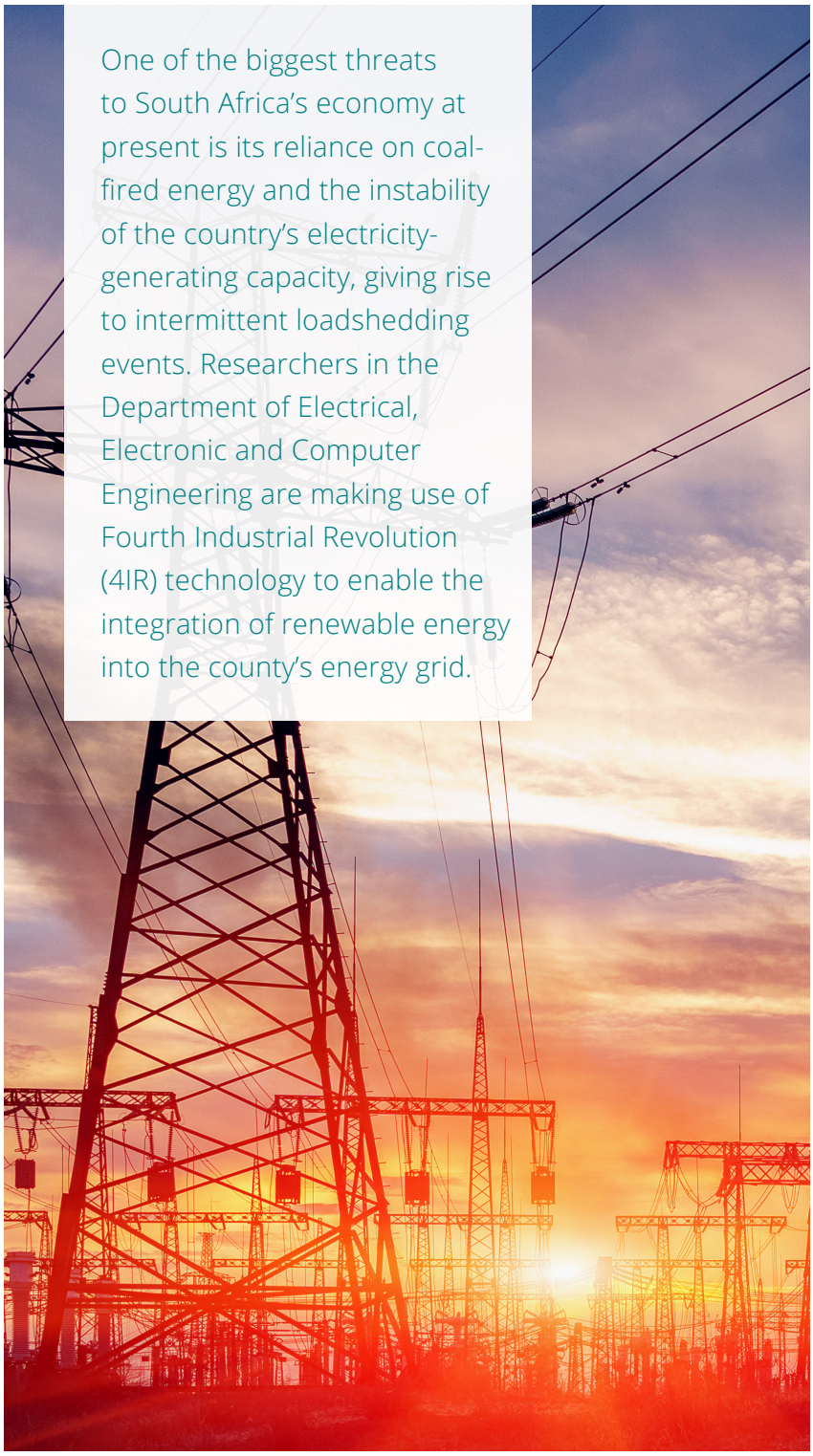
Smart grids spark the modernisation of South Africa's energy grid

Prof Raj Naidoo



One of the biggest threats to South Africa's economy at present is its reliance on coal-fired energy and the instability of the country's electricity-generating capacity, giving rise to intermittent loadshedding events. Researchers in the Department of Electrical, Electronic and Computer Engineering are making use of Fourth Industrial Revolution (4IR) technology to enable the integration of renewable energy into the county's energy grid.

The application of communication and data collection technologies to provide more information on the state of the country's energy grid is a particular focus area of the Department's Smart Grid Labs.

This facility has established itself as a leader in smart grid research, where the power grid meets the Internet of Things (IoT). Its high-quality research, products, services and capabilities fill the widening gap between end-users and electricity suppliers across African markets.

Among other things, projects aim to determine how best to integrate renewable energy sources into conventional power systems using smart grids. This entails the application of smart distribution systems, smart metering and system diagnostics, and renewable energy integration, as well as smart prepaid metering (with time of use), advanced metering infrastructure (AMI) security and active network management.

The integration of smart technology such as sensors and smart devices for sharing information not only affects the national electricity system, but can also improve efficiency in residential, commercial and industrial sectors through connectivity. It does this by collecting important information from sensors in electrical systems that can reduce wastage and help investigate alternative sources of energy for specific tasks and times.

By deploying sensor technology, engineers working on an electrical grid can obtain additional information about the status of the grid, which will ultimately improve the efficiency of the system. This can help reduce wear and tear, extend the lifetime of the grid, and improve future grid design.

This fresh approach to smart grid research has benefits that will be realised across all sectors, empowering end-users, and delivering savings across the board, which will benefit utilities and municipalities as well.

For the household, the smart grid provides information on energy use in the house, which can advise homeowners on cost-saving activities, such as incorporating systems like solar water heaters or double glazing on windows. Municipal managers can also use this data to properly shape pricing for electricity and forecast future power demands to service the community better. For the commercial sector, smart grids can maintain productivity for a company by integrating secondary power sources and prioritising them accordingly, while for industry, this technology can vastly improve the efficiency of various electronic components. Ultimately, smart grid technology is focused on collecting more information on how electricity and power is being used to make better management decisions.

Capacity building and training forms an important element of the Smart Grid Labs' strategic planning. It currently has 15 master's degree and 13 PhD students, who are engaged in research related to the power grid. Research topics range from the protection of distribution systems and cost-effective ways of implementing the distributed energy resources into the current grid, to optimal renewable energy.

It also presents short courses in partnership with the Department of Mineral Resources and Energy (DMRE) and the South African National Energy Development Institute (Sanedi) on smart metering for beginners, practical smart metering, with a focus on audits and installation practices, a systems approach to smart metering implementation at municipalities, cybersecurity essentials, with a focus on AMI security in smart grids, and smart grid power distribution.

Towards the end of 2020, the Department trained graduates from technical and vocational education and training (TVET) colleges on hydrogen fuel cell systems in partnership with Bambili Energy, the Ministry of Higher Education, Science and Innovation, and the Energy and Water Sector Education and Training Authority (EWSeta). The purpose of this training was to develop competent, capable and work-ready technicians for the deployment, installation and maintenance of hydrogen fuel cell systems in South Africa and beyond. This is of particular significance for the future of renewable energy, as fuel cells are expected to play a significant role in providing energy to buildings and in off-grid electrification, particularly in areas where grid extension is not economically viable.

In addition, the Department's smart grid researchers offer consultation services to industry. In this capacity, they provide advice on aspects such as smart cities and smart grids, the green economy, product design and development, remote diagnostics, and the design and optimisation of renewable energy systems, including microgrids.

The Smart Grid Labs has a close relationship with Sanedi, Rand Water and the DMRE, and is working with these entities to understand and prevent the potential data security threats that might compromise smart grids. Located withing the City of Tshwane, it has also established strong ties with the metropolitan municipality. Together, with these stakeholders in local and national government, as well as the private sector, it is paving the way for a new approach to solving Africa's energy crisis.

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