decided with help from the village electrification committee and reflects the average income of the

beneficiaries. The tariff is lower than current household expenditure for kerosene, as revealed in the baseline survey. The Sanjeevani Trust supports the management committee in payment control and basic bookkeeping.

## ENVIRONMENTAL ISSUES

Replacing inefficient, expensive and hazardous kerosene and diesel with electricity generated from renewable sources is the most significant environmental impact of this project. Moreover, the zero-head turbine technology used has a particularly low environmental impact on the river's ecosystem.

## SOCIAL ISSUES

The first phase of the project included a study of the community's socio-economic baseline via a survey of 25 households, as well as a first wave of community workshops and capacity-building activities. The project partners were in close contact with the local management committee throughout the project. The project team tried to use locally-sourced components where possible.

## RESULTS & IMPACT

An initial evaluation against the baseline was conducted in May 2017. It showed a significant increase in the use of household electrical appliances, but not the expected rise in productive use. The rice mill, in particular, was not being used. The follow up revealed that while the mill had been used initially to clean the husk, the community was reluctant to use it because of the different quality of the flour produced. The choice of model for the locally-purchased mill was, therefore, a major obstacle to achieving the productive use goals. At the time of writing, the project team was considering possible solutions, such as replacing the mill with a different appliance.

However, other entrepreneurs in the community have harnessed the new system. One example is a carpenter, who uses the system to run an electrical polishing machine.

The goals of strengthening the community organisation and supporting local entrepreneurship to ensure long-term sustainability of energy access were achieved. The local committee is very active and now cooperates with other nearby communities to develop other electrification projects. The handover of the project from the project coordinator to the community envisages a final round of capacity-building activities and the supply of spare parts.

The Bhamane project helped to further refine and adapt an existing design for a hybrid turbine-PV system. The Bhamane experience allowed the coordinating partner to better evaluate potential new projects in terms of their technical and socio-economic feasibility.

## REPLICABILITY

The potential of distributed generation for rural electrification in India remains underexploited. With certain adaptations this project has the potential for replication in the same region and other water-rich and off-grid areas suitable for hybrid PV-kinetic systems. A 3 to 5 kW system as designed in this project would be sufficient for operating a mill for five hours a day and for meeting basic energy needs. To date, the partners have already selected two villages in Goa state for a follow-up project, and Gram Oorja is preparing a further roll out of the productive use-focused micro grid design in the north east of the country.

The project raised awareness and provoked interest in the region and it was presented to the Indian Ministry of New and Renewable Energy and to possible investors, as well as at conferences.

## LESSONS LEARNED

While household electrification has increased the general wellbeing of the local community, the system is underutilised and the project's goal of increasing economic activity was only partly successful due to the low acceptance of the rice mill. The lesson learned from this is that the potential productive use devices need to be more thoroughly researched and tested before implementation.

Moreover, the record low rainfall experienced in 2016 affected the hydro element of the system, meaning it could only work for six months of the year instead of the potential nine. Future project designs should consider the risk of variation in monsoon patterns and how strong seasonal differences in energy availability might impact on the choice of productive uses.

This project had a clear focus on technical standardisation and productive use of electricity. The technology used is relatively standardised, with pre-fabricated and pre-wired components that facilitate installation. The standard three-phase interface is designed with productive use devices in mind (mills, pumps etc.) and allows the community to select a productive use from a range of possibilities such as agricultural crop processing (as in the Bhamane case), food processing, manufacture or retail

Source: Final Report submitted to WISIONS by Smart Hydro Power GmbH
Pictures: WISIONS