

## **Electricity Access Pilot Project Proposal**

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### **Executive Summary**

The Earth Institute's advisory project in São Tomé e Príncipe seeks to provide technical input and coordination for the implementation of a pilot system for basic electricity access. The goal of this project is to provide the ability for one closely-spaced community of 100 to 200 households to have access to lighting, daily between the hours of 18:00 and 22:00 for a capital investment of \$100/hh or nearly 10 times less than traditional costs of rural electrification. The intention is for this initial pilot system to both serve as a reference for future access-focused projects and to provide an entry point for the pilot community and others toward more advanced energy utilization in later phases.

### **Site Selection**

Ubabudo has been selected as the pilot site based on the following criteria:

- Need: In Ubabudo there presently is no access to the general EMAE electrical grid or any other public electricity system.
- Willingness: Community leaders have expressed both a desire to participate in the Energy Access Pilot Project and a willingness to coordinate local ownership of the system.
- Physical layout: There are about 150 households within very close proximity. Ubabudo is a central location for several surrounding "sub-unit" communities of an older plantation. A pilot system here could lead to later systems in nearby communities.
- Previous Infrastructure: A generator and transmission lines (wires) were previously installed<sup>1</sup>, and though they are now in a state of disrepair, some of the distribution infrastructure could be re-used in this pilot project.

### **Choosing an Appropriate Power Generation Method**

For a diesel generator based system it is only ~\$100 a household to install the system and connect each of the 200 households. (Note because this is a pilot project where only one system is being installed costs our hardware costs will be closer to ~\$200 per household.) This is a much better access entry point for Ubabudo than other solutions that can require a cost of more than \$1,000 per household (connecting to the existing EMAE grid, hydro, solar, or others).

The pilot system will provide the same capacity for 1 to 2 years before it is either significantly modified or transitioned away from to a different method for increased capacity providing the opportunity for more energy utilization (greater consumption). This anticipated scaling transition also greatly impacts the choice of the power generation method.

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<sup>1</sup> The previous installation was provided as a Taiwanese donation six years ago. The system failed due to mismanaged usage resulting in overloading of the alternator. It will be imperative for this new pilot project system to focus on usage management training as well as maintenance planning and accessibility. For more information see the section on sustainability.

In considering installation, fuel, and maintenance costs, existing infrastructure, as well as implementation time, diesel generation has been chosen because it offers the lowest installation cost, the most easily near term scalable or transitionable method, it can be installed quickly, operating costs are low at the low consumption levels proposed, and local resources can easily install, service/maintain it.

After one to two years, a second phase could be implemented to transition energy generation to biomass-based system. Not only is São Tomé extremely well suited for biomass, but the method also offers several other benefits including local income through the collecting of fuel (agricultural waste, etc.). Another option for a second phase could be the transition to hydro-power or integration into the existing EMAE grid. However, before any of these options can be further explored it must be proven that the pilot community can successfully organize to financially/operationally manage the initial diesel generator system. The skills and abilities that are gained by the community to self-manage and organize will be very useful for later energy transitions as well as further development in areas of water, agriculture, transportation, education, and healthcare.

### System Criteria

The pilot system will be a very simple system focused on providing the most basic of access to those that presently have none. The main criteria for the system is that each household is limited to one 7-watt Compact Fluorescent Light (CFL) Bulb powered daily between 18:00 and 22:00. A comparison between CFL, a traditional bulb, and kerosene/wax based lighting is shown below.

	Light (Lumens)	Life (hours)	Price	Monthly Fuel Cost <sup>2</sup>
7-watt Compact Fluorescent Light (CFL)	400	10,000	\$3.00	~\$0.25
25-watt Incandescent Bulb	400	1,000	\$1.00	~\$0.75
Kerosene / wax (1 ml = 1 lumen / hr)	20	20 ml / h	\$0.75 liter	~\$2.00

Load limiters will prohibit the use of appliances, or any other electrical device greater than 10 watts. However, because there will not be a tamper detection device, the community must closely and collectively self manage the monitoring of over usage – a few people can break the system for everyone. As such a single community television will be provided as a donation by Columbia as an exception to the 7 watt CFL limitation. Households that wish to exceed the 7 watt CFL limitation will need to personally acquire private generation capacity on their own, separate from the system.

### Recommended Management Practices for Sustainability

For the system to both be sustainable and flexible, several things must happen inside and outside the community.

The community must own the system. Zatona, a local NGO specializing in community empowerment, should facilitate the Ubabudo in officially registering its energy commission as an association (see Appendix 1 for more info on important considerations for the association’s bi-laws).

The community must also self-monitor and self-manage the system. EMAE can not collect \$0.25 from each household every month, nor is it cost effective to install energy meters with complex tamper-control devices per household. Instead, entities within the community should manage

<sup>2</sup> Monthly cost is per residency and is based on 4 hours of use a day. Diesel based power generation is assumed to result in 1 kWh per 0.5 liters of diesel. Diesel is assumed to be \$0.50 a liter.

billing and usage monitoring from which one single monthly fuel payment should then be delivered to EMAE. For the system to be sustained, it will be critical for the community to self-police violations of energy use.

EMAE should provide diesel fuel and EMAE or some similar contracted entity should carry out regular maintenance of the generator and greater system in response to the local community's payment of the single monthly bill. EMAE or some similar contracted entity should also be responsible for initial installation of the system via funds paid by the community association via matching donations from Columbia and EMAE<sup>3</sup>.

Even though the cost of fuel will only be ~\$0.25 per month per household, it is strongly recommended that the association charge \$3.00 per household per month for the service. 50% of this (\$1.50 per household) could then be paid to cover fuel cost and delivery as well as regular oil and filter changes and other maintenances such as generator repair or wiring replacement. 50% (\$1.50 per household) should be kept untouched in a reserve, budgeted for future system upgrades. With this reserve, in a year the association would have enough money to afford a second generator to add considerable system capacity for expanded use, or perhaps transition to a biomass system.

### **Partnering Organizations**

The success of this pilot project will require cooperation between several organizations. These organizations are listed below.

#### Columbia – STP

Jan Hartman

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#### Columbia – US

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#### EMAE

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#### Ubabudo

Energy Committee – Manuel Estrella (sp?)

#### Zatona

Dionisio Amado

Tel: 22-12-30

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<sup>3</sup> To facilitate community ownership each residency should be required to pay the association for a provided CFL and load limiter.



# Sao Tome Electricity Access Pilot Project





# Rural electricity system, lighting only



	Light (Lumens)	Life (hours)	Price	Monthly Fuel Cost <sup>[1]</sup>
7-watt Compact Fluorescent Light (CFL)	400	10,000	\$3.00	~\$0.25
25-watt Incandescent Bulb	400	1,000	\$1.00	~\$0.75
Kerosene / wax (1 ml = 1 lumen / hr)	20	20 ml / h	\$0.75 liter	~\$2.00

Small 4kVA diesel generator & efficient CFLs:  
monthly cost per household<sup>[2]</sup> = current candle cost

[1] Monthly cost is per residency and is based on 4 hours of use a day. Diesel based power generation is assumed to result in 1 kWh per 0.5 liters of diesel. Diesel is assumed to be \$0.50 a liter.

[2] Monthly cost per residency includes fuel cost, maintenance allowance, and additional funds for future upgrades to the system (it will take approximately 12 months to save for an upgrade).