

An assessment of electricity supply and demand at Emfuleni Local Municipality

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Abstract

Globally, electricity has become a modern tool to supply energy to households. This study investigates the supply and demand of household electricity and sustainability of distribution centres at Emfuleni Local Municipality (ELM). South Africa follows a vigorous programme of electrification, spearheaded by Eskom. Eskom is a South African state-owned power company which strives to meet the country's increasing demand for energy. Residential energy demand is growing as population levels rise and the number of households in ELM increases. Recently (2008–2010) in South Africa there have been unprecedented levels of load shedding nationally and there is a shortage of centres to purchase electricity. Furthermore, households do not receive uninterrupted electricity on a daily basis, largely because of stolen electrical cables and illegal connections. Low-income residents of Evaton, ELM, were interviewed. Empirical surveys were conducted and a theoretical exposition drawn up to meet the objectives of the study. It was found that electricity supply and demand in ELM is adequate but there is a shortage of selling points in Evaton and there are barriers towards the effectiveness of electricity consumption. In addition, public awareness programmes must continue to educate the communities to avoid stealing the electrical cables. Illegal connection must be reported to the local councillors for them to make sure that this activity is stopped in Evaton.

Keywords: electricity sector; electricity supply and demand, Emfuleni Local Municipality, residential sector

Introduction

South Africa has seen significant levels of growth in electricity consumption and the level of demand. The study investigates the effectiveness of residential energy usage and the sustainability of the electricity sales centres at ELM.

This investigation is part (the first phase) of the research project conducted in ELM by the Department of Public Management at North-West University, Vaal Triangle Campus. The research sample was drawn from low-income households in Evaton, Emfuleni Local Municipality (ELM). The assessment that follows is based on theoretical, observational and empirical surveys (structured questionnaires) conducted in December 2010. As a pilot study, 25 low-income residents were interviewed in Evaton to meet the objectives of the study.

Background

The ELM is one of three local municipalities comprising the Sedibeng District Municipality (SDM) in Gauteng, South Africa. It is the most westerly local municipality in the SDM, and covers an area of 987 km². ELM is a largely urbanised municipality, with high population density compared to other municipalities making up the SDM. It houses about 80% of the SDM total population (ELM, 2009a).

ELM has two main town centres: Vereeniging and Vanderbijlpark. Sasolburg is 10 kilometres to the south, across the provincial boundary. There are six large townships in ELM (Evaton, Sebokeng, Sharpeville, Boipatong, Bophelong and Tshepiso) which currently lack the facilities generally associated with towns of their size. There are also a number of smaller settlements, mostly within approximately six kilometres of the above towns. These settlements are Bonanne, Steelpark, Duncanville, Unitas Park, Sonland Park, Waldrift, RustterVaal, Roshnee and Debonair Park. The area also comprises some

large residential areas, all of which require considerable investment in infrastructure and the upgrading of sub-standard environments (ELM, 2009a). Homes in the residential sector vary from shacks to houses that are more substantial.

ELM provides municipal services directly to the community and is licensed to provide electricity mainly in the Vanderbijlpark, Bophelong, Boipatong, Roshnee, Rust ter Vaal and Vereeniging areas, while Eskom is licensed to distribute electricity to the remaining areas. Free basic electricity (FBE) is provided on average to 9 000 consumers per month (4 500 by the municipality and 4 500 by Eskom) within the ELM area. FBE of 50kWh/month is provided to registered indigents. Eskom invoices the municipality on a monthly basis for all FBE issued by them to registered indigents that live in their area of supply, in accordance with a funding agreement (ELM, 2009b).

Overview of electricity supply and demand

South Africa has recently been following the world's most vigorous programme of electrification, spearheaded by Eskom. From 1994 to 2000, 3.1 million households per year were electrified and 70% of households now have electricity (the percentage is about 80% in urban areas and 50% in rural districts) (Department of Minerals and Energy, 2002). It is widely acknowledged that energy is a basic human need that is a prerequisite for development. Indeed, energy is a central feature of the Millennium Development Goals (MDGs), and whilst its lack is not directly a cause of poverty, improving poor households' access to energy services will improve their livelihood (UNDP in Davis *et al.*, 2008; Louw *et al* in Davis *et al.*, 2008).

Electricity issues were high on the political agenda in 2008 as South Africa confronted a crisis where reserve margins were at an all-time low, resulting in inadequate power supply to meet demand (Chessin, 2008). The South African Electricity Supply Industry (ESI) is essentially vertically integrated with Eskom generating 96% (including 5% imports) of the current requirements, municipalities 1% and others 3% (inter alia, independent power producers [IPPs]). Eskom is the only transmission licensee and is responsible for all transmitted electricity. The responsibility for distribution is shared between Eskom, the municipalities and other licensed distributors. About 180 municipalities distribute 40% of electricity sales to 60% of the customer base (DME, 2008).

Energy sector

Growth in the electricity supply industry in South Africa is driven by investment in noteworthy infrastructure projects including new power plant integration and grid strengthening programmes (*Business Wire*, 2010). Electricity demand contin-

ues to rise and in recent years has outstripped the available supply infrastructure to the point where the country suffered rolling blackouts. In January 2008, the DME and Eskom released a policy document: 'National response to SA's electricity shortage'. The plan includes work on the country's electricity distribution structure and the fast-tracking of electricity projects by independent power producers. The government is investing heavily in new power projects with plans to generate an additional 22 000 MW by 2017 (Energy Information Administration [EIA], 2010).

There are 27 operational power stations in South Africa (Eskom, 2010). The end-use of electricity in the country is currently divided among domestic (17.2%), agriculture (2.6%), mining (15%), industrial (37.7%), commercial (12.6%), transport (2.6%) and general (12.3%) end users (DME, 2008; Eskom, 2010). Of South Africa's energy demand, 29% is in the form of electricity (Eskom, 2010). In 2004, the Ministry of Minerals and Energy estimated that the domestic demand for electricity would be approximately 33 000 MW in 2004, and is growing at a rate of 1 000 MW per year. There is thus an urgent need to increase domestic generating capacity (Economist Intelligence Unit, 2005).

Electricity sector objectives

Because it is fully committed to its programme of rapid electrification of urban as well as rural households, Eskom is expected to meet the rise in electricity demand in both domestic and export markets in the medium and long term (EIU, 2005). This section provides a summary of the electricity sector objectives as detailed in the White Paper of 1998. The sector aims to:

- improve social equity by addressing the requirements of low income earners;
- enhance efficiency and competitiveness to provide low-cost and high quality inputs to all sectors;
- make environmentally sustainable short and long-term use of the country's natural resources;
- give consumers the right of choice of electricity supplier;
- promote competition, especially in the power generation sector;
- open non-discriminatory access to the transmission system; and
- encourage private sector participation in the industry (DME, 2008).

In view of this, the state seeks to ensure that there is an appropriate balance between meeting social equity, economic growth and environmental goals. This will hopefully be achieved by ensuring that electrification targets are met by providing low-cost electricity; better price equality; financial viability; improved quality of service and supply (includ-

ing security of supply); proper co-ordination of operation and investments and the attraction and retention of a competent work force (DME, 2008). Rapidly increasing electricity demand in South Africa has led the government to set out ambitious plans to expand the sector (EIA, 2010).

The Integrated National Electrification Programme (INEP) is one of the initiatives that has been launched. It is aimed at providing socio-economic support for previously unconnected households to give residents access to electricity. The programme creates new infrastructure while ensuring that existing infrastructure is rehabilitated and well maintained (DME, 2008).

Legislative framework

A number of legislative developments since 1996 that have had a direct influence on the electricity industry are acknowledged. Numerous institutional arrangements for electricity have been considered for South Africa and the resulting policy frameworks have thus far been highly uncertain. The legislative framework enables the electricity sector municipalities to facilitate coherent, transparent and accountable policy planning and implementation (Chessin, 2008). The government's policy has been to extend the electricity network to communities not previously served, and the proportion of houses that have electricity has increased sharply (EIU, 2005).

The following legislation is relevant when assessing electricity supply and demand in South Africa:

- Constitution of South Africa, 1996.
- Public Finance Management Act, 1999.
- Local Government Municipal Systems Act, 2000.
- Eskom Conversion Act, 2001.
- Municipal Finance Management Act, 2003.
- National Energy Regulation Act, 2004.
- Electricity Regulation Act, 2006.
- Municipal Fiscal Powers and Functions Act, 2007.
- Electricity Regulation Amendment Act, 2007.

Political will and enabling policies and regulations are important in implementing universal access to modern energy services (Academy of Science of South Africa, 2010).

The residential sector

In South Africa, residential energy (including that in ELM) falls into three categories: traditional energy (such as wood, dung and bagasse); transitional energy (coal, paraffin and liquefied petroleum gas; and modern energy (electricity) (DME, 2002). South Africa is a country of extremes and is also in transition. Davis *et al.* (2008) indicate that the transition to electricity for low-income households has not been as rapid as anticipated. Islands with a rich modern economy lie in a sea of deprivation and poverty, and both are being swept along by an

unstoppable but uneven tide of change (DME, 2002).

The problems of uplifting the poor and developing the economy have become merged. The ELM residential sector is characterised by poor living conditions; the diseases of poverty; low education levels; high unemployment; large numbers of children per couple; and degradation of the environment. The Studies in Poverty and Inequality Institute (2012) points out that 'one of the main reasons for these living conditions is the high levels of poverty and inequality amongst the previously disadvantaged'. Only 33% of these population are employed meanwhile 29% are unemployed. According to Census 2011, Emfuleni Local Municipality has a reduction of 12.5% (47.2% 2001 to 34.7% 2011) among the unemployed households (Statistics South Africa, 2012).

The Census 2011 reported that electricity for lighting in the ELM has increased from 89.8% in 2001 to 92.2% in 2011 (Statistics South Africa, 2012). This is supported by sensible policies and the use of efficient technologies in order to benefit the previously disadvantaged communities. . Providing power to households does more than almost anything else to transform and improve the lot of the poverty-stricken residents (DME, 2002). In 2003, the South African government introduced the policy of free basic electricity to low-income households. FBE is a basic services support tariff, which allocates an allowance of 50kWh of free electricity each month to poor households.

The aim of the FBE policy is to enable impoverished households to increase their electricity consumption and alleviate the negative impact of energy poverty (Davis *et al.*, 2008). This policy seeks to address ways and means through which government intervention can bring about relief to poor electrified households and ensure optimal socio-economic benefits from the National Electrification Programme.

Low-income households are defined as those falling within the lowest 40% of income. Due to the inequities of the past, South Africa has had to provide infrastructure and subsidies to enable low-income households to make use of basic services (UNDP in Davis *et al.*, 2008; Louw *et al.*, in Davis *et al.*, 2008).

Findings

The data mentioned in this section was collected as part of the empirical survey conducted in Evaton.

Personal data

The empirical survey conducted in Evaton comprised 23 interviews; two residents were unwilling to be interviewed. The sample group comprised females (68%) and males (32%). Most respondents fell within the economically active age category

(38–44 age group), others were elderly (53–65 age group) and are the recipients of old-age pensions. Two disabled individuals were interviewed. All the respondents were in possession of South African identity books, which makes them eligible to apply for the provision of electricity and to lodge electricity complaints.

Education and employment

Education plays an important role in the wellbeing of any society. The highest level of education achieved by respondents in the sample group was Grade 10. An adequate level of education makes it possible for residents to report faulty measures and to purchase their electrical appliances. Of the respondents, 76% were unemployed and were thus available to be interviewed during normal working hours.

Residential data

Of those interviewed, 76% lived in houses, while 16% lived in informal residences (shacks). Most of the households in Evaton are shacks and backyard dwellings. Backyard homes account for more than 25% of rented dwellings in the ELM. Of those interviewed 50% live in houses while the other 50% live in the increasing number of shacks. In Evaton, main house dwellers as well as those who are tenants make use of electricity. On average, there are 5-6 occupants in each household.

Access to basic services

The sections that follow provide details of access to basic services

Services accessed by households

The provision of water, electricity and sanitation are linked. Of the respondents, 100% have access to water, although the water supplied is not a piped water system inside the homes. In each yard, there is a single tap which provides water for the homeowners and their tenants. On a daily basis, residents are required to collect water from the tap for their domestic consumption (washing, cooking, etc.). Of the respondents, only 40% have access to flush toilets. In most yards, three or four non-flushing toilet structures were identified. Only 52% of the respondents have access to refuse removal; 40% indicated that they burn their refuse inside their yards.

Access to electricity

All respondents indicated that they have access to electricity. This includes owners and tenants. All households have separate meter boxes that monitor their electricity consumption. The researchers were granted permission to inspect the connections, and illegal connections were observed. Two cable systems were identified. One was the authentic thick black cable used by the electricity sector. The sec-

ond type seen was a thin black or white electric extension cable widely available for purchase in local stores. This type of connection is only safe for leading power from one point to another within a single home.

It can be dangerous when the households connect illegal electricity cables. The authors found that some of the households used the clear sellotape (for stationary) instead of the electrical (insulation) tape for joining the extension cables. The extension cables were also used to connect and source electricity from the external main cable boxes. Such connections did not meet the guidelines regulated by the electricity sector. Meter boxes in some households also pose a threat because of faulty connections.

The respondents indicated that they do report faults to the electricity sector in their region, but if there is a response (which is by no means always the case), this is only after a long delay so the residents have to resort to illegal connections. Of the respondents, 44% indicated that they were highly satisfied with the provision of electricity; 28% said they were satisfied; while 24% indicated that they were dissatisfied with the electricity supply. Their grievances included the theft of electric cables; frequent electricity failures (of 1–3 days); poor delivery in adverse weather conditions (rainy seasons and winter); and lack of feedback from the electricity sector.

Effectiveness of electricity in ELM

The South African economy is energy intensive and it uses a great deal of energy for every rand of value added. There are huge benefits here in terms of improved health, economics and opportunities to join the modern economy. There are also drawbacks, largely because those living in most of the newly electrified households cannot afford to buy enough electricity to make it profitable for the utility (DME, 2002). The changes in energy consumption may have effects on the economy, employment, pollution and levels of health (DME, 2002).

Electrical appliances

Some low-income householders in ELM own labour saving devices used by middle income households. A range of electrical appliances were observed. Basic appliances include fridges, stoves (two/four plate stoves), audio-visual appliances (such as television, radio and DVD), heaters, kettles and irons. Luxury appliances include food processors; hairdryers; washing machines; vacuum cleaners; sewing machines; and toasters/sandwich makers (Sparknet, 2010).

Use of electricity

South African residential energy consumption is just over a tenth of the total energy consumption in the

country. There are those who can afford to turn on electrical power at the flick of a switch for their electrical devices. In contrast, the poor may well spend up to six hours a day collecting firewood to cook their food, and they use candles to light their households at night (DME, 2002).

Residential electrical consumption (domestic and the operation of residential businesses) can be broken up into five main categories: space heating, water heating, cooking, lighting and other social and economic needs. Such usage is high during peak hours (morning and evening).

Domestic operation

- Cooking appliances are identified as large consumers of electricity and are thought to be an important indicator of demand levels for households (Davis *et al.*, 2008). Residents in Evaton indicated that electricity is expensive and they use it with caution. In order to save electricity, cooking is only done at most twice – in a single day. Further, it was observed that householders use other energy types to save electricity.
- Space heating also consumes electricity in Evaton. Respondents indicated that they use electric heaters during winter. They use these heaters in the evening to warm the living and dining rooms while watching television.
- Hot water is required for washing dishes and clothes and for personal hygiene (Sparknet, 2010). In this case, 90% of respondents use a stove or a kettle to warm water, while the remaining 10% have the use of electric geysers.
- In Evaton, outdoor and indoor lighting is used in households. Good lighting is particularly important for learners and teachers for reading and studying at night (Sparknet, 2010). In 2009, the SDM embarked on upgrading lighting services in the three local municipalities. The bulbs in the SDM households were replaced with fluorescent globes. The aim was to maintain the standard in accordance with Eskom's directives to save electricity.
- Refrigeration and space cooling is also used for the storage of perishable products such as meat and vegetables. Access to refrigeration allows householders to buy perishable products in bulk, which saves money and time, especially since many low-income householders in South Africa live far from the supermarkets or chain stores that offer lower prices. Space cooling is a significant priority in hot and humid areas although many low-income households cannot afford this (Sparknet, 2010).
- Washing machines are an alternative to the more cumbersome methods for washing clothes. However, to date there is an imperceptible level of ownership of washing machines in low-income households (Sparknet, 2010). The

researchers witnessed residents in some households washing clothes by hand. This is usually done daily in a steel bath; collecting water from the tap (using buckets); and hanging out the clothes on a washing line to dry.

- Media devices (audio and visual equipment) are generally required to keep in contact (for both social and business purposes) with relatives, friends and colleagues located in different areas (Sparknet, 2010). Such devices are useful for keeping abreast of world events, such as news, current affairs and entertainment.

Residential business operation

Residential business operations were observed as part of this study. Some landlords and their tenants run business operations from their homes and this calls for the use of electrical appliances. Micro-enterprises are needed to generate income either as a sole source or as a supplement to other household income (Sparknet, 2010).

Some of the interviewees indicated that they sell cooked food, beverages (such as cold drinks and home-brewed cold beer), ice cream or ice licks. Others supply freshly slaughtered chickens, fresh meat, or run spaza shop operations. Other home businesses provide services such as hairdressing and beauty salons, welding, carpentry and car washes. Some small businesses also use hot water, for example, to clean freshly slaughtered chickens and for cleaning and cooking sheep heads (Sparknet, 2010).

Other types of energy

Low-income households use a variety of energy forms and instruments for electricity consumption. Electricity provision is not guaranteed in the low-income households as it is in the suburban areas like Vanderbijlpark and Vereeniging. Some households make use of alternative types of energy to meet their daily needs. Of the respondents, 48% use paraffin; 84% reported that they sometimes use wood to provide energy. Coal was reported to be expensive and only 64% of those interviewed said they could afford to purchase this commodity on a weekly basis, while 24% could not afford to buy coal at all. There appears to be minimal use of gas in low-income households because it is reportedly expensive. Solar cookers are still at the demonstration stage in South Africa and so no long-term data is available yet on their use (Sparknet, 2010).

A variety of other combustible materials are used in conjunction with the above mentioned types of energy. They include paraffin, wood, gas, coal, paper/cardboard boxes and cow dung. Charcoal is not commonly used in South African low-income households (Sparknet, 2010), although it is occasionally purchased to 'braai' meat outside for parties or at picnics. The respondents indicated

that they do not often use charcoal, because of its prohibitive cost (R30 to R40 per 3kg). In some households, these alternative types of energy are used on a daily basis while in others, they are stored for emergency use in the case of electricity failure.

Sale of electricity to low-income residents

Electricity is sold to industrial, commercial, agricultural and domestic consumers. Approximately 78% of the electricity is sold to industrial and commercial customers, while the remaining 22% is sold to domestic and agricultural consumers and is required for the municipality's own use (ELM, 2009: 2). In Evaton, households can purchase electricity in three ways. Firstly, they can buy electricity vouchers from the municipal offices. Secondly, these vouchers can be purchased from private institutions such as retail shops (supermarkets, mini-markets and spaza shops) and filling stations. Thirdly, they can buy electricity vouchers from the Eskom franchises. Respondents indicated that community members can also report faults at the Eskom offices.

The available selling points are inadequate in Evaton. Respondents indicated that they spend a great deal of time in reaching the respective points to purchase electricity. Most of those interviewed said they had to travel by taxi to another area to do so. This was usually the case for those who use the prepaid Eskom meter boxes. If only for reasons of security in the community and reducing the cost of power, the national utility (Eskom) must provide specific, sustainable locations in Evaton to sell electricity. As things stand at present, up to an hour is spent on travelling to purchase electricity vouchers; as much as R12 has to be paid for transportation.

It was also indicated that there are only two or three selling points in Evaton, while others are outside the township. Electricity usage varies from household to household. The monthly purchase of electricity ranges from as little as R50 per month to as much as R200. Seasonal periods also contribute towards the consumption of electricity. Some households only use electricity for cooking and lighting, while others need power for running small business enterprises. As indicated, if little electricity is used then usage is often complemented by other types of energy, especially in winter.

It is imperative that the distribution of electricity in the township (and indeed across the country) should be reviewed. In many places, there are still wooden electricity pylons crossing residential areas. This type of electricity transmission in the township must change to the use of an underground system. This will reduce the theft of copper cable that is so rife in many areas. It is argued by the International Energy Agency (2002) that lines installed underground can reduce the chance of the power supply being affected by storms. Severe weather condi-

tions are capable of knocking trees down onto the main lines. An underground system also reduces the possibility of starting forest fires when the lines are down. It is only possible to implement this kind of programme if the local authorities work in co-operation with the Department of Energy and with Eskom.

Recommendations

The following recommendations flow from the surveys conducted in Evaton.

Maintenance of residential electricity supply and demand

In South Africa, Eskom and local governments have initiated programmes to equalise electricity supply and demand. These programmes should be reviewed to improve effectiveness of the industry. The sale of electricity will need to be reviewed by the local municipality and Eskom.

Community awareness

The electricity and media industry provide awareness of effective electricity usage, yet on a daily basis we are informed about the misuse of household electricity. This may encourage householders to flatten the demand curve. All these measures need to be carefully thought through before being systematically implemented (DME, 2002).

Risk management

The theft of electric cables is a concern and interrupts the power supply. Some of the householders interviewed have resorted to using electrical extension cords from their houses to connect to the electricity pylons. These illegal connections are a major hazard and cause electricity failures in the community. Valuable time and money has to be directed on a daily basis to rectify problems caused by the theft of copper cables. Replacing wooden pylons is an urgent matter that must be reviewed by the local authority and Eskom. This may reduce the frequent theft of copper cables. Members of the community interviewed admitted to using extension cords from their homes to connect with electricity pylons.

Pre-paid suppliers/ selling points

In Evaton, there is shortage of pre-paid electricity vouchers. Some of the selling points have been closed down following vandalism, theft and even deaths. Security must be improved at these sites. Many of the selling points are situated outside the Evaton residential area. This means that householders are obliged to travel a considerable distance to purchase electricity and this often entails transport costs they can ill afford. The local authority and Eskom should consider the re-establishment of convenient, safe selling points for pre-paid electricity in Evaton and its surrounding areas.

Conclusion

Globally, electricity is seen as a modern tool to supply energy in households, since it allows for more efficient energy use than coal, wood and paraffin. A source of income and access to electrical appliances for cooking are among the determinants of low-income householders' electricity consumption. Electrification of households has reached its peak in Evaton, although the initiative is challenged by theft and illegal connections. There is effective use of electricity, although residents experience difficulty and expense accessing selling points. Proper management and safeguarding of such entities should be a priority in ELM.

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