

SA's path to sustainable energy for all

'Sustainable energy for all' can seem like a fanciful bumper sticker. Is it even possible? How does one begin to address it?

Climate change consequences have forced decision making and driven society to take on global goals to ensure the survival of earth's inhabitants. And the goals are intertwined with one impacting on the other.

'Affordable and clean energy' is number 7 of the United Nations (UN) Sustainable Development Goals (SDGs). It's the UN's 'International Decade of Sustainable Energy for All' currently. There is also 'Sustainable Energy for All' ([SEforALL](#)), a global non-profit organisation launched by former UN Secretary-General Ban Ki-moon.

Need for ongoing national discussion forum

The topic and the goal are immense – whether one considers it on a global or national level. It's transdisciplinary and cuts across industries.

There is also an emphasis on developing partnerships to tackle the challenge. At the same time, science, engineering and technology (SET) are positioned as key to finding solutions.

Consequently, the [National Science and Technology Forum](#) (NSTF) held a Discussion Forum on '[Sustainable Energy for All in South Africa](#)'. It ran from 16-17 April 2018 in Gauteng.

NDP's low-carbon economy

As part of the [National Development Plan's \(NDP\)](#) aims to eliminate poverty and reduce inequality by 2030, a [low carbon future](#) is positioned as the only realistic option. While the NDP presents an integrated energy sector with adequate investment in infrastructure, it recognises that trade-offs must come into play.

The integrated and diversified energy sector must support economic growth through job creation, export, and R&D for competitive advantage. The focus is on environmental sustainability and climate change mitigation but this is balanced with supply security, safety, affordability, and access. These remain relevant in today's context. While historically policies have focused on minerals and energy, renewable energy is now an integral part of SA's energy mix.

Policy context

South Africa is a signatory to the Paris (COP21) Agreement 2016 – which aims to reduce global warming through each country's actions – explains Dr Rebecca Maserumule, Chief Director: Hydrogen and Energy at the National Department of Science and Technology (DST). In her [presentation](#), she notes that South Africa's guiding frameworks include:

- The [NDP](#) with its focus on investments in energy infrastructure, affordable tariffs for needy households, and diversifying energy resources and supply options.
- The [National Climate Change Response Strategy](#) for long-term mitigation scenarios.
- The [Industrial Policy Action Plan \(IPAP\)](#) with its focus on re-industrialisation, support for local beneficiation, and local manufacturing.
- The [National Energy Act](#) and universal access to modern forms of energy services, energy security through guaranteed supply, optimal use of economically-viable energy resources, and addressing constraints on the renewable industry. This includes the [Integrated Energy Plan](#) (IEP) and the [Integrated Resource Plan](#) (IRP). The latter aims for 42% of electricity generation from renewable energy sources by 2030.

Research focus areas include clean coal technologies, nuclear energy, renewable energy (eg solar, biofuels, and wind), energy efficiency and energy demand management, and hydrogen and fuel cells research. In most cases, says Dr Maserumule, the research has been in place for over a decade through partnerships with key research institutions.

Systems around sustainable energy

One of the ways to understand sustainable energy is to look at its impacts in various areas. [Prof Sanette Marx](#), DST/National Research Foundation Research (NRF) Chair in Biofuels at North West University, considers three areas: environmental impact, economic impact, and social impact. We can consider something sustainable when it's equitable, viable, and socially and environmentally acceptable.

Broader definition of energy poverty

[Prof Roula Inglesi-Lotz](#), Associate Professor from the University of Pretoria, questions whether energy poverty is only lack of access? Energy poverty impacts not only on lighting – consider heating, cooking, and communications. Access to the latter has a knock-on effect because it affects knowledge transfer such as with internet access.

She presents the following definition: "... the absence of sufficient choice in accessing adequate, affordable, reliable, high-quality, safe and environmentally benign energy services to support economic and human development" (Reddy, 2000). She notes that the definition acknowledges the absence of choice and the role of affordable and adequate technology.

Renewable energy in waste

SA continues to innovate in the renewable energy space. Take the work done by IDEAS – the Institute for the Development of Energy for African Sustainability – at UNISA.

Using a transdisciplinary approach, the research focuses on environmentally-responsible chemical conversion technologies, with particular emphasis on sustainable and flexible small-scale solutions and using surplus and underused resources (such as municipal waste and sewerage). This is waste as a resource, not a health hazard.

Clean energy in organic waste

Consider a rural family who cooks on a two-plate stove for 2 hours a day (at simmer) and heats up 40 litres/day water to 50°C. One cow, with the family's human waste, could supply this energy.

[Prof Diane Hildebrandt](#), Director of IDEAS, explains that they have developed small-scale anaerobic biogasifiers. These are basically large double-walled bags where you feed in organic waste and slurry comes out on the other end. The slurry overflow has no smell and can be used as a fertiliser. The biogasifiers produce biogas while removing pathogens from waste (with consequent reduced health risks). IDEAS is developing a business case to show employment benefits, as well as cost reduction for immediate users and the municipality.

Developing clean coal technologies

Coal is not environmentally acceptable as such, but we can make it so through clean coal technologies, says Prof Sanette Marx. One of her research areas is hydrothermal liquefaction – a method to produce biochar for creating cleaner coal. The first patent and pilot plant occurred in 2016/17.

Prof Rosemary Falcon, currently a Director of the Fossil Fuel Foundation, was the SARChI (South African Research) Chair in Clean Coal Technology at Wits University until she retired last year. She and Dr Samson Bada are part of the [DST-NRF SARChI Clean Coal Technology Research group](#). Part of this is the High Efficiency and Low Emissions (HELE) Programme. It looks at options for environmentally-responsible use of coal.

About coal

- SA is the 7th largest producer of coal in the world and the 7th largest exporter.
- Coal accounts for the highest foreign exchange earnings in SA since 2011.
- It's the largest mining income earner, beating gold, platinum and diamonds.
- There are over 255 000 direct employees in coal-related industries. It also supports most major towns in Mpumalanga, Limpopo and some in KZN.

(DST-NRF SARChI Clean Coal Technology Research group)

What about shale gas?

Over the past few years, there has been a lot of debate around drilling for shale gas and its environmental impact. Research from the DST-NRF Centre of Excellence in Integrated Mineral and Energy Resource Analysis (CIMERA), University of Johannesburg, looks at '[Questioning the existence of an economic producible shale gas resource in the southern Main Karoo Basin based on results of the CIMERA-Karin drilling project](#)'.

One of the aims was to establish the maturity and shale gas potential by direct measurements of gas content. Prof Nicolas Beukes explains that nothing like this had been done before. Everything previously had been speculation including shale gas estimates.

After the CIMERA-KARIN Drilling Project with the first true gas measurements, very little to no gas was detected. The conclusion is that shale gas potential looks to be much lower than initially estimated. There are some provisos, such as the project not specifically targeting 'sweet spots'.

Prof Beukes explains that we need to do the science first. We need to answer the question of whether South Africa actually has an economically viable shale gas resource. This will avoid unnecessary environmental concerns and legal battles.

Models for SA's energy mix?

The [CSIR Energy Centre](#) has been developing models for SA's energy mix. Currently, energy is coal dominated with end use being 25% transport, 25% electricity and 50% heating and cooling.

CSIR's Mr Jarrad Wright explains that globally there have been significant cost reductions in renewable energy. Solar PV technology and wind technology, for example, have now become cost competitive. [Focusing on electricity](#), Wright showed that – whether there is a high or low demand forecast for South Africa – there is a gap. This needs to be filled in the least-cost manner and with a reliable and flexible energy supply.

Three scenarios were presented:

- The Draft IRP 2016 Base Case sees the energy mix as ½ coal, ½ nuclear, and ½ renewable energy.
- The Draft IRP 2016 Carbon Budget Case sees nuclear energy take a 40% share by 2050.
- The Least Cost Case is largely based on wind and solar PV complemented by flexibility (including existing coal, new gas, hydro and concentrated solar power). This case deploys considerable solar PV and wind – and flexibility – with no new investments in coal or nuclear capacity. The scenario includes a managed system of energy supply.

Speakers that addressed the forum can be contacted through the spokesperson, [Ms Jansie Niehaus](#).

[Video clips](#) with the full [presentations](#) and discussion can be found on the [NSTF](#) web site.

About the NSTF

The National Science and Technology Forum (NSTF), established in 1995, is a broadly-representative stakeholder body for all SET and innovation organisations in South Africa, which seeks to influence policy formulation and delivery.

The NSTF Awards are unique in SA, recognising the outstanding contributions of individuals and groups to SET and innovation.

The science bursaries page <http://www.nstf.org.za/bursary/> provides information on bursaries and bursary providers for science, engineering and related studies.

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