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How tackling tribology in SA could save energy

Engine and machinery friction is expensive, but there are new technologies that could cut industry's costs, writes Tony Carnie

22 June 2018 - 05:02 Tony Carnie



Motor mechanics: Merely changing the lubricating oils in car engines or power station gearboxes could help the country to save money, use energy more efficiently and be more environmentally sound, according to a new study by the Academy of Science of SA. Picture: TONY CARNIE

Tribology has nothing to do with the study of remote tribes. Rather, it is something that could help local motorists and businesses save nearly 18-million litres of petrol each year and potentially billions of rands in other energy costs, according to a panel of experts in a new study by the Academy of Science of SA.

SA's energy consumption is about twice the international average, yet it lags many others in implementing efficiencies.

The word tribology is derived from the classic Greek verb "tribo" (meaning "I rub") and is the study of friction, the killer of smooth mechanical efficiency.

In 1493, Leonardo da Vinci was one of the first scientists to study the laws of friction, but the word tribology only gained traction about 50 years ago when the British mechanical engineer, Peter Jost, published a report that highlighted the massive cost to the UK economy of friction, wear and corrosion.

The Jost Report of 1966 led to the formation of tribology societies and associations across the world and spurred new multidisciplinary research efforts focused on friction, lubrication and reducing wear and tear.

The Academy of Science of SA report, entitled The State of Research, Development and Innovation of Electrical Energy Efficiency Technologies in SA, cites a South African

Institute of Tribology study that argues that the effect of changing one can of engine oil — multiplied across an entire vehicle population — can translate into significant savings.

Many older motorists simply chuck a pint of SAE 40 motor oil into their engines in response to dip-stick warnings, totally ignoring newer multigrade lubricants, such as 15W40, which contain viscosity additives that allow the oil to flow differently under hot and cold conditions, thereby reducing friction, improving efficiency and reducing wear and tear.

Engine oil

Local tribologists note that a large portion of the South African car fleet is considered to be relatively old, with 40% of vehicles older than 10 years.

"It is assumed that the majority of these vehicles, as well as the taxi market, are using monograde SAE 40 engine oil. If it is assumed that these vehicles consume 30% of the petrol sales, changing them to multigrade 15W40 oils would result in between 7-million to 18-million litres of petrol savings," the tribology institute concluded.

Eskom ran a tribology experiment at the Matimba power station in Limpopo seven years ago, which involved switching to more efficient synthetic oils to lubricate the helical gear drives for its air condenser cooling fans. "Final results verified that synthetic gear oils lowered energy consumption by an average of 2.2%. If all gearboxes were converted to use the same synthetic lubricant, potential energy savings at Matimba would be 1,425kW, or roughly 11.5MWh a year," the tribology institute found.

"Converting all major gearboxes in Eskom to a suitable synthetic oil could conservatively provide savings as high as 20MWh or 140,000GWh.

"In the South African market, Eskom's oil usage is estimated at less than 0.5%, while the mining industry alone accounts for at least 15% to 20%. This makes the potential for energy savings approximately 30 times higher in the mining sector."

The Academy of Science of SA's report says it is difficult to make an estimate for all sectors, but potential savings in gearing applications alone throughout all industry could exceed 200MW and be as high as 600MW.

"It is not likely that all these applications would be converted, but even a low percentage uptake would have a significant impact in reducing power consumption," the report reads.

It also examines lighting — another major power guzzler. The report says artificial lighting accounts for about 20% of SA's electricity consumption and notes that more than 900,000 older lamps nationwide were replaced with more efficient ones over the six-year period ending in 2015.

"However, like many other developing countries in the world, SA is still lagging behind the most developed countries in the implementation of solid-state lighting technologies," the report reads.

"While many First World countries have already begun phasing out older lighting technology (incandescent and compact fluorescent bulbs), replacing it with solid-state lighting technology with specific set targets, SA does not yet have an overall and coherent policy on solid-state lighting."

The report says there are also very limited research and technology programmes in SA to improve energy efficiency in lighting. "Most energy efficiency projects are pilot projects run by Eskom. Furthermore, there is a very limited number of universities and

research institutes in SA that are doing fundamental research in the development of advanced materials for solid-state lighting."

The association notes that LED devices are not manufactured in SA but are imported mainly from China. While prospects for the competitive local production of LEDs are limited, the focus should rather be on using these devices in locally produced light fixtures.

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The report does not comment directly on complaints about the high cost of some of the new bulbs (and anecdotal evidence on how frequently they need to be changed) but suggests that the country needs to "develop capabilities in quality assurance, improvement of reliability and local manufacturing".

There is also a detailed section on the potential for new "smart grids", defined as "an electricity network that can intelligently integrate the actions of all users connected to it – generators, consumers and those that do both – to efficiently deliver sustainable, economic and secure electricity supplies.

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While most municipalities in the country are pursuing smart metering, the report singles out the City of Cape Town, City Power (Johannesburg), Eskom, eThekweni (Durban) and Nelson Mandela Bay (Port Elizabeth) for making the best progress on smart-grid projects.

Overall, the association believes that SA is in a "relatively unique position in terms of the energy intensity of its economy", with per capita energy consumption at roughly twice the international average and with electrical energy consumption about 40% higher than the international average.

"There is thus significant potential for energy efficiency improvements to act as a virtual and relatively low-cost fuel source to support poverty alleviation and job creation at a reduced environmental cost," the report says.

"Energy efficiency is an economically and environmentally attractive way to meet growing energy demand, but needs support to make a significant contribution as it may not be aligned with the aims of energy producers."

The report adds: "As a country rich in mineral resources, SA should not try to move away from energy-intensive industries that offer significant downstream beneficiation opportunities, but should rather strive to make these industries more energy efficient and competitive through research and development support."