

# Wood Stoves for Guatemala

## Redesigned Stove



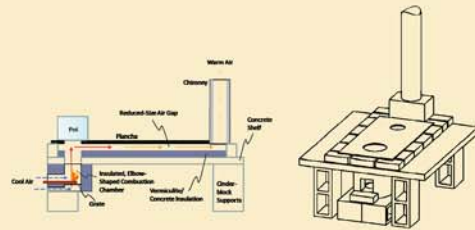
First prototype of the Redesigned Stove



Second prototype



Molded combustion chamber incorporating grate and ash tray



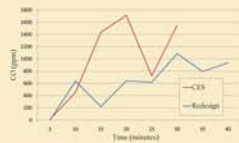
- Increased insulation throughout the stove
- Integrated elbow-shaped combustion chamber for more efficient combustion and better draft
- Smaller air gap under stove top for better heat transfer
- Incorporated grate for more heat transfer to air
- Ash tray for easier cleaning

## Improved Efficiency



More than twice as efficient as the old stove, the redesigned stove uses only a fraction of the wood.

## Reduced Emissions



Burning more cleanly, the new stove will further improve the quality of air inside the home environment and produce less soot in the chimney.

## Offsite Construction



The combustion chamber is a strong but insulating mix of concrete and porous vermiculite. Meant to be cast in molds in a central location, these can be made quickly in large batches and then transported to the respective stove sites. This helps minimize on-site construction.

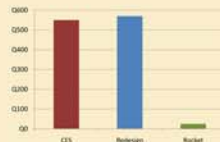
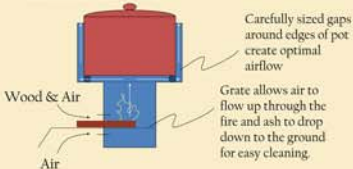
## New Business Opportunity

By using a construction technique for the combustion chamber that is nearly identical to one for constructing a stand-alone rocket stove, we hope to create an opportunity for CES to make and sell rocket stoves.

The ability to bring one of the highly efficient rocket stoves into a village as a visible demonstration would create a new marketing technique for the larger stove. The CES stove could then be sold as a durable and more sizable upgrade built on the same technology as the rocket stove.

## The Rocket Stove

A cheap, portable and efficient alternative to large wood burning stoves. It does not have the same character or durability of the larger stoves, but can serve a market larger market of users who cannot afford the CES stove.



## The Bucket Rocket



We built and tested a simple version of a rocket stove inside of a bucket. The pot sits on top of the stove, but since it lacks a skirt around the pot, a complete version of the stove would be even more efficient.

## Very Low Cost

The rocket stove costs a small fraction of the cost of the original CES stove and the improved stove, making it a more economical option for poorer families.

# F.W. Olin SCOPE Team



## Our Partner



- Development organization based in Guatemala
- Helping Guatemalans help themselves
- Offers a range of product lines and services
- Stimulates local economy by creating jobs and a market, rather than a relief model



## The Problem



Half of rural Guatemalans still cook every meal over an open, indoor fire.

### Health

- Dangerous CO and particulate emissions
- 36% of infant deaths are due to pneumonia (leading cause)<sup>1</sup>
- Safety hazard – people suffer burns from falling in

### Economic

- 71% live below the poverty line
- \$3,100: Annual income for family of 6
- \$400: Spent on wood for cooking per year
- \$200: Spent on wood used per year with an improved stove<sup>2</sup>

### Quality of Life

- Collecting firewood takes significant time and effort
- Children have less time to attend school and study
- Female student drop out rates are up to 82% in rural areas<sup>3</sup>

## Original CES Stove



"I used to get up at 5, now I get up at 6:30."

"I used to buy two areas of wood each month, now I buy less than one."

### Strengths

- Cost Savings
- Reduced Emissions
- High Plancha Temperatures

### Weaknesses

- Low Efficiency
- Plancha Bending
- Soot
- Cost

## Our Goal

- ↓ Base Cost of Stove
- ↑ Efficiency (Cost of Use)
- ↑ Desirability of Stove
- ↑ Safety and Health
- ↑ Ease of Construction

## Building



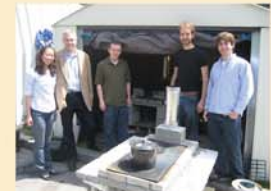
The team built a version of the CES stove to understand manufacturing techniques and prepare for testing.

## Testing



The stove was set up with various thermocouples, thermometers, and a combustion gas analyzer to gather data on the efficiency, boiling times, temperatures, and emissions of the CES stove.

## The Team



(L-R) Carmelle Tsai, Greg Van Kirk (CEO of CES), Christopher Carrick, Stephen Westwood, Ryan Hubbard, Melina Martinez (Babson MBA, not pictured)

Advised by Professor Jessica Townsend