

## The impact of electricity crises on the consumption behaviour of small and medium enterprises

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A Von Ketelhodt  
Sasol Limited

A Wöcke  
Gordon Institute of Business Science, University of Pretoria

### Abstract

*Small and medium enterprises (SMEs) will play a key role in future economic and social strategies in South Africa. However, we find that SMEs are particularly vulnerable to shocks in their external environment due to a general lack of skills and resources. This is critical as the future demand for electricity in South Africa is likely to outstrip supply and electricity will become increasingly unreliable and expensive. We surveyed 250 SMEs in Cape Town and found that the prevailing policy methods of changing electricity consumption behaviour: information campaigns, increasing prices, and providing rebates for energy savings, have had limited results and are unsustainable when applied to SMEs.*

*Keywords: Small and medium enterprises, electricity supply, electricity crisis, Cape Town, consumption*

### Introduction

Small and medium enterprises (SMEs) are regarded as particularly important to South Africa at its current stage of development according to the South African Government's Accelerated and Shared Growth Initiative for South Africa (AsgiSA) (South Africa, 2006). SMEs are relied on as the future engines of growth for the South African economy and a method to bring the informal economy closer to the formal economy, bring women and youth into the mainstream of the economy and advance broad-based black economic empowerment (South African Government, 2006; Department of Trade and Industry, 2006). However, SMEs are one of the most vulnerable sectors to an unstable environment and policy shifts. Unlike larger businesses, SMEs

generally lack the resources necessary to invest in alternative sources of energy and they generally do not have the in-house capabilities for sound asset management.

A small enterprise in South Africa is defined as employing fewer than 50 staff, while a medium enterprise is considered to have fewer than 200 by the South African Small Business Act (South Africa, 1996). SMEs contribute between 45 and 50% of South Africa's GDP and employ more than 50% of all formally employed in South Africa (Business Owner, 2006). The South African Government's future growth policy and industrial policies rely heavily on the future growth of this sector; however, SMEs are far more vulnerable to volatility in the macro-economic environment. SMEs are particularly vulnerable during expansion phases and are less likely to have in-house capabilities for sound asset and risk management. This was illustrated starkly in the 2006 Cape Town electricity crisis.

### The state of electricity supply in South Africa

A reliable, abundant, low priced source of electricity is critical to the success of the business sector in South Africa, and it has enjoyed one of the lowest priced electricity supplies in the world. Constraints are, however, starting to impact on the South African business environment. Environmental constraints, a lack of availability of low priced primary energy sources, and increased construction costs for new power stations are all adding pressure to electricity prices. The efficient use of energy is therefore an important issue that consumers will need to embrace in order to constrain future price increases, which in turn, will require a change in consumption behaviour by consumers.

South Africa is a developing nation, and has

grown its economy through manufacturing and mining, which are traditionally energy intensive industries. Despite it having some of the cheapest electricity supplies, South African use of energy has not been particularly efficient. Figure 1 below illustrates that South Africa has progressively used more energy to produce a US\$ of GDP and also more energy per capita in the time period 1971 to 2001. This has largely been due to extensive use of South Africa's abundant and low-priced coal reserves (Department of Minerals and Energy, 2005).

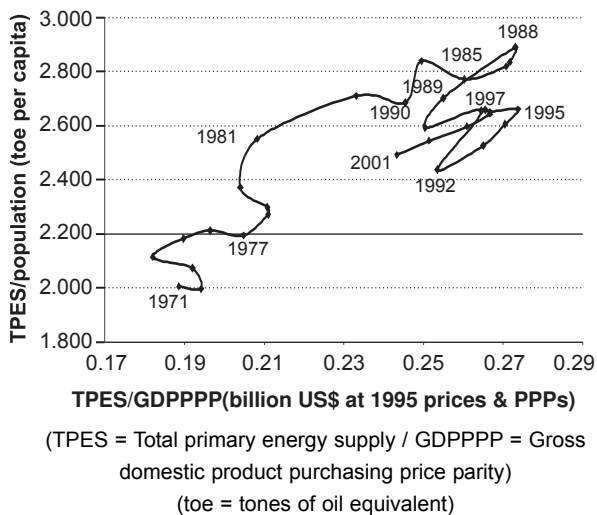


Figure 1: South Africa: changes in the energy required to produce 1US\$ of GDP and energy per capita (IEA, 2006)

The demand for electricity is likely to outstrip supply in the near future and Eskom, the parastatal electricity utility, is facing problems with supplying power at peak times on very cold days, in the evenings and mornings when large amounts of power are drawn. This is likely to get worse as urbanization and economic growth increase. One part of the solution is to build more power stations, either coal or nuclear, which in turn, may create environmental problems that will increase the price of electricity.

In March 2005 the Department of Minerals and Energy (DME) put out an energy efficiency strategy for South Africa (Department of Minerals and Energy, 2005) intended to achieve a 12% improvement in energy efficiency by 2015 set as a target in 2003 (DME, 2003). This is based on a 'business as usual' baseline scenario for South Africa, i.e. population growth rate of 1.3% p.a. (2000 = 44 million population; 2015 = 53 million population) and GDP growth of 2.8% p.a. The projections have been found to be somewhat conservative and GDP growth has been higher than projected, with consequences such as the electricity crisis that hit the city of Cape Town in 2006. Those hardest hit were entrepreneurs and small businesses.

### The Cape Town electricity crisis

Due to a series of unfortunate events, the Cape Town region experienced an electricity crisis in 2006, and this was compounded by the economic growth in the region and resulted in demand outstripping supply. The electricity crisis began in November 2005 with failure of switchgear followed by a series of compounding incidents, including a fire under a power line, a tripped transformer and a damaged generator that resulted from a misplaced bolt. One of the units also had to be shut down for routine maintenance during this period.

Cape Town suffered seven complete power outages between November 2005 and January 2006, which removed 1 326 megawatts (MW) from the power supply, which equated to just under 50% of the power requirements in the area. It was estimated by the Cape Town Chamber of Commerce and Industry, following a survey of members, that the blackouts cost the Cape Town economy about \$900 million directly (*Business Day*, 15 April, 2006). Some of the consequences of the blackouts were a loss of 12 days of production at the Chevron refinery (*Cape Business News*, April 2006). Multinationals that were considering investing in South Africa openly questioned South Africa as a destination (*Business Day*, 10 May, 2006) and neighbouring countries such as Namibia, which import electricity from South Africa were affected when South Africa cut their supply during the crisis (*Business Report*, May 2006).

There was a significant amount of confusion in various public statements and media reports. The CEO of Eskom reported in January that the repair to Koeberg could take up to nine months and further vague statements by Eskom about the causes and duration of the blackouts created further confusion in the minds of the consumer.

Environmental group, Earthlife Africa, for instance published a report that Eskom was misleading the public and was not truthful because of these vague statements (*Mail & Guardian*, 26 March 2006; *Mail & Guardian*, 30 March 2006). During the crisis, an intensive media campaign was adopted to try and manage the peaking power situation. Essentially, the levels of power consumption were monitored and when consumption moved close to a critical situation, television and radio were used to ask the public to switch off hot water cylinders, pool pumps and other appliances to bring consumption back down to a manageable level. The response rate to this initiative was closely monitored by Eskom. Although no official report has been published on the results of this campaign, interviews with members of the Energy Research Centre at the University of Cape Town and notes from a presentation by Eskom to the South African National Energy Association indicate that the initiative had some effect. Approximately half of the tar-

geted 400 MW was saved during the period.

There were various reports covering the extent of the damage to businesses and households. Examples of this include damaged computers, traffic congestion, perishables damaged in refrigerators, non-delivery to clients, and an oil refinery unable to operate (*Cape Business News*, April 2006; PlanetArk, 2006a; PlanetArk, 2006b). Other media reports estimated that \$425 million had been spent on the purchase of generators in Cape Town as a result of the power cuts (*Business Day*, 10 May 2006).

### Literature review

Health & Sitkin (2001) believe that organizational behavioural change has its base in individual behaviour and there is a strong link between individual and organizational behaviour. A change in behaviour can more easily be expected when there is both a positive personal attitude and a positive personal environment. The extent to which behaviours can be changed by interventions in the personal domain, such as education or information, depends on the strength of the contextual environment (Stern, 1999). Issues in the contextual environment include public policy and economic variables.

Crises have been shown to be an effective driv-

er of change in organizations, whether internal or external. These crises are thought to jolt the organizations to question their business strategy and in turn their mission, structure, systems or procedures (Bartlett 1983; Tushman et al, 1986). Organizational change not preceded by a crisis may not always be effective or sustainable. Rumelt (1995) states that effective organizational change is prevented by distorted perception, dulled motivation, and a failure to come up with a creative response. Reasonable responses are not implemented because of political deadlocks or action disconnects and a crisis is required to overcome these frictions and bring about change.

The Cape Town electricity crisis is not unique and other countries have dealt with the consequences of their crises primarily by changing the behaviour of consumers to manage demand. The most significant crises and measures are summarised in Table 1.

Lutzenhiser (1993) finds that energy consumption behavioural changes are most likely to occur when policy changes are used in conjunction with information. In the early 1970's consumers in the USA largely blamed the government and other external institutions for the energy crises of the 1970's but attitudes had changed by the 1980's and 1990's, and a majority of US households had

Table 1: Summary of various international electricity crises  
Source: IEA (2005)

<i>Year</i>	<i>Country, reason for electricity crisis</i>	<i>Measures taken to change behaviour</i>
2001	California, series of simultaneous events	200 different programs in all sectors; rebates for using less electricity than the previous year; public awareness campaigns; extensive daily media reports; rebates for efficient appliance purchases; business partnerships, updated efficiency standards; higher electricity prices to some customers
2001	Brazil, drought	Electricity rationing; penalties; media coverage of the shortage; daily status reports; conservation devices distributed to the poor; fuel switching
2001	Sweden, extremely cold day	Media broadcasts for conservation and explanations of the problem
2001 to 2003	New Zealand, drought and coal shortage.	Intensive media campaign; individual goals for all consumers; consumer hotline; website with information; rebates for successful conservation
2002	Norway, drought and early winter	Extensive media campaign; daily reservoir level reports; subsidy scheme for household electricity conservation; fuel switching; shut down some energy intensive factories
2003	Ontario blackout (for 50 million people and 60 GW load)	Media appeals for conservation; shutdown of government offices; closure of electricity intensive industries; electricity curtailments
2003	Pennsylvania, flood damage power plant	Major industry closure; warnings of blackouts; media releases encouraging conservation
2002	Tokyo, nuclear plant shut down	Media appeals for conservation; discussion programs on the problem; individual customer visits to ask for conservation; government buildings conservation; rescheduling of production; website information; renegotiation of interruptible contracts with large customers
2003	Europe, hot summer	Use of interruptible contacts; mass media appeals for conservation

reported that they had significantly cut back on energy consumption. However, he finds that behaviour changes are also affected by factors such as income differences, cultural backgrounds, roles played within the organization or household, which implies different reactions to programmes and policies to conserve energy. External factors such as weather, social processes, design of buildings, mechanical systems and appliances could also influence changes in behaviour.

McMakin, Malone, and Lundgren (2002) state that there is still quite a degree of uncertainty as to what motivates people to conserve energy. Their study found that people are more likely to adopt a new behaviour if it is easy and convenient to perform, if it fits their skills and resources, if neighbours and friends change similarly and if commitments to change have been made in public settings. They propose that individuals need sufficient personal control, self efficacy and other such self affirmation characteristics before they can actively care enough to take environmentally responsible actions that benefit others (McMakin et al, 2002).

Despite this the International Energy Agency (IEA) recommends that energy consumption behaviour be changed by increasing the knowledge of the consumer by means of media campaigns and real-time information, rebates for energy conserved, and higher prices for increased consumption (IEA, 2005).

Explanations of the sustainability of the changes in behaviour are somewhat more complex. Zabel (2005) explains that the basic approach by humans to natural resources results in their incorrect valuation. Examples of these approaches are:

- The scarcity of natural resources is measured in quantity and prices
- Everything can be decomposed into commodities and hence everything can be purchased
- All problems can be solved by spending money
- Natural resources are measured in terms of their extraction costs rather than in term of their overall scarcity.

As a result, natural resources tend to be over-exploited. Many of the existing social institutions, organisations, hierarchies and reward systems promote self-interested behaviour and hamper changes in individual value systems towards sustainability, as they provide advantages for those individuals that behave according to the prevailing values. Zabel (2005) states that it can be assumed that individuals habitually carry out tests of certain values regarding their potential dangers to the survival of the individual or the collective survival. It is therefore assumed that changes in the system that influence the survival of the individual or the collective could result in changes in behaviour. Changes in behaviour can not really be regulated from the outside. In the short run, extrinsic rewards or pressures

can induce certain kinds of behaviour, but people usually refrain from this behaviour when the external impulse is removed. Overall, Zabel (2005) concludes that people will tend to not simply change for the sake of changing, as the rewards for unsustainable behaviour are too great. As a result changes in behaviour tend to be short-term unless continually stimulated. This is supported by the findings of the IEA (2005) who found that normal energy consumption behaviour returned once the crisis has subsided, and this is made all the more difficult to sustain if the change was difficult or out of control of the individual or organization (McMakin et al, 2002).

### Methodology

A Likert-type questionnaire was developed from the literature review and sent to small and medium businesses in the Cape Town area. The questions were divided into three broad categories; what was the impact of the electricity outages on SMEs, what are the changes in behaviour, and how enduring are these changes likely to be? Prior to the finalization of the questionnaire it was tested with three companies outside the sample for reliability.

We randomly selected 2 900 of the 4 000 SMEs who were members of the Cape Town Chamber of Commerce for the survey. We received responses from 250, representing a 9% response rate, which is within the acceptable range of mail surveys (Harzing, 1997). A breakdown of the size of the companies, in terms of employees, is given in Figure 2.

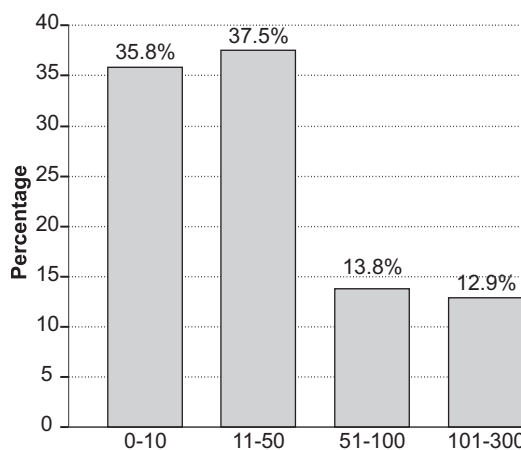


Figure 2: Employee complement s of respondent companies

The majority (73%) of the responses came from businesses of between 0 and 50 employees and the remaining 16% came from companies with 51 to 300 employees. The responses came mainly from manufacturing companies (25.2%), other (17%), 5.7% from IT businesses and 5.2% came from finance related businesses as shown in Figure 3.

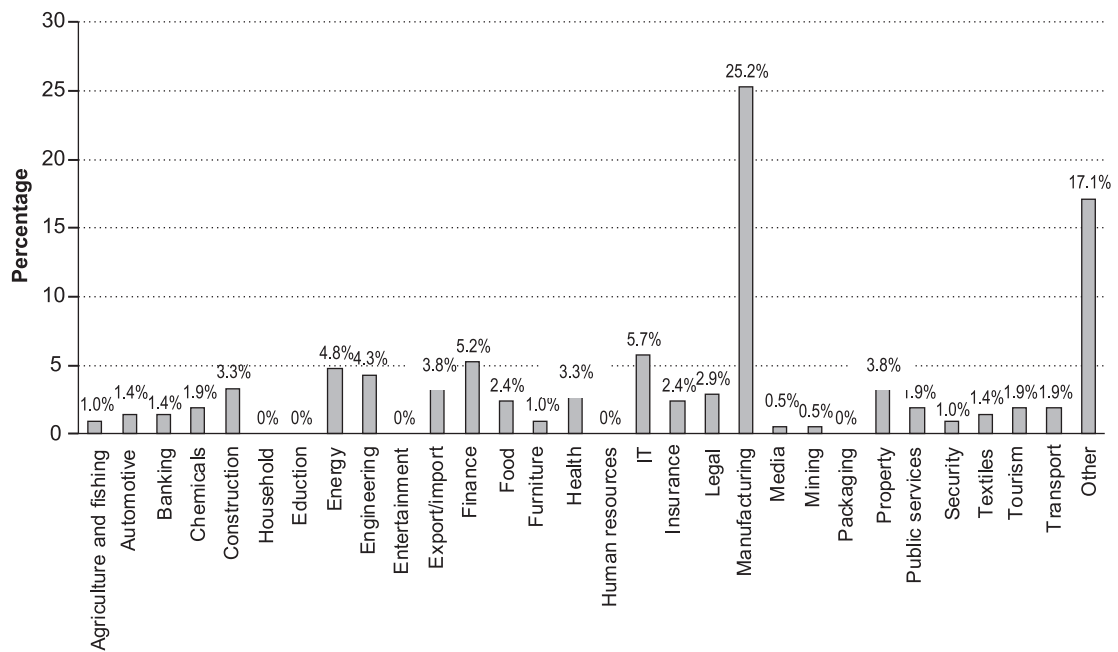


Figure 3: Business sector of the respondent companies

## Results

### **Impact of the electricity crisis**

The impact of the electricity crisis was quite extensively felt by these businesses, and most reported loss of trade or productivity due to carrying the cost of overheads while not trading. The majority of SMEs (89%) are heavily dependent on a stable supply of electricity, while 69% felt that they were severely impacted by the outages (see Figures 4 and 5).

The overwhelming majority (80%) also felt that they had lost business due to the lack of stable electricity. The impact is illustrated by some additional responses:

- Approximately \$143 000 damage and losses after equipment failure at an old age home,

- Bed and breakfast establishment lost business from international tourists
- Fruit exporter lost \$200 000 due to failure of cold rooms
- Computer failure during critical software development processes led to the replacement of computers and loss of productivity
- Loss of international clients for a small manufacturing operation due to failure to meet deadlines. Estimated cost to the company was \$95 000
- \$15 000 to install generators in a cold-room for a food supplier.

One way to reduce the impact of electricity outages is if one has information and can plan accordingly, but 68% of the respondents felt that they did

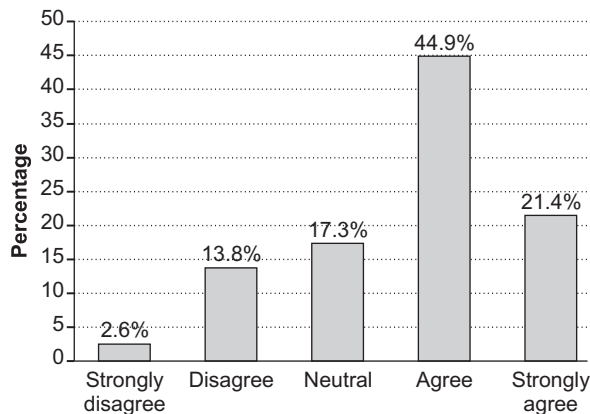


Figure 4: Question: My business was severely financially impacted by the recent energy crisis in Cape Town

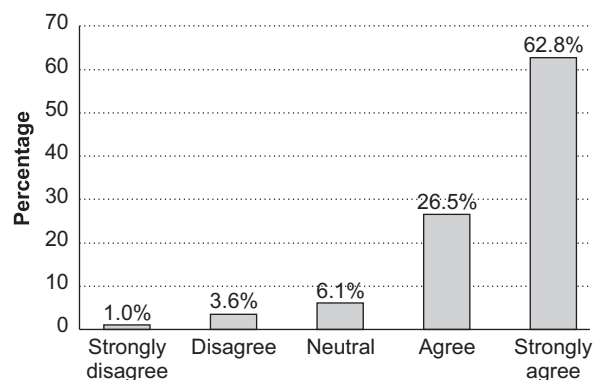


Figure 5: Question: My business is heavily dependent on a stable and secure electricity supply

not have prior knowledge about the extent of the electricity problems in Cape Town and could not plan accordingly. This is shown in Figure 6.

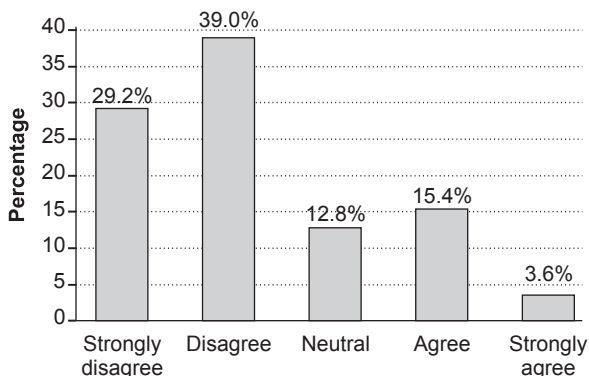


Figure 6: Question: I was aware of the problems with the electricity supply in Cape Town and was therefore quite prepared for the situation

### Changes in behaviour from the electricity crisis

The study by Lutzenhiser (1993) found that attitudes towards electricity provision were an important factor in driving the behaviour of consumers. 94% of our respondents believe that Eskom is responsible for the provision of cheap and reliable electricity, while 42% of respondents feel that they need to reduce their consumption and 45% do not – another 13% are undecided.

Actual changes in behaviour are more diverse, and respondents were given a wide range of choices and these are listed in Table 2.

The IEA (2005) recommends that changes in electricity consumption behaviour can be driven by information in the form of media campaigns, increasing electricity prices, and incentives or

rebates for reduced energy consumption.

Eskom tried to manage the electricity crisis primarily through an extensive media information campaign advising when power shedding would occur and ways to conserve energy. In response, only 43% of our respondents found this information helpful, despite 57% feeling that Eskom has been forthcoming and transparent in its attempts to provide information.

On the option of increasing electricity prices to change electricity consumption, 47% felt that an increase in prices would lead to their firm consciously saving more electricity, while 34% strongly disagreed and 20% were neutral. Rebates and incentives were seen similarly with 46% of respondents agreeing that rebates would assist their firms in consuming less electricity, 27% disagreeing and the remainder undecided.

In response to another question, 77% of the SMEs stated that the crisis made them realize that they are stakeholders in electricity in South Africa and need to assist and conserve energy. However, the permanence of the changes in consumption behaviour is not so certain. In response to the questions on duration of change, 52% have only taken interim measures while waiting for Eskom to restore normal electricity supply. 29% have taken a more long-term approach, while 19% are undecided. The installation of alternate sources of electricity such as solar power has been considered by a small group of 22% and only 21% of respondents have arranged for an energy audit. On the other hand, 60% have provided incentives or otherwise actively encouraged staff to conserve energy by, for example, turning off lights or air conditioners, and 46% have rewired some of their operations to protect equipment against power outages. Only 19% have considered the long-term impact of unstable electricity supply in business plans, while 31% are

Table 2: Changes in electricity consumption behaviour

Behaviours likely to change	Strongly disagree + disagree	Neutral/ undecided	Agree + strongly agree
The electricity crisis has resulted in my company having to reconsider future investments in South Africa	37%	36%	27%
My company will in future maintain a good working relationship with Eskom to encourage a better flow of information	16%	46%	38%
Energy considerations will be a major aspect of any future building plans	9%	18%	73%
We will in future have to maintain on-site generators	39%	19%	43%
The crisis has resulted in building stronger relationships with suppliers and customers to cooperate to overcome these future electricity problems	24%	46%	29%
There is nothing much my company can do to improve our energy consumption	26%	10%	64%
Energy conservation has become a major focus point of our future strategy	28%	38%	34%

unsure about the potential changes necessary, and 50% do not believe it will impact on their business over the long-term.

### **Discussion**

We have seen that unstable electricity supplies severely threaten the survival of small and medium enterprises. This is even more pronounced when the businesses do not have sufficient prior knowledge of the irregular outages. The major impacts on sustainability are the loss of revenue and customers during downtime, the failure to complete contracts on time, and an increase in overhead and unanticipated loss of productivity.

The evidence that not many companies have considered alternatives like solar energy could be due to the cost and the long payback period (*Mail & Guardian*, 17 March 2006). A solar water heater could cost anywhere between \$650 and \$1 400. The payback for such an item could be anywhere between 5 and 10 years depending on usage. The implementation of photovoltaics with batteries is seen by respondents as expensive and still quite a clumsy technology in comparison with grid-connected power. Additional barriers for proceeding with alternative sources of energy are more likely due to a lack of relevant information and access to up-front financing for the necessary infrastructure. This is an area for further research.

Many small and medium companies have however, provided incentives to staff to behave more conservatively in doing things like switching off lights or air conditioning when not in use. It is interesting that about one fifth of respondents haven't actually considered any changes in behaviour. In exploring the reasons for these responses, the question was asked whether short-term requirements of shareholders were one of the reasons inhibiting change. The response was that 20% felt it was not, 38% felt that it was and 43% were not sure. The spread of responses is most likely the consequence of the media information campaign conducted by Eskom during the crisis.

### **Media and information campaigns**

During the crisis Eskom ran an extensive media and information campaign to implement demand-side management measures and avert the rolling blackouts due to peak time power demands that could not be met. Consumers were warned via television and radio when power consumption in the region was about to reach a critical level and the risk of a blackout increased. Consumers were asked to reduce power consumption and were informed about when the peak power period had passed and normal usage may be resumed. The effectiveness of the campaign was monitored by the Energy Institute (EI), who suggests that consumers largely heeded the initiative (Energy Institute, October

2006). However, the ensuing political uproar over the outages and vague reports by Eskom led to a high degree of confusion by consumers, which is reflected in our results where most respondents did not find the information particularly useful. At best this contributes to the difficulty an SME has in evaluating information from the external environment, a loss of trust in the public utilities and the associated decision making problems. On the other hand, in the period following the crisis a significant part of the respondents feel that they are now important stakeholders in the provision of electricity in South Africa, but they are largely unsure what to do about it. A disturbing finding is that a relatively large number (31%) of respondents are rethinking their investment with implications for the future development of the SME sector. This is an area for attention by Government.

### **Increased electricity prices**

As a lever of consumption-behaviour change, price increases have a mixed chance of success. SMEs in South Africa are generally more vulnerable to the pressures of the market than larger firms (Falkena *et al*, 2001) and increasing prices would have the unintended consequence of inhibiting further development of the SME sector. Additionally many respondents felt that an increase in the electricity price would increase overheads but not lead to additional conservation – electricity is still a small factor cost and it is unrealistic for it to become a greater proportion of overhead than, for instance, salaries. This would probably have the unintended consequence of making these businesses economically unviable.

### **Incentives to change energy consumption**

Significantly two thirds of the respondents felt that there was not much that they could do to improve their electricity consumption. This is likely related to the size of the firm, the nature of its business, the cost of alternatives, the lack of resources to explore alternatives and the lack of bargaining power with the electricity generators and suppliers. Incentives could become a more important lever for behavioural change when actively supported by government agencies, for instance, with government providing free energy audits and involving the building industry and appliance manufacturers to educate consumers on energy based buying decisions.

### **Sustainability of behavioural changes in electricity consumption**

We do see some changes in consumption behaviour but the results are mixed and largely of an interim nature. This may be attributed to the view that the crisis was only temporary in nature, despite Eskom's public media campaign stating the need to permanently change consumption behaviour (*Mail*

& *Guardian*, 10 January 2006; *Mail & Guardian*, 30 March 2006). This is an attitude similar to that of the US public in the 1970's (Lutzenhiser, 1993) that government and the public utility are responsible for managing the provision of electricity in South Africa.

## Conclusions

Our findings may be limited by the size of the sample and the time frame for the study. The sample was based on members of the Cape Town Chamber of Commerce and Industry, and SMEs who do not belong may be even more vulnerable to change and capacity to plan ahead. An additional limitation is that the study was conducted in Cape Town over a period of four months and it would be desirable to revisit the study later to test the permanence of the behaviour changes.

Despite the limitations, the Cape Town electricity crisis has taught us several lessons. The suggested methods of encouraging changes in consumption behaviour; media and information campaigns, increase prices, and the provision of incentives (IEA, 2005) were found to have limited prospects of success with SMEs. The SME behaviour change in the Cape Town electricity crisis has been temporary and does not reduce their vulnerability to future external shocks. The most effective way to reduce vulnerability is to provide information-certainty in the external environment to enable SMEs to incorporate risk management into planning and business processes. We recommend that an ongoing media campaign be conducted to educate SMEs about their vulnerability and options to reduce risk. This should be supported by a free energy audit and expert advice on reducing energy consumption or managing risks from increasing electricity costs or an unstable electricity supply. SMEs need to re-examine their relationships and contracts with suppliers and customers so that they can spread the risk of unstable electricity supplies. This will include a review of the type of information provided by Eskom and channels for information. The media campaign needs to be ongoing, not simply during the crisis and the information needs to be trustworthy, accessible and timeous. During the Cape Town electricity crisis the information about when and where blackouts were to occur was generally incorrect.

In a country like South Africa where SMEs are seen as the major driver of economic growth, SMEs need to be nurtured and their vulnerability reduced – a stable electricity supply is critical in this regard. Similarly one can conclude that unanticipated changes to other infrastructural factors, such as telecommunications, transport and even local taxes, would lead to similar short-term reactions in SME behaviour. SMEs have sense of powerlessness to the external factors and generally do not plan for

them. SMEs tend to wait for the crisis to pass, while not reducing their long-term vulnerability to them. These attitudes or behaviours render the conventional consensus, such as media, price increases and incentives less effective. Future studies could examine other strategies for changing behaviour of SMEs as the three accepted strategies have shown to have limited effectiveness. Another area for research is external risk management techniques for SMEs with their limitations on resources and skills. A more in depth study of SMEs should be clustered into industries, or at least into production sales or production sectors.

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Received 7 May 2007; revised 20 December 2007