HAITI MISSION: GREAT IDEA

Graduate Research and Education for Appropriate Technology
Inspiring Direct Engagement and Agency

greatidea.uprm.edu

University of Puerto Rico, Mayagüez
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Access to Electric Energy and Clean Water
Duchity, Haiti

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1. GREAT IDEA Overview

GREAT IDEA …

- Sponsors interdisciplinary graduate thesis research on topics and themes related to Appropriate Technology (AT);
- Educates and mentors graduate students and faculty to explore through courses (created through the project) and seminars on AT;
- Researches attitudes about AT among engineering researchers;

… with the ultimate objectives to …

- Foster career tracks for the next generation of appropriate technologists;
- Change the paradigm for engineering and technology design;
- Benefit society with an increased incorporation of the principles of AT.

In particular, GREAT IDEA works with the community of Duchity, Haiti, located in the Southwestern peninsula in the department of Grand'Anse. Duchity is an regional economic center with a population of 20,000 people who mainly live off the land. Duchity has been an agricultural center for a long time, but many challenges such as hurricanes, flooding, drought, deforestation, poor sanitation, poor access to potable water, inappropriate finance for small businesses, and no access to electric energy prevail. GREAT IDEA works in Duchity to plan and develop

- Alternative sources of power, including solar and hydro-electric sources;
- Household-level water purification via ceramic and biosand filters.

The choice to work in Duchity originated from a partnership with Youthaiti, a non-profit organization from Milwaukee, WI.

2. Project Summary

Despite a long tradition of engineers and scientists volunteering their skills to develop "appropriate technology" to address humanitarian concerns (e.g., needs of developing societies or poor communities), relatively few have oriented their primary professional or academic activities to such work. In an effort to foster greater participation in ATas part of core graduate and professional research, GREAT IDEA has three principal components:

1. Sponsorship and mentoring of graduate students and faculty to conduct research and career development related to appropriate technology, including via construction of interdisciplinary thesis committees;
2. Development and delivery of new courses and seminars to educate students and faculty about principles, practices, and critiques of appropriate technology and technology practice in general;
3. Development and dissemination of a survey of faculty and graduate students (in engineering) to determine participation and interest in conducting research to problems of appropriate technology and humanitarian causes.

GREAT IDEA is sponsoring five Masters thesis students from several disciplines and focused on a variety of topics, including: Design and Assessment of a Low-cost Power Inverter; Incorporating Community Preferences in Planning a Local Transportation Project; Microbial Population Dynamics in a Biosand Filter, Cultivation of Bamboo as an Alternative Construction Material in Puerto Rico; and Management of Small Business. Further, the investigators (and student Rodriguez) are directly participating in the planning of development projects to bring electrification and clean water to Duchity, a mountain community in Haiti's southwestern peninsula.

Two new courses have been created: INTD 6095 Responsible Research in Appropriate Technology (Instructor: Frey, Fall 2013); and INTD 5095 Appropriate Technology: Toward Sustainable Wellbeing (Instructor: Castro, Spring 2012, Spring 2013). Several public lectures/seminars featuring internationally known scholars and practitioners have also been organized, including: Carl Mitcham (Colorado School of Mines); Indira Nair (Carnegie Mellon University); John Tharakan (Howard University); Mike Hatfield (Aprovecho Research Center, Cottage Grove, Oregon); and Kelvin Willoughby (Curtin University, Perth, Australia). One investigator (Castro) played a role in organizing the 5th International Conference on Appropriate Technology (South Africa, November 2012), and the PI's are co-organizing an international conference in Havana, Cuba (March 2013).

The attitudes survey has undergone several iterations and revisions. It is in the final design stage and should be completed by December 2013. This will lead to research results regarding attitudes and practice of appropriate technology and will potentially be relevant to continuing to reform graduate education to enable more students to choose and sustain research in appropriate technology.

The investigators are synthesizing the literature on appropriate technology in light of the experiences of the project. They are forming a strong interdisciplinary core of researchers that will continue to sponsor research in appropriate technology, including via a related project sponsored by NEH. These efforts are establishing Mayagüez as an international center for conversation and innovation in appropriate technology.

3. Appropriate Technology

Appropriate Technology broadly refers to both specific technologies and the practice and process of technology development that adhere to the following principles:

- Planning of new or newly installed technologies is done in partnership with the community that will be affected and/or in which the technology is specifically intended;

- Growth and innovation are achieved at rates compatible with “human scale”, such that technologies can capitalized and managed in proportion to the capabilities of the affected community;

- Convenience and efficiency are used to enhance opportunities for human labor rather than to fundamentally replace the need for human labor;

- Technologies should inspire local business opportunities

- Technologies should be eco-compatible, sustainable, and follow principles of natural capitalism;

- Progress is measured by benefits to human wellbeing and not necessarily by aggregate measures such as GDP.

4. Access to Electric Energy in Haiti - Duchity

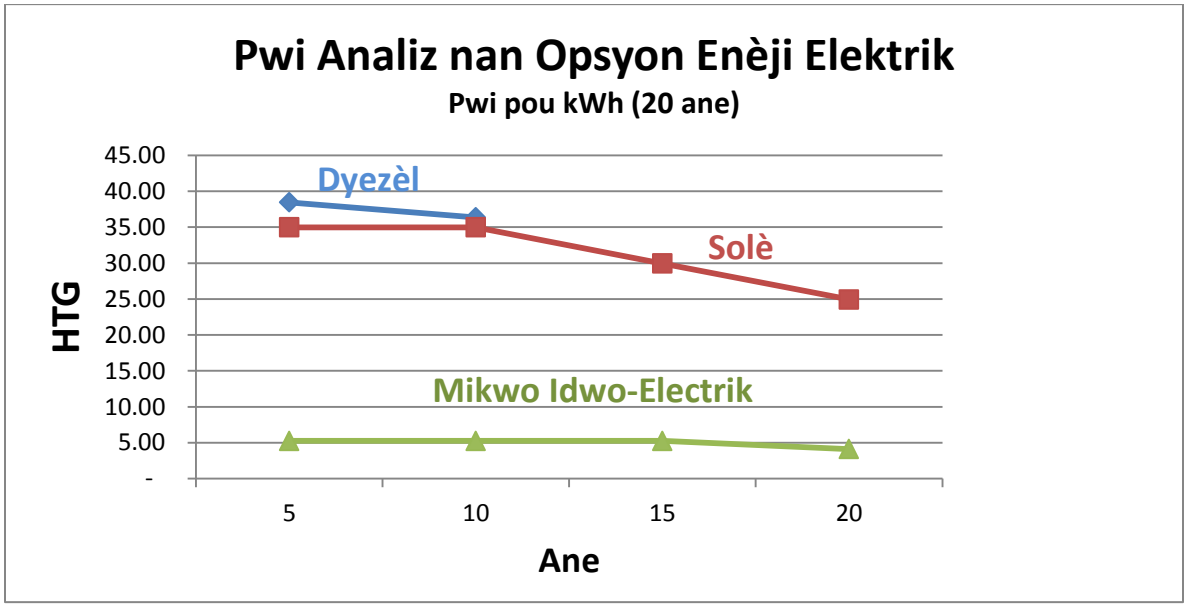
Partner of GREAT IDEA have been involved working with this community for nearly 10 years to provide energy to the central village of Duchity. St. Thomas Apostle Catholic Church (Naperville, IL) established the first electric micro-grid of the zone, powered by a 17 kW diesel generator that functioned from 2004 until 2012.

The community and the leaders of these organizations have approached a team at the University of Puerto Rico at Mayagüez (UPRM) to analyze different energy options for the community, with strong emphasis on renewable energy alternatives. The experience of the community with increased fuel cost, and three major needed repairs to the generator provided them with a very much real context to analyze the drawbacks of fossil fuel based electric power plants.

The ongoing efforts by team members at Duchity further explores the community's interest to tie renewable energy power systems to better local jobs and business opportunities. Ultimately, the next phase in the process is a business led effort with the great potential to be replicated because, while enabling very much needed electric energy to remote rural areas, it also provides a robust business model for market-driven private investment to penetrate a market often neglected. It has been said that if there are 2 billion people in the world living on $1 a day, that's a market $2 billion per day. The challenge is to provide a fair opportunity and a door to an improved quality of life while at the same time use the profit of a business model for it to be replicable at a global scale. An innovation that tackles this grand challenge is at the core of the vision of the project team for the future to improve the human wellbeing in rural communities at Haiti and also provide economic opportunities for professionals in Puerto Rico.

Recently GREAT IDEA, along with partners St. Thomas Apostle Catholic Church and the Rotary Club of Metro New York have developed some estimates for long term equivalent prices of electricity to be provided by a 15kW solar system and a 25kW micro-hydro electric system. A contract is being negotiated with the engineering company Sodeco, SA, from Port au Prince, to conduct an engineering feasibility study of the local Glace River.

The following chart summarizes the price per kWh to be delivered by various options over a 20 year period:



GREAT IDEA is also consulting with the neighboring community Gojèt to assess feasibility of solar power for their community.

5. Access to Clean Water in Haiti – Duchity

Like many other communities in Haiti, residents of Duchity draw water directly from local streams. A small pipeline system also delivers this water to several local faucets. These water sources have at least low level contamination of fecal bacteria.

GREAT IDEA is currently working with St. Thomas Apostle Catholic Church (Naperville, IL), the Vermont Haiti Project, and Youthaiti (Milwaukee, WI) to provide options for clean water in Duchity at the household level. Ceramic and biosand filters are being distributed to households, and local technicians have been trained to assist uses with maintenance and proper operation.

GREAT IDEA also installed and maintains a water quality testing laboratory in the local health clinic. Two technicians were trained to perform basic water quality testing.

It is hoped eventually new job and business opportunities can be created from the management and distribution of the filters and water quality testing service.

6. List of Papers Published and Recently Submitted

J.M. Rodríguez, B. Hernandez, P.J. Tarafa, and C. Papadopoulos. "Development of a Procedure and Apparatus to Quantify Pathogen Reduction Throughout an Intermittent Biosand Filter." *International Perspective on Water Resources and the Environment*. Quito, Ecuador, January 2014. Under Review.

D. Chacon, C. Papadopoulos, A. Figueroa, M. Castro, and D. Valdes. "Embedding Community Preferences In Visualizations: A Case Study Of Context Sensitive Design In Puerto Rico." Transportation Research Record. Under Review.

M. Castro-Sitiriche and M. Ndoye. "On the Links between Sustainable Wellbeing and Electric Energy Consumption". *African Journal of Science, Technology, Innovation and Development*, 2013. DOI:20421338.2013.809279.

W.J. Frey. "Training Responsible Engineers for Global Contexts*". Engineering Ethics for a Globalized World,* Coleen Murphy and Paolo Gardoni., Eds., 2013. Under Review. This work was presented at *Engineering for a Global World* (EGW-12), Champaign, IL, October 2012.

M.J. Castro-Sitiriche, G. Beauchamp-Báez, and L. Jiménez-Rodríguez (2013). "Solar Microgrids and Energy Poverty: Conceptual Framework for Sustainable Wellbeing and Technology Justice Assessment*". XII World Wind Energy Conference & Renewable Energy Exhibition: Opening Doors to Caribbean Winds*, Havana, Cuba.

M.J. Castro-Sitiriche, M. Ndoye; "Subjective Wellbeing and Sustainability: A Data Driven Look at Global Electric Energy Consumption", *Proceedings of the 5th International Conference of Appropriate Technology*, Pretoria, South Africa, pages 141-148, November 2012.

M. Castro-Sitiriche and C. Papadopoulos (2012). "Global Implications of Appropriate Technology". *Center for Hemispherical Cooperation in Research and Education in Engineering and Applied Science (Co-Hemis): Simposio sobre Iniciativa Internacionales en Investicación y Educación*. Mayaguez, Puerto Rico, November 2012.

R. Maldonado, C. Gomez, and M.J. Castro-Sitiriche,. "Simulation, Design, Hardware Implementation, and Control of a 9-level Flying Capacitor Multilevel Inverter with Particle Swarm Optimization Algorithm". *IEEE 13th Workshop on Control and Modeling for Power Electronics* (COMPEL), June 2012.

W. Frey, C. Papadopoulos, M. Castro-Sitiriche, F. Zevallos, and D. Echevarría. "On Integrating Appropriate Technology Responsive to Community Capabilities: A Case Study from Haiti", Proceedings of the ASEE Annual Conference and Exposition, San Antonio, TX, June 2012.

M. Castro-Sitiriche, C. Papadopoulos, W. Frey, and H. Huyke. "Sustainable Wellbeing Education in Engineering". *IEEE International Symposium on Sustainable Systems and Technology*, May 2012. DOI 10.1109/ISSST.2012.6228005.

C. Verharen, J. Tharakan, G. Middendorf, M. Castro-Sitiriche, and G. Kadoda. "Introducing Survival Ethics into Engineering Education and Practice". *Science and Engineering Ethics*, Springer, Online First™, December 8, 2011.

7. Media Exposure

"Desafíos de la Tecnología". Por Idem Osorio De Jesús (idem.osorio@upr.edu), *PRENSA RUM*, viernes, 5 de abril de 2013.
http://www.uprm.edu/portada/article.php?id=2498

"RUM Recibe Visita de Aprovecho Research Center". *Foro Colegial*, with Mariam Ludim, February 1, 2013.
http://www.youtube.com/watch?v=HDQo4Llrzno&feature=youtu.be

"Cuando Se Aprovechan los Recursos". Por Idem Osorio De Jesús (idem.osorio@upr.edu), *PRENSA RUM*, viernes, 1 de febrero de 2013.
http://www.uprm.edu/portada/article.php?id=2434

"En el RUM Persiste una Gran Idea". Por Wilfredo J. Burgos Matos (wilfredo.burgos@upr.edu), *Taller de Estudiantes PRENSA RUM*, viernes, 14 de septiembre de 2012.
http://www.uprm.edu/portada/article.php?id=2323

"Proyecto GREAT IDEA". *Foro Colegial*, with Mariam Ludim, August 10, 2011.
http://www.youtube.com/watch?v=9eS1HT_XBeo&list=PL9E37D6F667A6E17B&index=2

Foro sobre Haití, PRENSA RUM (anuncio). May 2, 2011.
http://www.uprm.edu/news/events/foro-sobre-haiti.html

8. Miscellaneous Excerpts

In this section are copies of recent publications and presentations (see http://www.greatidea.uprm.edu/publications).

9. Contact Information

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