

## OVERVIEW - GRAM VIKAS

Gram Vikas was established in 1979 in Odisha to further the cause of marginalized communities, especially the adivasis (tribal communities in India). Since then, over 565,000 people in 1,650 villages have partnered with Gram Vikas to build for themselves a life of dignity.

Gram Vikas' work spans a variety of areas. Some of these include water and sanitation (toilets, bathing rooms and potable water supply systems), education (four residential schools for over 1,300 children) and renewable energy (biogas, solar, micro-hydro and bio-fuels).

## OVERVIEW - GRAM VIKAS ENERGY PROJECTS IN KALAHANDI

Gram Vikas has several energy projects in Kalahandi –a concerted district wide effort in rural electrification. The table below lists the names of the villages and blocks where Gram Vikas has implemented energy projects, categorized by type of energy technology and current status (i.e. working or not working).

	Working	Not Working
Solar	-	Maligaon, Th. Rampur (2009)
Micro Hydro	<ul style="list-style-type: none"><li>• Amthagouda, Th. Rampur (2006)</li><li>• Punjam, Lanjigarh (2012)</li><li>• Karnivel, Th. Rampur (2010)</li></ul>	<ul style="list-style-type: none"><li>• Karlapat, Th. Rampur (2006)</li><li>• Purna Guma, Th. Rampur (2008)</li><li>• Bijapada, Th. Rampur (2018)</li></ul>
Wind-Solar Hybrid	Tijmali, Th. Rampur (2014)	Kamlaguda, Th. Rampur (2014)

## MALIGAON SOLAR ENERGY RENEWAL

Maligaon is a village of 45 households located in Thuamul Rampur Block of Kalahandi District, Odisha. Gram Vikas and the community of Maligaon have been partners for over 30 years. Together, Gram Vikas and the community of Maligaon have built toilets, bathing rooms and potable water systems for every home in Maligaon, educated children of Maligaon in Gram Vikas' residential schools and electrified every home in Maligaon at a time when the nearest point of connection to the main grid was over 30 kilometers away.

The last initiative listed above, to electrify every home in Maligaon, was implemented as a solar micro-grid in 2009. The main system components included a 9.63 kW total photovoltaic (PV) array capacity, 96 kWh tubular lead-acid battery bank and an Urja Bandhu (charge controller that makes available a fixed amount of energy daily) in every home.

This system was intended to introduce electricity to the people of Maligaon. Thus, the main use of the system was for indoor and outdoor lighting. Through the Urja Bandhu, each household was restricted to a fixed daily budget of electricity with a fixed monthly charge. The system was to be run and maintained by a single operator, an individual from Maligaon who was trained for this role.

Unfortunately, the 'single operator' model proved to lack the necessary checks and balances to prevent misuse. In 2013, the solar micro-grid failed due to the premature death of the tubular lead acid batteries, likely as a combined result of manufacturing defects and improper maintenance by the operator.

In 2014, the main grid was installed in Maligaon with simple single-phase (i.e. household use) electricity. However, blackouts last (at worst) up to months at a time in the monsoon season and almost all households still use kerosene lamps for lighting during blackouts.



Map of Odisha. Kalahandi District is indicated in red. Maligaon is indicated by the white dot.

Still, the arrival of the main grid in Maligaon along with a general increase in income has allowed the use of electricity in Maligaon to go beyond lighting. A few houses in Maligaon now have televisions and fans in addition to lights.

Overall, the main grid has given the people of Maligaon a tentative grip on the next rung up the energy ladder but it lacks the quality (single-phase is only for household use) and consistency (long blackouts) to allow them to truly ascend upward.

This project aims to provide the people of Maligaon a firm-footing on the next rung up the energy ladder for at least the next 10 years through the renewal of the micro-grid with the use of modern technologies and effective community management.

## TECHNOLOGY

The new technologies that will be included in the renewed system are 1) lithium ferrophosphate (LFP) batteries, 2) three-phase power, 3) additional 7 kW of solar panels and 4) smart meters.

### LFP Batteries

LFP is a relatively new battery technology with several advantages over the old tubular lead-acid battery technology that was originally used. These advantages are tabulated below.

Feature	LFP	Tubular Lead-Acid
Lifetime	10+ years	5 years
Maintenance	None	Top up with distilled water at least monthly.
Per unit cost (USD)*	11.3	18.8

Most notably, LFP batteries have the longest lifetime out of battery technologies used for micro-grid/ grid energy storage. Furthermore, lead-acid batteries require regular maintenance – namely monthly distilled water top ups – which is both time consuming and expensive. LFP batteries require no maintenance.

The new batteries will also have a battery management system (BMS) with remote monitoring capability. Thus, any potential problems will be detected early and remotely so that they can be solved before they can significantly affect the overall system performance.

### Three-phase Power

The original micro-grid in Maligaon only provided single-phase electricity which is suitable for household use. However, most livelihood activities that require electricity require three-phase power to cater to heavy inductive loads like pumps for irrigation or motors for refining crops.

Three phase power for livelihood activities is a vital part of the next rung up the energy ladder that the people of Maligaon currently do not have access to.

Thus, the new system will have consistent and high quality three-phase power to support any potential livelihood activities which will also be easily separated into three separate single-phases to continue to support household use.

### Additional 7 kW of solar panels

The original system in Maligaon had a 9.63 kW total PV array capacity. Based on new electricity usage analysis in Maligaon the current total usage is 7 kW. Since the renewed system is intended to work for at least 10 years and cater to energy intensive livelihood activities, the total PV array capacity will be increased to 16 kW.

Out of the (at least) 10 years that the system will operate, the first year will be for the people of Maligaon to familiarize themselves with the solar system at their current usage of 7 kW and learn the ropes of basic management and use of the system. Thereafter, the people of Maligaon plan to (on average) add 1 kW per year in the form of either livelihood activities or increased household use so that after 10 years their total use is about 16 kW.

\*Calculation of per unit cost can be shared on request.

### Smart Meters

Smart meters are devices that collect real-time data on energy consumption at the household level to be shared with the electricity supplier (Gram Vikas) and consumer. They also include intuitive software for consumers and suppliers to visualize and understand this data in order to promote sustainable usage.

Smart meters will allow better management and use of the system compared to the originally used analog meters, which were just simple charge controllers, in several respects as tabulated below.

Feature	Smart Meters	Simple Charge Controllers
Data & Analytics	Real-time data on energy consumption at the household level.	-
Security	Will shut down and inform supplier in case of tampering.	-
Energy Budgeting	Dynamic energy budgets that can be adjusted by the consumer based on purchasing power, total available electricity and other factors. Puts consumption in the hands of the consumer.	Static energy budgets. There is no mechanism for changes like family growth or increased income to influence consumption. System cannot adapt to change.
Payments	Pre-paid meter top up so that usage and payments are directly linked. Ensures payments are made as the meter will not allow use without sufficient balance.	Fixed charges and full dependence on operator(s) to follow up and collect monthly payments. Usage and payments are not linked (the energy budget is pre-programmed into the simple charge controller regardless of whether payments have been made).

## COMMUNITY MANAGEMENT

The original community management system for the micro-grid depended excessively on a single operator in Maligaon to oversee and carry out maintenance. This left out necessary checks and balances for technical maintenance, payment systems and to sustain a community sense of ownership.

As part of the renewal process, Gram Vikas conducted extensive groundwork to identify the pitfalls of the previous responsibility system and to design a new and sustainable system. Over the past ten months a household wise survey was conducted along with formal monthly community meetings and many more smaller informal focused group discussions.

The new responsibility system has been designed collaboratively by Gram Vikas and the people of Maligaon. It has also been informed by best practices\* developed by the [Renewable & Appropriate Energy Laboratory \(RAEL\)](#) led by Professor Daniel Kammen at the University of California Berkeley, the [Alliance for Rural Electrification](#) and the [World Bank](#) as well as feedback from the people of Maligaon obtained from discussions at the household, hamlet and community levels.

The goals of the new community management system set-out by the people of Maligaon are as below:

- Cultivate a robust and sustainable sense of community ownership of the solar energy system.
- Educate all community members, particularly women and marginalized groups, about how the system and each of its components work.
- Encourage and incentivize sustainable and productive use of electricity.
- Ensure the consistent and long-term cleaning/maintenance of the centralized technical equipment.

With these goals in mind from the start, the following community management system has been devised as below.

- Three women, one from each hamlet of Maligaon, will work as co-operators of the system. These women will be chosen by the people of Maligaon on the basis of their leadership in local governance and self-help groups (SHGs). Furthermore, women were preferred for this responsibility over men as, unlike men, most women do not seasonally migrate for work and can thus see to the maintenance of the system without significant interruption.
- Their responsibilities will include keeping all of the centralized technical equipment (solar panels, batteries and inverters) clean, keeping a daily log of total day and night consumption and facilitating payments for each of their respective hamlets through the smart meters. Gram Vikas will assist and train these women for their first few months as co-operators before they can capably take independent charge.
- For their work, the three women will each receive a fixed monthly salary to be deducted from the total payments received for electricity usage that they will facilitate via the smart meters. The leftover balance will be deposited each month in the bank account of the Village Water Water & Sanitation Committee (VWSC) Maligaon, the body created by Gram Vikas and the people of Maligaon to facilitate all Gram Vikas projects in Maligaon. This money collected via payments could be used for any future maintenance/repairs costs if necessary.

\*Specific best practices and studies that have informed the design of the renewed system can be shared on request.

## IMPACT & METRICS

In addition to new technologies and a redesigned community management system, the impact of the renewed system will also be monitored over its lifetime. A team from [Azim Premji University](#) led by [Professor Manu Mathai](#) has partnered with Gram Vikas to design the metrics and the methodology to track this impact. These metrics span many different impact areas such as energy access, income generation, kerosene replacement and carbon dioxide reduction etc.

The smart meters and community management system will also help Gram Vikas to keep a regular track of these metrics.

## BUDGET OVERVIEW

Category	Sub-Total (INR)	Sub-Total (USD)
Solar Panels	9,95,200	14,854
Batteries & Inverters	30,67,460	45,783
Smart Meters	3,36,000	5,015
Refurbishment of the Maligaon Powerhouse	3,26,000	4,866
Rewiring	5,61,000	8,373
Training/Education on Micro-Grid Management & Use	31,500	470
<b>TOTAL</b>	<b>53,17,160</b>	<b>79,361</b>

## SUPPORT

Gram Vikas is grateful for financial support for this project given by several entities including:

- [The Odisha State Planning Board](#)
- [The State Bank of India Youth for India Fellowship](#)
- [CAT International Projects](#)

## CONTACT

Should you wish to know more about the Maligaon Solar Energy Renewal project, kindly contact Eshaan Patheria or Ashutosh Bhat for further information.

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Mr. Lakhinath Takiri, a resident of the Schedule Caste (SC) hamlet of Maligaon, sits next to a fire in the late evening during a blackout.