

## A Cleaner Cooking System for Developing Countries

Student member develops biogas digester system that produces methane gas

By ANNA BOGDANOWICZ 6 August 2010



A combined brick, mortar, and plastic tank biogas digester installed this year in a village in Kenya. Photo: Justin Henriques.

It's hard to believe, but according to the World Health Organization, some 1.5 million people die every year in developing countries because of indoor pollution caused by burning wood, coal, and other fuels used for cooking and heating. But IEEE Student Member Justin Henriques is hoping to give households in these regions a safer energy option: biogas, a cleaner, more sustainable fuel derived from organic matter such as cow manure.

Henriques and volunteers from the nonprofit organization [Least of These International \(LOTI\)](#), in Charlottesville, Va., developed a relatively inexpensive, sustainable biogas digester system that produces enough methane gas to provide an hour's worth of fuel every day to cook for a family of five. The system is

composed of an air-tight tank that stores a mixture of water and manure outside the house while it ferments, and then pipes the resulting methane gas into the house and to the burner where it can be used for cooking.

"The anaerobic [lack of oxygen] fermentation process kills most of the pathogens in manure that would cause sickness," Henriques explains.

Such systems are by no means new; the technology was invented in the 1930s. Biogas systems have been tried in developing countries for years. However, they often fail and are discarded because they are either too costly or too difficult for villagers to maintain, according to Henriques.

Henriques is executive director and cofounder of LOTI, which aims to develop technologies to benefit those living in low-income countries. He is also a National Science Foundation Graduate Research Fellow and Ph.D. candidate at the University of Virginia, in Charlottesville. Henriques presented his work on the biogas digester system in April at the [IEEE Green Technologies Conference](#), held in Grapevine, Texas.



A plastic tank modular biogas digester design before underground. Photo: Justin Henriques.

## **OFF TO KENYA**

Founded in 2005, LOTI sends its volunteers, who have backgrounds in technology, to areas in Africa, Latin America, and the Caribbean to investigate the needs of villagers that can be addressed with technology.

Henriques and his team traveled in 2006 to Namawanga, a remote village in western Kenya, where they learned a top priority for villagers is a cleaner, safer fuel for cooking. They use primarily wood to cook, but with poorly ventilated cooking areas typically located in the main living quarters, burning such materials has led to sickness and death.

After meeting with residents, nongovernmental organizations, and community leaders, Henriques and his team decided biogas was the right fuel for the community. In addition, the manure needed to run the system is widely available because the villagers keep cows.

"Traditional biogas digesters often require skilled labor to build and maintain, tend to take a long time to construct, and are often expensive," Henriques says. "Our goal was to build the system out of inexpensive parts that are locally available and wouldn't require the villagers to be skilled in construction."

The digester they developed cost about US \$200, took about 3 days to construct, and was made out of parts bought at the local market. The components are a 1000-liter water tank made of plastic, where the mixture is fermented and the gas stored; two tubes: one through which the water and manure are added and the other used to discharge the fermented mixture, which can be used for fertilizer; and a pipe that carries the gas to the burner.

A digester system was installed and used for one year by a family in the village. The family reported it worked consistently and very well, according to Henriques.

## **BIGGER AND BETTER**

Henriques recently sent an LOTI team back to Namawanga that installed a bigger and better system. The new system costs about \$700 because it relies on a 7000-liter tank to produce seven times more fuel than its predecessor. It should last for many years, says Henriques, who with his team will spend the next year testing it.

"The idea is that once we've finalized the design, the system will be available for all the villagers to purchase using micro-financing tools to ensure affordability," he says. Micro-financing would allow villagers and businesses in the community to take small loans with relatively low interest, several-year payback periods, and the option to use alternative forms of collateral.

"It's exciting and rewarding to use my technical knowledge to help the poor in developing countries," Henriques adds. "Actually, it's a privilege."

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