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South African National Energy
Development Institute

ENERGY INNOVATION FOR LIFE

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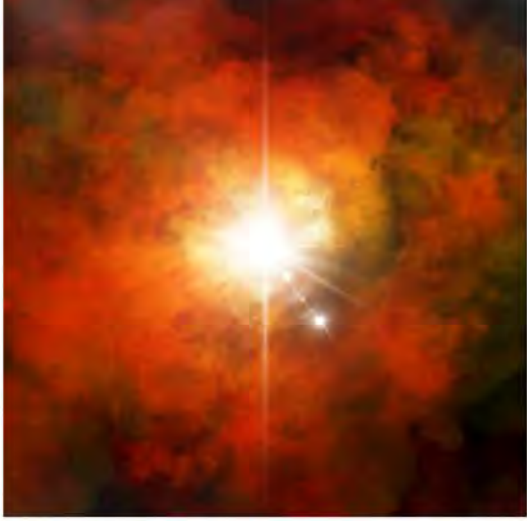


APPLIED ENERGY RESEARCH

Electric Vehicle RETROFIT OF BUS AND MINIBUS

There is a global shift towards sustainable and carbon neutral mobility, especially considering the European Union's (EU's) intention to ban internal combustion engines (ICE) by 2035. South Africa is a net exporter of ICE' vehicles. The transition to EVs in the country, has however been slow. There were around 6400 EVs in the country in 2022, while 400 new EVs were sold in 2023.

SANEDI has contracted the University of Stellenbosch to do research and development in retrofitting a minibus and bus, with an electric engine and associated mechanical and electrical components. This project is an exciting collaboration between SANEDI, Stellenbosch University (Faculty of Engineering), Oxford University, and Rham Equipment. Within SANEDI, this project resides under the Cleaner Mobility Programme. Cleaner Mobility

A team of engineers from Stellenbosch University (SU) joined forces with Rham Equipment to retrofit a minibus with electric propulsion, thereby converting a petrol or diesel minibus to an electric vehicle. According to team leader, Prof Thinus Booysen of the Department of Industrial Engineering, this is the first electric taxi of its kind in South Africa.

The prototype was recently completed and is operational. It is being tested for road safety, after which performance testing will commence. The South African National Energy Development Institute provided funding for the retrofit, while SU's Transport Services donated one of the minibuses from its fleet.

Thinus says South African manufacturers now have a window of opportunity to open plants in Africa to produce electric vehicles locally. "Most of the locally manufactured petrol cars are being exported. Yet this boon to the economy will end as developed countries transition to electric vehicles in the run-up to 2035," he warns. "Remaining in the slow lane of the transition to electric vehicles could put thousands of jobs at risk. The automotive industry and our government cannot afford to be caught asleep at the wheel."

One of Thinus' team members, Stephan Lacock, is a master's student in Electronic Engineering at SU. Funded by Golden Arrow Bus Service, he helped design the

advances Research and Development that demonstrates alternatives ways of mobility, which improves environmental, social, and economic conditions.

SANEDI has contributed research funding, while university's Transport Services donated a minibus to retrofit. Stellenbosch University partnered with Rham equipment to convert a petrol or diesel minibus with electric propulsion. This is the first retrofitted electric vehicle in South Africa. The prototype was completed and is fully functional. The vehicle was tested for road safety and performance testing will soon follow. The retrofitted minibus has a range of 120km, reaches speeds of up to 120km/h, a battery with capacity 53.760 kWh, and external charger rated 210Ah.

Electric Vehicles are more environmentally friendly, are quitter, require less maintenance, and contributes to the country's climate change objectives and targets, notwithstanding global Sustainable Development Goals (SDGs) goals. There are an estimated 250,000 minibus taxis in the country, which commute around 70% of the local population. A research study in 2015, demonstrated that minibus taxis emitted 5.5 million tons of CO^2 equivalent of emissions per annum. It therefore makes good sense to transition petrol and diesel minibus taxis to low carbon transportation technologies. This approach is cheaper and more environmentally friendly than producing new electric vehicles.

EV technologies have the potential to considerably reduce Greenhouse Gas (GHG) emissions and noxious gases. This will greatly assist South Africa in meeting its climate obligations in response to the Paris Agreement. The Paris Agreement is a legally binding international treaty on climate change. Over 196 parties adopted the agreements at a UN Climate Change Conference (COP21) in Paris, France, on 12 December 2015. Electric vehicle manufacturers in South Africa have a window of opportunity now to open plants in Africa to produce electric vehicles locally.

ELECTRIC BUS

Vialability and VALIDATION of innovation

South Africa has an energy nexus and is largely reliant on coal as a non-renewable (finite) energy source. Coal is largely polluting and a large contributor of greenhouse gas emissions (GHGs), if not treated. Renewable energy is a sustainable form of energy, which has benign environmental effects. The Viability and Validation of Innovation for Innovation and Service Delivery (VVISD) is a programme initiated by the Department Science and Innovation (Programme 5). The programme seeks to address service delivery challenges in municipal environments pertinent to energy management technologies which can improve quality service delivery. It ais also attuned to the presidential district development model which seeks to improve capacity and technology innovation development in municipalities that improves service delivery.

The Department Science and Innovation (DSI) have received European Funding to plan, design, and implement the VVISD programme. The programme encourages participation of vulnerable communities such as black women, youth, and persons with disabilities. It requires stakeholder engagements with industry, private sector, higher learning institutions, and civil society.

Objectives

The project has the following objectives in mind:

- Support SA Government to improve the NSI and respond to priorities of the NDP.
- Develop policy and programme interventions through dialogue and consultations with non-conventional partners/government stakeholders that will stimulate investment in RDI for service delivery which will improve access to socio-economic rights to all, especially women, youth, and vulnerable groups.
- Support learning from models that have been successful in applying innovation and commercialisation of technologies arising from existing cooperation and other projects.

Smart Meters

Benefits

The programme has several benefits, which include but is not limited to:

- Improving municipal service delivery by investigating and implementing energy management innovations and technologies in partnership with the municipalities.
- Advancing the Presidential District Model of empowering communities at the local level.

- Promote training and development of citizens through stakeholder engagement and potentially provide temporary employment opportunities.

Stakeholders

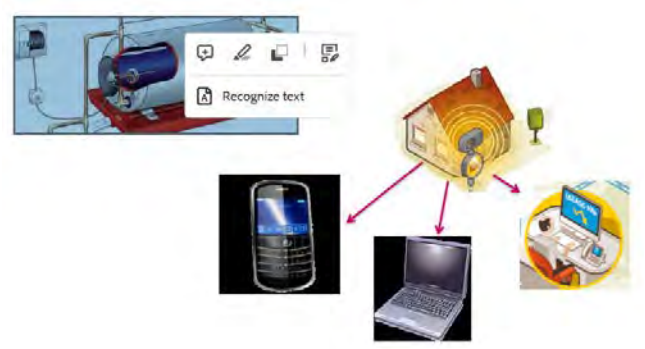
Key stakeholders include the DSI, TIA, CoGTA, and SALGA. The DSI have appointed TIA as the funding agent and SANEDI as programme implementing agent for the energy management component. The programme comprises five subprogrammes: Innovative Technology Solutions, Decision-support Tools, Innovation Capacity and Capability, and Integration of Innovation. Municipalities have submitted proposals to the DSI during an open call. Five municipalities were successfully awarded to participate in the energy management component. These municipalities include the City of Cape Town, Drakenstein, Mbombela, Rustenburg and uMhlathuze.

Free Basic Alternative Energy

Project Scope

Projects vary in nature and scope but essentially address renewable energy, energy efficiency and demand-side management which is typically aligned with the core mandate and objectives of SANEDI. Projects currently contemplated are illustrated in Figure 1.

- Projects by and large involve load management through geyser control technologies.
- Free Basic Alternative Energy (FBAE) aligned to the national FBAE policy. Implementation of smart technologies to improve meter reading and billing which enhances revenue collection.
- Load management technologies further involve reducing streetlight energy consumption and household geyser consumption in residential homes. Streetlight diming and switch off technologies are available to control streetlight energy demand. Ripple control is also available to switch-off household geysers remotely, during peak demand.
- The deployment of renewable energy off grid technologies like river micro hydro technologies and PV roof installations on municipal buildings are being contemplated.



Gesyser Tag

- And finally, CCTV and WiFi extension of current technologies are promoted through installation of CCTV camera technologies to reduce theft and vandalism of electrical infrastructure, i.e., cable theft, public access to municipal services, and community safety.

Current Status

The project is currently under year 2 of the programme. Substantial progress has been achieved. All five municipalities have been engaged to confirm and determine the technologies which are amendable to deploy in respect of their areas of interest. A requirements analysis was performed to conform the type and capability of technologies to be deployed. An interim project execution plan was developed for all five municipal projects. Working group committee meetings have been regularly held to uphold good project governance. Expression of Interest were compiled for the five projects ready to go to market to gain an understanding of the appetite and capability to support the uptake of suitable technologies and appropriateness thereof, to improve quality municipal service delivery.

Streetlights and Geyser Ripple Control

LONG-TERM Joint European Union - African Union Research and Innovation Partnership on Renewable Energy

Long-term Joint European Union - African Union Research and Innovation Partnership on Renewable Energy

The Long-term European Union – African Union Partnership on Renewable Energy (LEAP-RE) programme promotes the increasing use of Renewable Energy, by applying a balanced set of research, demonstration, technology transfer, human and institutional capacity projects from African and European countries. A consortium comprises 83 countries, with 39 partners from Europe and 44 from Africa. An estimated budget of € 32 Million, with includes € 15 Million from the European Commission (EC), under Horizon 2020 was raised.

The DSI a consortium member, appointed SANEDI as the implementing and financing agent to oversee projects implemented by awarded South African Research projects. The first Joint Call yielded seven projects, which are currently active, and research is ongoing. Significant progress is being achieved across these projects. The Department Science and Innovation (DSI) committed R22 million toward funding the south African partnering projects for Joint Call 1. Leap-Re International has further committed R5.7 million as top-up funding for the programme.

Leap-Re International released a second Joint Call in 2022. Countries and funding organizations participating in the call included: Algeria (MESRS, DGRSDT), Egypt (ASRT), Morocco (MENFPESRS, IRESEN), South Africa (DSI, SANEDI), Togo (University of Lomé); European countries: Belgium (FRS-FNRS), Finland (AKA), France (ANR, NEXA), Germany (FZJ-PtJ), Portugal (FCT), Romania (UEFISCDI), Spain (CDTI), UK (Loughborough University). Leap-Re appointed five South African Research partnering institutions under Joint Call 2.

A budget of R8.6 million was awarded to the five South African partnering projects. The latest round of projects includes **BIOTHERP** which focuses on hybrid biochemical and thermochemical conversion of slaughterhouse biowaste for Renewable Energy production. **D3T4H2S** a project involving data driven digital twin, for improved hydrogen storage vessels, which addresses challenges for energy transition. **OPTIMG** involves the optimization of micro-grids for water-energy-food. **SHE** has to do with the development of an integrated and mobile solution for low-cost cooking, and power generation. And finally, **SmartAPV** deals with smart Agri-voltaic Systems for Fruits.

Plasma GASIFICATION

NECSA and SANEDI have developed a mobile plasma gasification technology system which treats green waste and produces electricity as part of the treatment process. The system was improved to treat a range of biomass waste types, which may include surrogate COVID PPE waste. Given its mobile capability the technology can be placed on site and obviates the need to transport waste to a fixed waste site.

The technology can treat between 0,2 and 0,5 tonne organic (green waste) per day although the system can be scaled. It can also produce between 10 and 25 kW of electricity. The diversion of green waste from landfills has a significant benefit since the decomposition of such materials in landfills emit methane gas, a Greenhouse Gas (GHG), has a global warming potential twenty-one times more than carbon dioxide. GHGs contribute significantly to climate change, a global environmental challenge.

Whilst diverting waste from landfills which in most instances are constrained by space and ground and air pollution, the technology lends itself to off grid electricity generation capacity.

Objectives

The Plasma Gasification project has several objectives at hand, which includes but is not limited to the following:

- Address SANEDI's strategic objectives of addressing climate change and the countries global climate change obligations and targets by reducing for example, methane production in landfill sites, along with other toxic leachates seeping into surface and subsurface soil and water resources.
- Contributing to the Just Energy Transition strategic objectives with the potential of empowering women and youth through establishing community cooperatives, which can bring waste to drop-off sites and potentially earn an income.
- Technically assess the current plasma gasification system with a view to improve functional capability, material robustness, and presentability.
- Branding of the system with NECSA and SANEDI logos and material.
- Demonstrate the technology at defined municipal waste sites, while training and developing operators at local municipal sites.
- More importantly, to conduct a feasibility study with respect to the potential to produce hydrogen through the gasification was MSW in support of the national strategy to become a global leader of hydrogen production and export.

Benefits

Benefits of the project include the following:

- The technology treats waste which ordinarily lands up in landfills, where the degradation thereof produces greenhouse gases (GHGs), which contributes to climate change.
- The technology can treat a range of waste streams like sharps, needles, and tyres.
- The resultant syngas can be used to produce green electricity that can be sold into the municipal grid.
- The project can empower woman and youth through establishing co-operatives that collect and bring wate to municipal sites where the technology is stationed.

Highlights

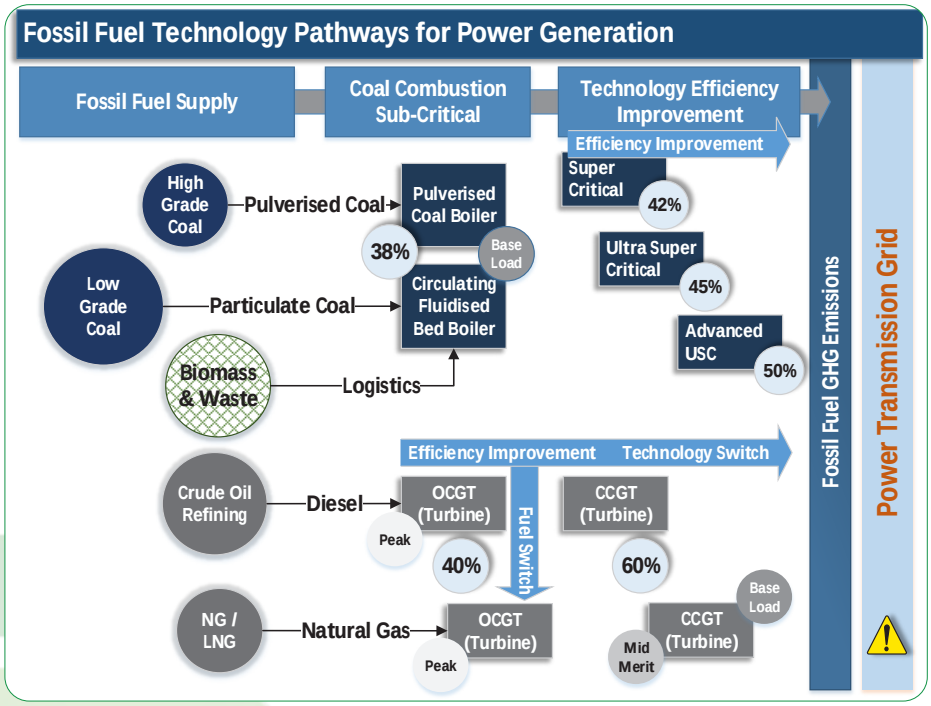
The system was not initially designed for hauling to different sites across the country but transported and assembled at a fixed location. Work will be done to make the unit more robust for purposes of travelling. A roadshow will be conducted at municipal sites across a range of sites throughout the country. The unit will also be branded. A feasibility study will be commissioned to determine whether the technology can produce hydrogen. This initiative supports the country's endeavours to become a world leader in producing hydrogen for both local use and exporting it globally.

Plasma Gasification Pilot

Electronic Controls

Cleaner **FOSSIL FUELS**

The supply of raw materials (coal, oil, and gas), the conversion of the raw materials through combustion and conversion processes, and the management of the emissions from these activities are the three main sectors in the fossil life value chain that contribute to greenhouse gas emissions. Cleaner fossil fuels are those that are linked to dependable fossil fuel technologies that are currently on the market and reduce greenhouse gas emissions in comparison to the technologies currently in use in South Africa. Therefore, the main criteria to qualify as a cleaner fossil fuel technology is the use of technologies such as High Efficiency Low Efficiency (HELE) and capturing of emissions to achieve a net reduction in GHG emissions relative to existing technologies.



EFFICIENCY OF CURRENT FLEET

Majority of SA coal plants are sub-critical designs averaging around 38% efficiency. High grade coals are scarce and most of coal stock today is low grade material.

Supercritical Technologies amongst others, have potential for HELE (Higher Efficiency = Lower Emissions).

ROAD TO CLEANER FOSSIL FUELS IN SOUTH AFRICA

The government of South Africa has come to understand the advantages of a low-carbon economy, especially in terms of supporting efforts to mitigate climate change. The South African government has already pledged to cut carbon emissions in accordance with the country's set goals. The Nationally Determined Contribution (NDC) target range for the nation for 2025 has been revised as of September 22, 2021. Previously set at 398-614 Mt CO2-eq, it now ranges from 398-510 Mt. The fact that our 2030 mitigation target range has been revised from 398–614 Mt CO2-eq to 350–420 Mt CO2-eq is more significant. The adoption of multiple techniques will be necessary to achieve the goal of attaining these emissions reduction targets. Cleaner fossil fuel technologies are an excellent business plan to take into consideration.

A three-phase initiative, of which two have been completed, was started by the sub-programme and is called the Roadmap towards Cleaner Fossil Fuels for South Africa. Phase I assessed the supply and demand for energy in the coal, oil, and gas value chains, identified feasible solutions to control GHG emissions, and suggested alternative feedstock possibilities. Phase II focused on a smaller set of technologies (based on specific techno-economic criteria) and offered a more in-depth analysis and feasibility study of the technological options. The technology's suitability for the country's Just Energy Transition and climate change regulations was also looked into. Now that the project is in its third and final phase, we are moving forward.

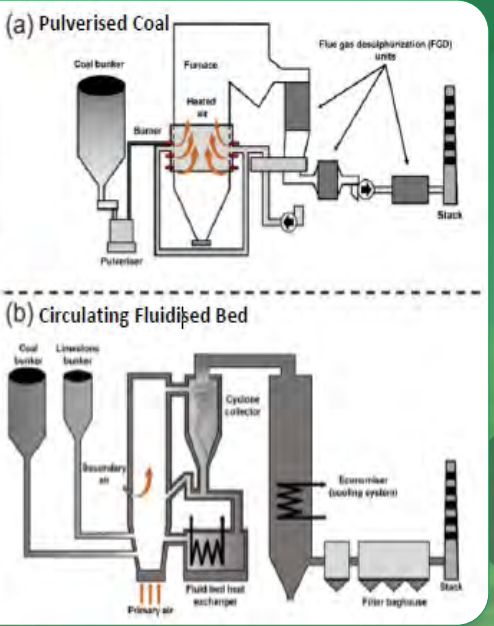
The third and final phase aimed at looking at the implementation of the coal to power value chain with specific focus on technologies listed below:

- Steam Generation Technologies in power industry
- Ultra-Supercritical Stream Boilers (High Efficiency Low Emissions (HELE) technology)
- Pulverised vs Circulating Coal Fluidised Bed
- Flue gas clean up technologies – SOX, NOX and particulate matter emissions control equipment.
- Skills assessment

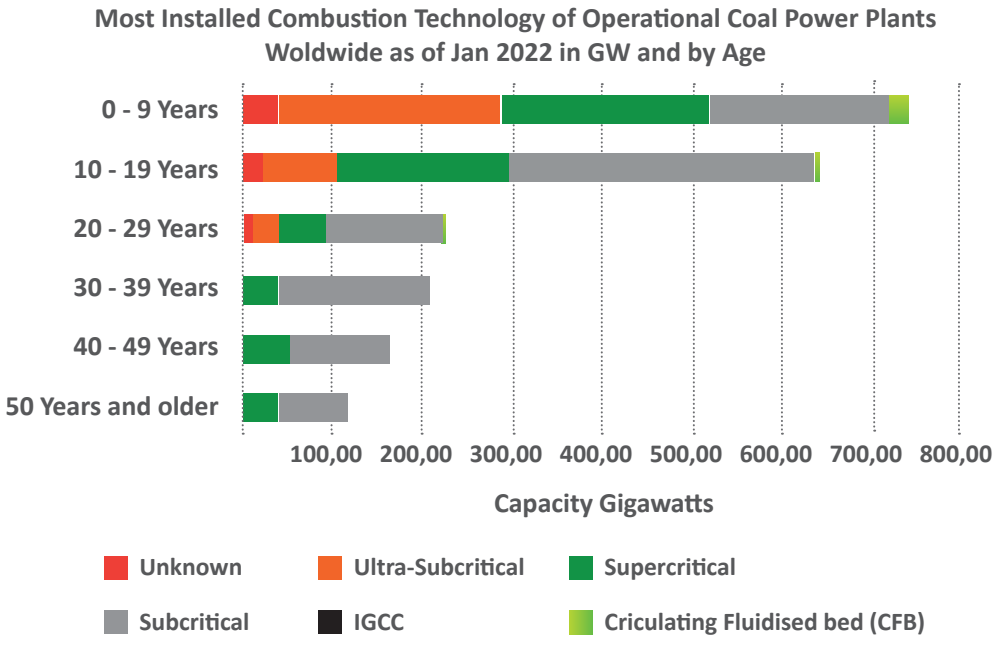
Current findings include a comparison of implementable technologies such as Pulverised Coal and Circulating Fluidised Bed

Description	Coal CFB	Coal PC	Benefits of Coal CFB
Fuel size	6-12 mm	<75 micrometre	Crushing cost is reduced
Fuel range (Ash plus Moisture)	Up to 75%	Up to 60%	Accepts wider range
High sulphur fuels (1-6%)	Limestone injection	FGD plant required	Less expensive SO_2 removal system
Auxiliary fuel support (oil and gas)	Up to 20-30%	Up to 60%	Less oil consumption
Auxiliary power	Higher	Lower	If FGD is used in PC Coal,

Description	Coal CFB	Coal PC	Benefits of Coal CFB
consumption			CFB power is lower
Emissions SO_2 ppm	<200 ppm	<250 ppm with FGD	Lower emissions in process.
NO_2 ppm	<100 ppm	<100 ppm with Selective Catalytic Reduction (SCR)	No SCR system required
Boiler efficiency %	Same	Same	No difference
O&M cost	5-10% lower	5-10% higher	Lower because of less moving equipment
Capital cost	5-10% higher	5-10% lower without FGD and SCR	
	8-15% lower	8-15% higher with FGD and SCR	



Globally, there has been an increased deployment of cleaner fossil fuels technologies such as Ultra/ Supercritical steam generation, especially in the last decade.



Cleaner Fossils Fuels Road Map Roundtable discussions – objective was for an organised conversation on the Cleaner Fossil Fuels Road Map for South Africa. The event was well attended, with stakeholders from Mintek, Eskom, University of Johannesburg/CIMERA, FFF-Carbon, University of the Witwatersrand and North West University. The conversation probed the presented Cleaner Fossil Fuels Technologies, offered insights, gaps and future scope for the next phases of the road map. The overall discussion emphasised the importance for collaboration, information sharing, to grow the information base for future research and avoiding duplication. SANEDI plans to hold similar discussions on a regular basis with the aim of getting more stakeholders involved in the Cleaner Fossil Fuels initiatives and research.

Other Fossil Fuels Related Work: Through the sub-programme, SANEDI has continued to support Carbon Capture Utilisation and Storage (CCUS) initiatives in the country, it has actively participated in Council for Geoscience's Workshops/ Seminars as a valued stakeholder. The sub-programme participating in themes surrounding 'The Role of Clean Coal Technologies towards South Africa's Just Energy Transition Programme'.

Sasol Sigma Colliery- The purpose of the visit was to observe the Coal Quality Management System executed at the mine. The technology is capable to sort coal according to specification on a conveyor belt and discard non-conforming coal. This helps the coal burning process become more efficient, which may lead to reduced polluting emissions. The SANEDI benchmark technologies that are currently utilised in the country, to help in the reduction of Greenhouse gas (GHG) emissions. This is done without

A LEGACY TO SUPPORT FUTURE CLEANER FOSSIL FUELS in SOUTH AFRICA

The Dr Tony Surridge Grant Funding Programme – the grant funding programme is named as such to honour the contribution of Dr Tony Surridge, who dedicated the last two decades contributing toWARDS the advancement of Cleaner Fossil Fuels research and development, as such, he was one of the one of the researchers that introduced and advanced Carbon Capture & Storage to South Africa, and a valued member of the SANEDI family. From 2006, Dr Surridge was a General Manager- Cleaner Fossil Fuel Use at SANEDI during which time in 2009 established and was the Head of the South Africa Centre for Carbon Capture and Storage.

The grant funding will collaborate with universities in cleaner fossil fuels research, especially in the Coal and Gas value chain, where focus will be on:

- Coal- Decommissioned power plants- retrofit with Cleaner Fossil Fuels technologies
- Coal- Pre-combustion technologies coal quality sorting/tailings/ discards, post-combustion ash – beneficiation
- Gas – Alignment of IRP 2023 and Gas Master Plan (GMP)
- Gas – Availability to SA/characterisation/suitability/GHG emissions reduction technologies

SANEDI's Cleaner Coal Research Specialist in the news contributing to the wider topic of Cleaner Fossil Fuels; argues the case for coal in the energy mix of South Africa and the world.

> *While coal still has a place in our energy mix, we* **NEED CLEAN** *up its act, says SANEDI's clean coal research specialist, Gcobisa Melamane*

"In a world that's being battered by extreme weather occurrences owing to climate change, it seems like heresy to claim that coal still has a place. The fact is, it does, but on condition that we can clean up its act, begins SANEDI's clean coal research specialist, Gcobisa Melamane. South Africa's loadshedding crisis continues to underline the importance of a stable electricity supply to keep the economy moving. At least for now, the controversial term 'baseload' in this country indicates electricity generation from coal and, to a lesser extent, some nuclear "The point is that South Africa, and indeed the world, needs a mix of energy sources," says Gcobisa Melamane, clean coal research specialist at the South African National Energy Development Institute (SANEDI). "None of the sources and technologies we currently have can meet the needs of economies and societies on their own." South Africa's Integrated Resource Plan, drawn up by the Department of Mineral Resources and Energy (DMRE) in 2019 and currently under review, recognises this fact by placing coal's status quo at more than 80% of the energy mix. While that percentage is targeted to decrease by almost half (42%) by 2030, coal is expected to remain the dominant energy source for the foreseeable future. In addition, the coal mining and energy generation industries employ thousands of people, adding a socioeconomic impact to the process of transitioning from one type of energy source to another. South Africa is not alone in its reliance on coal. Over the past year, several European countries that had

previously sworn off coal had to fire up their coal power stations again to deal with the energy shortages that resulted from geopolitical circumstances in the northern hemisphere. Melamane adds, however, that it's not business as usual in the coal space. Significant time, effort and resources are being dedicated to developing technologies that will limit the environmental impact of coal-fired electricity generation. "SANEDI is one of the organisations in the country researching technologies that can make the use of fossil fuels cleaner so we can keep using them in a more responsible manner in South Africa. We still have abundant coal resources, and it remains a cheaper source of energy. We need to use it while we have it, which makes cleaner technologies a necessary and worthwhile investment."

SMART GRID Programme

A Smart Grid (SG) is 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.

The Smart Grids programme responds to the current industry challenges such as energy reliability, energy efficiency, systems operations efficiency, customer satisfactory, economic, and environmental challenges. The programme conducts research that proposes solutions to support just energy transition to sustainable and cleaner technologies that ensure South Africa's energy transition aspirations.

The Smart Grids programme focuses on expanding the deployment of Smart Grids technologies to increase automation and improve performance as well as efficiency within the South African Electricity Distribution grid (SANEDI 2024).

Objectives

- Provide a common vision for Smart Grids for South Africa
- Facilitate a Smart Grid knowledge-sharing forum, for both the Electricity Supply and Distribution Industry and relevant government departments.
- Implement applied research pilots within municipalities to introduce various Smart Grids concepts.

Just Energy Transition Research Programme in Collaboration with South African Universities and Universities of Technology

SANEDI has collaborated with 6 Universities to conduct research that will put forward solutions to eradicate ongoing energy crises in South Africa with 5 themes, namely:

- Energy Planning & Policy Input Development
- Energy Efficiency & Demand Side Management
- Grid Planning & Sustainability
- Systems Operations Management
- Power Grid Digitalisation

The purpose of this programme is to propose solutions to support the transition to sustainable and cleaner technologies that ensure South Africa's energy transition aspirations as contained in the Department of Mineral Resources and Energy's Just Energy Transitions (JET) framework.

Demand Projection Model in Support of IRP Update 2023

Background of the Project

Through the JET Research Programme, SANEDI in collaboration with the Energy Systems Group at the University of Cape Town developed a new generation of electricity demand forecasting models, to aid the current and future capacity expansion planning processes, referred to in law as integrated resources planning.

Long term scenario-based projections of electricity demand are very important for policy formulation and developing generation capacity expansion plans. A long-term view is required as electricity generation infrastructure has long lead times and footprints that last many decades. Econometric methods used for short-term forecasting using statistical time series methods have some limitations when applied to long term electricity demand projections. Real increases in tariffs not seen prior to 2010, the availability of new cost competitive efficient appliances/equipment, lower than anticipated economic growth and supply constraints have combined to result in a demand trend that could not be anticipated by extrapolating from historical data. This was acknowledged in the discussion of the forecast in the 2019 IRP, however at the time, an alternative method could not be found. In the coming years, we expect further changes such as a continued change in the composition of the economy, electrification of end-uses such as transportation and process heat, hydrogen production, more self-generation etc… which will have major impacts on the evolution and profile of the demand "seen" by the national grid. Thus, the development of a more bottom-up approach of projecting demand is required (SANEDI 2003).

Objectives of the Project

The objective of the project was to develop a spreadsheet-based bottom-up demand projection tool to support generation expansion planning. The tool provides a first step towards improving the approach for generating long-term electricity demand projections by addressing some of the short-comings of time-series based projection methods by allowing the user to explore scenarios:

- With projected structural changes in the economy, and what this means for the evolution of overall demand profile;
- With the addition of new demands such as electrified transport and hydrogen production, assuming different charging profiles and locations for p rivate transport (home vs elsewhere);
- If required, to specify different rates of penetration of on-site generation such as roof-top PV

Results

A reference high-growth scenario showing hourly projected demand at the sent-out level is presented in this report. In this scenario the electricity demand is projected to increase by around 200 TWh between 2023 and 2050, with peak demand projected to grow from around 35 000 MW to around 62 000 MW. Electrification of transport, accelerating after the mid-2030s, and assumed high GDP growth are the two main factors driving electricity demand up in this scenario.

How much of this demand may be met by "Onsite Generators" is not determined, as these are regarded as supply options in the capacity expansion model used in the IRP process.

In conclusion, it has been possible to calibrate an hourly sector-based demand model against the 2017 hourly record of electricity sent out. Future scenarios of electricity demand can now be generated by varying assumptions and constraints in SATIMGE runs.

Recommendations

The model in its current form provides demand projections at a high temporal resolution (hourly), but for a single node model. Given current bottlenecks on the transmission network, planning should be done in a spatially disaggregated way. Also, the non-homogeneity in how different sectors may evolve in different geographic locations requires future demand forecasts to be spatially disaggregated. The spatial disaggregation, price responsiveness, and the exploration of the uncertainty space is left for future work.

References

SANEDI (2003). Demand Projection Model in Support of IRP Update 2023 3-6.
SANEDI (2024). Annual Performance Plan 2024-2025: 26-27.

DIGITALISATION Laboratory

The Data and Knowledge Management (DKM) programme was initiated to provide a mechanism for energy modelling and planning to support the alignment of national and local government energy objectives. Furthermore, the DKM programme aims to provide a data driven platform, where national and local government decision makers collaborate in addressing the objectives of the South African Integrated Energy Plan (IEP) and National Climate Change Response Strategy (NCCRS).

A few of the focal areas for DKM to collect and maintain and open central database of energy research and related data, develop suitable models for the South African Energy system and to develop technical know-how, knowledge and human capacity in energy modelling and planning.

The DKM Programme is in the process of launching a digitalisation lab to visualise, monitor and track data. Moreover, through the lab the programme aims to increase engagement and understanding amongst stakeholders, collected from organisational projects. The lab will provide access to advanced software, hardware, and expertise in data visualisation and analytics.

Objective

The objectives of the digitalisation lab include:

- Enabling stakeholders to visually explore large and complex datasets to uncover patterns, trends, and insights.
- The lab will be equipped with advanced visualisation software and tools specifically tailored for energy data analysis, such as geographic information systems (GIS), time-series visualisation tools, interactive dashboards.

Benefit/s

The digitalisation lab is a valuable resource for improving energy management, promoting sustainability, and driving innovation in the energy sector. By harnessing the power of data visualization, stakeholders can address complex energy challenges more effectively and work towards a more resilient and sustainable energy future.

Highlights of the Study

- The first phase of the digitalisation lab has kick-off, which encompasses the installation of a video wall for visualisation.
- The video wall is to be launched in the beginning of the new financial year.

National ENERGY CRISIS Committee

The National Energy Crisis Committee (NECOM) was established under the Presidency and has been tasked to implement the Presidential Energy Action Plan (EAP), which was announced by the President in 2022. NECOM focuses on removing barriers to new generation capacity and unlocking energy from various sources, including Eskom, independent power producers, businesses and households. This is a collective national effort to ensure South Africa has enough energy now and for the future.

Objective of NECOM Workstream 5

NECOM Workstream 5 focuses mainly on the management of consumption and demand initiatives to incentivise customers, this includes increasing energy efficiency and response measures by working with distributors, companies and customers.

Highlights

SANEDI in collaboration with NECOM Workstream 5 has held workshops with key stakeholders which focused on key factors such as:

- Addressing obstacles and lessons learnt towards increasing adoption rate of Energy Service Companies and Distributors
- Unlocking the funding options available to Distributors
- Knowledge sharing of best practices in energy efficiency and energy demand
- Mass rollout opportunities
- Regulation review to enable Distributors

In addition to the above mentioned workshop, dialogues with ESCo's from SANEDIs database were held to better unpack barriers related to Eskom's Distribution Demand Management Program (DDMP) and Demand Response Program (DRP), as well as discussing the registration method for the SANEDI ESCo register. There has been active participation from key stakeholders such as Eskom, Department of Mineral Resources and Energy, municipalities, banks and distributors.

NECOM Workstream 5.

GEYSER Roadmap study

South Africa is currently facing a national energy crisis. The South African mismatch of electricity supply and demand has resulted in load shedding from stage 1 to stage 8, with stage one shedding 1000MW and stage 8 shedding 8000MW.

The residential sector in South Africa comprised of approximately 16.9 million households in 2016, of which approximately 86% were electrified. Electrified households consume roughly 17% of the country's total grid electrical energy to provide energy services, the most significant of which is resistive water heating. Approximately 8 million South African households have geysers, 300 000 of those electricity geysers have load management systems. This indicates that there is an untapped opportunity within the residential load management systems for geysers.

Objective of the study

In an effort to contribute to mitigating the crisis, SANEDI in collaboration with the University of Cape Town is developing a Residential Load Management roadmap for geysers in middle and high-income households within South Africa. The project objectives are strategically aligned with the contribution towards sustainable energy solutions, energy security and climate change adaptation, mitigation, and resilience.

The project focuses on the following:

- Number of geysers installed within middle and high-income households
- Types of geysers installed
- Maintaining the geysers using load control devices
- The distribution of geyser control devices in income groups (Mega Watt and Mega Watt per hour)

Benefits of the study

- Dispatchable peak demand reduction
- Utility least cost option
- Improve voltage stability and avoided line losses during heavy-load conditions.
- Improved customer relations
- Low electricity cost to customers
- GHG emissions reduction

SMART METERING
Application training

DKM is committed to strengthening the capacity of South Africans and creating opportunities for skills development within the energy sector as part of the strategy to support its aim. As a result, the sub-programme put in plan, the provision of energy related training as part of their annual target.

Smart metering is core to data management in any sector of the energy industry from residential through to industrial plants. SANEDI's request for training in Smart Metering Application provides support to what is relevant to government department decision makers and employees for decision making on policies and regulations that support the implementation of smart meters. The training also supports organisations that have to ensure there is capacity, skills and knowledge on how to implement smart metering strategies and technologies to meet the expectations of government. The training took place on the 19th of September 2023 and was for only one day, delivered in a hybrid facility to delegates in class and others that preferred online attendance.

The deliverables included:

- The provision of soft printable copies of training manuals with printing instructions.
- Continuous Professional Development points (CPD) for trainees attending each training session.
- Certificates of attendance for each trainee summarising the training or upskilling outcomes achieved.

Objective

The overall objective of the training was to equip South Africans in the energy sector to gain knowledge and have an understanding on the following topics:

- The fundamentals of smart metering
- Smart metering ISO standards
- Health and safety protocols of smart metering
- Detection of smart meter error/dysfunctionality
- Maintenance of smart meters
- Smart meter auditing and verification
- Smart meter data management
- Analysis of meter data, to identify trends
- Optimisation strategies to enhance efficiency and revenue generation
- Integration of the Smart Meters to the Head End System
- Interoperability between various smart meters.

The benefits of smart metering outweigh the cost of the investment when used as intended as real-time use trends allow adjustments to processes and electricity use patterns enabling cost savings, energy savings, decision making for future energy efficiency opportunities, as well as managing the performance of implemented projects.

Highlights

The training was successfully completed, with 217 delegates registered and a 146 recorded as confirmed for

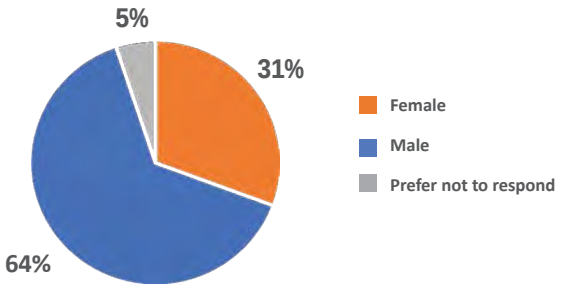
Training Attendees.

attendance, and 137 in attendance qualifying for Attendance Certificates. All delegates had to complete the evaluation to provide feedback on the training to SANEDI.

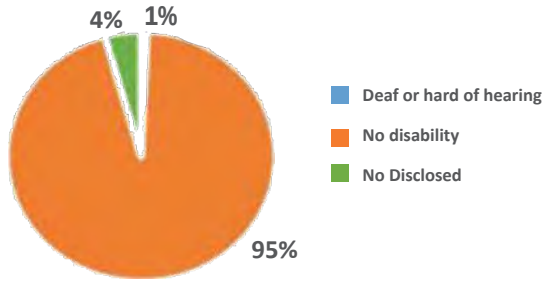
All attendees that were in the venue and online for more than 90% of the time received the credits on their attendance certificates. Those with less than the required hours received certificates without credits. Attendance registers were enclosed for in person delegates and online delegates signed in with tracking. This in in compliance with ECSA and AEE requirements.

Below are the demographics for training:

Gender

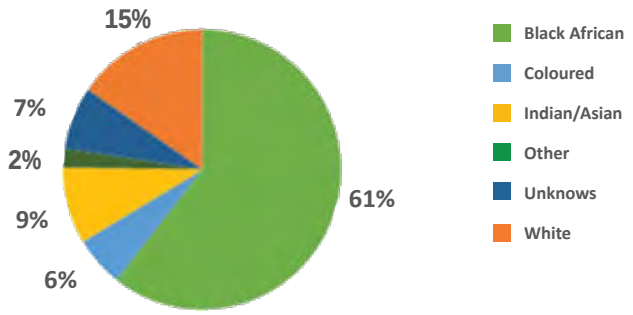


Disability

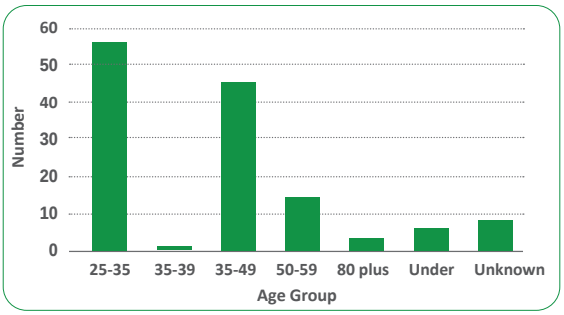


Row Lable	Count of Race
Black African	83
Coloured	8
Indian/Asian	12
Other	3
Unknown	10
White	21
Grand Total	**137**

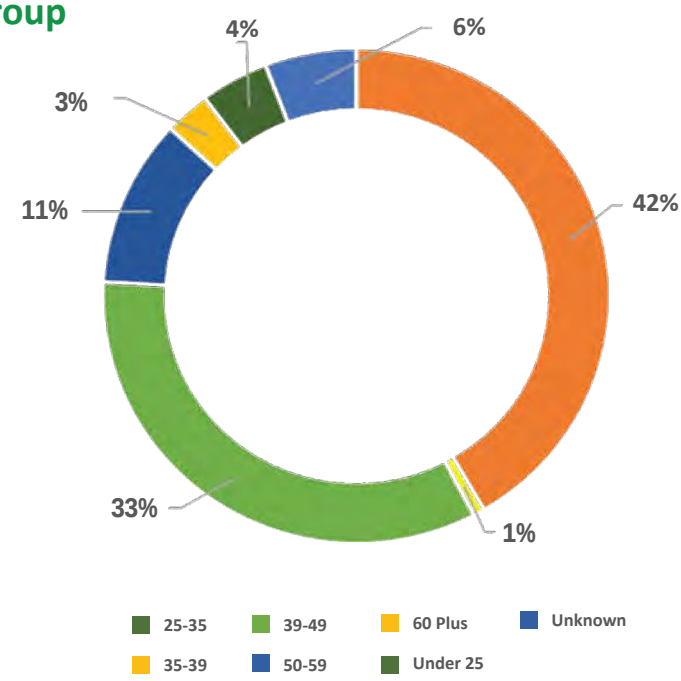
Race



Row Lable	Count of Age Race
25-35	57
35-39	1
35-49	46
50-59	15
60 plus	4
Under 25	6
Unknown	8
Grand Total	**137**



Age Group



The delegates appreciated the opportunity to attend the training, and found it valuable for their own personal development, the municipalities and utilities found it valuable for their work, and the benefits and value of investment in smart metering is realised and understood.

BURSARIES

One of the key focus for the Data and Knowledge Management programme is to develop technical know-how and to provide research support and advice on government initiatives regarding energy data collection, energy modelling and planning.

With the national energy crisis, South Africa requires an increase energy skills and research. It is therefore, imperative to transform the energy research and development (R&D) human capital available to the country, not only by growing it, but by ensuring that women and previously disadvantaged individuals (PDIs) receive sufficient support through a bursary programme. The Bursary Programme assists students who need financial support in the Science, Technology, Engineering and Mathematics (STEM) fields.

To contribute to increasing efforts in energy research, The Data and Knowledge Management programme, through the Just Energy Transition (JET) programme, collaborated with the University of Johannesburg to provide energy related bursaries to post-graduate students for the 2023/24 academic year. The bursary programme is named after the late Mr. Barry Bredenkamp who was the general manager at SANEDI. Barry Bredenkamp was a "struggle veteran" in the energy efficiency revolution and an advocate for skills development in the energy sector.

Objectives

The objective of the Barry Bredenkamp bursary programme was to assist post-

graduate students who require financial support through university education and provided support with all study related costs for Masters and Doctoral students. The Barry Bredenkamp Bursary Programme was awarded to suitably qualified and highly motivated applicants from the University of Johannesburg in the Faculty of Engineering & the Built Environment and Faculty of Science to undertake Postgraduate research (Masters or PhD) under the thematic area of Power Grid Digitalisation:

- E-mobility technologies and adaptation, Monitor Green E-mobility strategy.
- Charging of electrical vehicles (EV), charging infrastructure, location, cost.
- Coordinated Voltage Regulator and Smart Inverter Settings with High Levels of Distributed Energy Resources (DER)
- Cybersecurity considerations for Distributed Energy Resources
- Restricted Security Area Surveillance based on Power System Digital Twins.

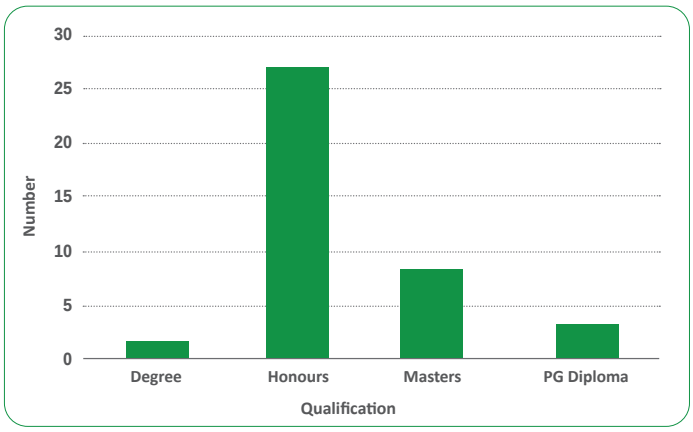
Benefits of Bursary Programme

The relevance of the Barry Bredenkamp Bursary Programme was:

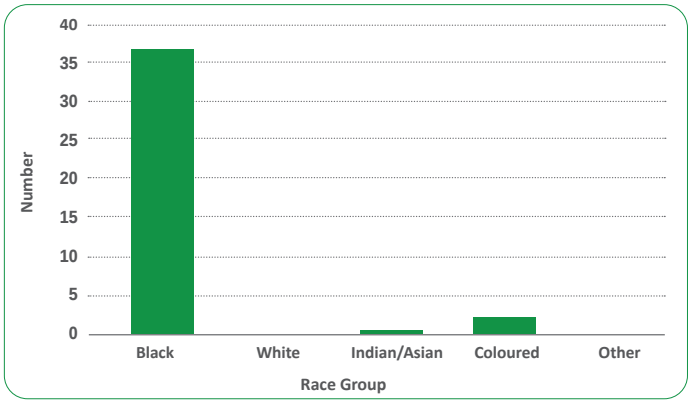
- Contribution of the Barry Bredenkamp Bursary Programme to the promotion of research in Power Grid in higher education institutions
- Increase participation of Science, Technology, Engineering Mathematics (STEM) field in the energy sector
- Capacity of the Barry Bredenkamp Bursary Programme to address the particular needs and constraints of the target groups and to provide access to higher education for students, in particular those from disadvantaged groups and female students
- Potential to improve the skills and competencies of students

Highlights

- The bursary shared via the UJ student email to over 4000 UJ students and UJ staff
- In total, 39 applications were received.
- 11 applicants were women, whereas, 28 were men.
- The Bursary was awarded to 5 Masters and PhD Students
- 100% youth were awarded as the bursary criteria was targeted at youth



Qualifications of Bursary Applicants.



Racial Diversity of Bursary Applicants.

MASTERS AND PHD
Energy tracers

The trace investigation of Energy Masters and PhDs (Doctor of Philosophy) in South Africa is undertaken by the South African National Energy Development Institute (SANEDI) in collaboration with the University of Pretoria. The aim of this investigation is to identify the thematic energy research activities in South Africa at Masters and Doctor of Philosophy (PhD) level and develop base line statistics. Such information is of critical importance for funding selective support for the field and to undertake priority implementation and produce the required skills in the field of energy.

Knowledge of the thematic priorities of PhDs and Masters is of critical importance for matching skills with available and new jobs. Similarly, time series analysis can provide information on how numbers of energy PhDs are linked to the total number of PhDs produced in the country. The deliverables included:

Objective of the Study

The objective of this proposed trace investigation is to identify the thematic energy research activities in South Africa at Masters and PhD level and develop base line statistics. Specific Objectives:

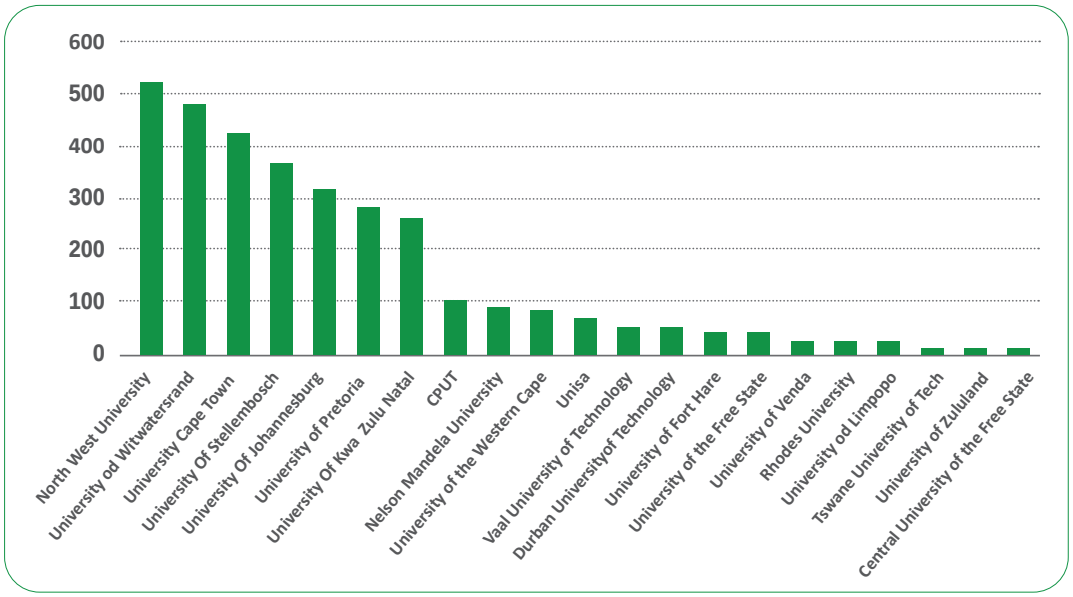
- Identify the thematic priorities of energy PhDs and Masters during the period 2010-2019 (base-line statistics)
- Link energy PhDs to Masters and total number of PhDs in the country.
- Link thematic priorities at PhDs with thematic areas emphasised at Masters level.
- Interoperability between various smart meters.

Benefit of the Study

- Knowledge of the thematic priorities of Masters and PhDs is of critical importance for matching skills with available and new jobs.
- Put in place strategies for previously disadvantaged individuals/institutions.
- The information can also be used to identify the academic pipeline of emerging scholars.
- Masters & Doctoral education and training in any country is a lengthy and costly process. This makes it imperative that policy makers (including funding agencies) are informed about the return on this investment.
- The results of the investigation can be used to gain a deeper understanding of the common trends in energy research.

Highlights of the Study

- In total 3140 Masters were produced from 2010 until 2019.
- The University of North-West produced 506 Masters followed by the University of Witwatersrand and UCT with 455 and 409 Masters respectively.
- The annual production increased from 204 Masters during 2010 to 406 during 2019.
- From the year 2010 until 2014 a total, 250 PhDs were produced.
- The University of Kwa-Zulu Natal produced 58 PhDs followed by the University of Witwatersrand and University of Pretoria with 44 and 27 s respectively.



Number of Energy Masters Graduate 2010 – 2019 by University.

ENERGY
Efficiency

ACTIVE DEMAND SIDE MANAGEMENT (DSM) in South Africa

Energy efficiency is often seen as a 'nice to have' or only for 'big corporations' but not applicable at home or to small to medium businesses because it is expensive or not necessary.

> ***"We simply must balance our demand for energy with our rapidly shrinkin resources. By acting now, we can control our future instead of letting the future control us." ~ Jimmy Carter***

South Africa continues to face an energy crisis as a result of several issues, such as energy inefficiency, Eskom's operational and financial problems, policy and regulatory ambiguity, inadequate system design, a lack of capacity, a lack of investment in new power generation, aging infrastructure, ongoing maintenance; breakdown issues with coal-fired facilities, and an increase in demand for electricity that cannot be meet by the grid. Now when Eskom struggles to achieve the desired energy availability factor (EAF), the energy crisis became evident. This compelled Eskom to act quickly and introduce load shedding in 2007 (a demand side response of planned outages to help a strained grid). Demand response, which shifts or curtails energy demand during peak times to help the utility grid when needed, has always been implemented through incentive-based schemes with a focus in energy intensive load stakeholders.

However, in 2007 a rise in supply constraints from the utility grid led to the implementation of demand response through load shedding to all customers in varying levels. Load shedding has become worse with stages ranging from stage 1 (need to conserve 1,000 MW, equivalent to a million kettles) to stage 8 (required to save 8,000 MW, equivalent to 8 million kettles). Studies show that since the beginning of 2023, there have been around 2 896 hours of load shedding. The economy, investor confidence, and the standard of living for all citizens have all been severely impacted by load shedding. While load shedding poses a socioeconomic difficulty, its purpose is to prevent a total blackout, which might have catastrophic consequences if it ever were to occur.

The South African government has implemented a number of initiatives to lessen and ultimately eliminate load shedding, with an emphasis on expanding the energy supply system however these have been hampered by additional difficult issues such as slow implementation, capacity and skill shortages, poor coordination, and insufficient investment amongst others.

With that said, consumers are subjected to electricity price increases that are higher than inflation. Everyone, regardless of economic level is affected by the increasing cost of electricity, hence the growing rate of rooftop solar PV integration as a cheaper alternative. It has become apparent that energy security, and affordability is a serious issue in the country hence more citizens resort to illegal connections and stealing electricity. There is also a lack of energy-saving awareness for consumers. As a result, it frequently takes an informed individual or organisations to identify and implement energy efficiency, demand response, or behavior modification solutions to lower consumption and costs. Amongst other issues, it is due to inadequate energy efficiency practices and limited access to energy-saving technologies that consumers pay high electricity bills. Consumers will continue to pay high electricity bills as a result of rising electricity tariffs, market saturated inefficient appliances, inadequate insulation, lack of regulation that promote efficiency and unchanging behavior.

Theft and unauthorized connections disrupt the network, which leads to expensive cable maintenance/replacement or overall electricity system disruptions. Additionally, this has an impact on distributors such as municipalities to effectively collect and account for energy bills (revenue). However, the lack of affordable electricity drives people to steal it. It is not a recommendable act to steal electricity for any reason because of the amount of investments that goes into generation, transmission and distribution to obtain power as end-users, therefore the government should empower communities in order to eliminate poverty for socioeconomic growth that leads to access and affordability.

On the other hand the big issue of load shedding disruptions is affecting everyone, especially those that cannot afford small-scale embedded generation. Investing in small-scale embedded generation such as rooftop solar photovoltaic is recommendable and good for the environment. However, it has some charges when consumers remain grid-tied. This causes more challenges especially for system distributors/ operators and the possibility of bidirectional power with high share of grid-tied small-scale solar PV systems being a big concern. End-users are also being affected by the high cost of electricity, similar to load shedding. Because of this, more businesses are searching for alternatives, such as energy-saving techniques and small-scale integrated generation. Similarly, some homeowners are managing their energy use, particularly for high-energy appliances like hot water heaters. Demand side management (DSM) interventions with strong payback periods and low capital requirements are undoubtedly necessary for all South Africans to take part in, if we plan to assist in balancing energy supply and demand. DSM is often the last resort, being overtaken by the integration of renewable energy sources with high capital requirements. Research has demonstrated that installing rooftop solar PV will cost less capital when combined with DSM measures.

It is advised to begin with an energy audit to find areas where energy and money may be saved, then invest in and take advantage of those opportunities before integrating solar photovoltaic systems and other backup options like battery energy storage systems. Now energy efficiency (EE) is a technique under demand side management (DSM) implemented to use less energy to deliver the same goods and services, whilst significantly achieving energy-cost savings. The goal of EEDSM is to reduce energy consumption, reduce/shift peak demand whilst achieving cost savings. Therefore, EEDSM can also help to lessen load shedding and to stabilise the grid.

Although there has been careful planning in terms of policy development, strategy decision (National Energy Efficiency Strategy-NEES), funding, and implementation goals (NEESP), engaging stakeholders particularly those in the residential sector presents a significant challenge because of either a lack of energy efficiency knowledge and the fact that the majority of residents are trapped in poverty to even be keen to participate in DSM interventions.

Active Demand Side Management (DSM) refers to the collaborative strategies and measures undertaken by governments, utility companies, businesses, organisations

and different load stakeholders (residential, commercial, industrial sector) to manage the patterns and levels of energy consumption. Often DSM directive uses a top-down approach whereby end-users (residential sector) are encouraged to reduce energy usage by switching off power when not in use. The top-down DSM approach has been well received and popularized by intensive energy users because of the incentive-based demand response schemes. These schemes aim to encourage energy intensive industries to adjust their electricity usage in response to grid constraints with a contractual agreement to receive financial incentives for doing so. However, the top-down approach has its limitations when it comes to the residential sector because it's not an enforcement but a plea whenever the grid is stressed for end-users to switch off or reduce consumption. This means an end-user is not forced to comply switching off unused appliances such as lights, geysers as shown by pole results undertaken by Eskom this month of February 2024 in Figure 1 below.

One could assume that with the constant load shedding events increasing in stages, high energy bills that results in high cost of living, everyone is taking part in achieving energy-cost savings through simply implementing DSM measures. Imagine how our grid would look today if around 89.30% of South Africans with access to electricity committed to supporting government attempts to end load-shedding. They could do this by contributing to energy efficiency, demand response, and behavior changes. However, the reality is that majority of people lack awareness and often DSM interventions are preached to the 32% converted in conferences, seminars, webinars etc. Perhaps a lack of residential incentives, lack of awareness about the advantages and necessity of implementing DSM is the reason why so many people do not prioritize this intervention.

Despite the fact that a lot of initiatives, support from policies and regulations, and supply-side assistance are being provided to end load shedding and provide energy security for South Africans. By lowering energy usage across the load profile, demand side measures might accelerate that process (reduce morning and evening peak demand) of finally getting rid of load shedding. Yes, it will take different solutions, starting with EEDSM. With that said, end-users can benefit greatly from the implementation of an active demand side management program in a number of ways, including reduced environmental impact, enhanced small-scale embedded renewable integration, cost savings, and optimised electricity usage. It can also lessen the requirement for Eskom to use backup reserves by making the electrical system more sustainable and efficient.

Because of the advantages of EEDSM, the SANEDI Energy Ffficiency programme recently created a sub-program called Balancing Energy Supply-Demand (large-scale roll-outs). Although the sub-program is still

Eskom Hld SOC Ltd social media post

in its infancy, its primary goal is to promote the widespread implementation of DSM measures, with a particular emphasis on the residential sector. Yes, behavior change and awareness-raising are still important components of DSM, and they will continue to be so in concurrent with the large-scale implementation of scientifically proven DSM solutions. Like anything else, this is a significant investment when conducting large-scale roll-outs, that needs to be well coordinated and planned in order to prevent repeating the mistakes made in the past when attempting large-scale energy roll-out initiatives. In order to acquire funding for large-scale roll-outs t projects hat will produce excellent results, the sub-programme is analysing various study outputs and recommendations and attending pertinent energy industry engagements (webinars, conferences) to understand the current opportunities and challenges within the the DSM field.

Demand side management (DSM) must be actively implemented by all South Africans. This can be done in a number of ways, such as spreading awareness through word-of-mouth, changing behavior, purchasing energy-efficient appliances (A+), moving usage from peak to off-peak times (smart controls), or any combination of these. The main objective is to end load shedding, which will have an impact on socioeconomic growth and contribute to a more sustainable future. According to Wikipedia, the proverb "It takes a village to raise a child" refers to the idea that for children to experience and grow up in a safe and healthy environment, a whole community must come together to support and encourage them. Likewise, in order to put an end to load shedding, save costs, and ensure that present and future generations may live in a sustainable environment, the entire community must unite in support of and implementation of DSM measures with other energy solutions from the residential, commercial, and industrial sectors.

Energy Performance Certificates
Annual Energy Insights 2023/24

Ms. Nqobile Ngcobo, Ms. Sinovuyo Noji and Mr. Lesley Ramaila

> ***The Regulation empowered SANEDI by mandating it to maintain the National Building Energy Performance Register (NBEPR) which holds relevant EPC data and building particulars.***

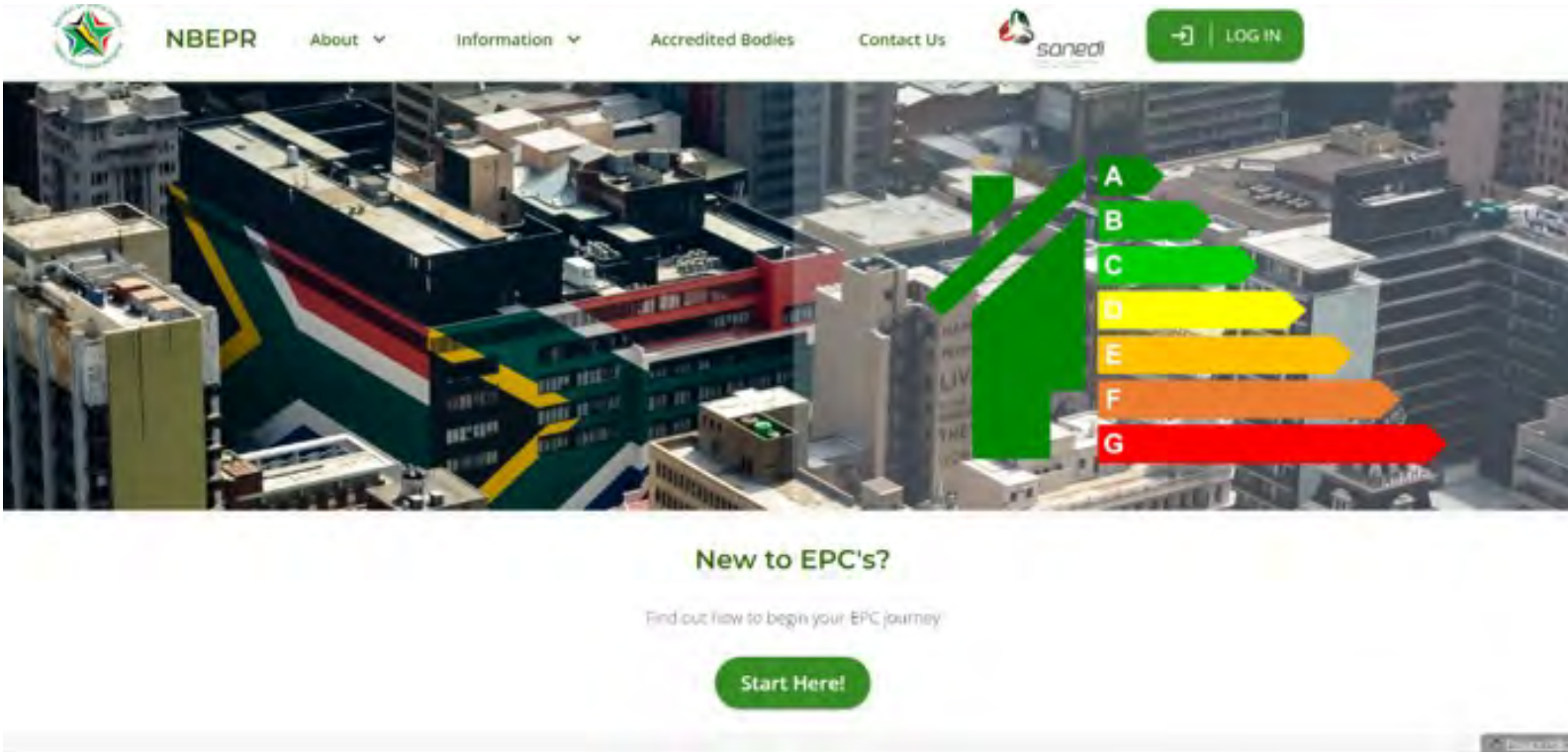
The Energy Performance Certificate (EPC) Regulation has been in effect for the past four (4) years and has since had two (2) amendments, the first one extended the deadline to compliance to 07 December 2025 and in August 2023, the second one, introduced compulsory registration of the type and size of buildings where building owners and accounting officers would have to register their building's occupancy classification and the total floor area within the National Building Energy Performance Register (NBEPR).

In addition, the second amendment stipulated that from 31 July 2024, EPCs will no longer be issued by a SANAS Accredited EPC-Inspection Body (EPC-IB) but by a Registered Professional. These Registered Professionals are individual professionals who will be registered by SANEDI to undertake the issuance of Energy Performance Certificates (EPCs) in accordance with the EPC standard SANS 1544:2014.

With the statement above, the EPC Subprogramme focused on the development and deployment of an online National Building Energy Performance Register (NBEPR) database and web platform. This online portal is intended to be utilised by stakeholders across the spectrum of the EPC sector. The goal and mission is to ensure that buildings who need to comply meet it without any hinderances.

Purpose of the online National Building Energy Performance Register (NBEPR)

- To ensure that the process to compliance with the Regulation is seamlessly met by building owners and accounting officers within the stipulated deadline.
- To host, maintain and display relevant energy performance data of non-residential buildings within the public and private sector for the purpose of establishing new energy efficiency targets for buildings in South Africa.



The newly developed EPC webpage in line with the online National Building Energy Performance Register (NBEPR)

- To support policy formulation and implementation using credible datasets.
- To evoke an energy efficiency consciousness to owners and occupants of buildings, for them to embark on the energy efficiency journey.
- To contribute to the global climate change goals and to showcase the international best practices used.

With this being said, the Subprogramme was compelled to develop and deploy an online NBEPR portal which serves as a register and data repository of all buildings within the regulated building classifications and sizes. This portal accommodates building registrations, issuing of EPCs by the SANAS accredited Inspection Bodies and hosting of certified copies of EPCs.

Benefits of the NBEPR

- It is an online portal which is accessible to all user and can accommodate high volumes.
- It is a register which holds credible data pertaining the energy performance of buildings as datasets submitted are an outcome of assessment conducted using SANS 1544: 2014.
- The datasets are not only limited for the use of energy performance certificates but go beyond the scope which can ultimately inform
- To encourage building owners and or accounting officers to improve the energy performance of their buildings so that they are more efficient and ultimately have A-rated buildings.

The NBEPR is a one-stop robust, stable, accessible, and effective online platform that acts as a register which includes particulars of all registered buildings that fall within the regulated building occupancy classifications, as well as all issued Energy Performance Certificates (EPCs) together with relevant assessment data of all buildings within the regulated building classifications in South Africa.

The NBEPR platform has been designed to accommodate 4 sectional portals namely,

- Registration of buildings,
- Application and issuing of Energy Performance Certificates,
- Submission of certified EPC copies and;
- A revamped website.

Functionalities of the NBEPR platform

Registration of Buildings

Building owners and accounting officers can now register buildings, however they must create their profiles to activate their user account which will give them access to the portal. The registration portal is a user friendly and easy to process.

The building registration portal consists of a 5-step process for a user to successfully register their building, the steps are as follows:

- **Step 1:** The primary and alternative contact individuals that need to be contacted for further enquiries or documentation regarding the registered building, normally this will be the building owner and/or accounting officers and/or their secondments details.
- **Step 2:** Entity details of the managing organisation/ institution and their ownership status over the building being registered, the organisation/institution is also required to allocate a SANAS Accredited Inspection Body to the building for the purpose of EPC application process.
- **Step 3:** Population of the building address information of the building being registered (specifically, the street, suburb, city, province, and zip code).
- **Step 4:** Building energy details consisting of the building's current energy consumption, including billing method, metering method as well as an overview of the current usage and cost over a period of 12 months.

- Step 5: Building occupancy including the building's occupancy classifications as stipulated on the occupancy certificate, number of floors within the building starting from ground floor, the square meters of the building, year of construction, year of building plan approval, date on the occupancy certificate, year of last major renovation.

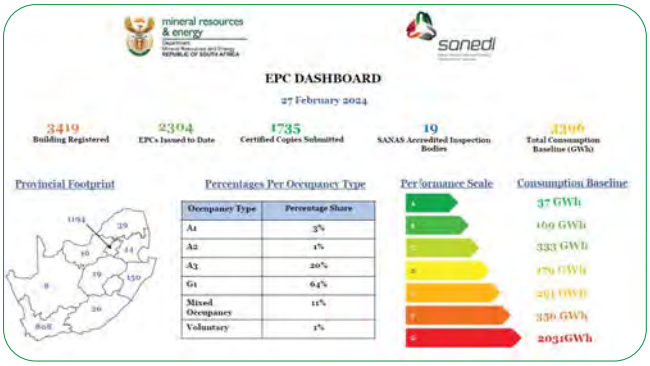
After populating all the required fields, the building will be registered successfully, and the user will automatically receive a building registration number for the said building.

Application and Issuing of Energy Performance Certificates

This is conducted by the technical expert, in this context it is the SANAS Accredited Inspection Body, The SANAS body, once appointed by the building owner or accounting officer will conduct an assessment in accordance with SANS 1544:2014, thereafter they will need to populate the collected and analysed datasets onto the NBEPR. SANAS body will be granted access to the registered building by the building owner or accounting officer by selecting the applicable SANAS body. Once selected, the SANAS body will be able to populate the database and issue an EPC. The SANAS body needs to sign off and upload the signed off certificate onto the NBEPR.

Submission of Certified EPC Copies

This function has been made accessible only to building owners and accounting officers, to submit their certified EPC copies that within 3 months from date of issue as stipulated in the EPC regulation. The system also accommodates for bulk uploads which are used primarily



EPC Dashboard Analysis from the National Building Energy Performance Register as at 27 February 2024

for uploading large quantities of data when registering buildings and submitting certified EPC copies, which is convenient for entities with a large portfolio of buildings across South Africa.

Online Website

The development of the website consists of public web pages with Energy Performance Certificate related contents for all groups of stakeholders namely;

- The dashboard containing the overall metrics and statistics regarding the current building registration, energy consumption certifications data,
- Featured articles that contains all the articles that have been posted onto the site, along with any attached images to be viewed by the different users,
- Frequently Asked Questions (FAQs) that contain commonly asked questions and answers categorised and viewable by any user,
- A contact us form which is used by users wishing to request information or comment on anything that is not supported by the system directly.

The Subprogramme administers the National Building Energy Performance Register (NBEPR) and has the function of managing, monitoring all user portals and ensuring that the database contains accurate and credible data for research and policy formulation and implementation as required by the Department of Mineral Resources and Energy (DMRE).

The EPC database allows SANEDI to showcase an overview of the consumption usage in the various occupancy classifications which will add value to policy making in terms of determining which buildings would require to implement energy efficiency interventions which will ultimately reduce the use of energy consumption and contribute to mitigation of the carbon footprint for those buildings based on credible data.

Based on figure 2 we see the total consumption baseline is 3396 GWh/annum, this baseline is high considering there are only 2304 certified buildings, the dashboard also depicts that according to the energy efficiency scale most of these buildings are G-rated. Also, we see an uptake in the registration of buildings after 5 months since its promulgation, there's also 75% of building owners and accounting officers who are fully compliant to the EPC regulation against the certified buildings. Fully compliant speaks to building owners or accounting officers who submitted their certified EPC copies.

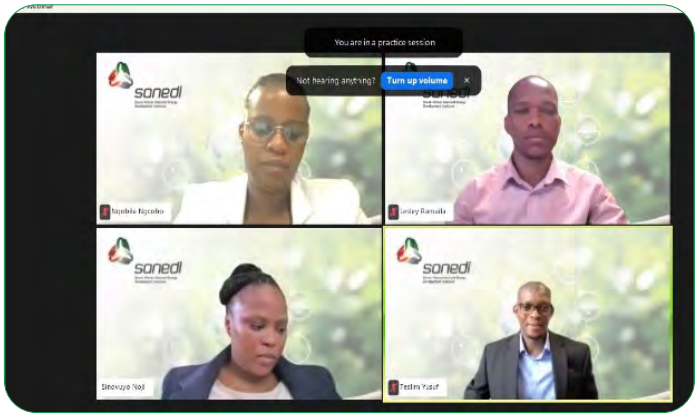
It should also be noted that of the 2304 certified buildings, 907 obtained EPCs between 2021 and 2022 and are about to reach their 5-year validity period, therefore the first set of renewals will occur in 2026.

Awareness and Stakeholder Engagement

The Subprogramme promoted awareness through various stakeholder engagements within this financial year, the main highlights were the production of two (2) EPC videos in August 2023 and hosting two (2) online webinar series in October and November 2023 with various stakeholders. The EPC videos were created to bring awareness to all relevant stakeholders of the EPC regulations and the steps taken to apply and obtain an EPC.

This online webinar series was designed to guide relevant individuals from the private and public sectors on how to use the then newly released building registration portal of the online National Building Energy Performance Register (NBEPR) platform to register their buildings in compliance to EPC Regulation.

EPC Videos launched in August 2023



EPC Webinar held in October 2023

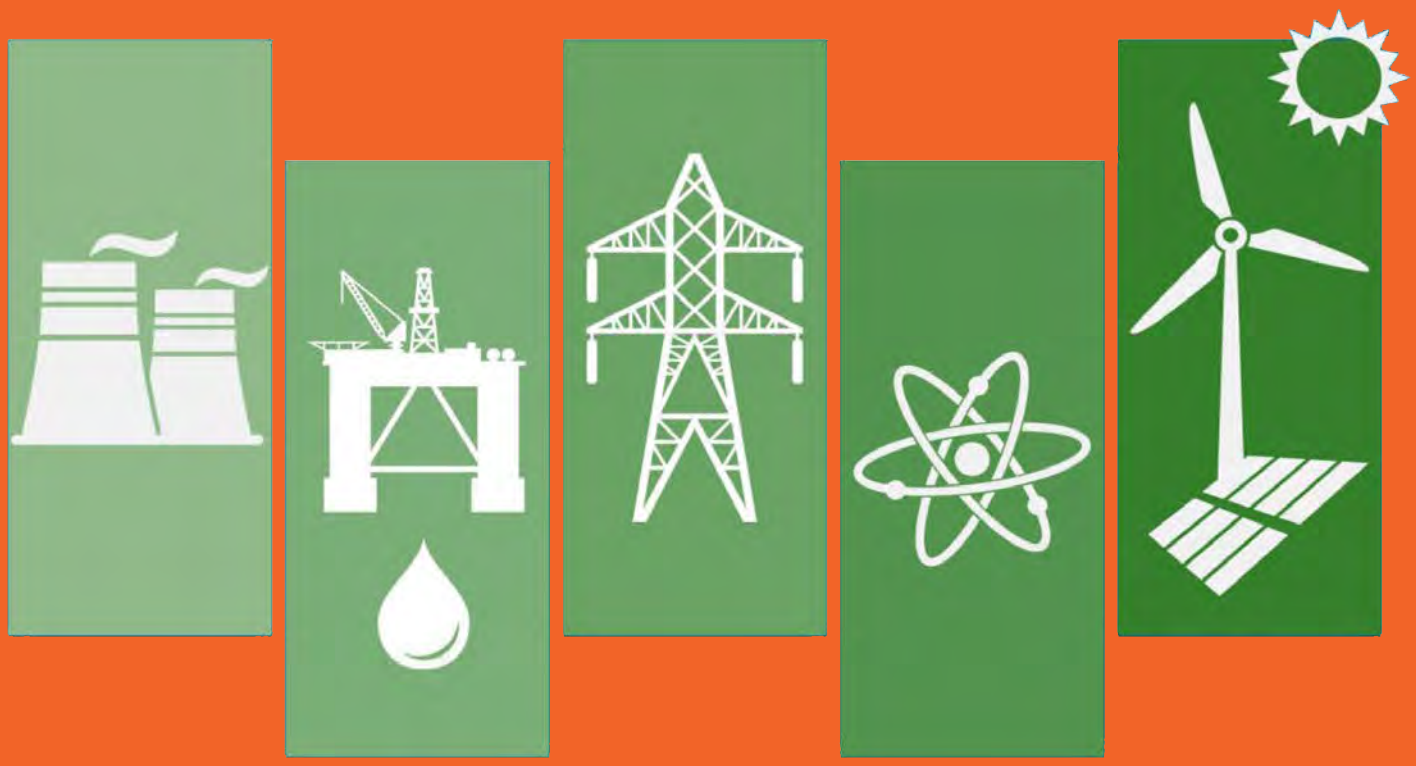
Tanzanian Delegation with UNDP on EPC Study Tour

SALGA Workshop with Municipalities in Mpumalanga

SALGA Workshop with Municipalities in Limpopo

Reference

Department of Mineral Resources and Energy: Notice 700 of 2020 and 1937 of 2023



ESCo MARKET Devevelopment

The ESCo Register was elaborated by DMRE, SANEDI, GIZ and SAEEC. World Bank supported an ESCo Market Development study elaborated by Econoler and Carbon Trust.

> ***Energy Efficiency as a first fuel to cope with energy insecurity***

International experience and the results of the local market review suggest that for longer-term market support, institutional interventions or long-term programmes that change the operational approach of Financial Institutions are preferred over short-term subsidy or incentive-driven programmes. Two financial mechanisms, a Super ESCo and a dedicated EE debt fund, are proposed as means to address market barriers and also to have catalytic and multiplier impacts. It is noted, however, that these are not mutually exclusive to other interventions, including certain shorter-term financial mechanisms.

Accelerating EE Investment in South Africa through a Super ESCo Model Approach

South Africa has an established ESCo market with 131 ESCos (2022) listed in the SANEDI Register and more are not registered. However, since the end of Eskom DSM programme, it seems that ESCo activities have slowed down. As no aggregate turnover data for the ESCo industry are available, it is difficult to quantify the actual ESCo market size (excluding non-EE activities) and trends.

We can therefore assume that the South African ESCo sector certainly exists but is still at an early stage and waiting for a business accelerator. The only external existing elements accelerating the market are the 12L tax incentive scheme and the Building Energy Performance Certificates that drive some business activity.

The South African EE market is not unlike many early-stage markets around the world, with a series of common challenges that include barriers hindering the

widespread implementation of EPCs. The Super ESCo approach can help tackle obstacles in both the public and private sectors since it can be well-positioned to overcome obstacles. This could be an option for the Energy Efficiency in Public Buildings and Infrastructure Programme (EEPBIP) implementation. With regard to Public Infrastructure, EE in the Water and Sanitation sector needs to be incubated by ESCos to rehabilitate the ailing state of water treatment plants and to expand the ESCo Market in SA.

The Super ESCo could foster the growth of a domestic ESCo sector assuming adequate government support. What follows are results that the Super ESCo can expect to achieve in the South African EE market.

Increasing Competitiveness in the Market by Developing Local Capacity

The SA ESCo market has many companies that are able to perform a wide number of activities and master several technologies. These ESCos are mainly classified by the SANEDI Register as Tier 1 companies. However, even among Tier 1 companies, only a few are really large. Based on this, only a few ESCos can act as integrators of complex projects implementing and guaranteeing a diverse selection of EE measures (e.g. lighting, HVAC, pumps, and motors).

As a first step, the Super ESCo initiative can help tackle this barrier by facilitating the creation of new ESCos through capacity building workshops to allow both small companies to diversify and new companies to operate as ESCos much more rapidly. Technical assistance (TA) and due diligence can also be channelled through the Super ESCo when smaller ESCos conduct Investment Grade Audits (IGAs) and prepare feasibility reports. TA can also include project integration, M&V, and project implementation best practices. Partnerships aimed at tendering between large and small companies will be viewed favourably. Aggregating smaller ESCos could also lead to new larger ESCos capable of bidding on more complex projects.

Taking as a reference the Etihad ESCo (135 projects in the building sector in the first four years), it can be assumed that 30 to 40 or more projects could be implemented per year within a short time. This means that, even with some ESCos being awarded several bids, there is room for more very large ESCos in SA.

ESCo aggregation, dimensional growth, and developing public sector experience are all positive elements that will flow toward the private sector. Once the ESCo market matures, the Super ESCo will develop its own internal ESCo ratings and quality controls and standards as well as guide government policy to create a more sophisticated ESCo market. It will also provide feedback to SANEDI and work with them to further reinforce the SANEDI ESCo Register.

Energy Efficiency in the Water and Sanitation Sector

The energy consumption of water and wastewater treatment plants amounts to approximately 35 % of the municipal energy consumption beside Public Lighting in Buildings and Streets.

Huge potentials for EE in the Water and Sanitation sector can be achieved by modernising the aeration technology in the course of water treatment for both, fresh water and wastewater. The conversion from surface aeration by motors and propellers needs to be shifted to fine bubble aeration from the ground of a treatment basin powered by compressed air. The energy savings for fine bubble aeration are around 60% compared to surface aeration which is another fuel for municipal energy security.

Another fuel for energy security is the implementation of Cogeneration (CHP) powered by biogas on wastewater treatment plants. Around 55- 60 % of the plant energy consumption can be covered by own generation of electricity through Cogeneration.

As water treatment plants provide often a spacious area further electricity can be generated by Photo Voltaic (PV) sun panels to cover the remaining need of electricity.

Holistic concepts for Energy Efficiency need to be developed and implemented to make the water and wastewater treatment plants “Energy plus” as state of the art implementations in the US and Europe are showing. Holistic Energy Efficiency concepts in the Water and Sanitation Sector are another fuel and milestone for energy security.

The way forward

This gained knowledge by SANEDI ESCo Team of ESCo Market Development with the support of World Bank must be further digested and further disseminated in the SA ESCo Market and their stakeholders including financing institutions and commercial banks. An appropriate financing mechanism such as a recommended Revolving Fund must be studied and understood by all participants including Government.

DSI ENERGY SECRETARIAT

POWERING THE FUTURE
South Africa's Ambitious Hydrogen Strategy

Embrace the energy revolution: green hydrogen, already a reality, is set to reshape our energy future, heralding a new era of sustainability and innovation.

In the pursuit of sustainable energy solutions and economic growth, South Africa has embarked on a groundbreaking initiative known as the Hydrogen South Africa (HySA) Flagship Programme. Rooted in the National Hydrogen and Fuel Cell Technologies (HFCT) Research, Development, and Innovation (RDI) strategy, the HySA projects represent a visionary approach to harnessing the potential of hydrogen as a clean, renewable energy source. This comprehensive strategy not only aims to enhance energy security but also positions South Africa as a global leader in green hydrogen production and export.

The HySA Programme encompasses a multi-faceted approach, spanning research, development, and commercialization efforts across three distinct sub-programmes: HySA Systems, HySA Catalysis, and HySA Infrastructure. Each sub-programme is strategically designed to address key challenges and opportunities in the hydrogen and fuel cell technology landscape, with a focus on innovation, efficiency, and sustainability. From the development of hydrogen fuel cell systems and prototypes to the advancement of catalytic processes and infrastructure for hydrogen production and distribution,

Hydrogen Solar to Hydrogen Mobile Refuelling Systems and linked to renewable energy for mobile applications.

Members of the Project's Joint Coordinating Committee (JCC) at HySA Infrastructure in Potchefstroom on 14 Nov 2023

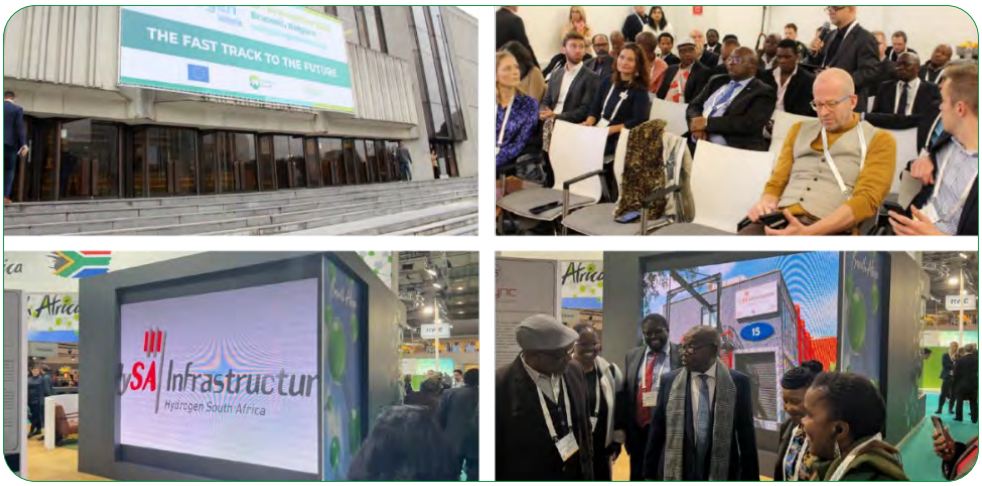
HySA Infrastructure exhibiting at the South Africa Green Hydrogen Summit

the HySA initiative represents a transformative step towards a more sustainable and prosperous future for South Africa and beyond.

By zooming in to one of fantastic work done by HySA infrastructure at the North-West University (NWU) as a Centre of Competence which is the development of integrated Hydrogen Solar to Hydrogen Mobile Refuelling Systems and CLIENT II linked to renewable energy for mobile applications and supporting infrastructure for ammonia infrastructure facilities. Based on Solar-to-Hydrogen project evidence that it is finally appreciated by Industry (i.e., Toyota South Africa used it for refuelling of the Mirai), ended up coming on board in projects pilotation.

The DSI Energy Secretariat's role in advocating for collaboration with other nations to reinforce the principles of the hydrogen South Africa projects is indeed pivotal. By participating in a series of hydrogen conferences both domestically and internationally, they aim to attract the attention of institutions and entities investing in green hydrogen production. One notable collaboration is with Japan, focused on a project titled "Development of New Ammonia Synthesis System using Renewable Energy and Hydrogen." This collaboration took a major leap in advancing towards hydrogen-related technologies and solutions. The gathering in Potchefstroom for the second meeting of the Joint Coordinating Committee (JCC) between the Hydrogen South Africa Centre of Competence (HySA) at the North-West University (NWU) and JICA partners, held in a hybrid format, demonstrated the commitment of all parties involved to drive progress in hydrogen-related initiatives. Such meetings provide a platform for exchanging expertise, sharing insights, and fostering deeper collaboration towards achieving common goals in the realm of green hydrogen production and utilization.

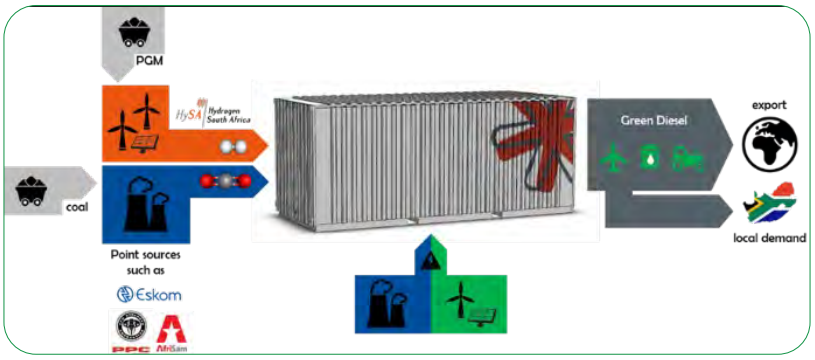
HySA Infrastructure showcased South Africa's potential as a leading green hydrogen production hub at the South Africa Green Hydrogen Summit (SAGHS) 2023 in Cape Town, exhibiting working demonstrators and contributing to the successful booth design alongside other entities. The Energy Secretariat under the South African National Energy Development Institute (SANEDI) invited North-West University to be part of South Africa's Ministerial delegation during hydrogen week in Brussels underscores the nation's commitment to global hydrogen initiatives and the recognition of expertise within the field. These efforts collectively advance South Africa's position in the global hydrogen market and contribute to building a capable state through innovation and collaboration.



SA Ministerial delegation in Brussels for the H2 Week, 20-24th November

COAL CO2-X PROJECT:
Power-to-Liquid

The economy of sub-Saharan Africa is expected to quadruple in size with its population doubling in the next 20 years. With this, the region's energy demand will increase drastically which will coincide with largely increased emission levels of the greenhouse gas carbon dioxide (CO^2) as long as the energy source is fossil-based. In order to address curbing this impact of CO2, the South African National Energy Development Institute (SANEDI) being led by the Department of Science and Innovation (DSI) Energy Secretariats within SANEDI, came into an agreement with the University of Cape Town and North-West University HySA Infrastructure to develop a Technology/IP that produces low-cost green diesel that is free of sulphur or and can be used locally or exported.



The conversion of flue gases from hard to abate industries into green diesel.

The Coal CO^2-X Project involves capturing, separating, and converting the flue gases that are emitted from the power plant into a variety of commodities. A built-and-commissioned IP called "Power to Liquid Technology" that is containerized (Figs. 1 and Fig. 2) is converting captured CO^2 from these gases and combines it with green hydrogen from the North-West University HySA Infrastructure and catalysts to produce pure green diesel with superior combustion properties compared to conventional diesel (Fig.2).

For a two-stage catalytic process that includes the activation of CO^2 through the Reverse Water Gas Shift reaction and the manufacture of diesel in a Fischer-Tropsch synthesis stage, the UCT research team created new catalysts and reactor concepts over the first three years of the project. The technology, which can be adjusted to produce a variety of products, is applicable to CO^2 from various sources including hard-to-abate industries, biogenic CO^2 and even CO^2 derived via direct air capture.

This project perfectly aligns with the goals of the Carbon Capture, Utilization and Storage initiative—of which South Africa is a member—and the Clean Energy Ministerial forum. Additionally, it is one of the Hydrogen Society RoadMap flagship projects. This project not only reduces CO^2 emissions, but with the money that is being provided by the DSI, it has created employment opportunities for artisans, electricians, general workers, and internships for graduates. It also supports students with a bursary. Through its integrated approach, the project supports government's goal of increased mineral beneficiation of PGMs ore by creating a local hydrogen consumption industry, while at the same time reducing CO^2 emissions of existing infrastructure in line with the Paris Agreement.

SANEDI plays a significant role in the monitoring and evaluation of this project and ensures that the project gives back to the community by employment of deserving individuals, while on the other side bringing change to the community.

Green hydrogen containerized charging station at NWU HySA Infrastructure that can supply green hydrogen for modular diesel production systems.

MASIA VILLAGE:
A water -food- energy nexus

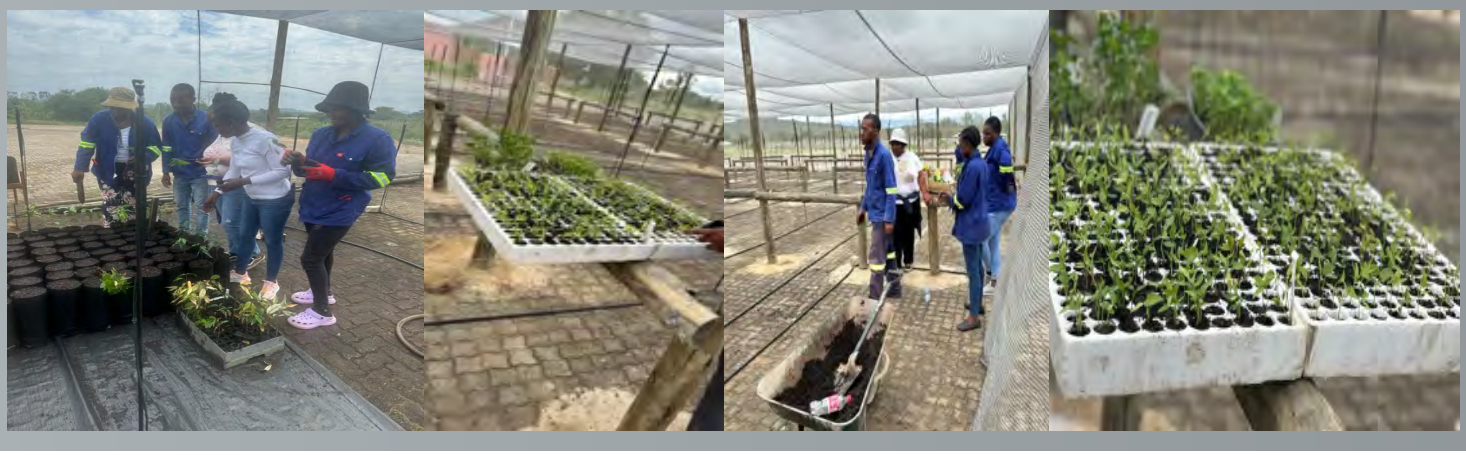
Rooftop Solar PV, battery and inverters. The water storage tanks fitted with water pumping system and the sweet potato field and produce at Masia Village.

Set in Vhembe District Municipality in Limpopo with vast natural resources including cultivable land, suitable for farming with potential for job and wealth creation, the DSI Energy Secretariat at SANEDI in partnership with various stakeholders has enabled the deployment of Renewable Energy technology to optimise this community's development activities.

The Masia Village project is a water- food- energy nexus where agricultural systems are powered by renewable energy and green hydrogen. This initiative boasts a 20x 20m fruit tree nursery, 20x20m vegetable seedling nursery and a 12x15m potting structure, an incubation chamber and two storage spaces. With Masia Village constituting 15 villages, this initiative not only ensures the sustainable development of this community but also food security and job creation. A borehole supplying the building and irrigation requirements has been fully fitted and 5 x 5000L storage tanks and water pumping system installed.

A solar system fitted with 36 rooftop solar PV with a combined total of 19.8 kW and a 20kW Li-ion battery for storage power, a 2.5- 4kW Solar dish Brayton cycle system, a 5kW H2 Fuel Cell system and an additional 20 kWh Li-ion storage power-up the building and the borehole.

This project has lead to job and skills development in the area where youth including TVET graduates, matriculants were trained in solar installation. As an ongoing process, interns are being trained on agricultural production. Employment has been created from the inception of the project including the Managers and 5 TVET graduates being trained to run the centre.



Aspiring future education,
INVEST IN LEARNING

The Renewable and Sustainable Energy RSE Hub, one of the flagship programs under the Department of Science and Innovation-Energy Secretariat (DSI-ES) through the South African National Energy Development Institute (SANEDI), is responsible for designing cutting-edge media and science labs which have all the aspects of 4th industrial revolution and green energy technologies. There are three disadvantaged school in Limpopo which were selected for these demonstrations, namely Mugoidwa Secondary School in Vhembe district, Moloke Primary School in Sekhukhune East district launched by the Minister of Higher Education, Science and Innovation on 24th of March 2023 and the last one is Russels Bungeni Secondary School in Vhembe district. They provide a wealth of changes to address Science Technology Innovation (STI) priorities, particularly in the fields of robotics and coding, internet of things, smart communities, and future-ready education.

Mugoidwa Secondary school Media Laboratory

Russel Bungeni Secondary School Science Laboratory

The laboratories were made from recycled shipping containers joined together and manufactured to provide a secured and aesthetically brilliant piece of structure to secure the equipment. The Mugoidwa lab has been powered with a 2.2 KW solar Photovoltaic (PV) system on the roof and 8.2 kW hours of energy storage which makes it completely off-grid. The smart monitor screen shows the energy generated by the solar PV and the amount that is being used by the computer. The structure is constructed with insulation in the ceiling and walls to protect against sunrays penetration and to cool the lab. The laboratories were designed to accommodate 42 learners. They have 30 computers loaded with google education software and a smart screen for teaching with the South African school curriculum.

This responds to the DSI decadal plan of 2022-2032 and is directly associated with the Societal Grand Challenge #2: “the future education, skills, and work”. RSE Hub and spokes, in collaboration with the Department of Higher Education and Training (DHET), aim to improve the quality of education and internet connectivity in underprivileged areas and provinces. Educators will be equipped with several teaching strategies that will broaden learners’ knowledge. It also drives the agenda of empowering small medium enterprises (SMEs), as solar PV were locally manufactured from Durban.

The Minister and Deputy Minister of DSI will be launching the laboratory at Russels Bungeni Secondary School. This is after a success implementation, monitoring, and evaluation from the DSI-ES under the leadership of Prof Sampson Mamphweli. Two more media laboratories of a similar nature are planned and budgeted for two schools in Mpumalanga and North-West Province.

sanedi

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