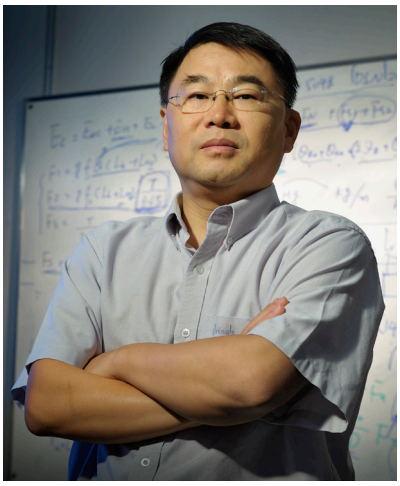
Focused energy-efficiency research – addressing the gap

The University of Pretoria's Hub for Energy Efficiency and Demand-side Management is at the cutting edge of innovation and research in energy-saving engineering.

Energy efficiency remains an abstract academic topic, underpinned by an endless set of definitions and an alarming shortage of technical and academic skills. In June 2008, the University of Pretoria launched the Hub for Energy Efficiency and Demand-side Management in an attempt to shed more light on these topics through focused research and to provide a general pool of high-level expertise in energy efficiency at tertiary level. At the forefront of this innovative and much-needed postgraduate programme is Prof Xiaohua Xia, a lecturer in the University's Department of Electrical, Electronic and Computer Engineering. He is also the director of the hub.

Prof Xia notes that the objective of the hub is threefold: to train students, to trade knowledge and to develop technology in the focus areas of energy efficiency and demand-side management. The hub is a five-year initiative that will put its efforts into bursary management and the training of postgraduate students. Although it is a virtual hub by nature, comprising intellectual capital, it is administratively hosted at the Centre of New Energy Systems (CNES) on the University's Hatfield Campus.

The initiative came about when the South African National Energy Research Institute (SANERI) issued a tender for the establishment of a centre to host postgraduate programmes in energy efficiency and demand-side management in an attempt to meet SANERI's human capital growth objectives as stipulated by the Energy Research and Development Strategy. SANERI is a subsidiary of the Central Energy Fund (CEF) and a joint initiative between the Department of Science and Technology and the Department of Energy. Six academic institutions submitted proposals to host the programme and the University of Pretoria's Faculty of Engineering,



→ *Prof Xiaohua Xia.*

Built Environment and Information Technology was awarded first prize. By winning the bid, it was selected by the SANERI Board to host the centre.

Diverse expertise

The hub's research topics are clustered around different research groups and in various departments of the University of Pretoria. These research topics include energy-efficient drives and power electronics, energy-efficient housing, fuel and process efficiency, energy-efficient power integration with renewable and alternative energy, energy optimisation and standardisation tools and applications in industries, energy-efficient lighting, energy efficiency in heat transfer and energy efficiency in transport. These research topics are covered by the Department of Electrical, Electronic and Computer Engineering, the Department of Chemical Engineering, the Department of Mechanical and Aeronautical Engineering, the Department of Civil Engineering and the Department of Architecture.

The hub's core staff members comprise six full professors, three associate professors and two senior lecturers, five of whom have National Research Foundation (NRF) ratings.

Vast progress has been made since the launch of the hub. In 2009, the centre funded 25 honours and master's degree students in engineering, as well as two doctoral students. The total number of students undertaking courses has grown from 27 in 2008 to 61 in 2009. Six short courses have been developed, 25 research topics have been identified and 33 research papers have been completed.

"From an academic point of view, there is excellent expertise in energy efficiency across the country, but the mobilisation of that research is often missing. In terms of human resources, there is a shortage of high-level technical people in energy efficiency, which results in research efforts that are more scattered rather than focused. However, it must be said that there is strong expertise across the country, with some specialists in leading international positions," comments Prof Xia.

The hub therefore aims to grow and develop focused skills at PhD level and to connect professional and academic expertise in energy efficiency and demand-side management so that it can be collectively addressed at academic level and filtered through to industry. The hub aims to include and liaise with various academic institutions across the country and provides bursaries to students from several tertiary institutions in South Africa. The objective is also to obtain a more even gender representation in the fields of energy-efficient engineering. The hub therefore invites participation from female students in particular.

The annual budget received from SANERI, including bursaries, amounts to R4.5 million. Additional funds are secured from Eskom and the NRF. Other interdepartmental funding is also obtained.

Pioneering research

Although there are several research groups within the hub, Prof Xia highlights some pioneering work that has been conducted by the Industrial Energy Optimisation Group. He is personally involved with this group and can therefore cite direct information, but qualifies that dynamic research is being conducted by all the focus groups across the various departments in the School of Engineering at the University of Pretoria.

The Industrial Energy Optimisation Group has conducted significant studies on the optimisation of conveyor belts and material-handling systems. Broad-based studies have been conducted on a national basis and several papers on this topic have been published.

According to research conducted, there are approximately 50 000 conveyor belts in South Africa. Conveyor belts are responsible for about 16% of the total energy consumption by industrial users. "If we can save only 10% of the energy consumed by all conveyor belts and material handling systems in South Africa, we can save an amount of energy that is equivalent to building a large coal-fired power station with a generation capacity of 1 000 MW," says Prof Xia.

Several energy-consumption models have been developed, and some of these have been translated into commercial products. According to Prof Xia, a number of companies from France are in consultation with the University of Pretoria about intellectual property and the purchasing of these conveyor belt product designs. The work in this regard is continuing.

Prof Xia also highlights the exceptional research that has been conducted to optimise the winder systems of deep-level underground mining operations by managing the winders more effectively in off-peak periods, while not compromising the shafts' production requirements.

According to Prof Xia, the research and training efforts of the Hub for Energy Efficiency and Demand-side Management have already resulted in a significant improvement in energy efficiency knowledge, technology development and skills transfer in South Africa, and will continue to do so in the next years of research action.

→ *Wind turbines generate clean energy.*