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Recommendations for the energy efficiency technology landscape in South Africa

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Faced with the looming prospect of Day Zero insofar as Cape Town's water supply is concerned, the matter of water conservation has never been more relevant. The Cape Town drought has certainly raised awareness amongst the general public about the need to use water sparingly and efficiently. It is hoped that, for sound environmental reasons, at least some of the conservation measures introduced will endure beyond the current crisis.

Another valuable resource that is not currently in the spotlight owing to resource constraints, but which is also critically important, is energy. Energy, like water, needs to be used efficiently not only for the environmental sustainability of the planet, but also for potential economic benefits that may ensue from using energy more efficiently.

The topic of energy efficiency therefore has broad relevance and was the focus of a recently published report, titled The State of Research, Development and Innovation of Electrical Energy Efficiency Technologies in South Africa, by the Academy of Science of South Africa (ASSAf) [http://dx.doi.org/10.17159/assaf.2017/0017]. The study was funded by the Department of Science and Technology (DST) and aimed to explore the energy efficiency technology landscape in South Africa, with a view toward making recommendations that will ensure that energy efficiency is accorded the profile that it deserves in the country. South Africa's per capita energy consumption as a function of per capita gross domestic product (GDP) is approximately double the international average, and electrical energy consumption is about 40% higher than the international average, so there is plenty of room for energy efficiency improvements. Commonly referred to as the 'low hanging fruit', energy efficiency is a means to reduce energy intensity at a relatively low cost and to manage growth in energy consumption.

South Africa has small but notable research activities in energy efficiency, with significant contributions in industrial energy systems in mining, metallurgy and minerals processing and the measurement and verification of energy efficiency initiatives. The traditionally strong research areas in renewable energy, power systems, integrated building energy systems and energy storage are converging on interdisciplinary topics such as smart and micro-grids. There is growing interest in emerging research areas such as solid state lighting (SSL), smart and micro-grids, measurement and verification, and tribology. Research outputs in energy efficiency increased from 2007 up to 2014, but since then have stagnated, which is a sign that some intervention is needed.

The report focused on three specific fields, *viz.* smart grid technologies, SSL, as well as tribology.

Smart grid technologies

Smart grid technologies introduce a layer of digital intelligence to the grid to enable the industry to respond to grid dynamics, restore power interruptions, accommodate alternative energy options, and to facilitate demand response strategies. There is significant potential for improving the efficiency of the electrical energy value chain by introducing smart technologies. For example, rather than energy production following user demand, by synchronising energy availability and usage, much energy can be conserved. The smart grid-related initiatives currently pursued in South Africa are driven by imperatives other than energy efficiency, for example the need to improve renewable energy integration or to reduce CO_2 emissions. The transition towards smarter grids is slow since funding support is limited. Despite some pockets of progress, technology deployment in the form of smart grids is not leveraged to its full potential. While smart metering is pursued by most municipalities in South Africa, the larger metros/municipalities of Cape Town, Johannesburg, Durban and Port Elizabeth are making the best progress from a smart grid deployment perspective.

Smart grid-related research is taking place at the universities of Cape Town (UCT), KwaZulu-Natal, Pretoria (UP), Stellenbosch and the Durban University of Technology, with UP and UCT being the most productive in terms of publications.

It was concluded in the report that an integrated approach and enabling policies are needed for the roll out of smart grids and that the research and training facilities in smart grids at South African universities need to be strengthened.

Solid-state lighting (SSL)

Lighting comprises 20% of the electricity consumption in South Africa and hence there are major opportunities to improve energy efficiency. Although there have been various successful programmes that have begun phasing out older lighting technology and replacing it with SSL technology, South Africa is lagging seriously behind most developed countries in terms of implementation. Furthermore, South Africa does not yet have an overall and coherent policy on SSL.

Light-emitting diode (LED) devices are not currently manufactured in South Africa; however, the report concluded that the opportunity for competitive local manufacturing of LED devices is limited due to scale limitations and the availability of cheap imports from China. The focus should rather be on the utilisation of such devices in luminaires, as well as the development of capabilities in quality assurance, improvement

of reliability and local manufacturing of luminaires. It is expected that this would lead to further opportunities for after-sales support and maintenance of such devices.

There is very limited fundamental research in the development of advanced materials for SSL taking place – the University of the Free State is currently the most active in this respect.

Tribology

Although the focus of the report is on electrical energy efficiency, it also provides inputs on how a focus on tribology (the science and technology of friction, wear and lubrication of interacting surfaces in relative motion) can increase energy efficiency and reduce wastage.

Research and teaching in tribology are conducted at the leading South African universities, as well as at the Council for Scientific and Industrial Research (CSIR) and Mintek covering topics such as wear and materials development, corrosion and wear, lubricant development and evaluation to reduce wear and increase energy efficiency, coatings, the use of laser technologies to produce more wear-resistant surfaces, and conditioning monitoring and maintenance management.

The study made few but significant recommendations as follows:

1. Energy efficiency must be accorded the priority that it deserves in future iterations of the Integrated Resource Plan (IRP) - energy efficiency should be regarded as the 'first fuel' and it must be emphasised in policy development and implementation.

2. A national Energy Efficiency and Demand Side Management (EEDSM) roadmap must be compiled – a focus on energy efficiency can achieve considerable savings if it is supported by a clear strategy.

3. Research and training facilities in EEDSM must be strengthened - the EEDSM hub at UP established by the DST in 2008 has shown the benefits in terms of research outputs of having critical mass in a focused area. Further investment in this facility is recommended to support the implementation of national programmes.

4. A national monitoring, evaluation and reporting framework on energy efficiency must be established – the South African National Energy Development Institute (SANEDI) should be mandated to develop policy interventions to build on gains already made in energy efficiency.

5. Research and training facilities in smart grids at South African universities must be strengthened – there is an urgent need to enhance the depth of research undertaken, to improve research funding and to strengthen linkages with the private sector.

6. A coherent policy on SSL must be developed and support for local manufacture of luminaires provided.

7. The energy efficiency aspects of the Tribology Roadmap must be implemented.