

Executive Summary

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Project Title:

Development Plan of a Sustainable Micro-Hydro Power Plant and Distribution System for a Tribal Village Cluster in Rural India

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Project Period: 08/31/2008 - 08/31/2010

Description and Objective of Research:

*Our project is based around the **potential** of green, decentralized, energy-enabled development.*

India today is a thriving paradox. There is an India that is a country of infinite promise, where national industries are becoming global influences, where foreign investment is a way of life, and where the only bound to growth lies with the next skyscraper, stock offering, or online transaction. There is also an India that is riddled with poverty, where stable households and health standards are as foreign as iPods™ and industrialization. Many people live on less than \$1/day and each rupee is hard earned and meticulously spent. While experts and economists forecast India's international dominance, this rural India is almost always forgotten.

The goal of Columbia University Engineers Without Borders (CU-EWB) is to provide people in this area of the world an equitable means of opportunity and livelihood. This team has forged a partnership with a renowned Indian NGO, Gram Vikas (GV), in order to design and implement a scalable energy program in the rural Kalahandi District of Orissa, India. Using a micro-hydro power (MHP) system, CU-EWB aims to use green energy as a catalyst to spur economic growth and development in multiple target villages through a cluster approach starting with the village of Purnaguma. Micro-hydro power is a sustainable source of energy that has significant results with a minimal environmental footprint. In a MHP project, water is diverted from a stream or river and sent down a penstock to spin a turbine connected to an alternator to generate electricity.

Instead of considering this project as purely an energy venture, we are using the generation of power as a foundation for the larger goal of a sustainable and replicable design on both a local and global level.

Summary of Findings (Outputs/Outcomes):

The goal of Phase I was to design, implement and document a scalable micro-hydro system in Purnaguma to form the basis of a “cluster approach” and extend the benefits of electricity to multiple villages in the surrounding region.

One major challenge we faced in Phase I was selecting the target village. After surveying seven villages in the Kalahandi District, we narrowed our choices down to two: Bada Tikraguda and Purnaguma. Both villages are at favorable locations and exhibit a great need for electricity. However, we came to the conclusion that Purnaguma was the ideal location for our first implementation as they had a more active population and showed great willingness to work with CU-EWB and Gram Vikas. Once this village was chosen, we used village data from two survey trips to design a micro-hydro system tailored to the needs and characteristics of Purnaguma. We also built the most specific part of the system, a replicable turbine design which will serve a dual purpose of operating in the Purnaguma system and teaching machinists in the district to locally build turbines for future projects.

An integral part of the success of this project is community involvement. Through the collection of the “corpus fund,” the villagers feel ownership of the project. By empowering a village to own and generate its own power, our project will instill in them a feeling of pride and hope – both intangible, and yet key for the success of the project,

By looking beyond our initial narrower approach to developing the Kalahandi District with solely electricity, CU-EWB is now concentrating on how the villagers can best utilize the energy for income generation, improved health, sustainable maintenance of the system, and an overall improvement in quality of life.

The name “Engineers Without Borders” does not speak nearly to the number of different disciplines we have represented in our team. The versatility of our project is not only present in the composition of our team, but also in the fact that we innovate on multiple issues facing development in this area of the world, many of which are broadly applicable. The wide range of experiences and specialties of the group allows us to approach these problems holistically - impacting the status quo in infrastructure (solving the problem of access to central power), social ownership (through the corpus fund and village labor) and general economic improvement.

Conclusions:

The three pillars of sustainable development according to the widely accepted Brundtland Commission (formerly known as the United Nations Commission on Environment and Development) are *Social* (people), *Economic* (prosperity) and *Ecological* (the planet), paralleling the three goals of the P3. These are the three cornerstones of our approach to our project.

Following the development of Purnaguma, CU-EWB’s next task is to repeat such a process in a cluster of surrounding villages. We realized that a vital factor for selecting a successful village is its social preparedness for a micro-hydro system. Thus, we recommend that this be considered with equal weight to engineering feasibility in future village selection.

Proposed Phase II Objectives and Strategies

CU-EWB initially entered Phase I with plans to simply build a micro-hydroelectric system. However, after team members visited the project site in the summer of 2007, the team decided that only providing electricity would not address the deeper problems of village development in this region.

As a result, the team decided to create Economic Stimulating (ES) ventures in order to aid Purnaguma in making better use of the electricity as well as to address the immediate lack of capital we encountered during the assessment trips. These ES ventures will act as catalysts for achieving self-sustainability and economic development in Purnaguma and the surrounding cluster.

The first ES venture is providing a low cost and replicable method of water filtration for the villagers since contaminated water is a leading cause of many illnesses. The water filter will be made out of clay and rice husks and is simple to make but highly effective. More importantly, local artisans will be able to efficiently reproduce these filters. The second project is an education program for the villagers. The program is made so that the villagers will know how to address electricity properly and be able to maintain the turbine through detailed pamphlets, manuals and videos our team will make in the United States. Finally the last ES venture is a micro-enterprise for selling cooking oil made from locally grown seeds. The cooking oil will be sold for profit in a Bhawanipatna, a nearby city. This steady income will hopefully be able to jumpstart economic growth and sustainability in Purnaguma.

This project will also be used as an educational tool both in India and in the United States. Once the micro-hydro system has been implemented in India, other villages will take on similar projects by learning from the designs of the system in Purnaguma. This process is further aided by that fact that the turbine for Purnaguma will be made locally by trained mechanics who will have the capability to reproduce the turbine for other villages. This can also be applied to the ES ventures as the water filters and cooking oil equipment will be manufactured locally, lowering costs. In the United States, students at Columbia University will learn about the impact of this design in the developing world through courses like "Engineering for Sustainable Communities." In addition, students on campus will also learn about our efforts through CU-EWB's press releases, presentations of the prototype, online *Wiki*, and various campus presentations at institutions around the nation.

The Purnaguma system is scheduled to be completed in June 2008 during a summer implementation trip. This will allow the team to continue research on future sites for the cluster and set the stage for livelihood production systems which will be formally introduced after the testing phase in the fall of 2008. Finally, this will lay the foundation for the implementation of multiple MHP systems in the surrounding cluster.

Publications/Presentations:

The Earth Institute at Columbia University
The William J. Clinton Foundation
The Department of Environmental Protection, Massachusetts
Engineers Without Borders USA
The Schlumberger Ltd. Foundation

The JP Morgan Good Venture Competition

CU-EWB also produced a promotional video that can be seen at http://www.youtube.com/watch?v=qPdn_WWhrR8 and several healthcare pamphlets that are available upon request.

Supplemental Keywords:

Gram Vikas, Columbia University-Engineers Without Borders, Practical Action, Micro-Hydro Power, Corpus Fund, Cluster Approach, Economic Stimulating Ventures, Sustainable Development, Energy-enabled development, Scalable plan

Relevant Web Sites:

<http://www.cu-ewb.org>

<http://www.ewb-usa.org>

<http://www.gramvikas.org>

<http://www.practicalaction.org>

<http://www.cuewb.org/india-wiki/tiki-index.php>