

Activity 7



Fuel Source Survey at Ezamokuhle community



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Contents

EXECUTIVE SUMMARY	6
1. BACKGROUND	8
1.1 Air Quality Offsets Guideline.....	8
1.2 ESKOM’S Approach to Air Quality Offsets.....	8
1.3 ESKOM’s Planning, Monitoring and Verification (PMV) Project	9
2. INTRODUCTION	11
2.1 Activity 7 – Fuel Source Survey	11
2.2 Study Key Tasks	11
3. METHODOLOGY	12
3.1 Approach To Study.....	12
3.1.1 Local leadership approval.....	12
3.1.2 Identification of fuel merchants	12
3.1.3 Ethical framework utilised in fuel merchant engagement	13
3.1.4 Safety and security of the fieldworkers.....	13
3.2 Fuel Survey	13
3.2.1 Process flow for fuel survey	13
3.2.2 Study area.....	14
3.2.3 Fuel Survey questionnaire	15
4. RESULTS & DISCUSSION	16
4.1 Fuel Merchants identified in and around Ezamokuhle.....	16
4.2 Fuel Merchants Profile.....	16
4.3 Fuel Merchants Supplier Location	18
4.4 Price, Quantity & Weight of Fuels Sold.....	19
4.4.1 Price & Weight of Fuels	19
4.4.2 Quantity of Fuels Sold.....	20
4.5 Fuel Merchants Perceptions	21
4.6 Coal Quality Analysis.....	22
4.6.1 Emissions & Coal Quality	22

4.6.2 Coal Analyses Results	23
5. CONCLUSION.....	25
6. ACKNOWLEDGEMENTS	27
7. REFERENCES	28
ANNEXURE 1.....	29
FINAL FUEL SURVEY QUESTIONNAIRE.....	29
SECTION I: Interview information	29
SECTION A: Purchased Fuel	30
3.2.....	32
Section B: Fuel Merchant Perceptions.....	37
Section C: General Comments	39
ANNEXURE 2.....	40
Report Disclaimer	40
Copyright.....	40
ANNEXURE 3: FUEL MERCHANT RESPONSES.....	41

LIST OF TABLES

Table 1: Eskom PMV Activity Schedule	10
Table 2: Summary profile of Fuel Merchants	17
Table 3: Location from which coal and wood is sourced by Fuel Merchants	18
Table 4: South African local coal classification system	23
Table 5: Results from coal analysis (air dry basis)	23

LIST OF FIGURES

Figure 1: Concept Schedule for the implementation of Eskom's air quality offsets (Matimolane, 2020)	8
Figure 2: Eskom's Phased approach to the rollout of air quality offset interventions (Matimolane, 2020)	9
Figure 3: Process flow for fuel survey for Ezamokuhle	14
Figure 4: Ezamokuhle Zones for Field Survey	15
Figure 5: Locality map showing location of fuel merchants (red outline shows perimeter of Ezamokuhle)	16
Figure 6: Locality Map show location of suppliers to Fuel Merchants	18
Figure 7: Price of fuels sold by fuel merchants	19
Figure 8: Average measured weight of a bag of coal by ARM	19
Figure 9: Quantity of fuels sold	20
Figure 10: Demand of fuels compared to a year ago	21

EXECUTIVE SUMMARY

The Ezamokuhle community fuel source survey was conducted during July-August 2022. A questionnaire was used to interview six fuel merchants identified during the Activity 6 community source survey walk-through the community. In addition, samples were taken of the coal supplied by the merchants and were analyzed to compare coal quality and potential air quality impacts.

Results indicated that all sources of fuel originated from outside Ezamokuhle, prior to distribution by merchants into the community. Only one hardware store in close-by Amersfoort provided LPG (gas) and to an even lesser extent, paraffin and spirits to the community. LPG prices at R316 per 9 kg bottle are competitive compared to other towns, increased significantly in the past year as elsewhere, and are typically provided in 9 kg cylinders. Although the coal from the Amersfoort store is the most expensive coal option, the anthracitic coal quality was best from this source with least emissions anticipated on combustion. Availability and fuel prices from this retailer are constant through summer and winter and all sales are done on a cash-only basis for residents.

However, most coal and wood are provided by five other fuel merchants situated inside Ezamokuhle. Interviews with these fuel merchants provided a different perspective- coal and wood is sold in small quantities of one or two bags, mainly to the elderly, and often on credit that is not provided in town. Merchants paid cash for their fuels, imported from Ermelo and Witbank Zama Zama's. The biggest concern from merchants was unreliability of supply of coal and wood.

Competitive prices were charged by merchants for coal and wood, ranging from R100 to R160 per bag of coal, and R30 to R65 per bag of wood. Even though the bags are sold to contain 50 kg of fuel, variability of about 30% was found on weighing the bags, that can be expected due to humidity and poor quality of fuels. Analyses of the coal revealed that most coal sold in Ezamokuhle is of Grade D or even worse quality with low energy, high sulfur, high ash, and high volatile content, making for poor air quality on combustion. Monthly consumption of coal was at least 17.6 tons and 9.8 tons of wood in winter with data obtained just from four of the merchants; on very cold days consumption can be much higher due to demand. Summer consumption was about 60% less due to reduced need for space heating but need for cooking continued.

According to fuel merchants, coal and wood is mainly used for cooking and space heating, and to a lesser extent for water heating. Electricity is only used for lighting and LPG is too expensive for

extensive use in Ezamokuhle. Paraffin and dung was not reported as a fuel option. These perspectives will be tested in household surveys with the community directly in due course.

Preliminary opportunities were identified to improve air quality in the PMV project for the Ezamokuhle area. Alternative fuels than coal and wood (such as gas and electricity) are perceived to be very costly but does not consider the poor coal quality and the unreliable supply of poor-quality coals to merchants, that provides fertile ground for change towards improved fuel quality. To however achieve change, careful consideration is required to develop suitable financing models (such as credit) for fuel supply and to communicate benefits of insulation and cleaner fuels to the community, starting with the local school where LPG use was terminated.

1. BACKGROUND

1.1 AIR QUALITY OFFSETS GUIDELINE

An environmental offset is an action(s), designed to compensate for a negative environmental impact of resource use, a discharge, emission or other activity. The Department of Environment, Forestry & Fisheries (DEFF) defines air emissions offsets as an intervention, or interventions, specifically implemented to counterbalance the adverse and residual environmental impact of atmospheric emissions in order to deliver a net ambient air quality benefit within, but not limited to, the affected airshed where ambient air quality standards are being or have the potential to be exceeded and whereby opportunities and need for offsetting exist (Notice 333 of 2016).

1.2 ESKOM’S APPROACH TO AIR QUALITY OFFSETS

DEFF’s Air Quality Offset Guideline has shaped and informed Eskom’s Air Quality Offsets Implementation Plan. This Plan has been based on a scientific process of feasibility studies, testing and demonstration, and on consultation with key stakeholders. Figure 1 illustrates the concept schedule for the phased implementation of Eskom’s air quality offsets.

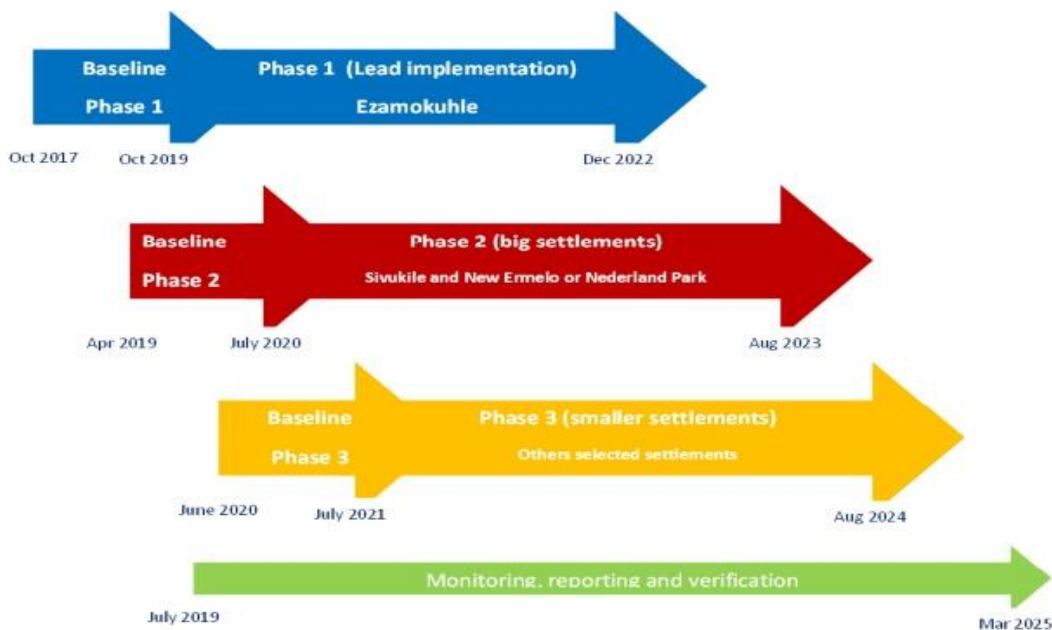
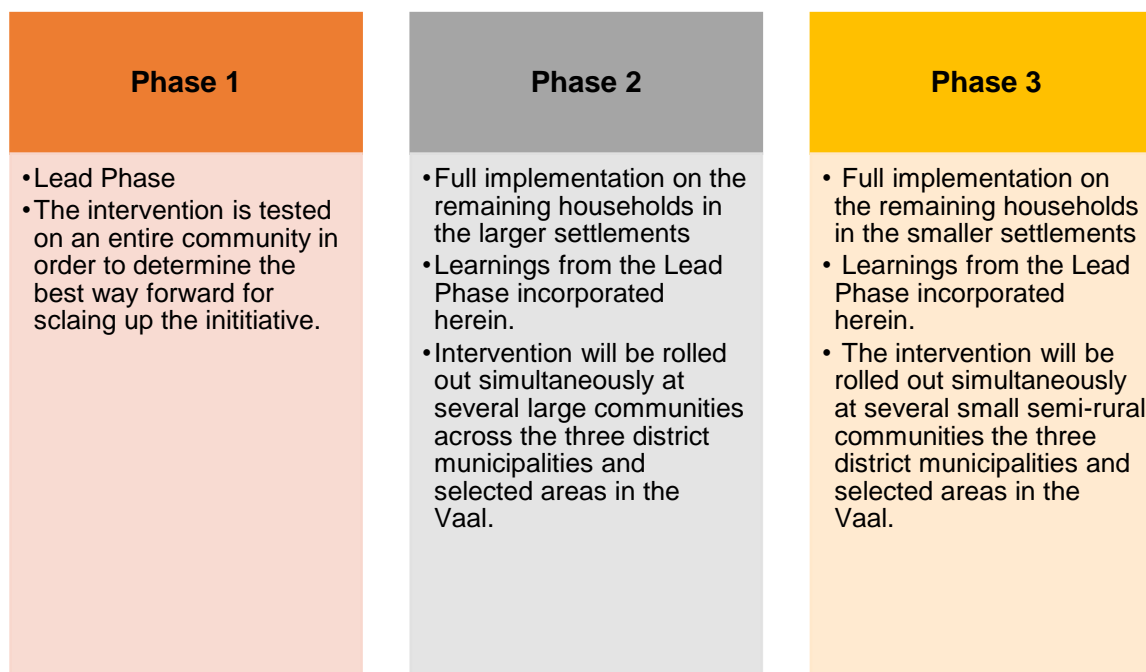


Figure 1: Concept Schedule for the implementation of Eskom’s air quality offsets (Matimolane, 2020)

Eskom has adopted the phased approach (Figure 2) herein to increase the probability of success and to ensure that learnings from early phases are incorporated into the large-scale roll-out. (Matimolane, 2020).

Figure 2: Eskom’s Phased approach to the rollout of air quality offset interventions (Matimolane, 2020)



Eskom’s air quality offsets programme is designed to reduce human exposure to harmful levels of air pollution by reducing emissions from local sources, like domestic coal burning and waste burning. Thus, air quality offsets can improve ambient air quality in low-income communities in the vicinity of Eskom’s power stations. Eskom has developed air quality offset (AQO) implementation plans for Majuba Power Station (Ezamokuhle township); Hendrina Power Station (Kwazamokuhle township) and Lethabo Power station (Sharpeville).

1.3 ESKOM’S PLANNING, MONITORING AND VERIFICATION (PMV) PROJECT

For Eskom’s PMV Project, interventions to reduce household emissions from domestic coal/wood burning will be rolled out in KwaZamokuhle and Ezamokuhle in the Mpumalanga Highveld. For formal dwellings the intervention will be a thermal insulation retrofit and an electricity starter pack and installation. The intervention for informal dwellings still needs to be selected and tested. Interventions also need to be identified and implemented to improve air quality in Sharpeville, Gauteng. Since domestic coal burning is less prevalent in Sharpeville, it is expected that a community-scale intervention, like reducing waste burning, will be more suitable there.

Air Resource Management (ARM) (Pty) Ltd has been appointed by Eskom to support the PMV services in support of the *Phase 1: Lead implementation* at: KwaZamokuhle; Ezamokuhle and Sharpeville. Its ARM (Pty) Ltd understanding that the overall objective *Lead Implementation Phase* is to benefit the specific local communities, minimize implementation risk, increase practical and scientific knowledge, and develop and refine monitoring, reporting and verifications processes. To achieve this, Eskom has included sixteen targeted work package Activities (Table 1) for these respective communities. This report focuses on **Activity 7: Fuel source survey at Ezamokuhle community**.

Table 1: Eskom PMV Activity Schedule

Activities	Kwazamokuhle	Ezamokuhle	Sharpeville
Activity 1: Preliminary air quality assessment		✓	
Activity 2: Gather Area intelligence		✓	
Activity 3: Rapid in situ assessment		✓	
Activity 4: Obtain ethical clearance		✓	
Activity 5: Census	✓	✓	✓
Activity 6: Community source survey		✓	
Activity 7: Fuel source survey		✓	
Activity 8: Household surveys		✓	
Activity 9: Annual (household/community) surveys and monitoring of project effectiveness	✓	✓	✓
Activity 10: Ambient air quality monitoring	✓	✓	✓
Activity 11: Conduct indoor air quality monitoring	✓	✓	
Activity 12: Atmospheric Dispersion Model	✓	✓	✓
Activity 13: Design of Intervention		✓	✓
Activity 14: Development of Database Reporting	✓	✓	✓
Activity 15: Strategic Assistance and offsets methodology	✓	✓	✓
Activity 16: Research and Development	✓	✓	✓

2. INTRODUCTION

2.1 ACTIVITY 7 – FUEL SOURCE SURVEY

In accordance with the scope of work, *Activity 7: Fuel Source Survey at Ezamokuhle community*, ARM must collect data to identify sources and suppliers of various fuels (energy sources) supplied and in use in the selected area. ARM is to investigate the business model and supply chain of each fuel and estimate the quantity and cost of fuel to the households. The fuels (energy sources) to be investigated include electricity, coal, dung, wood, LPG, paraffin, or any other fuels used in the community. An emphasis of the study will be to investigate the business model and supply chain of coal merchants in Ezamokuhle.

2.2 STUDY KEY TASKS

The key tasks for this activity include:

- 1) to gather information on various fuel sources;
- 2) interview fuel merchants and other role players in the area &
- 3) conduct assessment and report on findings.

3. METHODOLOGY

South Africa has improved household access to electricity from an estimated 36% at the end of 1993 (DME, 2001) to an estimated 84% in 2016, significantly greater than the average for Sub Saharan Africa (World Bank 2018). Although there has been much progress in the provision of electricity to households, many still rely on traditional sources such as wood and coal (Israel-Akinbo, Snowball & Fraser 2018, 76)

Although the major obstacles preventing people from discontinuing domestic coal combustion are poverty, the ready availability and social acceptability of coal together with other social customs cannot be underrated.

In this Study we focus on trying to unravel some of the complex energy-use business model and supply chain of these fuels in the Ezamokuhle community. The local fuel merchants operating in Ezamokuhle were surveyed to determine the business model, supply chain, quantity of fuels been sold to the households. The fuel source survey was conducted during a winter campaign in July-August 2022.

3.1 APPROACH TO STUDY

3.1.1 LOCAL LEADERSHIP APPROVAL

In partnership with the Eskom Communications team, authorization & approval from the local Ezamokuhle leadership was requested to conduct the fuel source survey. The request for authorisation included a formal letter detailing the purpose of the research, data collection methods, reporting, ethical considerations, and the intended contribution of the study.

3.1.2 IDENTIFICATION OF FUEL MERCHANTS

In conjunction with the Eskom PMV project team and other local stakeholders in Ezamokuhle, fuel merchants were identified in Ezamokuhle. In addition, during the *Activity 6: Community Source Survey*, merchants were identified by their coal yards and other signs of selling wood and coal. ARM also identified two coal merchants whilst undertaking particulate matter sampling in Ezamokuhle in August 2021. ARM engaged with these coal merchants as part of the fuel survey and requested their assistance with the identification and contact details of other fuel merchants operating in the area.

3.1.3 ETHICAL FRAMEWORK UTILISED IN FUEL MERCHANT ENGAGEMENT

As the fuel merchant's livelihood depends on the fuels business, our approach was framed considering the following mandatory principles below:

- 1) Consent is first obtained from the fuel merchants to participate and share their information with us including Eskom.
- 2) Ensure that ethical research integrity and respect for all participants is upheld throughout the surveys.
- 3) The surveys were based on multistage stratified area probability cluster sample designs.
- 4) Due to the small scale of the survey, it was agreed that ARM will conduct the surveys with trained, Zulu-speaking employees as fieldworkers to accommodate the sample population.

3.1.4 SAFETY AND SECURITY OF THE FIELDWORKERS

A safety file was developed to ensure safe access and execution of the work by field workers. Detailed health and safety procedures were available to explain how to deal with potential Covid-19, incidents, robberies, electrical cords, car accidents, protest action, driving, electrical tools and more. The fieldworkers strictly adhered to Eskom life-saving rules (9240-62196227).

3.2 FUEL SURVEY

3.2.1 PROCESS FLOW FOR FUEL SURVEY

Figure 3 highlights the process that ARM adopted to conduct the fuel survey. The fuel surveys were conducted by in Zulu by ARM personnel onto mobile devices. The data from these devices were securely transferred to the cloud in real-time on JotForm. Provided the fuel merchant provided consent, weighing of coal & wood was done after the interviews.

The fuel survey provided ARM personnel a detailed, expert, objective perspective on the fuel merchants in the Ezamokuhle airshed. It also allowed the ARM team to directly build strong face-to-face relationships and networks with the fuel merchants to understand their needs, wants and expectations.

Critically by ARM personnel conducting the survey, it allowed the ARM project team to gain insight of the fuel merchants operating in the target area to evaluate and correct oversights in the Eskom

PMV project plan. Where the fuel merchants provided consent, our team was also able to independently weigh (where applicable) the quantity of fuel been sold.

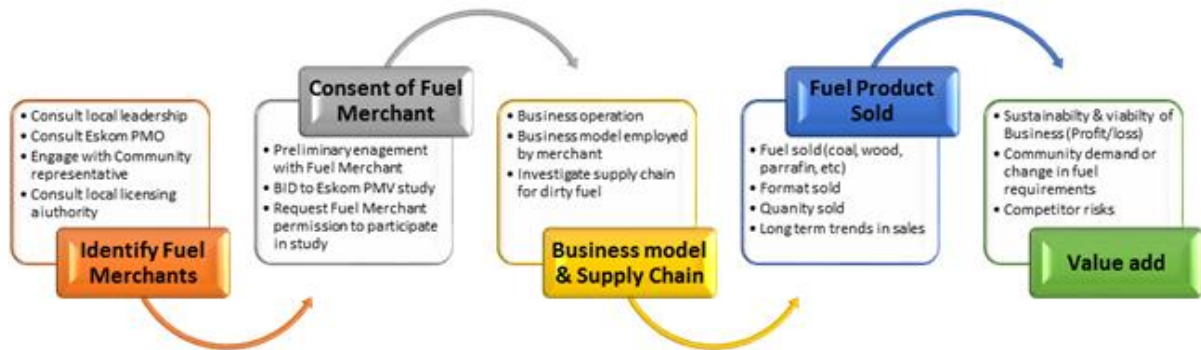


Figure 3: Process flow for fuel survey for Ezamokuhle

3.2.2 STUDY AREA

For the study, Ezamokuhle was sub-divided into nine distinct zones (Figure 4) and fieldworkers interviewed fuel merchants that were operating in these zones. In addition to Ezamokuhle, ARM also investigated the fuel merchants that operate in the Amersfoort town that may potentially supply the Ezamokuhle community with fuels. ARM did note on the previous sampling campaign for *Activity 1* that the local hardware store were retailing anthracite coal for the middle to upper income market segments. This was further unpacked as part of this study.



Figure 4: Ezamokuhle Zones for Field Survey

3.2.3 FUEL SURVEY QUESTIONNAIRE

A detailed fuel survey questionnaire (**Anexure 1**) was developed to capture the purchased fuel data and the perceptions of the fuel merchants.

4. RESULTS & DISCUSSION

4.1 FUEL MERCHANTS IDENTIFIED IN AND AROUND EZAMOKUHLE

Six fuel merchants were identified in the Study and were approached for interviews. Figure 5 shows the location of each of these fuel merchants. Five of the merchants are located in Ezamokuhle and one (hardware store) in Amersfoort. The detailed interview response for each merchant is summarized in Annexure 3, while a summary is provided in the following sections, detailed recordings are kept for future reference if required. One additional merchant was identified in China 2, but they were very apprehensive to answer the survey questions and preferred not to be interviewed.



Figure 5: Locality map showing location of fuel merchants (red outline shows perimeter of Ezamokuhle)

4.2 FUEL MERCHANTS PROFILE

Table 2 below provides a summary profile of the fuel merchants that were identified in the Study. It is evident that primary fuels sold by the Ezamokuhle fuel merchants are coal and wood. The fuel merchant in Amersfoort sells paraffin and spirits in addition to coal. Competitors exist for all fuel types except paraffin and LPG where the fuel merchant in Amersfoort is the sole supplier; however, prices are fixed country wide.

The fuel merchants in Ezamokuhle are dominated by males with the majority of them in their middle 30's. For the fuel merchants in Ezamokuhle, the fuels business is their primary source of income.

These merchants are established businesses with the majority been in operation for a period > 5 years. This is an important point for Eskom to note as the current Eskom air quality offset intervention is misaligned to their current business operating model. Its key that Eskom proactively engages the fuel merchants to understand the opportunity and willingness of these fuel merchants to diversify their business model. For example, this could include these merchants undergoing supplier development by Eskom in order for them to be able to resale LPG canisters.

The fuel merchants have stated to ARM that any proposed future business model must be viable and sustainable for them to consider it. In particular, Fuel Merchant D was very apprehensive of Eskom. He was the only merchant unwilling to weigh coal and wood with a deep distrust of Eskom's initiatives. He enquired as to whether merchants will be compensated by Eskom for their loss of business. Merchant is of the opinion that the intervention ignores the cost of living, saying that electricity and gas are too expensive. Additionally, Fuel Merchant E does not believe gas and electricity is financially viable for the community, for example he mentioned that the high school does not use gas anymore. Stated that solar is a good option for Ezamokuhle, but resources are not easily accessible for this to happen. Fuel Merchant F reiterated that LPG is too expensive for the households, while coal and wood remains affordable.

Table 2: Summary profile of Fuel Merchants

Fuel Merchant	Location	Gender	Age	Main Source of Income	Years spent of selling fuels on premises	Fuel Sold
Fuel Merchant A	China 2	Female	36	Fuel Business	2 years	<ul style="list-style-type: none"> • Coal • Wood
Fuel Merchant B	Phumula	Male	36	Fuels Business	> 5 years	<ul style="list-style-type: none"> • Coal • Wood
Fuel Merchant C	Smallville	Male	33	Fuels Business	2 years	<ul style="list-style-type: none"> • Coal
Fuel Merchant D	Roestein	Male	60	Fuels Business	> 5 years	<ul style="list-style-type: none"> • Coal • Wood
Fuel Merchant E	Jabavu	Male	Not specified	Fuels Business	> 5 years	<ul style="list-style-type: none"> • Coal • Wood
Fuel Merchant F	Amersfoort	Female	Not specified	Hardware Store	> 5 years	<ul style="list-style-type: none"> • Coal • Wood • Paraffin • Spirits

4.3 FUEL MERCHANTS SUPPLIER LOCATION

Based on the fuel merchants feedback its evident that the coal is sourced outside of Ezamokuhle. The coal originates from suppliers located in Ermelo & Emalahleni (Figure 6) and is transported to Ezamokuhle by trucks or vans. Its noted Fuel merchant E sources his coal directly from the Zama Zama’s. Wood is also sourced from Ermelo & Emalahleni whilst Fuel merchant E collects his wood from Ezamokuhle.

Table 3: Location from which coal and wood is sourced by Fuel Merchants

Fuel Merchant	Location from which Coal is sourced	Location from which Wood is sourced	Distance in km (Roundtrip to Ezamokuhle)
Fuel Merchant A	Ermelo	Ermelo	112
Fuel Merchant B	Emalahleni	Emalahleni	278
Fuel Merchant C	Not Specified (Transported by truck)	Not Specified (Transported by truck)	
Fuel Merchant D	Not Specified (Transported by truck/van)	Not Specified (Transported by truck/van)	
Fuel Merchant E	Ermelo (Zama Zamas)	In Ezamokuhle	112
Fuel Merchant F	Not Specified (Transported by truck)		

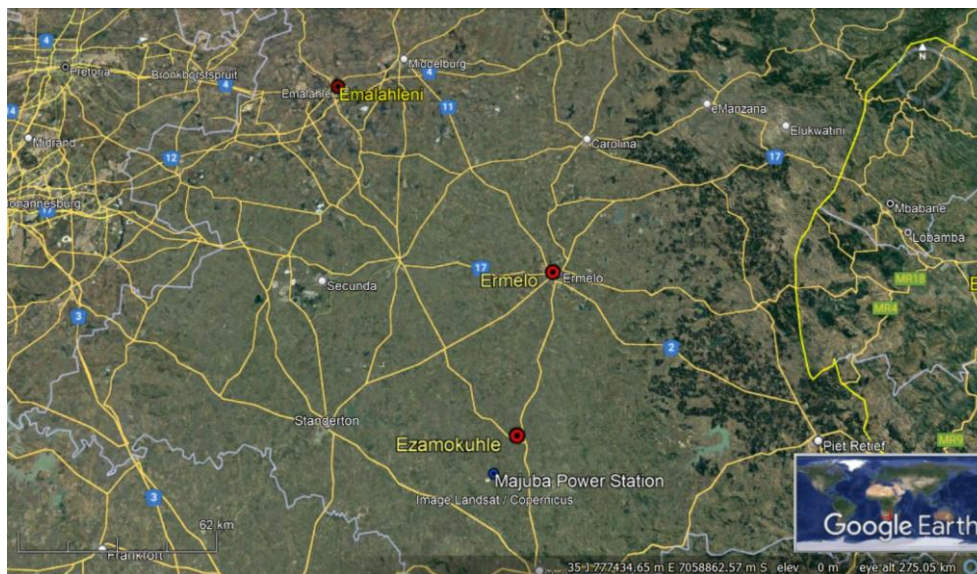


Figure 6: Locality Map show location of suppliers to Fuel Merchants

4.4 PRICE, QUANTITY & WEIGHT OF FUELS SOLD

4.4.1 PRICE & WEIGHT OF FUELS

The price of coal to the community varies from R100 to R160 per bag. However based on ARM actual measurements, the weight of a bag is variable and varies from 48 kg to 60 kg (Figure 8). Wood is sold for R30 to R65 per bag, yet again based on ARM actual measurements the weight of a bag is variable, between 29 kg and 38 kg. Only Fuel Merchant F provides LPG at R312 per 9 kg bottle and paraffin and spirits is available at about R32.00 for 750 mL. Only one merchant hiked prices in winter, but the rest kept prices of fuel the same in summer and winter- the exception being LPG where the price rose significantly in the past year due to external factors, nationwide. All fuel merchants, except one, noted that the price of wood and coal sold was the same as the previous year.

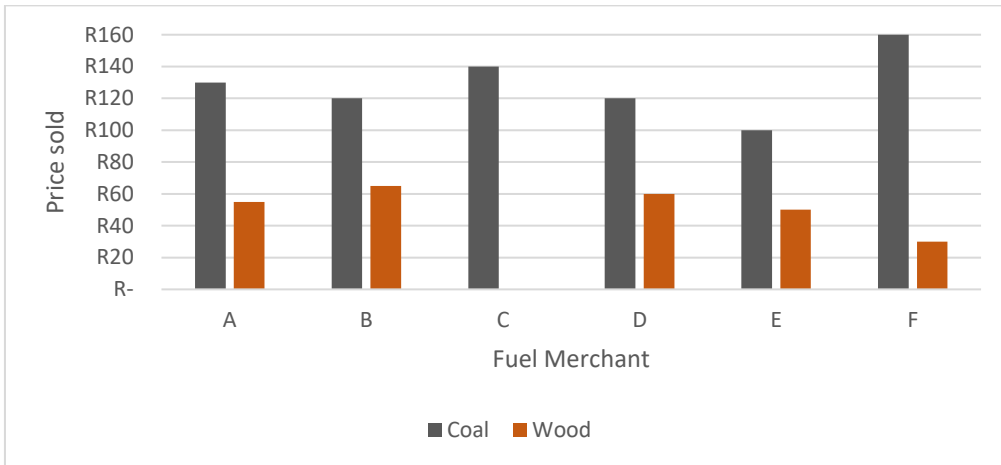


Figure 7: Price of fuels sold by fuel merchants

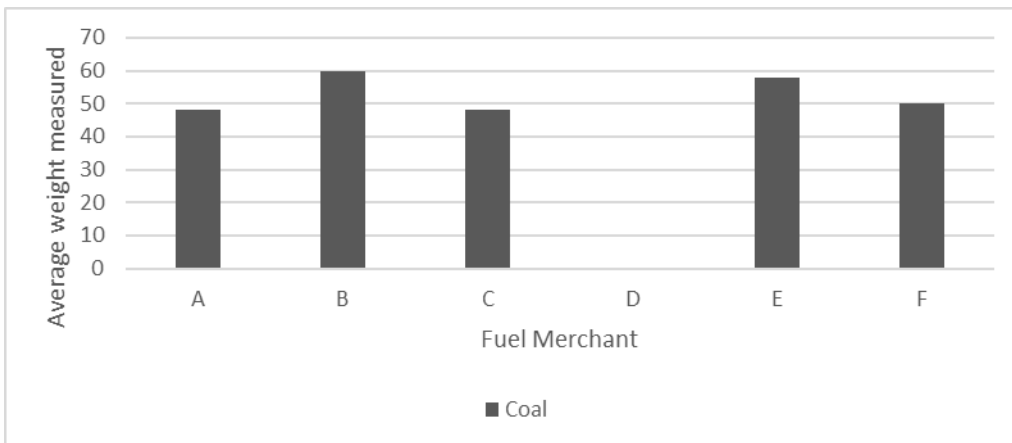


Figure 8: Average measured weight of a bag of coal by ARM

4.4.2 QUANTITY OF FUELS SOLD

Four of the fuel merchants provided their coal sales figures (Figure 9). Collectively these merchants sold about 352 bags of coal per month in winter (352 x 50 kg = 17.6 tons coal). However, Fuel Merchant E also mentioned maximum sales of about 5 tons coal every three days during winter when it is very cold, pending coal availability.

In summer coal sales dropped by about 60% to 7.5 tons per month from all merchants interviewed. The quantity of wood sold is a smaller fraction than coal: 325 bags of wood with a weight of average 30 kg equated to about 9.8 tons of wood sold in winter. However, these numbers should be taken lightly as the bags of wood weighted highly variable and sales figures are highly dependent on availability; reliable summer and winter figures are also not available from merchants. During the Census/Energy and Household surveys, more information will be obtained from the community in terms of actual quantities utilised.

In terms of the demand of fuels compared to a year ago, three fuel merchants noted the coal & wood demand the same whilst two noted an increase in demand with only one merchant noting a decrease in demand (Figure 10).

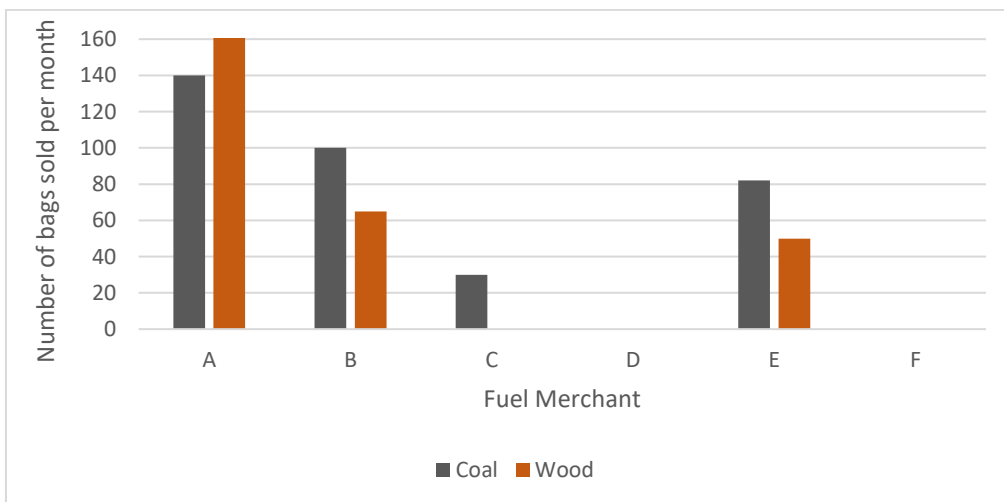


Figure 9: Quantity of fuels sold

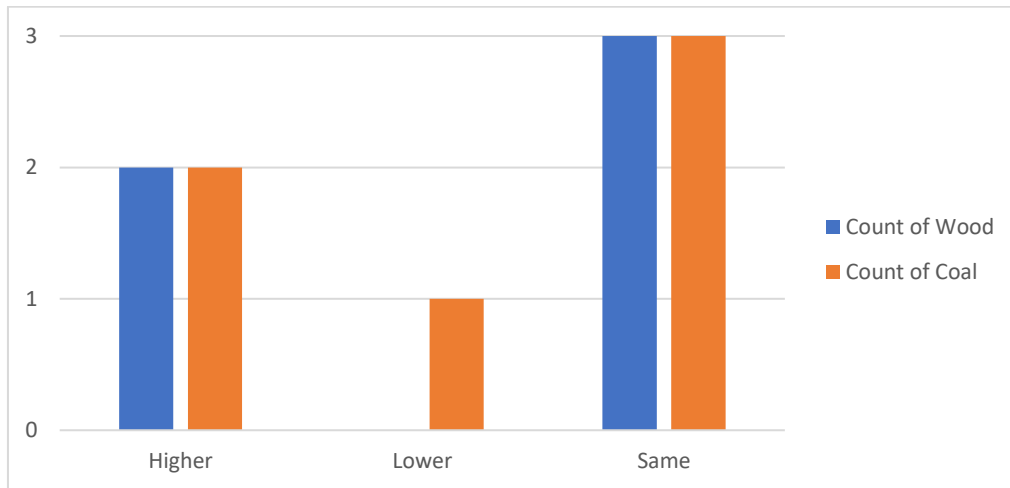


Figure 10: Demand of fuels compared to a year ago

4.5 FUEL MERCHANTS PERCEPTIONS

The fuel merchants all agreed that coal and wood is affordable, while gas (LPG) and electricity is expensive to community members. However, all coal suppliers raised the concern about coal supply – availability ranked top of the list of merchant concerns. Other concerns raised include price and the distance to transport coal from the Zama Zama’s in other coal-mining towns to the community.

The buyers of fuel in the community are mostly the older generation that collect one to three bags from the merchant. Responses differed on the uses- while everyone agreed coal and wood is used for cooking and space heating, merchants provided different responses to the water heating question. Electricity is used mainly for lighting, and to a lesser extent for heating of space and water depending on affordability. Customers very often bought fuel supplies in cash or on credit, except at the commercial business in town.

4.6 COAL QUALITY ANALYSIS

After obtaining consent of four Fuel Merchants (B, C, E & F), ARM purchased a ~50kg bag coal from each merchant which was subsequently sent to an accredited laboratory for analysis. The analysis undertaken included a proximate, sulphur and calorific value (CV) analysis. This was done to gain a better understanding of the coal quality & its impact on pollutant emissions.

4.6.1 EMISSIONS & COAL QUALITY

Coal burning results in emission of gaseous (SO_2 , NO_x , CO_2) and particulate matter (both PM_{10} and $\text{PM}_{2.5}$). These pollutants, especially particulate matter and SO_2 are directly related to the coal composition. Proximate analysis measures the moisture, volatile matter, ash and fixed carbon contents in coal. The volatile matter in the coal is a proxy for the smoke/ particulate matter that is released during coal combustion. The lower the volatile matter, the lower the particulate matter emission. Volatile matter is determined in accordance with ISO 562 standard method.

Ash content gives an indication of the amount of impurities in the coal. Ash is a diluent in the coal and is determined in accordance with the ISO 1171 standard method. Moisture is determined in accordance with SANS 5924 standard method and the results on an air-dry basis are used to express results of other analysis on a dry basis. Moisture is also a diluent to the coal. Fixed carbon content is determined by difference (i.e. $100 - \text{ash} + \text{moisture} + \text{volatile matter}$). It is the fixed carbon that gets combusted and produces CO and CO_2 .

Sulphur (S) in the coal forms part of the ultimate analysis which include Carbon (C), Hydrogen (H), Nitrogen (N) and Oxygen (O) that are present in the organic structure of the coal. Sulphur in coal can occur either as sulphate, organic and/or mineral form. However, irrespective of the form, it will report as SO_2 during coal burning. Sulphur in the coal can be controlled via amongst others, the beneficiation of coal which also reduces the ash content of the coal. Nitrogen in the coal contributes somewhat to NO_x emissions although a major part of nitrogen during combustion comes from the air. Nitrogen in coal is hence not controlled for coal utilisation. Carbon, Hydrogen and Nitrogen in the coal are determined in accordance with ASTM D5373 standard method whilst Sulphur is determined in accordance with ASTM D4239. Oxygen is determined by difference.

The other property of relevance to this study is the calorific value (CV) of coal. This is the heating value of coal and is measured in megajoules per kilogram (MJ/kg) using the ISO 1928 standard method. The CV of the coal is diluted by ash and moisture which are not combustible. One of the South African classification systems uses CV to decide the grade of coal (Table 4). According to this system, A grade coal would have a CV of >27.5 MJ/kg (ad) B grade >26.5 MJ/kg, C grade >25.5

MJ/kg and D grade >24.5 MJ/kg. All these grades are supplied to the domestic market through merchants.

Table 4: South African local coal classification system

Parameter	A grade	B grade	C grade	D grade
CV in MJ/kg (ad)	>27.5	>26.5	>25.5	>24.5

4.6.2 COAL ANALYSES RESULTS

Results of the coal samples obtained from Ezamokuhle fuel merchants (Fuel Merchants B, C & E) as well as from the commercial store in Amersfoort (Fuel Merchant F), are shown in Table 5. Fuel Merchant B sample in Ezamokuhle originates from very low-grade coal that has a CV of only 16.81 MJ/kg which puts it below the D grade coal on the classification system. This coal should ideally be the cheapest in the market. The total sulphur in this coal is also relatively very high at 1.74%. The volatile matter is however relatively lower which bodes well for particulate matter emissions to atmosphere.

Table 5: Results from coal analysis (air dry basis)

Sample	%Moisture	%Ash	%VolatileMatter	%FixedCarbon	CalorificValue (MJ/kg)	%Total S
Fuel Merchant B	1.7	45.7	19.1	33.5	16.81	1.74
Fuel Merchant C	2.5	25.0	27.8	44.7	24.38	1.06
Fuel Merchant E	2.5	20.2	26.8	50.5	25.38	1.44
Fuel Merchant F	1.4	13.6	9.9	75.2	29.05	2.31

Fuel Merchants C & E are both supplied with D grade coal with a CV of 24.4 and 25.4 MJ/kg, respectively. The total sulphur in the coal supplied to Fuel Merchant C is lower (i.e. 1.1% (ad)) when compared to all the coals tested. The total sulphur in the coal supplied to Fuel Merchant E is higher at 1.44% (ad). The volatile matter for both coals is similar and normal for the coal mined in Mpumalanga. **At this level of >27% (ad) for volatile matter, the area is expected to be very hazy in winter with high particulate matter emissions.**

The coal supplied to the commercial hardware store in Amersfoort (Fuel Merchant F) is very different to the other three coal samples tested in this study. With the volatile matter of only 9.9% (ad), the coal from Amersfoort seems to be anthracitic. Anthracitic coals are a natural low smoke fuel and best suited to this domestic market. The energy content of the coal is also very high with a CV of 29.1 MJ/kg and this is typical of anthracitic coals. Anthracitic coals are also characterised by high carbon content as it is observed in Table 5. The high sulphur content of 2.3 % (ad) in the coal used from Fuel Merchant F will however contribute significantly to the SO₂ localised emissions loading in the area that its burnt.

In conclusion, even though the coal procured by the fuel merchants and the community is cheap, the quality is also poor and due to the low heating value probably more coal is combusted, and the high ash content contributes to poor air quality.

Fuel Merchant F in Amersfoort provides a better coal quality that can alleviate particulate pollution somewhat on combustion.

5. CONCLUSION

Currently, coal and wood are provided by the fuel merchants at an affordable price to the Ezamokuhle community. Supply is however unreliable from Zama Zama's, and merchants struggle to provide these fuels. In addition, the poor quality of the coal supplied in Ezamokuhle is of concern from an air quality perspective but is available on the user doorstep. The coal merchant in Amersfoort (zone 10) provides a much higher quality of coal but makes transport costs more challenging from town. The high price of gas (LPG) and electricity was cited by many fuel merchants as a limitation to introduce cleaner fuels as was expected but was the go-to solution when other fuels were not available.

However, beyond costs other concerns were also raised about the introduction of cleaner fuels. For example, even though merchants pay cash for fuels, wood and coal are available in small quantities to the communities that they can afford and is often sourced on credit by the bag. On the other hand, LPG is not available in small quantities (9 kg costs R315) and not available on credit from the sole supplier in Amersfoort (as is electricity which is mainly used for lighting only).

Decision-makers that procure fuels are the aged in the community (Gogo's, pensioners, elders) who will be critical to interview in the coming surveys for more information.

The improvement opportunities identified for the PMV project are diverse:

- Coal and wood supplies are constrained and allows introduction of alternative solutions.
- Coal quality is poor and cleaner coal will already alleviate the air quality problem to some extent.
- Fuel merchants can provide a valuable resource to introduce alternative fuels.
- Alternative funding models for the community should be considered when alternative fuels are introduced, for example to accommodate credit facilities.
- The massive spike in coal and wood use during winter (with resultant emissions) can be alleviated by a combination of better insulation and improved fuel types that needs to be communicated to users.
- The next survey activities will explore the options in more detail with the communities.

The survey of fuel merchants provided a wealth of information to guide the next activities of the PMV project. The future community surveys will provide more accurate information on fuel source use as

Activity 7: Fuel source survey at Ezamokuhle community



experienced by households, compared to the perspective of fuel merchants provided in this report. The questionnaires used in future surveys can now be amended.

6. ACKNOWLEDGEMENTS

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- Mr Doctor Nzimande
- Mr JM Nleko
- The other three fuel merchants who have wished to remain anonymous.

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ANNEXURE 1

FINAL FUEL SURVEY QUESTIONNAIRE

Eskom Masibambisane fuel energy services survey	Air Resource Management (Pty) Ltd and Eskom (Pty) Ltd
November 2021	Tel _____

Introductory note (read to respondent): Hello, my name is I am a researcher from Air Resource Management/ Eskom’s Masibambisane Project.

We are conducting a survey for Eskom about fuel energy use in Ezamokuhle. We are interested in learning more about the energy sources that different households use for lighting, cooking, and heating, as well as the affordability and safety of coal and other energy sources. We ask that you help us by participating in a short interview, which should only take about 30 minutes. The information you give will be kept confidential.

SECTION I: INTERVIEW INFORMATION

QUESTIONNAIRE NUMBER

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Activity 7: Fuel source survey at Ezamokuhle community



I.1 Fieldworker name:			I.5 Area		
I.2 Date of survey			I.6 Household No		
I.3 Respondent age			I.7 Cell phone No		
I.4 Respondent sex	F	M	I.8 Consent has been read and obtained?	Yes	No
I.9 Signature of respondent					

SECTION A: PURCHASED FUEL

A.1 Could you please tell us how long you have been selling fuels at this premises?					
Years	(1) 0-1 years	(2) 1-2 years	(3) 2-3 years	(4) 3-4 years	(5) >5 years
Number					

A.2 What is your main source of income?				
(1) Fuels Business	(2) Salary from another Job	(3) Grant	(4) Pension	(5) Other (Specify)

A.3 What fuels do you sell at your business? (Mark all applicable)				
(1) Electricity	(2) Coal	(3) Wood	(4) Paraffin	(5) Other (Specify)

A.4 What is the price, quantity, and availability of the fuels that you sell at your business?				
Fuel	Unit	Price per Unit	Quantity	Availability
Electricity	kwh			
Coal	kg			

Activity 7: Fuel source survey at Ezamokuhle community

Wood	kg. equivalent			
Paraffin	liter			
LPG	cylinder			
Battery (dry cell)	voltage			
Other (Specify)	kg. equivalent			

A.5 What is the total quantity of the fuels you have sold on average per month?			
Fuel	Unit	Quantity sold per month	Highest demand in Summer or Winter?
Electricity	kwh		
Coal	kg		
Wood	kg. equivalent		
Paraffin	liter		
LPG	cylinder		
Battery (dry cell)	voltage		
Other (Specify)	kg. equivalent		

A.6 Where do you get the fuels you sell at your business? (Mark all applicable)		
Fuel	In Ezamokuhle	Outside of Ezamokuhle (Specify)
Electricity		
Coal		
Wood		
Paraffin		
LPG		

Battery (dry cell)		
Other (Specify)		

3.2

A.7 How do you transport the fuels to your business? (Mark all applicable)		
Fuel	Supply Source (Truck, Car, Motorcycle, Van, Animal, Handcart, Hand-carried, Other)	Time required to Go to Supply Source and Return to Business (Specify in Hours and Minutes)
Electricity		
Coal		
Wood		
Paraffin		
LPG		
Battery (dry cell)		
Other (Specify)		

A.8 How do you pay for the fuels that you buy at your supplier? (Mark all applicable)			
Fuel	Cash	Credit	Barter
Electricity			
Coal			
Wood			
Paraffin			
LPG			
Battery (dry cell)			
Other (Specify)			

A.9 How does your customer pay for the fuels that they buy from you? (Mark all applicable)			
Fuel	Cash	Credit	Barter
Electricity			
Coal			
Wood			
Paraffin			
LPG			
Battery (dry cell)			
Other (Specify)			

A10 State person(s) with the following responsibilities				
Energy source used	(a) Who decides to buy and when to buy? (man/ woman / daughter/ son /....)	(b) Who comes to fetch/buy? (man/ woman / daughter/ son /.....)	(c) Who pays? (man/ woman / daughter/ son /....)	(d) How much do they buy/fetch at a time?
(a) Electricity	(1)	(1)	(1)	(1) R
(b) Paraffin	(2)	(2)	(2)	(2) R
(a) LPG / gas	(3)	(3)	(3)	(3) R
(b) Coal	(4)	(4)	(4)	(4) R
(c) Wood (bought)	(5)	(5)	(5)	(5) R
(d) Dung	(6)	(6)	(6)	(6)

A.11 What is the price of fuels sold now compared to a year ago?			
Fuel	Lower	Higher	Same
Electricity			
Coal			
Wood			

Paraffin			
LPG			
Battery (dry cell)			
Other (Specify)			

A.12 What is the Ezamokuhle community demand for the fuels now compared to a year ago?			
Fuel	Lower	Higher	Same
Electricity			
Coal			
Wood			
Paraffin			
LPG			
Battery (dry cell)			
Other (Specify)			

A.13 What is the price of fuels in Winter compared to Summer?			
Fuel	Lower	Higher	Same
Electricity			
Coal			
Wood			
Paraffin			
LPG			
Battery (dry cell)			

Activity 7: Fuel source survey at Ezamokuhle community



Other (Specify)			
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A.14 Do you have any difficulties in obtaining the fuels you sell at your business? (Mark all applicable)				
Fuel	Availability	Price	Distance	Other
Electricity				
Coal				
Wood				
Paraffin				
LPG				
Battery (dry cell)				
Other (Specify)				

A.15 Are there any competitors selling the following fuels in Ezamokuhle?		
Fuel	Yes	No
Electricity		
Coal		
Wood		
Paraffin		
LPG		
Battery (dry cell)		
Other (Specify)		

A.16 Do you see competitors as a risk to your fuels business in Ezamokuhle?

Activity 7: Fuel source survey at Ezamokuhle community



Fuel	Yes (Specify Reasons)	No
Electricity		
Coal		
Wood		
Paraffin		
LPG		
Battery (dry cell)		
Other (Specify)		

A.17 How much longer do you see yourself continuing your fuels selling business at Ezamokuhle?					
Years	(1) 0-1 years	(2) 1-2 years	(3) 2-3 years	(4) 3-4 years	(5) >5 years
Number					

A.18 Can we get your consent to weigh the fuels been sold here?		
Yes	No	If No, could please provide a reason (Optional).

A.19 (Only if answer is Yes to Question A.18) Specified weight of fuel sold and Actual weight Measured				
Fuel	Specified Weight	Measured Weight 1	Measured Weight 2	Measured Weight
Coal				
Wood				
Paraffin				
LPG				
Battery (dry cell)				
Other (Specify)				

SECTION B: FUEL MERCHANT PERCEPTIONS

B.1 What types of energy are used for the following household tasks in Ezamokuhle? Please choose more than one if necessary. Rank them from most frequently to least frequently used (top 5).

	1. Electricity	2. LPG Gas	3. Paraffin	4. Wood	5. Coal	6. Candles	7. Ethanol gel	8. Solar	9. Dung	10. None
<i>Example – cooking</i>	1	5	2	3	4					
Cooking										
Lighting										
Heating of Home in Winter										
Water heating										

B.2 Do you think that the cost of fuel for the customer is affordable?

Fuel	Yes	No	Don't know
Electricity			
Coal			
Wood			
Paraffin			
LPG			
Battery (dry cell)			
Other (Specify)			

B.3 How much of the household budget do you think is spent on fuel?

Fuel	Little	A lot	Don't know
Electricity			
Coal			

Wood			
Paraffin			
LPG			
Battery (dry cell)			
Other (Specify)			

B4 What do you think the Ezamokuhle households did because of the increase in electricity prices in the last 12 months? (Choose one option)

Continued to use the same level of electricity and paid the extra amount for it	
Reduced the amount of electricity used	
Used other energy sources, such as paraffin, gas, coal, wood, and candles	
Other (specify)	
Don't know	

B.5 Do you think the fuel meets the households needs?

Fuel	Yes	No (Why not)	Don't know
Electricity			
Coal			
Wood			
Paraffin			
LPG			
Battery (dry cell)			
Other (Specify)			

B.6 Are there any alternate fuels for Ezamokuhle?

Yes (Specify)	No	Don't know

B.7 What are the barriers to using these alternate fuels (Mark all applicable)				
Fuel	Availability	Price	Distance	Other

SECTION C: GENERAL COMMENTS

C.1 Are there any general comments?

THANK YOU FOR YOUR TIME!

ANNEXURE 2

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ANNEXURE 3: FUEL MERCHANT RESPONSES