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Household coal use in an urban township in South Africa

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Abstract
Coal is used as a domestic source of energy by low-income households in South Africa. Coal is an affordable fuel source and provides a dual utility – it warms the house and allows cooking to take place in the same appliance utilising only one fuel. Despite affordability and accessibility of the fuel, the use of coal results in extremely high levels of air pollution and concomitant respiratory diseases – an estimated $160 million per annum in South Africa. Access to electricity does not result in households switching away from coal since electricity and electrical appliances are regarded as unaffordable. This paper presents information collected during a baseline energy survey in an electrified urban township in South Africa, and outlines the way in which coal is used and purchased by poor households. An alternative fire lighting method, proven to reduce smoke and air pollution form coal fires has been demonstrated to households with promising results. An integrated approach, addressing energy efficient housing design, the supply of clean and efficient energy appliances together with the use of the alternative fire lighting method, is recommended to address pollution from household coal use.

Keywords: coal, coal use, coal stoves, household ependiture, Vosman Township

1. Introduction

The South African energy economy has long been dominated by coal – it contributes around 75% of total primary energy consumption in South Africa (DME, 1998). Although the majority of coal is used in electricity generation by the national utility Eskom, high levels of household coal use, especially in areas close to coal mines and areas experiencing cold winters, are still prevalent. Household coal use is estimated at 3% of total coal consumption, and an estimated 950 000 households use coal as a household energy source, especially in winter. Although coal is a relatively cheap fuel (households typically pay less than R2.00 (32 US cents) per kilogram), there are specific health and safety problems associated with the use of coal.

South Africa's industrial and power generation sectors are responsible for some air pollution, but studies conducted in Gauteng (Scorgie et. al, 2003) found that household coal burning was the largest contributor to local air pollution in the area – electricity generation contributed 5%, industries and commercial organisations contributed 30% and domestic coal burning contributed 65%. A similar study (Matthee, 2004) found source contributions to quantifiable particulate emissions in the city of Johannesburg to be 48% attributable to domestic coal burning, 22% to scheduled processes, 20% vehicle-tailpipe emissions and 10% to tailings impoundments. The worst incidents of poor air quality in South Africa occur with the burning of wood, dung or coal (Terblanche, et al., 1992). This situation proves to become particularly problematic when these fuels are used within poorly ventilated households, especially in informal settlements and rural villages.

According to Scorgie et al. (2003), approximately 2000 children die annually as a result of respiratory infections caused by air pollution. It is considered the sixth largest killer of children under four in South Africa, and it is estimated that illnesses related to air pollution cost Government in the order of R1,2 billion per annum (Trade and Industry Chamber, 2004). Apart from the air quality problems caused by coal, other problems can also occur, such as suffocation or CO poisoning caused by poor ventilation in houses, irritation to eyes, noses and throats as well as aggravation of illnesses such as asthma, TB and HIV/Aids. Lastly, coal causes smelly clothes, damage to furniture and curtains and ultimately undermines self-esteem and self-worth, as one coal using township resident explained: 'My hands are always dirty and I am ashamed because my clothes smell of coal smoke (Community member, Orange Farm, 2003)'.

The South African Department of Minerals and Energy subscribes to a policy of universal access to electricity for households by 2012. However, it is acknowledged that coal use may continue, despite

households having access to electricity: 'Research has shown that electrified low-income households continue to use a range of fuels because electricity is found to be less cost effective (Department of Minerals and Energy, 1998)'. It is, however, not only the low cost of the fuel that makes coal attractive for low-income households. Coal provides thermal energy for space heating and cooking simultaneously, killing two birds with one stone, so to speak – one fuel and one appliance provides energy for two end-uses. It is because of this dual utility that other energy forms find it difficult to compete with coal.

Coal is burned in a variety of stoves (bought and home-made) as well as home-made imbhawulas, tin drums punched full of holes and used as a brazier, illustrated below.

Figure 1: Imbhawulas in Vosman

Commercially purchased coal stoves are often prized possessions and passed on to other family members, effectively ensuring that old coal stoves are never discarded, but also ensuring that smoky, badly ventilated stoves with broken chimneys stay in use and contribute to the problems associated with coal use.

The paper will outline some findings around coal use in a low-income, electrified township of South Africa. The findings will also touch on the manner in which households acquire coal in the township, describing a unique situation where coal is collected from a nearby abandoned mine dump. Lastly, the paper will discuss potential solutions to make the inevitable use of coal safer and less harmful to individuals and the environment.

2. Background

The data presented in this paper was collected during a project sponsored by Anglo Coal in the interest of community development and social investment in the Vosman Township near Witbank in the Mpumalanga province of South Africa. Anglo Coal appointed PDC, a private research and consulting firm, to implement a project aimed at demonstrating and popularising the Basa njengo Magogo alternative fire lighting method to 10 000 households. The data presented in the paper was mostly collected during the baseline study of the broader programme.

Data collection was effected through a questionnaire-based interview conducted with the household member responsible for procuring household energy and specifically coal. Households were randomly selected from the three Wards in the project area. In total, 142 interviews were conducted. Of the total 142 interviews conducted, 76 were conducted with female respondents, while 36 were conducted with male respondents. The high number of female respondents confirms the traditional position of women as the procurers and managers of household energy.

The township can be described as a fairly typical example of an urban township in South Africa. Sections of the township had been electrified around 3 years ago, and general service provision improved with the installation of water reticulation and water borne sewage. However, many challenges remain – roads are un-tarred, informal houses jostle for space with formal houses, no system for refuse removal is in place and health services are lacking. Houses are built from a variety of materials including highly energy-inefficient material such as zinc, illustrated below.

Figure 2: A zinc house in Ward 7, Vosman Township

The houses are not insulated and only rarely have ceilings. Indoor temperatures can be as much as 5 degrees lower than the outside temperature during winter, necessitating a large amount of fuel to make it remotely comfortable inside the house.

Coal is often the fuel of choice because of its availability, affordability and dual utility as discussed above.

The average household in the project area was found to consist of 5 people, with the highest number of people per household reported being 13, and the lowest 1. This is higher than the 2001 reported national household size of 3.8 for South Africa (www.info.gov.za/aboutsa).

Almost 50% of the sample reported household earnings of less than R500 per month and in total, 81% of the sample earned below R1500 per month. Although household income levels were found to be low, most households in the sample generated some form of income, either through employment or micro enterprises and even farming activities. In total, 58% of the sample gained an income through employment or self-employment, while only 29% of the sample relied on welfare or pension payments and remittances as a household income. Only 13% of the sample reported being unemployed.

3. Coal use and household expenditure on coal

By far the majority of the households in the Vosman sample (92%) reported using coal as a household fuel, and only 11 (8%) households reported not using coal at all, as illustrated below.

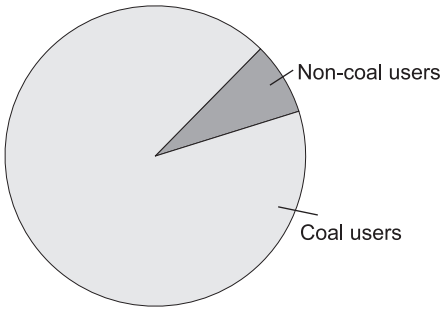

Figure 3: Household coal use in Vosman

The pattern of multiple fuel use was also visible with no household reporting using less than 2 fuels. Multiple fuel use refers to the practice of households utilising a range of fuels and appliances at the same time, or interchangeably because of their availability and accessibility (PDG, 1998). This means that households can use, for example, a coal stove, a paraffin stove, a gas cooker, an electric stove, as well as wood for cooking, depending on which fuel is available, which appliance is in working order, or what type of food has to be cooked and the time available to prepare the food. Market Support Associates (2003) concluded that the overwhelming majority (two-thirds) of low-income households use more than one cooking energy technology (the average household uses two).

Research further indicated that low-income households clearly do not abandon the use of other fuels once they are connected to the electricity grid, and that the use of fuels such as coal, paraffin, wood and gas continues despite having access to electricity for a significant period of time. For example, Market Support Associates (2003) concluded that 'even in electrified households, electricity is only the fourth most used form of cooking energy. Furthermore the presence or absence of electricity has less effect on fuel choice than other demographics, particularly affluence or age'. Recent research carried out by Lloyd et al. (2004) in the Cape Town township of Khayelitsha, however, paints a slightly more positive picture. Lloyd et al (2004) found that among households with a regular metered supply of electricity, 68% use an electric stove as their main source of cooking appliance, while 53% of households with electricity from an extension cord connection use an electric stove – the remainder used paraffin stoves. Based on the research, Lloyd et al. (2004) concluded that households are progressing well towards a total transition to electricity but that this may only be true for the specific area, since broader regional data still indicates a slow uptake of electricity for thermal uses. Therefore, despite progress being made in specific areas towards higher utilisation of electricity for thermal uses, evidence suggests that multiple fuel use remains the norm in some areas as un-electrified areas of South Africa.

The majority of households in the study reported using coal stoves, as can be seen from Figure 4.

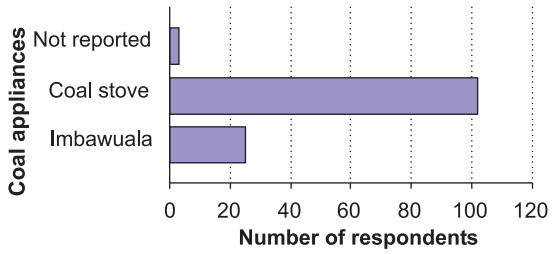

Figure 4: Coal appliances used

Coal stoves were generally found to be in a bad state of disrepair, adding to the smoke pollution inside the house. Note the badly sealing doors and cracks in Figures 5 and 6. A number of home-made coal stoves, called 'purulwanas' were also found (Figure 7).

Coal was used for cooking, space heating, water heating and ironing by households in the project area. Households reported using coal in winter and summer, although the frequency of coal fires made was reported to be less in summer than in winter.

The majority of respondents (65%) reported buying coal in tin buckets, followed by bags and small truck loads. Tin buckets reportedly cost

Figure 5: Coal stove in disrepair (a)

Figure 6: Coal stove in disrepair (b)

Figure 7: A home-made coal stove or purulwana

between R7.50 and R10.00 with most households reporting paying R7.50 per bucket. Truck loads varied from as low as R190.00 to R1000.00 – the price would depend on the size of the truck and where the coal was bought. Prices per bag varied between R28.00 and R35.00 per bag, with most people reporting paying R30.00 per bag.

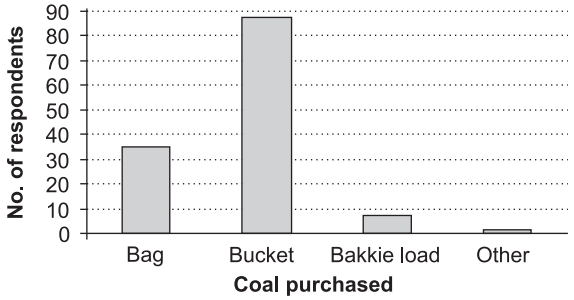

Figure 8: Coal purchase by container

4. Coal supply

Households in Vosman obtain coal by purchasing from coal merchants as well as by collecting coal from a nearby old coal dump. Households don't admit freely to collecting coal from the dump as it is prohibited and they can be prosecuted. Collecting from the dump is also dangerous and households report hearing explosions (most possibly from methane gas) and the coal caving in. There is also a very bad smell around the dump and people have reportedly become ill and vomited while collecting coal. The quality of the collected coal is also very low since it is full of stones, very big in size, brittle and reportedly it does not burn well and it is difficult to light. Lastly, out of the 13 coal merchants selling coal that were interviewed, 1 admitted selling coal from the dumping site. However, the project team suspects that more merchants are selling coal from the dump or mixing it with coal bought elsewhere.

Figure 9: The coal dump where households collect coal

In total, 13 coal merchants or sellers were interviewed. Interestingly, 8 of the 13 merchants are female and reported owning the coal selling business. What is notable is that unlike coal yards in other townships such as Orange Farm, Tembisa and Alexandra, the coal yards of Vosman are micro-enterprises, often operated from the owners' homes and selling only coal as opposed to other products

such as wood, LPG, paraffin or spaza shop-type food products. From the available data it is not possible to speculate on the relationship between the size of the operations and the gender of their owners, but this may be an extremely interesting issue to explore.

Figure 10: A female coal seller and helper

Out of the 13 sellers, 4 reported also selling other energy carriers – 3 sold coal and wood, while 1 sold coal and paraffin. Data suggests that some coal sellers sell on average 5 tonnes of coal per month during summer and 10 tonnes of coal per month during the winter period. From responses, it could be seen that sales figures double from summer to winter. The average tonnage sales figures should be treated as indicative only, since not all sellers could answer exactly how much they sell per month – another indication of their unstructured approach to selling coal. In terms of monthly income from selling coal, merchants reportedly sold on average R1670 worth of coal per month during summer and R2450 worth of coal per month during winter. It was impossible for coal sellers to calculate how much profit they were making from the business of selling coal.

Merchants reported a variety of problems that they experience as a coal merchant. Extending credit to households who then do not repay the merchant was the most often cited problem and 6 of the 13 merchants mentioned it: 'They want credit but they don't pay' and 'Customers want credit then they don't pay back and they make my profit shot' also 'People don't have money to buy coal and wood. They say give me one bag of coal and end of the month I will pay you. End of the month they don't pay.'

The second most mentioned problem relates to the quality of the coal (mentioned by 3 sellers, all buying their coal from the same supplier, namely Graspan, Middelburg): 'The quality of the coal changes and my customers complain. Sometimes it is good and sometimes it is bad'.

The same respondent mentions that sometimes the coal is like 'black sand' which she can't sell and she cannot return to the mine. The second respondent said: '…sometimes the coal does not burn, and then people don't buy from me'.

Households as well as coal merchants experienced problems with coal, as discussed above. Households listed the following problems:

- The coal does not burn well
- The quality is poor, the coal is full of stones
- Coal is expensive
- Coal smoke makes us sick
- Coal smoke makes curtains and walls inside the house dirty
- You cannot use coal when you have an HIV/Aids patient in the house

5. Conclusions and recommendations

Vosman Township is situated in the heart of coal mining country in South Africa, and the chances of households ever completely abandoning coal are slim. Negative impacts resulting from coal use can be minimised through an integrated approach to address not only the symptoms of the problem, but also the causes.

Addressing the supply of coal, the first intervention recommended is to provide training to existing coal sellers to enable them to source and negotiate for better quality coal. Coal mines and large suppliers are selling the lowest quality coal for consumption in the townships and consumers are paying a premium for low quality fuel. Training provided to coal sellers should include basic business management and administration so that sellers can manage issues such as credit extension in a sustainable manner. Coal sellers should also be supported to stock cleaner, healthier fuels and energy efficient appliances, as well as make these items available to households in an affordable manner. Lack of access and the affordability of cleaner, safer and healthier fuels and appliances are often some of the biggest barriers for households – they are not aware of the existence of the products and they cannot afford to buy them without credit. Products that can be made available include heat retention devices, solar cookers, gel fuel and gel fuel stoves, safe paraffin appliances as well as LPG.

The actual aim of the project was to implement a demonstration and training programme, illustrating an alternative fire lighting method called the Basa njengo Magogo method. By stacking a coal fire differently and lighting it from the top, more than 80% of smoke can be eliminated (Trade and Industry Chamber, 2004). The method has successfully been demonstrated to more than 80 000 households in coal burning areas of South Africa. The Basa Njengo Magogo (BNM) alternative fire lighting method represents the highest impact on health from a benefit-cost and employment point of view since the method can potentially reduce ambi-

ent air pollution caused by the use of household coal in a relatively short period, by approximately 40 – 50% (Trade and Industry Chamber, 2004). A wide scale implementation of the BNM method holds the potential, not only to reduce air pollution, but also to result in coal and monetary savings for low-income households.

On a broader policy level, the importance of incorporating energy efficient design principles cannot be stressed enough. Energy efficient houses will reduce the amount of fuel required for space heating as well as ensure healthier indoor environments.

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