Energy Profiling for Off-Grid Energization Solutions in Namibia

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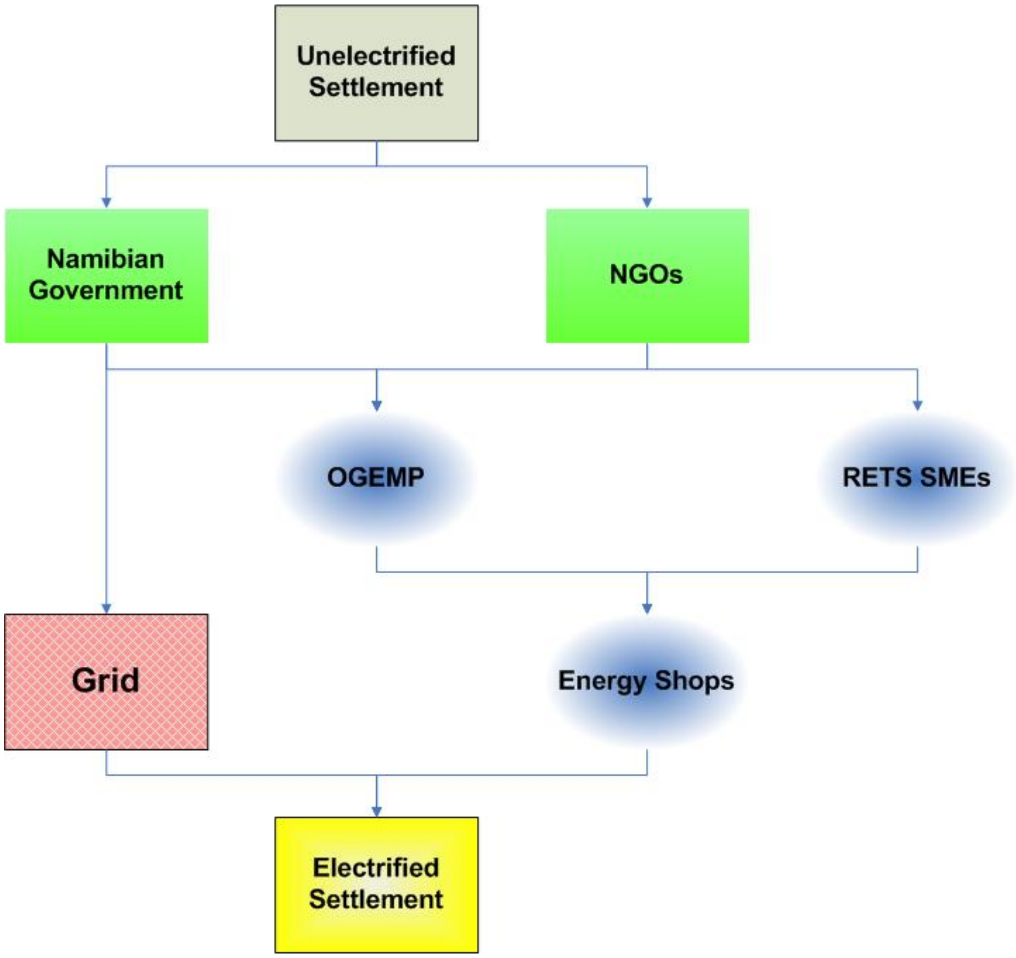
EXECUTIVE SUMMARY

In Namibia, more than two out of three people live without electricity (Ministry of Mines and Energy & NamPower, 2000). Over the next 20 years, approximately 3800 communities will remain unconnected to the grid. In order to provide basic energy services to these communities, the Namibian government plans to help subsidize entrepreneurial ventures selling energy fuels and services called energy shops within these communities (Ministry of Mines and Energy & Namibia Renewable Energy Programme, 2007). The Desert Research Foundation of Namibia (DRFN) is testing the concept of these energy shops by assessing the feasibility of introducing renewable energy technology and services (RETS) into existing and prospective small and medium enterprises (SMEs). To perform a proper market analysis for the introduction of RETS, an entrepreneur must assess the current energy usage and services within an unelectrified community and the available energy technology.

Rural energization is a global problem that has enormous ramifications in Namibia. While only 12% of the rural population and 34% of the entire population has access to electricity (Rural Electricity Distribution Master Plan [REDMP], 2000), the Namibian government has promised access to basic energy for all of its citizens (http://www.mme.gov.na). For most countries, conventional grid electricity can be used to provide these services. However, due to Namibia's considerable size and low population density, this option is economically infeasible for both the consumer and supplier. In addition, the country is not able to produce the amount of electricity necessary to provide power to all of its citizens on the grid. In order to compensate for these critical problems, the government has developed the Off-Grid Energisation Master Plan (OGEMP). The OGEMP outlines an alternative energy distribution plan centering on the concept of individually-owned, institutionally-regulated energy shops to provide accessible and affordable energy to communities. Figure 1 illustrates the Namibian electrification plan. These energy shops would provide basic energy fuels

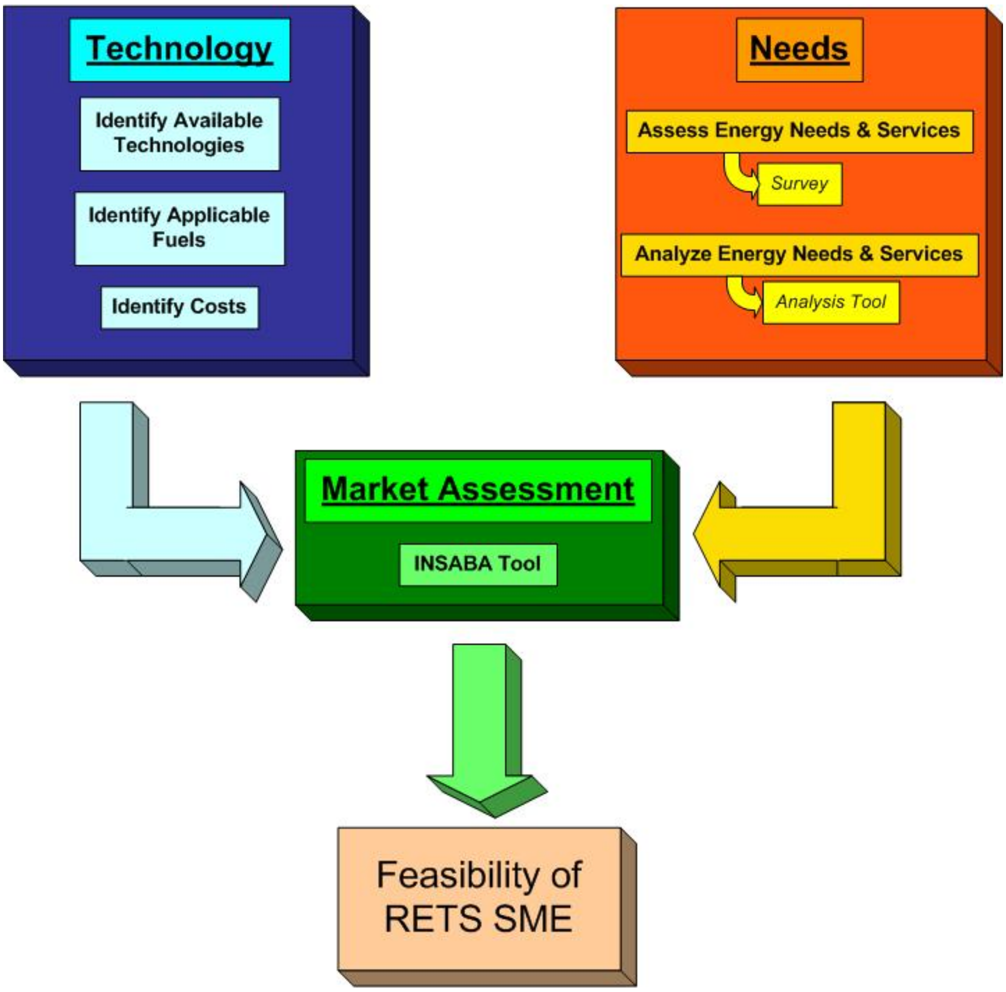
and services to unelectrified areas throughout rural Namibia. Energy services would include charging cell phones or 12V lead-acid batteries while wood, bio-diesel, and ethanol gel could be provided for fuel. The shop is also envisioned to allow customers to purchase solar photovoltaic (PV) arrays through multiyear loans (OGEMP, 2007). Through a wide variety of products and services, these shops would be able to provide for the energy needs of the community.

Figure 1: Namibian Electrification Overview



In order to prove the feasibility of the energy shop concept, the DRFN is testing the introduction of RETS into existing and prospective SMEs. To determine if there is a market for RETS, the needs of the community and available technologies must be identified (Figure 2). It is envisioned by the DRFN that a prospective entrepreneur will receive an energy assessment survey from a SME support organization (SMESO), administer the survey within his community and bring the data back to the SMESO. The SMESO will analyze the surveys using an analysis tool and provide recommendations to the individual as to what products and services he could offer. Using this counseling, the entrepreneur would then be able to start up his own RETS SME. This will lead to a business providing basic energy services to the community and income generation to the entrepreneur, while not taxing the monetary resources of the government.

Figure 2: Process to Prove RETS SME Feasibility



The goal of this project was to fulfill one half of the knowledge necessary to complete the market assessment, which was the needs portion of the assessment. From this goal, two research objectives were created:

1. Determine the current energy usage and services within Havana, an informal settlement on the outskirts of Windhoek, Namibia.
2. Analyze the data gathered by the survey to identify potential markets in Havana for possible renewable energy technology and services (RETS).

Furthermore, we conducted an initial investigation of available renewable energy technology which could meet the energy needs of Havana. Using this data, we performed a basic market analysis using the INSABA tool to test the feasibility of two prototype RETS SMEs.

The EPOGES Toolkit

To meet these research objectives we created the Energy Profiling for Off-Grid Energization Solutions (EPOGES) Toolkit, which consists of an energy assessment survey and a data analysis tool. The energy assessment survey was created to be nationally applicable and administrable by an entrepreneur showing due diligence. The data analysis tool was developed to be accessible to SMESOs with little required training to provide accurate compilation and analysis of the survey results. By providing these tools, entrepreneurs will be able to supply their communities with the energy fuels and services they require while introducing sustainable renewable energy as a viable alternative to currently used fuels.

The survey was developed using a cyclical process. We began by conducting situational research in the settlement of Havana to produce qualitative data on the current energy fuels and services used in the area. We chose to work in Havana because the DRFN had previously worked with an entrepreneur in the settlement to create a solar cell phone charging shop. Following the informal assessment of this settlement, we conducted interviews with experienced surveyors. Finally, we analyzed similar energy surveys from NamPower, the electrical utility company in Namibia, as well as the EnPower Toolkit, an energy survey and analysis tool that is too complex for an entrepreneur to use without extensive training. After developing a working draft of the survey, we began testing the survey. We tested the survey on several students at the Polytechnic of Namibia (PoN) as well as discussed it with an entrepreneur in Havana. Once pre-testing was completed, we conducted 50 surveys within the Havana community. These were completed by two teams of two students and a translator. We made revisions to the survey throughout this process based on our observations and feedback received during the testing.

With the data collected, we began developing the data analysis tool. We used Microsoft Access for data entry because it allowed fast, accurate compilation of a database. We then exported the data from Access into Microsoft Excel. We built the entry forms within Access so that they closely resembled the actual survey. Finally, the analysis in Excel was completed by interviewing individuals at the DRFN to determine useful statistics. Microsoft Office programs were chosen because they were widely used by SMESOs.

In order to determine the credibility and applicability of the EPOGES Toolkit, we cross-checked the data we gathered from Havana and interviewed several SMESOs. To prove the credibility of the data collected by the survey, we chose the most widely used fuel and cross-checked the average amount used, as reported by our analysis tool, with the results of the EnPower survey. We also cross-checked the average price the analysis tool generated with that of local stores. To determine the applicability of the toolkit, we interviewed several SMESOs to find out if they will be able to use the toolkit. We also trained a native speaker to deliver the survey and then had him conduct the survey to ensure that it was easily administrable.

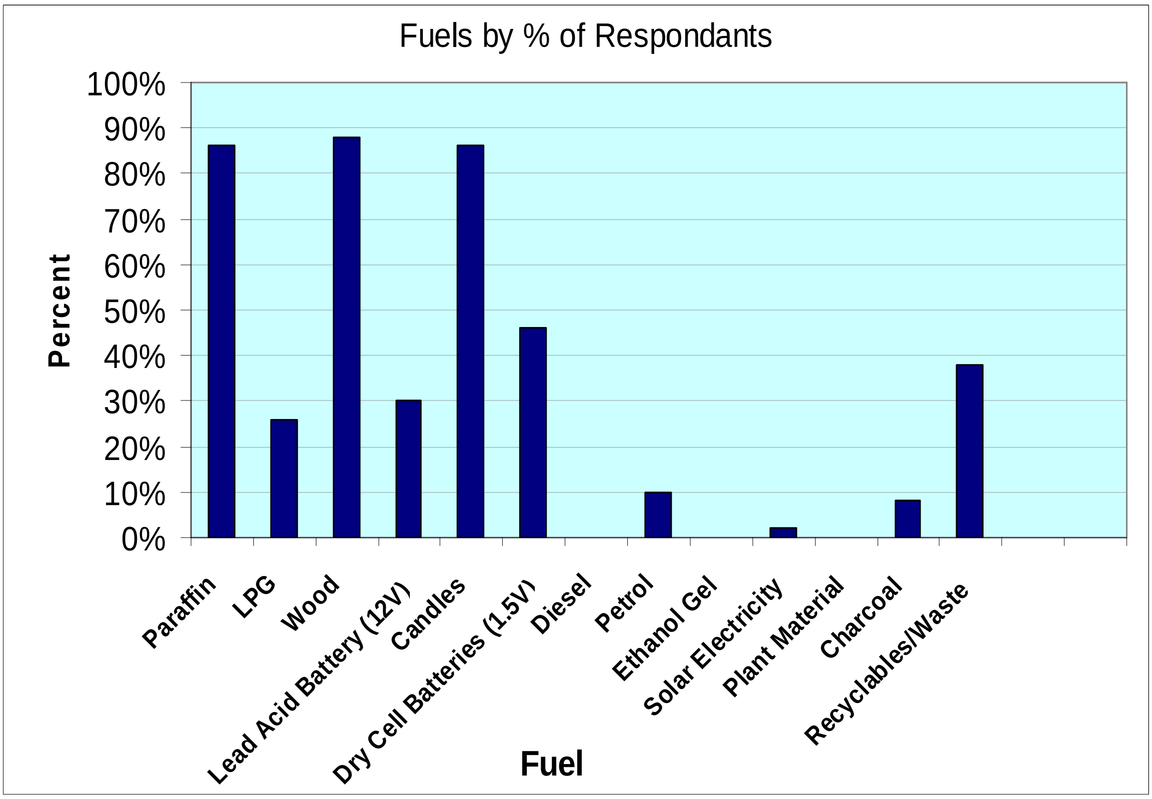
Results & Recommendations

After gathering our data and analyzing the results, we developed a number of conclusions and recommendations. These included the market potential for the introduction of RETS as well as some recommendations for possible businesses. More research needs to be conducted on RETS pricing, availability, and potential to determine their feasibility within Namibia. The EPOGES Toolkit, however, allowed us to determine what energy fuels and services to focus on to provide alternatives.

From our data we determined the following:

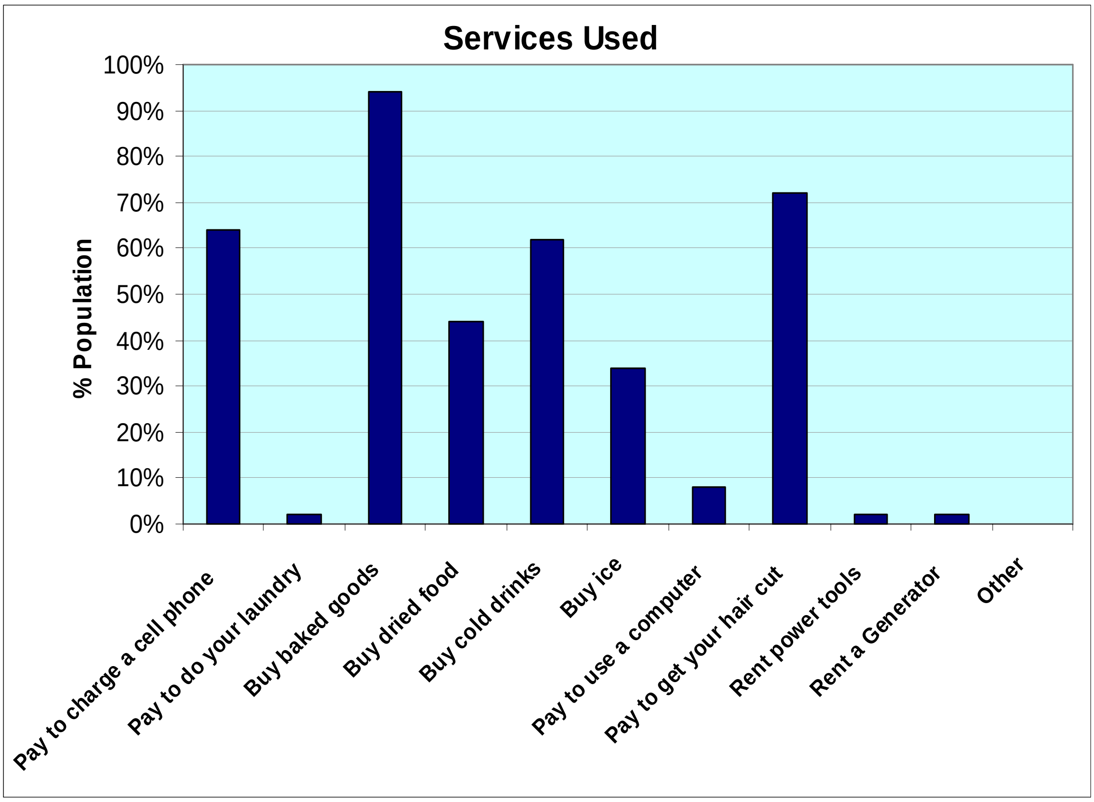
- Average home energy costs per month were:
  - N$212 for energy
  - N$290 for services
  - N$499 total (N$659 including travel – e.g. taxis)
- Average home business costs per month were:
  - N$298 for energy
  - N$320 for services
  - N$717 total (N$925 including travel)
- Most common fuels were paraffin, wood, and candles (Figure 3)
  - Typically used for cooking and lighting

Figure 3: Energy Fuels Used in Havana



- Some potential alternatives include:
  - Bio-diesel (paraffin alternative for cooking and lighting) can be used in existing lamps and stoves
  - Ethanol Gel (alternative for cooking)
    - Inexpensive at N$1.60 for 1L
    - New stove or lamp is required
  - Photovoltaic lantern (replacement for candles and lamps)
    - Could be paid off over time, typical expenditure on candles is N$45 per month
- Most common services were haircutting, buying bread, and charging cell phones (Figure 4)

Figure 4: Energy Services Used in Havana



- Potential alternatives include:
    - Solar haircutting
        - Currently done far away from the unelectrified settlement and often taxis are used for travel, compounding the cost
        - Men get haircuts 2-3 times per month at a cost of over N$20 on average
        - Service can be offered as an add-on to existing services from a PV array, initial cost for an inverter and clippers is about N$450
    - Solar battery charging
        - Lead acid (12V) car batteries and cell phones are commonly used
        - Charging often requires transportation to on-grid areas
        - Cell phones are charged on average 6-7 times per month at a cost of N$5.50
        - Lead acid batteries are charged on average about once per month at a cost of N$17
- INSABA Market Analysis
    - Solar cell phone charging and haircutting
        - Payoff – 16 months
        - Profit per month after payoff – N$380
    - Solar cell phone charging, haircutting, 12 volt battery charging
        - Payoff – 2 years
        - Profit per month after payoff – N$1500

To validate the credibility of our data, we cross-checked the amount used and the price of the most common fuel used within the settlement. Paraffin (kerosene) was found to be the most common energy fuel within Havana with approximately 85% of the community utilizing this fuel for lighting and cooking. We determined from our survey that the average monthly usage of paraffin was 16.4 liters per household at a price of N$6.14 per liter. We compared this figured with that produced by the EnPower survey, which was conducted in a settlement near Havana a few years earlier. The EnPower survey found that the average usage of paraffin within that community was 16.7 liters per month per household, a difference of 1.8% from our findings. To cross-check the price of paraffin, we visited stores within the community and in a nearby town to determine pricing of paraffin. We found that within the settlement, paraffin was sold at N$6.50 per liter, while in town it was sold for N$6.15 per liter. These figures are close to the average selling price that our survey determined. This verification allowed us to ascertain that our EPOGES Toolkit was reasonably unbiased and could provide accurate information.

Lastly, we assessed the applicability of the EPOGES Toolkit by interviewing several SMESOs. We met with SMEs Compete and the Joint Consultative Counsel (JCC), two SMESOs within the Windhoek area. After explaining our project and showing the SMESOs our toolkit, we received feedback on the EPOGES Toolkit. We discovered that most SMESOs use Microsoft Access and Excel regularly. Since our analysis tool was based on these programs, the organizations would be able to use them and alter them to cater to their needs. We also ascertained that our toolkit provided the SMESOs with the information necessary for the needs assessment portion of a market analysis. Our final determination was that our toolkit was useful and provided the needed data.

While we have outlined some possible RETS that could be introduced within Havana, further analysis needs to be done to provide prospective entrepreneurs with a complete list of RETS options. The cost of replacement fuels, startup materials needed to provide certain services, as well as identifying potential suppliers needs to be taken into account when introducing RETS into SMEs. Our project provided the needs assessment portion of the market analysis. The recommendations presented must be further evaluated before introduction in a RETS SME.

A full copy of this report can be obtained by contacting Robert Schultz at the Desert Research Foundation of Namibia.

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Energy Profiling for Off-Grid Energization Solutions in Namibia

An Interactive Qualifying Project Report
submitted to the Faculty of
WORCESTER POLYTECHNIC INSTITUTE
in partial fulfillment of the requirements for the
Degree of Bachelor of Science
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Report Submitted to:
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Robert Schultz & The Desert Research Foundation of Namibia

ABSTRACT

In Namibia, over 3800 unelectrified settlements will not receive grid power for 20 years. The Namibian government has proposed the implementation of privately-owned, institutionally-regulated renewable energy businesses to help provide energy services to these areas. The EPOGES toolkit, prepared for the Desert Research Foundation of Namibia, allows an entrepreneur to assess the market in an unelectrified area for the introduction of a renewable energy business. These businesses will provide income generation and accessible energy services to unelectrified communities.

AUTHORSHIP

Jason Frey - Jason contributed greatly to the Introduction section and wrote the Background section of the paper. He served as the main editor for all drafts, editing all sections before they were compiled into the paper. In addition, he discussed the survey with the entrepreneur in Havana and conducted several surveys within the Havana community. Finally, he composed and edited all of the presentations.

Ryan Kendrick - Ryan developed the Abstract, Introduction, and Results sections of the paper. He also wrote the initial drafts of Appendices K and L which outlined the interviews that he and John performed with the SMESOs. Along with John, he administered the pilot surveys to Polytechnic of Namibia students and most of the surveys in Havana. Ryan and John also developed the data analysis tool and the corresponding section of the user manual.

Jodi Lowell – Jodi wrote the initial draft of the Methodology section and developed the energy assessment survey with John. She also wrote the first section of the user manual, compiled the report, managed the bibliography, and formatted the report. She also aided Jason in editing the drafts of the paper. Finally, she discussed the survey with the entrepreneur in Havana along with Jason, and tested the data analysis tool and user manual on students from the Worcester Polytechnic Institute.

John Rothermel - John, along with Jodi, wrote the initial draft of the Methodology and Results sections as well as the case studies found in Appendices H and I. In addition, he contributed to the editing of the Results and Recommendations sections. He also administered pilot surveys to Polytechnic of Namibia students with Ryan and completed most of the surveys in Havana. Finally, he contributed to the development of the data analysis tool and the corresponding section of the user manual.

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- Finally, students at the Polytechnic of Namibia, Joint Consultative Council and SMEs Compete who provided feedback on the EPOGES toolkit.

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ABBREVIATIONS

DFID	Department for International Development
DRFN	Desert Research Foundation of Namibia
ECB	Electricity Control Board
EPOGES	Energy Profiling for Off-Grid Energization Solutions
INSABA	Integrated Southern Africa Business Advisory
JCC	Joint Consultative Council
LPG	Liquid propane gas
MME	Ministry of Mines and Energy
NGO	Non-Governmental Organization
OGEMP	Off-Grid Energisation Master Plan
PoN	Polytechnic of Namibia
PV	Photovoltaic
REDMP	Rural Electricity Distribution Master Plan
RETS	Renewable Energy Technology and Services
SCPC	Solar cell phone charging
SME	Small and Medium Enterprise
SMESO	Small and Medium Enterprise support organization
UNDP	United Nations Development Programme
WPI	Worcester Polytechnic Institute

1.0 INTRODUCTION

One in three people throughout the world live without electricity (www.enersol.org). Most of these people live in rural areas, far from the existing electrical infrastructure. For many countries, it is difficult to fund electrical grid expansion. In addition, many countries do no have the energy production facilities to meet the increasing demands for electricity. This is a global concern since electricity plays a vital role in modernization on both the micro and macro scale. On the micro scale, electrification provides lighting and heating to families and schools, as well as powers medical equipment in rural clinics; on a macro scale, it allows for the creation of modern industry. This modernization is necessary to improve quality of life for people in developing countries.

Namibia is one country that is greatly affected by both a strained electrical infrastructure and a large percentage of unelectrified areas. As the country rebuilds itself after more than a half century under apartheid rule, the national electrical grid has not been able to meet the demands of its growing customer base as Namibia still buys almost half of its energy from South Africa. Problems in electricity production and distribution have been compounded by limited financial resources. It has been projected that over 3800 unelectrified settlements will remain unconnected to the national electricity grid during the next 20 years. If action is not taken to provide an alternative energy infrastructure, then the residents of unelectrified settlements will continue to miss the personal and business opportunities afforded by electrification and modernization.

To address the short-comings of the current electrical infrastructure, the Namibian government has worked in conjunction with non-governmental organizations (NGOs) to formulate an alternative to grid power. The proposed Off-Grid Energisation Master Plan (OGEMP) promotes the development of small entrepreneurial ventures to provide renewable energy technology and services (RETS) to unelectrified communities. Since many residents of rural areas do not have the financial means to purchase renewable energy technology, these shops would offer RETS products while providing access to financial loans necessary for purchasing the technology. These shops would be privately owned, but would be coordinated and supported by a central coordinating body.

The development of RETS to meet the needs of unelectrified locations in Namibia is a logical solution to the electrification problem because of the environmental benefits, long-term sustainability of RETS, and the increasing scarcity of fossil fuels. According to Ward (2002), "the cost per kWh [for solar energy] is less than nuclear power" (p. 13) and the cost of RETS will continue to decrease as the technologies are refined. Also, the use of RETS will not increase the amount of pollution generated by fossil fuels and nuclear power. The acceptance of RETS within rural communities can also help fight deforestation by decreasing communities' dependence on wood as a primary fuel. RETS provide sustainable energy production in countries lacking conventional fuels while promoting environmentally friendly practices and business development opportunities.

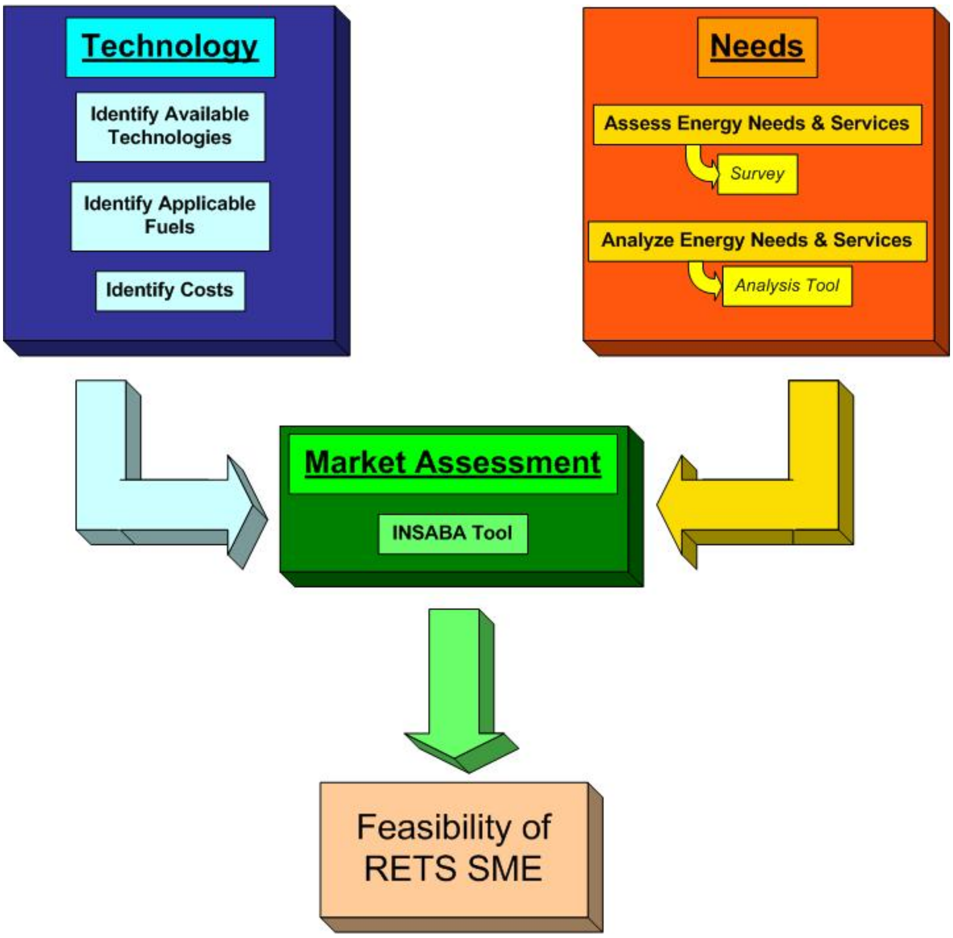
Of the renewable energy technologies which could be offered in Namibia, solar energy has the greatest potential due to the native climate: the solar exposure and intensity per day in Namibia are among the highest in the world, and averages between 5 and 6 kWh per square meter per day (Ward, 2002). According to Yaron, Irving and Jansson, (1994) solar energy is the most cost effective, long-term energy technology for Namibia. It is also a cleaner and safer alternative to a large grid infrastructure based on conventional fossil fuels. Photovoltaic (PV) arrays, a technology which converts solar energy to electricity, are capable of supplying power for basic lighting and entertainment purposes at a lesser cost in the long term than many alternatives (Yaron et al., 1994). On the other hand, there are some limitations to solar technology. PV arrays have a high initial cost which hinders usage, especially in lower income areas. Also, current PV arrays are not cost-effective for providing electricity on a large scale. This makes the use of PV arrays unrealistic for large industrial projects. In view of these advantages and disadvantages, the Namibian government has recognized the benefits of solar technology and has focused on using only solar products to meet the energy needs of rural areas through the OGEMP.

In order to test the feasibility of the energy shops proposed by the OGEMP, the Desert Research Foundation of Namibia (DRFN) is piloting small and medium enterprises (SMEs) offering RETS. There are many SMEs established in Namibia, ranging from cuca shops and shebeens, convenience stores and bars respectively, found in many informal settlements to larger manufacturing firms. As cuca shops and shebeens are abundant in informal settlements lacking electricity around Windhoek, they have been the focus of introducing RETS into established businesses. If the

DRFN can prove the feasibility of a RETS SME as a sustainable business venture, then the Namibian government can use a similar plan for the national introduction of energy shops as an alternative to grid power.

To determine the feasibility of RETS SMEs within individual locations, a complete market assessment must be conducted (Figure 5).

Figure 5: Process to Determine RETS SME Feasibility



As proposed, this proof of concept requires two major evaluations: those of current energy needs (orange box) and of available renewable energy technologies (blue box). The energy needs within a community can be determined through an energy needs survey and an analysis tool that compiles the results of the survey. The second evaluation of available technologies can be completed by a coordinating body. The results of these two evaluations can then be combined through the Integrated South African Business Advisory (INSABA) Tool to produce the overall energy market assessment. This market assessment can then indicate whether the RETS SME is feasible within the entrepreneur's specific community.

Before this project, there was neither a standardized energy needs and services assessment survey for an unelectrified community nor an analysis tool designed to summarize such a survey built specifically for use by entrepreneurs. These two tools had to be developed in order to provide accurate data on the energy needs of rural communities so that the coordinating body could match appropriate RETS to specific communities. Without this information, the coordinating body would have to make uninformed decisions concerning which RETS would be introduced into a community. Without accurate data from the community, there is a greater chance of rejection of the new technology.

To fulfill the need for accurate energy usage data, our project goal was to enable prospective entrepreneurs to assess and analyze the energy needs and services in an unelectrified settlement. To achieve this, we completed the following objectives:

1. Determine the current energy usage and services within Havana, an informal settlement on the outskirts of Windhoek, Namibia.
2. Analyze the data gathered by the survey to identify the potential market in Havana for possible renewable energy technology and services (RETS).

In order to meet these objectives, we developed the Energy Profiling for Off-Grid Energization Solutions (EPOGES) Toolkit, consisting of an energy assessment survey and a data analysis tool. This toolkit will be used by future entrepreneurs and SME support organizations (SMESOs) to investigate the market for RETS SMEs in unelectrified settlements throughout Namibia. In our recommendations, we used the results generated by our toolkit and performed an initial investigation into available renewable energy technologies that could meet the needs of Havana. We also took the next step in the DRFN's process by using the results from our energy needs and renewable energy technologies assessment as well as the INSABA tool to perform a market analysis for two potential businesses. The results of these analyses are detailed in Appendix I: Case Study for Solar Cell Phone Charging and Haircutting and Appendix J: Case Study for Small SME Using Energy Basket 15 from the OGEMP.

In summary, rural electrification is not a problem specific to Namibia; it is a global problem. Without electricity, many rural localities will not be able to enjoy the personal opportunities and economic development which electrification can foster. Namibia is one country tackling the problem through a two-pronged approach: providing grid electricity from the public sector where economically feasible while utilizing the private sector to introduce renewable energy technologies and services in other locations. Since the government lacks funding for the expansion of the grid and the facilities to increase energy production, the OGEMP will utilize privately-owned, institutionally-regulated energy shops that will provide renewable energy technology and services. Currently, solar energy is the renewable energy of choice for the energy shops due to the abundance of sunlight found in Namibia. In order to determine whether these energy shops will be sustainable, the Desert Research Foundation of Namibia has created a pilot program which has introduced small and medium enterprises which offer renewable energy technology and services. For these renewable energy technology and services small and medium enterprises to be successful, a market analysis must be completed of the prospective entrepreneur's community. One of the inputs to the market analysis, assessing and analyzing the energy needs of the community, did not previously exist for use by entrepreneurs. Our project filled that gap and provided a standardized procedure for collection and analysis of energy needs data in unelectrified communities.

2.0 BACKGROUND

In this chapter, we will explore how income generation through RETS SMEs established by community entrepreneurs will create a viable renewable energy infrastructure. We will first acknowledge that rural energization is a global problem with national responsibilities and consequences. We will examine how past programs around Africa have both succeeded and failed by investigating the causes of failure. We will also investigate the Namibian context: both the current energy problems that the people face and the Namibian government's solutions to those problems. Finally, we will examine at the energy shop concept as proposed by the OGEMP and how our project will fit into that larger initiative.

2.1 Rural Energization

One in three people throughout the world live without electricity (www.enersol.org). As many first and second world countries exponentially increase their energy consumption, many countries without existing energy infrastructures are being left behind. The United States, for example, has about 6 percent of the world's total population, yet accounts for 30 percent of the world's energy consumption. In contrast, India is inhabited by 20 percent of the total population and accounts for 2 percent of global energy usage (Ward, 2002).

Often in many developing countries, grid electricity access does not expand beyond urban environments, leaving many rural residents without electricity. Since the capital necessary to expand the grid does not exist in many developing countries, it is necessary for the governments of these countries to legislate regulations controlling their energy industries while outside sources provide the necessary capital to develop the grid or promote alternative energy systems. For example, the United Nations Development Programme (UNDP) helped co-sponsor a project with the Namibian Ministry of Mines and Energy (MME) called Biomass Energy Conservation Strategy and Management Tool (Schultz, 2002). Developing countries can use the capital invested by outside sources to pursue projects.

Meeting the basic energy of its citizens is a vital step for the modernization of developing countries and improving quality of life. Yaron et al. (1994) claim that electrification "brings economic growth, better public services and a feeling of integration with the modern world previously lacking in non-electrified communities"

(p. 11). If a steady energy supply is introduced to an area, modern industry can develop in that region. This creates jobs, increases the access to goods closer to the residents' homes, and improves the roads into and out of the settlement, since goods would have to be transported to and from the industry. Along with improved roads come an increase in the number of taxis available in the area, as well as possibly establishing a bus route connecting the settlement to the nearby cities, towns, or settlements. Other public services that could be improved include increasing the quality and services available at local schools and health clinics (Yaron et al., 1994). Energy could even be used to power lights around a field so that late night soccer games would be possible, providing an outlet for the residents' entertainment.

2.1.1 The African Energy Context

In terms of global energy consumption, the African continent can be regarded as a developing region. In 1999, Western Europe used 151 gigajoules (GJ) of energy while the entire continent of Africa used only 25 GJ (Ward, 2002). Biomass energy still supplies around 80 percent of an African villager's needs, while the conventional fuels of most industrialized countries are exclusively available in only a few nations: Libya and Nigeria for oil and South Africa for coal (Ward, 2002). Without access to large reserves of conventional fuels or the capital to purchase sufficient amounts of energy from other countries, many African governments have been forced to seek alternative means to provide their citizens with basic energy needs.

Several countries have attempted to implement alternative energy programs with varying degrees of success. Failures in rural energization programs can be organized into three categories: lack of community involvement and support, societal resistance to change, and lack of education concerning energy within the community. Many unsuccessful programs have also failed to include input from community members while imposing solutions. This leads to resentment, distrust, dissatisfaction, and a lack of desired deliverables. Sebitosi and Pillay (2005) note that "[t]he initiator or proposer must learn to balance his act of influencing while [remaining] open to learning from the influenced" (p. 2049). This balance is important when ensuring the sustainability of a project. The rural electrification of Zimbabwe provides an example of a program which did not include feedback from the community. Zimbabwe was granted the funds for a Global Environment Fund and World Bank rural electrification program using solar PV systems. Over the course of 5 years, 8,000-10,000 households were electrified (Zimbabwe Rural Electrification Study, 2000). Since the communities were neither involved in the decision making process nor received proper training for maintenance, when equipment began to fail, no one could service them and the systems became useless. The Zimbabwe Rural Electrification Study (2000), however, blames the failure of the project on the decreased value of the Zimbabwean currency. Regardless of the controversy, the program failed to sustain itself and left rural residents without electricity and with misconceptions about solar PV systems (Sebitosi & Pillay, 2005).

Societal resistance to change has also proved to be an obstacle to the introduction of new technology. Many societies with a strong sense of cultural identity may find it objectionable to divert from their traditional ways and may choose to reject outside influences and new ideas. For example, in order to reduce time spent collecting firewood and environmental destruction, solar cookers may be introduced into communities. The solar cooker may not imbue the food with the same taste and texture as a traditional wood-burning stove, however. This could present a problem in the preparation of some traditional meals which, in turn, could affect the acceptance of the new technology (Sebitosi & Pillay, 2005).

Finally, failure to educate rural inhabitants about energy and conservation can also lead to difficulties when implementing rural energization. As Sebitosi and Pillay (2005) documented:

> "[w]hile opening the International Domestic Use of Energy Conference 1998, the Vice Chancellor of the Cape Technikon, Dr. Balintulo, remarked, 'We all know electricity, but we all know, experience and appreciate it differently. People in the townships have told our Energy Technology Unit, during a countrywide survey, that they perceive electricity to be an unreliable source of energy'" (p. 2048).

Without proper education, residents of rural areas do not understand how electricity works along with its capabilities and limitations. Also, lack of education can also lead energy distributors to offer sub par service. Van der Vleuten, Stam & van der Plas (2007) note that "energy policy documents have stressed the importance of the services that energy delivers rather than the energy carrier itself" (p. 1440). If residents are not educated about electricity, energy carriers would have the freedom to provide services with a lack of regulations, dependability, and price standards. As a result of poor service, residents with limited education may distrust electricity based on their experiences and therefore desire to remain unconnected to the grid. Not all programs have been met with failure, though.

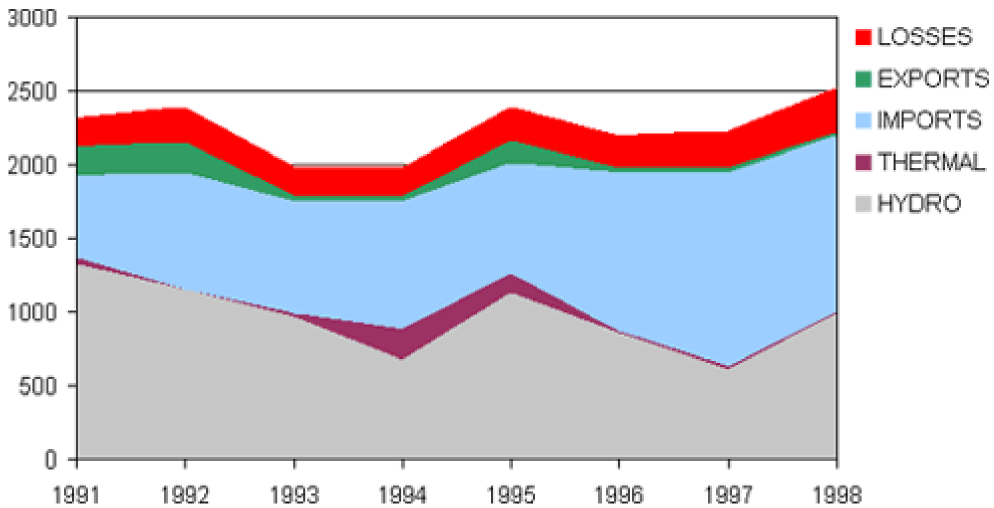
Kenya is one example of successful implementation of solar energy systems. Economic sanctions imposed by the World Bank forced the Kenyan government to prioritize its budget which led to a decrease in the amount of capital invested in rural energy projects. As a result, rural residents living in off-grid villages built a solar PV infrastructure without guidance from their government or the World Bank. It has been argued that the lack of government and international interference allowed the communities to empower themselves to invest in solar equipment (Sebitosi & Pillay, 2005). With an understanding of what energy needs they had, the Kenyan people were able to create the means to electrify their own communities.

By learning from the failures and successes, several important aspects of a successful alternative energy program have emerged. First, the community must be involved in identifying what energy needs must be met as well as be given the skills to service the systems. Second, renewable energy technologies must be introduced in a manner that acknowledges societal resistance to change. Small steps must be taken when introducing new technology so that the old customs are not challenged. Finally, education of the capabilities and limitations of electricity is necessary in order to create realistic expectations in the minds of the end users. If these factors are taken into account, the chance of success for a rural energization program increases greatly.

2.1.2 The Namibian Energy Context

Even though Namibia is one of the lesser populated countries in the world, it has the highest per capita energy usage in Africa (Stage & Fleermuys, 2001). Since the amount of energy produced in Namibia is not sufficient to fulfill the country's needs, additional energy is imported from other countries. Between 1991 and 1998, the amount of imported electricity steadily grew (Figure 6). By 2001, nearly 50 percent of Namibia's electricity was supplied by South Africa's electric company, Eskom, and a fraction is purchased from Zambia's company, Zesco (Stage & Fleermuys, 2001).

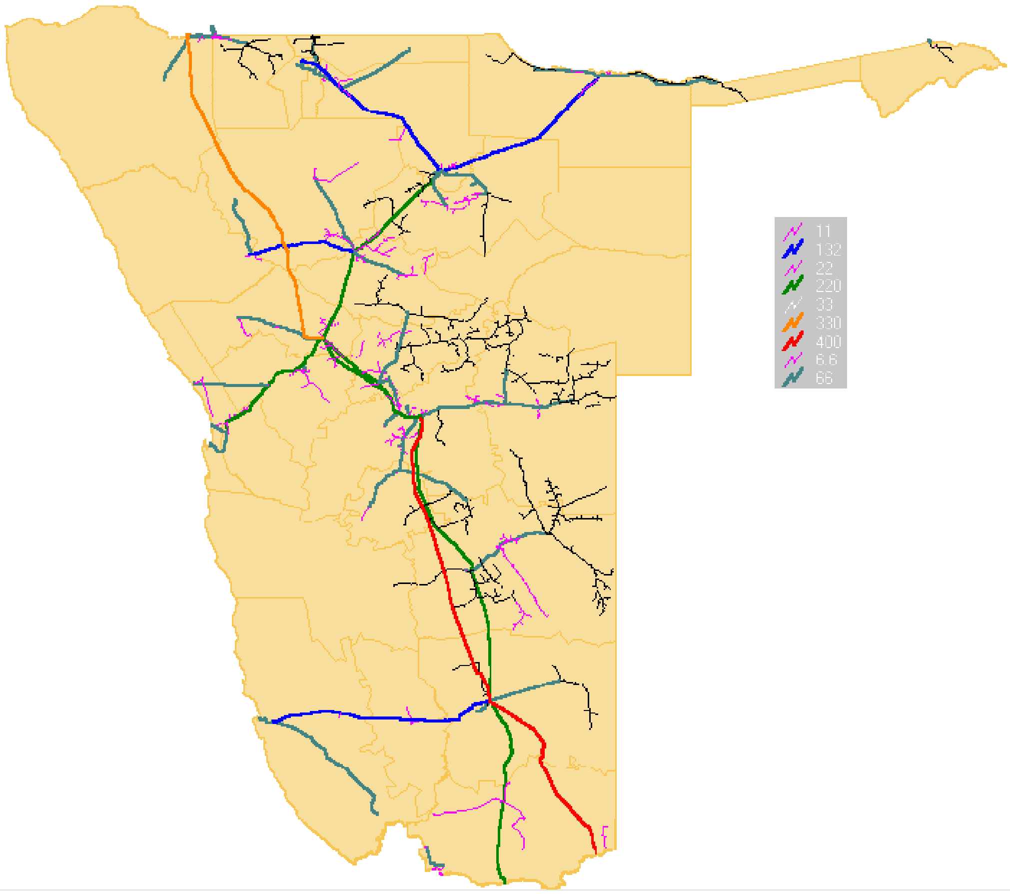
Figure 6: Electricity Production in GWh



Note. Figure is taken from the Ministry of Mines and Energy. Retrieved April 4, 2007, from http://www.mme.gov.na/energy/statistics.htm

Limited energy production is not the only problem facing Namibia. The national grid's infrastructure, which was built in the 1960's and 1970's, is currently stressed to the point where there are frequent black-outs (Electricity Control Board [ECB] of Namibia, 2005). Also, the grid has been centralized around the main urban areas and does not reach into many rural areas (Figure 7). Currently, only about 14 percent of the 106,554 rural localities in Namibia have a connection to the national grid (OGEMP, 2007). While there are some policies and plans set in place to increase the percentage, limited funding hinders expansion of the grid. As a result, most informal settlements and rural areas rely on candles or paraffin to light their homes, car batteries to power their small electronics, and fuel-wood or small biogas digesters to provide additional energy (Consulting Service Africa, 2005).

Figure 7: The National Transmission Grid



Note. This figure is taken from the Ministry of Mine and Energy. Retrieved April 4, 2006, from http://www.mme.gov.na/energy/transmission.htm

One of the main obstacles that many Namibians face in obtaining access to modern energy is the cost of purchasing energy and maintaining the infrastructure. Currently, even those who receive grid power are paying extremely high prices for it and prices are only expected to increase. The Namibian Electricity Control Board (ECB) recognizes that even though the cost of electricity is high for customers, NamPower is still selling electricity at a loss (ECB of Namibia, 2005). If the prices remain high, residents of informal settlements will not be able to afford to connect to the existing grid even if access is made available.

If Namibia is to extend modernization to its rural areas, three factors must be overcome. First, Namibia must find an alternative means of energy production which does not rely on electricity imports. By relying on other countries, Namibia becomes dependent on the energy industries of developing countries that will need more electricity for themselves in the coming years. Second, Namibia must create an alternative infrastructure to reach rural areas. The current grid is already strained and is too expensive to expand into many rural areas. Finally, they must find a cost-effective way, in terms of both supply and demand, to provide electrification. NamPower must find a way to provide energy at a profit to them while keeping the price of the electricity within the financial means of Namibians. Without confronting these problems, Namibia's energy problem will become a crisis during the next decade even without the inclusion of all rural communities onto the grid.

2.2 The Role of the Namibian Government in Energy Production & Distribution

Since its independence from the South Africa's apartheid government, the Namibian government has strived to extend services previously reserved for white to all citizens. In an effort to promote social upliftment, one of the Ministry of Mines and Energy's objectives is that "all households shall have access to affordable and appropriate energy supplies" (http://www.mme.gov.na). They have realized that there are many hurdles to clear before such goals can be met. Through several government papers and laws, the Namibian government has formulated an approach to tackling the problem of rural electrification in Namibia.

In 1998, the Namibian government released the country's first policy guidance document that addressed the energy supply of the country. The Energy White Paper "embodie[d] a new, comprehensive energy policy aimed at achieving security of supply, social upliftment, effective governance, investment and growth, economic competitiveness, economic efficiency and sustainability" (White Paper on Energy Policy, 1998, p. 1). It set the goals for the electrification of 25 percent of the rural communities while also reducing the dependence on imported electricity to 25 percent of the total peak demand in Namibia by 2010 (EMCON Consulting Engineers, 2001).

In order to meet these goals, the government first tried to regulate Namibia's electricity production and distribution through the Electricity Act of 2000. This provided the logistical and legal framework for the establishment of the Electricity Control Board (ECB) to regulate Namibia's electricity (Electricity Act, 2000). The Technical Electricity Regulations found within the Electricity Act, specifies the technical aspects by which the energy distributors must abide (Electricity Regulations: Technical, 2000), ensuring the quality of service provided to the customers. These quality standards not only help the growth of Namibia's economic sector, but it also prevents rural residents from forming a negative opinion of electrification.

Branding also plays a role in creating positive opinions about electrification. The ECB's Strategic Plan for 2006-2010 establishes an agenda for the energy plans and policies for the period of 2006-2010 while addressing public perceptions of electricity. The plan stresses the branding of the ECB and its subsequent association with reliability and trust (Strategic Plan 2006-2010, 2005). Positive branding can be effective only if the ECB can provide reliable energy.

Since the current grid is strained and energy production is limited, the Namibian government adopted a two-pronged approach in the Rural Electricity Distribution Master Plan (REDMP) in 2000: provide connections to the grid where funding allows while introducing renewable energy technologies and services where feasible (Rural Electricity Distribution Master Plan [REDMP], 2000). During the development of the plan, research was done across Namibia to determine where grid connections could be made and where renewable energy would provide a better alternative. How to provide renewable energy as a sustainable option in these areas remains under consideration, though.

The Ministry of Mines and Energy tried to introduce a renewable energy program in 1996 called "HomePower!." This program established a revolving credit fund which could be used by households to purchase solar systems. Unfortunately, this program did not enjoy the success hoped for due to the high costs limiting access of the systems to those with high incomes (Mueller & Tobisch, 2001). The program did teach the government that "private ownership, locally available service and reliable material provided a high degree of customer satisfaction" (Mueller & Tobisch, 2001, p. 2).

Figure 8: PV Array Offered by HomePower!

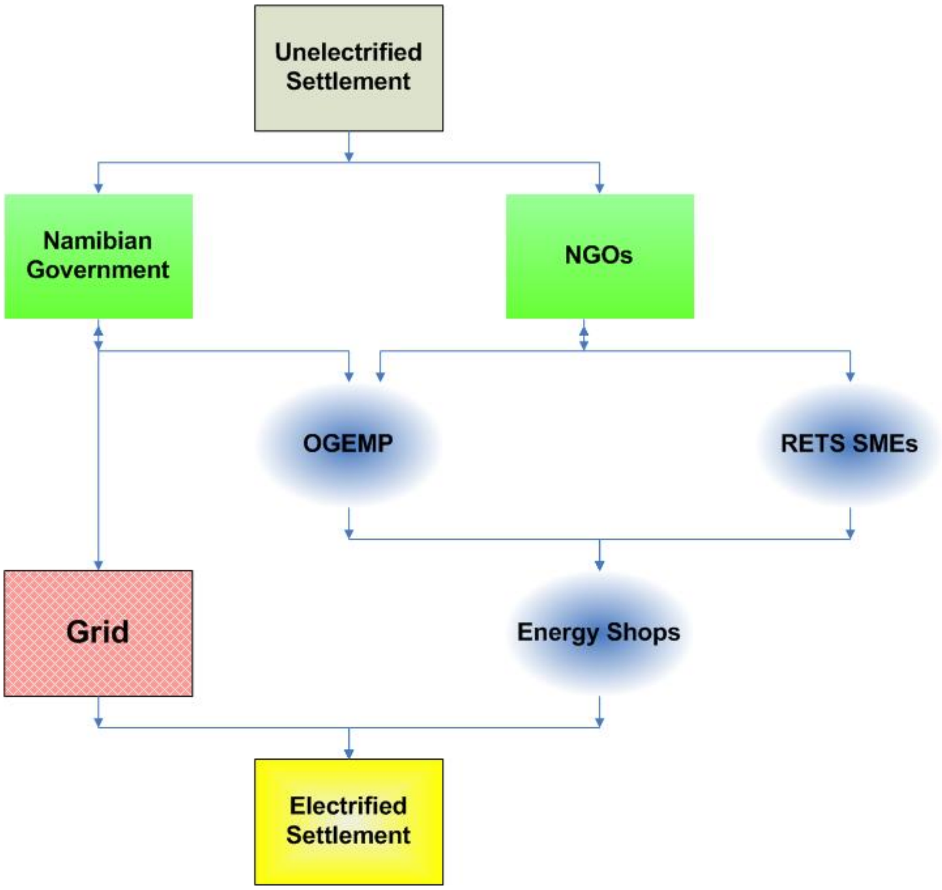
Note. Picture taken from the Ministry of Mines and Energy. Retrieved April 11, 2006, from http://www.mme.gov.na/energy/solar.htm

These lessons learned have been incorporated into Namibia's latest renewable energy plan: the Off-Grid Energisation Master Plan (OGEMP) released in 2007. This plan provides energy services through individually-owned, institutionally-regulated "energy shops." As had been learned through the HomePower! program, these shops will be privately owned and will offer local service while providing quality products from a central coordinating body.

An energy shop, as outlined in the OGEMP, will provide basic energy products and services to the community. It is envisioned that all energy shops will provide basic supplies such as batteries, liquid propane gas (LPG), and light bulbs at a reasonable cost. In addition, battery charging services will be offered using a PV array. Finally, the shop will offer the possibility to order and finance private energy baskets, or packages of appliances and a suitable PV array for their customers. Specifically, an energy basket would contain a range of energy products, such as a set of lights with a suitable solar array, which will fit the needs and economic profile of the unelectrified residents. These baskets would be provided and coordinated by a central organization which would send the baskets to the shop for distribution. For financing, the shop will also provide loans, coordinated by a private contractor, so that the energy services can be paid off over time (OGEMP, 2007).

The Namibian government has attempted to tackle the problem of rural energization since achieving independence. Striving to meet its commitment to provide electricity to its citizens while recognizing the problems in the current grid, Namibia has adopted a two-pronged approach to providing rural energy: expand the grid where cost-effective while promoting the creation of energy shops in areas distant from the grid (Figure 9).

Figure 9: Overall Namibian Approach



The energy shop approach addresses all of the reasons for failure of previous energization. By placing the shops into the private sector, the communities are empowered to determine what services are needed while creating local business. Cultural resistance is combated by offering both traditional and renewable energy sources. With these options, consumers will less likely feel forced to purchase new technology and can adopt the technology that they feel comfortable with. Energy education can be provided by demonstrations of the technology by both the institution which regulates the shops as well as the shop owners. Since the consumer is freely purchasing the technology, the shop owners must provide accurate information about the technology in order to market their products. By learning from past energization programs, the OGEMP has a greater potential for success.

2.3 Non-governmental Organizations and their Role in Rural Energization

Nelson Mandela once stated "Development can no longer be regarded as the responsibility of government alone. It requires a partnership of government with its social partners: private sector, labour and non-governmental organisations" (http://www.info.gov.za/speeches/1997/05230w39797.htm, ¶ 18). In many large scale government initiatives, the implementation of the project relies on the assistance of non-governmental organizations (NGOs). While the government has the potential create national guidelines and projects, NGOs can foster better relations with the local people by working directly with the people involved. NGOs are capable of increasing public awareness and education about government projects. As Scherl (1996) revealed, "…it is recognized that in many cases NGOs are an important and inevitable intermediary for informing people at the community level and mobilizing community action" (p. 13). They can also run pilot programs, collect data, and present their results and recommendations to the government in order to help the government make a more educated decision (R. Schultz, personal communication, February 5, 2007).

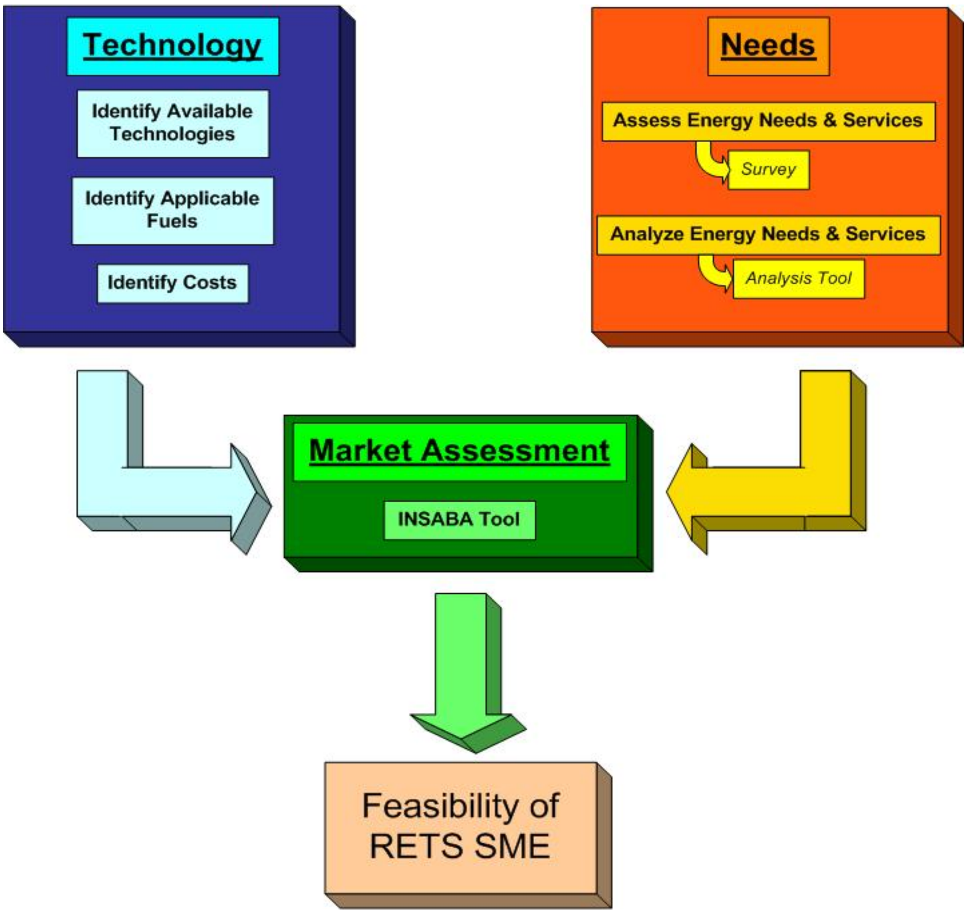
One non-governmental organization (NGO) that has played a major role in influencing the Namibian government's energy policies is the DRFN. Its mission statement is: "The DRFN empowers decision-makers at all levels through capacity building, facilitation, knowledge generation, and sharing in order to promote sustainable development" (www.drfn.org.na). The DRFN's Energy Desk helps to spread knowledge and raise awareness of renewable energy technology (DRFN Annual Report 2005-2006, 2006). The DRFN is currently assisting rural energization by helping to develop the energy shop concept as defined in the OGEMP.

The DRFN is currently involved in developing the energy shop guidelines outlined in the OGEMP as well as proving the feasibility of such an approach by investigating RETS small and medium enterprises (SMEs). SMEs contribute greatly to both the Namibian job market and Gross Domestic Product, as "Namibia's Shebeen [informal liquor outlets] Association claims that an estimated 75,000 people are employed in Namibian shebeens, making it the highest employer after the civil service" (Schultz & Schöneburg-Schultz, 2006, p. 1). By using currently established businesses as a basis for the introduction of RETS, this approach will involve the community to determine what products can be sold.

To aid the success of many of these small businesses, the assistance of SME support organizations (SMESOs) is needed. These organizations have emerged to provide guidance to small business owners who have little experience in the business world. The creation and coordination of RETS SMEs will need SMESOs to handle analysis aid that SME entrepreneurs can access on their own.

As envisioned by the DRFN, a feasibility assessment of RETS SMEs requires two major evaluations: those of the current energy needs and of the available renewable energy technologies (Figure 10). The current energy needs within a community can be determined through an energy needs survey and an analysis tool that compiles the results of the survey. The second evaluation of available technologies can be completed by a coordinating body. The results of these two evaluations can then be combined through the Integrated South African Business Advisory (INSABA) Tool to produce the overall energy market assessment. This market assessment can then indicate whether the RETS SME is feasible within the entrepreneur's specific community.

Figure 10: Process to Determine RETS SME Feasibility



Based on the DRFN's research on RETS SMEs, they will then make recommendations to the government concerning the establishment, regulation and support of energy shops.

With the help of NGOs, the Namibian government is tackling the problem of rural energization within Namibia. Since NGOs can foster better relations with the local population while also being able to devote more time into research, they are integral to developing an alternative approach to grid electricity that will be culturally acceptable. As an example, the DRFN has been a major component in developing the guidelines for the energy shops proposed by the OGEMP. Their work in proving the feasibility of RETS SMEs will lay the groundwork for establishing energy shops throughout Namibia.

Our project aided the DRFN's program by providing the tools to conduct and analyze the energy needs of unelectrified settlements throughout Namibia. To determine the needs of an unelectrified settlement, an energy assessment survey and a data analysis tool were needed. All though these deliverables have been created in the past, such as the EnPower Toolkit, they were too complex to be used by entrepreneurs within unelectrified settlements. Our toolkit was geared to be used nationally by any entrepreneur with business potential and SME support organizations (SMESOs). This will enable the private sector to begin understanding the energy needs of their communities. With this understanding, appropriate RETS can be investigated for introduction into unelectrified communities to benefit both the community and the entrepreneur.

2.4 Summary

Rural energization is not a problem specific to Namibia, but to the entire developing world. Unfortunately, many countries do not have the capital to fund rural energization programs even though electricity is fundamental to the process of modernization which can produce a higher standard of living while creating numerous economic possibilities. As the technological gap widens between developed and developing countries, more capital is required from external sources to fund rural energization programs.

Not all programs that have been funded by the developed world have been successful, however. Africa, with many developing continent, has seen its share of successful and failing programs. By analyzing several case studies, three reasons for failure emerged: lack of community involvement and empowerment, cultural resistance to the acceptance of new technology, and a lack of community education about the benefits and limitations of electricity. If these factors are recognized by future programs, the programs have a much better chance of success.

While Namibia has its own cultural context, the problems it faces are similar to those faced by many other countries: limited funding for electrical grid expansion and a lack of energy production capabilities. With only 14 percent of rural localities connected to the grid, Namibia faces a monumental task to provide electricity to its citizens (OGEMP, 2007). If their rural energization program learns from the failures of others, though, it has a chance of success.

The Namibian government is highly invested in making such programs successful. Since Namibia's independence, the Ministry of Mines and Energy has made it an objective to provide basic energy services to all citizens. Recognizing the limitations of the current grid system and the opportunities afforded by renewable energy, the government has adopted a two-pronged approach towards rural energization (REDMP, 2000). This includes providing grid access where communities are close enough to the existing grid infrastructure to be affordable while introducing energy shops carrying basic energy supplies and renewable energy technology in more remote locations.

This renewable energy approach was developed by the government in conjunction with NGOs. These NGOs can provide a better understanding of smaller communities than the government can due to their focus on working intimately with communities. One such NGO, the DRFN, is currently working on proving the feasibility of renewable energy technology and services small and medium enterprises in order to lay the foundation for the introduction of the energy shops. To do this, two major inputs are needed to create a market assessment: an evaluation of the available technology and associated costs as well as the energy needs and services within the communities themselves. If entrepreneurs are able to assess and analyze the energy needs and services of their communities, they are empowered to offer products and services suitable for their communities. If this concept is proved, it can help create a successful renewable energy program for the entire country. A successful energy shop program will decrease the demand for grid access while providing reliable energy services to all. Now we will describe the process we completed to achieve our project goal and our part of the larger proof of concept.

3.0 METHODOLOGY

The goal of this project was to complete the first half of the DRFN's assessment of the feasibility of RETS SMEs. Specifically, we developed a standardized method for prospective entrepreneurs to assess the market for energy fuels and services in an unelectrified settlement. To help us do this energy needs and services assessment, we established two objectives. The first objective was a two-step process: develop a survey that could be administered by an entrepreneur with no surveying experience to evaluate the energy needs of people in an unelectrified location and then test it in an actual unelectrified settlement. We used the settlement of Havana outside of Windhoek, Namibia for this test. The second objective was to create an analysis tool using Microsoft Access and Excel to compile the data into easily readable charts that depict important energy usage and services trends. The following material presents our methodology for accomplishing these objectives.

3.1 Develop Energy Needs Survey

In order to assess the market for energy fuels and services in an unelectrified settlement, an entrepreneur needs to understand current usage of fuels and services within their target area. Currently, no survey tool exists that meets this need. Therefore, we created a culturally acceptable and easily administrable survey that engages the community in the entrepreneur's research. To confirm that the survey had these properties, we used a multiphase development process. First, we determined what information needed to be learned. To do this, we needed background information about typical energy usage and services in unelectrified settlements in Namibia. Therefore, our first step in creating the survey was to do an informal energy assessment in our pilot settlement of Havana. Next, we held multiple brainstorming sessions on survey structure and gained valuable insight from more experienced researchers. Finally, we tested the survey through a pilot process as well as a test run of 50 surveys within Havana. By incorporating these outcomes, we were able to develop a survey that would uncover the data we wanted while remaining culturally appropriate for the context we would be working in.

3.1.1 Pre-Survey Research

Before we could begin developing a survey, we needed to gain an initial understanding of energy fuels and services used in unelectrified locations and how to structure a survey. To do this, we researched currently available energy fuels and services, methods of creating surveys, as well as previous energy-related surveys applied within Namibia. For example, we examined the survey that Venasius Amukwa, the entrepreneur and DRFN's contact in Havana, had conducted in Havana before he established his RETS SME, a Solar Cell Phone Charging (SCPC) shop (Appendix A: Survey Conducted by Venasius Amukwa) to determine what questions he thought would be helpful for a RETS business. We also examined the NamPower Mini-Grid and Off-Grid Study Business Questionnaire (Appendix B: NamPower Mini-Grid and Off-Grid Study), which was helpful in determining what questions should be included in the survey. This survey has been previously applied in Namibia, and, therefore, the content was, for the most part, relevant and applicable to the development of our energy assessment tool. Lastly, we based our situational research on similar information found in the EnPower toolkit, assembled by the United Kingdom's Department For International Development (DFID) (Appendix C: EnPower's Situational Research Guide).

Situational research is the research stage in which the current situation of the specific communities is investigated. It involves getting the "feel" of the community and its energy needs and services; it also includes walking around the area, talking with settlers, and making observations of different energy sources and household appliances, such as stoves, refrigerators, and televisions, used in the area (EnPower toolkit, 2003). In our situation, it was also a way to introduce us to the surroundings so that we were both comfortable in and knowledgeable of the settlement while we were surveying. It created an opportunity to introduce ourselves to the local settlers, which was important to do carefully so that we could gain their acceptance and trust. To help with this, we created and memorized a pitch:

> "Hello. My name is [NAME]. We are students from the United States of America. We are investigating what types of energy are used in Havana: wood, gas, candles, paraffin, generators, etc. The information we are collecting will be used by the Desert Research Foundation of Namibia. The DRFN will then provide this information to the government to make recommendations for improving the energy supply in Havana. Do you have time for a few questions?"

The situational analysis also allowed us to begin fostering relationships with the settlers and begin making our presence known so that we did not appear threatening. Through utilizing the pitch, we also briefly discussed some energy issues with the locals to obtain a first-hand account of their energy needs that we might not have ascertained through observation alone. This informal analysis, therefore, allowed us to gain initial knowledge for the development of our survey and also to establish a relationship for future communication. This was essential for achieving our goal because it gave us a general idea of the fuels and services used in typical settlements like Havana.

We also had to make sure that we were conducting this research in an unobtrusive manner. Unobtrusive methods of research "are ways of gathering data in which subjects are not aware of their being studied…[It] is useful when the subjects to be studied are very suspicious and distrustful" (http://faculty.ncwc.edu/toconnor/308/308lect09.htm, ¶ 18). It was important to use this approach in Havana because we did not want to alarm the locals or make them uneasy about our presence. The observations made while in Havana included keeping a written tally of individuals we observed carrying wood and the number of radios we heard playing. This helped us determine if wood was a popular energy source and if radios were a popular energy appliance. In order to differentiate the energy needs of businesses and households, we also made observations of a local cuca shop. In this process we were able to get an initial understanding of the various energy applications in the settlement as a whole.

Following our situational analysis, we needed to expand upon the types of energy and services that were observed. While some of this information was discovered during our informal energy assessment, a more exhaustive list of fuels, services and appliances was compiled through additional research, brainstorming sessions, and input from experienced surveyors. For example, we conducted a brainstorming session on different types of services that require energy. These sessions allowed us to determine the most applicable services to ask about in the survey.

Another component used in the survey development was input from experienced surveyors. From our contacts at the DRFN, we learned various aspects about the Namibian culture that could not have been obtained through research or observations. This input was a crucial step in making the survey culturally acceptable. Without this knowledge, the survey would fail like many of the electrification programs in the past as discussed in our background section. From these experienced surveyors, we were also made aware of some technical aspects of a survey, such as including a heading for the interviewer's name, date of the interview, and interview number for documentation. These inputs, therefore, were not only helpful in providing useful information on cultural aspects, but also on the procedure of good surveying.

3.1.2 Technical Considerations- Survey Limitations

The raw material from our previous researching efforts was formed into questions, which were then compiled into a working draft of the survey. The survey questions had to be carefully thought through in order to gather accurate, useful information. According to Energy Consumption Series: Residential Energy Consumption Survey Quality Profile (1996), "in a broad sense, the term 'quality' covers the relevance, timeliness, and accuracy of the survey" (p. 1). Some of our limitations included the surveying experience of potential entrepreneurs, time required to administer the survey and input the data into the analysis tool, and the accuracy of the data. These limitations, therefore, not only affect the quality of our survey, but also impact how easily potential entrepreneurs can use the survey. As a result of this, they directly impact our goal of enabling prospective entrepreneurs to conduct an energy needs and services assessment within their targeted market.

Unlike most surveys where development and administration of the survey is done by the same person, we needed to develop a survey that would be used by others. Due to this consideration, our survey development process had certain constraints that were not typical of survey development. We needed to work within these constraints in order to develop a survey that was both culturally acceptable and easily administrable. One main concern was the limitation of the surveying experience of potential entrepreneurs. Since survey experience could not be assumed, the survey had to be as simple as possible. This focus on simplicity factored into how we approached the formatting, wording, and included instructions. A balance, however, had to be struck between simplicity and detail within the survey so as to provide useful information without using a surveying method that was too complex. Experienced surveyors at the DRFN also gave input about this balance which we used to make improvements to our working draft. The simplicity of the survey was measured in the second part of the survey development objective, the testing phase, when it was administered to various test groups.

Another limitation that was considered was the time required to conduct the survey, as well as input the data into the analysis tool. A potential entrepreneur might be restricted by the number of days he can take off from work or the time he is available outside of working hours. For example, Venasius, our original translator and the owner of the SCPC shop in Havana, was only available during the evenings and weekends. This left approximately two hours between when he arrived home from work to sundown. With this time restriction, we could only conduct between three to four surveys. This is an important consideration because most of the local population holds a similar work schedule. Also, the data from the numerous surveys that the entrepreneur conducts must be inputted into the analysis tool. The length and complexity of the survey directly correlates to the amount of time required to input the data. Therefore, a lengthy survey reduces both the amount of time that a SMESO's analyst can spend working with a potential entrepreneur and the number of potential entrepreneurs that can be assisted by these organizations. Therefore, the length of the survey was an important consideration.

In order to reduce the complexity of our survey, we decided to include only "quantitative" questions. This simplified the analysis tool developed for the SMESOs. Therefore, the questions had to be tailored in such a way that they were completely quantitative. This focus limited the possibility of extracting potentially useful information from respondents through elaborations on our questions. Since the ease of analysis was priority, this limitation was acceptable.

The last major limitation that we encountered was the issue of data accuracy. One of the most important sources of error that we foresaw was the issue of sampling. We contemplated creating a method for sampling, such as surveying every fifth house in Havana, but decided that this would not be a viable practice for potential entrepreneurs. Therefore, we decided that simplicity prevailed over a scientifically structured sampling technique. For example, a scientist would likely use maps to accurately determine how many homes were in the target area. He might then mark each house as high, medium, or low income and then randomly choose a set number of houses from each income bracket to sample. An entrepreneur, however, would not have the resources to do this, yet could still gather accurate data by simply going to a large enough number of houses within a certain range of his shop. In addition, other sources of potential error, such as biases, estimations, data entry, and assumptions made by the surveyor and respondent (Energy Information Administration, 1996), were out of our control, as they will depend on the work of the potential entrepreneur and the given respondent. Since we could not control these factors, we provided a thorough list of surveying clarifications to minimize the errors introduced by them.

3.1.3 Technical Considerations- Survey Structure

After identifying possible limitations, we needed to structure the survey. The format needed to be easy to use and easy to analyze using our data analysis tool. Structural considerations included the use of grids and checkboxes whenever possible, the flow of the questions, and a common appearance between the survey and analysis tool for ease of use.

After some consideration, we decided to adapt the approach used by the NamPower Mini-Grid and Off-Grid Study Business Questionnaire by using grids and checkboxes whenever possible, such as in the energy types section of the survey (Figure 11).

Figure 11: Types of Energy Section from Survey

Types of Energy		Paraffin	LP gas	Wood	Lead-Acid Battery (12V)	Candles	Dry Cell Batteries (1.5V or PM9)	Diesel	Petrol	Ethanol Gel	Solar Electricity	Plant material	Charcoal	Recyclables/Waste		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Q 8: Do you use...?																
Q 9: What is the energy used for?																
Food Preparation	1															
Room Heating	2															
Lighting	3															
Water heating - laundry	4															
Water heating - bathing	5															
Cooler (refrigerator)	6															
Deep-freeze (freezer)	7															
Generator	8															
Torch / flashlight	9															
Radio	10															
Hi Fi	11															
TV	12															
Hair cutting tools	13															
Power tools	14															
Other: ____________	15															

While these grids use more paper than simply annotating the energy use, they are quick and easy to use and analyze. The interviewer simply needs to record a checkmark or the quantity in the box for each response. Analyzers then do not have to decipher as much handwriting this way, resulting in more complete data. Possible error, however, can be introduced into this grid system as rows and columns can be easily confused if completed quickly. To minimize this error, we shaded every other vertical column. This shading helps prevent the interviewer from marking incorrect responses and will allow the individual completing the analysis to quickly trace down the columns as well. Utilizing grids and checkboxes, we were able to develop a survey that could be quickly and accurately administered. Finally, we also added an additional "Other" block for a response that was not included in this list to allow for any unforeseen factors occasionally encountered in the field.

Another factor that we had to take into account while creating the survey was the logical flow of questions. We arranged the questions so that lead-in questions would help guide the respondent's thoughts into the more detailed questions (Berg, 2007). For example, we asked the individual first how they traveled to buy or collect fuel before we asked how much it cost them to get there. Most of the problems involving the order of questions were identified during the piloting of the survey. Proper ordering of questions helped obtain more accurate data, as well as eased the flow of the interview.

Finally, an important consideration for the structure of the survey was the ease of data analysis. By developing our analysis tool in parallel with our survey, we were able to determine the best way to correlate the two tools. The ability to input the data directly into the analysis tool with little change in format saved time and confusion for the analyzer. Therefore, by arranging the survey into a table-like format, a front-end interface for the analysis tool was easily developed.

These technical considerations, however minor they may appear, impacted the quality of the survey. It was necessary for us to understand the surveying needs of the people utilizing this tool so they could be addressed during the development process. These typically revolved around the capabilities of the potential entrepreneurs, both in surveying experience and time considerations, but also the time considerations for the SMESO's analyst. The ease of use for both the potential entrepreneur and the SMESO's analyst was the focal point when creating the structure of the survey. The problems involving the limitations and structure were discovered during the testing stage of the survey development process, and improvements to the survey were made based on the findings.

3.1.4 Survey Content

Since the raw material that we decided to include in the survey was determined through our pre-survey research, the final step was to arrange the categories of questions. To do this, we organized the survey into five parts: demographics, appliances owned, types of energy used, amounts and costs associated with used energy, and potential energy services that could be offered. The following sections discuss the five sections of the survey.

Demographics

When a survey is conducted, it is necessary to collect certain demographical information. Typically, a balance is made between anonymity and identifying the respondent's demographics in order to avoid violation of the respondent's privacy. To do this, some surveys ask only for gender, age, and income. However, according to interviews conducted with experts in the DRFN, asking directly about income could be offensive. In our survey, we asked for the respondent's name, address and contact information, as well as the sexes and ages of all individuals within their household. This information allowed us to determine correlations between energy use and certain demographics. In addition, we could use the contact information to ask further questions if necessary. The demographic section of our survey allowed us to make connections between the respondent and their response. This information could be used to note trends in energy usage in different age or gender groups.

Appliances

The next section of the survey covered the appliances owned by the respondent. This section was originally the last part of the survey and was added to improve the accuracy and validity of our survey by confirming our findings from other sections. These extra questions would allow us to gain more confidence in our findings as well as avoid respondent error (Berg, 2007). For example, an individual talking about energy usage within their household could easily forget about small batteries used within radios and flashlights. By asking about both the flashlight and the batteries separately, the respondent is much more likely to remember the small details of their energy usage. Over the course of the development stage we moved the appliance section to follow the demographics section in order to improve the survey's overall flow. The purpose of this section, therefore, was to be a lead-in for the following section on energy usage.

Energy Used and Costs

The next two survey sections on types of energy used and the amounts and costs associated with that used energy were the core of the survey. This was among the most important data due to its relevance to potential RETS SMEs. The first section, energy usages, especially helped in determining the market potential of certain fuels or services based on their prevalence in the community. The next section determined the approximate cost and quantity of the energy that the respondent spent over the course of a month, as well as the convenience of obtaining the energy. This was useful information in order to determine how much the respondent was willing to spend for energy and the amount of money available for investment in a renewable energy technology, assuming the same amount of money could be spent on purchasing or paying off a loan for a renewable energy technology as is currently spent on other energy sources. The quantity of fuels used per month provided a basis for the amount of energy that would need to be supplied by a renewable energy technology. If the RETS SMEs were established, then this knowledge would be particularly useful in tailoring energy baskets around the typical energy requirements of the settlement. Lastly, the convenience of obtaining the energy was one of the most important concepts within the survey. This section determined how far the respondent traveled and how much he paid for his energy. This information allowed us to not only provide information about making energy more affordable, but also more convenient.

Energy Services

The final section of the survey involved assessing the market potential for energy services. For example, if most respondents owned a cell phone and had to take a taxi 20 kilometers into town to charge it, costing N$13 round trip plus the cost to charge the phone, then this method of charging is neither convenient nor cost effective. If a potential entrepreneur began offering the service of charging these cell phones at a reasonable price within the community, settlers would not have to take a taxi into town to obtain the same service. The service would be considerably more convenient for the settlers, and therefore, the potential entrepreneur would have a potential market for such a service. The energy services section of the survey served to evaluate the current energy services utilized by the community. The entrepreneur could then take this information to find a potential niche within the market.

3.1.5 Summary

The development of the survey was an intricate process involving multiple steps. First, an informal energy assessment was conducted through research on previous energy surveys and materials, situational research, brainstorming sessions, and input from experienced surveyors. This provided the raw material for the survey, but then the limitations of the end user, the potential entrepreneur, and to a lesser degree, the SMESO's analyzer, had to be factored into the overall scope and form of the survey. Many aspects of the structure had to be considered in order to produce a simple and easily administrable survey. The raw data and these technical considerations funneled into the creation of the five-part survey. After five working drafts, a final draft was finally prepared and ready for testing (Appendix D: Survey Piloted in Havana). It was through the testing phase that we determined the survey's effectiveness, clarity, and ease of flow.

3.2 Test Energy Needs Survey

Once the survey was constructed, we tested it to determine if any changes needed to be made to improve accuracy and ease of use. To accomplish this task, we conducted a pilot study to refine the survey before testing it on a large scale. Administering the survey to several students and discussing it with our contact within Havana, we were able to gain considerable perspective on the content. Having been involved in the survey development process, we were not able to evaluate the quality of the survey objectively. Using outside individuals, the survey was critically evaluated and further improved to meet our objectives. After completing this pilot study, we tested the survey in an unelectrified settlement to assess it on a large scale and to assess its validity and ease of use.

3.2.1 Testing Process

For our first test, we administered the survey to each other. This initial run-through allowed us to determine the approximate length of time that the survey would require as well as develop what questions needed to be clarified. This sample test survey also allowed us to gain perspective from both the surveyor's and respondent's side of the survey.

The second pilot study was conducted with several students at the Polytechnic of Namibia (PoN). Being Namibians, these students provided a new perspective of the culture. In addition, the students were easily accessible and able to speak English proficiently. In addition, we were able to determine what energy fuels and services Namibian students use. This information helped foresee how Namibians would perceive the survey.

The final stage to this pilot study was a discussion about the survey with a business owner within the settlement of Havana. We instructed him on how to administer the survey and took notes to see what questions or formatting he had difficulty understanding. This final test helped us determine ways to simplify the survey so that a potential entrepreneur could administer it with minimal difficulty.

3.2.2 Settlement Trial

After our piloting process was complete, we administered our survey in the settlement of Havana. Here we were able to put the improved survey to a real world test to determine if it accurately gathered data on energy usage and services in an unelectrified settlement. However, there were some limitations to this test. One of these limitations was that as researchers, we had more experience administering surveys than a business owner in an unelectrified settlement. In addition, our time to survey was limited as most residents are home only in the evenings and on weekends. Finally, since we are outsiders, we could not speak the local languages and were more likely to be perceived as intruders. We needed to compensate for these limitations before starting the settlement trial.

Due to time limitations, we decided it was necessary to administer the survey during the day as well as in the evenings and weekends. During the day, we were likely to interview more unemployed or self-employed individuals. By interviewing during the day, in the evenings, and on the weekends, we were able to get a variety of participants.

To minimize the impact of being viewed as outsiders, we used a translator to ease relations with the respondents. In addition, we were careful to cultivate relationships with people in the community before asking them to participate in our survey. This was where the introductions made during the situational analysis, including our pitch, came into play. Finally, we made an effort to be conscious of the culture and customs of the community by talking to our liaison in the DRFN and our contacts within the settlement. By following this approach, we hoped to be perceived as non-threatening as we conducted our survey throughout the settlement.

In order to obtain accurate information, we determined the sample size to be used. We determined that fifty surveys would be a reasonable sample size of Havana due to our time limitations. We selected areas to survey using maps of the settlement, restricting ourselves to areas around the locally established RETS SME. We identified reasonable boundaries for our survey based on local roads and marked boundaries for each group of interviewers so that we would not survey the same household twice.

Testing our survey in Havana allowed us to observe its functionality in a real-world setting. Lessons learned from this process further improved the survey by identifying problem areas within the survey. The data collected was then used in the development of our data analysis tool.

3.3 Analysis Tool Development

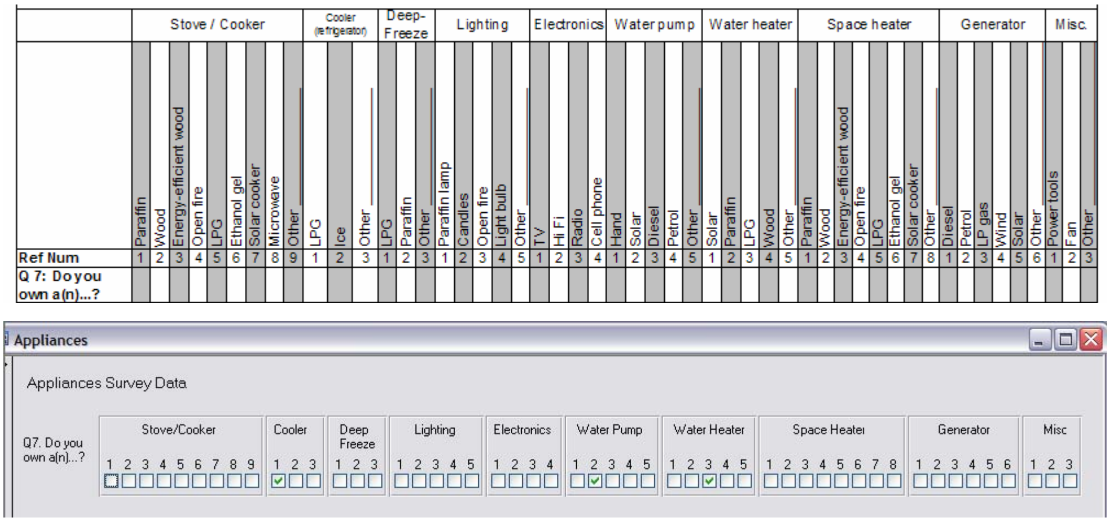
Once we collected pilot study data from Havana, we needed a method to analyze it. To ensure a standardized methodology for analyzing the data, we made a data analysis tool based on Microsoft Access and Excel, which was intended to be used by SME support organizations to identify energy markets for RETS. Since this tool would be utilized by SMESOs, it was designed for fast, accurate data entry and robust, concise data analysis.

3.3.1 Data Entry

The survey we administered provided us with hundreds of pages of raw data, which needed to be entered into a database. We determined that Microsoft Access would be a simple tool to utilize to build our survey database. This software tool was used to make forms that closely resemble the actual survey pages, which reduces error and time required for data entry. In addition, it was easy to export data from an Access table to an Excel spreadsheet for analysis. Using a combination of Excel and Access allowed us to develop an analysis tool that was effective and easy to use.

We decided to use Microsoft Access to develop forms that resembled the actual survey. For example, Figure 12 illustrates the similarity in appearance between the appliances section in the survey (top) and the data entry tool (bottom). Using this data entry tool, the individual would be able to transfer data from the written surveys to the analysis tool quickly and accurately.

Figure 12: Appliance Section from Survey and Data Input



Unfortunately, both Access and Excel have significant data limitations that made our tool development slightly more complicated. For example, neither program can handle more than 256 columns in a table or spreadsheet. Our survey, however, contained over 1000 variables. In order to compensate for these limitations, we were forced to use drop-down boxes and multiple tables and spreadsheets.

We limited the number of variables by simplifying checkmarks into multiple-choice drop-down menus when possible. For example, rather than enter a checkmark in three separate fields for whether the fuel was purchased, gathered, or free, we utilized a drop-down menu that would contain the same amount of information in one field. We considered using this same approach for other areas of the survey, but it could only be used when only one item could be selected.

The second method for overcoming the variable limitations of Microsoft Access and Excel was to break the tool into multiple tables and spreadsheets. By entering each section of the survey in a new table, we were able spread out our 1000+ variables over five different tables. This also helped organize the data entry tool so that it matched the survey's five main topics. This organization was a consideration for an analyst at a SMESO who had to input all of the data, making it easier to review a particular section from a specific survey.

After determining how to break up the data from the survey, we needed to develop the data entry tool itself. This process involved labeling each variable in a one-dimensional table. In order to keep the tool flexible for different fuel and service types, the variable names were reduced to numbers. For example, the first question in the appliances section of the survey, asked if paraffin is used by the respondent. Rather than calling the variable “Paraffin,” we labeled it “Fuel 1.” We then generated forms from these tables that closely resembled the pages of the survey itself. The final data analysis tool utilized a combination of checkboxes, numerical fields, and drop-down boxes to enter data quickly and accurately from the written surveys.

In summary, utilizing the combination of Microsoft Access and Excel allowed us to develop a data entry tool that was both efficient and less prone to error than using just Microsoft Excel. The final data entry tool was easy to learn and helped ensure accurate data entry.

3.3.2 Data Analysis

After entering the data using our tool from Microsoft Access, we were faced with several tables which contained hundreds of variables each that needed to be analyzed using Microsoft Excel. Before we could analyze the data, however, we had to clarify what statistics we wanted to generate and how we wanted to display them, such as using pie charts and tables. Given our resources, we created an Excel spreadsheet that contained the appropriate formulas necessary to generate the desired data displays.

We discussed what statistics would be of value to the end user with individuals at the DRFN and determined that the first step to building our tool was to summarize survey data. We did this by taking the raw data and outputting the appropriate statistics into a form identical to the survey. This allowed the user to quickly view the averages and percentages for different energy fuels and services and then take those data and generate their own graphics as needed. Most of this analysis was straight-forward averaging and percentages and was done quickly using Excel functions. Other data we decided to display included the maximum entered values in a separate form, which would allow the data analyst to find outliers and data entry mistakes. These outliers are important considerations because they can skew the data greatly and therefore cause the results to be inaccurate.

In order to determine the useful statistics in Excel, we needed to link the Access database to Excel. The best way to do this was to use the export feature of Access to translate the Access database into an Excel table. This information could then be copied and pasted into specific areas of our analysis tool to be analyzed.

After allocating room for 100 surveys, we determined that in order to analyze much of the data, we needed an area of the tool, used much like a scratchpad, for data that was useful to analyze but not useful to display. We used the area directly below the entered data for this purpose. The end user does not need to change this area or enter data there. After analyzing the data, we linked the cells in the summary sheet to the scratchpad area so that the user does not need to see the complicated analysis functions.

In conclusion, the completed analysis tool allowed an analyst from a SMESO to enter data quickly into the database while minimizing error. This data could then be easily copied into a marked area in the Excel spreadsheet. After copying this data, the user could then go directly to the summary sheets to view the analyzed data. This tool allowed the user to be flexible in building their own useful charts as well as having the ability to expand the tool to compute more complicated statistics if needed. In addition, the user could use the tool to analyze different fuels and services, since we kept the variable names general.

3.3.3 Data Credibility and Applicability

Once the data was collected, inputted into the analysis tool and analyzed, the data had to be validated. In order to do this, we needed to prove the toolkit's credibility and applicability. To check the credibility, we decided to crosscheck the price and consumption of the most popular fuel with external sources. We went into the settlement and asked about pricing at the local shops, as well as other stores further in town. Also, we validated usage data by comparing our figures with a previously conducted study in a nearby settlement. The EnPower Toolkit, conducted a few years earlier, provided this data.

In order to evaluate the applicability of our data entry tool, we decided to use two sources of validation: interviews with SMESOs and a simple test done by students from Worcester Polytechnic Institute (WPI). We interviewed two SMESOs to ensure that they would have the means to use our tools, such as experience and access to Microsoft Access and Excel. We were also interested in feedback on the usability of the survey, as well as the statistics and graphs displayed by the tool. Their general comments about the survey and analysis tool would determine whether our tools were suitable for the end user.

Using a number of WPI students who were not involved in the development of the data entry tool, we were able to determine the usability of our program. These students had basic computer skills without having extensive experience with Access. This made them an excellent choice for our testing process as their knowledge would be similar to that of a SMESO employee. After giving some basic instructions, we asked a number of individual students to enter five surveys into our data analysis tool and recorded the amount of time it took them to enter each survey as well as any errors or issues they encountered. In addition, we used their feedback for further improvements to the tool.

Data validation was essential to prove the credibility and applicability of our survey. We determined that our survey can produce accurate data by triangulating our results. We accomplished this using a variety of methods, including interviews with SMESOs and having students use our analysis tool. After completing this essential step, we determined that our energy assessment survey and data analysis tools are credible and applicable.

3.4 Summary

Developing a survey to determine the energy usages and services of an unelectrified settlement was an involved process. After researching, conducting multiple informal interviews with our liaison in the DRFN and our advisors, and considering many aspects involved in creating a survey, we developed a working draft. We piloted the survey on ourselves and several students at the PoN, as well as discussed it with our contact, a current RETS SME entrepreneur, in Havana. This piloting process allowed us to further improve the survey for accessibility and inclusion of pertinent data so that we could test it in an unelectrified settlement. After collecting the Havana data, we determined the relevant statistics, how to most effectively display them, and then built a data analysis tool that fulfills these requirements.

4.0 RESULTS AND DISCUSSION

The development of the EPOGES toolkit involved developing the survey and testing it multiple times on various respondents, as well as determining the best way to analyze and represent the survey data. Each time the survey was tested, communication issues and information gaps were identified and addressed. The final data analysis tool was a combination of the strengths of two separate computer programs that allowed for both powerful analysis and ease of data entry. This section will discuss the challenges we faced when developing the EPOGES toolkit as well as feedback we have received from the potential end users.

4.1 Development of Survey and Surveying Technique

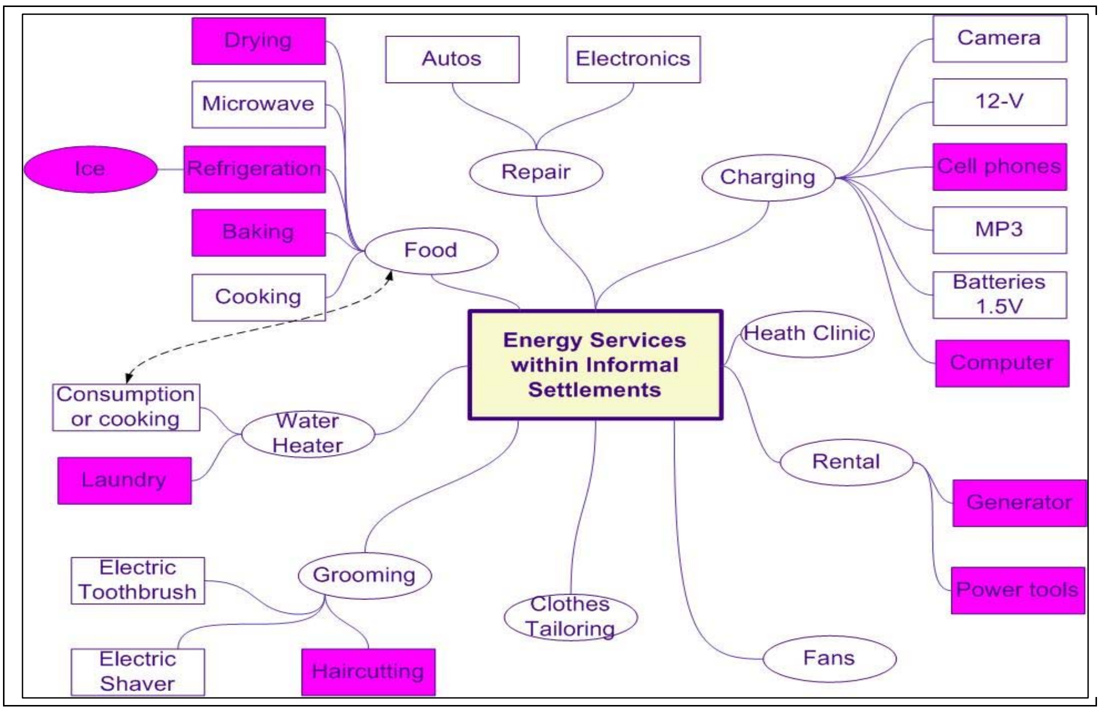
The development process for the energy assessment survey involved many hours of brainstorming and testing. We completed five different drafts of the survey before the first pilot study began. There were three major steps to developing our survey and surveying technique. They included conducting a situational analysis in our sample settlement of Havana in order to learn about the social context of an informal, unelectrified settlement, consulting experts at the DRFN and advisors from WPI on survey content and format, and lastly conducting multiple group brainstorming sessions concerning what information we would gather. Following these three steps, we were able to build a robust survey.

Before constructing the survey, we conducted an informal situational analysis of the Havana settlement. This included touring the settlement, meeting residents, and making observations. During this process we gathered some basic energy information about the settlement. We found that the most common fuels in the settlement were paraffin, also known as kerosene, and wood. In addition, we determined that these two fuels were not ideal as paraffin was unsafe, often causing house fires while wood was becoming increasingly scarce. Due to their prevalence and the concern for safety and supply in the community, paraffin and wood became the first two fuels included in our survey.

In addition to these observations, we gained qualitative insights into the settler’s attitudes about energization and the government. We found that in general people did not trust the government to provide energy. From this, we concluded that it was imperative that the people we surveyed were familiar with the purpose of our research and had realistic expectations. This included informing them that we were working for an NGO that was trying to help them. We still had to be careful not to promise anything to our respondents. Finally, our pitch proved to be a good introduction of ourselves to the settlers as most individuals were welcoming and agreed to participate in our survey.

The second step in the process of developing our survey was to consult experts from the DRFN and our advisors from WPI. The DRFN was able to help us develop an exhaustive list of possible fuels and energy uses that we might encounter in settlements of Namibia. This included such energy sources as paraffin, liquid propane gas, animal dung, and bio-gas. We included all of these fuels because our survey needed to be applicable in settlements throughout Namibia. However, we chose not to ask about certain fuels, such as animal dung and bio-gas which we knew were not used within Havana in order to shorten the survey time. In addition, we brainstormed a list of energy services that could be offered within the settlements, which is outlined in Figure 13. After making this list, we chose the services that could be provided using solar technology. This brainstorming session allowed us to include the most applicable services within the community in our survey.

Figure 13: Brainstorming Session on Energy Services within Informal Settlements



With the help of our advisors from WPI, we were able to formulate different questions that triangulated the information we needed. Our survey questions asked multiple types of questions that complemented each other and helped the survey validate the information it gathered. This redundancy reduced errors due to communication issues. For example, we asked questions about specific appliances and what fuels powered them. We also asked about specific fuels and how they were used. Using this structure, we asked the same question twice, once from the perspective of appliances and then from the perspective of fuels. During surveying, we found that asking these questions in different ways often helped us uncover additional information and to double-check responses to the survey.

The third step in developing the survey was compiling the questions into a working draft. This was accomplished by conducting multiple brainstorming sessions. These brainstorming sessions refined our content and structure. We decided that we would first determine demographic data, then fuel types and their uses, the costs associated with each type of fuel, possible renewable energy services, and finally appliances. The resultant survey, version 4, was used in our survey pilot tests.

4.2 Survey Test

Using version 4 of our survey, we were ready to conduct a pilot study. We first tested the survey by administering it to ourselves in order to work on wording of questions and general flow. We subsequently piloted it on PoN students who provided a Namibian viewpoint and indicated cultural issues and discussed the survey with our contact in Havana. We then surveyed 50 households and business within the Havana community.

4.2.1 Polytechnic of Namibia Students

We took a participatory approach when piloting the survey with PoN students. We first administered the survey and then afterwards asked them to comment on parts of the survey that may have caused confusion. In addition, we had one group member administer the survey while another took notes on possible ways to smooth out the interviewing process.

During the piloting sessions with PoN students, we quickly identified several issues. For example, the words "refrigerator" and "freezer" were unknown to most students. Namibians often refer to them as a "cool-box" or "deep-freeze" respectively. Also, we discussed the fact that many households doubled as small businesses in the settlements. Due to the high unemployment rate, the residents of many settlements sell goods and services to supplement their income. We decided not to ask about any services the business offered while conducting our survey because the business owner would likely buy his products at a wholesaler, not from a RETS SME or energy shop. Finally, we discovered that some settlements have illegal grid electricity connections. We had previously included a question on our survey that asked about grid connections, but we concluded that asking about grid connections might make interviewees nervous about talking to us and might endanger the surveyor. We determined from this information that questions asking about grid electricity needed to be eliminated.

4.2.2 Entrepreneur in Havana

The second pilot study was conducted with Venasius Amukwa, the owner of the DRFN's pilot solar cell phone charging shop in Havana. This pilot study provided valuable insight into making our survey more effective. For example, we determined that it is imperative that a person who speaks the native language be present when giving the survey, regardless of whether the interviewee speaks English or not. This was because there were considerable problems with communication resulting in incomplete parts of the survey in some cases. In addition, residents tended to get tired and disinterested in the survey if they had to overcome a communication barrier. Ensuring that a native speaker is present to administer the survey was a crucial step in making our surveying technique culturally acceptable.

In order to ensure our survey was easily administrable by the end user, we also trained Venasius and his sister, Suama, in administering the survey. We explained the fuel and service types, which required pictures and examples in some cases. In addition, we went over the survey structure and explained how to check certain boxes or fill in numbers. Other than having a few minor questions and clarifications, both individuals understood the survey and were able to explain correctly how they would administer it. From these observations, we concluded that our survey was easily administrable by a potential entrepreneur.

4.2.3 Havana Community

After making adjustments using insights gained from the pilot study we conducted with PoN students, we began our field test. We surveyed a total of fifty households and businesses in the settlement of Havana. The surveys flowed efficiently and were easily administered by ourselves and the two DRFN translators that accompanied us.

Our group was able to administer a majority of the surveys in two days using two teams. During this time, we encountered minimal cultural resistance and experienced few negative reactions to our survey. Typically after hearing our introductory pitch, individuals were willing to participate. Furthermore, individuals asked to take our survey in some instances. It is possible that the respondents were interested because of our appearance. After delivering our pitch, where we stated that we were from the United States, it is likely that we piqued the interest of many individuals. This interest increased the likelihood that a person would participate. The end user of our survey will not have this sort of attraction. The potential entrepreneur would, however, already be part of the community and would likely not encounter many problems with settlers not participating. Through our surveying experience in Havana, we concluded that our survey and surveying technique were culturally acceptable. The final version of our survey can be found in Appendix E: Final Survey.

4.3 Development of Data Analysis Tool

During the process of developing our analysis tool, we considered using different approaches. Eventually, we decided that we would take advantage of Microsoft Access's data entry interface while also utilizing Microsoft Excel's powerful analysis abilities. The two main goals we would meet were that the data could be easily entered and analyzed by a person with little training and that the analysis tool would provide the information needed by a prospective entrepreneur within his community.

4.3.1 Testing Ease of Use of our Analysis Tool

To prove that our data analysis tool was easy to use, we asked two WPI students with moderate computer experience to follow the instructions in our training manual (Appendix F: EPOGES Toolkit User Manual) and enter survey data into our data analysis tool. During this process, we were looking for any issues the individuals encountered while entering the survey data into the Access database. In addition, we looked at how easily the students transferred data between Access and Excel. We found that students with moderate experience could follow our manual and accurately enter information. After observing this, we concluded that our data analysis tool was easy to use and that the average person could use it correctly with little instruction.

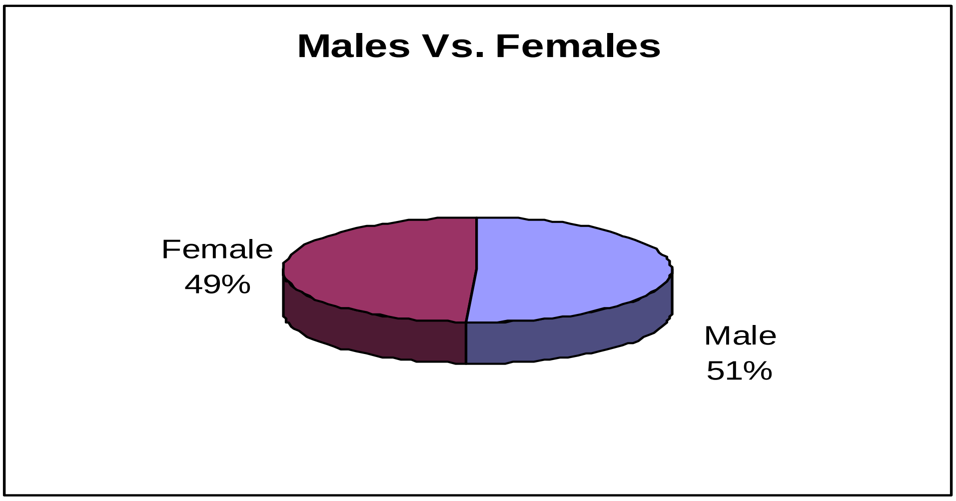
4.4 Statistics Produced by the Havana Study

This section will outline the data produced by the pilot study using the EPOGES toolkit. The toolkit generated statistics that describe the demographic data, appliance data, typical fuel usage, and energy-related services. These numbers were produced by the application of our survey to a total of fifty households and home businesses in the informal settlement of Havana outside of Windhoek, Namibia between the dates of March 31, 2007 and April 11, 2007. More statistics and graphs can be found in Appendix G: Results from Homes in Havana Survey and Appendix H: Results from Businesses in Havana Survey.

4.4.1 Demographic Data

The two important demographic figures we obtained were the percentage of males versus females as well as the age distribution in the homes we surveyed. This information was determined in order to evaluate the quality of the surveying technique. A survey that produced a majority of male respondents could mean that the surveyor interviewed friends, or did not take into account the female population. According to Figure 14, the gender distribution for our survey was nearly even for the households and businesses that we surveyed. With an equal gender distribution, we could ensure that the data we obtained was unbiased by gender issues.

Figure 14: Males vs. Females in Havana



As shown in Figure 15 and Figure 16 both the male and female age distributions show a strong representation of the adult age group with no individuals older than 60 years of age. This is likely due to the low life expectancy of individuals within settlements. In addition, there was a prevalence of young children and teenagers and a low number of children between the ages of six and ten. The adults often have children who are either young or are teenagers. This data can be analyzed further to determine connections between energy usage and household demographics.

Figure 15: Male Age Distribution

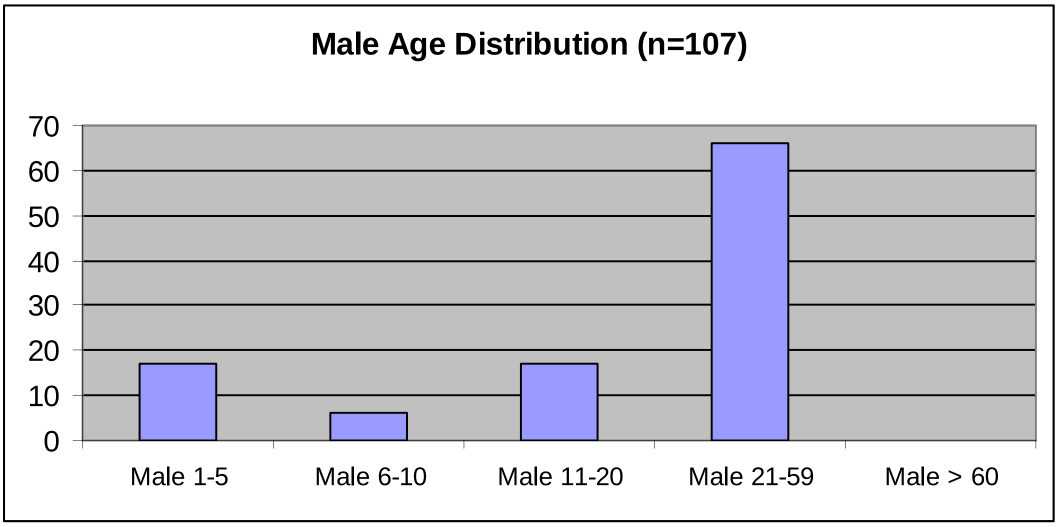
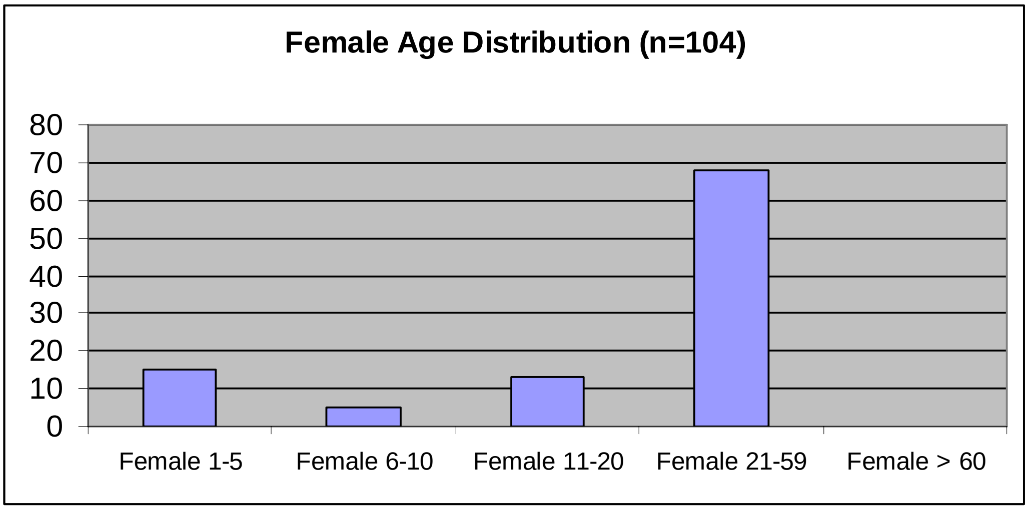


Figure 16: Female Age Distribution



4.4.2 Appliance Ownership

A section of the survey was designed to obtain information about ownership of different appliances in the settlement. This was used to determine the market for appliances that could use alternative forms of fuel. Also, since we asked about which fuels were used in these appliances, the appliance section served to triangulate the data on fuels and ensure its validity.

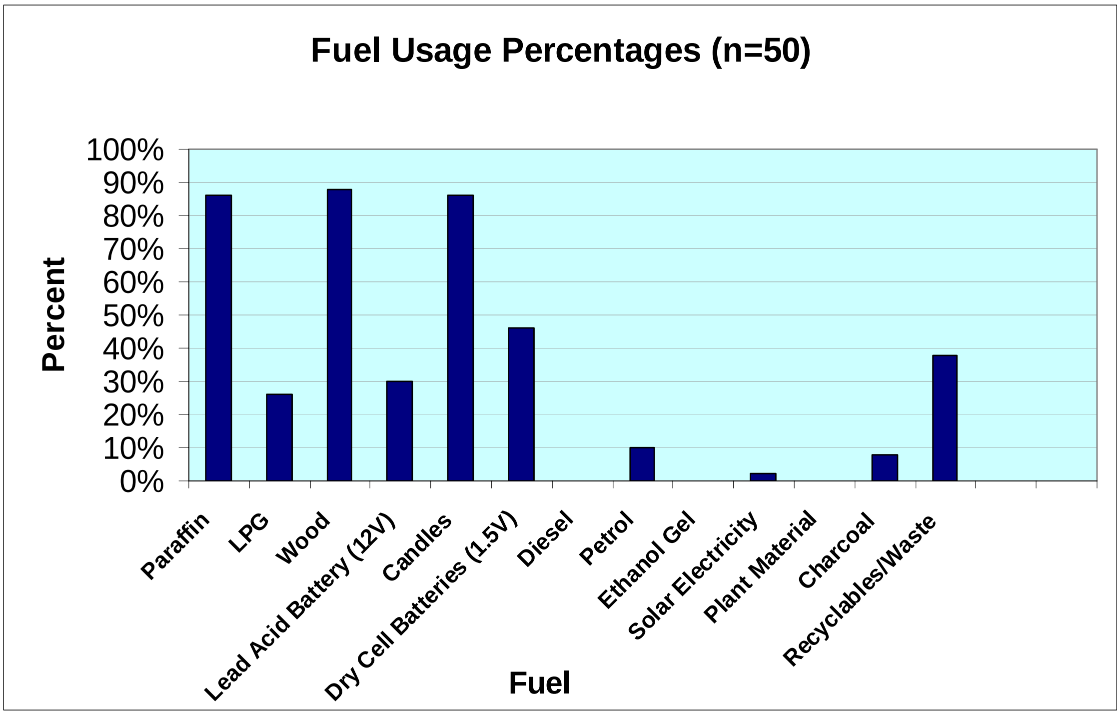
The appliances section of the analysis tool summarized the data gathered on energy consuming appliances used in a typical household. We found that paraffin stoves were the most common cooking appliance with 78 percent of the respondents using them. Also, a large percentage of individuals owned paraffin lamps at 60 percent and 82 percent used candles for lighting. From this information, we determined that cooking and lighting are the two most basic energy needs within a community. In addition, we found that no individuals owned a space heater, regardless of the cool winters experienced in Namibia. It is likely that space heaters are seen as a luxury because they require a considerable amount of fuel. This section allowed us to determine the typical appliances used for cooking, lighting and other functions.

4.4.3 Fuel Usage

In addition to appliance information, fuel usage information was also obtained through our survey. We asked about which fuels were used, how much was used, and how much it cost on average. This was important to the development of a RETS SME because it provided data that an entrepreneur would need to know in order to enter a market in an unelectrified area with a competitive RETS.

Figure 17 shows the data we obtained on which fuels were used most commonly in the settlement from our gathered data.

Figure 17: Fuel Usage Prevalence



Paraffin, wood, and candles were the most commonly used sources of energy in Havana with each of these sources being used by over 80 percent of the respondent households. This is likely because cooking and lighting were the two main energy consumers within a community. The relatively low cost of these fuels likely makes them more desirable for use. LPG, otherwise known as liquid propane gas, was used by about 25 percent of respondents, mostly for cooking. About 30 percent of respondents used 12V car batteries mainly for powering radios and Hi-Fi's. Dry-cell batteries were used by almost half the respondents, usually for small radios and flashlights. Finally, recyclables or waste was burned by almost 40 percent of respondents, mostly to start fires for cooking.

4.4.4 Energy Costs

After determining what fuels a respondent used and what it was used for, we asked additional questions on usage and costs. The average costs and usages are listed in Table 1.

Table 1: Average Household Fuel Usage and Costs

	Average Usage per Household	**Average Cost per Unit**
Paraffin	16.4 Liters per month	N$ 6.14 per Liter
Wood	12.9 Bundles per month	N$ 8.94 per Bundle*
Candles	29.5 Candles per month	N$ 1.51 per Candle

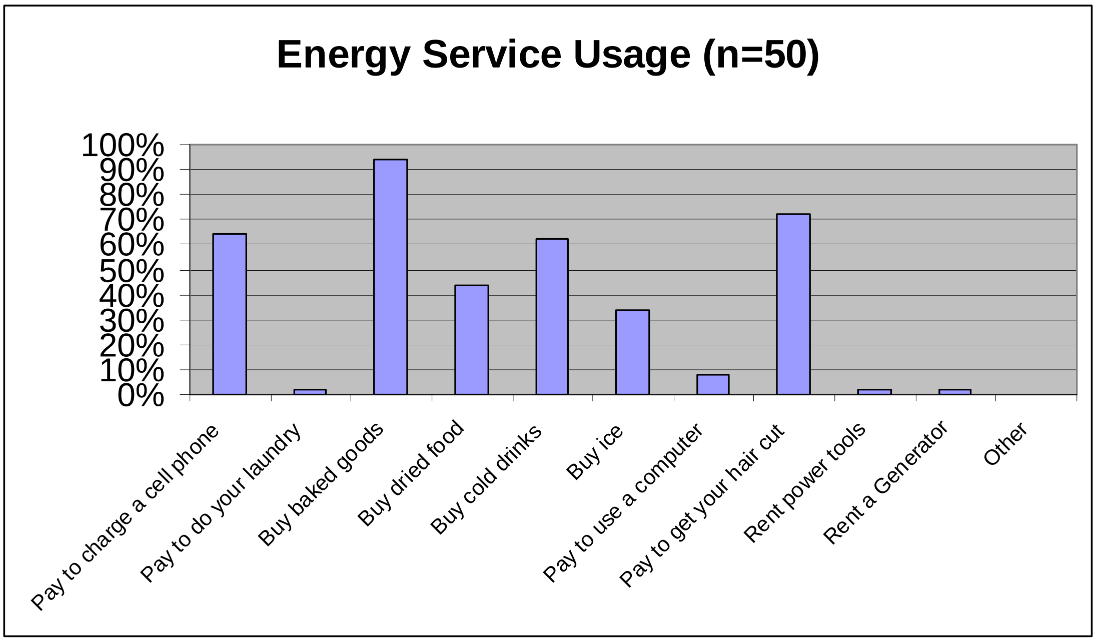
We determined from the travel data that paraffin and candles are available near the community including several locations inside the settlement. Wood could also be bought within the settlement, but many people walked several kilometers to collect wood several times a week. Knowledge on average usage and cost allowed us to do a cost analysis of their current fuels versus renewable sources. Since we determined that the most commonly used energy sources were relatively inexpensive and convenient, we realized that the introduction of fuel alternatives would have to focus on safety and environmental factors as well as being cheaper in the long run.

4.4.5 Energy Service Usage

Figures on the typical utilization of energy related services were obtained to uncover whether renewable energy services could be introduced within the settlement. We also obtained additional information about the usage frequency of these services and their costs. This data would be needed by an entrepreneur to offer these services in an unelectrified area. Figure 18 illustrates typical service usage within Havana.

* Only households that bought wood and did not collect it.

Figure 18: Energy Service Usage



Paying to have a cell phone charged, buying baked goods, and paying to get a haircut were the most commonly utilized energy services. Over 60 percent of people pay to have their cell phone charged, more than 90 percent buy baked goods, and over 70 percent pay to get their hair cut. It is likely that cell phones are prolific because they are the only means of communication within a settlement. In addition, bread is a staple of the average resident's diet and cannot be baked within their homes, causing people to purchase it frequently. Finally, haircutting is often used due to the culture, with nearly every man within Havana having short hair. We found that they typically cut it between two and three times every month due to their preferred hairstyle. The average costs and frequency of service use are listed in Table 2. Not included in the prices are the travel costs incurred by traveling to electrified areas where these services are offered. Charging cell phones and hair cutting were two major services which required residents in Havana to travel to electrified areas. With this data, an entrepreneur could determine the approximate price he should charge for these services to compete with other local businesses while providing the service in an unelectrified area. Furthermore, once he predicted the size of his customer base for each service, he could calculate what his income would be each month though that service.

Table 2: Average Frequency of Usage and Costs for Services

	Average Frequency of Usage	**Average Cost of Service**
Charge Cell Phone	6.6 times per month (per person)	N$ 5.48 per charge
Baked Goods	15.6 times per month (per household)	N$ 6.70 per bread
Get Hair Cut	1.8 times per month (per person)	N$ 34.29 per haircut

4.5 Accuracy of Survey Results

To ensure that our surveying method was capable of producing minimally-biased data, we validated some of the statistics generated by our survey using other sources. Rather than look at all of our data, we focused on the most popular fuel source, paraffin, and cross-checked the amount used as well as the price of this fuel.

We validated our paraffin usage data using the EnPower survey that had been administered in a settlement within a few kilometers of Havana. While our survey produced an average paraffin usage of 16.4 liters per month per household, EnPOWER had produced a similar figure of 16.7 liters per month per household in a neighboring community. Judging from the similarity in these figures, we concluded that our survey had produced accurate usage statistics.

After verifying these usage statistics, we cross-checked the average cost per liter of paraffin in the settlement. To do this, we visited nearby stores that sell paraffin and found some pricing figures. We first obtained pricing from two local cuca shops where the price of one liter of paraffin was set at N$6.50. Following this, we traveled about four kilometers into town to a service station. There we observed a sign advertising one liter of paraffin for N$6.15. With our average cost of N$6.14, we could be fairly confident in our results. It is likely that many individuals that we surveyed travel in town to obtain their paraffin and may also obtain this fuel at lower rates when they purchase it in bulk.

After attempting to validate some of our data, we were able to find similar information from multiple sources. The EPOGES toolkit produced an average paraffin usage that was within 1.8 percent of the amount reported by the EnPower toolkit. In addition, the data we collected on the cost of paraffin was fairly consistent. It is clear from these results that we avoided higher than actual figures for usage and pricing of paraffin. This bias, if found, would have compromised the integrity of the energy assessment survey and data analysis tool. Fortunately, our cross-checking practices validated our survey data.

4.6 Applicability of EPOGES toolkit to SME Support Organizations

The next step in improving our EPOGES toolkit was to prove its applicability to SMESOs. Therefore, we met with two representatives from local SME support organizations, and asked whether the information provided by the toolkit was applicable to the startup of a SME and whether the SMESOs could use the data analysis tool. From our interviews, we received positive feedback about the content and ease of use of the EPOGES toolkit. See Appendix K: Small and Medium Enterprise Support Organization (SMESO) Contact Information, Appendix L: SMESO Feedback- SMEs Compete, and Appendix M: SMESO Feedback- Joint Consultative Council for more information on the interviews and SMESOs contact information.

4.6.1 SMEs Compete Interview

First, we met with Mr. Danny Meyer, the director of SMEs Compete, a small, for-profit SME consulting agency in Windhoek. Although SMEs Compete only deals with small businesses that have been operating for at least one year and not with the initial startup of SMEs, Mr. Meyer was still able to offer some useful feedback about the content and ease of use of our tool.

Mr. Meyer was quoted as saying that our survey takes a "very good approach" to the energy needs assessment (D. Meyer, personal communication, April 16, 2007). He also described our analysis data as "comprehensive and all-inclusive." According to Mr. Meyer, our toolkit provided the information needed for an entrepreneur to assess the business opportunities in the area.

Furthermore, we asked about the usage of analysis tools in SMESOs. We found that SMEs Compete and organizations like it often use very similar types of data analysis tools to perform analysis for small entrepreneurs. Employees at these organizations often use Microsoft Office tools and spreadsheets to compile information for the use of small businesses.

4.6.2 Joint Consultative Council (JCC) Interview

We also met with Ms. Tuwilika Hamwele of the JCC. The JCC was a coordinating body between SME support organizations in Namibia. Although the JCC does not provide counseling and services to entrepreneurs directly, Ms. Hamwele was familiar with the processes SMESOs use to assist entrepreneurs. She was also familiar with many of the tools that SMESOs utilize to help support entrepreneurs.

After discussing the EPOGES toolkit, she concluded that our analysis was complete and that all needed information for a startup business was provided, including both pricing and usage statistics of fuels and services. She concluded that SMESOs would be able to use our tool to assist an entrepreneur (T. Hamwele, personal communication, April 16, 2007).

4.7 Market Analysis Results

Although our project focused on providing the tools for performing an energy needs assessment, we used the results from our test in Havana to determine areas where RETS could be introduced to expand services and fuels provided in Havana and to introduce alternatives to currently used energy fuels. The alternatives that we have identified are discussed in our recommendations. In addition, we used the INSABA tool to perform a market analysis on two services that could be provided through RETS. These case studies are found in Appendix I: Case Study for Solar Cell Phone Charging and Haircutting and Appendix J: Case Study for Small SME Using Energy Basket 15 from the OGEMP.

4.8 Summary

The development of the EPOGES toolkit was an involved process. Our survey development required multiple consultations with experienced surveyors and DRFN personnel as well as many brainstorming and testing sessions. Limitations in Microsoft Access and Excel were compensated for in order to make the data analysis as user-friendly as possible. Comprehensive summaries of energy usage and services within surveyed communities were also provided by the EPOGES data analysis tool. We chose to display certain statistics that could be used to implement RETS into

SMEs such as fuel and service usages, average costs, and the average distance traveled to get the fuel or service.

Through out testing process, we concluded that the EPOGES toolkit was culturally acceptable and could be applied to any unelectrified location in Namibia. We minimized the complexity of the required surveying techniques and received little negative response when conducting the surveys. Likewise, after having students test our data analysis tool, we were confident that our analysis tool could be used to compile data from a large number of surveys by the average SMESO employee.

By testing our EPOGES toolkit in Havana, we found that the most common energy fuels used were paraffin, wood, and candles and that the most common energy services utilized were charging cell phones, getting haircuts, and buying baked goods. We also compiled statistics on the usage frequency, average prices and travel methods used to purchase the fuels and services. This data can prove valuable to an individual starting up a RETS SME by identifying what alternatives can be introduced as well as developing competitive pricing.

Finally, we checked the credibility and applicability of the results obtained in our survey. The EPOGES toolkit produced amount used and pricing data that was within a negligible degree of error when compared with the results from the EnPOWER toolkit as well as the price advertised in local stores. Furthermore, we received feedback from local SMESOs and concluded that our toolkit summarized the resultant data effectively, allowing a trained individual from an SMESO to make specific recommendations to a potential entrepreneur.

Once the EPOGES toolkit and data from Havana were proven valid and applicable to the development of a renewable energy business, we made recommendations on the substitution of renewable energy sources with current energy sources as well as the focus of future research for the completion of the DRFN's proposed market assessment plan.

5.0 RECOMMENDATIONS

After gathering developing the EPOGES toolkit and applying it to the settlement of Havana, we determined a number of recommendations based on our observations through the development process as well as the results we obtained from our case study. These include the market potential for the introduction of RETS as well as some recommendations for businesses. Also, more research needs to be done into RETS before a full market assessment can be completed. The EPOGES toolkit, however, allowed us to determine the best energy fuels and services on which to focus this research.

We looked at the following renewable fuels and services to meet the needs of individuals within settlements:

5.1 Renewable Fuel Alternatives

From our data, we determined that the most widely used fuels were paraffin, wood, and candles. These fuels were used almost exclusively for cooking and lighting. Several RETS alternatives are currently available to meet these needs.

5.1.1 Bio-Diesel

One possible alternative to paraffin would be bio-diesel. This fuel is environmentally friendly and is safer to use than paraffin. Bio-diesel is produced from vegetable oils and does not contribute to global warming or give off toxic fumes. In addition, it is safer to use than paraffin because a bio-diesel lantern will extinguish itself if it falls over while a paraffin lamp could set the house on fire. In addition, no additional stoves or lamps are needed, since bio-diesel can be used in any paraffin appliances. Bio-diesel, however, is not as efficient as paraffin, requiring ten to fifteen percent more fuel to provide the same amount of energy. A detailed cost comparison is needed in order to determine the viability of this alternative.

5.1.2 Ethanol Gel

Ethanol gel stoves are another possible substitution for cooking with both paraffin and wood. Ethanol gel is more environmentally friendly than paraffin because it is produced by processing sugar and does not contribute additional carbon dioxide to the atmosphere. In addition, ethanol gel, will extinguish if the lantern is tipped over similar to bio-diesel. Ethanol gel is fairly inexpensive at N$1.60 for one liter, compared to N$6.14 for paraffin, and can produce a significant amount of heat for cooking. This form of energy is currently used in some areas of Namibia, but has yet to be introduced in Havana. If an infrastructure for supply is developed, this technology could be used in Havana as well.

5.1.3 Photovoltaic Lantern

Another alternative would be replacing current lighting fuels with a small PV array and fluorescent light. While candles are fairly inexpensive, their costs compound over time. On average a typical resident in Havana uses about one candle every night and spends about N$1.50 on each candle. This results in an expenditure of N$45 every month, which could be put towards a simple solar PV lantern. Currently these lanterns cost between N$600 and N$1000. They require a new light bulb every year and new batteries every three years. With proper maintenance, however, a PV lantern can last for twenty years (Yaron, et al., 1994). With typical resident in Havana spending N$540 every year on candles a simple PV lantern could be purchased nearly every year. This alternative would be safer for the user and better for the environment. Most importantly to the end user, however, these alternatives would be less expensive in the long run and safer than their current method.

5.2 Renewable Service Alternatives

Many services requiring conventional fuels are currently utilized within Havana. We discovered that many people pay to have their cell phones charged and have their hair cut regularly. These services could be provided using renewable energy.

5.2.1 Solar Cell Phone Charging

From our data, we determined that the average individual has their cell phone charged six to seven times per month at an average cost of N$5.50 per charge. In addition, many individuals must take a taxi or walk to electrified locations to charge their cell phones. A photovoltaic array and charging system could be used to meet this need. While this would not be cost-effective for an individual, a business could be started that charges cell phones. A solar cell phone charging system costs about N$5000 (R. Schultz, personal communication, March 12, 2007) and requires new batteries every five years. This system could be paid off after only six months by charging ten cell phones per day at a cost of N$4 (R. Schultz, personal communication, March 12, 2007). In addition, other than battery replacement, the PV array is guaranteed for 25 years. If PV charging systems were implemented, cell phone charging would be provided conveniently and at an affordable rate within the community. See Appendix I: Case Study for Solar Cell Phone Charging and Haircutting and Appendix J: Case Study for Small SME Using Energy Basket 15 from the OGEMP for a more detailed analysis.

5.2.2 Solar Haircutting

Finally, haircutting could be a lucrative business opportunity within Havana. Most residents walk or take a taxi to electrified locations in order to use this service. A business could be started using a PV array, an inverter, and a pair of clippers. According to our results, the average person pays for a haircut about twice in a month, paying on average N$34. These haircuts could generate a considerable amount of income for a prospective entrepreneur within Havana. See Appendix I: Case Study for Solar Cell Phone Charging and Haircutting and Appendix J: Case Study for Small SME Using Energy Basket 15 from the OGEMP for a more detailed analysis.

5.3 Further Research

While we have outlined some possible RETS that could be introduced within Havana, further analysis needs to be done before a business can be started. The cost of replacement fuels as well as the cost of the startup materials needed to provide certain services needs to be taken into account when developing a business plan. In addition, proper advertising needs to be researched and a supply chain must be developed before these businesses can begin. Our project provided the needs assessment portion of the market research. The recommendations presented must be further evaluated with technical research and cost analysis before introduction in a RETS SME.

5.4 Summary

After gathering and analyzing the energy usage data in Havana, we developed several recommendations. Due to the prevalence of paraffin, wood, and candles for cooking and lighting, ethanol gel, bio-diesel, and PV lanterns would be cleaner, safer alternatives that are often less expensive. In addition, we recommend that solar cell phone charging and haircutting businesses be implemented within the community in order to provide energy services that are convenient and inexpensive. However, additional research is needed into fuel alternatives to determine their viability in Havana. In addition, a supply infrastructure would need to be built within the community.

If it is proven that there is both a demand for new, cheaper energy technologies and services in unelectrified settlements and that renewable energy technologies such as bio-diesel and solar electricity are effective alternatives, then energy shops will likely become the basis for rural electrification in Namibia. If this approach can be proven successful in Namibia, the same approach can be applied to rural energization programs throughout the world. These renewable energy programs will improve the quality of life for people currently living in unelectrified areas while providing a cleaner and viable alternative to conventional energy infrastructures.

REFERENCES

Annual Report: 2005-2006. (2006). Windhoek Namibia: Desert Research Foundation of Namibia.

Berg, B. L. (2007). *Qualitative research methods for the social sciences* (6th ed.). Boston: Pearson Education, Inc.

Consulting Service Africa. (2005). *Baseline study: Barrier removal to Namibian renewable energy programme (NAMREP).* Windhoek, Namibia: Ministry of Mines and Energy: Directorate of Energy.

Electricity act, 2000. (2000). Namibia: Ministry of Mines and Energy.

Electricity regulations: Technical. (2000). Ministry of Mines and Energy.

EMCON Consulting Engineers. (2001). *Rural electrification in Namibia: an information brochure*. Namibia: Desert Research Foundation of Namibia.

Energy Information Administration. (1996). Energy Consumption Series: Residential Energy Consumption Survey Quality Profile. Washington, DC: U.S. Department of Energy, Retrieved April 16, 2007, from http://tonto.eia.doe.gov/FTPROOT/consumption/0555961.pdf

Ministry of Mines and Energy & Namibia Renewable Energy Programme. (2007). *Off-grid energisation master plan for Namibia.* Consulting Services Africa.

Ministry of Mines and Energy & NamPower. (2000). *Rural electricity distribution master plan for Namibia*. EMCON Consulting Engineers.

Mueller, H., & Tobich, R. (2001). *The transition from pilot projects to large scale programmes: the case of Namibia*. Retrieved April 10, 2007, from http://roo.undp.org/gef/Solarpv/docs/bgmaterial/Misc%20PV%20Papers/WIRE%20-%20The%20Transition%20from%20Pilot%20Projects%20to%20Large%20Scale%20Programmes%20-%20The%20Case%20of%20Namibia.pdf

Scherl, Lea M. (1996). *Relationships and partnerships among governments, NGOs, CBOs, and indigenous groups in the context of the convention to combat desertification and drought.* Nairobi, Kenya: The Environment Liaison Centre International.

Schultz, Robert. (2002). Sustainable Energy News. *Biomass kick off in Namibia*, *39*, 15.

Schultz, Robert, & Schöneburg-Schultz, Daniela (2006). *Small and medium enterprises in Namibia: a brief situational analysis.*

Sebitosi, A. B., & Pillay, P. (2005). Energy services in sub-Saharan Africa: How conducive is the environment? [Electronic version]. *Energy Policy, 33*(16), 2044-2051. Retrieved February 5, 2007, from Science Direct database.

Stage, J., & Fleermuys, F. (2001). Energy use in the Namibian economy from 1995 to 1998. [Electronic version]. *Development Southern Africa, 18*(4), 423-442. Retrieved January 24, 2007, from Business Source Premier database.

Strategic plan 2006-2010. (2005). Electricity Control Board of Namibia.

United Kingdom's Department for International Development (DFID). (2003). *EnPower Toolkit*.

van der Vleuten, F., Stam, N., & van der Plas, R. (2007). Putting solar home system programmes into perspective: What lessons are relevant? [Electronic version]. *Energy Policy, 35*(3), 1439-1451. Retrieved February 9, 2007, from Science Direct database.

Ward, Sarah. (2002). *The energy book for urban development in South Africa*. Noordhoek, South Africa: Sustainable Energy Africa.

White paper on energy policy. (1998). Ministry of Mines and Energy.

Yaron, Gil, Irving, Tani Forbes, & Jansson, Sven. (1994). *Solar energy for rural communities: the case of Namibia*. Namibia: Intermediate Technology Publications Ltd.

Zimbabwe rural electrification study. (2000). Retrieved February 9, 2007, from Google database.

Appendix A: Survey Conducted by Venasius Amukwa

General:

- Size of Household
- Main info channels
- Current household development priorities

Renewable Energy:

- Type of fuels used (paraffin, wood, dry-cells, candles, etc)
- Quantity of fuel used per month
- Expenditure for fuel per month
- Energy appliances used (lamp, candle holder, wood saving stove, radio, etc)
- Energy services used (close lighting, area lighting, water heating for cooking, water heating for washing, cooking, entertainment, etc)
- Closest access point for fuels and appliances (in km)
- Expenditure for transport
- How fuels are obtained
- Fuel preferences conventional and RE

Energy Efficiency

If we combine the 2.1 RE Baseline and the 1.1 EE Baseline the following additional information needs to be obtained:

- Is the current in-door climate acceptable to the household?
- Is the household aware of how to influence the in-door climate?
- Record any examples (techniques, methods, technologies and behaviour changes) of EE in the household and community

Overarching issues that I suggest we develop into questions

- How will we distinguish issues that are mainly from peri-urban areas vs those in deep rural localities? I suspect there will be quite a few.
- What habits are currently an impediment to introduce other energy services
- What are the issues except lack of finances that people give for using one energy option vs another one
- Do people appreciate what they spend per month on energy related services, and how does this compare to their food expenses
- Are there opportunities, e.g. via energy shops, to satisfy some needs
- What do people really want, and what would they not likely take on board to energy services

Appendix B: NamPower Mini-Grid and Off-Grid Study

NAMPOWER MINI-GRID AND OFF-GRID STUDY
BUSINESS QUESTIONNAIRE

SECTION A – BACKGROUND

QUESTION 1 – Indicate name of business.		V
QUESTION 2 – Indicate name of settlement.		V
QUESTION 3 – Indicate type of business.		V
QUESTION 4 – Indicate type of building.		V
QUESTION 5 – Indicate approximate size of building.		V
QUESTION 6 – Indicate number of employees.		V
QUESTION 7 – Indicate average monthly turnover.		V

SECTION B – GROWTH TRENDS

QUESTION 8 – Indicate the following growth trends referring to the last three (3) years.

TREND:	Increased	Constant	Decreased	
Turnover				V
Number of Customers				V
Number of Employees				V
Physical Space				V

SECTION C – ELECTRICITY

INSTRUCTIONS

Complete the remaining questions in this section with reference to "TYPE OF ENERGY"

TYPE OF ENERGY	**Wood**	**Dung**	**Coal Charcoal**	**Kerosene**	**Gas**	**12 Volt Batteries**	**HH Batteries**	**Candles**	
QUESTION 9 – Indicate **main** type of energy used for each activity.									
Food Preparation									V
Heating									V
Lighting									V
Social									V
Heating of Water									V
QUESTION 10 – Indicate how the following energy sources are acquired.									
	V	V	V	V	V	V	V	V	
Purchased									
Collected									
Manufactured									
QUESTION 11 – Indicate the distance in km. that persons have to travel to acquire each of the energy sources.									
	V	V	V	V	V	V	V	V	
Distance in Km.									

QUESTION 12 – Indicate monthly costs of each of the energy sources.									
	V	**V**	**V**	**V**	**V**	**V**	**V**	**V**	
Monthly Costs (N$)									
QUESTION 13 – Will mini-grid / off grid energy sources be more efficient / convenient than current energy sources?									
	V	**V**	**V**	**V**	**V**	**V**	**V**	**V**	
Yes									
No									
QUESTION 14 – Indicate the ease of conversion from current energy sources to mini grid / off grid energy sources considering general circumstances.									
	V	**V**	**V**	**V**	**V**	**V**	**V**	**V**	
Easy									
Uncertain									
Difficult									
QUESTION 15 – If electricity is made available to the business, is the business owner prepared to pay and how much?									
Installations	Yes		No		**V**	Amount (N$)			**V**
Payments for electricity usage.	Yes		No		**V**	Amount (N$)			**V**
QUESTION 16 – Does the business owner know what an average business pays p.m. for electricity?	Yes		No		**V**	Amount p.m.? (N$)			**V**
QUESTION 17 – An average business pays approximately N$ ** p.m. for electricity. Is the business owner prepared to pay this amount?					Yes		No		**V**
QUESTION 18 – Is the business owner prepared to pay the following amounts to use electricity for these activities?	Food Preparation N$ (Client Input)				Yes		No		**V**
	Heating N$ (Client Input)				Yes		No		**V**
	Lighting N$ (Client Input)				Yes		No		**V**
	Social N$ (Client Input)				Yes		No		**V**
	Heating of Water N$ (Client Input)				Yes		No		**V**
	Entertainment N$ (Client Input)				Yes		NO		**V**
QUESTION 19 –Rank the following electrical appliances in terms of priority to be bought if electricity is supplied.									
(1 = Highest Priority / 8 = Lowest Priority)									
Radio / TV		**V**	Heater / Air-conditioner						**V**
Kettle / Urn		**V**	Office Equipment / Computer						**V**
Stove / Oven		**V**	Cash Register						**V**
Kitchen Appliances / Fridge		**V**	Vacuum Cleaner / Other Equipment						**V**
SECTION D – GENERAL									
QUESTION 20 –Give a description of the business' potential to be utilised as a future facilitator of energy sources.									
Utilities:									
Role in settlement:									
Accessibility:									
Stability:									

Appendix C: EnPower's Situational Research Guide

ENPOWER

T2 SITUATIONAL RESEARCH QUESTIONNAIRE

1.	**Geographic Data**	
	Question	***Answer/ Range, source of information, comment***
1.1	Village name	
1.2	Village – Other names	
1.3	Village Lat, Long Co-ordinates	
1.4	Boundaries	
1.5	Region, district	
1.6	Major town close by & distance	
1.7	Leadership Structure	
1.8	Distance between settlements/communities	
1.9	Distance between houses	
1.10	Road accessibility	
1.11	No. of houses & strata/castes of communities	
1.12	People in households	

2.	**Energy Related Analysis**	
	Question	**Answer/ Range, source of information, comment**
2.1	Wood availability	
2.2	Wood price bundle sizes	
2.3	Wood quality	
2.4	Charcoal	
2.5	Biomass	
2.6	Sun	
2.7	Wind	
2.8	Hydro	
2.9	Existence of other utilities	
2.10	Electricity network	
2.11	Community electricity Expectations	
2.12	Future Upliftment plans	
2.13	Previous Energy Interventions	
2.14	Available fuel	

2.15	How is fuel obtained?	
2.16	Who buys or gathers fuel?	

3.	**Economic conditions:**	
	Questions	**Answer/ Range, source of information, comment**
3.1	Economic conditions Monetary income	
3.2	Who contributes?	
3.3	Form of income	
3.4	Unemployment level	
3.5	Developmental initiatives?	
3.6	What growth potential?	
3.7	Economic activities?	
3.8	Modern energy services or traditional?	
3.9	Options for production of household appliances.	
3.10	Supply of raw materials?	

4.	**Socio-cultural conditions:**	
	Questions	**Answer/ Range, source of information, comment**
4.1	Cooking and eating	
4.2	Woman status	
4.3	Who decides?	
4.4	Role fireplace beyond cooking?	
4.5	Household composition	

5.	**Dissemination-relevant aspects:**	
	Questions	**Answer/ Range, source of information, comment**
5.1	Channels dissemination Household appliances? Broadcast signals	
5.2	Other organizations possibility of co-operation	

Appendix D: Survey Piloted in Havana

Q 1: Name of settlement				
Q 2:	□ home		□ business, type ____________________	
Q 3: Name of respondent				
Q 4: Address of location				
Q 5: Contact information				
Q 6: Number of household members/employees?				
Sexes/Ages	M / F Age:____	M / F Age:____	M / F Age:____	M / F Age:____
	M / F Age:____	M / F Age:____	M / F Age:____	M / F Age:____
	M / F Age:____	M / F Age:____	M / F Age:____	M / F Age:____
	M / F Age:____	M / F Age:____	M / F Age:____	M / F Age:____

	Stove / Cooker									Cooler (refrigerator)			Deep-Freeze			Lighting					Electronics				Water pump					Water heater					Space heater								Generator						Misc.		
	Paraffin	Wood	Energy-efficient wood	Open fire	LPG	Ethanol gel	Solar cooker	Microwave	Other ____	LPG	Paraffin	Other ____	LPG	Paraffin	Other ____	Paraffin lamp	Candles	Open fire	Light bulb	Other ____	TV	Hi Fi	Radio	Cell phone	Hand	Solar	Diesel	Petrol	Other ____	Solar	Paraffin	LPG	Wood	Other ____	Paraffin	Wood	Energy-efficient wood	Open fire	LPG	Ethanol gel	Solar cooker	Other ____	Diesel	Petrol	LP gas	Wind	Solar	Other ____	Power tools	Fan	Other ____
Q 7: Do you own a(n)...?																																																			

Types of Energy	Paraffin	LP gas	Wood	Lead-Acid Battery (12V)	Candles	Dry Cell Batteries (1.5V)	Diesel	Petrol	Ethanol Gel	Solar Electricity	Wind Electricity	Plant material	Charcoal	Animal Dung	Individual Bio Gas	Communal Bio Gas	Recyclables/Waste	Grid Electricity	Other ______
Q 8: Do you use…?																			
Q 9: What is the energy used for?																			
Food Preparation																			
Room Heating																			
Lighting																			
Water heating - laundry																			
Water heating - cooking																			
Cooler (refrigerator)																			
Deep-freeze (freezer)																			
Generator																			
Radio																			
Hi Fi																			
TV																			
Hair cutting tools																			
Power tools																			
Other: ______________																			
Q10: How much energy do you use?																			
Per month	L	kg	bundle	charge	candles	charge	L	L	kg	W	W	kg	kg	kg	unit	kg	kg	kWh	

Types of Energy	Paraffin	LP gas	Wood	Lead-Acid Battery (12V)	Candles	Dry Cell Batteries (1.5V)	Diesel	Petrol	Ethanol Gel	Solar Electricity	Wind Electricity	Plant material	Charcoal	Animal Dung	Individual Bio Gas	Communal Bio Gas	Recyclables/Waste	Grid Electricity	Other ___
Q 11: How do you get the energy?																			
Purchased																			
Collected																			
Free																			
Q 12: How much do you pay each time you buy/charge it?																			
Per unit	L	kg	bundle	charge	candles	charge	L	L	kg	W	W	kg	kg	kg	unit	kg	kg	kWh	
Q 13: How many times per month do you buy/charge it?																			
Q 14: How do you travel to get the energy? (method)																			
Walk																			
Bicycle																			
Taxi																			
Private car																			
Public bus																			
Other ______________																			
Q 15: How far do you travel to get the energy?																			
Distance (km)																			
Q 16: How much do you pay for the round-trip?																			
Travel costs each time (N$)																			

Type of Service	Pay to charge a cell phone	Pay to do your laundry	Buy baked goods	Buy dried food	Buy cold drinks	Buy ice	Pay to use a computer	Pay to get your haircut	Rent power tools	Rent a generator	Other ________
Q 17: Do you…?											
Q 18: How many times per month do you…?											
Q 19: How much do you pay each time to...? (N$)											
Q 20: How do you travel to…? (method)											
Walk											
Bicycle											
Taxi											
Private car											
Public bus											
Other ________________											
Q 21: How far or how long do you travel to...?											
Distance (km)											
Q 22: How much do you pay to travel each time to...? (N$)											

Appendix E: Final Survey

Q 1: Name of settlement				
Q 2:	□ home		□ business, type ____________________	
Q 3: Name of respondent				
Q 4: Address of location				
Q 5: Contact information				
Q 6: Number of household members/employees?				
Sexes/Ages	M / F Age:____	M / F Age:____	M / F Age:____	M / F Age:____
	M / F Age:____	M / F Age:____	M / F Age:____	M / F Age:____
	M / F Age:____	M / F Age:____	M / F Age:____	M / F Age:____
	M / F Age:____	M / F Age:____	M / F Age:____	M / F Age:____

	Stove / Cooker								
	Paraffin	Wood	Energy-efficient wood	Open fire	LPG	Ethanol gel	Solar cooker	Microwave	Other ___
Ref Num	1	2	3	4	5	6	7	8	9
Q 7: Do you own a(n)...?									

	Cooler (refrigerator)			Deep-Freeze		
	LPG	Ice	Other ___	LPG	Paraffin	Other ___
Ref Num	1	2	3	1	2	3
Q 7: Do you own a(n)...?						

	Lighting					Electronics			
	Paraffin lamp	Candles	Open fire	Light bulb	Other ___	TV	Hi Fi	Radio	Cell phone
Ref Num	1	2	3	4	5	1	2	3	4
Q 7: Do you own a(n)...?									

	Water pump					Water heater				
	Hand	Solar	Diesel	Petrol	Other ___	Solar	Paraffin	LPG	Wood	Other ___
Ref Num	1	2	3	4	5	1	2	3	4	5
Q 7: Do you own a(n)...?										

	Space heater							
	Paraffin	Wood	Energy-efficient wood	Open fire	LPG	Ethanol gel	Solar cooker	Other ___
Ref Num	1	2	3	4	5	6	7	8
Q 7: Do you own a(n)...?								

	Generator						Misc.		
	Diesel	Petrol	LP gas	Wind	Solar	Other ___	Power tools	Fan	Other ___
Ref Num	1	2	3	4	5	6	1	2	3
Q 7: Do you own a(n)...?									

Types of Energy		Paraffin	LP gas	Wood	Lead-Acid Battery (12V)	Candles	Dry Cell Batteries (1.5V or PM9)	Diesel	Petrol	Ethanol Gel	Solar Electricity	Plant material	Charcoal	Recyclables/Waste		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Q 8: Do you use…?																
Q 9: What is the energy used for?																
Food Preparation	1															
Room Heating	2															
Lighting	3															
Water heating - laundry	4															
Water heating - bathing	5															
Cooler (refrigerator)	6															
Deep-freeze (freezer)	7															
Generator	8															
Torch / flashlight	9															
Radio	10															
Hi Fi	11															
TV	12															
Hair cutting tools	13															
Power tools	14															
Other: ______________	15															

Types of Energy		Paraffin	LP gas	Wood	Lead-Acid Battery (12V)	Candles	Dry Cell Batteries (1.5Vo PM9)	Diesel	Petrol	Ethanol Gel	Solar Electricity	Plant material	Charcoal	Recyclables/Waste		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Q 10: How much energy do you use?																
Per month		L	kg	bundle	charge	candles	batteries	L	L	kg	W	kg	kg	kg	unit	unit
Q 11: How do you get the energy?																
Purchased																
Collected																
Free																
Q 12: How much do you pay each time you buy/charge it?																
Per unit		L	kg	bundle	charge	candle	battery	L	L	kg	W	W	kg	kg	kg	unit
Q 13: How many times do you buy/charge it?																
Per month																
Q 14: How do you travel to get the energy? (method)																
Walk																
Bicycle																
Taxi																
Private car																
Public bus																
Other _______________																
Q 15: How far do you travel to get the energy?																
Distance (km)																
Q 16: How much do you pay for the round-trip?																
Travel costs each time (N$)																

Type of Service	Pay to charge a cell phone	Pay to get your haircut	Buy bread	Buy cold drinks	Buy dried food	Buy ice	Pay to use a computer	Pay to do your laundry	Rent power tools	Rent a generator	Other ______
	1	2	3	4	5	6	7	8	9	10	11
Q 17: Do you…?											
Q 18: How many times per month do you…?											
Q 19: How much do you pay each time to…? (N$)											
Q 20: How do you travel to…? (method)											
Walk											
Bicycle											
Taxi											
Private car											
Public bus											
Other ________________											
Q 21: How far do you travel to…? (km)											
Q 22: How much do you pay to travel each time to…? (N$)											

Appendix F: EPOGES Toolkit User Manual

The EPOGES Toolkit

User Manual

A SMESO's Guide for the Use of
the EPOGES Toolkit

TABLE OF CONTENTS

1.0 About the EPOGES Survey and Analysis Tool

The EPOGES (Energy Profiling for Off-Grid Energy Solutions) baseline energy and services survey and analysis tools were developed by a team of Worcester Polytechnic Institute students from the United States of America working with the Desert Research Foundation of Namibia in April 2007. The toolkit can be obtained by contacting Robert Schultz (robert.shultz@drfn.org.na). The purpose of these tools is to provide meaningful data for an entrepreneur wishing to start an energy business in an unelectrified area. The survey and analysis tools were designed to be administrable in any unelectrified settlement in the country of Namibia. To test this, the survey was administered and the analysis tool was used effectively to provide an energy assessment of the energy usage and needs in the unelectrified settlement of Havana outside Windhoek, Namibia. The analysis tool uses a combination of Microsoft Access and Excel to compile and analyze the survey data. Only basic computer skills are required to use the toolkit.

Although Namibia is home to more than 11 languages, the EPOGES Toolkit is currently offered in only English and Afrikaans. These languages were selected for the survey to ensure that the entrepreneur can communicate with the commercial sellers and a large enough population of the target market, which is a critical component to a business's success.

2.0 Getting Started

First, it should be confirmed that the entrepreneur possesses a basic knowledge of the types of fuels and services used within the targeted community. If this knowledge is not known, a situational assessment of the proposed market should be completed (see EnPower Situational Research Guide for an example). This information will determine which types of fuels and services should be included in the EPOGES survey.

2.1 Instructions for Surveying

Information about the survey as well as a brief introduction on surveying itself must be discussed in detail with the entrepreneur. An in-depth explanation of surveying includes details on both the preparation and execution stages. Also, assume that the entrepreneur has no prior surveying experience. The survey should be reviewed question by question and the clarifications of each section of the survey should be discussed.

2.1.1 Survey Preparation

The preparation stage comprises of understanding the importance of a pitch, patience required while surveying, and collection of accurate data. The SMESO should assist the entrepreneur in the creation of an introductory statement that will introduce the entrepreneur and the purpose of his research to the respondents. Patience is required in order to obtain accurate data by not rushing the surveys or the surveying process. The entrepreneur should be encouraged to listen to what the respondents have to say regardless of its relevance to his survey. He should also be encouraged to collect a set of data as accurate and complete as possible since the analysis of this information is only as accurate as the data that is entered into the analysis tool. This means that he should closely examine the information he receives as he is giving the interview and should ask for verification if necessary. For example, if the typical respondents that the entrepreneur surveys pays N$4 to charge a cell phone, but one respondent pays N$30, the entrepreneur should inquire whether the respondent really meant this cost, if it included travel costs, or any other reasons he could think of as to why this respondent pays more for this service. He should be discouraged to interfere with this data by writing the numbers he feels is appropriate, but instead should indicate the numbers the respondent relays to him.

2.1.2 Survey Execution

The important considerations of the execution stage are the understanding of the importance of unobtrusive and non-threatening techniques, body language, and verbal language. The entrepreneur should understand how collecting the data while being unobtrusive and non-threatening would allow the respondent to feel more comfortable and open up to the entrepreneur. The entrepreneur's body and verbal language can influence the respondent's comfort and attitude, and therefore the elaboration of the responses. On the other hand, the importance of numerical answers should be stressed to the entrepreneur and the entrepreneur should be encouraged to inquire about questions that are answered incorrectly without being pushy or forceful with the respondent. For example, if a respondent replies that they buy bread “occasionally,” the entrepreneur should try to get a numerical number for that like “one loaf a week” by possibly suggesting answers, while being sure that the answer is the respondent’s own words.

The entrepreneur should be prepared to execute the surveys by having the necessary tools, such as a pencil and enough copies of the survey, and should also have practiced delivering the survey to become comfortable with it. The technique of delivering the survey should be demonstrated to the entrepreneur, and then the entrepreneur should attempt to administer it. This will allow the entrepreneur to receive feedback on his delivery of the survey and should clear up any misunderstandings he may have about questions, wording, or terminology. He should be encouraged to practice administering the survey a few times on his family or close friends in order to become comfortable and experienced with the survey itself as well as the act of conducting the survey.

2.1.3 Survey Clarifications

The following section explains the specific details of each of the five sections of the survey. It does not include the initial step of indicating the interviewer’s name, the date of the interview and the interview number on each page of the survey. This step is self-explanatory and should be done before the surveys are conducted. It is necessary that the entrepreneur understands the questions he will be asking and why he is asking them. Ensure that the entrepreneur's interpretations and comprehension of the questions is clear before he attempts to deliver the survey.

Part I- Demographics

The purpose of this section is to provide information about the demographics of the community so that correlations can be determined between energy usage and age and gender types. The contact information is required in case the entrepreneur must return to collect more information or clarify any details. It also allows for identifying different trends of energy usages and costs between homes and home based businesses by requiring the differentiation in this section.

Q 1: Name of settlement				
Q 2:	□ home		□ business, type________________	
Q 3: Name of respondent				
Q 4: Address of location				
Q 5: Contact information				
Q 6: Number of household members/employees?				
Sexes/Ages	M / F Age:___	M / F Age:___	M / F Age:___	M / F Age:___
	M / F Age:___	M / F Age:___	M / F Age:___	M / F Age:___
	M / F Age:___	M / F Age:___	M / F Age:___	M / F Age:___
	M / F Age:___	M / F Age:___	M / F Age:___	M / F Age:___

Q 1: Identify the name of the settlement where the survey is being administered.

Q 2: Identify whether the respondent is living in a household, running a business, or both. If the location of the business is the same as the household, such as a shebeen or cuca shop run out of the respondent's home, tick both types.

Q 3, 4, & 5: Indicate contact information including name of respondent, address of the household, and a phone number they can be reached at.

Q 6: Indicate how many residents/employees live/work in the household/business. Circle the gender and indicate the ages of the residents/employees. If the respondent is the owner of a business run out of his home, then indicate all household residents and business employees.

Note: residents are defined as persons living in the household for a majority of the year.

Part II- Appliance Use

The purpose of this section is to determine the appliances used by the respondent. From this data, trends can be identified about the different types of appliances used and the fuels that power them. It is also a lead-in for the next section, energy usage, because it requires the respondents to think about what they types of energy they use for their appliances.

	Stove / Cooker									Cooler (refrigerator)			Deep-Freeze		
	Paraffin	Wood	Energy-efficient wood	Open fire	LPG	Ethanol gel	Solar cooker	Microwave	Other	LPG	Ice	Other	LPG	Paraffin	Other
Ref Num	1	2	3	4	5	6	7	8	9	1	2	3	1	2	3
Q 7: Do you own a(n)...?															

	Lighting					Electronics				Water pump				
	Paraffin lamp	Candles	Open fire	Light bulb	Other	TV	Hi Fi	Radio	Cell phone	Hand	Solar	Diesel	Petrol	Other
Ref Num	1	2	3	4	5	1	2	3	4	1	2	3	4	5
Q 7: Do you own a(n)...?														

	Water heater					Space heater							
	Solar	Paraffin	LPG	Wood	Other	Paraffin	Wood	Energy-efficient wood	Open fire	LPG	Ethanol gel	Solar cooker	Other
Ref Num	1	2	3	4	5	1	2	3	4	5	6	7	8
Q 7: Do you own a(n)...?													

	Generator						Misc.		
	Diesel	Petrol	LP gas	Wind	Solar	Other	Power tools	Fan	Other
Ref Num	1	2	3	4	5	6	1	2	3
Q 7: Do you own a(n)...?									

Q 7: Checkmark the boxes of the appliances owned by the respondent.

Note: space and water heaters are appliances used specifically for those purposes. This does not include using a stove meant for food preparation to heat the water.

Part III- Energy Usage

This section determines the types of energy that the respondents use in their households. This determines the typical energy usages within the community. This section also serves as a lead-in for the next section, energy costs, by determining which fuels need to be priced.

Types of Energy		Paraffin	LP gas	Wood	Lead-Acid Battery (12V)	Candles	Dry Cell Batteries (1.5V or PM9)	Diesel	Petrol	Ethanol Gel	Solar Electricity	Plant material	Charcoal	Recyclables/Waste		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Q 8: Do you use...?																
Q 9: What is the energy used for?																
Food Preparation	1															
Room Heating	2															
Lighting	3															
Water heating - laundry	4															
Water heating - bathing	5															
Cooler (refrigerator)	6															
Deep-freeze (freezer)	7															
Generator	8															
Torch / flashlight	9															
Radio	10															
Hi Fi	11															
TV	12															
Hair cutting tools	13															
Power tools	14															
Other: ____________	15															

Q 8 & 9: Checkmark the appropriate energy usages for the types of fuels that the respondent uses regularly.

Note: Plant Material includes algae, crop residue, grass, leaves, etc. not including wood.

Part IV- Energy Cost

The purpose of this section is to determine the typical costs each household spends on energy per month. This includes the prices of fuels as well as the transportation cost involved in purchasing the fuels. The price spent per household per month establishes how much money would be available for investment in new renewable energy and the information about the transportation, such as distance traveled, determines the convenience of each type of fuel.

Types of Energy		Paraffin	LP gas	Wood	Lead-Acid Battery (12V)	Candles	Dry Cell Batteries (1.5V or PM9)	Diesel	Petrol	Ethanol Gel	Solar Electricity	Plant material	Charcoal	Recyclables/Waste		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Q 10: How much energy do you use?																
Per month		L	kg	bundle	charge	candles	batteries	L	L	kg	W	kg	kg	kg	unit	unit
Q 11: How do you get the energy?																
Purchased																
Collected																
Free																
Q 12: How much do you pay each time you buy/charge it?																
Per unit		L	kg	bundle	charge	candle	battery	L	L	kg	W	W	kg	kg	kg	unit
Q 13: How many times do you buy/charge it?																
Per month																
Q 14: How do you travel to get the energy? (method)																
Walk																
Bicycle																
Taxi																
Private car																
Public bus																
Other ___________																
Q 15: How far do you travel to get the energy?																
Distance (km)																
Q 16: How much do you pay for the round-trip?																
Travel costs each time (N$)																

Q 10: Indicate how much energy the respondent uses per month in the corresponding unit.

L	= liters
kg	= kilograms
bundle	= approximately the amount of wood an average-sized person could carry in one trip
charge	= number of times recharged
candle	= number of candles
batteries	= number of batteries
W	= Watts (power rating of the solar panel)

Q 11: Determine how the energy is obtained:

Purchased	= pay money for
Collected	= spent time collecting fuel
Free	= no time or money is spent in obtaining the energy

Note: Recyclable waste used as a fuel should typically be ticked as "Free" since the respondent is not paying for the waste for use as a fuel source. However, if the respondent specifies that he goes out of his way to collect this waste, such as actively walking around his area picking up trash to use as an energy source, then it should be ticked as "collected."

Q12: Indicate the cost the respondent pays per the corresponding unit each time he purchases the fuel. If the fuel is collected or is free, mark a zero in the appropriate box.

Q 13: Indicate how many times the energy is purchased, charged, or collected in a given month. Decimal places can be used if the respondent only purchases petrol every other month. (e.g. the interview should indicate "0.5" in the appropriate box to signify this value).

Q 14: Indicate the mode of transportation that the respondent typically uses to obtain the energy.

Q 15: Indicate the distance the respondent travels *one-way* to get the energy rounded to the nearest half-kilometer. For any distance under a quarter of a kilometer, write "zero."

Q 16: Indicate the *round-trip* cost the respondent spends each time they must travel to get to the energy.

Part V- Potential Services

This final section of the survey covers the services the respondents typically use. The purpose of this section is to determine which services could be met by the entrepreneur. Often, a service is utilized often, but residents are forced to travel far away from their community. This section of the survey will determine if the energy services are convenient and priced affordably.

Type of Service	Pay to charge a cell phone	Pay to get your haircut	Buy bread	Buy cold drinks	Buy dried food	Buy ice	Pay to use a computer	Pay to do your laundry	Rent power tools	Rent a generator	Other ___
	1	2	3	4	5	6	7	8	9	10	11
Q 17: Do you...?											
Q 18: How many times per month do you...?											
Q 19: How much do you pay each time to...? (N$)											
Q 20: How do you travel to...? (method)											
Walk											
Bicycle											
Taxi											
Private car											
Public bus											
Other ___________											
Q 21: How far do you travel to...? (km)											
Q 22: How much do you pay to travel each time to...? (N$)											

Q 17 & 18: Tick the appropriate boxes if the respondent uses any of the services listed in the columns.

Q 19: Indicate how much the respondent pays for the actual service each time they use it. Do not include the cost of transportation to the service.

Q 20: Indicate the mode of transportation that the respondent typically uses for the service.

Q 21: Indicate the distance the respondent travels *one-way* to use the service rounded to the nearest half-kilometer. For any distance under a quarter of a kilometer, write "zero."

Q 22: Indicate the *round-trip* costs the respondent spends each time he must travel to use the service.

3.0 Using the EPOGES Analysis Tool

The data analysis tool compiles the data collected from the EPOGES Survey, analyzes the data, and then displays it in a useful manner. The analysis tool can be customized to allow for different types of fuels and services used in the survey. This allows for the survey and analysis tool to be used for all types of fuels and services that are applicable to the settlement.

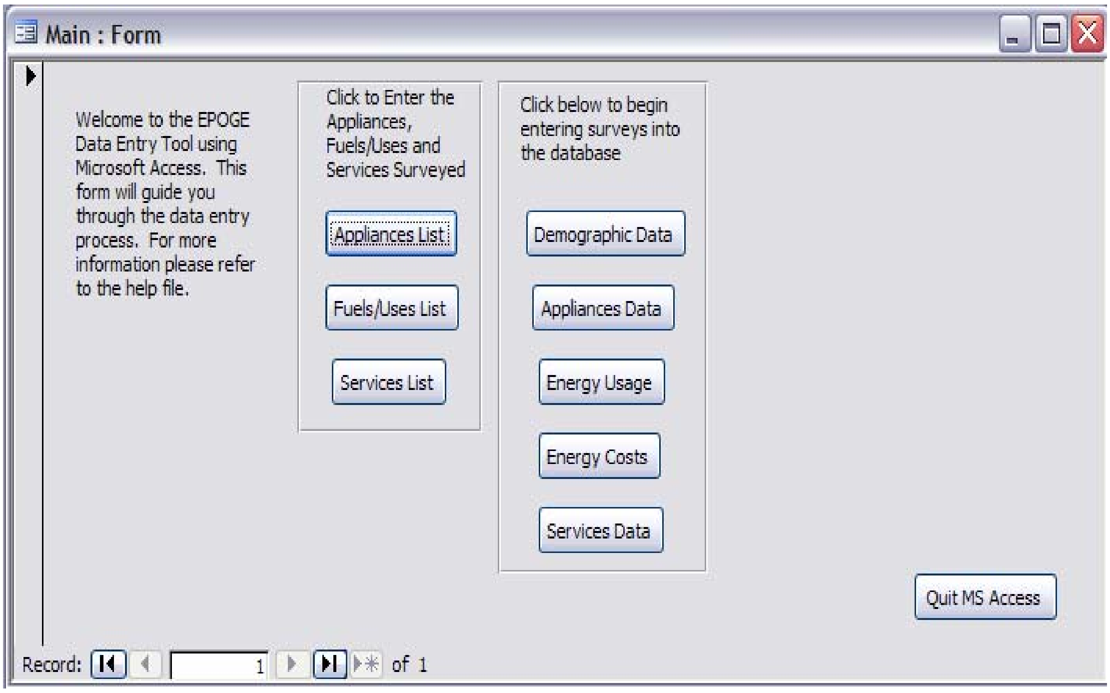
The data analysis tool consists of two parts: data entry and data analysis. The data entry part uses Microsoft Access and the data analysis is done in Microsoft Excel. It is assumed that these programs are available for use. Only limited familiarity with these programs is necessary for using the analysis tool. The data analysis is completed in four steps: configuring the files, entering the data, outputting the data to Excel, and displaying the analyzed data.

3.1 Configuring the Analysis Tool

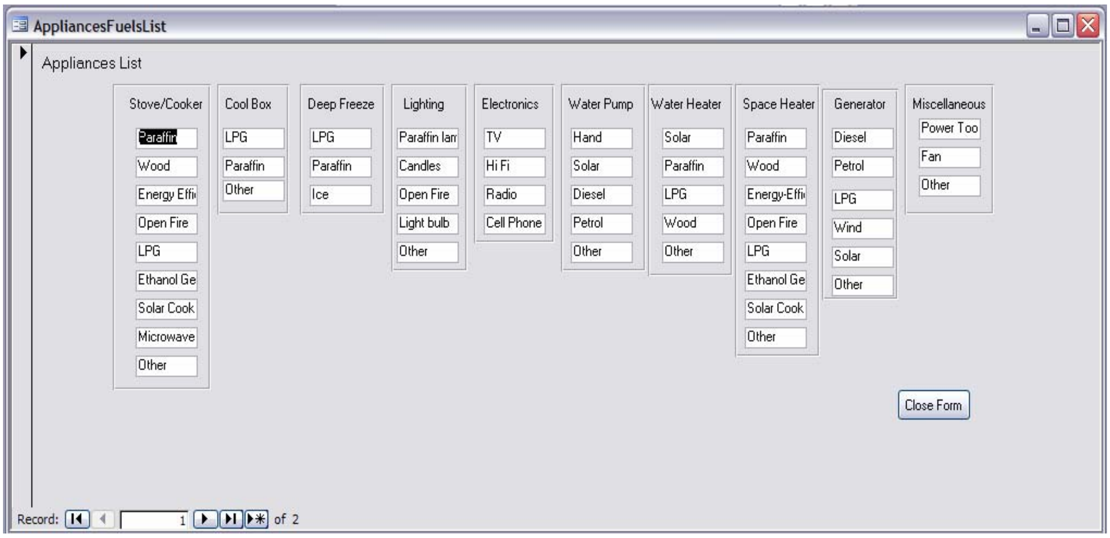
The files for the EPOGES Access database and Excel workbook should first be saved into a new folder in the Program Files folder or onto the desktop. No installation is needed unless Microsoft Office products are not already installed on the computer. When beginning a new analysis, open the Microsoft Access data entry tool (DET) called "EPOGES DET." When open, select the "File" menu from the toolbar and choose the "Back Up Database…" option. Save the file as a distinctive name, either the name of the targeted market, such as Windhoek, or the entrepreneur.

The template file is still open! To work in the database, select the "Open" option from the "File" menu. Open the database just saved. Now follow the instructions below to customize the database.

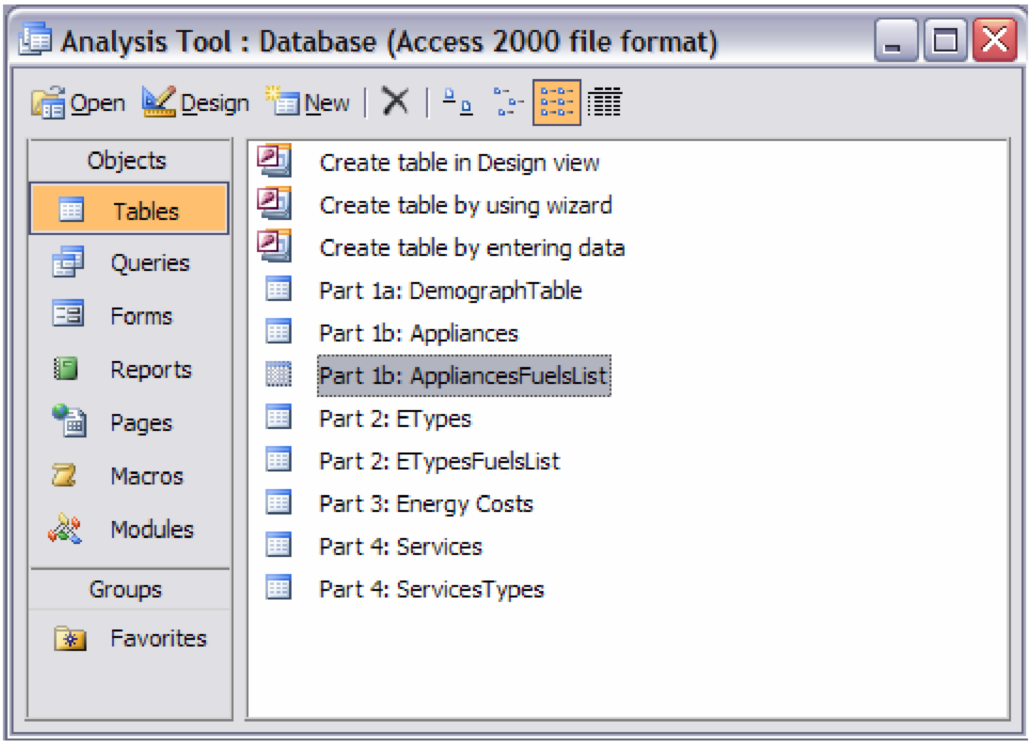
First open up "Main" in the "Forms" menu. This will bring up the following window.



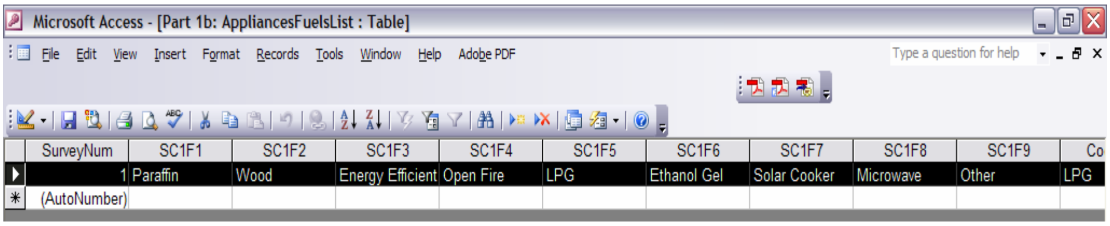
Clicking on the "Appliances List" button will allow you to list the different types of fuels that are used for each appliance. The default fuel listing is shown in the following window.



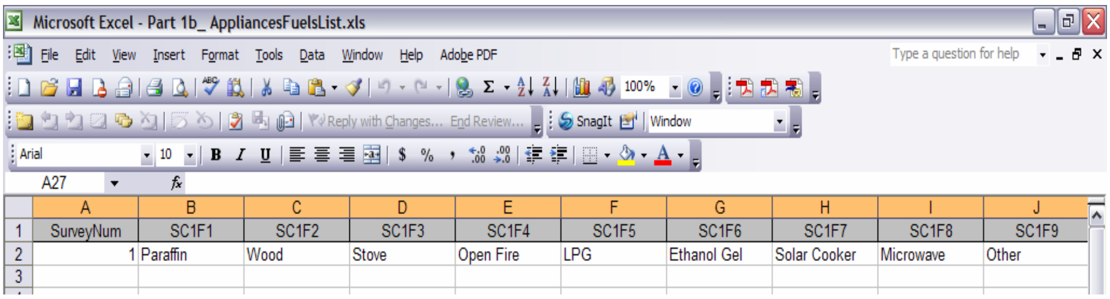
All the user must do is simply type in the new types of fuels for each appliance into these boxes. When done entering the appliance fuels, click "Close Form." Next, to import this information into the Excel spreadsheet, open up the table labeled "part 1b: AppliancesFuelsList" as shown below.



After opening the table, a window like the following will be displayed:



Click on “Tools,” “Office Links,” “Analyze it with Microsoft Excel.” A temporary excel table will be opened that will look like this:



Highlight the entire second row and copy it. Open the “EPOGES Analysis Tool” Excel document. When open, select the “File” menu from the toolbar and choose the

"Save As …" option. Save the file as a name similar to that of the Access file for easier recall of the files later. Paste the row copied from the temporary Excel table into the newly saved version of the EPOGES Analysis Tool spreadsheet. Paste it in row 1 of the sheet labeled "EnUs&SrvList." This will allow the proper labels to be displayed in the appropriate summary sheets and graphs.

To setup the other fields of the analysis tool like the Fuels/Uses List and the Services List, the same process must be followed except using their corresponding forms and tables.

The Fuels/Uses List is stored in the table labeled "Part 2: ETypesFuelsList" and the information should be copied into row 2 of the "EnUs&SrvList" spreadsheet.

The Services List is stored in the table labeled "Part 4: ServicesTypes" and the information in it should be copied into row 3 of the "EnUs&SrvList" spreadsheet.

Note: Remember to save the new version of the Excel spreadsheet often. Now would be a good time to do this.

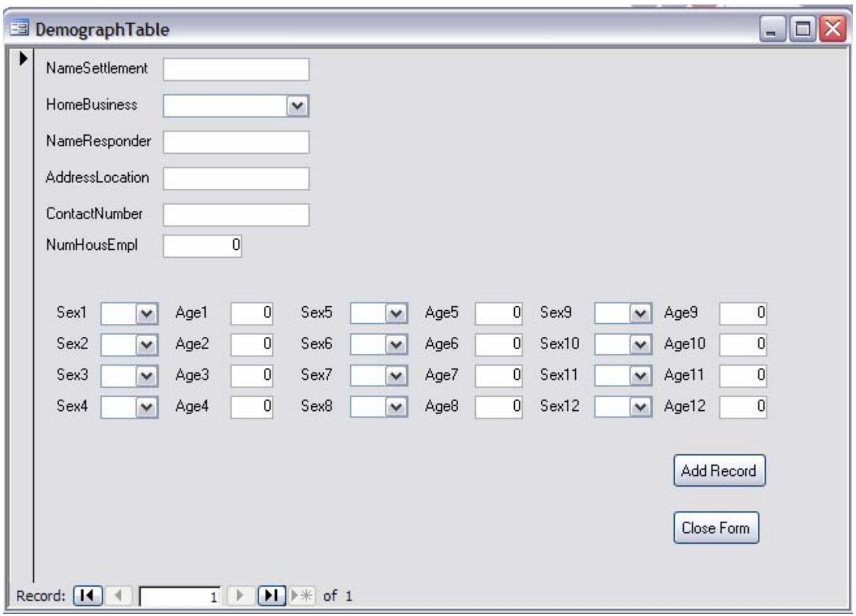
3.2 Entering Data into Access

The entry of data into a Microsoft Access database is divided into five different sections. The first section is the demographic data, the second is appliances and their corresponding fuels, the third is the types of energy and their uses, the fourth is types of energy and their associated costs, and the fifth is potential services that could be offered by renewable energy technologies. These five sections of data analysis correspond to the five separate sections of the survey.

Before starting, first gather all of the surveys and be sure they are organized according to survey number. Enter one section of all of the surveys into the analysis tool at a time, beginning with the demographic data, before moving on to the next section. Then open your data analysis tool and open the blank demographic data form.

3.2.1 Demographic Data Entry

To begin entering Demographic Data into the survey, click the button labeled "Demographic Data" on the "Main" form. This will bring up the following form:



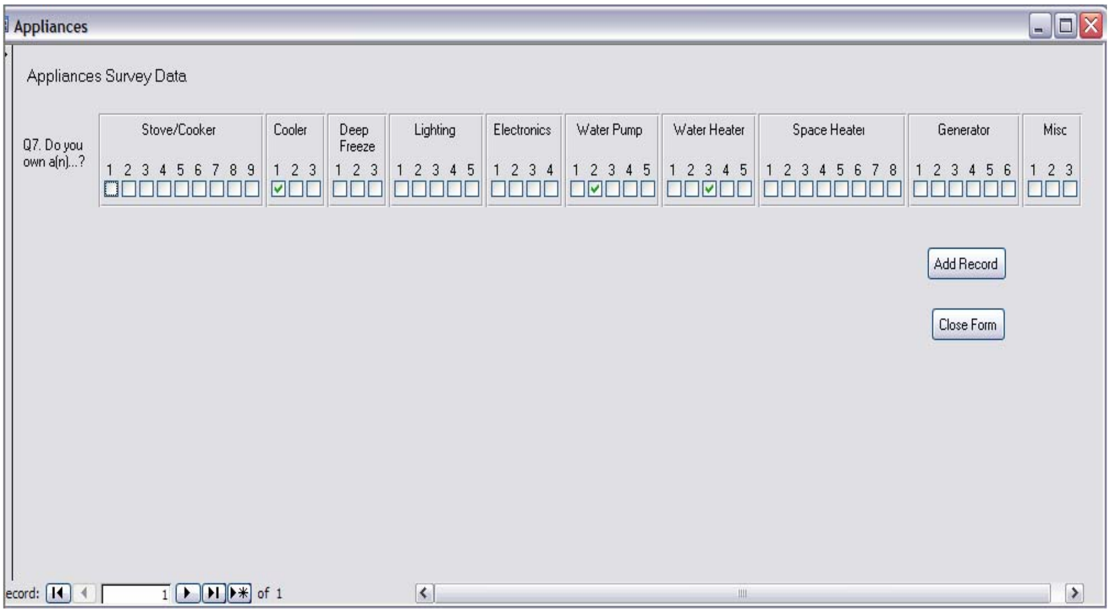
As you can see, the fields contained in this form are nearly identical to the fields contained in the first section of the original survey (as shown below).

Q 1: Name of settlement				
Q 2:	□ home		□ business, type_______________	
Q 3: Name of respondent				
Q 4: Address of location				
Q 5: Contact information				
Q 6: Number of household members/employees?				
Sexes/Ages	M / F Age:___	M / F Age:___	M / F Age:___	M / F Age:___
	M / F Age:___	M / F Age:___	M / F Age:___	M / F Age:___
	M / F Age:___	M / F Age:___	M / F Age:___	M / F Age:___
	M / F Age:___	M / F Age:___	M / F Age:___	M / F Age:___

After entering the data from the first survey, click the “Add Record” button. An additional form for the next survey will be brought up so the next demographic data can be entered. Continue entering the demographic data for all of the surveys. Once the demographic section of the last survey is entered, click the “Close Form” Button.

3.2.2 Appliance Data Entry

The entry of appliance data follows the same procedure as the entry of the demographic data. Simply click on the “Appliances Data” button on the “Main” form. The following form will open.



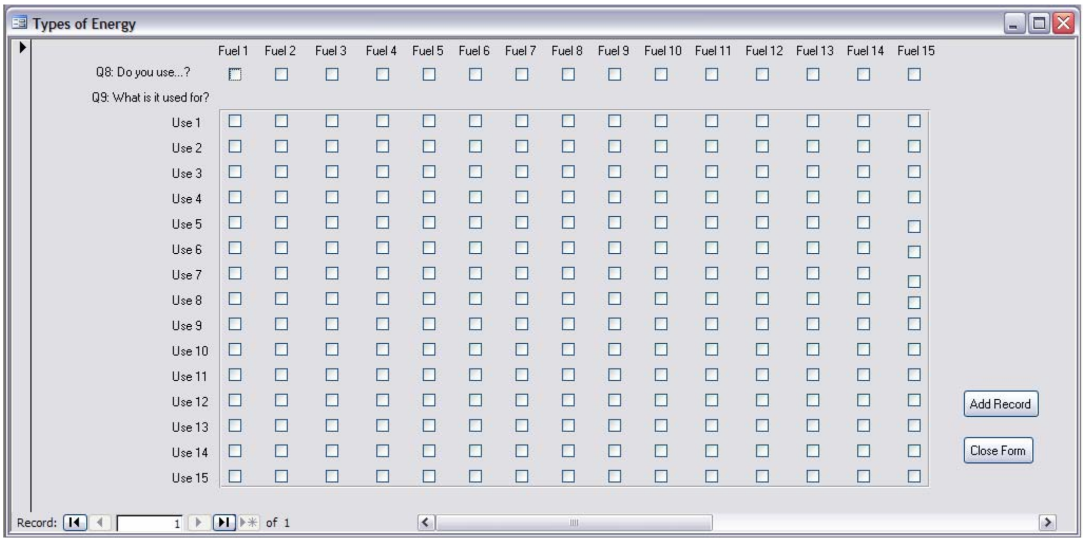
Again, the data entry form resembles the original survey form:

	Stove / Cooker									Cooler (refrigerator)			Deep-Freeze			Lighting					Electronics				Water pump					Water heater					Space heater								Generator						Misc.		
	Paraffin	Wood	Energy-efficient wood	Open fire	LPG	Ethanol gel	Solar cooker	Microwave	Other	LPG	Ice	Other	LPG	Paraffin	Other	Paraffin lamp	Candles	Open fire	Light bulb	Other	TV	Hi Fi	Radio	Cell phone	Hand	Solar	Diesel	Petrol	Other	Solar	Paraffin	LPG	Wood	Other	Paraffin	Wood	Energy-efficient wood	Open fire	LPG	Ethanol gel	Solar cooker	Other	Diesel	Petrol	LP gas	Wind	Solar	Other	Power tools	Fan	Other
Ref Num	1	2	3	4	5	6	7	8	9	1	2	3	1	2	3	1	2	3	4	5	1	2	3	4	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	6	7	8	1	2	3	4	5	6	1	2	3
Q 7: Do you own a(n)...?																																																			

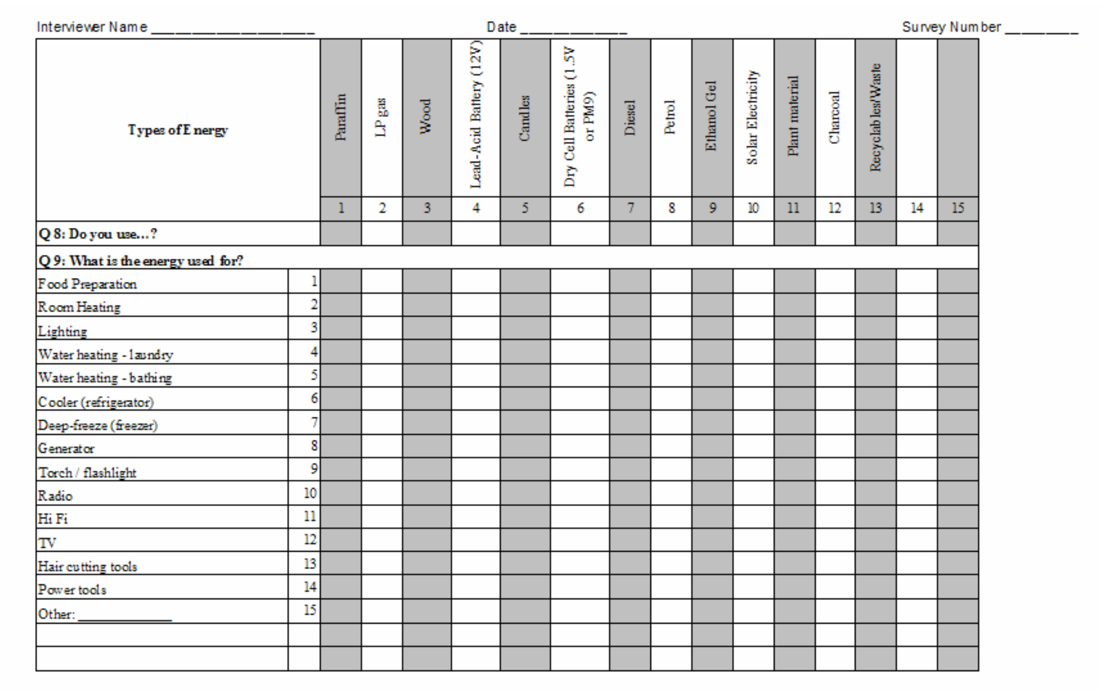
Simply check the boxes that are checked on the original survey. Again, click "Add Record" after entering each survey. Once the data from the last survey has been entered, click "Close Form."

3.2.3 Energy Usage Data Entry

The entry of appliance data follows the same procedure. Simply click on the "Energy Usage" button on the "Main" form. The following form will open:



It also resembles the setup of the original survey, as shown below.



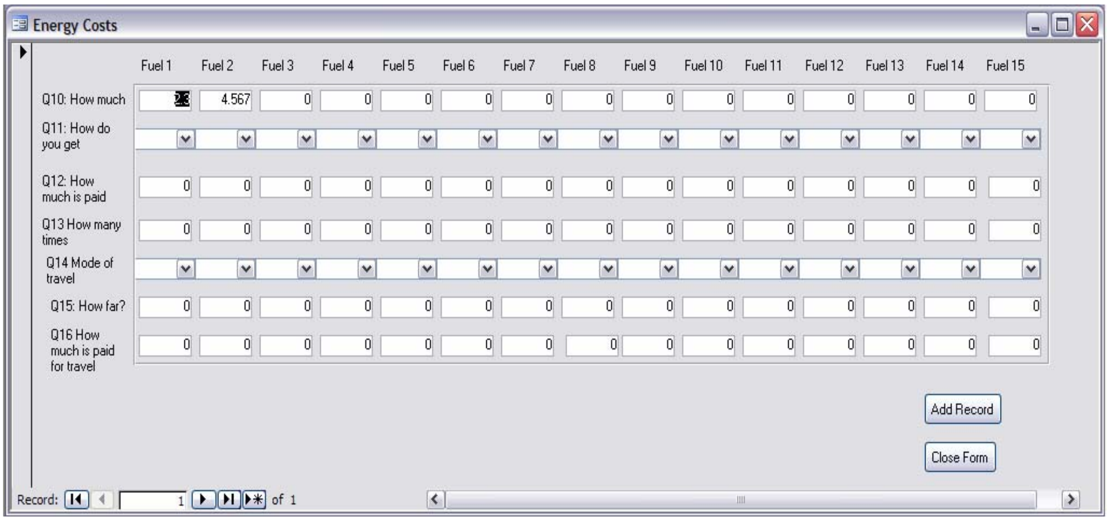
Interviewer Name ________________ Date ___________ Survey Number _______

Types of Energy		Paraffin	LP gas	Wood	Lead-Acid Battery (12V)	Candles	Dry Cell Batteries (1.5V or PM9)	Diesel	Petrol	Ethanol Gel	Solar Electricity	Plant material	Charcoal	Recyclables/Waste		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Q 8: Do you use...?																
Q 9: What is the energy used for?																
Food Preparation	1															
Room Heating	2															
Lighting	3															
Water heating - laundry	4															
Water heating - bathing	5															
Cooler (refrigerator)	6															
Deep-freeze (freezer)	7															
Generator	8															
Torch / flashlight	9															
Radio	10															
Hi Fi	11															
TV	12															
Hair cutting tools	13															
Power tools	14															
Other: __________	15															

Simply check the appropriate boxes that are checked on each survey. After each survey click the "Add Record" button to open up a new blank record. Once all forms are entered click the "Close Form" button.

3.2.4 Energy Cost Data Entry

On the "Main" form, click the button labeled "Energy Costs." The following data entry form will open:



The following is the nearly identical form assessing the Energy Costs in the survey:

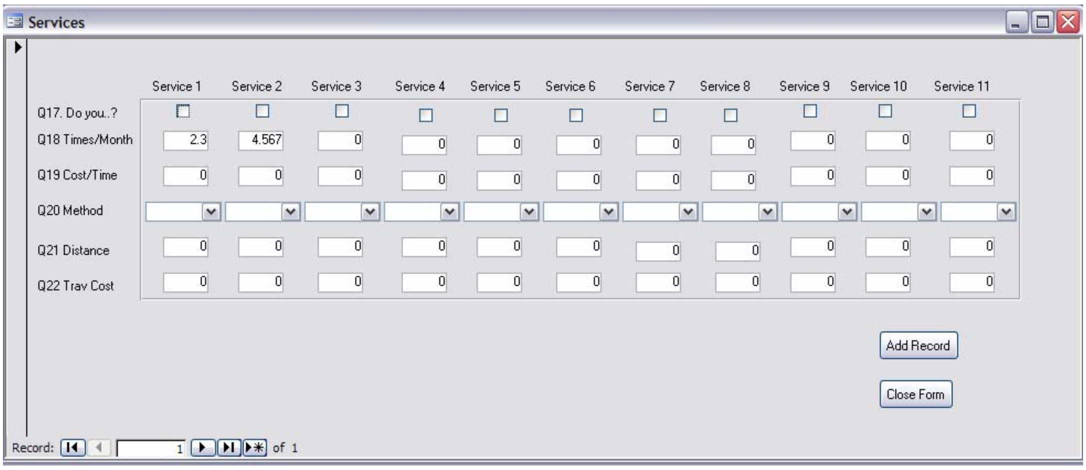
Interviewer Name ________________ Date ___________ Survey Number _______

Types of Energy		Paraffin	LP gas	Wood	Lead-Acid Battery (12V)	Candles	Dry Cell Batteries (1.5V or PM9)	Diesel	Petrol	Ethanol Gel	Solar Electricity	Plant material	Charcoal	Recyclables/Waste		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Q 10: How much energy do you use?																
Per month		L	kg	bundle	charge	candles	batteries	L	L	kg	W	kg	kg	kg	unit	unit
Q 11: How do you get the energy?																
Purchased																
Collected																
Free																
Q 12: How much do you pay each time you buy/charge it?																
Per unit		L	kg	bundle	charge	candle	battery	L	L	kg	W	W	kg	kg	kg	unit
Q 13: How many times do you buy/charge it?																
Per month																
Q 14: How do you travel to get the energy? (method)																
Walk																
Bicycle																
Taxi																
Private car																
Public bus																
Other ___________																
Q 15: How far do you travel to get the energy?																
Distance (km)																
Q 16: How much do you pay for the round-trip?																
Travel costs each time (N$)																

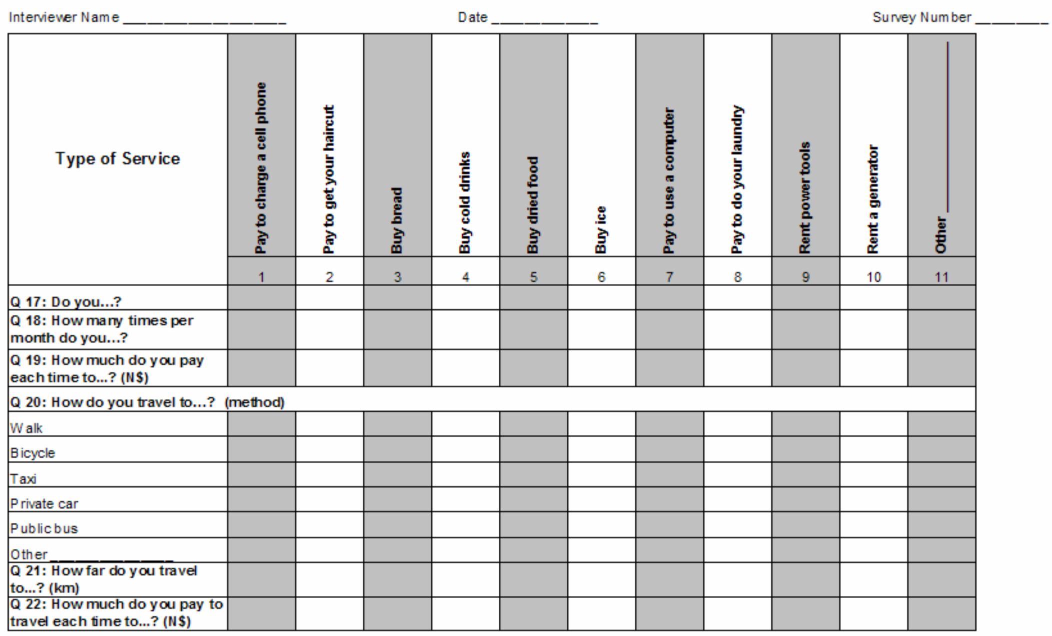
This form resembles the survey; however, a drop-down box was utilized for question 14 on the method of transportation to minimize error and the number of variables within the analysis tool. The remainder of the data on this form is entered as numerical data, rather than checkboxes. Simply enter the information in the given field and when done with the form click "Add Record" to continue to the next form. After entering the last form, click "Close Form."

3.2.5 Services Data Entry

The final form utilized in the data entry portion of the analysis tool is the services data form. Click on the "Services Data" button on the "Main" form to open it. This is how the form is displayed:



Yet again, this resembles the survey, as shown below.



Interviewer Name ________________ Date __________ Survey Number _______

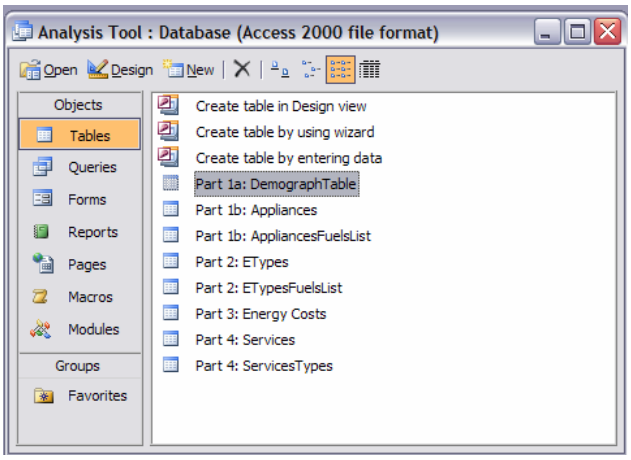
Type of Service	Pay to charge a cell phone	Pay to get your haircut	Buy bread	Buy cold drinks	Buy dried food	Buy ice	Pay to use a computer	Pay to do your laundry	Rent power tools	Rent a generator	Other ________
	1	2	3	4	5	6	7	8	9	10	11
Q 17: Do you...?											
Q 18: How many times per month do you...?											
Q 19: How much do you pay each time to...? (N$)											
Q 20: How do you travel to...? (method)											
Walk											
Bicycle											
Taxi											
Private car											
Public bus											
Other ____________											
Q 21: How far do you travel to...? (km)											
Q 22: How much do you pay to travel each time to...? (N$)											

This form contains a combination of checkboxes, drop-down menus, and numerical data. Simply enter the data as it appears on the form with the exception of the method of travel (question 20), which uses a drop-down box as before in the previous energy costs section.

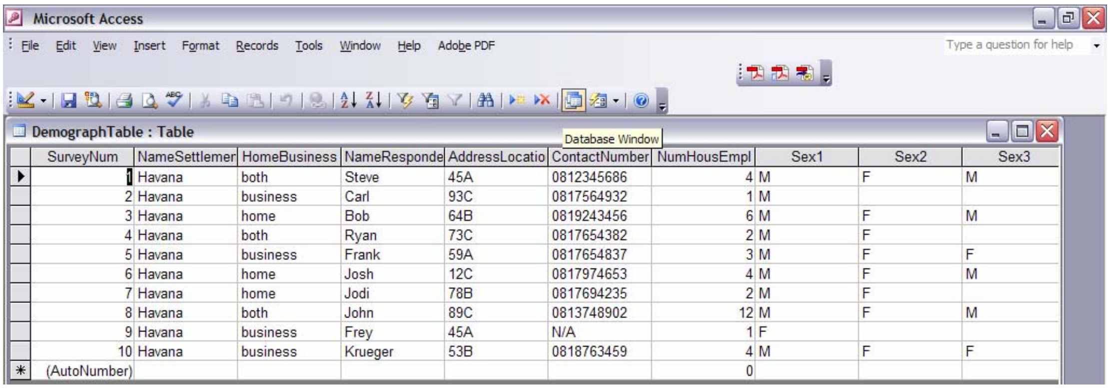
After entering each survey, click the “Add Form” button and when finished with all of the forms, click the “Close Form” button.

3.3 Outputting the Data

After entering all of the surveys into the data entry tool, it is necessary to move the data into Microsoft Excel for analysis. This is done similarly to the "Configuring the Analysis Tool" section. Simply click on the "Tables" button on the "EPOGES Analysis Tool: Database" menu and then double click on "Part 1a: DemographTable."

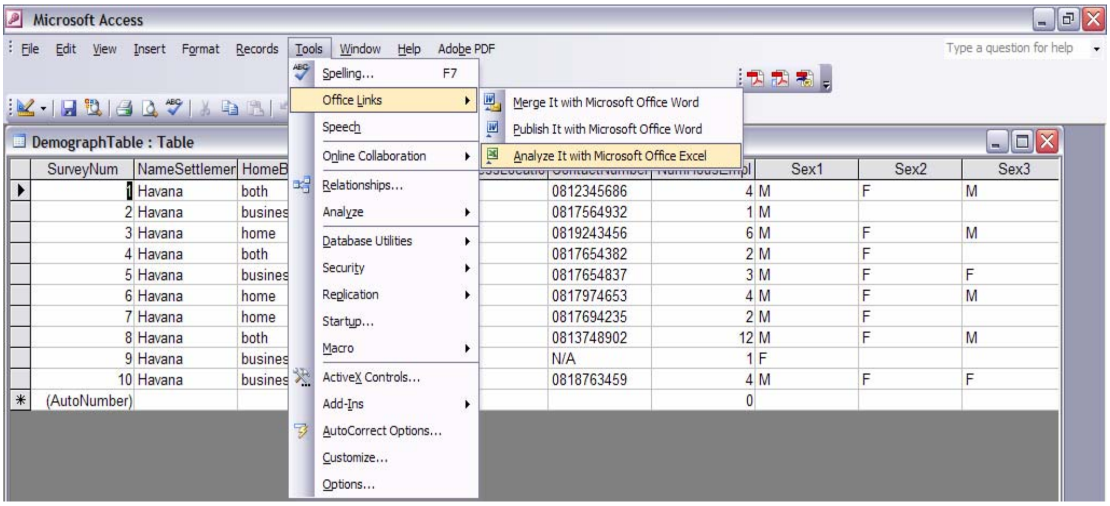


This will bring up a table similar to this:

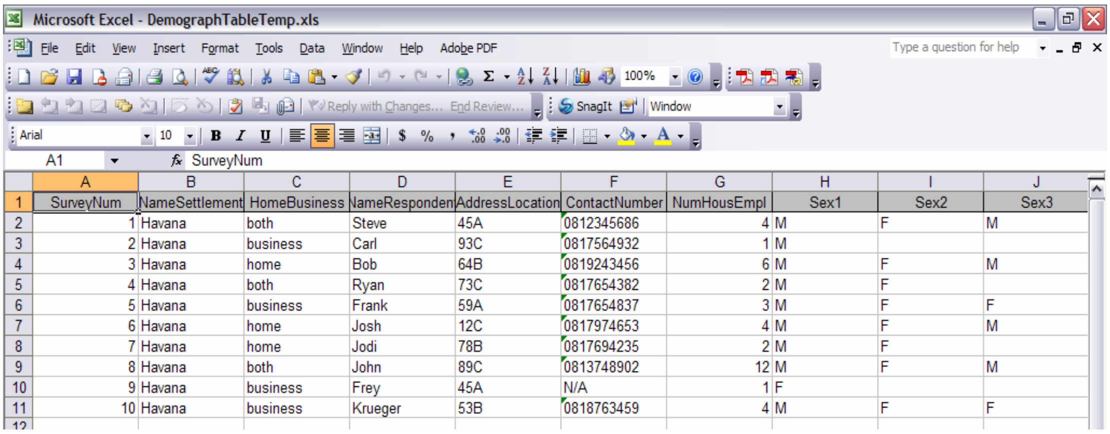


SurveyNum	NameSettlemer	HomeBusiness	NameResponde	AddressLocatio	ContactNumber	NumHousEmpl	Sex1	Sex2	Sex3
1	Havana	both	Steve	45A	0812345686	4	M	F	M
2	Havana	business	Carl	93C	0817564932	1	M		
3	Havana	home	Bob	64B	0819243456	6	M	F	M
4	Havana	both	Ryan	73C	0817654382	2	M	F	
5	Havana	business	Frank	59A	0817654837	3	M	F	F
6	Havana	home	Josh	12C	0817974653	4	M	F	M
7	Havana	home	Jodi	78B	0817694235	2	M	F	
8	Havana	both	John	89C	0813748902	12	M	F	M
9	Havana	business	Frey	45A	N/A	1	F		
10	Havana	business	Krueger	53B	0818763459	4	M	F	F
(AutoNumber)						0			

In order to move this data into Excel, click on "Tools," "Office Links," "Analyze it with Microsoft Excel," as shown below:



This will bring up an Excel spreadsheet like this:



In order to move this into the EPOGE Data Analysis Tool, copy and paste the information starting on row 2 down to the final record.

Note: MS Access on occasion will add a record to the bottom of the sheet that contains a reference number, but no data. Do not include this row in the copying process.

After copying this data, paste it into the "Demograph" table of the analysis tool. The section of the table is highlighted in yellow.

Continue this process for each one of the tables produced by MS Access. "Part 1b: Appliances" must be copied into "Appliances" in Excel, "Part 2: ETypes" into "Etypes," "Part 3: Energy Costs," "ECosts," and "Part 4: Services" into "Services."

After copying and pasting this data, the analysis will be done automatically in MS Excel. Now would be a good time to save the Excel workbook if this has not already been done since the initial save.

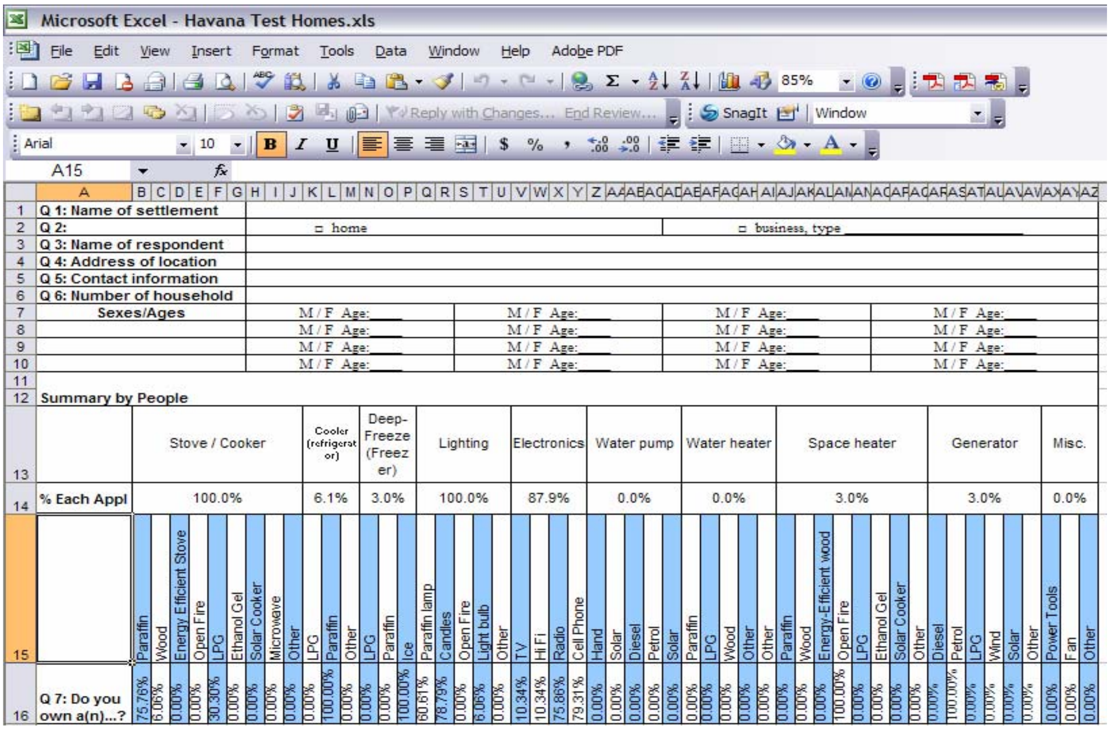
3.4 Displaying Summary Sheets

The end results of the analysis tool are displayed on several summary sheets within Excel. These sheets resemble the original survey and display useful statistics for the entered data. Typically, these statistics include averages, percentages, and maximum values (for detection of outliers).

Below, are some sample summary sheets.

3.4.1 Demographic and Appliances Data

In the "Demographics and Appliances Data" summary sheet, two useful tables are displayed. The first table summarizes the prevalence of each type of appliance. This is organized by appliance in general (e.g. stove/cooker) and by specific fuel used (e.g. paraffin stove/cooker). These percentages will not sum to 100% because often individuals will own multiple types of appliances. The second chart presents the percentages of what fuels are used for each appliance and only includes those who use the appliance. These percentages sum to 100% so that pie charts can be developed.



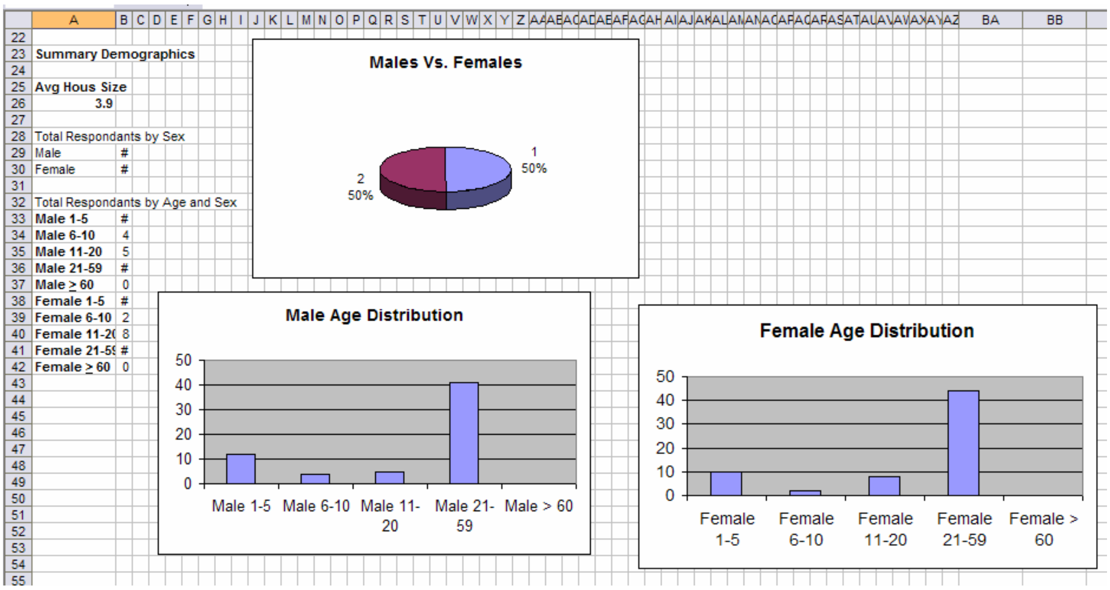
	Stove / Cooker									Cooler (refrigerator)			Deep-Freeze (Freezer)		
	Paraffin	Wood	Energy Efficient Stove	Open Fire	LPG	Ethanol Gel	Solar Cooker	Microwave	Other	LPG	Paraffin	Other	LPG	Paraffin	Ice
Q 7: Do you own a(n)...?	48.08%	3.85%	0.00%	28.85%	19.23%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	100.00%

	Lighting					Electronics				Water pump				
	Paraffin lamp	Candles	Open Fire	Light bulb	Other	TV	Hi Fi	Radio	Cell Phone	Hand	Solar	Diesel	Petrol	Solar
Q 7: Do you own a(n)...?	41.67%	54.17%	0.00%	4.17%	0.00%	5.88%	5.88%	43.14%	45.10%	0.00%	0.00%	0.00%	0.00%	0.00%

	Water heater					Space heater							
	Paraffin	LPG	Wood	Other	Other	Paraffin	Wood	Energy-Efficient wood	Open Fire	LPG	Ethanol Gel	Solar Cooker	Other
Q 7: Do you own a(n)...?	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%

	Generator						Misc.		
	Diesel	Petrol	LPG	Wind	Solar	Other	Power Tools	Fan	Other
Q 7: Do you own a(n)...?	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

In addition the tool displays a pie chart depicting the gender percentage of the households interviewed as well as bar graphs representing the age distribution for each gender:

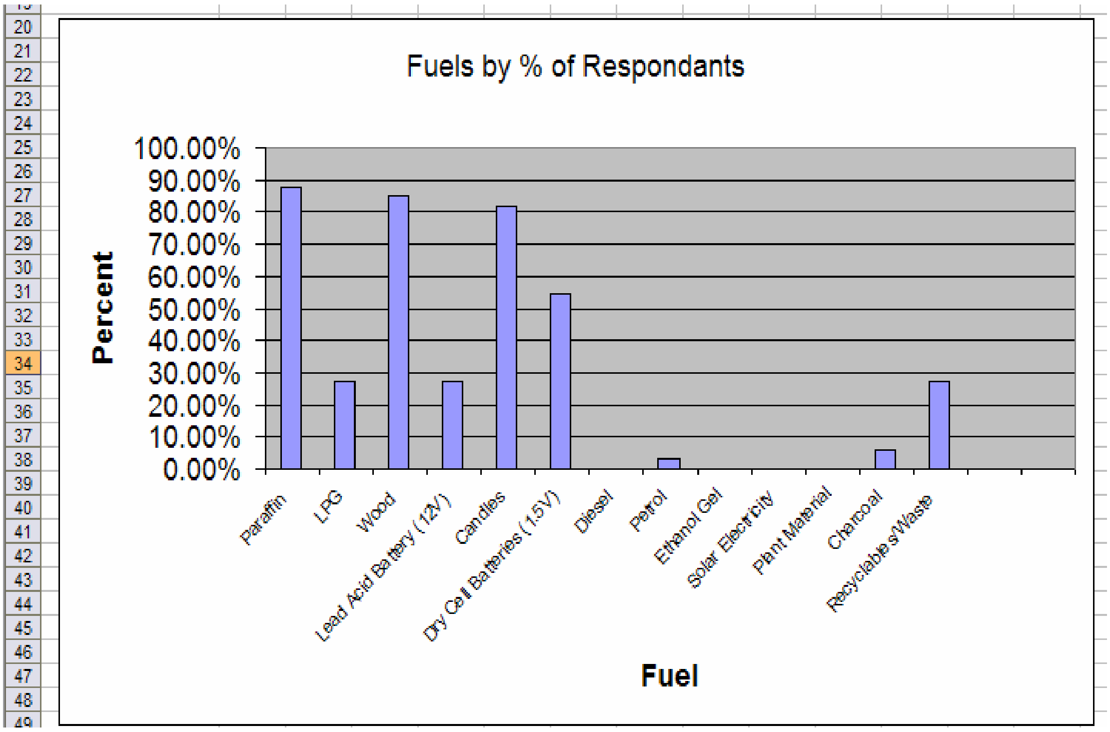


3.4.2 Energy Types data

In the next summary sheet, we outline the data from the "Energy Types" section of the survey. Here the toolkit displays prevalence of energy types (e.g. 90% of individuals use paraffin) and then the prevalence for usages (e.g. 90% of individuals use paraffin for food preparation):

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	**Types of Energy (%)**	Paraffin	LPG	Wood	Lead Acid Battery (12V)	Candles	Dry Cell Batteries (1.5V)	Diesel	Petrol	Ethanol Gel	Solar Electricity	Plant Material	Charcoal	Recyclables/Waste			
2	**Q 8: Do you use...?**	87.88%	27.27%	84.85%	27.27%	81.82%	54.55%	0.00%	3.03%	0.00%	0.00%	0.00%	6.06%	27.27%	0.00%	0.00%	
3	**Q 9: What is the energy used for?**																
4	Food Preparation	78.79%	27.27%	72.73%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6.06%	21.21%	0.00%	0.00%	
5	Room Heating	0.00%	0.00%	3.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
6	Lighting	51.52%	0.00%	6.06%	3.03%	81.82%	3.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
7	Water heating - laundry	9.09%	0.00%	30.30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6.06%	0.00%	0.00%	
8	Water heating - cooking	51.52%	15.15%	63.64%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	15.15%	0.00%	0.00%	
9	Cooler (refridgerator)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	% Who Responded that They Use Fuel X for Use X
10	Deep-freeze (freezer)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
11	Generator	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
12	Radio	0.00%	0.00%	0.00%	21.21%	0.00%	48.48%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
13	Hi Fi	0.00%	0.00%	0.00%	6.06%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
14	TV	0.00%	0.00%	0.00%	3.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
15	Hair cutting tools	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
16	Power tools	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
17	Water heating – bathing	6.06%	0.00%	6.06%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
18	EMPTY SERVICE	0.00%	0.00%	0.00%	0.00%	0.00%	6.06%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	

Graphics can then be generated from this data which summarize any information that the user chooses. One sample graph is provided that displays the prevalence of fuel usage:



3.4.3 Energy Costs data

The "Energy Costs" section of the toolkit displays several statistics on the average cost of energy. The first table displays the average usage of each energy type for those who use the energy (e.g. if two respondents use paraffin and they use 20L and

10L respectively, the toolkit will display 15L, ignoring its nonuse by other respondents). After this, the prevalence of energy purchased, collected, or free is displayed. Next, the average cost per unit is displayed, followed by the average number of times the fuel type is purchased or charged in a month. Next, the toolkit displays the prevalence of travel (i.e. what percentage walk, taxi, bike, etc.). Finally, the average round-trip cost per time for travel is displayed (e.g. N$13 for a taxi).

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
3	Types of Energy	Paraffin	LPG	Wood	Lead Acid Battery (12V)	Candles	Dry Cell Batteries (1.5V)	Diesel	Petrol	Ethanol Gel	Solar Electricity	Plant Material	Charcoal	Recyclables/Waste			Average Cost/Month ($N)
4	**Q 10: How much energy do you use?**																
5	Per month	L	kg	bundle	charge	candles	batteries	L	L	kg	W	kg	kg	kg	units	units	
6		14.8	14.2	10.3	2.7	25.3	5.6	0.0	20.0	0.0	0.0	0.0	20.0	1.9	0.0	0.0	
7	**Q 11: How do you get the energy?**																
8	Purchased	100%	100%	33%	100%	100%	100%	0%	100%	0%	0%	0%	100%	0%	0%	0%	
9	Collected	0%	0%	67%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
10	Free	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	
11	**Q 12: How much do you pay each time you buy/charge it?**																
12	Per unit	L	kg	bundle	charge	candle	battery	L	L	kg	W	kg	kg	kg	units	units	
13		6.17	9.72	9.25	18.15	1.56	10.62	0.00	6.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	211.63
14	**Q 13: How many times do you buy/charge it?**																
15	Per month	8.25	1.54	8.31	2.63	8.85	1.79	0.00	4.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	
16	**Q 14: How do you travel to get the energy? (method)**																
17	Walk	66%	0%	89%	33%	68%	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
18	Bicycle	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
19	Taxi	34%	89%	11%	67%	28%	50%	0%	100%	0%	0%	0%	100%	0%	0%	0%	
20	Private car	0%	11%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
21	Public bus	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
22	Other	0%	0%	0%	0%	4%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	
23	**Q 15: How far do you travel to get the energy?**																
24	Distance (km)	3.7	3.6	6.9	4.5	6.0	6.1	0.0	15.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0	
25	**Q 16: How much do you pay for the round-trip?**																
26	Travel costs each time (N$)	16.70	19.06	17.33	21.33	17.43	17.63	0.00	26.00	0.00	0.00	0.00	19.00	0.00	0.00	0.00	122.38
27																Total Cost of Energy Inlcuding Travel (Ave)	282.09

Finally, the toolkit displays the maximum values found for outlier detection.

33																
34	Types of Energy	Paraffin	LPG	Wood	Lead Acid Battery (12V)	Candles	Dry Cell Batteries (1.5V)	Diesel	Petrol	Ethanol Gel	Solar Electricity	Plant Material	Charcoal	Recyclables/Waste		
35	**Q 10: How much energy do you use?**															
36	Per month	L	kg	bundle	charge	candles	batteries	L	L	kg	W	kg	kg	kg	units	units
37		40	34	50	4	90	20	0	20	0	0	0	30	5	0	0
38	**Q 11: How do you get the energy?**															
39	Purchased															
40	Collected															
41	Free															
42	**Q 12: How much do you pay each time you buy/charge it?**															
43	Per unit	L	kg	bundle	charge	candle	battery	L	L	kg	W	kg	kg	kg	units	units
44		12	17	12.5	40	6	22.5	0	6	0	0	0	1	0	0	0
45	**Q 13: How many times do you buy/charge it?**															
46	Per month	40	4	30	4	40	6	0	4	0	0	0	3	0	0	0
47	**Q 14: How do you travel to get the energy? (method)**															
48	Walk															
49	Bicycle															
50	Taxi															
51	Private car															
52	Public bus															
53	Other															
54	**Q 15: How far do you travel to get the energy?**															
55	Distance (km)	10	8	90	15	25	15	0	15	0	0	0	7	0	0	0
56	**Q 16: How much do you pay for the round-trip?**															
57	Travel costs each time (N$)	26.00	19.50	19.50	26.00	26.00	26.00	0.00	26.00	0.00	0.00	0.00	19.50	0.00	0.00	0.00
58																
59																
60																
61																

3.4.4 Services Data

The "Services" summary sheet displays similar statistics to the "Energy Costs" section. It contains statistics on the prevalence of services usage, average usage (e.g. the average user charges their cell phone 6.5 times per month), average cost per use, prevalence of transportation method, average distance traveled, and average cost for transportation.

	A	B	C	D	E	F	G	H	I	J	K	L	M
3	Type of Service	Pay to charge a cell pho	Pay to do your laundry	Buy baked goods	Buy dried food	Buy cold drinks	Buy ice	Pay to use a computer	Pay to get your hair cut	Rent power tools	Rent a Generator	Other	Average Cost/Month
4	Q 17: Do you...?	64%	2%	94%	44%	62%	34%	8%	72%	2%	2%	0%	
5	Q 18: How many times per month do you...?	6.6	1.5	15.6	4.4	7.6	9.5	1.4	1.8	0.1	1.0	0.0	
6	Q 19: How much do you pay each time to...? (N$)	5.48	8.00	6.70	33.27	10.23	12.97	27.50	34.29	35.00	0.00	0.00	298.27
7	Q 20: How do you travel to...? (method)												
8	Walk	69%	100%	89%	14%	97%	6%	17%	47%	100%	0%	0%	
9	Bicycle	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
10	Taxi	28%	0%	6%	33%	3%	88%	83%	53%	0%	0%	0%	
11	Private car	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
12	Public bus	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
13	Other	3%	0%	4%	52%	0%	6%	0%	0%	0%	0%	0%	
14	Q 21: How far do you travel to...?	2.9	0.0	0.5	2.8	0.2	5.5	22.3	4.4	1.0	0.0	0.0	
15	Q 22: How much do you pay to travel each time	5.08	0.00	1.20	4.00	0.42	15.38	21.75	8.72	0.00	0.00	0.00	103.4
16												Total	401.68
17												Total Gross	749.38
18												(Excl Travel)	573.18

Finally, the toolkit displays the maximum values found for outlier detection.

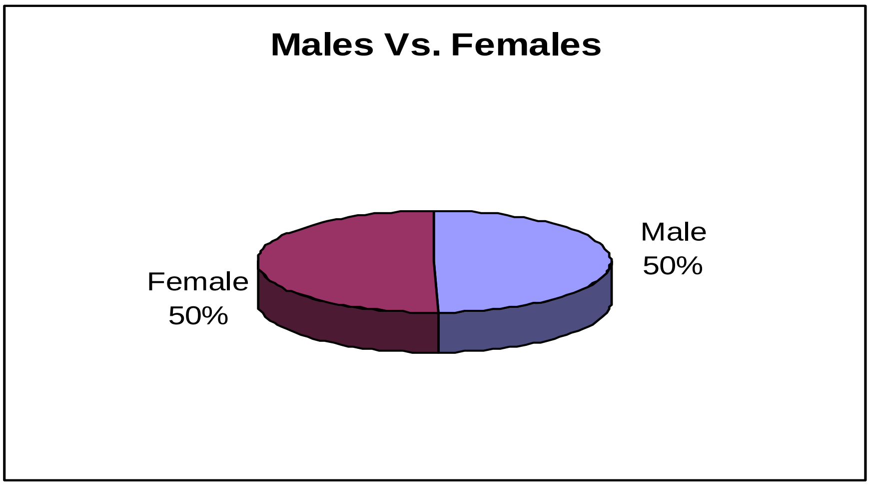
19	Summary (Maxes)											
20												
21	Type of Service	Pay to charge a cell phone	Pay to do your laundry	Buy baked goods	Buy dried food	Buy cold drinks	Buy ice	Pay to use a computer	Pay to get your hair cut	Rent power tools	Rent a Generator	Other
22	Q 17: Do you...?											
23	Q 18: How many times per month do you...?	20	1.5	30	24	90	10	3	4	0.1	0	0
24	Q 19: How much do you pay each time to...? (N$)	30	8	30	300	16	18	15	120	35	0	0
25	Q 20: How do you travel to...? (method)											
26	Walk											
27	Bicycle											
28	Taxi											
29	Private car											
30	Public bus											
31	Other											
32	Q 21: How far do you travel to...? (km)	10	0	8	15	0.5	8	25	25	1	0	0
33	Q 22: How much do you pay to travel each time to...? (N$)	19.5	0	19	19.5	0	19.5	18.5	19.5	0	0	0

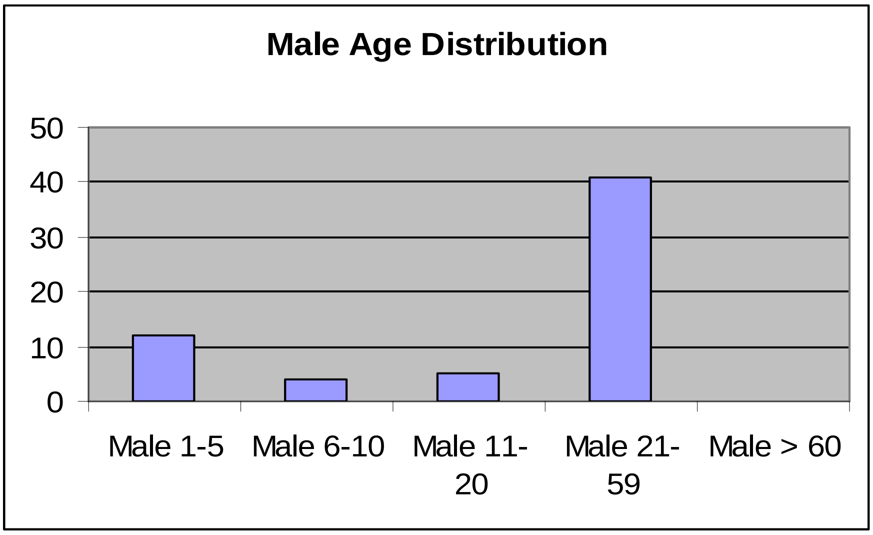
4.0 Summary

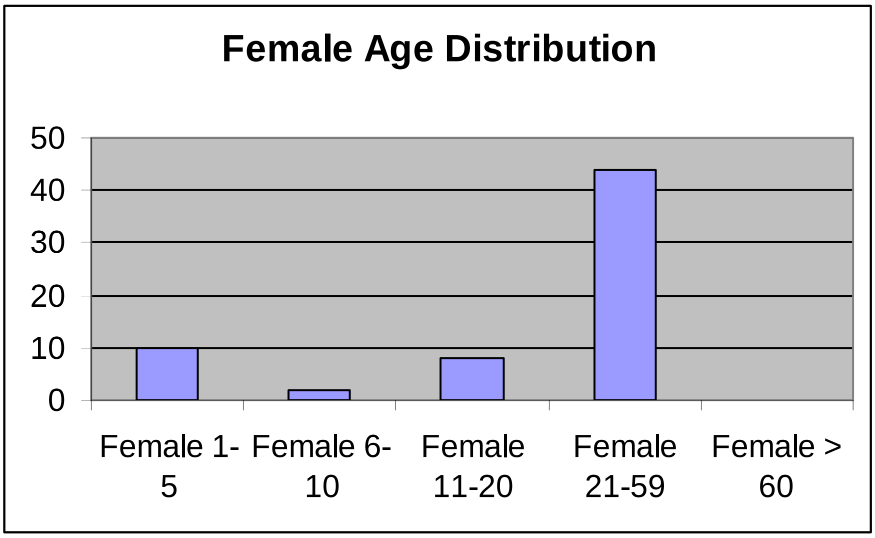
This user manual outlined the best methods for administering the EPOGES survey and analysis tool. Using the toolkit as prescribed will provide accurate and unbiased data that can be quickly analyzed and interpreted. Any additional graphs or analyses that the user would like to implement can be completed by altering the Excel portion of the analysis tool. To obtain a copy of the analysis tool or a full report of the study that lead to the development of this toolkit, please contact Robert Schultz at robert.schultz@drfn.org.na.

Appendix G: Results from Homes in Havana Survey

Part I: Demographics







Part II: Appliances Usage

Summary by People

	Stove / Cooker									Cooler (refrigerator)			Deep-Freeze (Freezer)			Lighting				
% Each Appl	100.0%									6.1%			3.0%			100.0%				
	Paraffin	Wood	Energy Efficient Stove	Open Fire	LPG	Ethanol Gel	Solar Cooker	Microwave	Other	LPG	Paraffin	Other	LPG	Paraffin	Ice	Paraffin lamp	Candles	Open Fire	Light bulb	Other
Q 7: Do you own a(n)...?	75.76%	6.06%	0.00%	0.00%	30.30%	0.00%	0.00%	0.00%	0.00%	0.00%	#######	0.00%	0.00%	0.00%	#######	60.61%	78.79%	0.00%	6.06%	0.00%

	Electronics				Water pump					Water heater				
% Each Appl	87.9%				0.0%					0.0%				
	TV	Hi Fi	Radio	Cell Phone	Hand	Solar	Diesel	Petrol	Solar	Paraffin	LPG	Wood	Other	Other
Q 7: Do you own a(n)...?	10.34%	10.34%	75.86%	79.31%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

	Space heater								Generator						Misc.		
% Each Appl	3.0%								3.0%						0.0%		
	Paraffin	Wood	Energy-Efficient wood	Open Fire	LPG	Ethanol Gel	Solar Cooker	Other	Diesel	Petrol	LPG	Wind	Solar	Other	Power Tools	Fan	Other
Q 7: Do you own a(n)...?	0.00%	0.00%	0.00%	#######	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Summary by Appliance

	Stove / Cooker									Cooler (refrigerator)			Deep-Freeze (Freezer)			Lighting				
	Paraffin	Wood	Energy Efficient Stove	Open Fire	LPG	Ethanol Gel	Solar Cooker	Microwave	Other	LPG	Paraffin	Other	LPG	Paraffin	Ice	Paraffin lamp	Candles	Open Fire	Light bulb	Other
Q 7: Do you own a(n)...?	48.08%	3.85%	0.00%	28.85%	19.23%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	#######	0.00%	0.00%	#######	41.67%	54.17%	0.00%	4.17%	0.00%

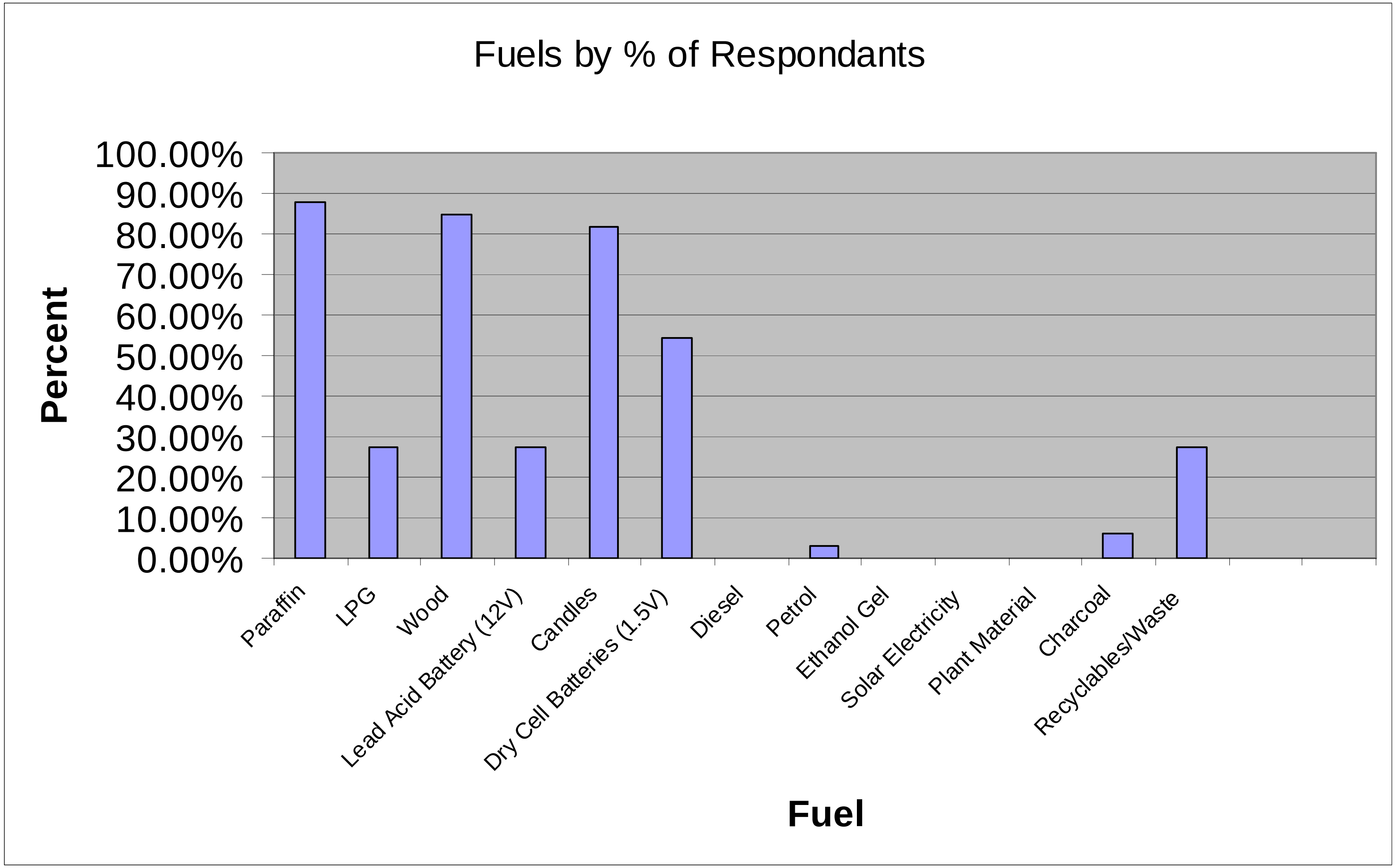
	Electronics				Water pump					Water heater				
	TV	Hi Fi	Radio	Cell Phone	Hand	Solar	Diesel	Petrol	Solar	Paraffin	LPG	Wood	Other	Other
Q 7: Do you own a(n)...?	5.88%	5.88%	43.14%	45.10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

	Space heater								Generator						Misc.		
	Paraffin	Wood	Energy-Efficient wood	Open Fire	LPG	Ethanol Gel	Solar Cooker	Other	Diesel	Petrol	LPG	Wind	Solar	Other	Power Tools	Fan	Other
Q 7: Do you own a(n)...?	0.00%	0.00%	0.00%	#######	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Part III: Types of Energy Used

Types of Energy (%)	Paraffin	LPG	Wood	Lead Acid Battery (12V)	Candles	Dry Cell Batteries (1.5V)	Diesel	Petrol	Ethanol Gel	Solar Electricity	Plant Material	Charcoal	Recyclables/Waste		
Q 8: Do you use…?	87.88%	27.27%	84.85%	27.27%	81.82%	54.55%	0.00%	3.03%	0.00%	0.00%	0.00%	6.06%	27.27%	0.00%	0.00%
Q 9: What is the energy used for?															
Food Preparation	78.79%	27.27%	72.73%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6.06%	21.21%	0.00%	0.00%
Room Heating	0.00%	0.00%	3.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Lighting	51.52%	0.00%	6.06%	3.03%	81.82%	3.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Water heating - laundry	9.09%	0.00%	30.30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6.06%	0.00%	0.00%
Water heating - cooking	51.52%	15.15%	63.64%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	15.15%	0.00%	0.00%
Cooler (refridgerator)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Deep-freeze (freezer)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Generator	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Radio	0.00%	0.00%	0.00%	21.21%	0.00%	48.48%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Hi Fi	0.00%	0.00%	0.00%	6.06%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
TV	0.00%	0.00%	0.00%	3.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Hair cutting tools	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Power tools	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Water heating – bathing	6.06%	0.00%	6.06%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
EMPTY SERVICE	0.00%	0.00%	0.00%	0.00%	0.00%	6.06%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

% Who Responded that They Use Fuel X for Use X


Fuels by % of Respondants
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
Percent
Paraffin
LPG
Wood
Lead Acid Battery (12V)
Candles
Dry Cell Batteries (1.5V)
Diesel
Petrol
Ethanol Gel
Solar Electricity
Plant Material
Charcoal
Recyclables/Waste
Fuel

Part IV: Energy Costs

Summary (Averages and %)																
Types of Energy	Paraffin	LPG	Wood	Lead Acid Battery (12V)	Candles	Dry Cell Batteries (1.5V)	Diesel	Petrol	Ethanol Gel	Solar Electricity	Plant Material	Charcoal	Recyclables/Waste			**Average Cost/Month ($N)**
Q 10: How much energy do you use?																
Per month	L	kg	bundle	charge	candles	batteries	L	L	kg	W	kg	kg	kg	units	units	
	14.8	14.2	10.3	2.7	25.3	5.6	0.0	20.0	0.0	0.0	0.0	20.0	1.9	0.0	0.0	
Q 11: How do you get the energy?																
Purchased	100%	100%	33%	100%	100%	100%	0%	100%	0%	0%	0%	100%	0%	0%	0%	
Collected	0%	0%	67%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Free	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	
Q 12: How much do you pay each time you buy/charge it?																
Per unit	L	kg	bundle	charge	candle	battery	L	L	kg	W	kg	kg	kg	units	units	
	6.17	9.72	9.25	18.15	1.56	10.62	0.00	6.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	211.63
Q 13: How many times do you buy/charge it?																
Per month	8.25	1.54	8.31	2.63	8.85	1.79	0.00	4.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	
Q 14: How do you travel to get the energy? (method)																
Walk	66%	0%	89%	33%	68%	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Bicycle	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Taxi	34%	89%	11%	67%	28%	50%	0%	100%	0%	0%	0%	100%	0%	0%	0%	
Private car	0%	11%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Public bus	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Other ____________	0%	0%	0%	0%	4%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	
Q 15: How far do you travel to get the energy?																
Distance (km)	3.7	3.6	6.9	4.5	6.0	6.1	0.0	15.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0	
Q 16: How much do you pay for the round-trip?																
Travel costs each time (N$)	16.70	19.06	17.33	21.33	17.43	17.63	0.00	26.00	0.00	0.00	0.00	19.00	0.00	0.00	0.00	122.38
															Total Cost of Energy Inlcuding Travel (Ave)	282.09

Summary (Maximums)

Types of Energy	Paraffin	LPG	Wood	Lead Acid Battery (12V)	Candles	Dry Cell Batteries (1.5V)	Diesel	Petrol	Ethanol Gel	Solar Electricity	Plant Material	Charcoal	Recyclables/Waste		
Q 10: How much energy do you use?															
Per month	L	kg	bundle	charge	candles	batteries	L	L	kg	W	kg	kg	kg	units	units
	40	34	50	4	90	20	0	20	0	0	0	30	5	0	0
Q 11: How do you get the energy?															
Purchased															
Collected															
Free															
Q 12: How much do you pay each time you buy/charge it?															
Per unit	L	kg	bundle	charge	candle	battery	L	L	kg	W	kg	kg	kg	units	units
	12	17	12.5	40	6	22.5	0	6	0	0	0	1	0	0	0
Q 13: How many times do you buy/charge it?															
Per month	40	4	30	4	40	6	0	4	0	0	0	3	0	0	0
Q 14: How do you travel to get the energy? (method)															
Walk															
Bicycle															
Taxi															
Private car															
Public bus															
Other ____________															
Q 15: How far do you travel to get the energy?															
Distance (km)	10	8	90	15	25	15	0	15	0	0	0	7	0	0	0
Q 16: How much do you pay for the round-trip?															
Travel costs each time (N$)	26.00	19.50	19.50	26.00	26.00	26.00	0.00	26.00	0.00	0.00	0.00	19.50	0.00	0.00	0.00

Part V: Services Used

Summary (Averages and %)

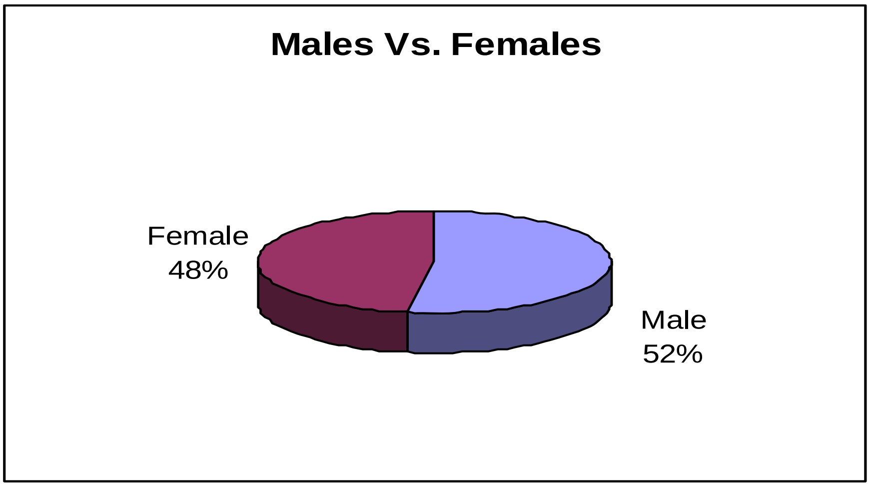
Type of Service	Pay to charge a cell phone	Pay to do your laundry	Buy baked goods	Buy dried food	Buy cold drinks	Buy ice	Pay to use a computer	Pay to get your hair cut	Rent power tools	Rent a Generator	Other	Average Cost/Month (N$)
Q 17: Do you...?	67%	3%	94%	42%	79%	18%	6%	76%	3%	0%	0%	
Q 18: How many times per month do you...?	7.4	1.5	14.0	4.1	8.3	4.0	1.8	1.9	0.1	0.0	0.0	
Q 19: How much do you pay each time to...? (N$)	5.90	8.00	6.48	44.61	7.82	12.42	11.00	31.29	35.00	0.00	0.00	**287.32**
Q 20: How do you travel to...? (method)												
Walk	64%	100%	94%	8%	100%	17%	33%	46%	100%	0%	0%	
Bicycle	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Taxi	32%	0%	6%	38%	0%	83%	67%	54%	0%	0%	0%	
Private car	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Public bus	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Other ______________	5%	0%	0%	54%	0%	0%	0%	0%	0%	0%	0%	
Q 21: How far do you travel to...? (km)	4.3	0.0	2.4	9.0	0.5	5.7	11.3	4.7	1.0	0.0	0.0	
Q 22: How much do you pay to travel each time to...? (N$)	17.93	0.00	18.75	17.38	0.00	18.80	18.50	17.42	0.00	0.00	0.00	**89.26**
											Total	**376.58**
											Total Gross	**658.67**
											Total (Excl Travel)	**498.94**

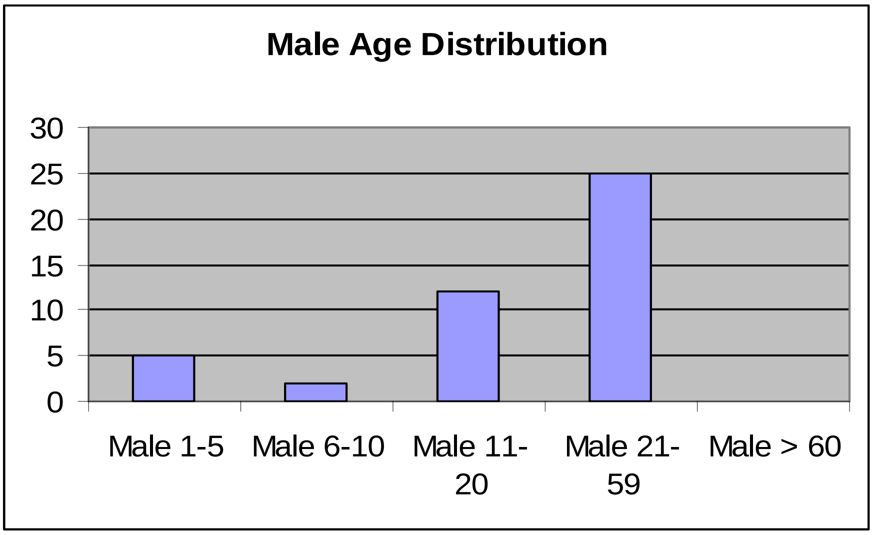
Summary (Maxes)

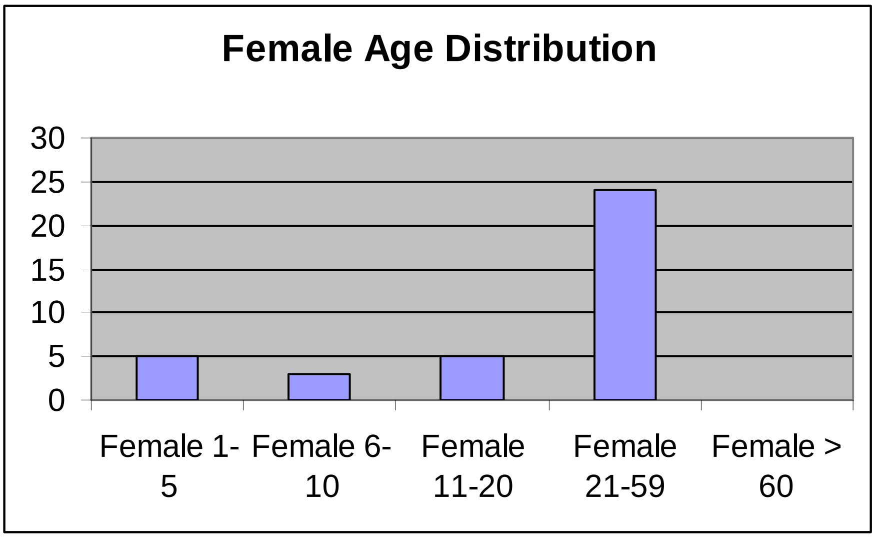
Type of Service	Pay to charge a cell phone	Pay to do your laundry	Buy baked goods	Buy dried food	Buy cold drinks	Buy ice	Pay to use a computer	Pay to get your hair cut	Rent power tools	Rent a Generator	Other
Q 17: Do you…?											
Q 18: How many times per month do you…?	20	1.5	30	24	90	10	3	4	0.1	0	0
Q 19: How much do you pay each time to...? (N$)	30	8	30	300	16	18	15	120	35	0	0
Q 20: How do you travel to…? (method)											
Walk											
Bicycle											
Taxi											
Private car											
Public bus											
Other ______________											
Q 21: How far do you travel to...? (km)	10	0	8	15	0.5	8	25	25	1	0	0
Q 22: How much do you pay to travel each time to...? (N$)	19.5	0	19	19.5	0	19.5	18.5	19.5	0	0	0

Appendix H: Results from Businesses in Havana Survey

Part I: Demographics







Part II: Appliance Usage

Summary by People

	Stove / Cooker									Cooler (refrigerator)			Deep-Freeze (Freezer)			Lighting					Electronics				Water pump					Water heater					Space heater								Generator						Misc.		
% Each Appl	100.0%									6.1%			3.0%			100.0%					87.9%				0.0%					0.0%					3.0%								3.0%						0.0%		
	Paraffin	Wood	Energy Efficient Stove	Open Fire	LPG	Ethanol Gel	Solar Cooker	Microwave	Other	LPG	Paraffin	Other	LPG	Paraffin	Ice	Paraffin lamp	Candles	Open Fire	Light bulb	Other	TV	Hi Fi	Radio	Cell Phone	Hand	Solar	Diesel	Petrol	Solar	Paraffin	LPG	Wood	Other	Other	Paraffin	Wood	Energy-Efficient wood	Open Fire	LPG	Ethanol Gel	Solar Cooker	Other	Diesel	Petrol	LPG	Wind	Solar	Other	Power Tools	Fan	Other
Q 7: Do you own a(n)...?	82.35%	41.18%	0.00%	0.00%	17.65%	0.00%	0.00%	0.00%	0.00%	0.00%	########	0.00%	80.00%	0.00%	20.00%	58.82%	88.24%	11.76%	23.53%	0.00%	31.25%	43.75%	75.00%	93.75%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

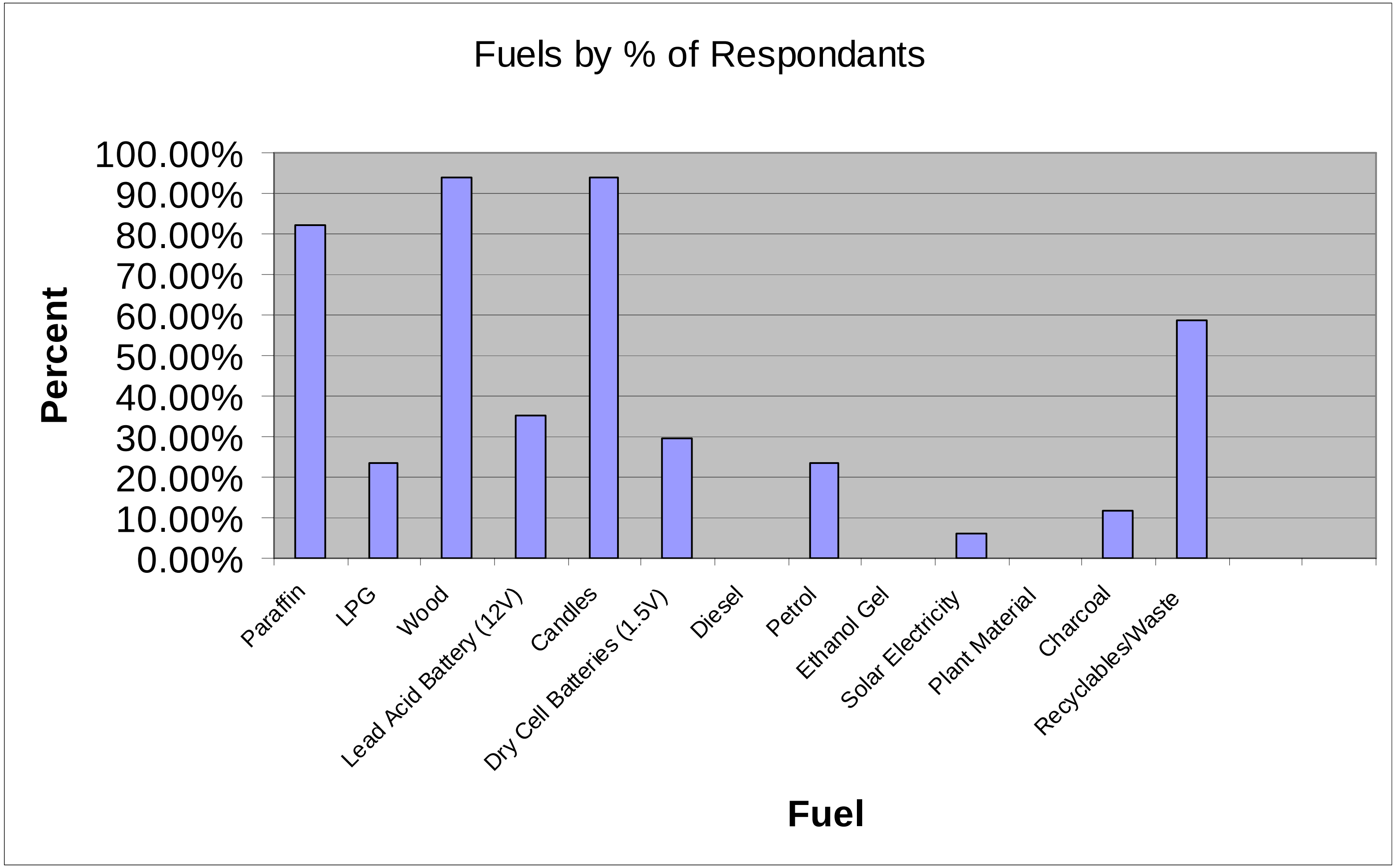
Summary by Appliance

	Stove / Cooker									Cooler (refrigerator)			Deep-Freeze (Freezer)			Lighting					Electronics				Water pump					Water heater					Space heater								Generator						Misc.		
	Paraffin	Wood	Energy Efficient Stove	Open Fire	LPG	Ethanol Gel	Solar Cooker	Microwave	Other	LPG	Paraffin	Other	LPG	Paraffin	Ice	Paraffin lamp	Candles	Open Fire	Light bulb	Other	TV	Hi Fi	Radio	Cell Phone	Hand	Solar	Diesel	Petrol	Solar	Paraffin	LPG	Wood	Other	Other	Paraffin	Wood	Energy-Efficient wood	Open Fire	LPG	Ethanol Gel	Solar Cooker	Other	Diesel	Petrol	LPG	Wind	Solar	Other	Power Tools	Fan	Other
Q 7: Do you own a(n)...?	43.75%	21.88%	0.00%	25.00%	9.38%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	########	80.00%	0.00%	20.00%	32.26%	48.39%	6.45%	12.90%	0.00%	12.82%	17.95%	30.77%	38.46%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Part III: Types of Energy Used

Types of Energy (%)	Paraffin	LPG	Wood	Lead Acid Battery (12V)	Candles	Dry Cell Batteries (1.5V)	Diesel	Petrol	Ethanol Gel	Solar Electricity	Plant Material	Charcoal	Recyclables/Waste		
Q 8: Do you use…?	82.35%	23.53%	94.12%	35.29%	94.12%	29.41%	0.00%	23.53%	0.00%	5.88%	0.00%	11.76%	58.82%	0.00%	0.00%
Q 9: What is the energy used for?															
Food Preparation	76.47%	23.53%	94.12%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	11.76%	52.94%	0.00%	0.00%
Room Heating	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Lighting	64.71%	0.00%	0.00%	5.88%	94.12%	0.00%	0.00%	17.65%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Water heating - laundry	11.76%	0.00%	11.76%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	17.65%	0.00%	0.00%
Water heating - cooking	41.18%	17.65%	58.82%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	35.29%	0.00%	0.00%
Cooler (refridgerator)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Deep-freeze (freezer)	0.00%	17.65%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Generator	0.00%	0.00%	0.00%	5.88%	0.00%	0.00%	0.00%	23.53%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Radio	0.00%	0.00%	0.00%	29.41%	0.00%	23.53%	0.00%	5.88%	0.00%	5.88%	0.00%	0.00%	0.00%	0.00%	0.00%
Hi Fi	0.00%	0.00%	0.00%	11.76%	0.00%	0.00%	0.00%	17.65%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
TV	0.00%	0.00%	0.00%	5.88%	0.00%	0.00%	0.00%	5.88%	0.00%	5.88%	0.00%	0.00%	0.00%	0.00%	0.00%
Hair cutting tools	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	5.88%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Power tools	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Water heating – bathing	11.76%	5.88%	23.53%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	5.88%	0.00%	0.00%
EMPTY SERVICE	0.00%	0.00%	0.00%	0.00%	0.00%	5.88%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

% Who Responded that They Use Fuel X for Use X


Fuels by % of Respondants
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
Percent
Paraffin
LPG
Wood
Lead Acid Battery (12V)
Candles
Dry Cell Batteries (1.5V)
Diesel
Petrol
Ethanol Gel
Solar Electricity
Plant Material
Charcoal
Recyclables/Waste
Fuel

Part IV: Energy Costs

Summary (Averages and %)																
Types of Energy	Paraffin	LPG	Wood	Lead Acid Battery (12V)	Candles	Dry Cell Batteries (1.5V)	Diesel	Petrol	Ethanol Gel	Solar Electricity	Plant Material	Charcoal	Recyclables/Waste			Average Cost/Month ($N)
Q 10: How much energy do you use?																
Per month	L	kg	bundle	charge	candles	batteries	L	L	kg	W	kg	kg	kg	units	units	
	19.5	64.3	17.0	3.4	36.1	8.0	0.0	115.0	0.0	20.0	0.0	15.0	42.2	0.0	0.0	
Q 11: How do you get the energy?																
Purchased	100%	100%	38%	83%	100%	100%	0%	100%	0%	100%	0%	100%	0%	0%	0%	
Collected	0%	0%	63%	0%	0%	0%	0%	0%	0%	0%	0%	0%	13%	0%	0%	
Free	0%	0%	0%	17%	0%	0%	0%	0%	0%	0%	0%	0%	88%	0%	0%	
Q 12: How much do you pay each time you buy/charge it?																
Per unit	L	kg	bundle	charge	candle	battery	L	L	kg	W	kg	kg	kg	units	units	
	6.10	16.17	8.50	15.75	1.44	5.70	0.00	5.93	0.00	0.00	0.00	1.90	0.00	0.00	0.00	397.73
Q 13: How many times do you buy/charge it?																
Per month	10.50	1.00	11.81	4.00	16.13	1.80	0.00	11.67	0.00	0.00	0.00	2.50	15.50	0.00	0.00	
Q 14: How do you travel to get the energy? (method)																
Walk	79%	0%	75%	40%	93%	0%	0%	0%	0%	0%	0%	0%	14%	0%	0%	
Bicycle	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Taxi	21%	100%	25%	60%	7%	100%	0%	50%	0%	0%	0%	100%	0%	0%	0%	
Private car	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%	0%	0%	0%	0%	0%	
Public bus	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Other	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	86%	0%	0%	
Q 15: How far do you travel to get the energy?																
Distance (km)	4.9	6.0	2.8	4.3	3.0	9.0	0.0	4.3	0.0	0.0	0.0	3.0	0.5	0.0	0.0	
Q 16: How much do you pay for the round-trip?																
Travel costs each time (N$)	16.83	19.00	16.00	19.00	18.50	17.70	0.00	16.00	0.00	0.00	0.00	19.00	0.00	0.00	0.00	119.50
															Total Cost of Energy Inlcuding Travel (Ave)	475.06

Summary (Maximums)

Types of Energy	Paraffin	LPG	Wood	Lead Acid Battery (12V)	Candles	Dry Cell Batteries (1.5V)	Diesel	Petrol	Ethanol Gel	Solar Electricity	Plant Material	Charcoal	Recyclables/Waste		
Q 10: How much energy do you use?															
Per month	L	kg	bundle	charge	candles	batteries	L	L	kg	W	kg	kg	kg	units	units
	60	225	60	10	120	12	0	200	0	20	0	20	300	0	0
Q 11: How do you get the energy?															
Purchased															
Collected															
Free															
Q 12: How much do you pay each time you buy/charge it?															
Per unit	L	kg	bundle	charge	candle	battery	L	L	kg	W	kg	kg	kg	units	units
	8.33	19	12	25	2.5	12	0	7	0	0	0	2.6	0	0	0
Q 13: How many times do you buy/charge it?															
Per month	30	1.5	30	10	30	2	0	30	0	0	0	4	30	0	0
Q 14: How do you travel to get the energy? (method)															
Walk															
Bicycle															
Taxi															
Private car															
Public bus															
Other _______________															
Q 15: How far do you travel to get the energy?															
Distance (km)	10	8	6	8	5	25	0	10	0	0	0	5	0.5	0	0
Q 16: How much do you pay for the round-trip?															
Travel costs each time (N$)	19.00	19.00	19.00	19.00	18.50	19.00	0.00	19.00	0.00	0.00	0.00	19.00	0.00	0.00	0.00

Part V: Services Used

Summary (Averages and %)

Type of Service	Pay to charge a cell phone	Pay to do your laundry	Buy baked goods	Buy dried food	Buy cold drinks	Buy ice	Pay to use a computer	Pay to get your hair cut	Rent power tools	Rent a Generator	Other	Average Cost/Month (N$)
Q 17: Do you…?	59%	0%	94%	47%	29%	65%	12%	65%	0%	6%	0%	
Q 18: How many times per month do you…?	4.8	0.0	18.5	4.9	4.0	12.0	1.0	1.7	0.0	1.0	0.0	
Q 19: How much do you pay each time to…? (N$)	4.60	0.00	7.13	13.43	20.67	13.25	44.00	41.50	0.00	0.00	0.00	**319.55**
Q 20: How do you travel to…? (method)												
Walk	80%	0%	81%	25%	83%	0%	0%	50%	0%	0%	0%	
Bicycle	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Taxi	20%	0%	6%	25%	17%	90%	100%	50%	0%	0%	0%	
Private car	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Public bus	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Other ____________	0%	0%	13%	50%	0%	10%	0%	0%	0%	0%	0%	
Q 21: How far do you travel to…? (km)	5.4	0.0	2.8	8.8	5.0	6.6	18.3	6.3	0.0	0.0	0.0	
Q 22: How much do you pay to travel each time to…? (N$)	18.50	0.00	19.00	18.50	13.00	18.61	16.67	17.50	0.00	0.00	0.00	**130.85**
											Total	**450.40**
											Total Gross	**925.46**
											Total (Excl Travel)	**717.28**

Summary (Maxes)

Type of Service	Pay to charge a cell phone	Pay to do your laundry	Buy baked goods	Buy dried food	Buy cold drinks	Buy ice	Pay to use a computer	Pay to get your hair cut	Rent power tools	Rent a Generator	Other
Q 17: Do you…?											
Q 18: How many times per month do you…?	8	0	30	16	12	30	1	4	0	1	0
Q 19: How much do you pay each time to...? (N$)	5	0	27.5	25	80	20	60	90	0	0	0
Q 20: How do you travel to…? (method)											
Walk											
Bicycle											
Taxi											
Private car											
Public bus											
Other ______________											
Q 21: How far do you travel to...? (km)	25	0	5	25	5	10	25	25	0	0	0
Q 22: How much do you pay to travel each time to...? (N$)	18.5	0	19	18.5	13	19	18.5	19	0	0	0

Appendix I: Case Study for Solar Cell Phone Charging and Haircutting

Location – Havana, outside of Windhoek, Namibia
Owner of SME – Venasius Amukwa
Address of SME – HA 31A

The informal settlement of Havana, located just outside of Windhoek, Namibia is a growing unelectrified community with potential for the introduction of renewable energy technology and services small and medium enterprises (RETS SMEs). After analyzing energy usage and services within the settlement using the EPOGES toolkit in April 2007, it was concluded that adding a haircutting service to Cascades, a cuca shop offering solar cell phone charging, had the potential to be a profitable venture. Men in the area typically cut their hair two to three times a month at a cost of N$20 and typically travel by taxi into town several kilometers away at an average cost of N$13 round trip. Adding this service to Cascades would make haircutting more accessible to the Havana community and would provide additional income to the shop's owner.

The following pages outline a market analysis that was conducted using the INSABA toolkit to assess the feasibility and determine the payback period of a solar system, including a 20 Watt photovoltaic array, a 200 Watt inverter, hair clippers, a cell phone charger for ten phones, and a 15 Watt light. The cost of this system was N$5465 with the majority of the investment in the PV equipment. The solar array was warranted for 25 years, while the batteries require replacements every five years. In order to plan for these replacements, N$372 was put aside on the first month of every year although this expense should be saved on a monthly basis by the owner. The other components of the system were assumed to last for at least three years.

The entrepreneur currently charges an average of 40 cell phones per month. It is assumed that this trend will continue for the first three months after installment and will gradually increase to 55 cell phones per month by the end of the year. Growth is assumed to level off at 60 cell phones per month during the following years.

For haircutting, it is assumed that the shop will attract three individuals every weekend, producing twelve haircuts a month. This projected number is kept constant to keep the resultant payoff period conservative, though growth is expected. When these sales amounts are entered into the INSABA tool, the payback period for the solar system is determined to be about 16 months. After the investment is paid off, the monthly income remains constant about N$380. Due to the longevity of the system, the lifetime income generated by this system has the potential to be over N$100,000.

INSABA Preassessment of Project Proposals

Country:	Namibia
Pilot Region:	Havana, outside Windhoek
RE Technology:	Solar PV Array
Business Idea:	Offer cell phone charging and haircutting within an OG settlement

Proponent name, contact	Venasius Amukwa	
Years of experience as owner of business		5
Number of employees w/contract		0
Proponent uses bank account	(yes=5, No=0)	0
Experience with formal loan	(received=5, applied=3, no=0)	0
Experience in cost calculations, business p	(no=0, several=5)	3
Practice in maintaining/operating equipment (RET)	(none yet=0, regularly=5)	3
Total		**11**

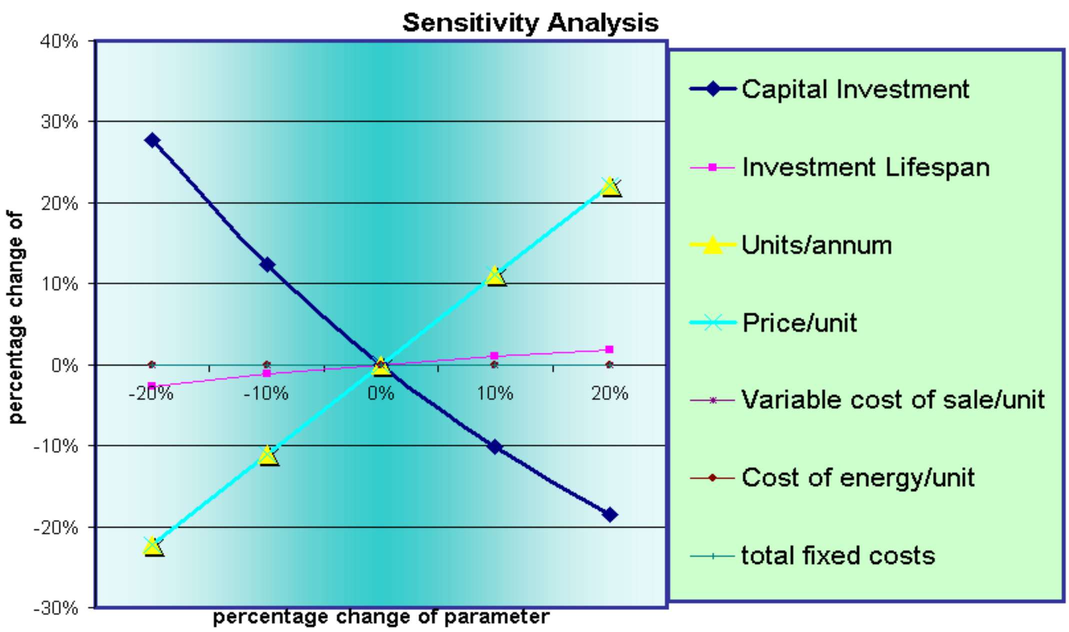
Calculation of ROI

	Solar System		Determination of parameters	Definitions
Investment Capital	5,465		Estimated, then computed for ROI0,3	Total cost of technology investment
Investment Lifespan	20		Estimated for solar array	Life of the technology - i.e. period before it must be replaced
Production	700		About two cell phone charges per day	Units produced per year
Price/unit	4.00		The current market price	Sales price per unit produced and sold
Revenue	2,800		Namibian	Sales price multiplied by number of units sold
Variable cost/unit	0.00		no other costs	Cost per unit produced e.g. material, processing packaging
Cost of energy/unit	0		no other energy	costs of power, fuel added to variable cost
Total fixed costs	0		Cost for display, handling	Annual indirect costs such as rent, telephones, salaries
Amortization/unit:	0.39	273		Amount needed per unit to cover investment in lifetime
Direct costs per unit:	0.39	273		Variable costs plus amortization plus cost of energy
Gross Margin/unit	3.61			Sales price per unit less the direct costs per unit
Fixed costs/unit	0.00			Total fixed costs divided by the number of units produced
Total costs	0.39	273		Direct costs plus fixed costs
Net Margin	3.61	**2,527**		Revenue less total costs
ROI	**46%**			Return on Investment = net margin divided by capital investment
Payback period years	**1.95**			capital investment divided by cash flow until intial expenses are compensated by the net margin

The graphic above comes from the INSABA toolkit and is used to assess different project proposals. In the "ROI" section, data about the actual money invested and payback period is entered to assess the expected return on investment

(ROI) of the project. Since this table only lets the user input one means of revenue at a time, we only assessed payback with profits produced through cell phone charging. With an initial investment of N$5465 and assuming two cell phone charges a day at N$4 the system should pay itself off in about two years according to the INSABA tool.

In the "Proponent" section, data is entered about the entrepreneur himself to help assess his abilities. This data is analyzed below in the Sensitivity Analysis section graphics. This analysis attempts to factor in the abilities and experience of the entrepreneur into the projected turnout of the investment. It predicts the expected percentage change in ROI given a change in several parameters (e.g. a 20% decrease in capital investment will yield a 28% increase in ROI). This analysis allows a business planner flexibility to increase profit given certain tradeoffs (e.g. a less expensive solar system could yield considerably higher profit).For this section we used information about the actual entrepreneur who currently runs the solar cell phone charging business, Venasius Amukwa. He has had five years experience running his cuca shop in Havana. We also gave him an average score of three for both experience in calculations and equipment maintenance.



Sensivity Analysis

ROI	Capital Investment	Investment Lifespan	Units/ annum	Price/ unit	Variable cost of sale/unit	Cost of energy/ unit	total fixed costs
-20%	59.04%	44.99%	35.99%	35.99%	46.24%	46.24%	46.24%
-10%	51.93%	45.68%	41.11%	41.11%	46.24%	46.24%	46.24%
0%	46.24%	46.24%	46.24%	46.24%	46.24%	46.24%	46.24%
10%	41.58%	46.69%	51.36%	51.36%	46.24%	46.24%	46.24%
20%	37.70%	47.07%	56.48%	56.48%	46.24%	46.24%	46.24%
-20%	27.70%	-2.70%	-22.16%	-22.16%	0.00%	0.00%	0.00%
-10%	12.31%	-1.20%	-11.08%	-11.08%	0.00%	0.00%	0.00%
0%	0	0	0	0	0	0	0
10%	-10.07%	0.98%	11.08%	11.08%	0.00%	0.00%	0.00%
20%	-18.47%	1.80%	22.16%	22.16%	0.00%	0.00%	0.00%

The table on the next page also comes from analysis of this business venture with the INSABA tool. This table allows the user to input multiple means of revenue to assess the payback from multiple services offered within a business. As you can see, in the "Products" section, the different services that the business will offer are included along with how many sales they are expected to make during each month. In this case, we used cell phone charging and haircutting. We are estimating a consistent 12 haircuts per month. In the case of cell phone charging, we estimated about 40 in the first months with an increase to about 55 by the end of the year.

Next, the price for each sale is entered in the section labeled "Turnover." We assumed that each haircut would cost N$15 with each cell phone charge costing N$4. In the "Material" section, the cost of providing each service is entered. In our case, there is no continuing cost to provide each service.

In the "Overhead Cost" section, we entered the amount for the original investment, N$5465, in the first month. Assuming a negligible amount of money is spent towards marketing, communication, or vehicles, this is the only cost associated with the implementation of the shop.

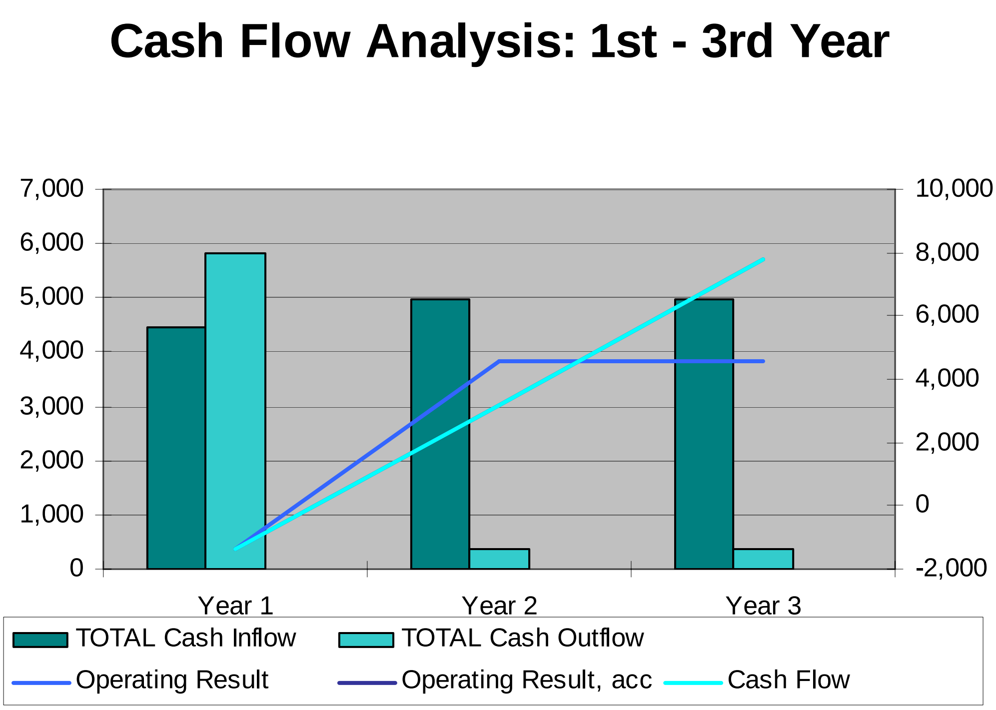
At the bottom, INSABA calculates our businesses projected cash flow. By the end of the second year, the entrepreneur would have a total profit of almost N$4000, which would increase to almost N$9000 in the third year. This yields an overall payoff period of 16 months, which illustrates how the payoff period was significantly reduced with the addition of a haircutting service to the business.

Cash Flow Analysis

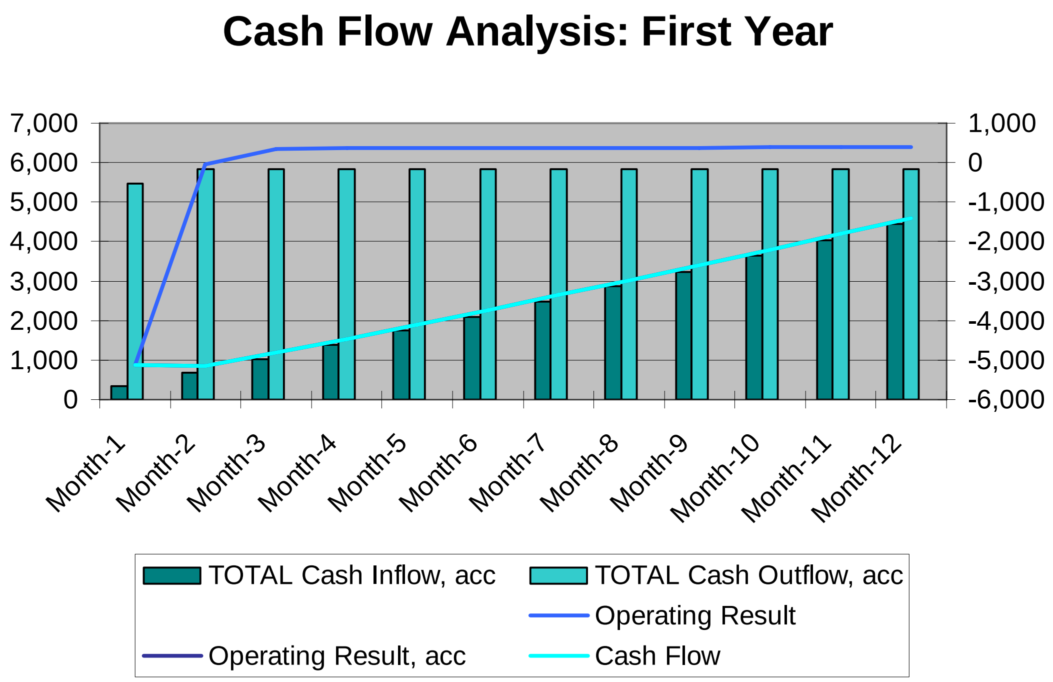
		Month-1 Year 1	Month-2 Year 1	Month-3 Year 1	Month-4 Year 1	Month-5 Year 1	Month-6 Year 1	Month-7 Year 1	Month-8 Year 1	Month-9 Year 1	Month-10 Year 1	Month-11 Year 1	Month-12 Year 1	Total Year 1	Total Year 2	Total Year 3
Products	***Sales***															
Haircutting	cuts	12	12	12	12	12	12	12	12	12	12	12	12	144	144	144
Cell Charging	Charge	40	40	40	45	45	45	50	50	50	55	55	55	570	700	700
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash Inflow																
Turnover	***Price***															
Haircutting	15.00	180	180	180	180	180	180	180	180	180	180	180	180	2,160	2,160	2,160
Cell Charging	4.00	160	160	160	180	180	180	200	200	200	220	220	220	2,280	2,800	2,800
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL Turnover		**340**	**340**	**340**	**360**	**360**	**360**	**380**	**380**	**380**	**400**	**400**	**400**	**4,440**	**4,960**	**4,960**
TOTAL Cash Inflow		340	340	340	360	360	360	380	380	380	400	400	400	4,440	4,960	4,960
Cash Outflow																
Material	***Cost***															
Haircutting	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cell Charging		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL Material		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Overhead Cost																
Staff A share		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Staff B														0	0	0
Office share		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Communication		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vehicle		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Marketing		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Investment		5,465			0								0	5,465	0	0
Investment Lifespan		10			1											
TOTAL Overhead		**5,465**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5,465**	**0**	**0**
Capital cost																
interest, redemption	**0%**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL capital		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL Cash Ouflow		5,465	0	0	0	0	0	0	0	0	0	0	0	5,465	0	0
Operating Result		-5,125	340	340	360	360	360	380	380	380	400	400	400	-1,025	4,960	4,960
/accumulated		-5,125	-4,785	-4,445	-4,085	-3,725	-3,365	-2,985	-2,605	-2,225	-1,825	-1,425	-1,025	-1,025	3,935	8,895
Capital input		0												0		
Cash Flow		-5,125	-4,785	-4,445	-4,085	-3,725	-3,365	-2,985	-2,605	-2,225	-1,825	-1,425	-1,025	-1,025	3,935	8,895

The following two graphics outline the cash flow of the business for three years. The bars and lines correspond to the same data in both graphs. The dark green bar labeled “TOTAL Cash Inflow” represents income, while the light green line bar “TOTAL Cash Outflow” represents expenditure. These bars line up with the left vertical axis. The light blue line on the graph labeled “Operating Result” represents the overall income minus expenditure. The light green line labeled “Operating Result, acc” represents income minus expenditure accumulated over each previous year. These lines are scaled to the axis on the right.

In the first graphic an overall deficit is observed of about N$1500. The gross income for each year, however, is near N$5000. Maintenance is taken into account by setting aside approximately N$500 for battery replacement every five years. This yields an overall profit, incorporating a modest growth, but not including initial investment, of about N$4500 every year. At this rate, the initial investment is paid off in about one year. The system itself with proper maintenance is guaranteed to last 25 years.



The second graphic outlines the cash flow in the first year by month. Although the system pays itself off in about one year, this figure includes a growth factor. In the first year, sales are projected to be lower than in subsequent years. This yields an overall deficit in the first year of about N$1500. Even with a lower productivity rate, 70% of the initial investment is paid off in the first year, requiring about 16 months for a 100% payoff. Since a five year loan is typically utilized for these types of systems, we concluded that a solar cell phone charging and haircutting system would be viable and profitable in Havana.



Appendix J: Case Study for Small SME Using Energy Basket 15 from the OGEMP

Location – Unspecified unelectrified locality in Namibia
Owner of SME – Unspecified
Address of SME – Unspecified

The Off-Grid Energisation Master Plan (OGEMP) provides several "energy baskets" that a potential energy shop would sell. These baskets fulfill a wide variety of needs for individual households and also suggest a number of RETS for SMEs. One basket proposes a 200 Watt AC solar system with three hair clippers, a cell phone charging station, 12 volt lead-acid battery charging station, and six 15 Watt lights. The entire system costs N$25,790 and can be paid off using the "Home Power!" loan at five percent interest over five years. In addition, the system's PV array is warranted for 25 years. While the batteries only last five years, the cost of replacement is factored into the analysis.

A market analysis was completed using the INSABA tool to determine the feasibility of this system to pay itself off within five years while providing income to the owner. It was assumed that this SME could charge at least forty cell phones per month. Growth was factored in such that the SME would be charging 50 cell phones per month by the end of the first year. In addition, it was estimated that the business would charge ten 12 volt lead-acid batteries per month during the first few months and would increase to 15 by the middle of the first year. It is likely that this figure will be higher depending on the location. Finally, it was assumed that haircutting would be a main service of this SME. The basket contains three hair clippers and can easily power all three at one time. Using a conservative estimate of 20 haircuts per month at startup and growing to 50 haircuts per month by the end of the first year, we determined the amount of time required to pay off the system. As can be seen in the figures below, the payback period for the basket given our proposed sales is just over two years. The income generated assuming stagnation after this point is over N$1500 per month

This table shows the items included in the small service SME energy basket as outlined in the OGEMP as well as their associated costs. This system is designed to provide cell phone charging, hair cutting, and 12 volt battery charging.

Energy Basket 15: Small Service SME									
Appliance / Fuel	Quantity	Appliance / Fuel Cost	Appliance / Fuel subtotal	Required energy	Units	Unit Cost	Monthly Fuel Cost	Monthly Maintenance Cost	Total monthly operation & maintenance budget
220V electric light 15 W CFL with fitting	6	N$ 30.00	N$ 180.00	~	Vah/month	N$ -	~	N$ 3.67	
Cellphone charger	10	N$ 90.00	N$ 900.00	~	Vah/month	N$ -	~	N$ -	
Hair clippers	3	N$ 120.00	N$ 360.00	~	Vah/month	N$ -	~	N$ -	
HiFi - AC	1	N$ 500.00	N$ 500.00	~	Vah/month	N$ -	~	N$ -	
Battery charger (12V/10A/150W)	1	N$ 1,450.00	N$ 1,450.00	~	Vah/month	N$ -	~	N$ -	
Solar PV 200 - AC	1	N$ 20,000.00	N$ 20,000.00	~	~	~	~	N$ 27.00	
TOTAL			N$ 23,390.00				N$ -	N$ 30.67	**N$ 30.67**
TRANSPORT OF PRODUCTS TO ENERGY SHOP			N$ 1,000.00						
INSTALLATION			N$ 1,400.00						
TOTAL PRICE			**N$ 25,790.00**						

INSABA Preassessment of Project Proposals

Country:	Namibia
Pilot Region:	Any
RE Technology:	Solar Charging and Haircutting
Business Idea:	provide haircutting and battery / cell phone charging within an OG settlment

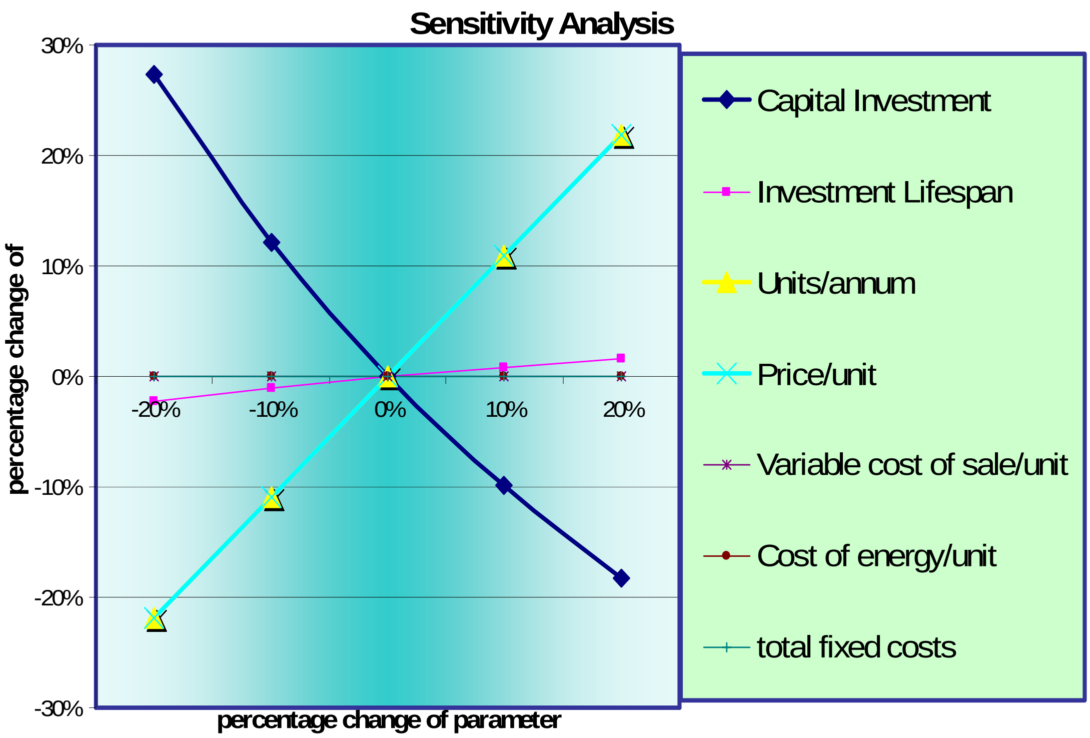
Proponent name, contact	none	
Years of experience as owner of business		5
Number of employees w/contract		0
Proponent uses bank account	(yes=5, No=0)	5
Experience with formal loan	(received=5, applied=3, no=0)	5
Experience in cost calculations, business p	(no=0, several=5)	3
Practice in maintaining/operating equipment (RET)	(none yet=0, regularly=5)	3
Total		**21**

Calculation of ROI

	Small SME		Determination of parameters	Definitions
Investment Capital	25,790		Estimated, then computed for ROI0,3	Total cost of technology investment
Investment Lifespan	25		Estimated for Solar Panel	Life of the technology - i.e. period before it must be replaced
Production	600		50 haircuts per month	Units produced per year
Price/unit	20.38		The current market price	Sales price per unit produced and sold
Revenue	12,228		N$	Sales price multiplied by number of units sold
Variable cost/unit	0.00		No other costs	Cost per unit produced e.g. material, processing packaging
Cost of energy/unit	0		no other energy	costs of power, fuel added to variable cost
Total fixed costs	0		Cost for display, handling	Annual indirect costs such as rent, telephones, salaries
Amortization/unit:	1.72	1,032		Amount needed per unit to cover investment in lifetime
Direct costs per unit:	1.72	1,032		Variable costs plus amortization plus cost of energy
Gross Margin/unit	18.66			Sales price per unit less the direct costs per unit
Fixed costs/unit	0.00			Total fixed costs divided by the number of units produced
Total costs	1.72	1,032		Direct costs plus fixed costs
Net Margin	18.66	**11,196**		Revenue less total costs
ROI	**43%**			Return on Investment = net margin divided by capital investment
Payback period years	**2.11**			capital investment divided by cash flow until intial expenses are compensated by the net margin

The graphic above comes from the INSABA tool and is used to assess different project proposals. In the "ROI" section, data about the actual money invested and payback period is entered to assess the expected return on investment (ROI) of the project. Since this table only lets the user input one means of revenue at a time, we are only assessing payback with profits produced through haircutting. According to the INSABA tool, with an initial investment of N$25790, 50 haircuts per month at N$20.38, the average price of a haircut in Havana, will pay the entire investment off in 2.11 years.

In the "Proponent" section, data is entered about the entrepreneur himself to help assess his abilities. This data is analyzed below in the Sensitivity Analysis section graphics. This analysis attempts to factor the abilities and experience of the entrepreneur into the projected turnout of the investment. It takes into account the percentage change in ROI given a change in several parameters (e.g. a 20% decrease in capital investment will yield a 28% increase in ROI). This analysis allows a business planner flexibility to increase profit given certain tradeoffs (e.g. a less expensive solar system could yield considerably higher profit). In this case we assumed a fairly well experienced entrepreneur with five years experience, a bank account, has received a loan previously, and has moderate experience in both calculations and equipment maintenance.



Sensivity Analysis

ROI	Capital Investment	Investment Lifespan	Units/ annum	Price/unit	Variable cost of sale/unit	Cost of energy/ unit	total fixed costs
-20%	55.27%	42.41%	33.93%	33.93%	43.41%	43.41%	43.41%
-10%	48.68%	42.97%	38.67%	38.67%	43.41%	43.41%	43.41%
0%	43.41%	43.41%	43.41%	43.41%	43.41%	43.41%	43.41%
10%	39.10%	43.78%	48.16%	48.16%	43.41%	43.41%	43.41%
20%	35.51%	44.08%	52.90%	52.90%	43.41%	43.41%	43.41%
-20%	27.30%	-2.30%	-21.84%	-21.84%	0.00%	0.00%	0.00%
-10%	12.13%	-1.02%	-10.92%	-10.92%	0.00%	0.00%	0.00%
0%	0	0	0	0	0	0	0
10%	-9.93%	0.84%	10.92%	10.92%	0.00%	0.00%	0.00%
20%	-18.20%	1.54%	21.84%	21.84%	0.00%	0.00%	0.00%

The table on the next page allows the user to input multiple means of revenue to assess the payback from multiple services offered within a business. As you can see, in the "Products" section, you enter the different services that the business will offer and then how many sales they're expected to make during each month. In this case, we are using haircutting, 12 volt battery charging, and cell phone charging. We are estimating about 20 haircuts per month increasing to 50 by the end of the year. With 12 volt battery charging, we estimate about 10 during the first month with an increase to about 15 per month by the end of the year. In the case of cell phone charging, we estimate about 40 in the first month increasing to about 60 per month by the end of the year.

Next, the price for each sale is entered in the section labeled "Turnover." We assumed that each haircut would cost N$20.38, each 12 volt charge costing N$17.30, and each cell phone charge costing N$4.

In the "Material" section, the cost of providing each service is entered. In our case, there is no continuing cost to provide each service.

In the "Overhead Cost" section, we entered the amount for the original investment, N$25822, in the first month. Assuming a negligible amount of money is spent towards marketing, communication, or vehicles, this is the only cost associated with the implementation of the shop.

At the bottom, INSABA calculates our businesses projected cash flow. As you can see, by the end of the second year, the entrepreneur has a total profit of over N$5000 in the second year after the initial investment is paid off and then another

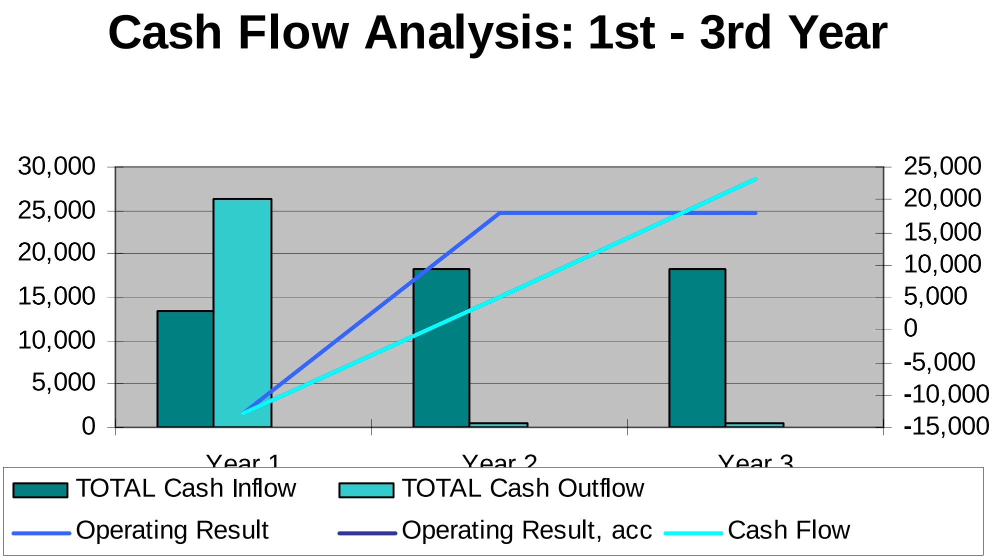
N$23000 in the third year. This means that the payoff period was significantly reduced with the addition of the 12 volt and cell phone charging services to the business.

Cash Flow Analysis

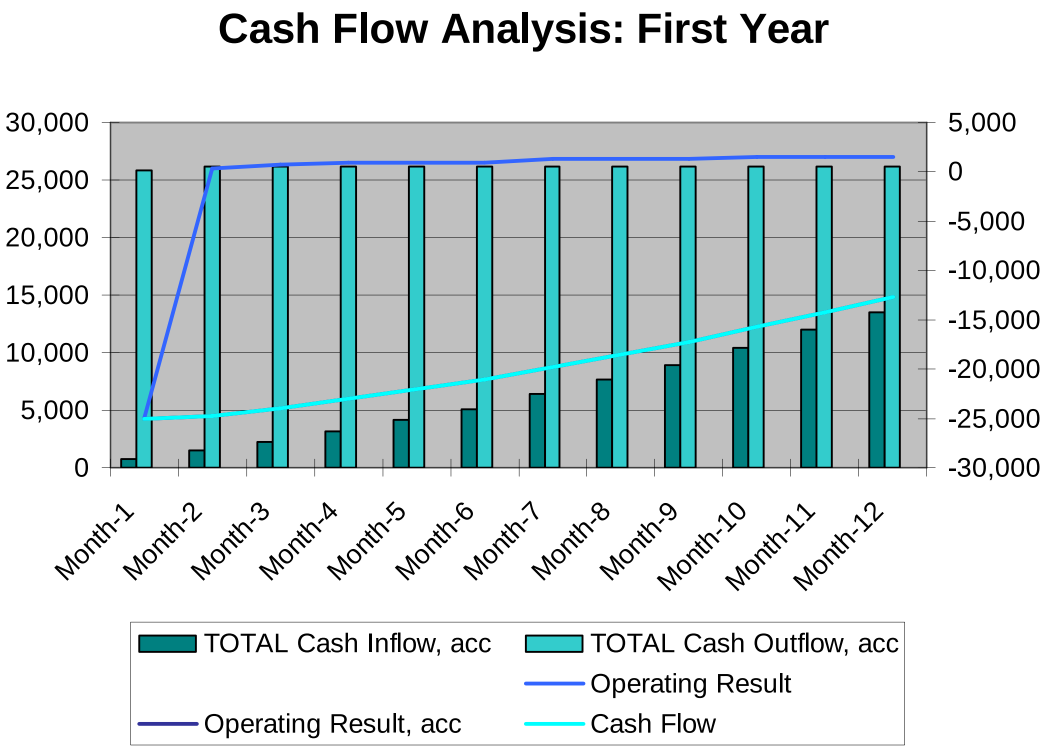
		Month-1 Year 1	Month-2 Year 1	Month-3 Year 1	Month-4 Year 1	Month-5 Year 1	Month-6 Year 1	Month-7 Year 1	Month-8 Year 1	Month-9 Year 1	Month-10 Year 1	Month-11 Year 1	Month-12 Year 1	Total Year 1	Total Year 2	Total Year 3
Products	***Sales***															
Haircutting	cuts	20	20	20	30	30	30	40	40	40	50	50	50	420	600	600
12VCharging	charge	10	10	10	10	10	10	15	15	15	15	15	15	150	180	180
CellCharging	charge	40	40	40	45	45	45	50	50	50	60	60	60	585	720	720
Cash Inflow																
Turnover	***Price***															
Haircutting	20.38	408	408	408	611	611	611	815	815	815	1,019	1,019	1,019	8,560	12,228	12,228
12VCharging	17.30	173	173	173	173	173	173	260	260	260	260	260	260	2,595	3,114	3,114
CellCharging	4.00	160	160	160	180	180	180	200	200	200	240	240	240	2,340	2,880	2,880
TOTAL Turnover		**741**	**741**	**741**	**964**	**964**	**964**	**1,275**	**1,275**	**1,275**	**1,519**	**1,519**	**1,519**	**13,495**	**18,222**	**18,222**
TOTAL Cash Inflow		741	741	741	964	964	964	1,275	1,275	1,275	1,519	1,519	1,519	13,495	18,222	18,222
Cash Outflow																
Material	***Cost***															
Haircutting	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12VCharging	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CellCharging		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL Material		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Overhead Cost																
Staff A share		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Staff B														0	0	0
Office share		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Communication		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vehicle		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Marketing		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Investment		25,822	372											26,194	372	372
Investment Lifespan		25	1													
TOTAL Overhead		**25,822**	**372**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**26,194**	**372**	**372**
Capital cost																
interest, redemption	**5%**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL capital		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTAL Cash Ouflow		25,822	372	0	0	0	0	0	0	0	0	0	0	26,194	372	372
Operating Result		**-25,081**	**369**	**741**	**964**	**964**	**964**	**1,275**	**1,275**	**1,275**	**1,519**	**1,519**	**1,519**	**-12,699**	**17,850**	**17,850**
/accumulated		**-25,081**	**-24,712**	**-23,972**	**-23,007**	**-22,043**	**-21,079**	**-19,804**	**-18,529**	**-17,255**	**-15,736**	**-14,218**	**-12,699**	**-12,699**	**5,151**	**23,001**
Capital input		0												0		
Cash Flow		**-25,081**	**-24,712**	**-23,972**	**-23,007**	**-22,043**	**-21,079**	**-19,804**	**-18,529**	**-17,255**	**-15,736**	**-14,218**	**-12,699**	**-12,699**	**5,151**	**23,001**

The following two graphics outline the cash flow of the business for three years. The bars and lines correspond to the same data in both graphs. The dark green bar labeled "TOTAL Cash Inflow" represents income, while the light green line bar "TOTAL Cash Outflow" represents expenditure. These bars line up with the left vertical axis. The light blue line on the graph labeled "Operating Result" represents the overall income minus expenditure. The light green line labeled "Operating Result, acc" represents income minus expenditure accumulated over each previous year. These lines are scaled to the axis on the right.

In the first graphic, an overall deficit is observed of about N$15000. The gross income for each year, however, is near N$18000. Maintenance is taken into account by setting aside approximately N$1000 for battery replacement every five years. This yields an overall profit, incorporating a modest growth, but not including initial investment, of about N$1400 every year. At this rate, the initial investment is paid off in about two years while the system is guaranteed to last 25 years with proper maintenance.



The second graphic outlines the cash flow by month in the first year. Although the system pays itself off in about two years, this figure includes a growth factor. In the first year, sales are projected to be lower than in subsequent years. This yields an overall deficit in the first year of about N$15000. Even with a lower productivity rate, about 50% of the initial investment is paid off in the first year, requiring about two years for a 100% payoff. Since a five year loan is typically utilized for these types of systems, we concluded that an SME incorporating haircutting, cell phone charging, and lead-acid battery charging would be profitable in Havana.



Appendix K: Small and Medium Enterprise Support Organization (SMESO) Contact Information

SMESO: AgriFutura			
Office #:	061-227630	**Fax #:**	061-236372
Address:	P O Box 31487 Windhoek	**Website:**	N/A
Contact:	Colin Usurua	**Email:**	agrifutu@mweb.com.na
Position:	Director		

SMESO: Comitato Internazionale Per Lo Sviluppo Dei Popoli			
Office #:	061-254201	**Fax #:**	N/A
Address:	N/A	**Website:**	N/A
Contact:	Alberto Zardi	**Email:**	cisp@iafrica.com.na
Position:	Consultant		

SMESO: Consultburo			
Office #:	061-256892	**Fax #:**	061-252715
Address:	P O Box 86321 Eros	**Website:**	N/A
Contact:	Birgit Dempsey Werner Sell	**Email:**	birght@consultburo.com wsell@iway.na
Position:	Director Coordinator: SMEs		

SMESO: Institute of Management Leadership Training (IMLT)			
Office #:	061-230555	**Fax #:**	061-231277
Address:	P O Box 22524 Windhoek	**Website:**	http://www.imlt.org.na/
Contact:	Fanie Oosthuisen	**Email:**	fanie@imlt.org.na
Position:	Managing Director		

SMESO: Joint Consultative Council (JCC)			
Office #:	061-220545	**Fax #:**	061-237394
Address:	P O Box 23653 Windhoek	**Website:**	http://www.jcc.com.na/
Contact:	Tuwilika Hamwele	**Email:**	tuwilika@jcc.com.na
Position:	JCC Coordinator		

SMESO: Khomas Women in Development			
Office #:	061-218723	**Fax #:**	061-265893
Address:	P O Box 7061 Windhoek	**Website:**	N/A
Contact:	Alwine Awases	**Email:**	kwid@cyberhost.com.na
Position:	Director		

SMESO: Namibia Rural Development Project			
Office #:	061-237279	**Fax #:**	061-234378
Address:	P O Box 24886 Windhoek	**Website:**	N/A
Contact:	Nelson Kanovengi	**Email:**	nrdp@iway.na
Position:	Project Officer		

SMESO: Namibia Women's Network			
Office #:	061-246331	**Fax #:**	061-247581
Address:	P O Box 8961 Bachbrecht	**Website:**	N/A
Contact:	Marianne Erastus	**Email:**	nwn@iway.na
Position:	National Coordinator		

SMESO: !Nara Training Centre			
Office #:	061-222860	**Fax #:**	061-222864
Address:	P O Box 4157 Windhoek	**Website:**	http://www.nnf.org.na/ENVDIR/pages/nara.htm
Contact:	Hosabe Honeb	**Email:**	hhoneb@naratc.org.na
Position:	Manager: Business Development Programme		

SMESO: Okutumbatumba Hawkers Association			
Office #:	061 260234	**Fax #:**	N/A
Address:	N/A	**Website:**	N/A
Contact:	Veripi/ Kandenge/ Kandiimuine	**Email:**	N/A
Position:	Director		

SMESO: Premier Consult			
Office #:	812-714853	**Fax #:**	061-222402
Address:	P O Box 40657 Windhoek	**Website:**	N/A
Contact:	Charles Mungule	**Email:**	premier@iway.na muweman2@hotmail.com
Position:	Director		

SMESO: The Rossing Foundation of Namibia			
Office #:	064-510098	**Fax #:**	064-510814
Address:	P O Box 284 Arandis	**Website:**	N/A
Contact:	Petra Ondigo	**Email:**	pondigo@rossing.com.na
Position:	SME Coordinator		

SMESO: Shack Dwellers Federation			
Office #:	061-228697	**Fax #:**	061-239397
Address:	PO BOX 21010 Windhoek	**Website:**	N/A
Contact:	Edith Mbanga	**Email:**	nhag@iafrica.com.na
Position:	National Facilitator		

SMESO: SMEs Compete			
Office #:	061-247129	**Fax #:**	061-248591
Address:	Private Bag 13368 Windhoek	**Website:**	http://www.smescompete.com/
Contact:	Danny Meyer	**Email:**	danny@smecompete.com
Position:	Director		

SMESO: Urban Trust of Namibia			
Office #:	061 248708	**Fax #:**	24 8711
Address:	Private Bag 13291 Windhoek	**Website:**	
Contact:	Santos Joas	**Email:**	utnjoas@mweb.com.na
Position:	Executive Director		

SMESO: University of Namibia (UNAM) Small Business Development Centre			
Office #:	065-2232271	**Fax #:**	652-232000
Address:	P O Box 2654 Oshakati	**Website:**	N/A
Contact:	Nathaniel Haukongo	**Email:**	nphaukongo@yahoo.co.uk
Position:	Coordinator		

SMESO: Windhoek Vocational Training Centre			
Office #:	061 211742	**Fax #:**	+264 (61) 21 23 79
Address:	P.O. Box 3771 Windhoek	**Website:**	http://www.wvtc.edu.na/index.php
Contact:	Corrie Arries	**Email:**	arries@wvtc.edu.na
Position:	Head of Administration		

SMESO: Women's Action for Development (WAD)			
Office #:	061-227630	**Fax #:**	061-236372
Address:	P O Box 370 Windhoek	**Website:**	http://www.wad.org.na/
Contact:	Pamela McMaster	**Email:**	pa-ed@mweb.com.na
Position:	Training Coordinator		

Appendix L: SMESO Feedback- SMEs Compete

Small and Medium Enterprise Support Organization (SMESO) Feedback			
SMESO:	SMEs Compete		
Phone #:	061-247129	**Website:**	http://www.smescompete.com/
Contact:	Danny Meyer	**Position:**	Director
Comments:			

Address:
NCCI House-Ground Floor
2 Jenner Street, Windhoek West
Private Bag 13368
Windhoek, Namibia
danny@smescompete.com

Background Info:

SMEs Compete started as a USAID funded organization. Funded until February 2006, and then became privately owned.

To qualify as a client for SMEs Compete, a business must have been operating for at least a year, must be owner-driven, and must have an address.

Often run the workshop “So you want to start a business” to teach people about the risks involved and the sacrifices that must be made. This helps people to decide if being an entrepreneur is for them.

SMEs Compete often does pro-bono work for the Polytechnic of Namibia and for the Chamber of Commerce.

Said we can contact IMLT and CISP, two other organizations that work with SMEs, especially ones in the informal sector.

IMLT-no phone number for IMLT was given
CISP- 061-254-201 “Alberto”

Feedback on EPOGES toolkit from interview:

Our surveying method follows a “very good approach”

Survey is “Comprehensive and all-inclusive”

Suggested that maybe we add in a section specifically on entertainment in shebeens like jukeboxes and hi-fis. This section would only be used for businesses.

Also, suggested that it may be interesting to see the age distribution in relation to what fuels and services were utilized.

Often times, SME support organizations will use Microsoft Access and Excel tools to perform analysis for entrepreneurs just as the EPOGES toolkit would.

Appendix M: SMESO Feedback- Joint Consultative Council

Small and Medium Enterprise Support Organization (SMESO) Feedback			
SMESO:	Joint Consultative Council (JCC)		
Phone #:	061-220545	**Website:**	http://www.jcc.com.na/
Contact:	Tuwilika Hamwele	**Position:**	JCC Coordinator
Comments:			

Addresses:
Joint Consultative Council
No. 196 Caesar Street, Katutura, Windhoek
P.O. Box 23653 Windhoek
tuwilika@jcc.com.na

Background Info:

Mission Statement: "The JCC renders an effective promotion and support service to the SME promoting organisations and private sector initiatives in order to enhance equitable economic growth in Namibia"

The JCC is really a network of SME Service providers. They organize and distribute resources for SME support organizations.

A tool like the EPOGES toolkit should first be given to the JCC and then the JCC can distribute it among SMESOs.

Most SMESOs are not funded by the government. They are usually not for profit, but need to charge small fees to the entrepreneurs it helps.

Tuwilika would like a copy of our final report when it is finished.

Feedback on EPOGES toolkit:

"Not missing anything"

Would like to see a chart or something that shows the current costs of fuel for people in the settlements compared to what renewable fuels and technologies would cost. She believes this will help to make our project much stronger.