

Alternative Cooking Solutions for Monwabisi Park



An Interactive Qualifying Project submitted to the faculty of Worcester Polytechnic Institute in partial fulfillment of the requirements for the Degree of Bachelor of Science.

ABSTRACT

The primary goal of this project was to investigate better stoves for cooking in the informal settlement of Monwabisi Park that would best satisfy the following criteria: safe, healthful, accessible, inexpensive, socially acceptable, and sustainable. We researched stoves that safely used paraffin and presented two options that best met the criteria to the community. We hope that the use of these stoves will improve the health of residents while also decreasing fire hazards throughout the settlement.

This project report is part of an ongoing research program by students of the WPI CTPC to explore and develop options for sustainable community development in the informal settlements of South Africa. For more information please go to:

<http://www.wpi-capetown.org/>

The following is an executive summary of a full project report that has been implemented as a website available at:

<http://wpi-capetown.org/projects/2009/energy/>

AUTHORS

DAVE ARNOLD
NINA BASS
AMANDA CLARK

PROJECT ADVISORS

PROFESSORS
SCOTT GIUSTO &
JOE PETRUCELLI

SPONSOR

CITY OF CAPE TOWN
ENVIRONMENTAL
RESOURCE MANAGE-
MENT DEPARTMENT



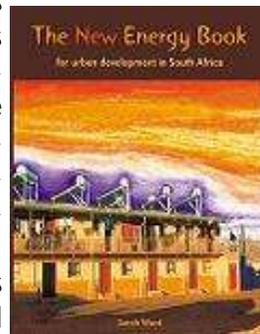
Figure 1: A fire that occurred while we were in Cape Town. It burnt down four homes.

PROBLEM STATEMENT

The residents of Monwabisi Park, an informal settlement outside of Cape Town, South Africa, commonly use unsafe paraffin stoves as a less expensive cooking alternative to electric and gas stoves. These stoves are dangerous for a number of reasons. Toxins emitted by these stoves are at unsafe levels and lead to respiratory illnesses. Additionally, when paraffin is sold, it is poured into unmarked recycled soda bottles that children can accidentally ingest. The primary concern of residents in Monwabisi Park, however, is the fire hazard associated with unsafe flame stoves. These paraffin stoves can be knocked over easily, causing them to blow up and start fires that spread easily due to the close proximity of the homes and

the building materials used. According to UNICEF, burns are the fourth highest cause of death in children under fourteen in South Africa (Ward, 2008). It is clear that there are serious problems with the current cooking techniques and a new system must be established.

Efforts have been made in the past to provide the residents of Monwabisi Park (as well as other informal settlements in the area) healthier and safer ways to cook. In an attempt to draw residents of informal settlements away from the use of paraffin, the government tried to make gas more accessible (Eskom). This attempt was not well received because the gas containers were difficult to transport (Jacobs, 2009). Others have suggested sustainable cooking options such as hot boxes and solar cookers (Ward, 2008). Another study completed in 2008



According to UNICEF, burns are the fourth highest cause of death in children under fourteen in South Africa (Ward, 2008).

by a group of students from Worcester Polytechnic Institute (WPI), in Monwabisi

Park collected useful data on existing conditions in energy usage in heating and cooking, but left much to explore specifically regarding cooking (Kehrer *et al.*, 2008).

While these past studies, along with many others, outline the problem well and begin to offer solutions, they have fallen short of making long-lasting improvements. The problem of using unsafe, inefficient cooking practices still persists in informal settlements, specifically in Monwabisi Park, despite these previous efforts.

METHODOLOGY

MISSION AND OBJECTIVES

The primary goal of this project was to offer a better means of cooking for the existing and new housing in Monwabisi Park, South Africa that will best satisfy the following criteria: safe, healthful, accessible, inexpensive, socially acceptable, and sustainable. We also looked to teach members of the community ways to reduce energy consumption that would better their health and safety with respect to energy use. Our objectives were as follows:

- ◆ Understand the existing energy practices in Monwabisi Park.
- ◆ Plan and design sustainable and healthful alternatives to current cooking methods.
- ◆ Test and present the new alternatives to the community for feed-

back.

- ◆ Develop a plan for making these alternatives available to the community.

In order to accomplish our objectives, we followed a methodology of researching, testing in the community, and giving recommendations. First we worked with some residents of Monwabisi Park to help us interact with the community. The information we learned through interviews helped us determine our course of action which narrowed down our scope to finding a safe way to cook with paraffin. We then tested the options we discovered through research and presented the ideas to the community.

CO-RESEARCHERS

A co-researcher program was established to help accomplish **the entire project center's goals in 2008 and continued in 2009.** The



Figure 2: Siya, a co-researcher, lighting a safe stove.

co-researchers were residents of Monwabisi Park that spoke English as well as Xhosa, their native language. This was a crucial skill that allowed us to interact and communicate with other people in the community. Through this program, our team was able to work closely with one co-researcher in particular, named Siya Magada, who was vital component of our project.

INTERVIEWS

During our first week in Monwabisi Park, Siya helped us interview ten residents who cooked with paraffin, electric, and gas stoves in order to learn more about each stove and its use. We asked them how much it cost to cook with each of their stoves (both what the stove itself cost and its fuel for regular use), what they typically cooked and how long it took them to make it, and if they had any concerns with their current stoves. We also asked them about their home heating. We formed a personal relationship early on with Siya and he took a specific interest in our project, which made the interview process much easier.

NARROWING OUR FOCUS

After conducting interviews and surveys in the community, we determined that it would be most useful for us to focus on cooking practices. Originally our focus included home heating, but after speaking with members of the community, we soon realized that cook-

ing was a larger concern. Ultimately, we decided to look more into safe paraffin stoves since paraffin fuel is affordable and readily available in Monwabisi Park.

We formed a personal relationship early on with Siya and he took a specific interest in our project, which made the interview process much easier.

SAFE PARAFFIN STOVES

Then we contacted various stove companies, specifically one called Arivi, which made safe flame stoves. Arivi sent us a prototype of one such stove to test and present to the residents of Monwabisi Park. We distributed the Arivi Safe Paraffin Stove to eight randomly-selected residents throughout the park for overnight testing. Along with the stove, we gave each participant a questionnaire regarding their experience with the stove to understand



Figure 3: The Arivi Safe Paraffin Stove

their individual thoughts. All surveys were completed, and one liter of paraffin was given to each resident in return.

We also found a safe primus stove that was manufactured by a company called ParaSafe. The ParaSafe Stove had similar safety features to the Arivi stove, so we decided to first compare the two. We first compared the ease of lighting each stove, then boiled one liter of water in pots of the same size on the



Arivi and ParaSafe Stoves side-by-side. We noticed that they boiled the water at roughly the same amount of time. Then we presented both of the stoves to the community to gauge the community's perspectives on them.

COOKING PROFILE

Next we conducted a week-long cooking survey that profiled ten randomly-selected families using different types of stoves (four that used flame stoves, three that used a primus stove, two that used a gas stove, and one that used an electric stove). In this survey, we asked people to record the amount of paraffin they bought throughout the week as well as how long they used their stove each time they cooked a meal. This "cooking pro-

file" helped us better see how much money residents actually spend on cooking every week so that we could evaluate energy costs and potential savings. Figures in Table 1 are a summary of results from our week-long cooking survey.

Typical Meal	Average Time Cooked (Hours)
African Salad	1.30
Baked Bread	2.50
Meat	1.00
Pap	0.5
Porridge	0.75
Rice	0.61
Samp	3.17
Steamed Bread	2.75

Table 1: Cooking Time for Typical Meals
*based on a survey of 6 homes.



Figure 5: Pap cooked on the Arivi Stove



Figure 6: Presenting to the Community

PRESENTATIONS

Lastly, we presented the Arivi and ParaSafe stoves to the community at two local store owners' shops. Using Siya as a translator, we explained who we were, demonstrated the use of each stove as well as their safety features, and boiled water to demonstrate the efficiency of the stoves. During the presentation, we were able to answer any questions that residents had and learned about their concerns. The presentations were successful; they stimulated interest in the safer stoves and we received great feedback, and even gratitude, from the observers.

RESULTS AND DISCUSSION

EVALUATION OF SOURCES

The main sources of energy available in Monwabisi Park are electricity, liquefied petroleum gas, and paraffin. Over half of the

population in C section has access to electricity.

After speaking with our sponsors Jacques de Toit and Cindy Jacobs during the first week, we discovered that prices for electricity have been rising at an increasing rate, which causes serious concerns for the future of electricity in the settlement (Jacobs, 2009). Of the residents we spoke to who had access to the grid, most avoided using electric stoves because they wanted to save electricity to use for other appliances.

Gas is also available to people in C section, but it is difficult for residents to purchase because they often spend money day-by-day rather than accumulating enough money to buy a gas canister refill.

The only gas store in C section refills a tank of gas for R82, which can last from two weeks to a month depending on usage (Interview with Store Owner, 2009).

Paraffin is the least expensive fuel to buy at a time in Monwabisi Park; it is sold for R6.50 per liter in stores throughout the settlement.

As shown in Table 2, using paraffin at an average of six liters every week costs the same or even more than using gas even though it is less expensive to buy at one time. There are still misconceptions in the community

around the cost of gas which are difficult to change, especially when the cost of a gas stove itself is usually more than residents can afford to buy.

COMPARING STOVES

Currently, unsafe flame stoves cost between R60 and R70 whereas the safe stoves we found would cost between R150 and R200. Though the safe alternatives are more expensive, we found that most residents are very interested in purchasing the stoves we presented because they are much safer than what they are currently using. When lifted or tilted, the stoves self-extinguish. They are also more efficient than the unsafe stoves, so residents will buy less paraffin every week. By comparing how much is spent per week on current stoves to what would be spent with the safe stoves, we estimated that it would only take about ten or eleven weeks for the Arivi Stove to pay for itself.

By calculating how much energy is in paraffin fuel and hav-

	Paraffin	Gas
Cost	R6.50/Liter	R82/ refill
Quantities	5-7 Liters per week	1 tank lasts 2-4 weeks
Average Cost/week	R42	R21-41

Table 2: Fuel Cost Analysis

Stove	Cost (R) / BTU
Flame Stove	4.556×10^{-4}
ParaSafe Stove	3.254×10^{-4}
Arivi Stove	3.037×10^{-4}

Table 3: Cost Analysis of Paraffin Stoves

ing knowledge on the efficiencies of the paraffin stoves, we were able to complete a cost analysis of the different paraffin stoves, as shown in Table 3. From a phone call with a representative from Arivi, we learned that the current flame stoves are approximately forty percent efficient and that the Arivi Safe Paraffin Stove is sixty percent efficient. Meanwhile, the ParaSafe Stove is advertised to be forty percent more efficient than the current stoves.

As Table 3 clearly shows, use of a flame stove is the most expensive because it is not very efficient. The Arivi Stove is the most efficient, so it will have a much smaller operating cost – allowing residents in Monwabisi Park to save about thirty-two percent of money spent on paraffin!

It will be very helpful for the residents to have an opportunity to save money, especially when money saved is from a resource that they use daily. Money would not be spent on healing injuries and illnesses resulting from unsafe paraf-

Stove	Price (R)	Speed of Boiling	Safety	Maintenance	Other Comments
Current Flame	50-70	More than 20 minutes to boil 1L of water	-unstable -unsafe level of emissions	-easy maintenance	-Dangerous on windy days -Food tastes like paraffin
Current Primus	150	11 minutes to boil 1L of water	-no safety shut off -unsafe level of emissions	-parts hard to find	-less commonly used -have to tend to it to adjust pressure
Arivi Flame	200	11 minutes to boil 1L of water	-Self shutoff -low emissions	-has warranty -can be cleaned out	-longer to ignite -most stable and attractive -does not need to be watched -could heat room
ParaSafe Primus	Similar to current primus	7 minutes to boil 1L of water	-Self shutoff -low emissions	-many parts	-have to hand pump it to maintain the pressure -easy to light

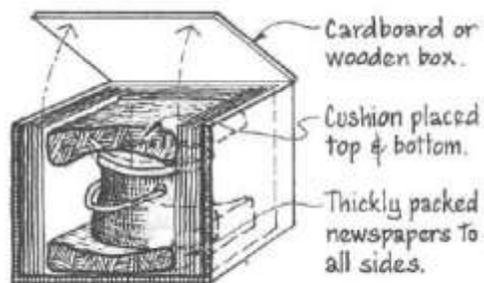
Table 4: Paraffin Stove Comparison

fin stoves. Once a safe stove has paid itself off, the savings of the residents will begin to accumulate.

Another in-depth comparison of the ParaSafe, Arivi, and current paraffin stoves can be found in Table 4.

Table 4 shows that there are benefits and drawbacks to each type of stove. The biggest draw-

backs to the Arivi and ParaSafe Stoves are their prices and possible maintenance problems, while the biggest drawbacks with the current stoves are their low efficiency and dangerousness. We, as well as most of the people we interviewed in Monwabisi Park, agree that safety outweighs the cost of the stoves, especially when the efficiency of the safer options will make them much more affordable over time.



How to make a hotbox

Figure 7: How to Make a Hot Box (Ward, 2008)

THE HOT BOX

In addition to looking at safe paraffin stoves, we also looked into sustainable options for reducing cooking energy use that could be easily made using materials found in the settlement. One option for decreasing energy con-

sumption is to teach members of the community how to make a hot box. A hot box is a well-insulated box that continues to cook food after the food has been heated on a stove. This method would save fuel because the stove **wouldn't be used** for as long, saving money. The original idea

for constructing the hot box was taken from Sarah Ward's book, The New Energy Book, although we did tweak it to match the resources available in the park.

The hot box we made used: a cardboard box, recycled newspaper, a towel, and a bag used for the sandbags for construction of eco-beam sandbag structures. We stuffed newspaper into the bag to use as a pillow to put on top of the pot that is placed in the hot box. To test it, we brought two and half cups of water to a boil with a cup of rice and let it simmer for five minutes on low heat after. Immediately following the five minutes, we put the pot into the hot box. After forty five minutes the rice was cooked, and after five hours in the hot box,

...the biggest problem holding residents back from using safer methods is due to the prices of those options.

the rice was still steaming. After testing the hot box we discovered that this design is successful in cooking food after it is first heated on a stove.

CONCLUSIONS AND RECOMMENDATIONS

Through interviews and research, we can confidently conclude that most residents are aware of the dangers associated with using paraffin flame stoves, and that the biggest problem holding residents

back from using safer methods is due to the prices of those options. In order for a new technology to be widely accepted and be sustainable, it must be low cost;

funding or finding a way to finance the safer methods is critical. Currently paraffin is the most convenient fuel for residents to buy be-



Figure 8: Answering questions about the stoves.

cause most have trouble accumulating the R82 needed to refill a gas canister. Consequently, it is the most common fuel used throughout Monwabisi Park.

HOT BOXES

We recommend the use of hot boxes to save money on fuel and decrease the risks of using unsafe stoves. This is a simple solution since it can be made out of materials easily found in the settlement; the unsafe stoves would not be used as much, reducing health and safety risks, and there would be no initial cost, thus residents will immediately begin to save money.

STICKERS

Though we cannot stop people from using paraffin, there are ways that we can make using paraffin safer. First, we recommend that when buying paraffin, stickers be placed on a container to clearly show that the liquid inside is hazardous. This should dramatically decrease the risk of children accidentally swallowing paraffin. We also highly recommend that safe paraffin stoves be used in the settlement.

IMPLEMENTATION

The next step is to make the safe stoves available in Monwabisi

Park. This can be accomplished in a few different ways. One approach is to work closely with the City of Cape Town to try to provide stoves to a number of people in the settlement. This would only be a start, since it would not establish ongoing sale of stoves. However this would serve as a meaningful trial run for the stoves in an informal settlement.

Another approach would be through the cash stores in the community. If twenty to thirty stoves were distributed to three or four different stores in the settlement, then the stoves would be more accessible to the community. The main problems associated with this



Figure 10: Buying a Liter of Paraffin at a cash store.

approach would potentially be the reluctance of the stove companies to sell their product at stores in the settlement as well as the inability of storeowners to afford or even fit twenty to thirty stoves in their storage areas.

These are all options that would need to be looked into further before deciding on stove distribution.

SAFE PARAFFIN STOVES



Figure 9: Arivi Safe Paraffin Stove (left), ParaSafe Primus (right)

There are two stoves we researched that best met our criteria that we would suggest: the Arivi Safe Paraffin Stove and ParaSafe Primus Stove. Both of these stoves decrease fire risks since they self extinguish when lifted or tilted. The emissions from these stoves are also safe and will not cause respiratory illnesses. After presenting these options to the community, we have received positive feedback and interest in both, and therefore believe that both can be successfully implemented within the settlement.



Figure 11: The only gas store in C section.

References

Arivi, 2009. *The Safe Economical Stove*. From <<http://www.myarivi.com>>

Cape Town Project Center of WPI (2008). *Envisioning Endlovini — Options for Redevelopment in Monwabisi Park, Cape Town, South Africa* (1st ed.). Worcester, MA: Worcester Polytechnic Institute. Retrieved from <<http://www.wpi-capetown.org/Atlas.pdf>>

Jacobs, Cindy. Personal Interview. 18 September 2009.

ParaSafe. *Completely Safe Paraffin Stoves*. Promethea Corporation, 2008. From <http://www.promethea.biz/parasafe_index.html>

Ward, S. (2008). *The New Energy Book for Urban Development in South Africa*. South Africa: Sustainable Energy Africa.

