# INTERSESSIONAL PANEL OF THE UNITED NATIONS COMMISSION ON SCIENCE AND TECHNOLOGY FOR DEVELOPMENT (CSTD)

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Contribution of South Africa

to the CSTD 2017-18 priority theme on 'The role of science, technology and innovation to increase substantially the share of renewable energy by 2030'

**2017-2018 Inter-Sessional Panel of the UNCSTD**

**"The role of science, technology and innovation to increase the share of renewable energy by 2030"**

1. **What are the policies (renewable energy strategies, regulations, standards, fiscal measures, financial incentives, etc.) in place in your country/region that encourage renewable energy projects or aim at increasing the share of renewable energy in your country's energy mix?**

South Africa's energy policy promotes the development and inclusion of multiple energy resources in order to improve energy security. The Integrated Energy Plan (IEP) and Integrated Resources Plan (IRP) shape the country's energy sector. The IRP, a policy adjusted 20-year electricity plan, has set a target of 9400 MW capacity to come from solar energy resources by 2030. Most of the proposed technologies are available in the market while some still have room for technology improvement.

Over the past five years, energy demand has been outstripping supply. The commitment to ensure a secure supply of energy is one of the foremost drivers of the development of the Renewable Energy Independent Power Producer Procurement Programme (REI4P) in the context of IRP 2010. The REI4P is designed to contribute to meeting South Africa's renewable energy target while encouraging foreign investment and developing socio-economic and environmentally sustainable growth.

Funding through the REI4P is provided to companies that focus on projects that deal with onshore wind, solar photovoltaic (PV), concentrated solar power and other such biomass, landfill gas, hydropower and biogas. Through the supportive policy environment and secure investment framework established by the Department of Energy's (DoE) REI4P, South Africa is the ninth-leading

destination for clean energy investment among the Group of Twenty (G20) of the world's developed and emerging economies.

## 2. RENEWABLE ENERGY DEVELOPMENT IN SOUTH AFRICA

The renewable energy efforts of South Africa reached a milestone with the commencement of the Wind Atlas for South Africa (WASA) project, which was initiated in parallel to the rollout of the REI4P[1]. The WASA project was initiated by the DoE, with the South African National Energy Development Institute (SANEDI) as the Executing Partner, and the key implementing partners being the Global Environmental Facility (GEF) through the United Nations Development Programme (UNDP) and the government of Denmark. The aim of the project is to enable South African authorities to do long-term planning of large-scale exploitation of wind power in the country.

The first large-scale high-resolution wind resource map was made from the WASA database. The map identifies the best suitable sites for the location of wind farms, and the project offers significant cost saving and time saving benefits to planners, policy makers, the Energy Supply Commission and the wind industry. The WASA project has also produced an innovative extreme wind atlas that estimates extreme wind speeds with a 50-year return period to assist wind energy developers to make informed decisions when selecting wind turbines and designing wind farms around areas with relatively strong winds.

SANEDI, established by the National Energy Act[2], serves a mandate as a catalyst for sustainable energy innovation, transformation and technology diffusion in support of South Africa's sustainable development. Renewable Energy Centre of Research and Development (RECORD), as part of SANEDI, exists to support, coordinate and streamline the renewable energy research and development

[1] http://www.energyintelligence.co.za/reippp-all-you-need-to-know/
[2] http://www.energy.gov.za/files/policies/NationalEnergyAct_34of2008.pdf

taking place in South Africa. It encourages cooperation amongst research institutions through the establishment of clusters in order to make better use of scarce resources. RECORD supports a number of collaborative projects in renewal energy, testing, training and demo facilities. These include:

- supporting the Microalgal Technology Development and Demonstration Centre (MTDDC) at Upington;
- training graduates in technical service to wind and solar industries of South Africa in collaboration with the South African Renewable Energy Technology Centre (SARETEC) at the Cape Peninsular University of Technology (CPUT); and
- supporting the Centre of Energy Research at the Nelson Mandela University (NMU)[3] to house a PV testing and research facility to map the performance of PV panels and simulate their response to different climates under South African conditions.

The draft Integrated Energy Plan[4] (IEP 2012) suggests that solar radiation will become a more prominent source of energy in all scenarios for the future. Understanding the energy and electricity demands in South Africa is important in evaluating how solar technologies can assist in addressing the national challenge of security of supply. In addressing South Africa's energy systems challenges (universal access, energy security and environmental impact), the Department of Science and Technology (DST) has committed to support research and development that may facilitate the transition towards a cleaner national energy system.

In this regard, the Department provides strategic guidance and financial support to the development of low carbon technologies that will contribute towards economic growth and universal access to modern energy services for all citizens, without compromising environmental protection needs and policies.

**Main actors in the South Africa renewable energy may be summarized in the table below**

[3] NMU was originally NMMU- Nelson Mandela Metropolitan University- name change in October 2017

[4] http://www.energy.gov.za/files/IEP/IEP_Publications/AnnexureA-Technical-Report-Part1-Demand-Modeling-Report.pdf

| ACTOR/ACTION | Policy | Regulation | Energy supply | Energy Research | Incentives | Energy use | Financing projects |
|---|---|---|---|---|---|---|---|
| DOE | X | | | | | | |
| NERSA | | X | | | | | |
| Eskom | | | X | X | | | |
| Municipalities | | | X | | | | |
| IPPs | | | X | | | | |
| Consumers | | | X* | | | X | |
| Lenders | | | | | | | X |
| Research councils | | | | X | | | |
| Energy Intensive Users | | | | | | X | |
| SARS (revenue service) | | | | | X | | |
| Universities | | | | X | | | |

* Consumers are increasingly taking advantages of opportunities in selling electricity from their small-scale embedded generation units

## Key relevant documentation:

**IRP2010-2030:** Integrated Resource Plan
http://www.energy.gov.za/IRP/irp%20files/IRP2010_2030_Final_Report_20110325.pdf
IRP is due for update in 2017/2018. The IRP2010-2030 is generally considered to be outdated but it is still the latest officially promulgated Integration Resource Plan for the country. As a result, it is the official IRP for South Africa

**REIPPP Program:** Overview of the program
http://www.energy.gov.za/files/WOESA/2015/easterncape/Perspectives-on-the-REIPPPP-and-the-investment-and-business-opportunities-it-offers.pdf
https://www.ipp-renewables.co.za/

**Regulations:** Electricity Regulations on New Generation Capacity
http://www.energy.gov.za/files/policies/22736_reg_721.pdf

**Standard:** Renewable Energy Grid Code
http://www.nersa.org.za/ContentPage.aspx?PageId=685&PageName=Renewable%20Energy%20Grid%20Code

## 3. RENEWABLE ENERGY PROJECTS IN SOUTH AFRICA

In an effort to realise the above, DST in partnership with the DoE commissioned the development of a Solar Energy Technology Roadmap (SETRM) which has a number of chapters including one which focuses on research. The research, development and innovation (RDI) component was approved by DST EXCO in March 2015 and has been incorporated into the broader roadmap. The EXCO approved Solar Energy RDI Technology Roadmap[5] (SERDITR) supports efforts to realise the objectives of the National Development Plan[6], Integrated Resource Plan (IRP 2010), Industrial Policy Action Plan and South African Renewable Initiative and the transition to low carbon economy (Green Economy).

The SERDITR seeks to use the current SA opportunity of improving energy security and energy access to develop local capabilities in engineering, research and industrial development (both upstream and downstream) while minimising emissions from the energy sector. The roadmap proposes five thematic areas, namely: supporting strategic planning in the energy sector; support further development for solar thermal technologies, supporting further development PV technologies; support seamless integration of solar energy technologies into the energy system; and stimulate industrial manufacturing and support the use of solar technologies by industries.

The Coalgae project is part of the DST Bio-fuels Demonstration Programme (BDP), which aims to support the Bio-fuels Industrial Development Strategy[7] as approved by Cabinet in December 2007. The focus of the DST BDP is to further

[5] http://sterg.sun.ac.za/wp-content/uploads/2010/11/p48-brent.pdf
[6] https://www.gov.za/sites/www.gov.za/files/Executive%20Summary-NDP%202030%20-%20Our%20future%20-%20make%20it%20work.pdf
[7] https://www.gov.za/sites/default/files/biofuels_indus_strat_0.pdf

develop late generation technologies, which are at different stages and hold the promise of addressing energy security and waste management challenges without interfering with the food chains.

The purpose of the NMU project is to demonstrate the commercial viability of growing algae and converting it into energy products. The project has been focusing on three main areas namely:

- Growing and harvesting algae: There has been continuous improvement in ensuring that the designs of the photo bio-reactors are optimised. This included amongst others using materials that enables optimal algae growth, allow maximum mixing of the growth media and sunlight penetration. The project has managed to perfect algae harvesting techniques, developed relevant analytical protocols and automated control systems for algae growth;
- Combining algae with coal fines to form the Coalgae: The coal fines or discards which can be an environmental nuisance are mixed with the microalgae in an irreversible process that naturally excludes some of the mineral particle. This improves the quality of the algae/coal fine mixture leading to a cleaner coal based product that is formed by extrusion, pelletisation or briquetting;
- The technical aspects of using the Coalgae and converting it to oil: The Coalgae is a weather resistant product, conforms to mechanical tests and performs well on combustion testing. Coalgae may be used as a substitute in applications that require coal, or may be further processed through thermo-chemical conversion processes (like pyrolysis or gasification). These processes will either produce a bio-fossil crude oil blend or a synthetic gas, products that may be further processed into a variety of drop-in fuels, including gasoline, diesel, kerosene, aviation fuel and heavy fuel oil.

In the process of developing the Coalgae product, the NMU team has created new knowledge leading to at least five patents being filed and one which has been granted already. These patents broadly relate to the photo-bioreactors

systems, processes of cultivating micro-algae and upgrading of coal fines using micro-algae.

In parallel to this work the NMU team has appointed an engineering firm Hatch-Goba to undertake a pre-feasibility study to investigate the up scaling of the Coalgae production into a 1 hectare facility. In this regard, the Coalgae would be subject to independent testing and if successful, it will be followed by piloting at the 1 hectare scale in the 2017/18 financial year. This pilot plant will require a capital investment of R60 million and an operational budget of R20 million per annum.

The Nelson Mandela University Institute of Chemical Technology, InnoVenton, has been conducting the Microalgae to Energy (MA2E) project, funded by the DST and Technology Innovation Agency (TIA), for several years. The project has achieved significant breakthroughs in microalgae cultivation and processing with discard coal fines, which have generated a number of patents.

Following the success of the MA2E project, which is ongoing and entering a pre-commercialisation phase with its first product, Coalgae®, the DST provided funding for the expansion of the current Microalgae-to-Energy (MA2E) project into more encompassing Microalgae Technologies Project with the long-term view to establish a Research Centre, or even Centre of Competence in Microalgae Technologies.

**Success stories of renewable energy projects under the REIPPPP in South Africa**

As of the end of September 2016, the REIPPPP had made the following significant impacts:

- 6 376 MW of electricity had been procured from 102 RE Independent Power Producers (IPPs) in 6 bid rounds
- 2 738 MW of electricity generation capacity from 51 IPP projects has been connected to the national grid

- 11 064 GWh of energy has been generated by renewable energy sources procured under the REIPPPP since the first project became operational (making a 15% contribution to morning and evening system peak periods).

Investment, economic, social and environmental impacts:

- Investment (equity and debt) to the value of R194.1 billion, of which R53 billion (27%) is foreign investment, was attracted;
- Created 28 484 job years for South African citizens, or 32 323 jobs (Full time equivalent) for South African citizens;
- Socio-economic development contributions of R256.2 million to date, of which R40 million was spent in this reporting quarter;
- Enterprise development contributions of R80.5 million to date, of which R14.4 million was spent in this reporting quarter;
- Carbon emission reductions of 11.2 Mton $CO_2$ has been realised by the programme inception to date.

**Key factors for sustainability of the programme or individual projects**

- Clarity on renewable energy policy and targets
- Well-designed procurement programme
- Transparency of the procurement process
- Contractual arrangements which enable fair allocation of risk in energy procurement
- Transparency and dependability of the regulatory environment
- Prospect for adequate or reasonable rate of return for investors
- Procurement programme anchored by long-term power purchase agreements (15-25 years) which allow for stable project revenues to service debts for the capital intensive projects
- Coordination and information sharing between electricity procurer and the transmission grid owner/operator to ensure sufficient capacity to feed electricity into the grid
- Implementation of mature technologies (with proven operational performance track records) under the procurement programme

- Strong financing sector to support project developers under the procurement programme