



ECOPOWER LIBERIA

Cheap, Reliable, Renewable
Electricity from Biomass

Monrovia, Liberia
Philadelphia, PA, USA

Tel: +231 (0) 88 643 0813
Tel: +231 (0) 76 482 894

April 6, 2013

Project	Implementing a bioenergy pilot project with practical demo and training
Activity 2	Training at Booker Washington Institute (BWI) vocational training center

Background

The primary objective of the project is to train qualified technicians in the operation and maintenance (O&M) procedures of the biomass generator.

The students of Booker Washington Institute have shown remarkable aptitude and readiness to take on these tasks. We focused on training students from the electrical and auto mechanics departments, because their skill sets are closely aligned with the workings of the generator.

Our goal was to end up with 15 highly trained expert operators. As the students progressed through the training and gained confidence and proficiency, they were ranked as follows:

Familiars: Instruction in concepts of the technology and limited hands on operations

Proficients: Able to operate the system and prepare biomass fuel

Experts: Able to take system apart and rebuild it, troubleshoot and maintain.

Training outcomes

Over a period of 3 weeks of intensive hands on instruction, we trained:

140 Familiars

25 Proficients

15 Experts (AKA the Biomass Brothers)

Locally relevant teaching content

When the introductory part of the lecture turned to gasification, we spent about an hour in a conversation about charcoal making.

Charcoal is the most widely used cooking fuel in Liberia, as much as 98% of the population uses charcoal, so everyone in the room was familiar with the process. Charcoal making is an artisanal activity, which is in essence biomass gasification. The charcoal maker lights a fire under a pile of wood, and then quickly covers it with blankets, leaves and sand, to prevent air and retard the combustion. The wood is thus exposed to heat for about a week or so. The end result is a much reduced mass. We asked the students to guess why the wood ended up at half its original size. They were surprised and delighted to learn that the wood was gasified, and in fact the difference in mass is the CO and H that are produced when wood is heated in an oxygen deprived environment.

We then lit a long wooden stick and passed it around so students could see how the wood is first gasified, and that the flame is actually gas combusting, not the wood (see pictures)

Using charcoal making to explain gasification was very effective. The students understood the process almost intuitively.

Note progression of char-making on blackboard



Training the Familiars

Session 1: March 25 & 26 , auto mechanic dept.

Session 2: March 27 & 28 , auto mechanic dept.

Session 3: March 29 & April 1, electrical dept.

See data sheets for March 26, 28 and April 1

Each session had about 45 students and faculty in a classroom setting, and lasted 2 days.

Day 1: Introduced the students to the concepts of:

- Biomass pathways
- Converting plant biomass to electricity through gasification, digestion and fermentation
- Gasification specifics, and analyzing the charcoal-making process
- The chemistry of biomass gasification
- Conversion of the gas to electricity
- Types of gasification systems
- Production of tars and volatiles, and the difficulty of tar cracking
- Methods of eliminating tars and volatiles
- Effect of temperatures on gas quality



Lecture portion:

Demonstrating the difference between gasification and combustion.

Close observation of the components of a flame-gas mixes with air and combusts

Questions were allowed throughout. At first, students were shy, but after a few asked questions, others began to feel confident, and a flood of questions followed.

Day 2: Introduced the students to the 10kW power Pallet generator

- Safety overview
- Cleanliness, order and storage of tools in generating room
- Evacuation procedures
- Loading of biomass

Then is groups of 5-6:

- Sealing of system
- Start up procedure
- Flaring gas
- Bringing up to temps
- Interpreting temp data
- Interpreting pressure data
- Engine start up
- Interpreting data while engine is on
- Transitioning from flare to engine and back
- Shut down
- Post op safety check



Lecture portion-

The parts of the gasifier, and engine.

The movements of biomass, air, gas, and heat in the system.



Hands-on operation-

Safety checks, cold start, flaring, and starting the engine.

Training the Proficients

April 1 – 9 See data sheets dates

25 students **All training of Proficients is hands on, and includes:**

- Each student personally operates the machine by himself (under supervision)
- Interpret temps and pressure data displayed
- Generate electricity
- Adjust engine RPM and measure current
- Check oil, coolant
- Remove ash
- Limited trouble shooting

Biomass preparation

- Safely use the chipper
- Sift biomass and evaluate size and moisture
- Sort, dry and store biomass



Students operate the machine, under supervision



Cutting branches from a felled rubber tree at Firestone plantation



Harvesting bamboo



Students learned how to build a sifter



Sifting and sizing coconut shells



- Hands-on operation-
- Safety training
 - Operation of a chipper.
 - Evaluating the results