

Winner case study summary

SteamaCo, Kenya

Ashden Award for Business Innovation, supported by Citi

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Solar PV power station for the Entasopia micro-grid, Kenya



"I've started a hairdressing salon now that I have power for a hair dryer." Nancy, Entasopia



remote

monitoring and payment



25

micro-grids managed



businesses

started because of electricity

"SteamaCo's innovative product is helping to take energy access in off-grid rural areas to the next level. By developing hardware and cloud-based software to remotely monitor energy use and payments, it has overcome one of the key barriers to making micro-grids investable."

Ashden judging panel

The challenge

1.5 billion people don't have electricity. On paper, independent renewable-powered grids can make economic sense for providing affordable power, and with investment these could rapidly bring electricity to many more people. But the favourable economics can easily be overturned unless the micro-grid works reliably and customers pay regularly. Both of these are challenging in remote areas.

SteamaCo's approach

The founders of SteamaCo know first-hand the challenges of running microgrids. They therefore developed a system to manage the monitoring, control and payments remotely.

SteamaCo's hardware, which micro-

"Without tools like SteamaCo, micro-grids would not be possible, commercially."

Sam Slaughter, co-founder, PowerGen renewables

grid owners purchase and install in their power station, monitors and controls the supply to each customer. It talks to SteamaCo's web-based software, regularly sending data, like power use, and receiving data, like mobile-money payments. The software, which is leased by micro-grid owners, processes data and provides a dashboard for them to see the performance of their systems. For reliability, all data transfer is by SMS.

SteamaCo systems currently manage 25 micro-grids supplying renewable power (80 kW total) to about 1,000 homes and small businesses in Kenya

and Tanzania. Other systems manage different technologies, including a water grid in Nepal.

Micro-grid electricity powers homes, and enables businesses like electrical repair and hairdressing to start. With a SteamaCo system, payment is easy and flexible for users.

The SteamaCo system helps owners to keep track of the technical and financial performance of micro-grids. Real-time information, from the whole grid down to the individual user, means that problems can be identified early, and performance optimised.

Why they won

The 2015 Ashden Award to SteamaCo recognises how its founders have built an innovative technology-based business that removes a barrier to investment in micro-grids.

SteamaCo profile

For-profit business
US\$290k income 2014, 46% from sales
12 staff

Winner case study

SteamaCo, Kenya

Background

1.5 billion people, mainly in developing countries, still lack access to electricity, and many of them are unlikely to be reached by a national electricity grid for years. Individual solar-home-systems are becoming an increasingly popular purchase for powering lights and mobile phones in off-grid areas. But to provide the higher levels of power needed for businesses and larger domestic appliances, the up-front cost becomes too high for most households to afford.

On paper, small independent grids, powered by solar electricity, could make economic sense for providing affordable access to electricity. End-users pay per kWh of electricity, as on the national grid, and avoid the high up-front costs. Higher-power equipment, as well as lights and phone-chargers, can be used. Outside investment in micro-grids could rapidly bring electricity to many more people.

But translating a feasible concept on paper into a viable investment requires the system to work reliably and customers to pay regularly, both of which are challenging to achieve in remote, isolated areas. If frequent outside intervention is needed – for example, to fix technical problems or collect payments – then the favourable economics can easily be overturned.

The founders of SteamaCo had first-hand experience of the challenges of running micro-grids. They therefore developed the technology to manage the monitoring, control and payments remotely. Although initially for SteamaCo's own use, the service and technology are now sold to other micro-grid operators, helping to bring the benefits of electricity access to increasing numbers of off-grid customers.

The organisation

SteamaCo (previously called Access:Energy) is a private business registered and operating in Kenya. It was founded by Harrison Leaf and Sam Duby in 2012, combining their management and technical expertise to increase energy access through renewable energy. SteamaCo has 12 staff (3 female) and had an income of US\$290,000 (46% from sales, 54% grants) in 2014. Initially funded by its founders and private funds, it has recently launched an equity investment round to fund expansion.

The business model

SteamaCo's original business model was the production, sale and installation of individual renewable energy systems. It moved to installing micro-grids because more people could be reached by selling units of electricity rather than hardware. It was this experience that showed the value of remote management of metering, control and payments. The focus of the business is now the development and sale of the technologies that enable this. SteamaCo sells its hardware to micro-grid developers and leases the software on a monthly basis. It also provides consultancy services.

The technology

Hardware: the bitHarvester

The (patent-pending) bitHarvester hardware developed by SteamaCo comprises several discrete modules. These are designed to be easy to install and set up, so that SteamaCo staff do not need to be present. The modules can be unplugged and swapped if a fault occurs. The 'CONNECT' board monitors the power use and controls the power lines for up to fifteen customers. It includes a power sensor, a relay (so that the line can be switched on or off) and a circuit breaker (to limit the maximum allowed power) for each electricity customer. The CONNECT keeps track of the credit associated with each

Solar micro-grid technology

A typical solar micro-grid managed by SteamaCo technology uses an array of solar-electric (PV) panels to generate electricity; a bank of lead-acid batteries to store electricity for night-time use; and an inverter to convert the dc voltage from the PV array to the local ac mains voltage (240 volts in Kenya) so that customers can use regular mains appliances.

The system is installed in a location central to its customer base, with the batteries and inverter in a locked steel casing, and the PV panels mounted above to collect as much sunshine as possible. Each customer is connected to this central hub with an individual buried cable or via a satellite hub. The installed cost including cabling and connection boxes is about US\$70,000 for a 6 kW system serving 70 users.



Site agent Edward Tongai checks the bitHarvester at a micro-grid hub



Wiring the PV panels for a micro-grid

customer line and automatically switches them off once their credit runs out.

The THINK board saves data from up to 30 Connect boards (400 customers) and other sensors, and communicates with the web-based SteamaCo software dashboard. SteamaCo uses SMS messages sent via the mobile phone (GSM) network to send data, because this is generally the most reliable form of remote communication in off-grid areas. However, data is also backed up in non-volatile memory, so will not be lost if the GSM network goes down.

Data sent to the Steama software includes the power used by each individual customer, and the overall performance of the PV system. SMS messages received from the software bring information on payments made by individual customers.

The THINK board is installed, along with other micro-grid hardware, at the central hub (see box). CONNECT boards are installed there, and also at satellite hubs to manage the connections of more distant customers. THINK boards can also be used to monitor other things, for example water use.

Software: Steama

The Steama software performs a wide variety of data management operations. It processes the monitoring information received from bitHarvesters along with the payment notifications from mobile-money providers, updating the bitHarvester when someone makes a payment. It sends automated SMS messages to customers about their balance status. It can also be programmed to send customised alerts to staff or do one-off processes for a customer or group of customers – for example, to make tariff changes. All data is encrypted and backed up on cloud-based servers.

The front end of Steama is a dashboard providing micro-grid owners and operators with a range of options for viewing and analysing the technical and financial performance of their systems. For example, kWh use and payments can be inspected, from whole systems down to individual customers. Technical parameters of systems, like battery voltage and temperature, can be checked. The Steama software team regularly develops new dashboard features in response to customer needs.

How much does it cost and how do users pay?

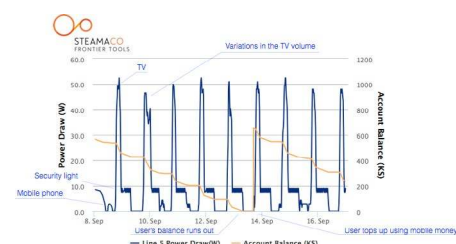
Micro-grid owners, who are SteamaCo's direct customers, pay a one off charge of around US\$1,500-2,000 for the bitHarvester hardware, and then a licence fee of around US\$100/month for the Steama software. This licence fee allows them to view their own micro-grids on the Steama dashboard, and get data from it.

Tariffs for electricity use are set by the micro-grid owner and implemented via Steama. Typically their customers pay a connection fee of around US\$10 and then a charge of around US\$2-4 per kWh for electricity used. Although high compared with grid electricity, this is considerably cheaper than kerosene for lighting and comparable with the charges for pay-as-you-go solar-home-systems. Connection to the national grid, even if available, would cost significantly more, at about US\$1,000.

Achievements

SteamaCo installed its first fully-automated micro-grid management system in 2013. By April 2015, 25 systems were in use. These systems are managing 80 kW of renewable-powered minigrids, with about 1,000 homes and small businesses connected, and generating 50 MWh/year of electricity (and growing). Three of the grids are owned and operated by SteamaCo itself, the others are owned by five investors - Vulcan, E.ON, PowerGen, Renewable World and Cleanstar Ventures - who pay for different levels of support from SteamaCo. 23 of the micro-grids are in Kenya, and the remaining two in Tanzania. The technology is currently being installed on a microgrid in Benin.

The bitHarvester was designed to be used more widely than just with micro-grids, and several additional SteamaCo management systems are in use on different types of asset.



The Steama dashboard shows a customer's power use (blue) and credit balance (orange).



"There wasn't enough power to run a soldering iron on my solar-home-system, so people had to take their radios 100km for repair. Now with power from the micro-grid, I can fix them here in Entasopia."

John Pambio



With micro-grid electricity, the petrol pump works all the time, and trade has increased.

For example one manages a village water grid in Nepal, another monitors multiple items including diesel use, water consumed and power across multiple internal circuits for a fleet operating company headquarters, and a third monitors different uses of mains power in a large shopping mall.

Benefits of micro-grid electricity

Households with electricity from micro-grids enjoy many benefits from electric light and phone charging. In Kenya, mobile phones provide access to mobile money for many users and, increasingly, internet as well. The higher levels of power available from a micro-grid, compared to a solar-home-system, mean that household items like televisions, music systems and irons can also be used.

Micro-grid electricity also opens up business opportunities, as the Ashden visiting assessor saw in the trading post of Entasopia in South-West Kenya. Some businesses, like the filling station, had previously used diesel generators but switched to micro-grid power because it was more reliable and cheaper. In Entasopia, 'reliable' means not having to send the diesel generator 100 km for repair when it breaks down, a considerable cost and hassle. New businesses had started up. The owner of a small hardware shop started doing electrical repairs because he had power for a soldering iron. Another shop owner opened a small hairdressing salon, because she had power for a hair dryer.

Displacement of kerosene for lighting and diesel-powered generation cuts greenhouse gas emissions. For the 25 micro-grids managed by SteamaCo technology, annual savings are an estimated 485 tonnes of CO₂ per year.

Benefits of SteamaCo technology and service

SteamaCo micro-grid management makes payment easy and flexible for customers. Prepayment by mobile money, in whatever amount a customer wants, fits with different earning patterns. Automated SMS reminders warn when credit is low, and free balance checks via SMS help customers keep track of their spending on electricity.

The owners of 22 micro-grids who pay for services from SteamaCo are able to monitor system performance and payments on a daily basis and down to an individual customer if needed. They can troubleshoot and sort out problems before they become serious, for instance if they observe that a battery voltage is starting to fall too low, they can send someone out to check. The high visibility of the micro-grid system that the Steama dashboard provides can be used to improve the performance of the system: for example, to identify if there is sufficient spare capacity in the daytime to consider additional uses like water-pumping. The fact that the majority of SteamaCo's business has come from repeat orders and returning customers, shows that micro-grid owners value the technology and service.

The future

There is keen interest in micro-grids in many countries, as a way to provide significant levels of electricity in remote areas. To grow the sector rapidly, private investment in the micro-grid hardware is needed. SteamaCo aims to be a significant provider of the asset management systems to this growing sector, in many countries. The company has recently launched an investment round to scale up growth.

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What if the mains grid comes?

One factor that puts off investment in micro-grids is the possibility that the mains grid might be extended to a site, and put the micro-grid out of business. SteamaCo encourages micro-grid developers to use cabling that meets mains specification, so that the micro-grid could, at a later date, be connected. SteamaCo management technology could still be used for power monitoring and payment processing, and the PV moved to another site.



"I use the micro-grid power for all the equipment in my Club – lights, sound system, TV, DVD. The power is stable so it doesn't damage the equipment, that's a huge benefit to my business."

Ibrahim Chegi, owner of Club 360



A barber now uses electric clippers and has light for working in the evening.