

Zinc-air Energy Storage Systems for Rural Electrification in Madagascar

Madagascar, the fourth largest island on earth, is home to nearly 26 million people – most of whom have no source of electricity

Located approximately 400 kilometers (250 miles) off the southeast coast of Africa, Madagascar is one of the world's least developed countries. According to the World Bank, just 23% of the population has access to electricity; in rural areas, only 5%.

This situation is beginning to change, however, as forward-thinking entrepreneurs develop new funding, and market models bring electricity to villagers eager to buy it.

Finding the Proving Ground

In 2017, NantEnergy partnered with Henri Fraise Fils & Cie, the local Caterpillar® dealer in Madagascar, to develop a solar + storage microgrid. This important demonstration project is located in the Tsiroanomandidy district of a village called Belobaka, 234 miles (376 km) northwest of Madagascar's capital, Antananarivo—and it has become a proving ground for the value of microgrids based on renewable solar energy and advanced storage batteries.

Ninety percent of Belobaka villagers are farmers, and the village's most important crops are maize, cassava, and rice. Traditionally, rice has been harvested with generator-powered threshing machines that run on diesel fuel. Diesel, however, is not only expensive—with a per-liter cost of 3,500 Madagascar ariary (MGA) or 0.99 U.S. dollars (USD)—but it is a significant contributor to the community's already high pollution levels.



As the installation of a microgrid reduces diesel exhaust and creates additional electric power for homes and businesses to purchase, Belobaka was an ideal choice for this venture.

In Phase I of the \$1.5 million, 2-phase project, the microgrid will generate and deliver electricity for the first time to up to 400 households and local businesses. The business model was created to fit the needs and expectations of customers. Users in rural areas, such as those in Belobaka, have more modest power demands than do urban users (average load profile for rural customers is 1.2 kWh/day, compared to an average 4.5 kWh/day consumed by city dwellers, according to the national electricity operator Jirama). Additionally, a cell phone SIM card or rechargeable card supports a pay-as-you-go model for the power, which costs 1,500 MGA per kWh (0.43 USD/kWh).

Building a Market

The NantEnergy project team went door-to-door, recruiting the families and businesses that would become the first participants in the microgrid. Each had to agree to two requirements: To pay a deposit (125,000 MGA, or 3 USD, for homeowners; 200,000 MGA, or 56 USD, for business owners' triple-phase systems), and to have an on-site smart meter installed, from either SteamaCo or SparkMeter. Meanwhile, the NantEnergy and Caterpillar



Customer Category: Remote microgrid

Partner: Henri Fraise Fils & Cie

Financing Partner: United States Trade Development Agency

System Size: 83kW (peak) solar panels, 16 battery storage systems totaling 315 kWh (48V)

Battery Type: Zinc-air

Meanwhile, the NantEnergy and Caterpillar teams engaged a local general contractor to begin installing the equipment: 83kW (peak) solar panels; 16 battery storage systems totaling 315 kWh (48V); and 100 power poles to carry 400 meters of low-voltage lines.

In addition to providing electric power for threshing machines, lights, and other uses, Phase I of the project also generated dozens of local jobs in Belokaba. Phase 2 will include an additional 400 homes and businesses... and over the next few years, NantEnergy hopes to install microgrids in nine additional villages of similar size, ultimately bringing electricity to a total of eleven Madagascar villages.

More than half of the project financing was provided by a United States Trade Development Agency (USTDA) grant of \$800,000. The USTDA grants are designed to leverage U.S. technologies to facilitate early-stage infrastructure development in developing countries.

“Having served people in these rural farming communities for nearly 100 years, we knew how much they needed electrification, and that they would pay for it if we could

“When we first turned on a light, my daughter was so amazed and so happy! Now she has more time to read and do homework, and we can even use electricity to cook, so the air in our home is so much better and healthier for her.”

Local Belobaka Resident

deliver it affordably,” said Nicolas Verbert, Vice President of Henri Fraise. “Without NantEnergy’s zinc-air batteries, the project economics wouldn’t have worked; they are ideal for the climate and longevity, as well as cost.”

Says Julien Rakotonomenjanahary, mayor of Belobaka, “This is a moment long awaited by the local population. Healthcare, education and even the local economy will see changes.”

Belobaka Energy Capacity, Power Installed and Energy Consumption Estimation

ACTIVITY	Household		Revenue	Connection’s Capacity		Installed		Equipments
	%	H	\$/Mth	%	H	kW/h	kW	
Farmer	84%	672	100	30%	202	0.1	20	Lamps (LED150), Radio, Phone Charger
Merchant,Retailer	12%	96	150	40%	38	0.5	19	+Freezer
Artisan, Industrial	4%	32	250	50%	16	5.5	88	+Husking, Welding, Crushing, Cutting Machine
Total		800		32%	256		127	