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South African National Energy Development Institute.

ENERGY INSIGHTS

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FOREWORD

THE 2021/2022 YEAR HAS BEEN BOTH AN EXCITING AND CHALLENGING YEAR FOR SANEDI. RECEIPT OF A NUMBER OF PRESTIGIOUS AWARDS ARE RECOGNITION FROM INDUSTRY THAT SANEDI 'S CONTRIBUTION TO THE ENERGY SECTOR AND THE IMPACT THAT IT IS MAKING IN SHAPING THE LOCAL ENERGY LANDSCAPE.

Very sadly though, the loss of an esteemed colleague (the general manager of Applied Energy, Research and Innovation) Dr Minnesh Bipath in August 2021, dealt us an unexpected blow and left a big gap for us to fill. Although shattered, we were determined to stay the course in order to ensure that we continue to work towards our ultimate goal of enable transition for sustainable development for the benefit of all south Africans.

South Africans have had to become accustomed to rolling blackouts as ESKOM implemented load reduction interventions in an effort ease the demand load from the Grid. This is undoubtedly very disruptive to economic activity and is having a negative impact on the economic growth and development. It is crucial that these grid availability challenges are addressed and continued investment in research and innovation will enable tackling these matters as well as preventing the repeat of the same in years to come.

Inefficient energy usage continues to plague many parts of the economy and further exacerbating challenges with the Grid. SANEDI in partnership with UCT, commissioned a Residential use study in 2020 with the result that an assessment was made to understand the potential impact of the S&L programme on residential energy usage as well as in assessing the potential for enhanced energy efficiency through extended MEPS as well as EE awareness campaigns to influence changes in use patterns.

There are a number of energy efficiency interventions that SANEDI is currently implementing. The sole objective being to creating efficiencies throughout the economy by implementation of demand side management initiatives and by accelerating the shift by energy consumers through policy support instruments, incentives and other market-based mechanisms. SANEDI's strategy rests on three pillars: climate response, service delivery within the municipal context, and convergence. We continue to pilot technologies that will aid the institute's just transition, and the provision of data and information that supports policy, in order to create an enabling environment.

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To deliver sustainable energy programmes for the future, there needs to be a balance between migrating into a sustainable green economy, energy security and managing the negative impacts of transitioning the economy. With the end prize of trying to achieve a better life for all in mind, we need to ensure that we don't make decisions today that could exacerbate poverty, unemployment and income inequality. By responding to the challenges, we are faced with from a climate perspective, we also need to make sure no-one gets left behind.

Recent geopolitical developments around the world have highlighted again that we exist within a global energy system and challenges in one part of the world can have a significant impact on what transpires at National level. The subject of energy security has come under the spotlight and needs to remain very much at the top of our agenda as we transition. Emphasis also needs to be placed on research and innovations as we continue exploring opportunities that will broaden our energy mix as much as possible, and to place more reliance and focus on developing local technology and skills. The need for ongoing funding for energy research cannot be stressed enough.

"The more we are able to reduce demand, especially from the inefficient use of energy, the more will be available for a more secure and consistent supply."

In South Africa we are confronted with significant numbers of unemployed youths, poverty and income inequality. The energy sector has the potential to mitigate some of these challenges. Through research and development and the deployment of various available technologies we are enabling the government to tackle these social and economic issues.

As a woman in the energy sector and with the recent celebration of International Women's Day, it goes without saying that gender equality is always important. The South African Government has done tremendous work to ensure that the rights of women to actively participate in our economy are protected.

In 2021, we hosted a seminar on 'Opportunities for Women in the Energy Sector' and we recently joined the Department of Mineral Resources and Energy in a similar forum. Both of these events highlighted the opportunities available to women. Sometimes, access to information is the biggest barrier women encounter. We have therefore committed to partnering with them and providing them with as much information as is needed to make informed decisions and significant career moves.

The challenges that exist in South Africa today require extraordinary people who are committed to resolving them and would like to see the country reach new heights. This is Team SA and I encourage each and every one of you to join us and make a difference in growing our economy and ensuring a secure, reliable, renewable and affordable energy supply.

Yours in energy

Lethabo Manamela

ENERGY SHAPESHIFTER 2021

Lethabo Manamela, SANEDI's interim chief executive officer, was awarded the energy sector's premium award as Shapeshifter 2021 by the South African National Energy Association (SANEA).

Under her leadership, SANEDI achieved 97% of its annual targets, despite the Covid-19 pandemic, which placed severe restrictions on funding and constrained the logistical rollout of initiatives. The institute also achieved two years of clean audits.

Lethabo was appointed interim CEO just as South Africa entered its first Covid-19 lockdown in March 2020. Formerly the chief financial officer of SANEDI, Lethabo has shifted shape and successfully applied her acumen to move South Africa's energy landscape.

SANEDI RECEIVES AEE 2021 AWARD

SANEDI has been globally recognised for its hard work in the energy sector, especially considering South Africa's transition from carbon-intensive to a cleaner, more energy efficient one.

The institute received the prestigious annual Association of Energy Engineers (AEE) 2021 Sub-Saharan Africa Region Institutional Energy Management Award for its ongoing contribution to the energy sector. Awards are presented to individuals and organisations around the world for their dedication and performance in the energy efficiency and renewable energy industry.

About the award, Lethabo Manamela says, "I am inspired to make a meaningful difference. We need solutions that are implementable, verifiable and result in real change. We are the solution to South Africa's many challenges. We need to roll up our sleeves and get to work for the good of our great nation."

In addition to the Energy Management Award, SANEDI's Barry Bredenkamp, general manager: Energy Efficiency and Corporate Communications, was recognised with the Sub-Saharan Africa Region Energy Practitioner of the Year Award. Barry was instrumental in getting many of SANEDI's energy efficiency initiatives off the ground.

NEW DIRECTORS TO DRIVE SANEDI'S LOW CARBON MANIFESTO

SANEDI has announced its new board of ten directors to take the organisation into its next phase and further down the road of a low carbon or a net zero future. The board will be chaired by Sicelo Xulu.

Gwede Mantashe, the minister of Mineral Resources and Energy (DMRE), appointed SANEDI's new board members in December 2021. Nominations were accepted in January 2022 and the first board meeting has been held and subcommittees formally constituted.

Chairing the board is Sicelo Xulu, a fellow member and past chief executive officer of the South African Institute of Electrical Engineers. A professional engineering technologist registered with the Engineering Council of South Africa, he has served at a number of entities including City Power Johannesburg where he held the role of managing director. The other board members are: Lungile Mtiya, Abegail Boikhutso, Tumelo Mashabela, Ilze Baron, Jongikhaya Witi and Mthokozisi Mpofu. Noma Qase, Gerhard Fourie and Olga Chauke sit on the board as alternate members.

Lungile Mtiya, appointed as deputy chairperson, comes with more than 10 years' experience in human resources with labour relations, labour law and bargaining council knowledge.
Between them, the directors bring a wealth of proficiency to the table covering industries including clean energy, intellectual property, chemical engineering, climate change, finance, law and human resources. They are all leaders with outstanding reputations in their respective fields and are excited to take SANEDI into a new phase as the global energy industry evolves.

As with Xulu and Mtiya, each new member of the board offers a unique set of skills, deep insight and supports the vision of the future of SANEDI.

Lindiwe Chauke - Department of Fisheries, Forestry and Environment: Lindiwe has wide-ranging expertise in climate change mitigation in multiple sectors including transport, waste and agriculture.

Gerhard Fourie - Department of Trade, Industry and Competition: Gerhard is the chief director for Green Industries in the branch of Industries and Competitive Growth.

Ilze Baron - Department of Trade, Industry and Competition: Ilze is the director for Green Industries in the branch of Industries and Competitive Growth.

Jongikhaya Witi - Department of Environmental Affairs: Jongikhaya is the chief director for Climate Change Monitoring, Evaluation and Migration. He is also a member of multiple professional bodies including the Water Institute of South Africa and the National Association for Clean Air.

Abegail Boikhutso - With 20 years of experience in finance, Abegail brings multiple skills to the board. She has also held various public and private sector roles in the industry.

Mthokozisi Mpofu - Department of Energy: Previously the deputy director general for the Energy Programme and Project Management unit, Mthokozisi is now chief director for Electricity Infrastructure for the department.

Nomawethu Qase - Department of Energy: Currently the director for Renewable Energy Initiatives for the department, Nomawethu has a wealth of expertise in the energy sector.

Tumelo Mashabela - Tumelo is a patent attorney with a decade's worth of experience in intellectual property. She is also a proud member of the South African Institute of Intellectual Property Law. Her patent experience brings significant value to SANEDI as it moves into the technology transfer arena.

WHAT'S TRENDING?

SANEDI's interim chief executive officer and energy sector leader, Lethabo Manamela, identified three key trending issues that she believes South Africa should tackle with greater urgency. These are: energy efficiency, a just energy transition, and a green hydrogen economy.

Energy efficiency, a just energy transition, and a green hydrogen industry are the primary challenges that SANEDI believes should be demanding greater attention. These are critical as we strive to reduce our carbon footprint and ensure energy security, particularly in a currently vulnerable and volatile global energy space.

Energy efficiency

There is a need to promote greater energy efficiency as a highly effective, least-cost means to take pressure off the country's constrained electrical grid. This would ensure a more consistent electrical supply and reduce the need for load shedding. However, large-scale energy efficiency initiatives need to be adopted to make this a reality.

SANEDI, in collaboration with the Department of Mineral Resources and Energy (DMRE), is supporting a new study to assess ways in which South Africa can develop a nation-wide cohort of well qualified Energy Service Companies (ESCOs). These would need to specialise in energy efficiency and provide a full range of services to support measures organisations can take to save electricity.

This also involves working with the World Bank to develop financing models that would be best suited for these ESCOs. The project is underway and will be completed in due course. It has the potential for ensuring that we transform the ESCO market into a vibrant and thriving sector in South Africa. Its objective would be to create jobs, improve energy efficiency within the economy and employ many young graduates who really need new job opportunities. Coupled with the work that is currently being done under the ESCO market development with support of the German-South African Energy Partnership (GIZ) and the DMRE, we are on the right track towards success.

We continue to ensure that by engaging with our partners, GIZ and the Energy and Water Sector Education Training Authority (EWSETA), we are able to identify critical skills gaps, and develop and implement training interventions. We are currently implementing a capacity building programme that will see 20 youth from Technical and Vocational Education and Training (TVET) colleges equipped with much needed technical skills for measuring energy performance and conducting energy audits.

Another major energy efficiency drive is the Energy Performance Certificates for four categories of buildings: office blocks, entertainment facilities, educational institutions and places of public assembly such as sporting facilities and community centres. Buildings need to be certified by early December 2022 and are rated based on the amount of energy they consume per square metre. It is estimated that between 150 000 and 200 000 buildings should be certified. The ratings are based on an A to G scale that is similar to the energy efficiency ratings of appliances, with A being the most efficient. Certification needs to be prominently displayed in the foyer of the building.

Our work in this regard with the DMRE continues to ensure compliance with the new regulations on energy efficient buildings. Work is currently underway to guarantee that we have the necessary infrastructure from a SANEDI perspective to maintain the register of certificates, and for measurement and verification processes.

A just energy transition

This is the move from a fossil-fuel based economy to a low carbon one – a critical step in mitigating the effects of climate change.

Achieving a just energy transition is central to the work of the Presidential Climate Commission, which aims to ensure that the lives and communities of high-emitting energy industries are not left behind as the country shifts to a low-carbon emissions economy. The Commission believes that a well-managed just energy transition can be a strong driver for new and better jobs, social justice and poverty eradication.

What is key for the energy transition is to better understand the challenges and opportunities it will bring and to develop measures that will ensure that we tackle any difficulties and embrace the prospects it presents. Another aspect to consider would be availability of technologies needed for the energy transition, what level of maturity are they at and what the integration of these technologies will mean for existing energy systems. It will also be important for us to understand what intervention will be required to bring these technologies to maturity and the timing of such interventions if we are to be met any of the targets set towards net zero or carbon neutrality.

In making the transition possible, SANEDI is looking to track stakeholder initiatives in an effort to present a better picture of the change and the impacts thereof on the power sector, communities and livelihoods. We continue to pilot technologies, deliver capacity building and promote initiatives that will ensure that the skills required for the transition are available.

A green hydrogen economy

Hydrogen is a key priority for South Africa. It also presents significant economic opportunities for the country. The development of a green hydrogen industry is clearly defined in the South African Hydrogen Valley Report. This report was commissioned by the Department of Science and Innovation (DSI) in partnership with Anglo-American, Bambili Energy and ENGIE. SANEDI played a supporting role in the development of this report.

According to the study, hydrogen will importantly offer South Africa an opportunity for beneficiation of platinum group metals (PGMs) – a significant economic win. It is expected that hydrogen could contribute between US$3.9 - 8.8 billion to the gross domestic product of South Africa by 2050 and can create between 14 000 and 30 000 jobs per year by 2050.

The report envisages the establishment of three hydrogen hubs located in Johannesburg, Durban/Richards Bay and Mogalakwena/Limpopo. The hubs would host pilot projects and contribute to the launch of a hydrogen economy.

The Hydrogen Society Roadmap was launched in February 2022. SANEDI continues to provide support, through the Energy Secretariat, to the DSI to ensure the implementation of Hydrogen Society Roadmap initiatives. We have also partnered with the GIZ to present a series of knowledge sharing webinars to stakeholders seeking a better understanding of a hydrogen economy globally and in South Africa as per the approved government plans.

Partnering with the DSI, Bambili Energy and the EWSETA, capacity building initiatives will be explored to ensure that the skills required for the hydrogen economy are available.


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Energy
efficiency
Shift

SANEDI leads initiative to train young artisans to rate energy efficiency in buildings

In December 2020, the government gazetted new regulations under the National Energy Act for owners of four categories of buildings, to obtain and prominently display an Energy Performance Certificate (EPC) or risk a fine, imprisonment, or both. Building owners have until 7 December 2022 to comply.

The four categories of buildings are: offices, entertainment facilities, educational institutions and places of public assembly such as sporting facilities and community centres. The regulations apply to government buildings of more than 1 000 m2 and privately-owned buildings of 2 000 m2. The EPC gives the building a rating based on the amount of energy consumed per square metre.

To enable this EPC licensing, SANEDI, in partnership with the Institute of Energy Professionals Africa, is undertaking an EPC Practitioner Skills Programme. Through this programme, SANEDI is leading an initiative to train and equip 50 qualified, but mostly unemployed, young electricians to measure and obtain the energy usage data required to issue EPCs for buildings in terms of the new regulations. SANEDI will also maintain an EPC register on behalf of the Department of Mineral Resources and Energy (DMRE).

The three-month skills training programme is supported by the DMRE, the Energy Water Sector Education and Training Authority, GIZ Skills Development for a Green Economy programme, a German Technical Cooperation Programme and the South African Department of Higher Education and Training.

These young electricians will be trained to assemble all the critical energy usage data required by South African National Accreditation System's (SANAS) accredited companies to rate buildings. The course combines theoretical and practical training in which mentors play a prominent role. In addition, each trainee will receive a R15 000 stipend for the three-month programme.

EPCs are issued by companies accredited by SANAS. However, many more energy companies employing extra people with EPC skills will be required to obtain energy usage data for buildings covered by these regulations. The EPC Practitioner Skills Programme therefore has the potential to create thousands of jobs.

Aside from creating jobs in the new EPC sector, the experience gained by qualified EPC practitioners will provide them with opportunities to become involved in other aspects of energy efficient buildings. This could include the planning and installation of energy efficient products, equipment and devices. Electrical contracting and energy services companies may also want to add EPC work to their offering, creating further employment opportunities.

Currently, two technical and vocational education and training colleges in Ekurhuleni and Cape Town are looking at offering the EPC Practitioner Skills Programme once their lecturers have been trained.

More energy efficient buildings will reduce demand on the national electrical grid, thereby easing load shedding, reducing carbon emissions and helping the country meet its international obligations to combat climate change.

The EPC process will help building owners determine how much energy they consume, and areas in which they can reduce their consumption. In turn, they will also save on electricity costs and boost the value of the building. Energy-efficient buildings are also far healthier for all concerned.

An Energy Performance Certificate rates a building based on a scale of A to G in a similar method to energy efficiency appliance ratings.
An A-rated building is the most energy efficient and typically will consume up to 115 kilowatt hours of electricity per metre squared, per annum.
A D-rating is the benchmark rating which is in line with national building regulations.

> *I lost my job last year when my employer decided not to renew my contract. You then find yourself sending out applications for jobs and you seldom get a reply. You just end up sitting at home. It's really tough.*
>
> *...says Doctor Senamela, a highly qualified mechanical engineering technician who also completed an energy management skills programme. Having now completed the EPC practitioner course, he has been fortunate to find work with a company accredited to issue EPCs.*

Spotlight on energy efficiency as conflict continues between Russia and Ukraine

A global energy supply crisis affecting electricity and fuel security has been incited by the ongoing conflict between Russia and Ukraine. Energy efficiency is the single most effective tool to remedy this predicament.

Russia, as the world's third largest oil producer, and a major supplier of gas to European countries, has sent the rest of the world scrambling to use energy more efficiently and take on board alternative renewable resources.

Soaring oil prices brought about by the uncertainty of supply and reliance on Russian gas, has created a globally unsustainable energy climate. Prioritising energy efficiency has therefore taken centre stage. Globally, countries need to reduce demand on their power grids. However, unavoidable timeframes and massive infrastructure development required to create energy security does not happen overnight. It is now up to every individual, household and business to prioritise their energy consumption.

Here at home, Eskom is feeling the pinch of rising diesel prices amidst a constrained global supply. And with winter approaching, demand is expected to escalate. These costs will inevitably be passed down to consumers. Electricity users need to take demand off our national grid and potentially lessen the chance of load shedding, so that critical maintenance can be carried out on power plants while reducing the need to use diesel turbines when units trip.

Mid-month fuel data released by the Central Energy Fund, has projected that fuel prices could reach an unprecedented R24.00 a litre for petrol and R23.60 for diesel. If this comes to fruition, South Africans will be subjected to the most extreme fuel prices in history.

While energy security has temporarily taken precedence over sustainability and the climate change agenda, efficiency measures are still one of the most economic interventions against it. This will have multiple benefits for consumers.

SANEDI, mandated to promote and advance energy efficiency, has numerous tips and ideas for commercial and residential consumers. These can be found on their website. There are also tax and financial incentives to support energy efficiency through projects such as the "Bridging Information Gap of Energy Efficiency in Buildings Initiative."

Numerous other partnerships that SANEDI is involved in, are all examples of successful energy efficiency projects. These include the CSIR's photovoltaic solar tracking system, biogas creation from food waste, Energy Performance Certificates for buildings and energy efficiency labelling standards for plumbing fixtures, to name a few. All of these will make a difference to securing energy supply in the immediate and long-term.

South Africa's first Energy Efficiency Strategy was published in 2014 to promote efficiency practices and regulations across high-consuming sectors of the economy.
The economic benefits of improving energy efficiency have been well documented since the first Oil Crisis in the early 1970s, and again in 1993, as tensions rose between the United States and Iran.

Conserving water saves energy

South Africa can significantly improve energy and water efficiency by aligning its tap labelling programme with international standards. This is evidenced in the "flow follows function" approach outlined in the CLASP report on water efficiency opportunities.

SANEDI and CLASP (a non-governmental organisation focusing on appliance and equipment energy performance and quality) have established that by correctly plumbing fixtures, electricity needed to heat water can be significantly reduced. At the same time, water use will decrease.

South Africa's National Water and Sanitation Master Plan identified a national water supply deficit of 17% by 2030 and called for water efficiency as a critical focus area. In keeping with this, one of the interventions targeted by the Master Plan includes the development of a labelling scheme for taps and fixtures in line with international standards by 2025.

The South African Bureau of Standards (SABS) Special Committee responded accordingly by participating in the International Standards Organisation (ISOA) project to develop an ISO standard for water labelling systems. Once published, this will be applied to establish a water efficiency labelling programme in South Africa.

The CLASP report entitled "In-depth Assessment of Water Efficiency Opportunities in South Africa" supported by SANEDI, encourages a "flow follows function" approach in the labelling and standardisation of taps and installations. As South Africa predominantly imports commercially available taps, adoption of the labelling programme will help to conserve both water and energy. Water flow rate targets should be set to improve water efficiency, while labelling should be defined by the function of the faucet. The report also states that the best minimum and maximum flow rates should not compromise a user's experience.

The report goes on to recommend that the South African National Standards should introduce uniform descriptions of tap types, where they will be used and their required functions. Furthermore, it warns of potential consequences whereby flow rates are reduced to save water, but as a result the user ends up showering for longer therefore consuming more water and more energy to heat it up.

Lavatories, taps and showers typically consume 40-60% of the total annual potable water use in domestic and commercial areas. Businesses and homeowners are actually paying for water three times: buying, heating and wastewater disposal. Moreover, inefficient water use typically increases utility bills. By modelling our labelling system on international standards, there should be significant improvements in energy and water efficiency in line with global results.

THE SANEDI AND CLASP REPORT ON WATER EFFICIENCY OPPORTUNITIES WAS RELEASED AHEAD OF NATIONAL WATER WEEK (20-26 MARCH 2022).

Offsetting carbon tax through waste to energy projects

South Africa's Carbon Tax Act No. 15 of 2019 was promulgated to help mitigate the effects of climate change. As one of the largest greenhouse gas emitters in the world, there is a need to tighten up measures to significantly reduce these emissions. Carbon projects certified by the international Verified Carbon Standard can be used to obtain carbon credits to offset carbon tax.

The Carbon Tax Act encourages cleaner practices by incurring a tax on emissions above a specified threshold. In South Africa, a 10 megawatt (MW) (thermal (th)) threshold applies. It is up to organisations identified as being capable of emitting 10 MW (th), to prove if they have emitted less than this amount and are therefore not liable for this tax.

South Africa's carbon tax was introduced in a phased approach, however the carbon tax rate increases annually. In line with the country's commitment to the 26th United Nations Climate Change conference (COP26) held in Glasgow, the tax rate will be increased every year to reach US$20 per tonne. This will be a significant annual increase cost for emitters, particularly when the second phase of the Act is implemented, in order to reach the target of at least US$30 by 2030. The waste, agricultural, forest and other land-use sectors are excluded from phase one of the Act.

In the 2022 Budget Speech, Finance Minister Enoch Gogongwana, announced an extension to the first phase of the Carbon Tax Bill till 31 December 2025. During this first phase, entities can utilise carbon credits to offset their carbon tax payments. Taxed entities are able to utilise allowances created as regulations under the Act, including a 60% basic or fossil fuel allowance, a 5%-10% trade exposure allowance, a 5% threshold allowance, and a 5%-10% carbon offset allowance.

In the 2021/2022 tax year, entities are likely to pay less than R144 per ton of carbon from one of the projects certified under the international standards, to the South African Revenue Service. This tax rate has effectively "set" the upper price that a ton of carbon can fetch from the local South African market. This price "fixing" or "certainty" provides projects with the ability to include carbon income and expenses in their financial return on investment models, or to estimate the profitability of potential investments.

Waste to energy projects can now model the likely carbon revenue returns more accurately, based on volumes of emission reductions the projects are expected to generate over its lifespan. By registering with any of the global standards, the option to sell credits internationally exists.

The Carbon Offset Regulations that came into effect in December 2019, provides tax-paying entities the opportunity to purchase carbon offsets or credits from an internationally-certified carbon project. A project needs to be certified by. one of the Greenhouse Gas (GHG) Crediting Programs. These include the Verified Carbon Standard (VCS) under VERRA, the Gold Standard or the Clean Development Mechanism.

A carbon project in South Africa, and registered with one of the international standards, would have to follow the standard's specific process, rules and requirements. Under VERRA's standards, which forms part of the most globally recognised VCS, and can be likened to an International Standard Organisation's (ISO) standard such as ISO 9000, 14000, or 50 000, projects must conform to the primary standard or rules and provide supporting documents.

The roles of the Standards in the offsetting industry and carbon tax in South Africa can be explained using VERRA's standards. Projects that follow these standards can monitor and measure the carbon approved from the environment, using greenhouse gas accounting methodologies, and realise carbon credits called issuances. Once these credits are issued, they can then be sold. VERRA checks the quality and integrity of the supply, and corporates, the financial sector and other buyers create the demand. By purchasing offsets, organisations can reduce the emissions tax bill payable to the South African Revenue Service.

An example of a project that transferred from the Clean Development Mechanism to VERRA in 2022, is the Johannesburg Landfill Gas to Energy Project. This project's objective is to collect and utilise or destroy the landfill gas generated at five of Johannesburg's landfill sites. The project was developed by Energy Joburg (Pty) Ltd.

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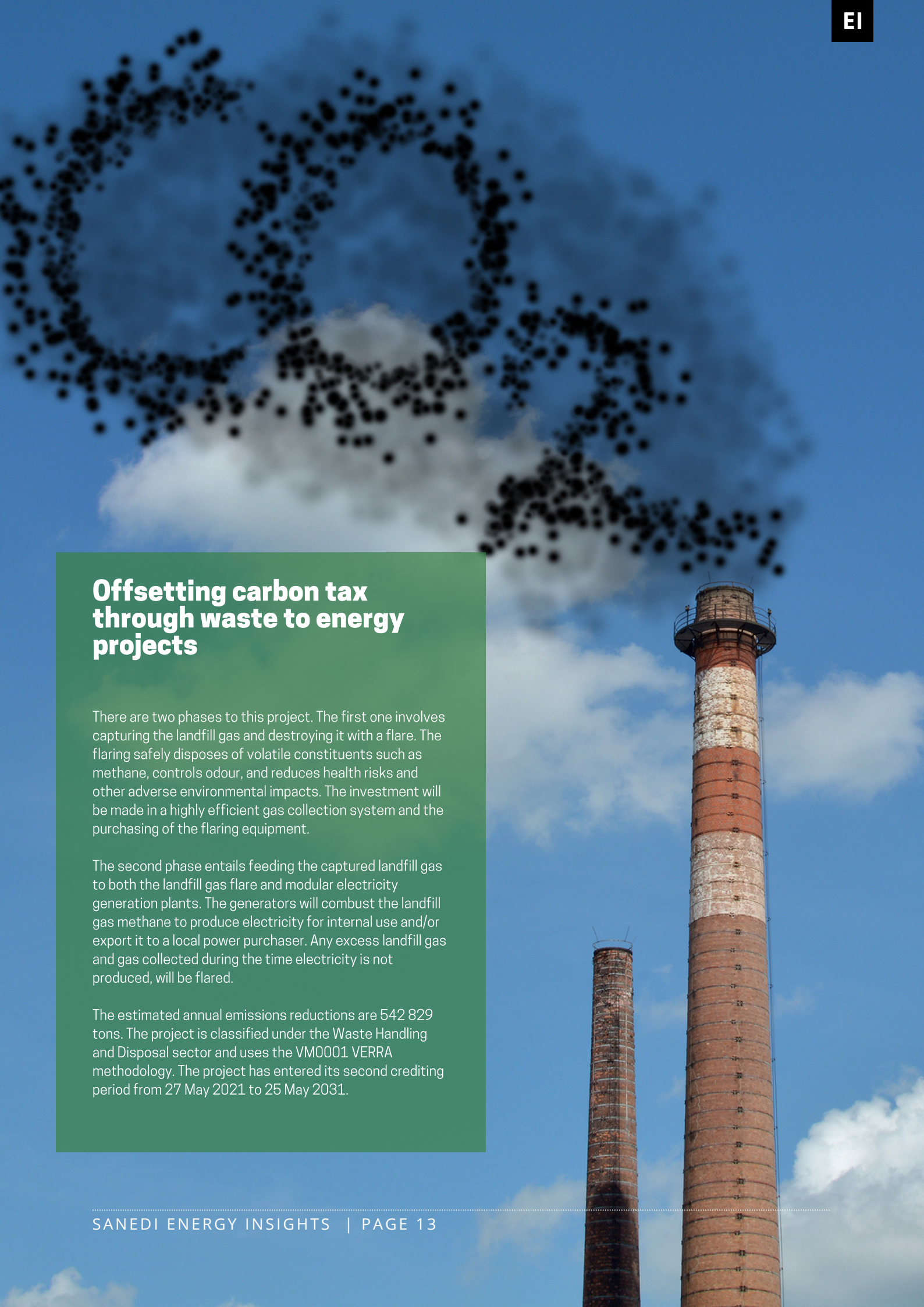

Offsetting carbon tax through waste to energy projects

There are two phases to this project. The first one involves capturing the landfill gas and destroying it with a flare. The flaring safely disposes of volatile constituents such as methane, controls odour, and reduces health risks and other adverse environmental impacts. The investment will be made in a highly efficient gas collection system and the purchasing of the flaring equipment.

The second phase entails feeding the captured landfill gas to both the landfill gas flare and modular electricity generation plants. The generators will combust the landfill gas methane to produce electricity for internal use and/or export it to a local power purchaser. Any excess landfill gas and gas collected during the time electricity is not produced, will be flared.

The estimated annual emissions reductions are 542 829 tons. The project is classified under the Waste Handling and Disposal sector and uses the VM0001 VERRA methodology. The project has entered its second crediting period from 27 May 2021 to 25 May 2031.

South Africa recognised as a potential powerhouse in the micro-digester sector

SANEDI collaborated in a review to determine the impact of micro-digesters to eliminate organic waste through micro-digester technology. This technology can help mitigate both South Africa's energy and organic waste challenges. Approximately 40% of all waste that ends up in landfills is organic and biodegradable, and can be converted into biogas.

In conjunction with the University of Johannesburg Process Energy and Environmental Technology Station (UJ PEETS), the DSI/NRF/Newton Fund SARChI Trilateral Research Chair in Transformative Innovation, the 4th Industrial Revolution and Sustainable Development (UJ-TRCTI), SANEDI participated in a review of the impact of its activity on the micro-digester sector over the last five years. The review also sought to map a five-year approach in the context of SANEDI's new strategy, the national skills shortage, the 2019 Integrated Resource Plan, and growing unemployment levels.

The project involved reviewing more than 100 anaerobic digesters installed by SANEDI at community development facilities, early childhood development centres, schools, universities and households in six of South Africa's provinces. Data was collected through a stratified sampling strategy in Gauteng, Limpopo and KwaZulu-Natal. The digesters under review were all small-scale, producing less than 0.5 kilowatts of power or less than two kilowatts of biogas a day. SANEDI installed underground–fixed, balloon and flouting digesters as part of community-based development projects over the last five years.

The project assessed the operational performance and efficiency of installed micro-digesters, its technology and variations thereof, demographics of the beneficiaries and climatic conditions. This served to identify operational gaps in functionality. UJ PEETS also conducted audits at the various sites to identify gaps and recommendations to improve operations and to provide training on operating and maintaining micro-digesters.

The review indicated that based on South Africa's geographical location and average ambient temperatures, the country has the potential to be a powerhouse in eliminating organic waste through the use of micro-digesters. Lessons learnt related to the ease of use of the technology, the development of sustainable business cases for specific contexts, and leveraging waste management and agricultural input from the production of liquid fertiliser through micro-digester technology. It also recommended the development of financial models for these scenarios.

In addition, studies show that South Africa's uptake of micro-digester technology is low in comparison to other African countries. Reasons for this include no subsidisation of the technology costs, difficult operations and maintenance, insufficient training and support, competition from other fuels and renewable energy technologies and an unsupportive regulatory environment.

In response to the review outcomes, a sector plan was developed to strengthen the micro-digester sector in South Africa. This was done through engagement with stakeholders from SANEDI, the South African Biogas Industry Association, universities, the private sector and various government departments.

The potential size of the sector is estimated to be 21 000 units initially, followed by a maximum annual demand potential of 54 000 units. If a continuous market penetration rate of 1% is assumed, this would equate to 5 400 units a year until 2030. The micro-digester sector has significant opportunities to grow but requires action by sector players and partnerships with stakeholders in allied industries.

The tried and tested technology at both micro and industrial scale, could shape the way of life for millions of South Africans through job creation, energy access and waste management. If implemented correctly, micro-digester technology can address the challenges of climate change and overburdened landfill sites, while contributing positively to the energy mix.

Anaerobic digestion of biodegradable organic matter using a micro-digester has the potential to provide communities with alternative energy sources through the conversion of organic waste material into gas.

Micro-digesters can contribute to reduced carbon emissions, improved waste management and poverty reduction.

Transforming waste into energy: the road ahead

Waste to energy (WtoE) technology has an important role to play in producing energy and reducing waste. The Waste to Energy Roadmap for South Africa identifies 20 alternative waste treatment technologies for the effective recovery and valorisation of waste into biogas and energy.

The opportunity to turn tons of waste into energy exists in both micro and macro scales. And, provided it is done methodically, it should help reduce greenhouse gas emissions and slow down climate change.

South Africa's waste sector provides thousands of people with formal and informal livelihoods, and contributes significantly to the economy. The identified alternative waste treatment technologies are ready to be introduced into existing waste management infrastructure and will add value to this sector. The technology will derive energy from both biodegradable and non-biodegradable waste.

The Roadmap is the product of a partnership between the South African Research Chairs Initiative (SARChI), Chair in Waste and Climate Change at the University of KwaZulu-Natal, and SANEDI. The partnership arose from a memorandum of agreement between SARChI and SANEDI to undertake research on waste, resources management and clean energy.

The Roadmap, available early in 2022, will deliver:

1. Up-to-the-minute reporting on WtoE technologies in South Africa and elsewhere
2. A policy review on WtoE technologies in South Africa
3. A map of technologies, waste streams and by-products
4. Assessment of the technologies in terms of economic feasibility, environmental sustainability, social acceptance, job creation potential, and institutional frameworks for implementation
5. Localisation mapping of the technologies in South African municipalities and specific successful case studies and lessons learned
6. Stakeholder engagement report
7. Preliminary implementation guidance for future implementation.

South Africa's waste-to-energy plan has the potential to be successfully implemented systematically and under optimal conditions.

More efficient electric motors will drive down energy consumption

The adoption of new Minimum Energy Performance Standards (MEPS) for electric motors in South Africa, will realise drastic energy savings and alleviate pressure on the country's electricity supply crisis.

SANEDI, together with CLASP (The Collaborative Labelling and Appliance Standards Program) has released a report commissioned by the Department of Mineral Resources and Energy (DMRE) on the necessity of introducing and regulating MEPS for electric motors in South Africa. South Africa's industrial sector is dominated by motors that fall under the lowest class of international efficiency standards (IE1).

The report found that electricity demand could be potentially reduced by as much as 0.25% in 2023 should the inefficient IE1 motors be replaced with more efficiently rated IE3 ones. IE3 electric motor units have a premium efficiency rating of 94.2% with potential energy savings of between 15% and 16%.

South Africa's economy depends on energy-intensive industries such as mining, chemicals, agriculture, iron, and cement making. These industries all run electric motors for extended periods, even up to 17 hours a day. The DMRE study revealed that about 32 companies in these sectors consume about 40% of the country's electrical energy.

It is therefore imperative that the government adopts the use of energy labels and stewards awareness programmes to accelerate the transition to significantly more energy-efficient equipment. The report calls for regulation in the industrial sector to be treated as an urgent priority, given the widespread use of electric motors in the country.

The repair of motors and the pre-used sales sector was identified as a barrier to the government's energy efficiency efforts. Standard and labelling programmes do not typically regulate the secondhand market. This meaningfully slows down the pace at which standard and labelling policy objectives can be achieved.

The report calls for companies to refrain from selling their old electric motors, which are most likely non-compliant with the new energy performance standards; particularly to the agricultural sector where emerging farmers would be the most likely recipients.

Some South African distributors are already making the shift towards IE3 electric motor units and support the government's intention to forge ahead with the new efficiency standards programme which is now long overdue.

In line with international standards, the report recommends that the Department of Mineral Resources and Energy should proceed in implementing MEPS for level IE3 electric motors in the 0.75 to 375 kilowatt range for 2, 4, 6, and 8 pole motors. In its research, it considered the Urban-Econ Feasibility Study of 2019 to help reach its conclusions. This study suggested that 200 000 electric motor units are sold each year in South Africa, with at least 69% of them between the 0.75 and 11 kilowatt size range. Of these, between 40% and 50% are non-compliant with energy standards, while another 40% have a below standard rating.

The report also assumes that the new performance standards will be formally introduced in 2023, to allow affected stakeholders a transition period to adjust to costs and move to IE3 electric motors.

Eskom's own Integrated Annual Report for the year, also finds that more efficient MEPS will have the potential to reduce electricity demand by 0.25% in 2023. This will also increase as older electric motors are replaced with the newer IE3 models over time.

The DMRE-SANEDI and CLASP report concludes that if the electric motor MEPS programme is effective, it should offer meaningful electricity savings which will directly benefit Eskom. Not only will it assist Eskom with its current supply challenge, but it will improve the competitiveness of South Africa's industrial base, by reducing load shedding risks and operational costs.

DMRE-SANEDI and CLASP's report entitled **"Cost-benefit analysis to introduce Minimum Energy Performance Standards (MEPS) for Electric Motors in South Africa"**, will assist ESKOM with its current supply challenge.

Renewable Energy

Tailoring photovoltaic technology to meet demand

SANEDI and the Council for Scientific and Industrial Research (CSIR) are collaborating on Energy. CSIR hopes to identify the most effective options to enable solar-powered electricity generation systems to keep supplying electricity even when the sun is not shining.

The CSIR has installed 1 800 photovoltaic modules on its Pretoria campus to provide the institution with both electricity and research opportunities. The modules, covering a surface area of 3 493m2, some of which are controlled by a ground-mounted single- and dual-axis solar tracking systems that allow them to follow the movement of the sun from east to west. This is the first 100% South African designed and constructed tracking system and substructure in the country. Although installation and maintenance is more expensive than fixed solar panels traditionally seen on roofs, it is able to produce more electricity than a non-tracking system. The benefits of additional electrical production will therefore outweigh the installation costs in the long term, so should be fully recuperated.

Four percent of the electricity required by Pretoria's CSIR campus is met by this project. In addition, it aids Eskom by reducing demand on the national grid and easing the impact of load shedding. It also reduces the CSIR's own carbon footprint significantly, with an estimated annual carbon dioxide saving of 1 200 tons. The plant has an estimated lifespan of at least 25 years.

The CSIR project has multiple benefits. It is a valuable research facility and training ground for photovoltaic engineers and technicians, and the advanced solar tracking units are highly visible on one of the busiest roads (N4 highway) in the country. This serves to spark interest and advertise the value of solar power and renewable energy. As the CSIR operates mainly during the day, conditions for solar energy generation are highly favourable. The photovoltaic system is ideal as it can meet the primary daytime energy demands of the campus.

But, what happens on those cloudy days? We need a solar plant that can continue to provide electricity - garnering the sun's rays and storing them is therefore crucial. The photovoltaic plant needs to store surplus electricity generated on a sunny day in order to supply it at night, on cloudy days, or during peak demand periods when the national electricity grid is under more pressure. Research into how this technology can be tailored to meet different requirements is rapidly gaining momentum.

SANEDI, paired with the CSIR's leading research expertise, are therefore collaborating with partners to explore different storage options - primarily using battery technology for small-to-large scale photovoltaic systems. This will go a long way in encouraging people to use solar power without worrying about electricity shortages when the sun is not shining.

What do we mean by photovoltaic systems?

Photovoltaic is the process of converting sunlight into electricity.

Panels consisting of numerous solar cells containing semi-conductor materials are able to release electrons when exposed to the sun's radiation. The electrons from the solar cells are drawn together through these conductors to make up the generating capacity of one module. Many modules can be connected together to produce electricity.

Photovoltaic energy system benefits:

- Clean
- Silent
- Renewable
- Low maintenance
- Unlikely to fail
- No direct greenhouse gas emissions.

Green soldiers turn kitchen food waste into biogas

SANEDI has teamed up with the SA National Defence Force (SANDF) to install biogas plants at two military bases to reduce or eliminate the use of fossil fuels, facilitating cooked meals for about 220 people a day.

The biogas plants will turn kitchen food waste that is normally sent to landfill sites into biogas to reduce the amount of electricity used in one of the SANDF's kitchens and virtually eliminate the use of liquid petroleum gas (LPG) in the other.

SANEDI has installed the biogas plants at the Air Force Base (AFB) and the 523 Electronic Warfare Squadron base, both in Makhado in the Limpopo province. It has also trained personnel in plant maintenance. The process is quite labour intensive and daily upkeep is essential. The biogas plants need to be regularly 'fed' and can take up to six months to start producing gas optimally.

The Makhado Air Force Base feeds about 200 people a day and once fully operational and producing gas, is expected to replace much of the coal-fired electricity and provide a stable energy supply. It is estimated that the new plant will save approximately R250 000 in electricity costs over its 20-year lifetime. At the 523 Electronic Warfare Squadron, the plant is expected to entirely replace the use of LPG for cooking meals for its 20 staff. In addition to saving energy costs, the renewable biogas facility will also help the SANDF to secure optimal supply in a constrained national energy system.

Use of biogas at these two different size defence force bases demonstrates that the plants can be scaled and tailored to specific needs and provide a range of solutions. The biogas plants consist of large, enclosed, sealed anaerobic digesters in which waste material is decomposed to produce methane gas. These units are installed underground for aesthetic purposes and to maintain a fairly constant temperature. The units are fed with kitchen and other waste materials such as cow dung, sourced from local farmlands to ensure the digesters enjoy a "well-balanced diet."

Another advantageous by-product of the anaerobic organisms is that they produce an organic fertiliser that can be used on food or ornamental gardens. This will be used in the gardens at the bases, thus generating further savings.

Biogas has other key benefits: low-cost technology and waste recycling opportunities.

The kitchens at AFB Makhado produce a significant quantity of food waste which now feeds the biogas plants. This puts less strain on our already oversaturated landfill sites. In keeping with the SANDF's mission to dispose of waste responsibly, through their "Green Soldiering" initiative, this supports the government in its zero waste to landfill objective.

These biogas plants are expected to reach full production in 2022. The project is one of several energy saving programmes being undertaken by the SANDF and SANEDI partnership.

About BIOGAS

Biogas, primarily consisting of methane and carbon dioxide, is produced through the natural biological decomposition of organic material in the absence of oxygen.

Waste material such as animal and human excreta, manure, biodegradable food, agricultural crop residues and municipal sewage sludge, can all be used to feed the anaerobic digesters in sealed units. The methane gas released during the decomposition process can be harvested as a fuel for cooking, heating and lighting purposes. It can also be used at large scale to drive turbines and generate electricity.

Reviving solar water heating for a sustainable future

SANEDI and the Council for Scientific and Industrial Research (CSIR) have partnered once again to find ways to make heating and cooling more energy efficient. One of these collaborations focused on evaluating heating potential using different technology solutions.

The advantage of using solar technology is that it is readily available and cheaper than fossil fuel-based alternatives. By switching to low-carbon technologies, individuals and businesses will protect themselves against high electricity tariff increases, save money, ensure better and consistent supply of energy, and contribute to reducing carbon emissions.

The two organisations have established a thermal laboratory to test and compare a range of low carbon technologies and develop business cases for identifying the most effective solutions at different scales.

Heating and cooling are intensive energy consumers. Typically, they account for between 40% and 50% of electricity costs in companies and households. They also draw a substantial amount of power from the national coal-based grid, contributing to increased carbon emissions.

Solar water heating, on the other hand, is highly energy efficient. It is an easy and powerful way to save electricity, alleviate pressure on Eskom, ease load shedding and reduce carbon emissions. The technology is not new and can be used proportionately – from small household to large-scale industrial, commercial and agricultural installations. Each solar thermal system will make a sustainable difference and ensure that you have hot water when you need it.

Examples of the effectiveness and efficiency of solar water heating are captured in the Southern African Solar Thermal Training and Demonstration Initiative (SOLTRAIN) that is funded by the Austrian Development Agency and in which SANEDI and University of Stellenbosch are the South African partners. Projects undertaken by SOLTRAIN in South Africa include:

- The WITS Junction student residence complex in Johannesburg that uses on average 94 000 litres of hot water a day. A combined solar water heating, co-generation and gas heating system was installed. It is estimated that R40 million will be saved in electricity and other energy costs over its 20-year lifespan.
- The installation of a solar water heating system at the South African National Defence Force's air force base in Hoedspruit, Limpopo. A saving of over 500 000 kilowatt hours of energy and over R1.2 million in electricity costs has already been realised.
- The replacement of electric boilers with a hybrid solar thermal and heat pump hot water system at the Centurion Building retirement residence in Cape Town. A saving of R220 000 in electricity costs have been recorded since the new low-carbon technology was implemented.
- Klein Karoo International's ostrich by-product production facility replaced its heating system with a solar thermal plant that saved just over R413 000 in its first year of operation.
- The Melomed Gatesville Hospital in Cape Town that switched to a hybrid solar water heating and heat pump system, saving R130 000 a year.

In addition to the SOLTRAIN initiative, SANEDI has also managed solar thermal projects on behalf of the Gauteng provincial government. These include the installation of three 300-litre high pressure solar geysers at the Frida Hartley Shelter for Women in Johannesburg, and the fitting of solar water heaters at Sibonile Primary School. Estimated savings from these initiatives amount to R39 000 and R10 000 a month respectively.

"We want to identify the most savvy, energy efficient thermal technologies to use for heating and cooling, tailored towards specific types of businesses. These can then be presented to companies for evidence-based consideration."

- Dr Karen Surridge (SANEDI's Manager for Renewable Energy)

Transitioning away from finite fossil fuels

In her thought piece on renewable energy, Dr Karen Surridge, renewable programme manager for SANEDI, explores what needs to be done to stimulate the uptake and implementation of readily available renewable resource technologies to grow our economy. In essence, renewable energy systems will ultimately need to be affordable and meet individual requirements to ensure they have energy-on-demand.

Currently, over 80% of grid electricity generated in the SADC region is from coal, and approximately 90% in South Africa. However, the region continues to face electricity challenges and security of supply can be intermittent. This presents a significant threat to economic growth and development. Add to this the ever-present threat of climate change and global warming, considered to be catalysed by emissions from predominantly fossil fuel-based electricity/energy production, and the future starts to look a bit bleak.

However, all is not lost, we are lucky enough on planet Earth to have three viable energy sources that can be harnessed for sustainability and security of supply. These are fossil fuels, nuclear energy and renewable energy. What we need to do now is find a responsible way of blending these sources reliably, to ensure sustainable development for humanity.

There is a growing drive towards movement away from fossil fuels, to some extent nuclear energy, and towards the energy source that is popularly considered to be “Green” (Renewables). However, a responsible blend of all three is what will give us the ability to transition away from the finite fossil fuel resources - we will eventually run out of coal, oil, and gas. But, renewable energies like sun, wind, biomass and water are able to provide a sustained energy supply for our planet.

Solar energy is available to harness as either a heat or light resource. Wind energy is available worldwide, and for the countries blessed with an abundance of water this can also be harnessed to provide a renewable energy source. Other globally, less exploited, renewable energy sources include geothermal and ocean energy, of which there are many different types. Renewable energy is usually found in nature, and while it is free, it does require technology to exploit it, but technology to harness these valuable resources comes at a cost. So, what is that cost and is it worth our investment? Well, our government certainly seems to think so if the Integrated Resource Plan (IRP 2019) is anything to go by. It makes provision for a far more diversified energy resource plan through to 2030. The main renewable energy resources contained in this plan are for wind and solar electricity generation in order to supply our national grid and supplement our predominantly aging coal-fired power stations.

Today, various technologies are available for deployment in the renewable energy sector, and South Africa is at the forefront of this development through our REIPPP (Renewable Energy Independent Power Producer Procurement) Programme. The question is: What needs to be done to stimulate widespread uptake and implementation of these technologies while growing the local marketplace and ultimately
the national economy?

continued...

Initially, renewable energy systems demonstrate that the resources can deliver energy within required parameters. However, skills and industry must then be developed in order to build and maintain the technology associated with these systems. This leads to the concept of the "Just Energy Transition", which essentially means that we need to develop our country to serve the required energy sources with skills and technology. As technology familiarity and uptake increases, the local industry will start developing in stages to manufacture and support subsequent requirements. By way of example, the country has seen an exponential growth in the scale and skills of solar thermal technology. South Africa is now rated in the top twenty (as per square meters in a single installation) of District and Residential Heating Global Capacity (IEA, 2019) milestone installations.

But how can this be translated from grid scale supply and support, to today's property owners? Usually two main points are considered when deciding to move over to renewable own-energy. Firstly, capital cost (CAPEX) and the payback period, and secondly the amount of time required to save on traditional energy costs and cover the capital cost of the system. Other factors include the desire for energy autonomy or independence, energy security and long-term cost benefits in terms of saving once the payback period has lapsed.

To meet the above, each renewable energy system needs to be tailored to the customer's demands and affordability. This will also determine the potential return on investment. Most renewable energy technology deployed at large scale is mature and proven.

Significantly, it is becoming known and accepted in the property market and the resultant financial service industry, which seems to be becoming more open to offering finance towards these systems. But consider what to do when the sun doesn't shine or the wind doesn't blow. You would need a way to store energy for use at this time. Storage technologies go hand-in-hand with renewable energy, especially at a smaller-scale, and system additions like batteries will often increase the price and payback period of an integrated system. It all depends on the needs of the user and what they are willing to pay to ensure they have energy on demand.

Hydrogen Economy

Hydrogen, a key priority for South Africa

South African hydrogen valleys could supply up to 80% of the country's energy demand. They also present a significant opportunity for economic development in the country.

In 2021, SANEDI released a promising feasibility study on South Africa's future green hydrogen economy. The report was commissioned by the Department of Science and Innovation (DSI) in partnership with Anglo American, Bambili Energy and ENGIE. It focused on opportunities to transform three primary hydrogen hubs. These are the Bushveld Complex in the North West and greater Johannesburg region in Gauteng, the Mogalakwena area in Limpopo, and Durban and Richard's Bay in KwaZulu-Natal. In addition, nine promising pilot projects were earmarked to kickstart the hydrogen valleys. The projects fall into the mobility, industrial and buildings' sectors.

The development of a hydrogen economy will create new jobs, and has the opportunity to monetise the platinum industry through beneficiation of platinum group metals. It is expected that these catalytic hubs could create between 14 000 and 30 000 jobs a year and contribute an additional US$4 billion to our gross domestic product by 2050.

President Cyril Ramaphosa has stated that hydrogen fuel cells, as an alternative energy source, are now a key priority for South Africa. Furthermore, global commitments towards hydrogen production and demand create an opportunity for South Africa to engage in energy export at the international level. It is anticipated that global demand for hydrogen will reach 140 gigawatts by 2030.

SANEDI's study found that policies need to be strengthened to promote the growth of the hydrogen economy. Key regulatory and policy enablers are required to support Ramaphosa's priority and to launch hydrogen projects.

This includes a suite of policy enablers which should ease the positioning of renewable energy sources and electrolysers, make near-term Capex affordable, encourage hydrogen applications, create momentum for future demand, and formalise the hydrogen sector through standards and labels.

Supporting policies around the deployment of renewable energy sources, and land and water use, must also be coherent with creating a hydrogen economy and sustainable future.

South Africa's hydrogen valleys will face both local and international competition. This could be from other hydrogen exporting countries such as Morocco and Australia, and domestically from other ports in South Africa such as Boegoebaai.

SANEDI recommends that the hydrogen valley hub prioritises the consolidation of domestic demand and creates economies of scale, before embarking on ambitious export projects or leveraging international funds to develop export infrastructure. In addition, the co-location of demand and supply provides synergistic opportunities within the hub that will help initiate and scale up pilot projects.

As an example of this synergy, demand is primarily driven by the mobility sector and the growth of fuel cell-heavy and medium-duty trucks along the major N3 freight corridor between Gauteng and the KwaZulu-Natal ports. This demand will grow as the cleaner hydrogen fuel cells reach cost parity with diesel trucks. The busy ports of Durban and Richards Bay offer opportunities for the use of hydrogen in port operational vehicles such as forklifts, for the unloading and moving of cargo from these trucks.

Recommended policy enablers

Ease positioning of renewable energy sources and electrolysers by offering financial incentives to lower capex cost, and fast track renewable energy source deployment through simplified permitting procedures. (This is already evident in the amended licensing threshold for embedded independent electricity generation to 100 megawatts).

Make near-term capex affordable for hydrogen supply infrastructure. This can be achieved through direct financial support, financial incentives and carbon taxes. Put sector planning in place to create momentum for future demand and provide transparency on future take-off. Encourage technology partnerships to share the risk of new projects.

Ensure standards and labelling to harmonise technology specifications and guarantee the safety of hydrogen production, transport and its applications.

Smart Grid

Proudly South African innovative plasma gasifiers demonstrate efficiency in waste-to-energy technology

Towards the finalisation of an environmentally friendly waste gasification and waste-to-energy proof of concept, an innovative and proudly South African design, which validates the feasibility to convert waste-to-energy more efficiently.

In light of the growing need for sustainable and energy efficient systems across the globe, SANEDI commissioned the South African Nuclear Energy Corporation (Necsa) to design and build a more effective waste-to-energy and waste gasification system. The results of this project, the PlasGas and PlasWen systems, are now ready for market adoption across both the public and private sectors.

The waste treatment product in question is a small-scale, mobile container unit which uses solid waste like wood chips or metal, and other combustible municipal waste such as plastic, as feed material to produce syngas. This can be converted into energy products including electricity, fuel, hydrogen, heat and steam.

The electricity generated by this combustible material can then be used as auxiliary power to sustain the plant. Excess electricity generated can be used elsewhere, depending on the scale of the operation. The larger the system, the more electricity will be produced. This can then be sold as “green” energy.

Plasma gasifiers make use of a plasma arc torch as the primary heat source. The plasma torch forms a tail-flame which is directed into the gasification reactor and ranges in temperature from 2 000 °C to 7 000 °C. This releases a high amount of energy in a small space. The higher plasma temperature results in a more complete gasification. This increased gasification temperature also minimises air pollutants to levels well below those of other conventional processes that use natural gas, diesel, oil burners or LPG gas as a heat source.

Another advantage of this unit, compared to conventional gas to waste technologies, is the closed system, which makes it substantially safer. It also ensures that no further waste is created by producing materials that can be sold off as by-products to other industries.

Unlike similar technologies from other regions in the world, the innovative design is specifically aligned to and tested in South Africa’s unique climate conditions.

This proof of concept can be manufactured to fit a container and scaled to requirements, with the right finance and investment by the public and private sectors.

South Africa is freeing up the energy market by promoting competition through regulatory changes. These now allow independent, private producers to generate up to 100 megawatts of electricity without a licence from the National Energy Regulator of South Africa (NERSA).

President Ramaphosa is now encouraging municipalities with good financial standing to take advantage of the adjusted regulations, thereby helping them reduce their reliance on the constrained national power grid. This is done through embracing newer, sustainable, more efficient ways of producing energy and re-using waste. In doing so, local governments will benefit from independent energy security and reap the benefits of new investments and job creation as their cities transition into a cleaner, greener form of energy.

Dr NJ Smith of SANEDI directed the design concept of this project under the auspices of Dr IJ van der Walt from NECSA.

Data & Knowledge Management

Measures taken towards net-zero energy of wastewater treatment plants

The South African National Energy Development Institute (SANEDI) and the Department of Mineral Resources and Energy (DMRE) are currently implementing energy-efficient interventions in selected wastewater treatment plants (WWTPs) in municipalities across South Africa.

Through the installation of energy efficiency technologies and small-scale renewable energy, including a combined Heat and Power system (CHP), this project is contributing to achieving net-zero energy within WWTPs. It is expected that projects of this nature, together with other energy efficiency projects as implemented over the next few years, will contribute to the achievements of the set-out target of 20% reduction in energy intensity of municipal services provision. This is in line with the sectorial target as stated within the post-2015 National Energy Efficiency Strategy.

Energy efficiency retrofits is currently being implemented in three WWTPs based upon their current energy consumption and the potential energy cost cutters. Savings is achieved from the use of energy efficiency technologies such as energy efficient electric motors (IE1, IE2 and IE3, variable speed drives, solar photovoltaic systems, and LED lights for buildings within the plants.

Another ongoing project by the DMRE and SANEDI is the pre-feasibility studies been conducted in 14 WWTPS to address municipal energy consumption. In addition to reducing greenhouse gas emissions and municipal energy consumption, the project also offers job opportunities as well as upskilling of unemployed individuals as field worked. These fieldworkers l collect and analyse data from plants where they have been stationed at analysts from SANEDI and Energo Power will drive the processing of all energy related datasets to determine energy baselines and the potential of savings. To date, 28 fieldworkers have been appointed across seven Provinces and 11 municipalities to support municipal officials with the data collection. Of these fieldworkers, 15 are women and 27 are youths. Furthermore, these fieldworkers are undergoing training on energy efficiency and small-scale renewables and will receive accreditation from the University of Pretoria and Energo Power once completed.

Energy efficiency capacity building will also be realised and will aid municipal officials in their understanding of the positive environmental and financial implications of energy efficiency interventions within their plants.

The project is funded by the National Treasury General Budget Support Progamme through a grant from the European Union.

Understanding residential appliance electricity usage in South Africa

Electricity use in South Africa's residential sector is under-researched and needs to be better understood in order to realise and monitor the full potential of energy efficiency. Residential sectors have the opportunity to gain from the various economic and social benefits of energy efficiency on a global scale. These include poverty alleviation, energy security, and improved health and welfare.

SANEDI's Data and Knowledge Management programme, in collaboration with the University of Cape Town, conducted a study on the energy consumption of electrical appliances within the country's residential sector. The study covered energy consumption within the low, middle and high income groups.

Appliance infiltration rates and mean annual energy consumption estimates were used to approximate the national annual electricity consumption for the residential sector, under a range of scenarios. These were based on the National Energy Efficiency Strategy (NEES) post 2015 targets in terms of appliance efficiency goals and the impact of likely savings up to 2040. Results were then compared to a controlled case where no substantial improvements are made in appliance efficiency, other than lighting, and measured from 2020 onwards.

Data collected through the research surveys and from municipalities, was used to inform the Low Emissions Analysis Platform (LEAP) model. This model is used for estimating energy savings which can be achieved by using rated energy efficient appliances and is based on the current National Standards and Labelling (S&L) programme. Out of this, three future scenarios were explored, representing business as usual, the proposed Minimum Energy Performance Standards (MEPS), and best practice.

The study went on to include further analysis t of data and representation of residential electrical appliances and their end uses in the LEAP model. This helped contribute to a better understanding of the impact of the S&L programme on the sector. Furthermore, the study enabled a review of the potential energy savings up to 2040 under various scenarios and provided inputs to the review of future NEES targets.

Results of the modelling indicated that both market-driven and mandated efficiency improvements could reduce the sector's electricity use significantly. However, appliances included in the MEPS and S&L programmes would need to be expanded and stricter efficiency levels would need to be applied.

Research has shown that, over time, the S&L programme has resulted in a drop in energy intensity of 4.2% in the lower income group during 2020. Meaningful savings have also been achieved between 2015 and 2020 across all income groups. Modelling also shows that if the S&L and MEPS programmes continued as they are, and appliance standards remained at the current level, there would still be a saving of 10% in 2030.

The new Energy Performance Certificate Guideline for Industry

An Energy Performance Certificate (EPC) Guideline has been developed to assist accounting officers and building owners of non-residential buildings to successfully obtain their mandatory certification.

This guideline provides insight into the EPC regulations, standards and easy-to-implement processes so that accounting officers/building owners can obtain compliance. SANEDI and the DMRE in collaboration, have developed the EPC Guideline to create awareness and assist in educating the various stakeholders within the industry value chain about mandatory energy performance certificates for non-residential buildings.

The EPC regulations support our post - 2015 National Energy Efficiency Strategy and Climate Change Policy, as 15% of our current Greenhouse Gas (GHG) emissions are generated from buildings.

The EPC Guideline is a step-by-step document that takes affected stakeholders through the certification process. Key regulations and standards have been used in the guideline to simplify the process and drive compliance. Some of these key standards are: SANS 10400-XA:2021, with reference and alignment to SANS 10440-XA:2011, and SANS 1544:2014.

During the development of the guideline, consultation with focus stakeholder groups such as architects, engineers, energy companies and educational institutions contributed significantly to the development of the guideline The draft guideline was well received in the industry, and SANEDI and the DMRE were commended on the initiative.

In the guideline, the data collection requirements and processes for issuing of EPCs are covered and the compliance and monitoring approach is articulated.

Energy footprint study of the Automotive, Pulp and Paper industrial subsectors

To strengthen policy implementation and facilitate data rich industrial energy efficiency practices, two industrial sub sectors were selected in order to determine their energy footprints and savings potential. These were the pulp and paper and the automotive industries.

The post-2015 National Energy Efficiency Strategy's vision is to reduce the energy intensity of the economy through energy efficiency. To achieve this, multiple strategies need to be implemented to address the gaps in compiling relevant data. SANEDI's Data and Knowledge Management programme and the Department of Mineral Resources and Energy's (DMRE) Energy Efficiency directorate, conducted a study to determine the energy footprint and savings potential for both the pulp and paper and the automotive industries. A further intent of the project was to complement the DMRE's Energy Efficiency Target Monitoring System's in informing policy developments for the two identified industrial subsectors and the Integrated Energy Plan.

The study involved collecting energy and activity data from these sub sectors using a variety of methods. This was followed by measuring and analysis, which were aided by Greenhouse Gas (GHG) emission calculations. In addition, relevant stakeholders were trained on the correct processes and methods used to determine the energy footprint.

Benefits of the project include the development of energy efficiency indicators (an international best practice) through the collection of disaggregated data; establishing a carbon footprint for these two industries in order to calculate GHG emissions; training of selected stakeholders to improve on their understanding of energy efficiency and strengthening policy formulation by computing the energy footprint and savings potential of the two selected industrial subsectors. This study forms a crucial part of SANEDI and the DMRE's implementation role as stipulated within the South African Industrial Energy Efficiency Phase II GEF-UNIDO funded project.

This project, in collaboration with multiple national and international entities, and contributes to the development of policy and regulatory mechanisms that address national energy efficiency objectives.

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