



## B2G Systems

### Biogas Stove for Village in Nicaragua



#### Team Members

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#### Background:

In a world inundated with technological advances, many people in underdeveloped nations still lack the most basic of necessities. Nicaragua, the largest country in Central America and the second poorest in the Western Hemisphere, is one such nation. Because We Care Ministries (BCWM) was founded by Dr. Donald Gillette and works in rural villages in the northwest part of Nicaragua to provide economic and emergency relief. The people in these villages do not have a safe way of preparing food in their homes and currently use open wood-burning stoves which give off harmful emissions.

Last year a USNA capstone design team, Hago Fuego, was successful in working for Dr. Gillette to develop a bio-digester, operating on animal waste. It was theorized that the biogas produced by the unit could be coupled with a simple stove system and thus be utilized as a cleaner-burning fuel source. This would provide a safer alternative for the people in rural villages to prepare meals in their homes.

#### Objectives:

This year, B2G Systems will design, build, and test a simple and low cost stove system compatible with the existing bio-digester and capable of providing enough energy to boil water in order to cook meals. Additionally, the stove system will consist of materials readily available in the rural Nicaraguan villages ensuring that it is practical and affordable for Dr. Gillette to provide to the villagers.

Ongoing work / testing:

The team conducted several interviews with Dr. Gillette in order to understand his vision for the project. During the interviews a list of customer requirements was generated. He wanted the system to be low cost, boil enough water for one meal a day, be made of materials available locally in Nicaragua, involve little set-up, and operate using biogas from the existing digester.

The team reviewed pre-existing biogas stove systems being used in several underdeveloped parts of the world. Although there are stoves available for purchasing, they are outside of the customer's requirements for cost and set-up. Thus, the team developed several designs for a simple stove system that could be built by the local villagers at a low cost.

The design chosen for further testing involves a metal can, such as a soup can, for the main body and support of the stove. The can would have holes drilled into the top in order to hold the flame once the fuel and air mixture is ignited. Several different can sizes as well as different hole locations will be tested to determine the best design. Figure 1 below demonstrates one possible design using materials which would be readily available in the rural villages.



**Figure 1: Soda-can design**

Each prototype will be tested by placing the prototype in the fume hood and inserting the fuel source nozzle into the prototype. The fuel composition of  $\text{CH}_4$  will be varied from 40 to 60 percent with  $\text{CO}_2$  composing the rest of the fuel mixture. This will be done

by varying the flow rate of the two gases accordingly with a rotameter to achieve the desired fuel mixture meant to mimic the biogas.

Several members of the B2G Systems team will be traveling to Somotillo, Nicaragua in March and will have the opportunity to test the best designs with the built bio-digester on site.



**Figure 3: B2G Systems**