What is a Gasifier Stove?

Gasifier stoves are metallic biomass-fuelled cooking stove designed in a way that the fuel is first converted into combustible gases through intense heating which then burns with a clean flame.

In comparison, combustion in conventional open fire is not controlled and results in production of smoke and other forms of harmful gases such as carbon monoxide. Therefore, gasifier stoves allows for cleaner cooking than traditional cookstoves.

Applications

Gasifier stoves can be used to cook food and heat water. They are compatible to the cooking habits of the rural majority in East Africa that currently rely on firewood as fuel, and could be used as substitute for other conventional stoves such as charcoal cookstoves or three stone fireplace.

The key markets include:

- Peri-urban households cooking with firewood and charcoal
- Rural households cooking with firewood
- Restaurants and other users

Benefits

- Significant fuel savings over traditional three stone fireplace
- Clean burning: less air pollution than many types of biomass stove, including charcoal cookstoves that releases a lot of carbon monoxide.
- Fast cooking
- Use of readily available biomass materials, such as agricultural residues.
- Modern appearance yet affordable (e.g. from less than US$10 to US$100 )can potentially offer the following benefits over traditional biomass fuels (firewood or charcoal).
Fuel

The following non-exhaustive list indicates the types of fuel that can be used:

• Dry firewood
• Sawdust
• Agricultural waste (e.g. coconut shells, husks, twigs)
• Wood shavings, chunks or twigs.

The burn time varies with amount and type of fuel used, mainly within the range of 30 minutes to 1 hour.

Types of Stove Designs

A key distinction between different types of household gasifier stoves is how the air is fed, either by natural or forced draft.

Natural Draft

The simplest way to get air into the combustion and fuel chambers is through ‘natural draft’. Fresh air is sucked in as the hot air rises (hot air is lighter than cold air).

Advantages:
• Simple, cheaper to build
• Cheaper to operate as no batteries are used
• No moving parts, so less likely to break down

Disadvantages:
• Airflow cannot easily be regulated to change heat setting
• Potentially less efficient

Forced Draft

Alternative designs exist where airflow is forced using a fan. Batteries most often power such fans.

Advantages
• Precise regulation of air-flow for different heat settings
• More efficient, due to control of air flow

Disadvantages
• More expensive to build and operate (e.g. replacing batteries)
• May break down rendering it useless, especially in rural setting where support services are minimal.

Business Opportunities

Why Gasifier stoves production could work for you?

• You have an interest in new technology and willing to take a risk
• You are a very effective salesperson and able to explain the benefits of new products to clients
• You are willing to innovate around with the design in order to make it work better for your clients
• High ultimate sales potential; very large market if it can be developed

Market

Gasifier stoves have the potential to penetrate all the household segments due to benefits such as good performance, efficiency and low emissions. The following target market segments stand out:

• Households currently cooking with firewood using an improved stove - Sales could be either from consumers looking to replace equipment at the end of its life, or active decisions to change to an improved stove. Appropriate and careful pricing will be very important.
• Households cooking with firewood in a 3-stone fireplace - If people are willing to switch from using a 3-stone fireplace, the gasifier stove must demonstrably be a worthwhile investment – if firewood is currently collected for free, other benefits, such as the reduced smoke, rather than fuel economy will require emphasis through marketing.
• Businesses (e.g. street food vendors) cooking with firewood - Such organisations/enterprises are likely to be receptive to the fuel (and money) saving benefits of gasifier stoves.
• Institutions: Large sized gasifier stoves would work very well in institutions such as schools or hotels, which are heavy consumers of charcoal and fuelwood.
Marketing

Many would-be consumers have either never seen or heard about a gasifier stove. This means active marketing and awareness raising will be needed to enhance market penetration. This could include activities such as public demonstrations, targeted free product trials and selling from strategic locations.

Production

Simple manual draft gasifier stoves are within reach of technicians in the informal fabrication (Jua Kali) sector. They require only basic raw materials such as sheet metal, tin cans, screws and pop rivets, and can be made with simple hand-tools such as tin snips, pliers, hammers and screwdrivers.

There are two ways of working toward success:

1) **Non-technical businesspersons** employ a skilled technician to produce stoves according to agreed specification.

2) **Technicians and metal workers** take on the challenge of the sales and marketing aspects as well as overseeing production at his/her workshop.

Investment Analysis

The following presents an analysis of how an informal sector (Jua Kali) workshop owner could invest in a gasifier stove business.

Table 1: Investment analysis for Gasifier Stove production

<table>
<thead>
<tr>
<th>INVESTMENT</th>
<th>Income (USD)</th>
<th>Expenditure (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Owned already</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Working capital</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Materials (100 stoves @ $ 7.50 per stove)</td>
<td></td>
<td>$750.00</td>
</tr>
<tr>
<td>Salary (1 technician, business-owner @ $150 / month)</td>
<td></td>
<td>$150.00</td>
</tr>
<tr>
<td>30 days casual labour @ $3 per day</td>
<td>-</td>
<td>$90.00</td>
</tr>
<tr>
<td>Transportation to market place</td>
<td>-</td>
<td>$25.00</td>
</tr>
<tr>
<td>PROFIT AND LOSS A/C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monthly Income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 units @ $12 each</td>
<td></td>
<td>$1,200.00</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>$1,200.00</td>
</tr>
<tr>
<td>Monthly Expenditure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total costs (Materials, Salaries as above)</td>
<td>-</td>
<td>$1,015.00</td>
</tr>
<tr>
<td>Loan repayment (12 months @ 15%)</td>
<td>-</td>
<td>$97.27</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>$1,112.27</td>
</tr>
<tr>
<td>Net Profit</td>
<td></td>
<td>$87.73</td>
</tr>
</tbody>
</table>

The bulk of the investment would be working capital; it is assumed that the workshop owner already possesses the necessary tools, since the stove production does not require any specialised tools. Materials make up the biggest cost, and are relatively high compared to traditional cookstoves.

The model balance sheet below assumes that you can sell 100 stoves per month, at a sales price of US$12 (approximately KES 900, TZS 16,300 or UGX 25,000). This is a challenging target and will require active, focused marketing activity to achieve. However, as shown in Table 1, the business can be profitable even when the initial working capital loan repayments and salaries/wages are factored.
3 TECHNICAL POINTERS

The following technical pointers are included to aid the understanding of the gasifier stove concept and how such stoves could be produced.

Plans

Gasifier stoves require careful design to work properly but offer performance advantages over a traditional charcoal stove. An example of a design plan of a simple natural draft gasifier stove is shown in Figure 4. It has both inner and outer chambers. The fuel is placed in the inner chamber, called combustion chamber, which contains small holes to supply just enough air for gasification. Combustion air is channelled in the gap between outer and inner chambers.

This type of gasifier plan was developed from an original design promoted by the Appropriate Rural Technology Institute, India and is currently in use in Kenya (see Figure 1 further above).

Materials

To produce the stove pictured below you will need the following materials:

- **Outer chamber** - galvanized iron sheet gauge 28. A sheet of average weight 8 kg can produce lining for 3 stoves.
- **Inner chamber** - galvanized iron sheet gauge 26. A sheet of average weight 8 kg can produce lining for 5 stoves.
- **Stand (legs) and pot holder** - scrap metal. 2kg of scrap metal would make ‘legs’ and ‘pot holders’ for 3 stoves.

![Figure 4: Plan for Natural Draft Gasifier Stove (based on Appropriate Rural Technology Institute stove design)](image)

Design Parameters

The following parameters are critical to the performance of the stove:

- **Air flow to combustion chamber** - larger amount of airflow leads to faster rate of cooking.
- **Diameter of fuel canister** - larger diameter leads to faster rate of cooking.
- **Air flow to gasification chamber** - must be neither too large nor small for effective gasification to occur.
- **Volume of fuel canister** - a larger volume will lead to a longer cooking period.
- **Overall height of stove** – the taller the stove, the more effective is its natural draft, and also ensures that the stove burns clean.

REFERENCES

Articles


Web links for more information

General overviews of gasifier stoves:

- [http://www.bioenergylists.org/taxonomy/term/112/all](http://www.bioenergylists.org/taxonomy/term/112/all)
- [http://www.woodgas.com/cookstoves.htm](http://www.woodgas.com/cookstoves.htm)
- [http://journeytoforever.org/at_woodfire.html#woodgasstoves](http://journeytoforever.org/at_woodfire.html#woodgasstoves)

Specific stove designs or products:

- [http://www.alphaindia.co.in/wood_stove.asp](http://www.alphaindia.co.in/wood_stove.asp)
- [http://www.arti-india.org](http://www.arti-india.org)