



### WorldStove Five-Step Program

#### ***A Five-Step Program to Reduce GHG Emissions, Conserve Fuelwood, and bring Industry to Developing Nations***

Hundreds of millions of people rely on woodfuels for most of their energy needs, despite the problems associated with traditional use of woodfuels, including energy inefficiency, deforestation, increasing use of time for collection of fuel, and deleterious health and environmental effects. (Scurlock and Hall. 1989; Barnes, 1994)

“The general pattern in developing countries is that with increasing income people generally move up the energy ladder from firewood to charcoal or kerosene and then to liquefied petroleum gas (LPG), natural gas, or electricity for cooking.” (Barnes, et al. 1994). This pattern is easily understood. Gathering firewood, normally left to the women and children, is often dangerous, requires hard work, and walking long distances, in other words, effort and time which could be better spent on other activities. If burned in open fires, wood fuel is smoky and inefficient. Charcoal is compact and cleaner to burn and to store, but more expensive to buy. For urban dwellers, wood may not be an option, and kerosene and propane too expensive. This, and a global increase in urbanization, may explain the increase in charcoal consumption despite an apparently sufficient supply for firewood. (Arnold, et al. 2003). Implicit in the Barnes article is the assumption that people will buy and use improved stoves which have desirable features and pay back the investment quickly.

While the energy ladder concerns the sources of energy people use, there is a parallel ladder, the *carbon ladder*, one which expresses the carbon outputs of different fuels. Locally collected firewood, that is, fallen branches, fallen trees, and other biomass slated for passive decay, is carbon neutral. However, for firewood harvested from healthy trees, the carbon footprint is positive, converted to charcoal (which releases 70% of the energy of wood, and 50% of the carbon) the footprint per unit of useable energy is greater still. Next come the fossil fuels, nonrenewable and carbon positive, and the finally, with the largest carbon footprint of all, electricity, most often from turbines driven by fossil fuels.

The energy- and carbon ladders are thus linked to each other, and we suggest that, in the same way, new stoves should be linked with new fuels. This might help to reduce both the energy poverty of many people and also their carbon footprints.

For this effort to succeed, stoves and fuels need to be adaptable to local cooking and heating customs and also to the different fuel types seasonally available.

In Burkina Faso, for example, some families are currently spending €3 per day on firewood imported from Ghana (Arzouma Oubda (tribe leader near Dassoui), personal communication). Yet the country has disposal problems with agricultural waste:

- Karité shells are too flammable to burn in an open fire;
- Peanut shells, because of their bulk, burn up too rapidly;
- Mango trimmings are too bulky; and
- Pulp from sugar cane needs special treatment to burn well, as will trimmings from mango trees, etc.

We propose that agricultural waste such as these and others, can be converted to appropriate fuels for new stoves.

The purpose of the five-step program is threefold:

1. Improve health for stove users
2. Improve environmental conditions; and
3. Create jobs

The five-step program is outlined below.

### **Step 1: Establish the “Stove Hub”:**

(Three Biucci stoves, 30 Beaner stoves, and one HF Briquette Press  
The Stove Hub consists of staff and facilities which will introduce, demonstrate, manufacture and maintain the stoves used in the five step program. They will also operate a small, hand powered briquette mill which will supply initial operations. Ideal locations for stove hubs include, but are not limited to, a women’s shelter, technical schools, and places adjacent to agriculturally based industries.

Institutions are good starting points because they serve large numbers of people and, having high visibility, serve to introduce the stoves to a community. For these reasons, we begin the five step program with three of the Biucci large cooking stoves, which are specifically designed for institutions. The limited number of kitchen stove operators at the institution can be trained in skilled use of these stoves. Another benefit of institutions as starting points is that they often keep better records on fuel consumption than do home users (ITDG Boiling Point, No. 29 1992). In addition to the large introductory cook stoves, thirty small stoves are distributed to members of the community as educational tools.



The Stove Hubs receive income from the five step program which allows them to become financially independent. Members of the shelter, or students who work in the stove hub, receive training which should enable them to leave the Stove Hub and start their own Stove Hubs.

**Step 2: Build a factory for stove assembly:**

Needed equipment will include metal cutters, seam rollers, and welding equipment in some areas, but masonry equipment in others. Stove Hub members assemble 500 LuciaStoves from donated critical components and locally available materials. They also sell, service, and teach the use of these 500 stoves to purchasers. Sales of stoves provide employment at the Stove Hub as well as generating funds to purchase a steady supply of critical components and locally available materials.

**Step 3: Stove Hub purchases or receives a hammer mill and large (600kg per hour) pellet plant**

These will serve rising fuel demands and increase earnings at the Hub.

**Step 4: Char Collection and Fuel Supplies.**

Step 4 involves quantification and grading of char produced. A small lab is established which allows the Stove Hub to weigh, catalog, and grade char being produced by stoves in their community. Only accurate bookkeeping entitles the Stove Hub to measurable carbon credits, and agencies which grant these credits have the right to inspect and verify the quantity and quality of produced char. Grading of the char assures also that it is used as an appropriate amendment for specific applications.

There are several modes for LuciaStove owners to obtain pellets from the Stove Hub:

- Purchase pellets outright;
- Exchange biomass, at a rate of 2 kg biomass for 1 kg for pellets;
- Exchange 200 g certifiable char for 1 kg pellets; or
- Any combination of the above, with a strong emphasis on barter and community cooperative models.

The above values will depend on the availability and quality of biomass and the financial capabilities of people. Price of pellets should be higher than cost of their production since they take away from carbon scheme which is contributing to the Stove Hub.



### Step 5: The char produced at the Stove Hub

Once quantified and cataloged, char produced through the Stove Hub stoves is either donated or sold to food programs to increase crop yields or to afforestation programs to reduce seedling mortality and combat desertification. WorldStove offers technical assistance or partnerships to understand the biochar produced and how it is best used

Postscript: In explaining his KickStart program, Martin Fisher stated that, "... our mission is not to design or sell pumps. Our mission is help people escape poverty." We share his ambition to end poverty, but our mission is also to sell stoves which will reduce indoor- and outdoor air pollution, and to help avert climate change by sequestering carbon and reducing fuel use.

Introducing biomass based pellets as fuel will have substantial effects on any economy moving along the energy ladder. For example, in 1985, the Kenyan charcoal industry included 30,000 full-time producers, 400 transporters, and 800 retailers. Material for charcoal production is becoming increasingly scarce. (Kammen and Lew, 2005). However, that for biomass pellets is comparatively ubiquitous. Its use would reduce the need for petroleum consuming transport and create employment opportunities throughout both rural and urban areas.

We have developed and produced the LuciaStove, a pyrolytic stove which consumes less than half the fuel of other biomass fuel stoves, thus reducing GHG emissions. **The LuciaStove, in pyrolytic mode, burns only the gas it produces** from small biomass or low cost pellets made from agricultural waste, thus conserving forests, and, in the process of doing so, converts 30% of the biomass weight to biochar for sequestration of carbon. Moreover, despite being the product of some sophisticated technology, this stove can be mass produced at low cost and then locally assembled to meet regionally specific traditions and locally available fuel. Built and sold locally, this will generating income for local sellers from both stove sales as well as carbon credits.



### Summary of the Five Step Plan:

- Step 1. Local group wanting this Stove Hub provides building, and personnel, WorldStove provides 3 Biucci and 30 Beaner stoves plus a small briquette press.
- Step 2. Once the Stove Hub has demonstrated availability of all materials necessary to complete construction of 500 stoves, WorldStove will arrange for the first 500 critical components, necessary tools and a small pellet press to kick start the program.
- Step 3. Before a large press (600kg per hour) is provided, the Stove Hub must demonstrate orders for stoves or fuel or having established a reliable demand for stoves.
- Step 4. If they demonstrate that they are measuring, evaluating, and storing char, then Stove Hub can enter the carbon credit program.
- Step 5: Once Stove Hub has collected 5 tons of char, WorldStove will help the Stove Hub develop a reforestation and soil restoration programs.

### Micro Financing Option

€35-50 is price of the stove to the consumer, depending on features.

This provides cash for Stove Hub to buy materials and allows end users to benefit economically from the very day they receive their LuciaStove.

This micro financing program has worked in WorldStove's Uganda pilot program and is now being applied to our programs in Burkina Faso. End users pay ½ the original daily cost of fuel.

So, if originally, €2 day for fuel, they pay €1 a day for stove.

Location	Cost of wood per day €	Days to pay for a 35 € stove
Dassoui	0.36	97
Tenkodogo	0.66	53
Ouagadougou	1.32	27

Once the stove has been paid for, in areas where WorldStove has conducted pilot programs disposable income for end users increases by a minimum of €0.36-€1.32 a day. This is an important savings where, in the extreme cases people are often forced to choose between purchasing food or the fuel needed to cook the food: in the less dire cases € 1.80 per day is enough to send three children to school.



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