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Energy efficient production in the automotive and clothing/textiles industries in South Africa

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Energy efficient production in the automotive and clothing/textiles industries in South Africa

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Introduction

Energy efficiency is the most effective means with which to address concerns over climate change, rising energy prices, and security of supply while at the same time supporting economic growth (Price and McKane, 2009). The industrial sector presents the biggest opportunity for savings as it is the primary contributor to global final energy consumption and energy-related carbon dioxide (CO_2) emissions, at 33 percent and 38 percent respectively in 2005 (IEA, 2008). The case for industrial energy efficiency is even stronger for developing countries. Firstly, the industrialization process causes these shares in energy consumption and energy-related CO_2 emissions to be considerably higher than in industrialized countries. Indeed, in 2005, industry in non-OECD countries accounted for 38 percent of energy consumption compared to 27 percent in OECD countries, and exceeded 50 percent in some cases (IEA, 2008). Secondly, and with exceptions, developing countries tend to be more carbon intensive than their industrialized counterparts due to a higher share of pollutive sources, such as coal, making up their final energy mix (IEA 2008). To illustrate, carbon intensity decreased in OECD countries over the period 1990 to 2005, helping to limit growth in CO_2 emissions to 15 percent. In non-OECD countries, however, carbon intensity continued to increase, contributing to growth in CO_2 emissions of 39 percent over the same period (IEA 2008). Furthermore, this trend is expected to continue, with most growth in industrial sector energy use and CO_2 emissions forecast to come from developing and transition economies (McKane et al, 2007).

Developing countries face a difficult dilemma. Most have been eagerly awaiting their turn to set off on the path of industrialization and enjoy the much needed fruits of economic growth. But they are also under pressure to choose their manner and speed of industrialization carefully in order to minimize the impact on the environment. This creates an obvious development challenge for government and industry, who are understandably concerned that expensive clean development could undermine international competitiveness, and they are especially reluctant to foot the bill when industrialized countries are largely to blame for our current climate concerns. But even though the goals of economic growth and environmental sustainability are often at odds, developing countries do have a particular opportunity to upgrade international competitiveness by adopting energy efficient best practices from the outset in new industrial facilities (McKane et al, 2007). Energy is usually costly and the gains to be made by conserving it are well documented. Based on proven technologies, improvements to industrial energy efficiency are estimated at 18-26 percent, reducing industry's CO_2 emissions by 19-32 percent (IEA, 2007). Apart from the direct economic gains, forward-thinking governments and firms would also ensure compliance with future environmental regulation.

The bulk of energy consumption is accounted for by energy-intensive industry - minerals extraction and processing industries, and within manufacturing the production of commodities such as iron and steel, paper, and cement. Correspondingly, the vast majority of the literature on industrial energy efficiency relates to energy-intensive industry. Consuming less energy, the automobile and clothing & textile sectors fall into the category of light manufacturing industry. However, economic development patterns indicate a shift from energy-intensive industries towards lighter, higher value-added industries, which are predicted to account for over half of all manufacturing energy use by 2050 (Price and Worrell, 2004).

In this paper we perform case studies on a selection of firms in the automobile and clothing and textiles sectors in South Africa. Our aim is to understand what drives and enables successful energy efficiency strategies in these sectors and extend the lessons to other developing countries. At the same time we also seek to identify factors that hinder progress in this area. We focus on internal commercial influences within firms and their supply chains in order to unpack the role of value chain drivers and governance structures in pursuing energy efficient production processes. In addition we also examine the impact of South Africa's energy policies in order to better define the role of developing country governments in initiating and supporting industrial energy efficiency improvements and creating a business environment conducive to the private pursuit of energy efficiency.

We begin in Section 1 by outlining the types of energy efficiency opportunities available to the manufacturing industry, describing the direction that global energy efficiency policy has taken, and paying specific attention to the automotive and clothing and textiles sectors. Section 2 positions South Africa's energy efficiency policy in global context. In Section 3 we begin the analysis of the energy efficiency challenges driving South African industry. Section 4 presents the case study interviews, methodology, and findings. Section 5 presents four selected case studies of pertinent firm experiences. We conclude by discussing the policy shortcomings apparent in respect of the automotive and clothing and textile industries.

1 Energy efficiency opportunities and the will to implement

Energy efficiency can be considered the main energy saving opportunity for the manufacturing industry (Moomaw et al, 2001). In theory, three factors should drive industry towards achieving it. The first is cutting energy costs. If energy constitutes a substantial input to industrial processes then this should be a straightforward incentive to improve energy efficiency. The second is regulation. Firms all over the world can expect growing pressure from their governments to cut carbon emissions. Such regulation could take the form of mandatory energy efficiency standards and targets, and/or market-based incentive schemes such as the European cap-and-trade system or a simple tax on carbon emissions, both of which penalize high energy consumption and reward emissions reductions. The third factor is that of shifting consumer preferences. Consumers are gradually beginning to favor firms who credibly demonstrate minimal environmental impact. This presents forward-thinking firms with an opportunity to develop and market low carbon products and gain market share from or collect a premium over more environmentally harmful alternatives.

The UK's Carbon Trust (2006) puts forward two broad categories of energy saving opportunities available to industry. The first is the direct reduction of energy consumption by optimizing internal production processes. The second involves indirectly reducing energy consumption by changing or reconfiguring the firm's products to consume less energy during use and disposal. The former is more within the scope of this paper than the latter. This is due to the fact that the products manufactured by South African automotive and clothing and textile manufacturers are designed and developed in high-income developed countries. The opportunity for local firms to shape the nature of the products they manufacture is very limited, particularly in the automotive industry, which has clear homologation rules relating to the manufacture of globally branded products.

To generate energy savings in production, firms should invest in new energy efficient plant equipment or in technologies that optimize the energy use of existing equipment. Moomaw et al (2001) assert that the technologies that offer the most scope for energy savings throughout the broad manufacturing sector are process control and energy management systems, process integration, and cogeneration of heat and power, while further savings are achievable through the adoption of high-efficiency electric motors and electronic adjustable speed drives. They estimate that the widespread adoption of these general utility measures would result in a 5 percent saving in global primary energy demand, with potential for further savings coming from industry- or process-specific measures. A case study on South Africa performed by Winkler et al (2007) explores the potential impact of energy efficiency measures on total national energy demand and emissions. Based on available technologies relating to, in order of impact, compressed air management; variable speed drives; efficient motors; efficient lighting; load shifting; heating, ventilation, and cooling; and other thermal measures, they estimate annual energy savings of 3 percent and a 5 percent reduction in total projected national emissions by 2020.

McKane et al (2007) stress the importance of system optimization in addition to the replacement or optimization of individual system components. While individual components such as motors and drives, compressors, pumps, and boilers offer an improvement potential of 2-5 percent, motor systems and steam and process heating systems offer an improvement potential upwards of 20 percent and 10 percent respectively.

If the national grid delivers energy generated from carbon-intensive sources, then firms with substantial electricity requirements could do more for the environment by generating their own power on-site, employing cleaner technologies such as those based on renewable sources or natural gas. This is often the case in developing countries, whose economies tend to rely on ageing coal-fired plants for their energy supply (IEA, 2008). In addition to the reduction in carbon emissions, generating power in close proximity to the end-user reduces system electrical losses and increases the potential for combined heat and power technology (Moomaw et al, 2001).

More generally, firms should gauge their supply chains for energy efficiency opportunities and roll out lean production strategies aimed at eliminating over-production and energy-intensive storage and waste (Carbon Trust, 2006). Firms should run internal campaigns to build awareness of the benefits of energy efficiency and develop the organizational structure and capacity to incorporate these benefits into their decision-making.

Opportunities in the auto and textile industries

As Galitsky and Worrell (2003) point out, the primary forms of energy utilized in the automobile parts and assembly sector are electricity, steam, gas, and compressed air. Energy costs in assembly plants represent on average only 1-2 percent of total operating costs (Canadian Auto Parts Association 2005; Galitsky and Worrell, 2003; BMA database). The figure for automotive component manufacturers is very similar, with the average for South African automotive component manufacturers also calculated at between 1-2 percent of total operating costs (B&M Analysts' automotive component manufacturer database). However, this average masks a highly variable rate of energy usage between component manufacturing sub-sectors. Automotive foundries and forges average well over 4 percent, whilst other (more labour intensive) sub-sectors, such as harness and electronics assembly, operate at levels well below the assembly plant average of 1-2 percent. Electricity consumes approximately two thirds of the energy budget for vehicle assembly plants, utilized primarily for compressed air, metal forming, lighting, ventilation, air conditioning, painting, material handling, and welding. Motors that drive plant equipment consume around 70 percent of total electricity demand, highlighting the importance of energy efficient motor systems. Fuel usage primarily centers on general heating as well as ensuring correct temperature and humidity in the painting line (Galitsky and Worrell, 2003).

Galitsky and Worrell (2003) conduct an analysis on the energy saving opportunities available to automobile assembly facilities, using a number of US assembly plants as case studies. They identify over 90 energy saving practices and technologies, splitting them into cross cutting utility measures and process-specific measures. Cross cutting utility measures offer immediate energy savings without impacting on the assembly process. They involve energy efficiency improvements to motors, compressed air, lighting, hot water and steam distribution, hot water and steam generation, power supply, and heating, ventilation, and air conditioning. While the savings brought about by each individual measure are small, the cumulative savings are substantial. Importantly, the majority of measures are financially profitable, offering relatively quick payback periods or even coming at a net negative cost depending on the size, age, and specific activity of the plant. The process-specific energy efficiency measures identified relate to painting, welding, and stamping. In addition to energy savings, many of the identified technologies yield improvements to product quality.

The production of textiles and leather constitute only 2 percent of total global industrial energy use (IEA, 2009). The way in which energy is used in the textiles industry is not well understood and the general literature on energy savings in this sector is somewhat sparse, despite this sector being of special importance in developing countries (Price and McKane, 2009). For this reason Price and McKane (2009) recommend that for these sectors, specific indicators be developed and, on this basis, appropriate data collected. Of course, this does not mean that energy efficiency opportunities do not exist in the sector.

A case study undertaken by the US Department of Energy (2001) exemplifies the benefit of system optimization in the textile industry. The study identified annual energy cost savings through the optimization of the compressed air system and the modernization of the mill's production equipment. Production was increased by 2 percent per annum whilst annual compressed air energy costs fell by 4 percent and maintenance costs by 35 percent. Simultaneously, the improved compressed air system resulted in a 90 percent reduction in compressor downtime and better product quality. Most importantly the project's payback period was only 2.9 years.

There clearly exist a number of presently available technologies that can be utilized in industrial facilities within the automotive and clothing and textile sectors. While the applicability of technologies differ per industry and plant activity, the majority of energy efficiency measures are shown to be cost effective or even at net negative cost, with payback periods typically less than three years.

Market forces, lean production, barriers to improving energy efficiency

Despite the various energy efficiency measures available to industry, do market forces alone have the potential to induce industrial energy efficiency? Market forces do have the potential to play a somewhat more prominent role if certain obstacles (such as information and the price of electricity) are overcome. However, market forces alone will not induce privately motivated firms to implement these measures on their own. Hence, policy intervention will still be required to drive the widespread uptake of energy efficiency measures.

The argument behind market forces inducing energy efficiency is essentially based on the application of lean production to energy use. Lean production describes production practice that delivers a given output using minimum resources - in other words the minimization of waste throughout the value chain. Environmentally efficient production, or clean production, describes production practice that delivers a given output while exerting a minimum negative externality on the environment. These concepts are to a large extent aligned insofar as both deliver more value at the lowest possible economic and environmental cost respectively. If energy is costly and constitutes an essential and significant input to industrial processes, it makes business sense for firms to invest in minimizing energy use. And since energy generation is the primary source of greenhouse gas (GHG) emissions, such investment is good news for the environment.

It is thus tempting to believe that due to the overlapping of lean and clean production practices rational, profit-maximizing firms will become energy efficient on their own. In practice it is not so simple.

Firstly, the profitability of saving energy and thus the amount of attention afforded to improving energy efficiency will depend on the quantity of energy used per unit of output in the production process. An alternative (indirect) measure of this is the cost of energy input as a proportion of total production cost. Energy costs in vehicle assembly plants and automotive component manufacturers represent on average only 1-2 percent of total operating costs (Galitsky and Worrell 2003; Canadian Auto Parts Association 2005) and similarly 1.81 percent for textile firms in South Africa (BMA database). Although this is the average, there is a wide variance between different types of operations and firms within these sectors. For example, for a spinning operation energy costs can constitute up to 5 percent of total operating costs.

Secondly, the degree of pressure on firms to cut direct energy costs will depend on the price of electricity. If this price is very low, then firms may simply feel that optimizing energy use is not worth the cost and effort required to do so. This was indeed the case in South Africa, whose electricity price of 22.1c/kWh ($0.03/kWh or €0.02/kWh) in 2008 was one of the lowest in the world. This is likely to be the case in many developing countries where utility firms are often still state-run and so low electricity prices may be applied as a tool to encourage local industrial development and attract foreign investment. Raising electricity prices is politically sensitive in developing countries as it conflicts with the goal of extending access to electricity to the poor, but clever policy design could insulate certain social groups from the prescribed price hikes. The elimination of conventional energy subsidies would allow market forces to come into play, amplifying the benefits of incorporating energy management into lean production strategies (Price and McKane, 2009).

Thirdly, benchmarking industrial energy use, selecting the appropriate energy saving technology, and undertaking energy efficient measures require technical expertise that is not readily available at many firms, even less so in developing countries (Price and McKane, 2009). Firms lacking expertise will thus have difficulty quantifying the costs and benefits of energy efficiency measures, which discourages them from committing capital to this cause. Thus, despite the fact that research and experience indicate financially profitable energy saving technologies with relatively short payback periods, a lack of awareness and organizational capacity may render industry reluctant to undertake costly energy efficiency measures. Fortunately, the cost-benefit issue appears founded more in perception, or at least in a lack of knowledge and experience, than reality. As awareness and technical know-how spread through industry, one would expect firms to increasingly incorporate energy efficiency into lean production strategies.

More difficult is on-site power generation from clean sources. Currently, renewable technologies are too costly relative to conventional energy sources and privately motivated firms will not have an economic incentive to invest in their own generation capacity if grid sourcing remains significantly cheaper. On the other hand, on-site generation derived from natural gas may be more cost effective and there is a strong economic case for the efficiencies yielded by cogeneration technologies. However, due to the non-storability of electricity, on-site generation also carries the added risk of mismatching energy supply and demand in production, especially if the technology is driven by intermittent factors, such as weather, or cannot be switched on and off at short notice. Feed-in tariffs are one possibility to overcome these barriers. Finally, industry's inherent slow capital stock turnover will invariably delay the replacement of energy inefficient machinery with efficient plant equipment (Bernstein et al, 2007). This may also delay individual or system optimization measures if the facility chooses to wait until the arrival of new plant equipment.

In summary, there are a number of barriers to the adoption of energy-efficient technologies. Critically these include willingness to invest, information and transaction costs, profitability barriers, lack of skilled personnel, and slow capital stock turnover (Worrel et al. 1996).

Fundamentally the gap between opportunity and implementation lies in the fact that "the principal business of an industrial facility is production, not energy efficiency. This is the underlying reason why market forces alone will not achieve industrial energy efficiency on a global basis, "price signals" notwithstanding. High energy prices or constrained energy supply will motivate industrial facilities to try to secure the amount of energy required for operations at the lowest possible price. But price alone will not build *awareness* within the corporate culture of the industrial firm of the potential for energy savings, maintenance savings, and production benefits that can be realized from the systematic pursuit of industrial energy efficiency. It is this lack of awareness and the corresponding failure to manage energy use with the same attention that is routinely afforded production quality, waste reduction, and labor costs that is at the root of the opportunity." (McKane et al. 2007: 2).

Theoretically therefore, driven by lean production, market forces do have the potential to pressure firms into the efficient use of energy. However, a market failure is likely to occur in sectors in which energy is a relatively small cost factor and in the context of a lack of awareness of the benefits of energy efficiency and a lack of expertise in implementing energy efficiency measures. Moreover, any market forces that are present will be weakened by a very low electricity price.

Policy intervention providing some form of incentives and penalties is thus required to induce the widespread uptake of energy efficiency measures in the automotive and clothing and textile industries. Awareness and training programs are also required to expose the means and benefits of energy efficiency. At the same time electricity prices need to be raised to a sufficiently high level. These actions will enable market forces to gain traction and increase the benefits of energy-focused lean production.

Global energy efficiency policy

In order to overcome these barriers it seems to be necessary to adopt effective industrial policies and programs to provide enabling environments for industry to easily implement energy efficiency technologies, practices, and measures (Price and McKane, 2009). In their proposed Industrial Standards Framework, McKane et al (2007) detail a comprehensive government-led approach to improving industrial energy efficiency. The key elements of their approach are outlined in Table 1. Their major policy recommendation is the establishment of industrial sector energy efficiency targets together with recognition of exceptional energy efficiency performance. This includes the provision of economic incentives as well as technical and financial support for participating industries. They emphasize government's role in increasing awareness and building organizational capacity through the establishment of energy management standards, the initial provision of system optimization training, and the creation of a system optimization library as a platform for the retention and dissemination of best practices.

Target setting agreements (or 'voluntary agreements') have been implemented in industrialized countries since the early 1990's. They are voluntary or legally-binding agreements concluded between government and industry with the aim of achieving specified energy efficiency improvements and emissions reductions over a specified time period, typically five to ten years (Bernstein et al, 2007). McKane et al (2007) outline the key elements of a target setting program as follows:

- Target setting process
- Identifying energy saving technologies and measures
- Benchmarking current energy efficiency practices
- Establishing an energy management plan
- Conducting energy efficiency audits
- Developing an energy savings action plan
- Developing incentives and supporting policies

- Measuring and monitoring progress towards targets
- Program evaluation

Table 1 Key elements of the Industrial Standards Framework

Element	Category	Purpose	Current Status	Importance	Compatibility
Energy Management Standard	Standard-Voluntary or Mandatory	Provides organizational guidance for "hardwiring" energy management into company management practices.	Existing standards in Denmark, Ireland, Sweden, Netherlands, US; developing in China, Spain, Korea, Brazil	Essential for management support; compliance w/standard can be met through other elements	Written as possible ISO standard w/ ISO-friendly documentation and continuous improvement requirements
	Training	Prepares management to implement standard	Existing training through Georgia Tech (US)		
System Optimization Library	Tool-Electronic reference document	Provides factory personnel and experts w/guidance on system optimization within the ISO context of procedures, projects, & work instructions	Library samples developed & reviewed; demonstration project planned	Essential-provides an incremental path to continuously improve and maintain system efficiency	Written in ISO language for use in ISO 9000 or 14000 program; supports corporate energy management goals; assist in development of system optimization projects
	Training	Prepares factory personnel and system optimization experts to use Library (follows system optimization awareness training)	Training to be developed as part of demonstration project		
System Optimization Training	Training	Expert training prepares a cadre of engineers to conduct factory assessments, train factory personnel, & assist in project development Awareness training alerts factory personnel to system optimization opportunities	Expert & awareness training developed as part of UNIDO Motor System Program (China)	Essential-provides the technical skills for small group of experts and prepares them to train others	Provides pathway to quickly develop energy-efficiency projects for energy management plan.
ISO 9001:2000 and/or 14001 certification	Independent Certification	Determines whether a factory is meeting ISO objectives for continuous improvement via procedures, projects, & work Instructions	Global program with >770,000 participating companies	Essential to use an energy management system (ISO or other) to document, sustain & improve energy efficiency	Other elements provide path for maintaining certification
Energy efficiency targets by industrial sector	Policy	Provides plant-specific energy efficiency targets based on continuous improvement that is non-prescriptive and developed in cooperation with the industrial sector	Extensive European experience; pilot program developed and demonstrated in Chinese steel industry	Very helpful-engages management in efficiency objectives, becoming a driver to use other elements	Compatible with all elements
Government Recognition of Outstanding Energy Management	Policy	Provides meaningful recognition program for factories who initiate and sustain continuous improvement for energy efficiency	Many examples of effective national recognition programs (See Section 4.6)	Very helpful for motivating companies to become energy efficient	Recognition based on measurable results from other elements

Source: McKane et al 2007

Price (2005) reviews 23 national energy efficiency target setting agreements in 18 countries around the globe. They are found to be more effective when applied within the context of a coordinated set of policies that provide economic incentives together with technical and financial support to the participating industries. Participation and probability of success are also found to be significantly higher within or under the credible threat of increased regulation or energy/GHG emissions tax programs if the reduction goals are not met. Consequently, some countries have adapted their programs to incorporate stronger incentives and penalties.

The Climate Change Agreements (CCA's) in the UK are an example of a national target setting program between government and industry. It forms an integral part of the Climate Change Program (CCP), initiated by the government in 2000 in order to achieve its Kyoto Protocol target of a 12.5 percent reduction in CO_2 emissions below 1990 levels by 2008-2012 and its more ambitious domestic goal of a 20 percent reduction in CO_2 emissions below 1990 levels by 2010. The CCA's are emissions targets negotiated between the government and 44 sector associations. They have since extended to 52 sectors, spanning over 9000 industrial facilities. In return for achieving their targets, participating facilities receive an 80 percent rebate on the Climate Change Levy (CCL), a tax on the use of energy applied to industry and the public sector as part of the Climate Change Program (DECC, 2000). The CCA's also include an emissions trading scheme, where firms can purchase additional allowances or sell excess allowances. The results of each biannual target assessment period compiled by AEA Energy & Environment (2009) are excellent, showing that total CO_2 emissions reductions were almost three times the target for the first assessment period, more than twice the target for the second assessment period and almost twice the target for the third and fourth assessment periods.

Energy management standards are important for facilitating the achievement of energy efficiency targets as they provide guidance to industrial facilities on how to incorporate energy efficiency into their management activities. Typical features include establishing accountability of energy management in a firm's organizational structure and the measurement, management, and documentation of all aspects of energy use and disposal (Price and McKane, 2009). The International Organization for Standardization (ISO) is currently preparing an energy management standard (ISO 50001), scheduled for release in early 2011. Targeting broad applicability across sectors and countries, it will be compatible with ISO's existing quality (ISO 9001) and environmental (ISO 14001) management standards and serve as a framework for industrial plants, commercial facilities, or entire organizations to manage energy (ISO, 2008).

Applying energy management standards to achieve emissions targets requires specific expertise relating to management systems and energy efficiency (Price and McKane, 2009). Capacity building programs are thus required in order to filter technical capacity from international experts to local experts and industry on a large scale. Government has a prominent role to play in initiating such capacity building programs.

The Carbon Trust was established by the UK government in 2001 to provide specialist support to business and the public sector in cutting emissions, saving energy, and commercializing low carbon technologies (Carbon Trust, 2009). The Carbon Trust also provides financial support to businesses wishing to reduce their carbon footprint.

In the US, since 1976, the Department of Energy's Industrial Technologies Program and Industrial Assessment Centers have conducted and made publicly available over 14,000 energy efficiency assessments, making over 100,000 recommendations (Rutgers University, 2009). The US Environmental Protection Agency's Energy Star for Industry program facilitates the sharing of best practices and promotes networking between industry partners (US EPA, 2008).

Specific expertise is required for the relatively specialized task of system optimization. To overcome the skills shortage, UNIDO, the US Department of Energy, the Energy Foundation, and the Chinese government coordinated the China Motor System Energy Conservation Program, a pilot training program aimed at building the required technical capacity to implement system optimization evaluations and solutions. Within two years after completing the program the trained experts conducted 38 industrial plant assessments and identified average savings per system of 23 percent (LBL, 2009).

The most successful efforts in improving energy efficiency have consisted of the simultaneous application of a combination of policies and programs (McKane et al, 2007). Denmark has experienced the greatest proportional impact on energy consumption. It has had financial incentives in place since 1992 through a tax on CO_2 emissions combined with target setting agreements, with supporting energy management standards introduced in 2001. The US, on the other hand, has placed more emphasis on exposing energy efficiency opportunities available to industry than on providing economic incentives to undertake these measures or on encouraging the use of energy management standards. Correspondingly, relatively few facilities make use of the energy management standard (McKane et al, 2007).

2 South Africa's energy efficiency policy

South Africa has followed a particularly environmentally harmful industrialization path. Its economy is dependent on energy-intensive industrial and mining sectors, which consume over two-thirds of its national electricity supply, and it relies heavily on cheap, indigenous coal as its main source of primary energy (DME 2008). Consequently, South Africa exhibits an exceptionally high carbon intensity in its final energy mix, exceeding that of both the US and China (IEA, 2008). Partly due to its abundance of cheap coal, South Africa has thus far enjoyed an exceptionally low price of electricity. But this has provided firms, as well as consumers, with little incentive to adopt energy efficiency measures and, from an energy standpoint, has contributed to a relatively wasteful production culture (DME, 2008). Conversely, this also means that there is substantial scope for energy savings through energy-focused lean production strategies that eliminate energy waste.

South Africa has no obligation to reduce GHG emissions under the Kyoto Protocol. Nevertheless, industrial energy efficiency has the potential to increase profitability, competitiveness, and employment (Howells and Laitner, 2005). The Department of Minerals and Energy (DME) released its first national energy efficiency strategy in 2005, and a review at the end of the first phase in October 2008. It sets a national target for energy efficiency improvement of 12 percent by 2014 relative to projected consumption. The program is implemented on a sector-by-sector basis with progress monitored and the targets reviewed after each of three stages. The strategy aims to achieve the required energy efficiency improvements through the following enabling instruments and interventions:

1. energy efficiency standards
2. appliance labeling
3. education, information, and awareness
4. research and technology development
5. energy audits
6. monitoring and targeting
7. energy management systems

South Africa's industrial sector is set a target for the reduction in final energy demand of 15 percent by 2014. Within the industrial sector the target is focused on the following sectors – iron and steel, chemical/petrochemicals, mining, paper and pulp, cement. The strategy is thus focused on energy intensive industry with no mention of light industry. While the DME

(2005/8) notes that the sector offers energy savings of around 50 percent of current consumption in comparison with international best practices, a "savings potential of at least 11 percent is readily achievable using low-cost to medium-cost technical interventions. Furthermore an additional 5 percent - 15 percent energy saving would be achievable via proven no-cost and low-cost techniques of energy management and good housekeeping" (DME, 2008:15).

The strategy notes the following principal barriers to the widespread implementation of energy efficiency measures: the historically low price of electricity, a lack of knowledge and understanding of energy efficiency opportunities, institutional barriers and resistance to change (principally at the firm level), and a lack of investment confidence. It sets out a number of steps to overcome these and emphasizes the importance of including stakeholders in the process. The strategy promises government-led energy efficiency demonstrations and the introduction of energy management standards as means to build industrial capacity in the field of energy management. This would increase awareness and expertise and could indirectly increase investment confidence as the cost and benefits of energy efficiency measures become more certain. However, the review of the first phase (2008) reports very little in terms of actual progress made.

A critical barrier not identified by the strategy is the voluntary nature of the energy efficiency improvement target. The DME (2005) states, "it should be stressed that this target is by no means a mandatory requirement, but rather a guideline to aspire to." International experience of target setting programs suggests that participation will be relatively low with unsatisfactory results in the absence of or without the threat of strict regulation or energy/GHG emissions taxes (Price, 2005).

Taking account of South Africa's various other pressing social concerns, no provision is made for financial support to industries or firms who actively pursue the energy efficiency target. Indeed the DME claims that the general measures proposed, such as energy standards and energy management systems, do not require substantial financial investment and that financing can be obtained through enabling mechanisms such as the Clean Development Mechanism (CDM). Price and McKane (2009), however, point out that the CDM project-based framework is not well suited to energy efficiency projects as the relatively invariably high transaction and carbon credit development costs tend to outweigh the relatively small emissions reductions resulting from energy efficiency projects. International experience suggests that target setting agreements are more effective in the context of a wider range of support instruments, of which finance is included (McKane et al, 2007).

The DME energy efficiency strategy is very much in its infancy. Little change has occurred between the 2005 and 2008 policy publications. The 2008 variant still contains little on achievements in regard to practical implementation.

The National Cleaner Production Center - South Africa (NCPC-SA) was launched during the World Summit for Sustainable Development in Johannesburg 2002 (www.ncpc.co.za). The programme is a collaboration between South Africa and UNIDO with financial assistance from the Department of Trade and Industry, the Council for Scientific and Industrial Research and the Governments of Austria and Switzerland. The aim is to enhance the competitiveness and productive capacity of industry, focusing on SME's through cleaner production techniques that minimize waste and pollution (NCPC, 2009). The NCPC-SA promotes the application of cleaner production and sustainable industrial development in South Africa using the UNIDO integrated cleaner production approach and provides:

- Promotion of environmentally sound technologies and investments
- Training
- Audits and technical assistance
- Information dissemination
- Technical advice to government on the application of multi-lateral environmental protocols
- Policy advice to government on the adoption of cleaner production guidelines and practices

The NCPC-SA offers training and skills development and technical services such as in-plant audits and assessments. It also aims to build a local and international clean production network. Both the automotive and clothing and textiles sectors are described as priority areas (along with chemicals and agro-processing). The textile sector program is claimed to be the most advanced while in contrast the automotive program has yet to be developed. Encouragingly, the Automotive Industrial Development Centre (AIDC) are said to have formed an agreement with the NCPC to implement cleaner production programmes in the automotive industry. The aim of developing these priority sectors is to address the specific demands of these sectors and to run sustainable cleaner production programmes in partnership with the identified sectors.

The clothing and textiles sector-specific project was officially established in January 2006, as a result of the incorporation of the Cleaner Textiles Production Project (CTPP) and its extension project, the Clothing and Textiles Environmental Linkage Centre (CTELC) into the NCPC. The CTPP was established in 2000 with funding from the Danish International Development Agency (DANIDA). The main aim of the CTPP was to address waste minimization within the textile industry and to facilitate implementation of activities that will illustrate improved environmental performance of cotton growing and textile manufacturing firms. In line with the planned conclusion of this project in 2003, the project was extended with the formation of CTELC, supported by both the DTI and DANIDA. CTELC focused on operations further down the textiles and clothing pipeline, aiming to strengthen the link between the clothing industry, retailers and cleaner textile production in South Africa. The objective was to raise awareness and knowledge of environmental issues in the manufacture of textiles and how these can be incorporated into textile products. To achieve this, most activities were focused on designers, buyers and retailers of textile products. With the conclusion of CTPP and its extension project CTELC, all activities of the project were incorporated into the NCPC clothing and textiles sector component.

A number of 'cleaner production quick scan assessments' have been undertaken at various clothing and textile plants. These are demonstrations of the benefits and potential for savings under clean production. In 2005/6 the NCPC-SA had undertaken 6 assessments of textiles plants, and 15 clothing companies were assessed in 2007/8 (NCPC-SA Management Report 2006, 2008). As an example, an assessment at Glodina textile plant in 2005/6 identified opportunities for savings in the following areas – boiler condensate recovery, energy losses in stenters, effluent sulphate concentration and air conditioning control. The assessment claimed that savings of R400 000 ($53,000 or €37,000) per annum could be realized through recovery of the condensate and a reduction in energy losses from stenters. (NCPC-SA Management Report 2006).

Relative to the US Department of Energy's Industrial Technologies Program and Industrial Assessment Centers, the NCPC-SA is also still in its infancy in terms of impacting on its target sectors.

The most significant factor driving energy efficiency within industry has not been government policy, strategy and institutional mechanisms such as the NCPC – SA. Rather this has been the sudden and cataclysmic rise in the cost of electricity, which has had the greatest impact on firm production behavior across all sectors. Although the original DME strategy document identified the need to address cheap electricity and apply a price that reflects the true economic, environmental and social cost of electricity generation, the sudden rise in the cost of electricity has not been a consequence of the DME strategy.

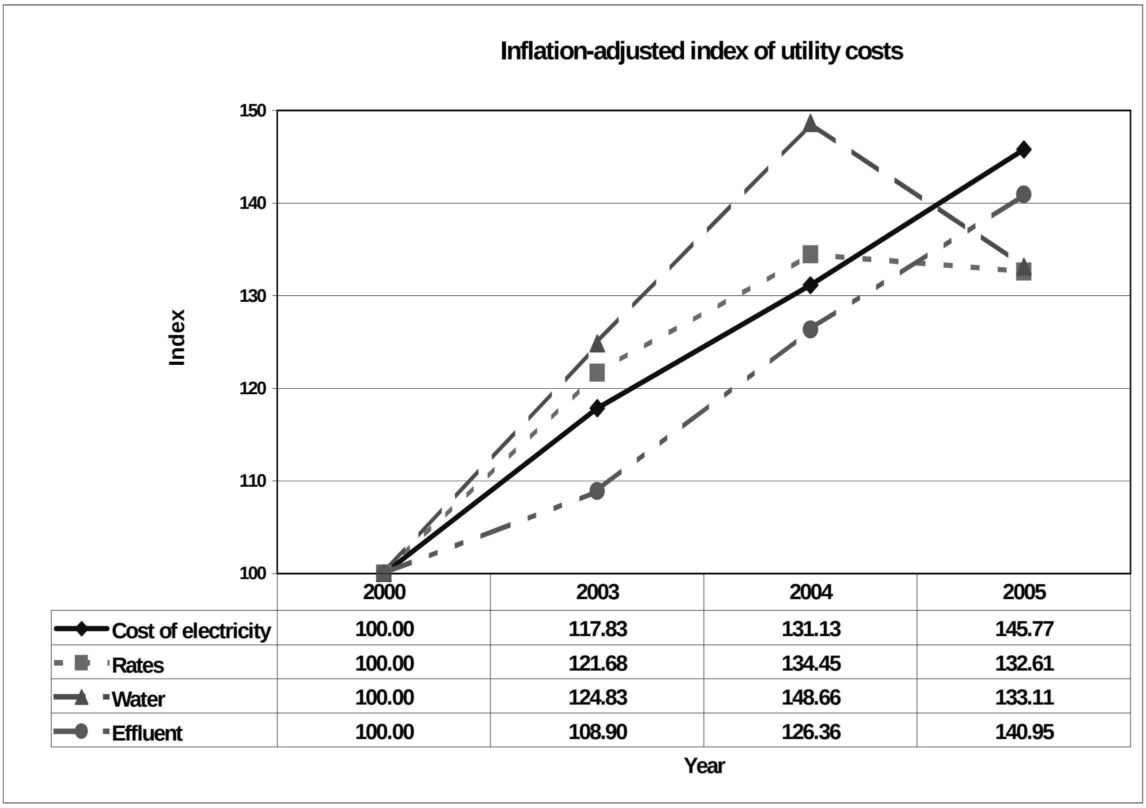
Electricity has historically been extremely cheap in South Africa. Indeed up until the mid 2000's electricity costs were amongst the lowest internationally. However, a major energy crisis arose in late 2007 when supply could no longer cope with demand, resulting in persistent, widespread blackouts. The crisis was a consequence of a lack of foresight in building sufficient supply capacity on the part of ESKOM, the government parastatal responsible for electricity generation and distribution. Eskom has since responded through a demand-side management (DSM) scheme based on a major increase in the price of electricity. In order to generate sufficient funding to build the requisite new power stations, ESKOM has chosen to raise the capital through a series of massive price hikes in the unit cost of electricity to be phased in over the next few years. The National Energy Regulator of South Africa (NERSA) approved an increase in the price of electricity of 27 percent in June 2008. It then approved a further increase of 31.3 percent in June 2009 (NERSA, 2009). For the period June 2010 to March 2012 ESKOM has submitted a proposal to increase electricity tariffs by 45 percent per annum. NERSA is unlikely to approve an increase of this magnitude but the increase is expected to be substantial.

How industry reacts is key to determining not only where South Africa positions itself in terms of environmental impact, but also in terms of global industrial competitiveness. In the next section we analyse the response of firms in the South African automotive and clothing and textile sectors.

3 Contextualizing the energy efficiency challenge to industry

These rapid and escalating electricity price increases have had a massive impact on industrial performance of firms in South Africa. This is apparent from the example of a sample of textile firms presented in Figure 1, which indicates the substantial increases in utility costs that a sample of textiles firms operating out of KwaZulu-Natal have experienced since 2000. The data was collected as part of a separate study that reviewed the effects of increasing utility costs on clothing and textile manufacturers in the Durban Metro area (Barnes, Findlayson and Esselaar, 2005). According to this graph, electricity costs experienced the sharpest increase in terms of utilities, of almost 50 percent over the 2000 to 2005 period, affirming the qualitative results of interviews conducted for this study, which indicated electricity costs as a major- if not the predominant- factor affecting "green" performance at clothing, textiles and automotive firms alike. In addition, Table 2 indicates the effect that this had in terms of the associated costs of production over the same time period: electricity as a proportionate share of total costs of production among the sample of textiles firms escalated from 1.58 percent of sales in 2000 to 1.81 percent by 2005. Since then, the industry has been subjected to numerous tariff hikes, the most recent of which has potentially undermined any competitive advantage that the region may have had over other production locations around the world.

Figure 1 Indexed increase in utility costs for textiles firms in the Durban Metro Area: 2000-2005



	2000	2003	2004	2005
Cost of electricity	100.00	117.83	131.13	145.77
Rates	100.00	121.68	134.45	132.61
Water	100.00	124.83	148.66	133.11
Effluent	100.00	108.90	126.36	140.95

Source: Barnes, Findlayson and Esselaar (2005)

Table 2 Electricity, rates, water and effluent costs as a percentage of real sales, 2000-2005

	2000	2003	2004	2005	% Change: 2000-2005
Electricity	1.58	1.51	1.74	1.81	14.74%
Rates	0.32	0.42	0.54	0.57	74.57%
Water	0.52	0.56	0.75	0.71	35.99%
Effluent	0.16	0.16	0.22	0.22	39.19%

Source: Barnes, Findlayson and Esselaar (2005)

In 2009, Benchmarking and Manufacturing Analysts conducted an analysis of the competitiveness of the KwaZulu-Natal automotive industry relative to its counterpart in Thailand. During the course of this study, the relative cost of electricity in each location was compared for a given load profile, based on actual firm-level data. The analysis revealed a cost advantage for KwaZulu-Natal automotive firms of approximately 72 percent (VAT inclusive) prior to 2009. However, the further hikes embodied in the revised 2009/2010 tariff structure indicated that this would not be the case going forward. A modelling exercise applying the new cost structure suggested that a firm operating under the same load profile would incur a 77 percent increase in its monthly electricity bill. Effectively, manufacturers operating out of the Kwazulu-Natal area lost any competitive advantage over competitors in Thailand as of the end of 2009. In an unprecedented reversal of circumstances, KwaZulu-Natal manufacturers are presently factoring in electricity costs that are 3 percent steeper than they would have incurred if they were operating in Thailand.

Electricity comprises 1 percent of the cost of sales (COS) of the average automotive component manufacturer in KwaZulu-Natal. Given that materials comprises 59 percent of COS, then electricity represents 2.5 percent of the COS controlled by auto component manufacturers. Based on 35 percent price increases over three years, this will more than double, potentially rendering firms uncompetitive (Barnes, Comrie and Hartogh, 2009), particularly when factoring in the very low operating margins automotive component manufacturers secure from their vehicle assembler customers. Shifts of only a couple of percent in the portion of a firm's COS that they control (generally only 30 percent to 40 percent of their total COS) can render a firm uncompetitive. This point is equally relevant to clothing and textiles manufacturers. Energy costs may not always represent a large component of the firms' overall COS, but they do represent an important part of the portion controlled by firms.

These increases are occurring in the context of a significant downturn in the performance of all of South Africa's major manufacturing sectors. The automotive and clothing/textile industries are no exception. Indeed it could be argued that they have been hit harder than most. This creates a crucial contextualization and external driving factor for the adoption of energy efficient 'green production' initiatives.

The extent of the challenges confronting firms in the automotive and clothing/textiles industries over the period 2005 – 9 is apparent from Table 3.

Table 3 Financial sustainability of firms in the automotive, clothing and textile industry

Component Manufacturers	**n**	**2005**	**2006**	**2007**	**2008**	**2009**	**Avg. 05-8**	**Avg. 06-9**
Sales (indexed, inflation adjusted)	61		100	107.69	105.43	85.03		
Value added (indexed, inflation adjusted)	59		100	97.64	98.25	94.61		
Employment	65		100	104.42	100.51	87.92		
Operating profit (% of sales)	57		10.89	9.21	9.29	8.83		9.55
ROI %	47		20.09	18.05	14.24	18.67		17.76
Capex (% of sales)	61		4.98	5.55	4.88	3.25		4.67
Training spend (% remuneration)	60		1.72	1.92	1.82	1.89		1.84
R&D expenditure (% of sales)	52		0.58	0.57	0.73	0.67		0.64
Clothing Manufactures								
Sales (indexed, inflation adjusted)	24		100	100.06	93.47	75.19		
Value added (indexed, inflation adjusted)	21		100	115.41	93.83	86.90		
Employment	24		100	100.96	97.26	82.39		
Operating profit (% of sales)	23		6.00	6.06	5.54	4.08		5.42
ROI % (for manufacturers only)	15		5.08	9.28	9.64	2.98		6.74
Capex (% of sales)	23		1.45	2.54	0.97	0.35		1.33
Training spend (% of remuneration)	22		1.60	1.47	1.41	1.17		1.41
Product development spend (% of sales)	20		1.76	2.07	2.10	1.81		1.93
Cut Make and Trim operators								
Sales (indexed, inflation adjusted)	19		100	99.90	99.22	93.08		
Employment	20		100	95.74	98.17	106.82		
Operating profit %	16		11.27	11.89	9.73	12.29		11.29
Capex %	20		3.20	2.23	2.28	2.66		2.59
Training spend	18		3.40	2.99	2.86	2.29		2.89
Textile Mills								
Sales (indexed, inflation adjusted)	12	100	99.30	96.34	85.96		95.40	
Value added (indexed, inflation adjusted)	10	100	95.52	97.15	81.82		93.62	
Employment	12	100	102.01	96.12	88.28		96.60	
Operating profit %	10	12.54	11.12	8.28	5.37		9.33	
ROI %	6	8.41	7.39	4.39	2.58		5.69	
Capex %	11	3.01	3.39	5.87	2.80		3.77	
Training spend	11	1.68	1.05	1.77	1.38		1.47	
R&D spend %	9	3.58	4.00	4.51	1.79		3.47	

Source: B&M Analysts database

The key conclusion from Table 3 is the decline in financial performance for both the automotive and clothing and textile industries from 2005-9. The trend for automotive component manufacturers is severe in respect of declining sales and employment. After a period of stability (2006-8) the industry clearly took a battering in 2009, with sales down 20 percent and employment 15 percent. Capex and R&D spend was reduced accordingly in 2009, although training expenditure remained consistent (although total remuneration declined in line with decreasing employment). Whilst ROI improved in 2009 this is on the back of firms not investing in new assets and therefore “sweating” their declining investment base more effectively. Operational profitability was also not too severely dented as a proportion of sales, although the actual value of sales has declined significantly and so the Rand value of profits secured would be substantially lower through 2009.

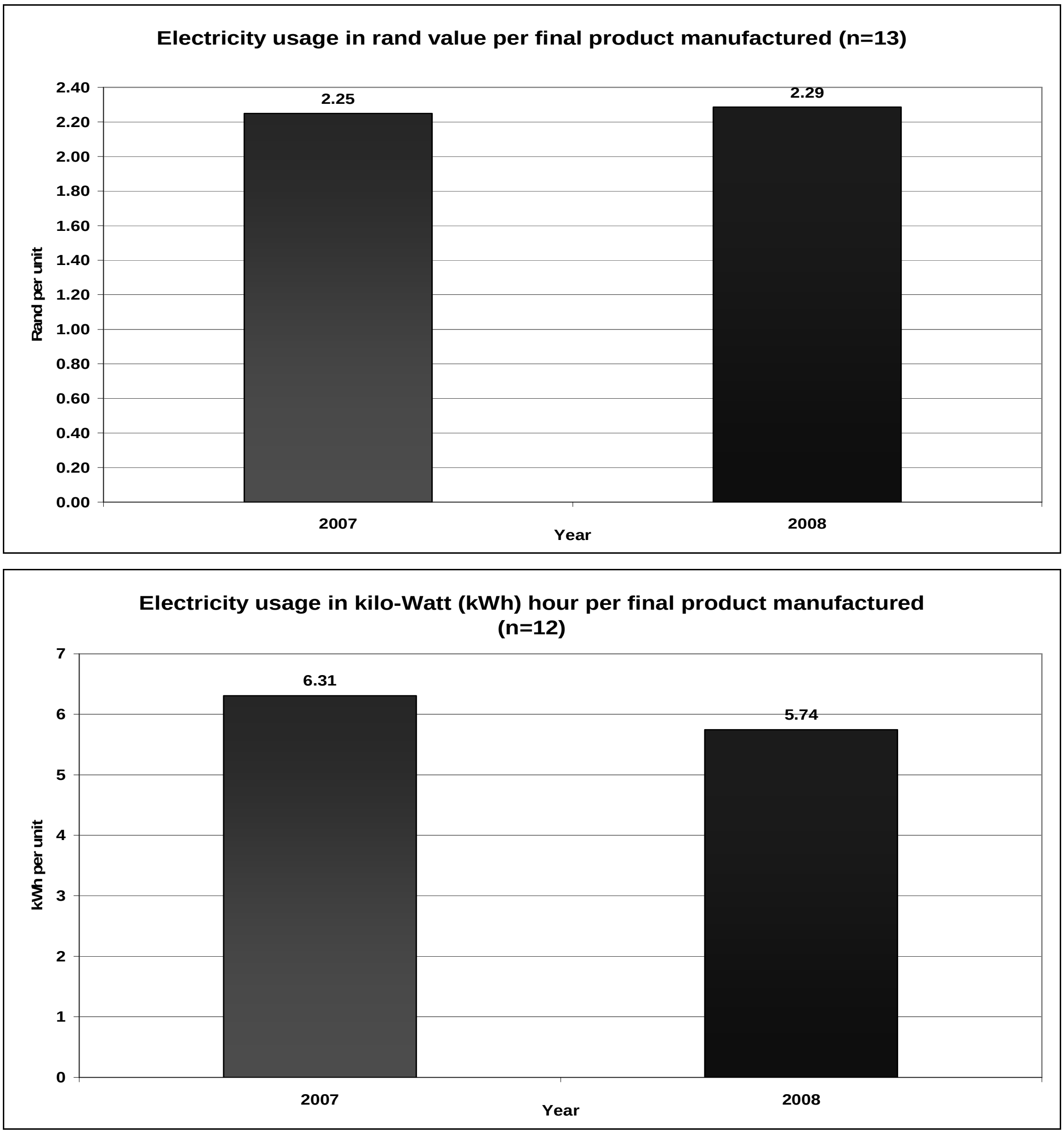
The trend for clothing and textiles manufacturers in terms of declining levels of investment is equally severe. This is evident for capex, R&D and training spend. Justifying future investment in the firms is becoming increasingly difficult given the poor operating (operating profits) and investment (ROI) returns. Most strikingly, B & M Analysts was unable to update its textiles database for 2009 because of insufficient benchmarks, primarily because a number of the firms normally benchmarked have either closed (SBH, Frame Vertical Pipeline) or are in such serious financial trouble that they did not believe they would benefit from being benchmarked. Amongst the clothing firms, the only flicker of hope lies with the CMTs who continue to perform “reasonably” – in respect of returns and investment levels.

Fundamentally, the context is one of severe market and operational conditions for firms; although the crisis for automotive component manufacturers is far more recent (and less severe) than for clothing and textiles manufacturers, who have experienced poor financial performance for a period of time.

The evidence above naturally calls into question the sustainability of the local industries, given their declining margins and sales. As electricity costs increase exponentially as a proportion of cost, firms’ returns on investment are diminishing and the viability of operations are compromised. The result is a forced response from industry participants, although the evidence from proactive firms that have implemented energy saving measures suggests that all efforts to date have failed to address the disjunction that exists between their resultant decreasing kilowatt usage and rising energy costs: the magnitude of the increase in tariffs is simply too great to be addressed in most cases. The risk to their respective industries is that major energy users are increasingly finding it more feasible to close down operations, rather than invest the capital required to address the problem of energy inefficiencies, in light of increasingly uncompetitive energy costs.

A fundamental challenge confronting manufacturers in SA is their inability to transfer utility cost increases on to the market. This is due to the liberalization of the SA economy and the surge in imports of tradable products. Evidence of this pressure is exhibited in Figure 2, which explores the consumption and cost of electricity at South African based automotive component manufacturers.

Figure 2 Automotive industry's electricity usage (2007 -2008)



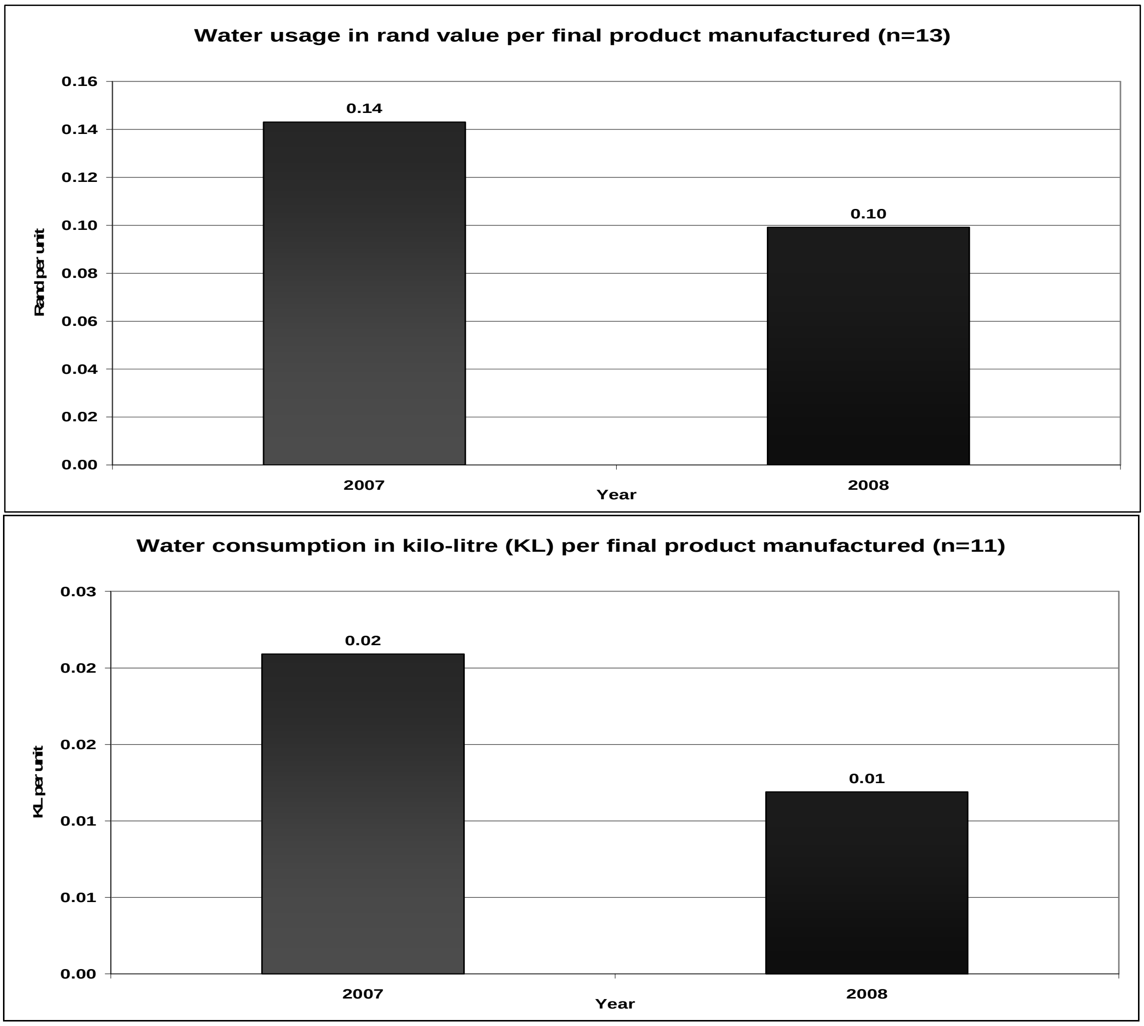
Source: B&M Analysts database

Figure 2 shows that the Rand cost of electricity per product manufactured increased marginally (1.8 percent) from 2007 to 2008 despite the 8.9 percent reduction in the amount of electricity used to manufacture each product. The same challenge exists for textiles manufacturers. Whilst the B&M Analysts' database does not capture the Rand value of electricity usage, it does capture usage against kilogram of production, and in this regard performance improved from

8.72 to 8.18 kWh per kilogram of production from 2007 to 2008, an improvement of 6.2 percent.

Further evidence of firms attempting to better use the resources available to them within their plants emerges in respect of water utilization (Fig 3) and scrap rate levels (Table 4).

Figure 3 Automotive industry’s water usage (2007-2008)



Source: B&M Analysts database

In respect of water usage, the data suggests that automotive component manufacturers decreased the Rand value of their water usage per product manufactured by a full 40 percent, although the average actual reduction in water usage for a slightly larger population of firms was 100 percent.

In contrast to the automotive component manufacturers, the four textiles firms for which we have data did not improve their water usage from 2007 to 2008. In fact, a small deterioration was evident – from 72.8 litres per kg of product manufactured to 73.3 litres, a decline of 0.6 percent. This is perhaps unsurprising in the context of the negligible investments made and very poor returns secured by textiles mills in 2008.

Table 4 Scrap rate usage in automotive and clothing/textile firms

Scrap rate change	n	2007	2008	Improvement
Automotive component manufacturers	40	1.58%	1.50%	5.1%
Clothing and textiles manufacturers	15	2.45%	2.39%	2.5%

Source: B&M Analysts' database

In terms of better utilization of scrap, Table 4 summarizes the available data for firms in the automotive and clothing/textile industries. Both sets of firms improved their scrap rates from 2007 to 2008, with their scrap loss value (expressed as a % of materials purchased) declining by 5.1 percent (autos) and 2.5 percent (clothing and textiles) respectively.

4 Energy efficiency as a strategic imperative

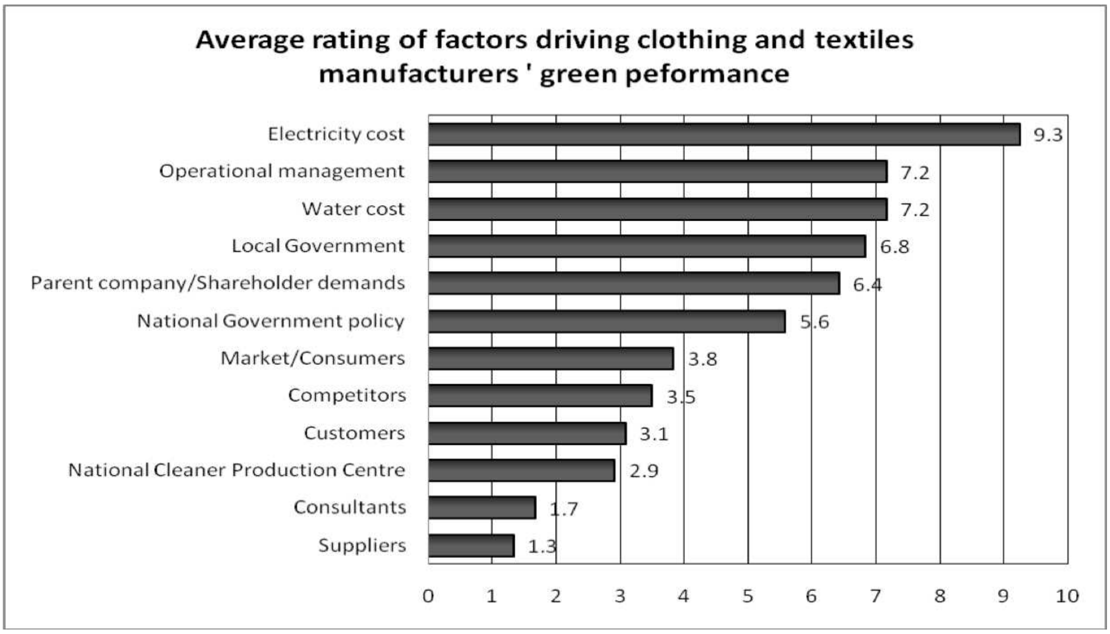
Arising from the interviews conducted with our sample, there is very limited evidence that firms view "green production" as a strategic imperative. When interviewed, only 20 percent of firms indicated that they had both a policy and a set of key performance indicators (KPIs) relating to enhanced green production within their operations, with 13.3 percent of firms indicating neither a policy framework nor the measurement of any KPIs. The majority of firms (56.7 percent) does not have a policy relating to green production, but do claim to be measuring "green" KPIs. The predominant KPI focused on by firms (in fact in 100 percent of the cases where firms do have KPIs) is their electricity consumption – most notably because this is a substantial, and growing, cost element within their business.

Table 5 Firm strategic imperatives re green production

	n	Policy and KPIs	Policy but No KPIs	No Policy but KPIs	No Policy and No KPIs
Automotive component	17	17.6%	11.7%	64.7%	5.9%
Clothing and textiles	13	23.1%	7.7%	46.2%	23.1%
Total	30	20.0%	10.0%	56.7%	13.3%

The importance of cost factors to the firms' response to improving their environmental performance is further emphasized in Figures 4 and 5. These figures unpack the factors driving green production at 13 surveyed clothing and textiles firms and 17 automotive component manufacturers. Respondents were asked to rate the importance of 12- predetermined factors on a 1-10 scale (where 1 represents total unimportance, 5 moderate importance; and 10 critical importance).

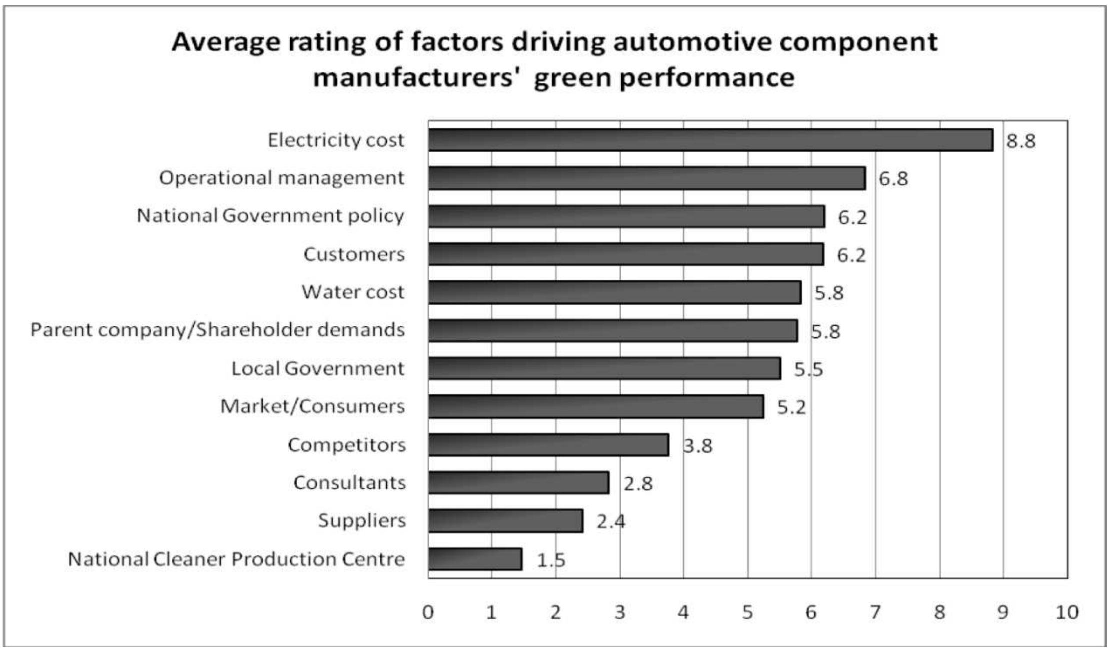
Figure 4 Drivers of clothing and textile firms 'green production'



Amongst the clothing and textiles firms (Figure 4) only one factor emerges as critical: Electricity costs (rating of 9.3). While four other factors were rated as important (operational management, water costs, local government and parent company/shareholder demands – all rated between 6.4 and 7.2), the balance of the factors were deemed either only moderately important, or not important at all. The least important factors in this regard – all rated below 3 - were suppliers, consultants, and the National Cleaner Production Centre, the government institution established to support green production in South Africa.

The responses received from the 17 automotive component manufacturers (Figure 5) were similar. Electricity costs (8.8) are again the only critical driver of green production, with operational management (6.8) again an important factor. However, unlike the firms in the clothing and textile sector, national government policy (6.2) and customers (6.2) were noted as important factors. The importance of the Motor Industry Development Programme to the automotive industry - in terms of the manner in which it forces the export orientation of the industry - and the producer nature of the value chain driving the automotive components industry stand out as potentially important factors.

Figure 5 Drivers of automotive firms 'green production'



This raises the following questions:

- Does a developing economy firm's export orientation influence its focus on green production?
- Do MNC dominated producer driven global value chains "force" environmental issues into developing economy manufacturers?

The three least important factors to automotive component manufacturers are consistent with that of the clothing and textiles firms - consultants, suppliers, and the National Cleaner Production Centre. The least important driver for the automotive component manufacturers is the NCPC - SA, scoring only 1.5.

The lack of a material enabling relationship of the National Cleaner Production Centre, the South African government's major institutional driver, to the process of driving energy efficiency in these two sectors is very problematic. Despite the fact that the National Cleaner Production Centre has historically been involved in projects within the clothing and textiles industry and has identified this sector as its model project, only three of the thirteen firms have utilized the National Cleaner Production centre. Furthermore none of the automotive component firms have ever utilized the NCPC – SA. Indeed, much more seriously, sixteen of the seventeen that were interviewed had never heard of the National Cleaner Production Centre. Whilst both the clothing and textile and automotive industry identified the national and local government's policy as important factors that are driving their green performance (with an average rating of between 5.5 and 6.8) the interviews show that this little to do with energy efficiency policy or 'green production' strategic interventions. The driving force has largely been exercised through punitive means of electricity shortages and the threat of penalties if firms do not reduce their electricity consumption by 10 percent.

Given the importance of external electricity costs as the main driver of energy efficiency efforts by the firms, it is not at all surprising that the majority of firms across both sectors (70 percent) reported that their energy efficiency interventions they have implemented are financially profitable. The reasons for this are obvious from an analysis of the key energy efficiency interventions being practiced by most of these firms (Table 6).

The most common energy efficiency intervention implemented in the clothing and textiles and automotive industries is the revision of lighting systems, with eight firms (three clothing and textiles and five automotive firms) identifying this as their key energy efficiency intervention. These involved simple changes to lighting systems, such as removal of excess light bulbs, change of light bulbs to energy efficient lighting, and installation of automatic off switches. This intervention had a success rate of 87.5 percent, required capital expenditure which was 100 percent funded internally by the firms, and did not require any training.

The upgrading of the power supply is the other most commonly identified major energy efficiency intervention with eight firms (three clothing and textiles and five automotive firms), identifying this as their key energy efficiency intervention. As with the lighting, the specific firm-level interventions varied across firms. However, overall, the firms focused on upgrading or installation of power factor correction, and recapitalization of the entire electricity supply layout. In line with the lighting interventions, all of the firms who upgraded their power supply financed the interventions themselves, and claimed a 100 percent success rate. The latter interventions were upgrade of power supply, air-conditioning reduction or removal, and changing of air compressors. The only intervention not requiring capital expenditure is the peak usage restructuring. The majority of interventions that were identified by the participating South African clothing and textile and automotive component manufacturers do not require training, with an average of only 28.57 percent of projects requiring training.

Table 6 Major energy efficiency interventions of all firms (automotive, clothing, textile)

Intervention	Entailed	No of firms that implemented	% projects experiencing success		% projects req. capex	% projects req. training	Interrupted production?	Finance by project
Lighting	Removal of excess lightbulbs; change to e.e. bulbs; automatic offswitch	3 C&T; 5 Autos	87.50		87.50	0.00	no	100% of projects self-financed
Upgrade power supply	Power factor correction; recapitalisation of electricity supply layout	3 C&T; 5 Autos	100.00		75.00	0.00	yes on one account	100% of projects self-financed
Capital upgrade	Investment in plant (eg. Dyehouse) or equipment (dryers/machinery)	3 C&T; 1 Autos	75.00	One firm involved in ongoing upgrade	83.30	66.70	no	1 firm had investment in dyehouse. This required borrowing from IDC at prime minus 5%; other projects self-financed by firms
Peak usage restructuring	Switching off machines on weekend; usage of high output machines in off-peak periods	1 C&T; 2 Autos	66.70	One firm experienced mixed success	0.00	33.30	no	Not necessary
Monitoring and measurement	Meter installation; fuel monitoring; analysis and intervention in compressors to lower demand	2 C&T; 3 Autos	60.00	One firm in ongoing development; one firm had not yet experienced success	80.00	50.00	no	Monitoring of fuel and compressor intervention did not require; one meter installation project not self-financed
Air conditioning	Switching off; reduction in usage	2 C&T; 2 Autos	100.00		25.00	0.00	no	3 projects did not require, one project self-financed by firm
Air compressors	Changed air compressors to be more efficient	2 Autos	100.00		50.00	50.00	no	One project did not require, other was self-financed
Average			**84.17**		**57.26**	**28.57**	**no**	**Financed by firm**

* In some instances the firms provided more than one major energy efficiency intervention

In the light of the importance of electricity as a cost driver, it is hardly surprising that both the lighting and upgrade of power supply relate to firms electrical systems and did not require any training. Cumulatively, therefore sixteen of the thirty firms (53.3 percent) that were interviewed had interventions that were specifically related to their electrical systems.

In the firm interviews we attempted to dig deeper into the drivers of green production by asking firms to rank the internal and external factors both enabling and hindering the advancement of green production within their operations (Table 7 and 8).

The 13 clothing and textiles manufacturers again focused on electricity/energy costs as the major factor – however as an internal and external enabler, rather than hindering factor. Firms clearly view escalating electricity costs as an enabler insofar as it provides management with the opportunity to convince their shareholders to invest in systems to reduce energy consumption. This appears to be the reason why management capacity is ranked as the most important internal enabler.

The clothing and textiles manufacturers (Table 7) again focused on electricity/energy costs as the major factor – however as an internal and external enabler, rather than hindering factor. Firms clearly view escalating electricity costs as an enabler insofar as it provides management with the opportunity to convince their shareholders to invest in systems to reduce energy consumption. This appears to be the reason why management capacity is ranked as the most important internal enabler.

Table 7 **Internal and external, enabling and hindering factors for clothing/textile firms**

	Internal Factors				**External Factors**			
	Enable	**Score**	**Hinder**	**Score**	**Enable**	**Score**	**Hinder**	**Score**
1	Management capacity	15	Lack of financial resources	33	Cost of electricity	13	Lack of national government support	12
2	Energy costs	13	Lack of knowledge of practical solutions	11	Customer pressures	11	Recession	11
3	Environmental awareness	9	Lack of environmental awareness	5	Cost of fuel	7	Lack of local government support	10
4	Shareholder demands	6	Lack of drive	3	Cost of water	6	Lack of customer demand/ incentives	6
5	New capital expenditure	4	Lack of human resources	2	Cost of coal	6	Lack of incentives from government	6

As reflected in Table 8, the automotive component manufacturers similarly focused on energy related costs as an enabling factor (for the same reasons as the clothing and textiles firms). A major distinction again relates to the producer driven nature of the automotive value chain, with firms emphasizing customer accreditation requirements as a critical external enabler of green production.

Table 8 Internal and external, enabling and hindering factors for automotive firms

	Internal Factors				External Factors			
	Enable	**Score**	**Hinder**	**Score**	**Enable**	**Score**	**Hinder**	**Score**
1	Energy costs	35	Lack of financial resources	30	Customer accreditations	26	Lack of local government support	9
2	Environmental awareness	19	Lack of environmental awareness	19	Cost of electricity	16	Lack of national government	8
3	Management	17	Lack of human resources	15	Availability of electricity	16	Lack of incentives from government	7
4	Measurement and monitoring	7	Lack of knowledge of practical solutions	7	Consultants	5	Lack of customer demand/incentives	5
5	5-S processes	5	Production process/equipment deficiencies	6	Parent company; customer pressures	5	Government policies	3

Note to Table 7 and 8: The data presented here is based on a survey question that asked participants to indicate the top factors – in order of importance - enabling/hindering their "green" performance. Accordingly, the results were weighted in terms of whether a category was ranked first, second or third in importance by each firm. Top priority factors were awarded a value of three, whilst second and third most important factors were awarded values of two and one respectively – meaning that the maximum score for an enabling or hindering factor would be 39 points. Composite scores dictated the final ranking as presented in the tables above.

The key issue emphasized here is that through the promulgation of value chain requirements relating to ISO14000 accreditation and the banning of the use of hazardous substances in manufacturing processes, the Original Equipment Manufacturer customers of automotive component manufacturers actively encourage the greening of production, whilst also ensuring that the "green elements" of production are factored into the costing of all potential suppliers. This is distinct from clothing and textiles manufacturers, where buyer driven value chain characteristics do not allow for the costing of green production into the price of products.

5 Case studies of four firms

The four case studies presented in this section were selected on the basis of the firms' proactiveness in embracing energy efficiency processes. The findings are not therefore representative of the general findings from the research, as presented above, but rather to illustrate the nature of interventions taking place at firms that have recognized the importance of enhancing their energy efficiency performance.

Case Study 1 Energy efficiency performance of a multinational automotive component manufacturer in South Africa

Federal Mogul Friction Products is a leading global automotive component manufacturer in South Africa. As the firm is part of a large multinational group its head office is abroad and the firm reports directly to this head office. Federal Mogul's energy efficiency interventions form part of the Environmental, Health and Safety Manager's responsibility. As with the vast majority of South African participant firms in the clothing, textile and automotive industries, Federal Mogul does not have a formal written energy efficiency policy in place. However, the firm does have specific energy targets that are set by the head office for the firm to adhere to. Specifically, Federal Mogul's directive from head office is to reduce both electricity and gas usage by 3 percent.

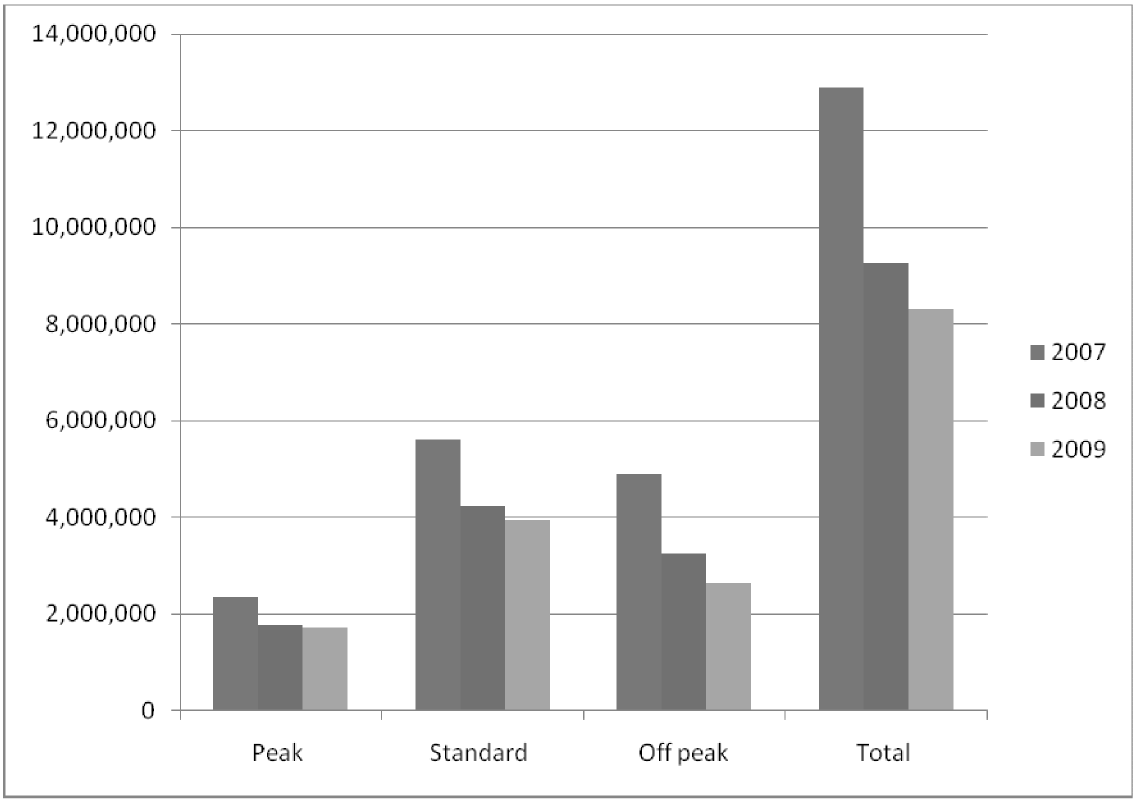
In 2008, the firm conducted two levels of intervention in an effort to reach the required energy efficiency targets set by head office. Firstly, the firm systematically created buy-in and environmental awareness of employees through the incorporation of training on the importance of environmental awareness in the firm's induction programme and refresher training. Secondly, the firm conducted a broad array of projects to reduce the firm's energy consumption. These include:

1. Utilization of pyrostic controls on furnaces so that they start slowly instead of immediately;
2. Lowering compressors so that only have compression that is necessary for current demand;
3. Programmed geysers are only utilized in low tariff periods;
4. Changing of fluorescent lighting to low voltage lighting;
5. Conducting analysis of top ten electricity utilizing machines in order to maximize utilization in low tariff periods.

Federal Mogul Friction Products also learns from sister companies through a group database where the group's member firms interventions are recorded and thereby create a database of ideas for the companies within the group. The firm has an environmental, health and safety committee which consists of both employee representatives and management representatives. In order to ensure project progress and success, this committee monitors the firm's monthly energy consumption and costs. As a large corporation with high levels of skill, knowledge and human resources, it is clear that firms such as Federal Mogul have an inherent advantage in terms of their ability to implement energy efficiency interventions.

Figure 6 below represents Federal Mogul's total electricity output (KwH) for 2007, 2008 and 2009 for each of the different tariff periods. Federal Mogul Friction Products is situated in the eThekwini municipality and there are different tariff periods for electricity for different times. Peak electricity hours are from 7h00 – 10h00 and 18h00 – 20h00. Off-peak electricity hours are from 22h00 to 7h00 and Standard electricity hours are from 10h00 – 18h00 and 20h00 to 22h00. As is evidenced by Figure 6, Federal Mogul managed to decrease their electricity output in all three tariff periods with an overall total reduction in electricity consumption from 2007 to 2009 of 35.5 percent.

Figure 6 **Federal Mogul Friction Products Electricity Output (KwH)**



Federal Mogul's key driver of energy efficiency performance has been directives from its corporate headquarters'. Other important factors identified as enabling the firm's performance include cost savings opportunities, the environmental awareness of staff, consultants and external awareness generation through seminars and workshops. Federal Mogul specified that support, in the form of newsletters and meetings, from the South African Metal Finishing Association had been pivotal in terms of informing industry on opportunities for energy reform. The key factors which were identified as hindering the firm's progress with respect to energy efficiency are the lack of knowledge of staff on other opportunities to reduce energy consumption; the cost of capital equipment and process constraints.

Case Study 2 Electricity blackouts threats induces energy efficiency savings

Allwear is a local clothing manufacturer of school, corporate and menswear in Northern KwaZulu-Natal, South Africa. The firm is a large manufacturer, and employs approximately 1 100 people. Whilst Allwear's management indicate that they have not identified a need to create a formal energy efficiency policy, the firm has had a number of energy efficiency interventions and does monitor and measure its electricity output (KwH and maximum demand (KvA) on a monthly basis.

In order to improve the firm's energy efficiency, Allwear installed power factor correction in 1997. Power factor correction reduces the maximum demand (KvA) and assists electricity users to lower their electricity tariffs where they are billed for maximum demand (KvA) and maximum output (KwH).

The firm's power factor corrector was sourced from a South African firm and management indicated that the investment payback period was two years.

In 2008, as a consequence of the electricity crisis and ESKOM's inability to meet demand, local municipalities, who distribute the electricity from Eskom, were forced to conduct load shedding exercises. Consequently different municipal zones underwent power cuts for specific time periods on a daily or weekly basis. As a result, the South African manufacturing sector was severely impacted. Allwear consulted with their local municipal authority and set up an agreement in which the industrial lists in the town would be exempted from the effects of load shedding, if they in turn agreed to reduce their electricity usage by ten percent. The firm's approach to achieving this objective was twofold.

Allwear's knitting division

Firstly, the firm's management team analysed its electricity expenditure and identified that the firm's air-conditioning system was the firm's major electricity consumer. Thereafter, the firm made the decision to stop all use of the air-conditioning system throughout the firm. Employee buy-in was cultivated through open communication and consultation with the workforce, highlighting the necessity of reducing electricity consumption so as to ensure the firm's sustainability was not undermined. Shop stewards were part of the firm's team from the very first meeting with the municipality. The office block also switched off their air conditioners so that the workforce knew that the CEO would work under the same conditions as the machinists.

The second initiative adopted involved the removal of excess light bulbs from the firm's offices and to adopt a policy of switching off lights when areas were not in use. The results of these initiatives were staggering and allowed the firm to reduce its monthly consumption from 660KwH to 410KwH in the summer months when air conditioning is utilized. This is a reduction of 37 percent in electricity output per month. Figure 7 below indicates that the firm's average maximum demand per month (KvA) reduced from 717 KvA in 2007, to 488 KvA in 2008 to 492 KvA in 2009. As a result of these initiatives the firm was successfully able to reduce its output and avoid electricity blackouts.

Figure 7 Allwear's average KvA consumption per month from 2007 to 2009

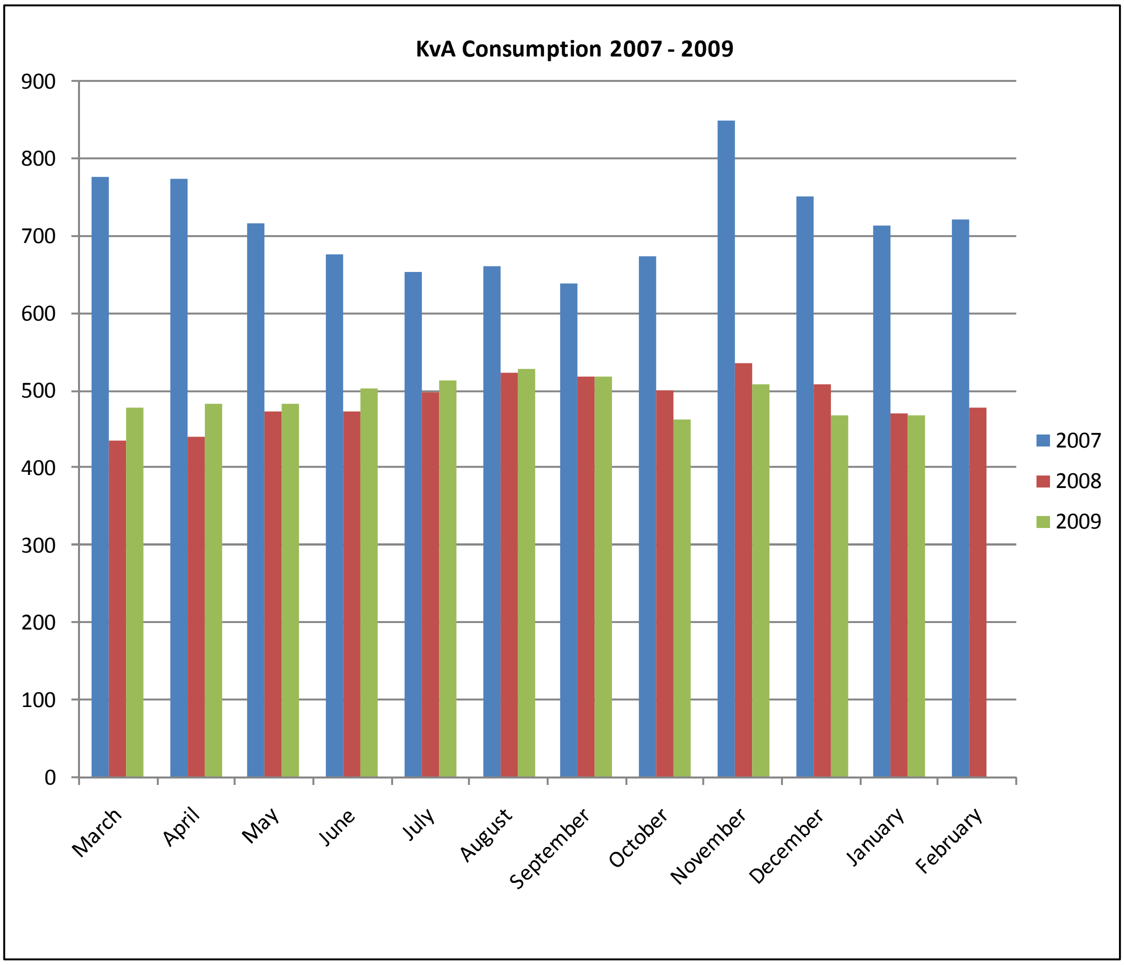
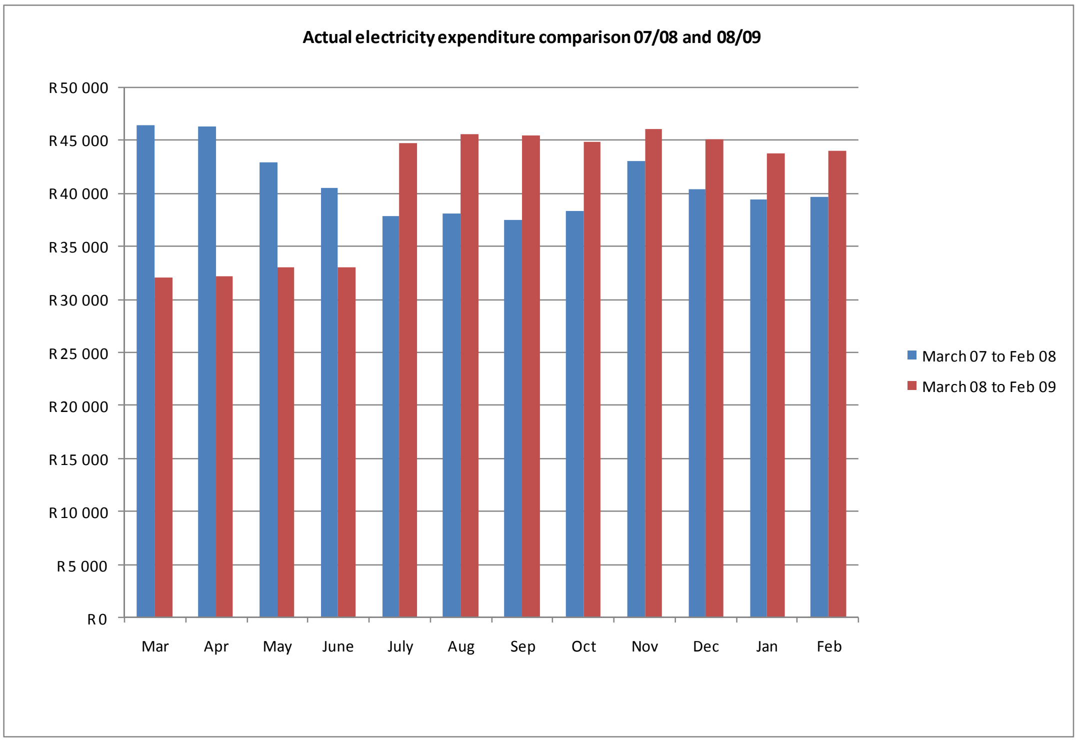


Figure 8 indicates that the firm's average electricity expenditure reduced from an average of R40 666 per month in 2007 to R38 958 per month in 2008. This is due to the increase in electricity cost over this period. Whilst the magnitude of the Rand savings achieved is not high, the firm has still managed to contain energy costs by becoming more efficient. Should the firm not have had these energy efficiency interventions, its electricity expenditure would have increased considerably and the firm would have been exposed to blackouts.

Management identified that the key factors which have driven Firm Z to improve its energy efficiency have been the threat of blackouts by the local municipality and the increasing cost of energy. Conversely, the major factors which have hindered the firm's progress with respect to energy efficiency were identified as poor operator attitude and the lack of innovative government policies. The firm identified that if the government provided the Firm with incentives to reduce energy efficiency, this would encourage them to do a lot more.

Figure 8 Allwear's average electricity expenditure March 2007 to Feb 2009

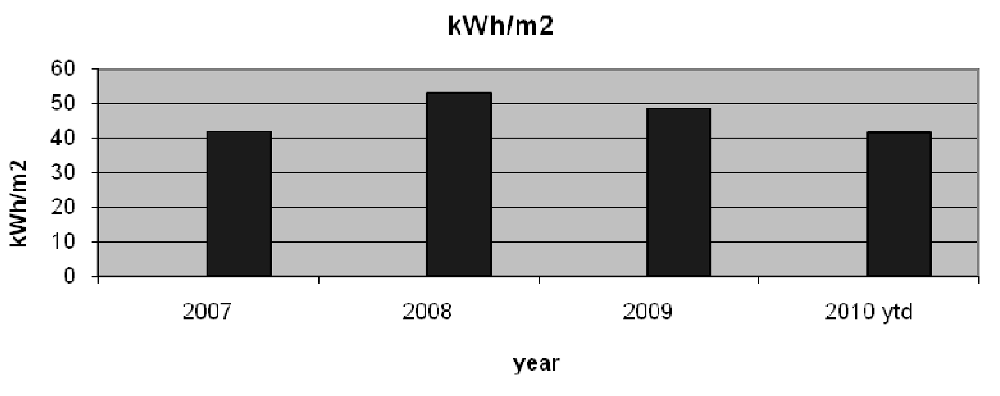


Case Study 3 Optimization of production planning on key energy using equipment to improve energy efficiency

Shatterprufe manufactures glass windows for the automotive industry in South Africa. The firm has three manufacturing facilities which manufacture over three million pieces of safety glass per annum. Shatterprufe's Struandale plant participated in the energy efficiency research. The Struandale plant is located in Port Elizabeth and is the exclusive producer of original equipment toughened rear-lights and door glasses for South African motor manufacturers. The plant supplies replacement glass locally and exports to international markets. This plant employs approximately 300 employees. In line with the research findings from the majority of automotive component manufacturers, Struandale does not have a formal energy efficiency policy. Despite this, the firm does monitor its maximum demand (KvA) and electricity output (KwH) per square metre of glass manufactured. In 2009, Struandale's management identified that it has a specific objective of reducing electricity output per square metre of glass manufactured by 30 percent and to reduce its maximum demand by 10 percent.

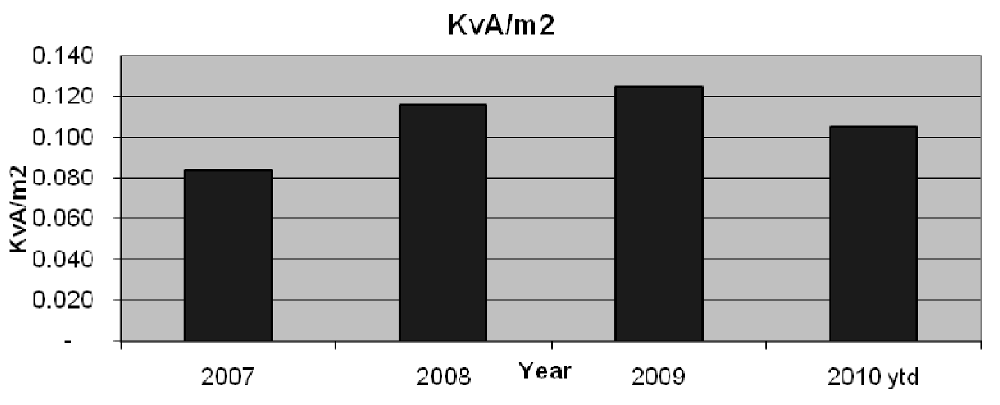
In order to achieve these energy efficiency targets, Struandale established an energy forum. This forum consists of a factory environmental manager, general manager and technical manager. The intervention initially analysed the firm's electricity output and the major contributors to this electricity output. It was revealed that the factory furnaces which are coupled with fans were the highest consumers of electricity. As a result of these findings, management made the decision to adjust the production schedule so that the fans and furnaces were: 1) utilized to the maximum in off peak periods; 2) switched off when not in use, and; 3) switched on in a staggered way, one machine at a time, so as to lower the maximum demand peak. These interventions were conducted in the middle of 2009.

Figure 9 **Struandale's average electricity output per square meter glass**



Year:	2007	2008	2009	2010 YTD
Average kWh/m2	41.83	53.37	48.73	41.72

Figure 10 **Struandale's average maximum electricity demand per square meter glass**



Year:	2007	2008	2009	2010 YTD
KvA/m^2	0.084	0.116	0.125	0.105

Figure 9 indicates that the firm's energy efficiency interventions have had an extremely positive impact on the firm's electricity consumption which has dropped from 48.73KwH/m^2 in 2009 to 41.72KwH/m^2 in 2010 YTD which are on par with the firm's 2007 electricity consumption levels and is a 14.34 percent reduction in electricity output. Similarly the interventions have also had a positive impact on the firm's average maximum electricity demand. Figure 10 indicates that the firm's maximum demand levels have been increasing year on year from 2007 to 2009. The energy efficiency interventions were then implemented in mid-2009. Overall a 16 percent reduction in maximum demand is evident from 2009 to 2010 YTD.

Shatterprufe's management indicated that this initiative is still in its infancy, as their objective is to go a step further by installing an electricity meter for every furnace (coupled with fan). This will enable the firm to develop a detailed understanding of the electricity usage of the individual machines and will allow the firm to then take further steps to optimize production in order to improve its energy efficiency. At the time of the interview, the Struandale plant was in the process of raising finance for this initiative. Struandale will be funding this initiative itself and the payback period for this investment is estimated to be within a year. Other initiatives identified by the energy forum include water recycling and the utilization of gas to heat water to recoup lost energy.

Struandale's management recognizes that, in order to ensure the success of their energy efficiency interventions, it must generate environmental awareness and buy-in from the entire company and not just from top management. The firm has utilized its mission-directed work teams to communicate this environmental awareness to all employees.

The firm's management identified the following key internal and external factors which have enabled or hindered its energy efficiency performance (in order of importance):

Internal enabling factors:

1) Management's commitment to improving the firm's energy efficiency;
2) Management's understanding of the firm's production processes and,
3) General environmental awareness.

External enabling factors:

1) The increasing cost of electricity;
2) Customer accreditation requirements obliging suppliers to have ISO 14001;
3) Local government policy;

4) Media awareness of the importance of the environment and energy saving.

Internal hindrances:

1) Limited technical resources internally;
2) Limited capital with the downturn in the world economy, and;
3) Lack of staff drive.

External hindrances:

1) the Lack of clarity in local government policy;
2) Lack of support from Eskom;
3) Lack of financial support;
4) Lack of support from National government.

Case Study 4 Improving energy efficiency through upgrade of capital equipment in the textiles sector

Firm X represents a major textile manufacturer in South Africa. This firm's major operations include knitting, dyeing and finishing. Whilst the firm does not have a formal energy efficiency policy in place, the firm's management indicated during the course of their interview that operating in the most energy efficient manner has become part of the way in which the firm operates. The key driver of this response is to necessarily save money and drive costs downwards. Firm X's managing director identified that whilst the firm's energy efficiency policies are being driven downwards by top management, everyone in the firm is aware of the need to operate in an energy efficient manner.

Firm X measures the following three key performance indicators: 1) Litres of water per kilogram of fabric produced, 2) Litres of Hfo Oil per metre fabric stented, and 3) Tons of coal per kilogram of fabric dyed. These key performance indicators are measured and correlated on a daily and weekly basis. Encouragingly, firm X has managed to improve its performance in relation to these key performance indicators. There have been two major interventions enabling the firm to improve its performance in this regard.

The first major energy intervention has been the upgrading of the dyehouse's capital equipment. The South African textiles industry has an aging capital base, with the average age of equipment in this sector being 13 years old in 2008 (BMA Database). One of the key factors which has undermined capital investment in this sector has been the availability of financial support. The poor performance of this sector in response to international competition has undermined the willingness of commercial lending institutions to lend finance to this sector. Firm X, however has been able to secure a loan from the Investment Development Corporation (IDC) at the prime lending rate less 5 percent. This IDC loan forms part of the R70 million in loan finance that has been set aside by the government as part of a comprehensive rescue package for the ailing South African clothing and textile sectors. This loan has enabled the firm to upgrade its capital equipment in the dyehouse, thereby enabling it to halve its water and steam consumption through: 1) A reduction in process time from 14 to 6 hours; 2) Utilizing less energy in their production process as a result of newer, more efficient machines; and 3) Lowering the reprocess rate and thereby lowering energy consumption. Firm X's management team has estimated that the dyehouse's carbon footprint will be reduced by approximately 40 percent and the total firm's carbon footprint will be reduced by an estimated 30 percent.

The second major intervention conducted by the firm to improve energy efficiency is investing in a dryer. The new dryer utilizes half the steam that the firm's old dryer utilized. Overall, the management estimate that the new dryer has resulted in a 10-15 percent reduction in the firm's total steam consumption.

The firm's management identified that the most important factors driving the firm's energy efficiency performance have been increasing water, electricity and fuel costs. On the other hand, the lack of readily available financial support has thwarted the firm's progress in this regard. This has been exacerbated by a lack of environmental awareness and deficiency of knowledge and skills of the firm's staff relating to opportunities for improvement. Firm X indicated that the lack of external support relating to opportunities for manufacturers to reduce their energy consumption and the lack of incentives from customers to become green have inhibited the firm's energy efficiency performance.

Conclusion

Energy efficiency in South African manufacturing has only recently appeared on the real agenda of manufacturing enterprises. The internalization of this awareness has however not been driven by government policy. Nor has it primarily emanated from the demanding requirements of the value chain drivers to whom the automotive component firms and clothing textile firms are supplying product. Quite simply the sudden awareness of the need to achieve some form of energy efficiency has clearly been driven by the external force of rapidly and unexpectedly rising electricity costs.

This focus on immediate cost drivers has conditioned the manner in which energy efficiency has been internalized in these firms. Their immediate reaction has been to seek the low hanging fruit of fairly superficial, albeit very real in terms of short term cost savings, initiatives focused on the plant context of lighting and air conditioning. These savings have clearly not been insignificant and should not be dismissed in and of themselves. They have made a financial difference to these firms and raised awareness of some of the issues concerned with energy efficiency.

However the fact that electricity cost saving aimed at short term gain has driven the process has meant that energy efficiency has not been internalized in the strategic framework driving long term objectives. Likewise nor have the principles of green production been translated into a restructuring of their plant production processes to achieve long term energy savings.

Given the extremely cheap electricity available to industry in the past, manufacturers clearly did not take energy efficiency seriously. They treated it as an externally imposed 'credence good' and hence wanted to be rewarded for good behaviour of acknowledging green issues. They are now taking it seriously because of the impact of utility costs and the threats of punitive action if cost savings are not achieved. The irony is that the very driver pushing them into green awareness is simultaneously the same factor inhibiting their capacity to fully embrace energy efficiency principles, and translate it into long term restructuring to achieve green production. For the combination of difficult economic conditions compounded by prohibitive utility costs weakens the ability of the firms to realize sufficient financial returns to recapitalize and achieve long term restructuring.

This is most apparent amongst the clothing and textile firms who are squeezed by a combination of a difficult operating and financial environment within which they are severely constrained by a lack of competitiveness, as well retail chain customers who are simultaneously very undemanding in respect of green issues and very demanding in respect of meeting cost requirements. It is therefore not surprising that issues of energy efficiency and green production remain at the most superficial level in this industry.

The position of the automotive component manufacturers is however more complicated. They are in a very different position from the clothing and textile firms, for they face an escalating set of value chain requirements from their most demanding customers (such as Toyota) insisting that green production becomes integrated into the component manufacturers production KPIs.

As is apparent from the interviews, the rising cost of electricity forced these automotive firms to put energy efficiency on the immediate agenda. But these producer value chain demands mean that they cannot rest on their laurels and focus solely on lighting savings. The utility cost rises have therefore done them an immense favour, for this has shocked them into the appropriate strategic space to deal with the value chain requirements emanating from increasingly green automotive assemblers. If they fail to internalize energy efficiency they face the medium term risk of losing their hard fought place in the assemblers supply chains, and this means long term economic ruin. For there is no such thing as an independent automotive manufacturer at the level these domestic manufacturers operate.

In these conditions government policy and strategic intervention should have a special role to play. However this has not been the case. Government policy has remained vague and at a paper policy level. Government should have a special role in a context where there are severe pressures to move towards energy efficiency but where there are insufficient financial returns to internalize green production processes. Under these conditions government should be providing a range of supporting mechanisms – financial, training, consulting etc – in order to align public goods with a firms private good. The interviewed firms identified government as one of their biggest constraints in achieving energy efficiency. Yet there are precious few government interventions to provide direct green incentives for firms to embrace energy efficiency in a deeply rooted manner. Instead the principle intervention has been indirect through the punitive stick of ESKOM's electricity pricing strategy. In a financial and sales environment where firms are treading water just to survive, one would expect much greater array of government energy efficiency mechanisms to incentivize firms to restructure and internalize green production methods for the medium to long term.

This is not only an issue of financial incentives. The firms also identified the lack of technical skills to deal with the requirements for achieving sustainable energy efficiency. They made it clear that if they do not have high levels of technical skills in energy efficiency then they will be unable to influence plant activities and ensure that all staff embrace green production awareness and behaviour. But the severe lack of skills and government failure to address the problem has been highlighted by numerous studies on the South African economy. This is cited as the biggest problem hobbling the long term competitiveness of South African industry. If the general problem of skill gaps and skill lacks is a problem, how much more so is it in respect of energy efficiency knowledge. In this respect government initiatives seem also to be lagging far behind.

Appendix A note on research methodology

The findings contained in this document are the result of an intensive research process that was initiated in October 2009. The research process comprised a mix of two research methodologies namely:

- Quantitative analysis of existing benchmarking data
- Firm level (automotive, and clothing/textile) interviews.

The quantitative data that was utilized for this research was sourced from Benchmarking and Manufacturing Analysts (BMA) database. BMA has run clusters in both the automotive and clothing and textile sectors, collecting data from these industries over a considerable period of time. BMA is the service provider to the South African Automotive Benchmarking Club in the automotive sector, and the KwaZulu-Natal Clothing and Textile Cluster and the Cape Clothing and Textile Cluster with a cluster membership of over 80 firms in each of these industries. BMA's benchmarking methodology includes the analysis of firm-level quantitative data that is provided by the firms, the application of a customer and supplier benchmarking questionnaire, as well as a process benchmark which includes qualitative interviews with the firm's management and employees. The quantitative data that has been utilized for this report has been sourced from the clothing and textile clusters and the automotive benchmarking club databases.

In addition firm level interviews were undertaken in order to analyse the strategic and operational changes that are taking place with respect to energy efficiency at South African automotive manufacturers and clothing and textile firms. Firms in both these sectors participating in the automotive benchmarking club and the clothing and textile clusters were asked to participate. Ultimately thirty firm level interviews spread over the two industries were conducted. This consisted of seventeen automotive component manufacturers and thirteen clothing and textiles firms. The interviews were conducted with senior management in each of the firms interviewed. A list of participating firms as well as the status of the management interviewed is enclosed below.

Table 9 List of clothing and textile firms interviewed.

NO	FIRM NAME	OWNERSHIP	NO. OF EMPLOYEES	INDIVIDUAL INTERVIEWED	DESIGNATION
1	Allwear	Locally Owned	1168	Dr. Jan-Henk Boer	Managing Director
2	Celrose	Locally Owned	638	John Comley	Managing Director
3	Colibri	Locally Owned	323	Mike Scott	Technical Manager
4	Dyefin	Locally Owned	162	Brenton Pooley	Managing Director
5	House of Monatics	Locally Owned	750	David Hampton	Works Engineer
6	International Trimmings	Locally Owned	418	Fred Christopher	Managing Director
7	Monviso	Locally Owned	1297	Ian Stein	Managing Director
8	Ninian & Lester (Textiles)	Locally Owned	333	Malcom Tyler	Managing Director
9	Prestige Clothing	Locally Owned	525	Graham Choice	Managing Director
10	Prilla	Locally Owned	275	Enrique Crouse	Managing Director
11	Rotex	Locally Owned	191	Martin Rohner	Director of Production
12	Spectrum Textiles	Locally Owned	11	Wouter Willemson	Managing Director
13	Zorbatex	Locally Owned	403	Mike Wood	Managing Director
	Average	Locally Owned	535		

Table 10 List of automotive firms interviewed

NO	FIRM NAME	OWNERSHIP	NO. OF EMPLOYEES	INDIVIDUAL INTERVIEWED	DESIGNATION
1	August Lapple	Multinational	1037	Willem Olivier	Purchasing Executive
2	Automould	Locally Owned	250	Brent Latter	Managing Director
3	Federal Mogul PE	Multinational	400	Johan Terblanche	QSHER Manager
4	Federal Mogul Friction Products	Multinational	352	Yakesh Nirmal	Energy Programme Manager
5	Feltex Fehrer PE	Multinational	250	Gert Harmse	Plant Manager
6	Formex	Multinational	430	Werner van Rensberg	Managing Director
7	Hesto Harnesses	Locally Owned	1639	John Chandler	Managing Director
8	Kaymac	Locally Owned	164	Alvin Pillay	Managing Director
9	PFK Electronics	Locally Owned	421	Martin Vermaak	Production Director
10	Pi Shurlock	Locally Owned	320	At Davel	Manufacturing Manager
11	Ramsay Engineering	Locally Owned	460	Andrew Turner	Managing Director
12	Rieter Feltex	Multinational	49	Robert Gooch	Managing Director
13	Senior Automotive	Multinational	256	Arnu Kreel	
14	Shatterprufe	Locally Owned	339	Gerhard Pretorious	Technical General Manager
15	Smiths Manufacturing	Locally Owned	259	Jéan Esterhuizen	Operations Director
16	Spicer Axle	Multinational	400	Keith Vosloo	Plant Manager
17	Webroy	Locally Owned	100	Rob Royston	Managing Director
	Average	Locally Owned	419		

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