wattnow

SAIEE THE OFFICIAL PUBLICATION OF THE SOUTH AFRICAN INSTITUTE OF ELECTRICAL ENGINEERS | OCTOBER 2023

ENERGY STORAGE

Serving Since 1909

Formed in 1909, The South African Institute of Electrical Engineers sports ± 6000 engineering professionals.

Why Join Us

Our members are professionally engaged in various engineering activities, including academic research, manufacturing, electronics, telecommunications, measurement and control, mining, and power infra-structural services. Members make meaningful contributions to the quality of life in communities and the steady advancement of technology. Their efforts are acknowledged in many countries worldwide.

Training Academy

We offer CPD training courses, a powerful learning tool to improve skills, ensuring that academic qualifications do not become outdated.

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One of our core objectives is to harness and foster the growth of Education in the Engineering sector, which has been faced with a debilitating shortage of skills.

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Corporates are invited to monthly forum meetings to discuss and brainstorm critical issues in South Africa and find solutions.

SAIEE

Our Purpose

To enhance the practice of electrical engineering in South Africa and the stature of our members through knowledge, networking, influence, education and communication.

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Dear **watt**now reader

As we South Africans are sitting in the woes of load-shedding, with it tapering off, the future looks bright – but not due to a shining light – it might be that more people and companies are finding their solutions in solar PV. With the green energy transition, you need a sound, reliable battery energy storage system pivotal in green energy supplies and electricity demands. This issue of **watt**now brings you "Battery Energy Storage" because this technology is crucial in ensuring homes and businesses can be powered by green energy, even when the sun isn't shining or the wind has stopped blowing.

Thank you to Prof Chandima Gomes, who contributed to several articles in this issue. His first article, on page 26, discusses "Large-Scale Battery Energy Storage Systems" and shares with us how the deployment of large-scale BESS systems is crucial in addressing the intermittent nature of renewable energy sources, which will ensure a stable and reliable power supply.

Page 34 features an article on the "Requirement of Standards and their Mandatory Implementation", where Prof Gomes shares certain case studies of accidents that happened due to the incorrect installation of BESS.

"How Battery Energy Storage Can Power Us to Net Zero" shows that in 2022, approximately 192GW of solar and 75GW of wind were installed globally. However, only 16GW/35GWh of new storage systems were deployed. Read more on page 36.

The November issue of **watt**now features Automation, and the deadline is 20 October. Please send your articles/papers to minx@saiee.org.za. You earn 0.1 CPD* credit when your article is published in **watt**now magazine.

Herewith the October issue; enjoy the read!

Minx

** - T's and C's apply*

Hydrogen Safety & Hazardous Areas Conference

IDC Technologies

4th & 5th December, 2023
CedarWoods of Sandton
Sandton, South Africa

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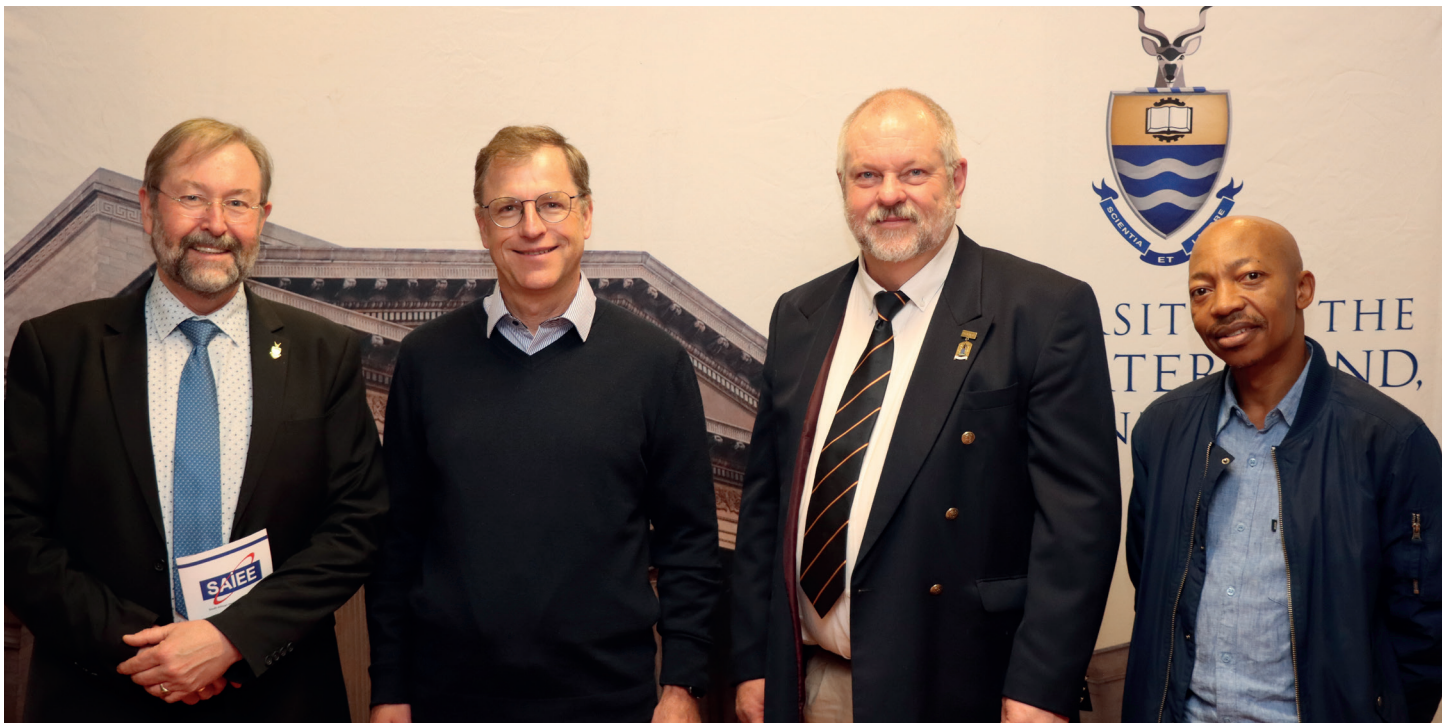
INDUSTRY AFFAIRS

72nd Bernard Price Memorial Lecture



From left: Prof Ian Jandrell, Deputy Vice-Chancellor: Systems and Operations Wits University; Prof Jan Meyer, 72nd BP Lecturer; Prof Jan de Kock, SAIEE President; and Leanetse Matutoane, SAIEE CEO.

The SAIEE, in conjunction with Wits University, hosted Prof. Jan Meyer as the 72nd Bernard Price Memorial lecturer. Prof Meyer's discussion on "Power Quality challenges that new technologies bring to distribution grids of the future" shared insight into the concepts of network disturbances, Electromagnetic Compatibility and Power Quality. This lecture presented practical examples based on field and laboratory measurements illustrating the impact of recent technologies on different Power Quality phenomena, both from the grid- and equipment side. It identified the importance of holistic approaches, including Power Quality, for the reliable operation of future distribution grids.

Prof Meyer received the Dipl.-Ing. PhD degree in electrical power engineering and postdoctoral qualification in Power Quality from TUD Dresden University of Technology, Dresden, Germany, in 1994, 2004 and 2018, respectively. He was appointed Professor in the "Power Quality" field in 2022 and is the team leader of the Power Quality research group at TUD Dresden University of Technology. His research interests include measurement, modelling, and simulation of network disturbances, especially distortion above 2 kHz, all aspects related to the uncertainty in Power Quality measurements, as well as the efficient and automated analysis of large amounts of data from Power Quality measurement campaigns.

Jan Meyer is a member of several national and international working groups on EMC standardization and co-chair of the German EMC Committee DKE UK 767.1. He is active in several CIGRE and IEEE working groups as well as the Technical Committee of CIRED, with the development of methods for emission limit allocation and the measurement-based determination of customer emission being a significant focus. He regularly gives invited speeches, provides tutorials, panels and workshops, and collaborates closely with many other universities and research groups in Power Quality worldwide.

Prof Ian Jandrell, Vice Chancellor of Wits University, invited Prof Meyer and distinguished SAIEE guests to a formal dinner after the lecture. SAIEE President, Prof Jan de Kock, invited Prof Meyer to present the BP Lecture at our KZN Centre the following night. A recording of the 72nd BP Lecture can be viewed here. wn

From left: Leanetse Matutoane (SAIEE CEO), Andries Mthethwa (SAIEE Past President).

From left: Prince Moyo (SAIEE Immediate Past President) and Paddy Padayachee (RET).

From left: SAIEE CGC members with Pascal Motsoasele (SAIEE Deputy President).

Guests

Guests

Guests

From left: Andries Mthethwa (SAIEE Past President) and Prudence Madiba (SAIEE Junior Vice President).

Prof Pat Naidoo (middle) with members of the UJ Student Chapter.

From left: Pascal Motsoasele (SAIEE Deputy President), Prudence Madiba (SAIEE Junior Vice President) and Prof Ken Nixon, (Wits).

*From left: Kgomotso Sethlapelo (CGC Chairman), Gerda Geyer (SAIEE), Maureen Nxumalo & guest (SAIEE CGC) and Minx Avrabos (**watt**now).*

*From left: Prof Fulufelo Nelwamondo (NECSA), Minx Avrabos (**watt**now), Andries Mthethwa (SAIEE Past President) and Pascal Motsoasele (SAIEE Deputy President).*

INDUSTRY AFFAIRS

TRANSNET National Port Authority honoured employees for their professional registrations

Transnet National Ports Authority (TNPA) with honoured staff members and representives from SAIEE, ECSA, SAIMechE and SAICE.

TNPA Staff in Durban.

The Infrastructure Department, under the guidance and support of the General Manager, Ms. Thecla Mneney, embarked on an initiative to recognise and celebrate the professional registration of its staff across all South African ports. A total of 45 employees have received professional registration from 2018 to 2023 under the categories of Professional Technician, Professional Technologist, Professional Engineer, Project Management Professional, Professional Quantity Surveyor, and Professional Construction Manager, to name a few.

This significant milestone is a testament to Transnet National Port Authority's (TNPA) unwavering commitment to excellence, relentless pursuit of knowledge, and professional employee growth.

Professional registration is essential for advancing and gaining recognition in the field of infrastructure. Registered professionals possess recognised knowledge, skills, and competencies, earning respect from the industry.

TPA hosted several breakfast events to honour and celebrate their employees' professional registration and motivate and encourage other employees to pursue their professional registration. These events kicked off at the TNPA Recreational Centre, Port of Saldanha, on the 18th of September and were completed in East London on the 1st of October.

Various Professional Bodies, such as the Engineering Council of South Africa (ECSA), the South African Institution of Civil Engineering (SAICE), the South African Institution of Electrical Engineering (SAIEE) and the South African Institution of Mechanical Engineering (SAIMEchE), were invited to share messages on the importance of professional registrations. wn

SAIEE MEMBERS GAIN INSIGHT INTO WEG AFRICA'S TECHNOLOGICAL EXCELLENCE

Members of the South African Institute of Electrical Engineers (SAIEE) recently visited the WEG Africa facility, situated in Longlake Ext 4, Johannesburg. Organised by the SAIEE together with WEG had the primary objective of showcasing the extensive capabilities of the facility, which serves as the cornerstone for WEG's operations on the African continent.

WEG Africa's extensive facility not only houses the company's head office but also boasts a vast stockholding of electric motors, gearmotors, variable speed drives, soft starters and gensets. Furthermore, it hosts state-of-the-art assembly lines ensuring that products are readily available to industry.

During the visit, SAIEE members were provided with a unique opportunity to gain a deeper understanding of WEG's technological prowess and its contribution to the rotating machinery market. Fanie Steyn, Manager Electric Motors at WEG Africa, shared comprehensive and valuable insights during presentations which highlighted aspects such as different topologies and motor designs, all the way u to the WEG IE9 electric motor.

The visit, which spanned an entire day, facilitated robust interaction between the SAIEE visitors and the technical team on hand from WEG Africa. The interactive session allowed visitors to pose questions, exchange knowledge and engage in stimulating discussions.

Steyn expressed his satisfaction at the high level of enthusiasm displayed by the SAIEE visitors. He noted, "It was truly gratifying to witness the depth of interest exhibited by the SAIEE visitors in both our facility and the diverse range of offerings that WEG brings to the market."

The visit underscores the commitment of SAIEE and WEG Africa to fostering collaboration and knowledge-sharing within the electrical engineering community. It serves as a testament to the invaluable contributions of WEG Africa in advancing technology and innovation in South Africa. wn

INDUSTRY AFFAIRS

SAIEE KZN Centre hosted 72nd BP Lecture in Durban

From left: Mahomed J Essop, Prof Oluwafemi, Dr M.F Khan, Prof Jan de Kock (SAIEE President), Krystle Annamalai, Richard Ahlschlager (SAIEE KZN Centre Chairman), Masondo Ndumiso, Chris Ramble, Prof Jan Meyer (72nd BP Lecturer) and Veer Ramnarain (SAIEE Senior Vice President).

The SAIEE KwaZulu-Natal Centre, in conjunction with the Durban University of Technology, hosted the 72nd Bernard Price Memorial Lecture at the Steve Biko Campus in Durban on the 13th of September 2023. The guest speaker for the evening was Professor Jan Meyer, who presented an insightful lecture on "Power quality – New technologies shaping the future of Distribution Grids". The presentation included an introduction to Power Quality, Network Disturbances and Electromagnetic Compatibility, as well as case studies highlighting the effects of new technology load equipment on power quality within distribution networks. The attendance at the event was phenomenal and included past SAIEE KZN Centre Presidents, Engineering Students and Lecturers from various campuses in and around Durban, including but not limited to Industrial and Utility representatives. The presentation stimulated the audience to re-thinking strategies concerning new equipment technology changes being employed in becoming efficient and greener, as well as its impact on the quality of supply. wn

KZN Centre hosted Student Visits to Vexila

DUT Student visit

MUT Student visit

On the 5th of June and 3rd of July 2023, engineering students from MUT and DUT had an opportunity to visit the Vexila factory in PMB, the first 100% African company to locally manufacture and supply 400 kV Composite Insulators to African Electrical Utilities. Students were welcomed by a team of experts who facilitated a tour that exposed students to the process of converting raw materials to produce a finished product whilst adhering to the health & safety, and quality management procedures. Vexila manufactures and supplies a wide range of Composite Insulators, Composite Cut-outs, and a variety of Line Hardware for Electrical Rail, Transmission and Distribution Overhead Power Line Infrastructure, and the students were excited to visualise first-hand the specifics and display innovative technology to produce quality products in KZN South Africa. wn

OPTIONS FOR RELIABLE ELECTRICITY SUPPLY IN KWADUKUZA

The Vuthela iLembe LED Support Programme's Synergy for Energy seminars held recently have unveiled the range of options available to secure reliable electrical power in the KwaDukuza local municipal area.

The two Vuthela seminars have examined how public and private sector stakeholders need to collaborate with local and national entities to counter the devastating impact of the ongoing loadshedding crisis.

Loadshedding and the lack of a reliable power supply is hindering the municipality's capacity to cater for growth and has had a big impact on the ease of doing business in the district, said Sibusiso Jali, Executive Director: Electrical Engineering Business Unit at KwaDukuza Local Municipality.

RECENT REGULATORY DEVELOPMENTS ARE CHANGING THE ENERGY LANDSCAPE SIGNIFICANTLY.

The KwaDukuza Local Municipality receives all its electricity from Eskom at present. In the future, this supply will be augmented by electricity provided by Independent Power Producers (IPPs), who may produce it from solar, hydro-electric, biomass, gas or ocean resources if feasible.

A draft policy on appointing IPPs has been developed and the process for appointing a service provider to undertake feasibility studies to procure IPPs has begun, said Jali.

A project is also underway to review tariffs, contracts, and metering systems for resellers of electricity, including housing estates, shopping centres, malls, apartment buildings and business parks.

Locally, the KwaDukuza Local Municipality has approved an Energy Policy and is developing new regulations to control the implementation of renewable energy options. Nationally, the Electricity Amendment Bill has been formally introduced into parliament.

Meanwhile, the process of receiving public comments on the South African Renewable Energy Masterplan (SAREM) has been completed. The plan is expected to be finalised by November this year and implementation will begin immediately.

The KwaDukuza Local Municipality Energy Policy has been approved by the Council on the understanding that it will be amended frequently, confirmed Chimene Pereira, Energy Office, Director: Special Projects, Office of the Municipal Manager, who managed the policy development process.

The next step will be to conduct a feasibility study around the best approach for KwaDukuza Local Municipality related to the cost of supply and its current infrastructure. "The cost-related implications are not fully understood," said Chimene. "There is a potential for revenue losses and tariffs must still be determined. We are not entirely sure what the financial implication for local government will be under the new policy."

The new policy will change the way that electricity is generated and procured, with the Council playing a greater facilitation role in the process.

The need for effective partnerships and collaboration between the private and public sector to address the impacts of the national electricity crisis emerged as a central theme at both seminars. wn

INDUSTRY AFFAIRS

ABB launches global Young Engineer Exchange Programme to attract next generation of talent for its hoisting business line

In a strategic move to bridge the burgeoning skills gap in the global mining industry, ABB has launched the Hoisting Young Engineer Exchange Programme to attract the next generation of talented engineering graduates to a career in mine hoisting. Young talent can apply for the program via the dedicated landing page.

The international, two-year programme features time spent in the participants' local engineering teams, followed by a couple of overseas rotations in ABB's key hoisting markets, namely Canada, Australia, Poland, South Africa, Sweden or China.

Within each rotation, graduates will learn about the latest industry technology and have the chance to apply it directly on ABB's customer sites. Unlike many traditional training programmes, ABB's new programme has an individually tailored schedule and involves direct customer work.

"The global mining industry is facing a significant talent shortage – we're seeing that demand is already outstripping supply, and there is much competition in the market to attract young engineering talent," said Lisa Gustavsson, Global HR Business Partner at ABB. "This is why we're excited to launch this global exchange programme for young engineers. We are giving young talent the opportunity to truly make a difference and work on some of the most exciting mine sites in the world. It's a significant step to ensuring that that the business will continue to attract the best talent in the market to serve our customers and build a world-class organization while contributing to a more sustainable future."

As ABB's hoisting business is growing rapidly, the company is looking to strengthen its organisation on both the project and service side, including senior employees with deep technical expertise as well as young graduate engineers.

"For our customers, the mine hoist is a business-critical application, and it is among some of the most technologically advanced solutions in their operations," said Björn Jonsson, Global Business Line Manager, Hoisting at ABB. "To deliver such projects, we need the best people to work closely with our customers from design to execution and servicing the technology throughout the lifetime of the hoist."

"The nature of work in the mining industry is changing. There is growing demand for data and digital literacy skills. To build a successful and sustainable business for the future, we also need to attract a different kind of talent," said Jonsson.

The mining industry plays a pivotal role in building a more sustainable economy. The availability of metals and minerals will decide the pace of the global energy transition. To continue to responsibly extract the metals essential for electric vehicles, wind turbines and solar panels – copper, gold, and iron, among others – deeper mines will be needed. For this, mine hoists offer a low-carbon, reliable and safe solution to transport ore from great depts.

ABB has been a leader in developing world-class hoisting solutions for over 130 years. Powered by electricity with the possibility to run off renewable energy sources, hoists are a future-forward solution. To date, ABB has delivered over 1 000 hoisting solutions globally. As the sole supplier of complete mine hoist systems, customers can benefit from low lifecycle cost, high reliability and system availability, short project execution time, and a single source of supply for complete systems, including service and spare parts.

ABB will continue to build the programme to help attract young talent to its growing hoisting business and offer graduates an exciting career in an industry vital for the green transformation. wn

STUDENT CHAPTERS

at an SAIEE Centre near you!

make a difference today - join us!

The SAIEE Student Chapter was established to provide unique opportunities for networking, mentoring, and bonding over common interests. The Student Chapter provides support both within the student community and local communities outside the SAIEE. It also serves as a gateway to forums, and panel discussions, while providing the opportunity to engage with engineers across the globe and to assist students with information relevant to their career path.

Click here on how to become a member today!

SAIEE

For more info, email Dudu Madondo - reception@saiee.org.za

INDUSTRY AFFAIRS

SAIEE KZN Centre visit Conlog

On the 7th of September 2023, Conlog, specialists in Electricity prepayment solutions, hosted the SAIEE KZN centre at their manufacturing facility at the Dube Trade Port in Durban. Presentations on Conlog's cutting-edge technology sparked stimulating discussions, followed by a factory tour combining the expertise, dedication and state-of-the-art machinery to produce robust metering solutions. Conlog is renowned for design and innovation and has over 200 patents and trademarks. Thanks to the Conlog team for your hospitality and insight into the excellent company culture, innovation and success. wn

UKZN CONGRATULATES NEWLY APPOINTED DVC: TEACHING & LEARNING – PROFESSOR THABO MSIBI

The University of KwaZulu-Natal's (UKZN) Vice-Chancellor and Principal, Professor Nana Poku, has announced Professor Thabo Msibi's appointment to Deputy Vice-Chancellor for Teaching and Learning.

The announcement comes after the University Council confirmed the appointment, effective from the 1st of November, 2023.

Msibi's new position entails leading institutional-wide strategic initiatives - He will play a key role in developing the Teaching and Learning strategy as defined in the UKZN Strategic Plan 2023–2032 and in leading the transformation of the Teaching and Learning Office.

Poku says Msibi has distinguished himself as a strategic visionary, an adept leader, and an accomplished problem solver, "Professor Msibi will play a crucial role essential to the university's core mission, and we eagerly anticipate the innovations and fresh perspectives he will bring to this position."

Msibi is currently the Dean and Head of the School of Education at UKZN, a position he has held since 2017. At the time of his appointment, he was the youngest Dean in South Africa.

In 2006, he joined UKZN as a Contract Tutor/Junior Lecturer in Social Justice Education, which marked the start of his professional career there. He advanced through the ranks in the years that followed, eventually holding the title of Senior Lecturer in Gender and education and Curriculum Studies by 2013.

Msibi holds a PhD in Education from the University of Cambridge, UK and a Master of Education from Teachers College, Columbia University, USA.

"He is also a proud alumnus of our institution. He has demonstrated remarkable leadership, including being the President of the Student

Representative Council, founding the Masakhane Youth Leadership Course, and founding the Community Development Association.

Msibi continues representing our institution as a subject matter expert and an active commentator on various topics. wn

UKZN Students visit NCPAlcohols

On the 13th of July, 25 UKZN students had the privilege of visiting the NCPAlcohols plant in Pinetown. The day commenced with the students watching a comprehensive safety induction video and being provided with the necessary personal protective equipment. After that, they were led by numerous plant engineers on a tour around the plant. As the students explored the facility, they gained valuable insights into the intricate processes of industrial alcohol production and the cutting-edge technologies and sustainable practices employed by NCP Alcohols. After the tour, the group convened for lunch, during which they engaged in lively discussions regarding the visit that sparked enthusiasm for the potential establishment of a SAIEE Student Chapter at UKZN, which would serve as a dynamic platform for knowledge exchange, networking, and professional development within the field of electrical engineering. wn

CUT Student Chapter visits Gariep Power Station

SAIEE CUT Student Chapters members on the site visit to the Gariep Hydro Power station.

SAIEE Student Members from the Central University of Technology (CUT) were treated to a site visit to the Eskom Gariep Power Station on the 3rd of October, 2023. The Chairperson of the SAIEE Freestate Centre, Mr Motoloki Lephoi and Mr Lucky Mokalusi, both lecturers from CUT, accompanied the students. They were all hosted by Mr Nimroid Sadiki from the Gariep Power Station. wn

CALL TO ACTION:
SAIEE Student Members VAC work

The South African Institute of Electrical Engineers, in conjunction with their Corporate Partners, is looking for vacation students to start vacation work that forms part of the practical components of their degrees or Diplomas during December 2023.

Requirements

- You are pursuing an Engineering Degree or Diploma at a recognised tertiary institution, doing a final year.
- You are an SAIEE Student Member in good standing.
- A certified copy of your ID
- Your CV.
- VAC work recommendation letter from your tertiary institution

Vacation students will be paid a monthly stipend during the vacation work period. Failure to comply with the above requirements will disqualify your application.

Send all applications to Dudu Madondo - reception@saiee.org.za with VAC work in the subject field.

CLOSING DATE: 13 OCTOBER 2023

BV continues on its transformation journey to Shaping a Better Workplace

Bureau Veritas, a world leader in testing, inspections and certification services, is continually on a passionate drive to fulfil its mission of shaping a world of trust through its unrivalled expertise, independent and worldwide presence to benefit society. The company is fast gaining ground on its sustainability trajectory to meet it's 2025 ambitions towards transforming the world we live in. Committed to creating better workplaces, a cleaner environment and improved business practices, Bureau Veritas (BV) enjoys an enviable reputation for being a company that walks the talk.

2025 AMBITIONS AND GENDER EQUALITY

With a strong commitment to achieving its 2025 objective of leading the Testing, Inspections and Certification evolution towards sustainable growth in Environmental, Social and Governance (ESG), BV invests heavily in People and Culture, Organization and Governance and Innovation and Technology. Human capital enjoys the utmost regard, and the company focuses on attracting the best talent to develop its next generations and ultimately build its culture across the globe – these factors are critical to accelerating the 2025 strategic direction of the company. Organizational development is strongly underpinned by a robust Corporate Social Responsibility (CSR) commitment, a living extension of the company's mission to create a world where trust and truth are respected and exercised in daily life. Gender equality is intrinsic to this commitment to change lives and thus ensure a fairer world. International teams with broad-based skills and diverse profiles, creating a more representative organization which is fast on track to achieve its goals. In line with its commitment and policy on inclusion, Bureau Veritas has aligned to the SDG of Gender Equality, setting itself ambitious targets for 2025 to reach 35% of female representation in leadership positions, which is supported through several initiatives.

GLOBAL AND AFRICA STATISTICS TO DATE

Bureau Veritas has made strides in its commitment to a more efficient and gender balanced operation, with increasing numbers of women in management and executive leadership, with robust plans in place to balance the corporate landscape even more. Today, on a global level, 69% of employees are male, whilst some 31% are female against an ambition of 35% by 2025. Women are present in a range of roles from executive leadership to subject matter experts in engineering, artificial intelligence, nuclear innovation, digital technology, human resources, accounting, marketing, and communications, legal and a host of alternative specialties.

In Africa, women make up some 28% of the human talent; with some 28% of these women being female senior decision-makers.

DR BEATRIZ MAGALHAES, COUNTRY CHIEF EXECUTIVE MOZAMBIQUE:

"Study hard, that is the most solid foundation you can create for yourself, it will help you with the confidence you require to focus on your achievements and not that of others. Secondly, choose

the right partner on your journey, one that will add and not subtract," she advises young woman. Education and job creation lie close to Magalhaes' heart, and she has made it her business to impact the communities around her by driving social responsibility.

Brazilian born Beatriz Magalhaes is the Chief Country Executive of BV Mozambique and has been in her role for two years. With a PhD in Structural Biology from the University College, London (UCL); Dr Magalhaes joined BV in 2016 to "reinvent herself". Initially a consultant, she was drawn to the company values of truth and transparency, which aligned closely to her personal value system.

Her career has been steeped in science, having been a university lecturer in Brazil before founding a green technology startup in her home country. A family woman at heart, with her mother firmly placed as her role model, she is motivated by the pleasure of a job well done. Key to her many accomplishments are adaptability and a keen understanding of a host of cultures, having grown up in various countries around the world and speaking several languages. Always putting her team first is part of her leadership style and is the secret ingredient to her success as a woman and business leader. The simple joy of encouraging a team to their own personal success motivates and inspires her. Caring for her staff is an invaluable characteristic that lies close to her heart, as evidenced by the impact of one of her recent leaders.

DR SWARUPA DESHPANDE, OIL & GAS MARKET LEADER AFRICA:

"Transparency is vital, be committed to your objective and work collaboratively.

We need to constantly upgrade our knowledge and technology prowess for innovative solutions. It is important to be firmly rooted whilst building strong teams and external networks with partners, clients, and stakeholders. There are no short cuts to hard work and dedication; and no alternatives for patience and compassion," she says, sharing the key ingredients to her success as a woman and business leader.

Dr Swarupa Deshpande spearheads Oil & Gas in Africa, one of BV's largest markets and has also spearheaded the team in South Asia. The soft-spoken Indian-born Deshpande has a PhD in Oil & Gas Management, an MBA, and a diploma in International Business Management. She was initially drawn to the company some 16 years ago because of its strict testing and quality control measures, it's absolute values of truth and transparency; collaborative and highly ethical culture.

She is inspired by being able to use her abilities to help contribute towards a better society, building an improved living world through BV's quality, health, safety, and environmental service support to the crucial energy sector to maintain the natural balance of the globe.

BV's ability to use technology, digital innovations, and sustainability solutions to improve the wellbeing of the industrial sector of the world further propels her to making a marked difference. She remains inspired by her Human Resources Director, as a dynamic and smart female role model with strong leadership qualities and team building abilities, with the innate ability to connect great minds. wn

How to be smart when going with PV

In the urgency to shield your household from the worst of loadshedding, you could end up with an investment that doesn't deliver the promised returns. Here's how to avoid the pitfalls when installing a PV system.

Solar panels have become a feature of the South African residential landscape over the past few years as homeowners seek a measure of energy self-sufficiency. Once you have made your home as energy efficient as possible with LED lights, a solar/gas/efficient geyser, gas cooker and energy-saving habits, the time is right to invest in a PV system with battery backup to keep you going during loadshedding.

It is always a good idea to know what your monthly electricity consumption in terms of kilowatt hours, this will be asked of you by any installer worth his/her salt. You can find this on your electricity bill, and it would be a good idea to compare what you were using before your energy efficiency interventions versus what you are using now. Once you know what you are consuming you will also know whether or not the installer is quoting you with specifications that will meet your needs.

"How much can I expect to pay for a PV system and will the ROI be worth it, are questions I get asked often, quickly followed by what can I do to not get taken for a ride," says Dr Karen Surridge, Renewable Energy Project Manager of the South African National Energy Development Institute (SANEDI). The answers are not simple one liners, but the guidelines Surridge gives will go a long way towards ensuring a happy PV and/or battery system investment.

1. Find the right installer

The starting point is a reputable installer with a solid reputation and good references. You can find installers in your area registered with the South African Photovoltaic Industry Association (SAPVIA) on the PV GreenCard website (https://pvgreencard.co.za). Registration means that the person has had the proper safety and quality training and will issue you with proof of compliance for the installation for insurance, finance and regulatory purposes.

You can also Google your potential installers and ask friends or social-media community groups for references, word of mouth can be a powerful recommendation. A certificate of compliance (CoC) as a line item on your quote is usually an indication of capability, since only registered tradespeople can issue such a document.

2. Know what you should be paying for

A PV system consists of PV panels, an inverter, batteries and the components that tie the system into your home's electrical system. The quote from your installer should be itemised and specify all these items.

- The inverter inverts the direct current (DC) produced by the PV panels (or batteries) into alternating current (AC), which makes the electricity available to your home and appliances. An inverter on its own is of no use. Never skimp on the inverter and always choose one with a built-in surge protector. While prices differ, a good 5 kVA inverter that is sufficient for an average four-person household should cost between R25 00 and R30 000.

- In terms of photovoltaic (PV) panels, go with a well-known brand that has a good reputation. Insist that the installer specifies the brand they intend to use so that you can do your own research. Nowadays, PV panels have a relatively high efficiency of about 20% and it is usually a 545 – 555 Watt panel that you will purchase. You are looking at a price range of approximately R 2 000 – R 4 500 per panel. For an average household, with a family of about four, 8 of these panels should be more than enough.

Once again do your research, make sure that you are satisfied with the specifications on the make of panel for which you are quoted.

- When it comes to batteries, there are a number of options from which you can choose, however, there are two factors that you need to consider the first one is the depth of discharge (DOD) and the second one is the number of cycles in the lifespan of the battery.
  - o Ideally, if it suits your pocket, Lithium Ion should be your battery of choice, but it is the most expensive option, coming in at about R25 000 – R30 000 for a 4.8kWh to go on your 5kW inverter. They are more energy dense than lead acid or gel batteries, meaning they last longer (up to 3000 cycles) and have a deeper cycle discharge ability. In laymen's terms this means that a lithium ion battery can comfortably go down to 20-5% power (discharging 80-95% into your household needs) before it needs to be recharged; not negatively effecting the lifespan of the battery.
  - o In terms of cost vs DOD and cycles, the next best option is to consider gel batteries. One would expect to pay around R 4000 – R 7000 for a 3.2kWh. These should only be run to 50% discharge, anything beyond this and you will risk negatively affecting their lifespan (100-1500 cycles).
  - o Similarly, deep cycle lead acid batteries should be discharged to no lower than 50%, never fully discharge a deep cycle lead acid battery because the deeper you discharge the battery the more it will reduce the battery's total lifespan (500-1000 cycles). Lead acid batteries are the least cost to buy and prices range from R3 000 – R 7 000 for a 3.2kWh (12V)
- Whatever Battery you select, insist on a brand name that you know or can research, both in terms of performance and price.

- Request an itemised quote for all the components needed to get the electricity from the panels into your home. These include roof brackets, wiring, the combiner box (which sits between your home distribution board and the inverter), labour costs, the certificate of compliance (CoC), switches, cables ,fuses (it is always good to buy a few of these to keep in reserve, they are inexpensive) and trunking.

- Switchgear and surge protection, which is the "brain" needed to balance the system, must also be specified, along with the level of tech integration that is offered.

- Lastly, don't be seduced into buying functionality and/or capacity you might not use, remember you are energy efficient now so you don't need such a large system, things such as wi-fi communication etc. are also a nice to have, but not essential.

"It is important to get a spec for the wattage on the inverter, panels and batteries," says Surridge. "You sometimes need a few more panels than you'd think, and you never want to run your inverter at its maximum. For example, if you have 2,8 kW coming in from the panels, you want a 5 kW inverter. In this way, you don't put strain on the inverter, which extends its lifetime. As far as possible, you want your inverter to last as long as your batteries."

3. Negotiate

Just because you have a quote from a reputable installer doesn't mean you have to accept it. Negotiate if you feel it is unreasonable, but without skimping on either quality or safety for the equipment, safety for your home electrical system and safety for you and your family. "A PV and/or battery back-up system can add tremendous quality to your life and up the resale value of your home," says Surridge. "It is therefore worth investing the time and effort to make sure you get the best value for your investment." wn

cigre Southern Africa | 11th REGIONAL CONFERENCE
POWER SYSTEM TECHNOLOGIES FOR SUSTAINABLE GROWTH IN AFRICA

24 – 27 October 2023
CSIR International Convention Centre
Pretoria, South Africa

The CIGRE Southern Africa 11th Regional Conference Highlights Crucial Topics in the Power Sector

The bi-annual CIGRE Southern Africa Regional Conference is a premier event for professionals in the power sector, kicking off on the 24th of October until the 27th October. The conference promises to inspire with a series of informative and insightful sessions aimed at addressing critical issues facing the industry. The conference, hosted at the CSIR International Convention Centre in Pretoria, features leading experts in the Southern African region and internationally who will be sharing their expertise and research findings to advance the field.

The event commences with a tutorial day diving straight into the following topics:

TUTORIAL 1: MITIGATING THE RISK OF WILDFIRES AND GRID STABILITY

The first tutorial, led by Andreas Beutel of ESKOM, South Africa, delves into the critical topic of mitigating the risk of wildfires near overhead power lines. Beutel's presentation will highlight the challenges posed by elevated wildfire danger environments, emphasizing the need for distribution utilities to prevent wildfire starts and transmission utilities to protect their lines. The study showcases the Prevent, Prepare, Respond, Recover (PPRR) framework of Emergency Management as a valuable tool for utilities.

TUTORIAL 2: LOW-COST SUBSTATION DESIGN FOR DEVELOPING COUNTRIES

The second tutorial, presented by Theuns Marais and Philip Koenig from Eskom, and Eys Bantu Professional Services respectively introduces Technical Brochure TB 740, focusing on cost-effective substation design. This comprehensive guide draws on international surveys and feedback from African utilities to streamline the substation design process. It encompasses aspects such as design philosophy, asset management, equipment selection, safety, and environmental considerations promising to be insightful for all levels of engineering professionals in the industry

TUTORIAL 3: WILDLIFE INTERACTIONS WITH ELECTRICAL INFRASTRUCTURE

Rudi Kruger from Eskom, South Africa, will lead the third tutorial, addressing the critical issue of wildlife interactions with electrical infrastructure. Kruger will discuss the impact of birds and other wildlife on power lines and substations, emphasizing the importance of mitigation measures to protect avian populations. The tutorial will shed light on the collaborative efforts of the CIGRE Working Group on "Wildlife and Electrical Infrastructure" and the resulting Technical Brochure TB 876.

One of the highlights of the conference will certainly be the panel discussion on the Effect of Inverter-Based Resources on the Southern African Grid chaired by Jana Breedt of Eskom, South Africa, which will draw day 1 to a close. The discussion will revolve around the challenges posed by inverter-based energy resources and their impact on system performance and stability. As South Africa transitions to cleaner energy sources, grid-forming inverters will be highlighted as a potential solution, but panelists will discuss the critical aspects against over-reliance amongst other key topics. The panel featured insights from Eskom, IPPs, and global perspectives, fostering a robust discussion on the future of the Southern African electricity network.

The conference continues day 2 with the keynote address delivered by Isabel Fick, General Manager, System Operator, Eskom, South Africa. Day 2 and 3 will be made up of the peer-reviewed conference papers showcasing a diverse line-up of sessions, fostering collaboration and knowledge exchange among industry leaders. The papers focus on grid reliance, social and environmental sustainability, energy security, digital transformation, and innovation in the industry.

Day 4 closes of with a rotational half-day technical tour of several of the CSIR laboratories and facilities, including the PV Testing lab, Indoor Energy Storage Testbed lab and the Virtual Security Operation Centre.

Amongst the wealth of knowledge that we will experience at the conference, lets also get together and network at the welcome drinks event on Tuesday 24th October and the Gala Cocktail Event on 25th October!

For more information or inquiries, please contact the Organising Committee Chair, Philip Konig or Anelja de Bok. wn

cigre Southern Africa

11th REGIONAL CONFERENCE

POWER SYSTEM TECHNOLOGIES FOR SUSTAINABLE GROWTH IN AFRICA

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After a thorough paper submission and peer review process, the draft programme has been finalised.

The conference will be preceded by a Tutorial Day on 24 October 2023. You can look forward to three knowledge-packed Tutorials as well as a Panel Session by Study Committee C4 with the topic: **Effect of inverter-based resources on the Southern African electricity network**.

The Regional Conference will kick off on the 25th of October with a key-note presentation by Isabel Fick, General Manager - System Operations from Eskom. After that we will jump straight in to more than 60 technical presentations over the next two days.

The first day of the conference will be followed by a Gala Cocktail Event.

An industry networking event not to be missed!

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Eskom's Battery Testing Facility

- SHAPING THE FUTURE OF ENERGY STORAGE

By: Lesiba Ramoroka, Thato Motsepe, Mogao Serumula, Cebolenkosi Zulu, Preshani Naidoo, Molaetsa Mphahlele, Sbongile Mdaki, Nkateko Mathye - The University of the Witwatersrand

In our changing world, where the shift towards renewable energy sources and more efficient power solutions is gaining momentum, energy storage plays a crucial role in shaping the future of electricity. Recently, we had the privilege of exploring Eskom's Battery Testing Facility, a part of our project to create a battery-powered backup supply for the Ga-Mafefe area in Limpopo. The facility tour, led by Prof. Hendri Geldenhuys and Mrs. Ronnell Clark, provided us with an understanding of energy storage advancements through tests like water testing, coal testing, oil testing and transformer oil testing. Mrs. Clark also shared insights into the challenges encountered during the commissioning process.

Ga-Mafefe is a village in Limpopo with a population of around 3,028 people. It faces the significant challenge of frequent power outages due to load shedding, affecting the community's social life. A group of eight final-year students (above authors) embarked on a project to address this issue. Our task was to design a battery-based backup system for Ga-Mafefe village. The project's complexity was that Ga-Mafefe's power supply originates from the Penge substation, located approximately 40 kilometres from the town, as seen in the picture below. This geographical distance presented a critical decision point for the group as they had to determine the optimal location for implementing the battery backup system.

EXPLORING THE FACILITY

As we stepped into the research centre, it was clear that Eskom is fully committed to battery testing. The facility was alive with engineers, researchers and scientists passionately working towards advancing energy storage technologies. Whether conducting tests on large-scale batteries or utilising state-of-the-art equipment, Eskom's dedication to achieving its goals was evident in experiments.

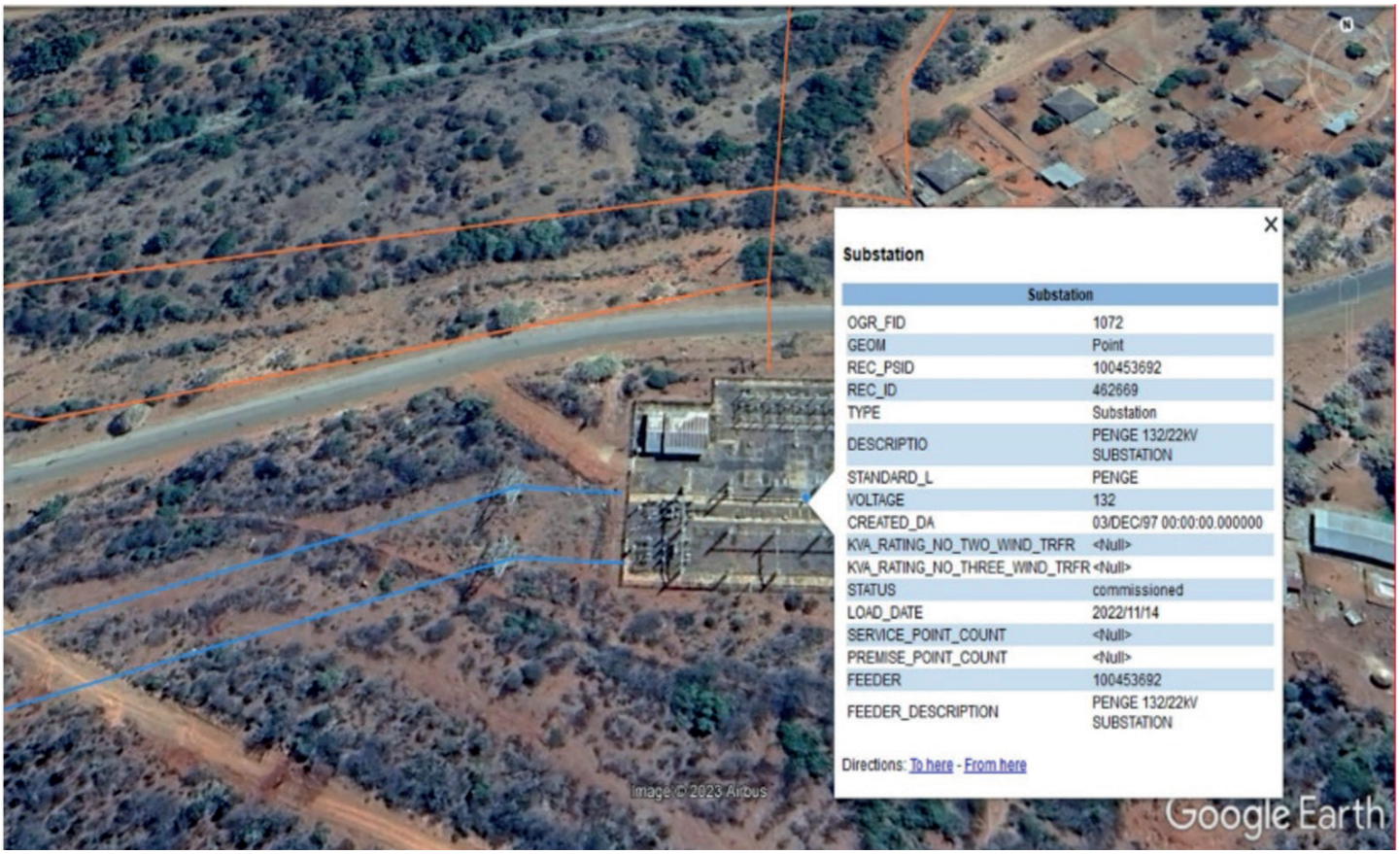
We began our exploration by researching battery technologies in use or being researched. Ronnell Clark highlighted two battery technologies: General Electrics (GE) lithium-ion battery and BYDs 200kW 1.2MWh lithium iron phosphate battery, which has been operational since May 2015. She mentioned that GE initially used a sodium nickel chloride battery. It didn't perform well and was replaced in 2019 with an efficient lithium-ion battery that utilises NMC (nickel manganese cobalt) technology. Mrs Clark emphasised the importance of maintenance in balancing the cells of these batteries to ensure optimal performance and longer lifespan. The focus on battery solutions is driven by land constraints that prevent the construction of dams for hydroenergy storage systems, showing how these technologies are pushing boundaries to improve efficiency and sustainability.

One crucial aspect of their research is energy arbitrage, an approach to optimise energy consumption by charging batteries during off-peak hours and discharging them during peak periods. This not only helps reduce costs but also contributes to stabilising the grid.

When evaluating battery options, Ga Mafefe town was found to have a peak power demand of 1.723 MW. They aimed to determine the battery technology for meeting Ga Mafefe's power requirements.

The Wits Team with Prof Hendri Geldenhuys and Mrs Clark.

Google Earth view of the village in relation to the Penge Substation.



The Penge Substation

Lithium-ion batteries have emerged as the leading choice due to their power and specific energy compared to alternatives like lead acid, nickel cadmium, nickel metal hydride and vanadium redox flow batteries.

This means that lithium-ion batteries can deliver power and store energy per unit of mass. On the other hand, sodium-sulfur technology may have specific power but higher specific energy, indicating its ability to store more energy for a given mass.

Understanding the details of energy tariff structures has been enlightening. Different sectors have varying tariff structures, and Eskom's research aligns their energy storage strategies with these structures to maximise cost effectiveness while ensuring a power supply.

Eskom's collaborative approach with industry partners is commendable. They collaborated with Bushveld Energy to test a vanadium redox flow battery. However, introducing this technology came with its challenges, highlighting the unpredictable nature of research and development in energy storage. Ensuring facility safety is crucial when it comes to energy storage systems. The controlled environment of the testing facility allows for assessing performance and safety measures, minimising disruptions and protecting the reputation of these technologies.

INFRASTRUCTURE AND MONITORING

The facility's infrastructure is imposing as it connects to the grid through substations and step-down transformers. It's crucial to monitor the charging and discharging activities to ensure integration with the grid.

The Ga-Mafefe village

CONCLUSION

Our visit to Eskom's Battery Testing Facility left us feeling inspired and hopeful for the future of energy storage. In a world that strives for more efficient energy solutions, the research, testing and collaborations happening here play a role in utilising and managing electricity. Eskom's unwavering dedication to efficiency, safety and adaptability contributes significantly towards an energy future that benefits all of us. The facility symbolises innovation, reminding us that the energy landscape is constantly evolving through groundbreaking discoveries. wn

Large-Scale Battery Energy Storage Systems:

REVOLUTIONISING ENERGY MANAGEMENT

South Africa has been grappling with a severe energy crisis marked by frequent power outages and supply shortages, commonly called "load shedding." This crisis has had far-reaching economic and social impacts, disrupting industrial operations, straining households, and deterring investment.

By Prof Chandima Gomes
Former Chairman of SAIEE Energy Storage Chapter and Distinguished Professor, University of the Witwatersrand

The situation is exacerbated by ageing power infrastructure, the financial challenges of the state-owned utility Eskom, and a heavy reliance on coal for electricity generation. South Africa is exploring various strategies to address this crisis, including renewable energy expansion, grid infrastructure upgrades, and private sector involvement. Energy storage systems play a vital role in this phase of energy transition.

Large-scale energy storage techniques are crucial for balancing electricity supply and demand, integrating renewable energy sources, enhancing grid reliability, and ensuring a stable power supply. Several energy storage technologies are currently available for large-scale applications, and among them, Battery Energy Storage Systems (BESS) are quite popular in many parts of the world.

Not only in South Africa but the growing global demand for energy, coupled with the increasing focus on renewable energy sources, has also led to a surge in the development and deployment of large-scale BESS. These systems are pivotal in addressing the intermittent nature of renewable energy sources like wind and solar, ensuring a stable and reliable power supply.

APPLICATIONS OF BESS

BESS find a wide array of applications across various sectors at present:

Grid Stabilisation: BESS can absorb excess energy during periods of low demand and release it during high-demand periods, ensuring grid stability and reducing the need for expensive peaker plants, which are specifically built to meet short-term, high-demand conditions and are not intended to run continuously like baseload power plants.
Renewable Energy Integration: BESS efficiently integrates intermittent renewable energy sources by storing surplus electricity when the sun isn't shining or the wind isn't blowing.

Load Shifting: BESS can shift electricity consumption from peak to off-peak hours, reducing consumer electricity costs and grid stress during peak periods.
Backup Power: They provide reliable backup power during grid failures or natural disasters, improving grid resilience.
Electric Vehicle Charging: Large-scale BESS can facilitate fast and simultaneous charging of electric vehicles, reducing strain on the grid.

TYPES OF BESS

BESS are mostly electrochemical devices that are one of the most

efficient in compactness compared with other mass energy storage devices. Several types of BESS are available at a commercial level, with capacities in the range of several megawatt-hours (MWh) to gigawatt-hours (GWh). Different kinds of BESS vary based on several key parameters and characteristics. These parameters influence the suitability of a specific BESS technology for various applications and determine its advantages and limitations.

Here are the main parameters on which different types of BESS differ:

Chemistry: BESS technologies are primarily distinguished by their battery chemistry. Standard chemistries include lithium-ion, flow batteries (e.g., vanadium, zinc-bromine), sodium-sulphur, lead-acid, and more. Different chemistries have varying energy densities, cycle life, and safety characteristics.

Energy Density: Energy density refers to the amount of energy a battery can store per unit of weight or volume. Lithium-ion batteries typically offer high energy density, making them suitable for compact applications, while flow batteries have lower energy density but are more scalable.

Power Density: Power density indicates how quickly a battery can deliver power. Some BESS, like lithium-ion, excel in power density, allowing for rapid discharge and response to sudden changes in demand.

Cycle Life: Cycle life represents the number of charge and discharge cycles a battery can undergo while maintaining its performance. Lithium-ion batteries generally have a long cycle life, which is essential for grid applications, whereas some other technologies may have limitations.

Scalability: Refers to the ease with which a BESS can be expanded or reduced in capacity. Flow batteries and other technologies are highly scalable, making them suitable for large-scale applications.

Round-Trip Efficiency: Round-trip efficiency measures how efficiently a battery can convert electrical energy from charging to discharging. Different BESS technologies have varying round-trip efficiencies, impacting their overall energy economics.

Safety: Safety is a critical parameter, especially for grid-scale BESS. Some chemistries, like lithium-ion, have safety concerns related to thermal runaway, while others, like sodium-sulphur, operate at high temperatures.

Operating Temperature: The operating temperature range can vary between BESS technologies. Some work well in high-temperature environments (e.g., sodium sulphur), while others are better suited for moderate temperatures.

Environmental Impact: BESS technologies have different environmental considerations. Some use abundant and non-toxic materials, while others may involve rare or hazardous substances.

Cost: The cost of BESS varies based on the chosen technology, scale, and market conditions. Lithium-ion is often considered the benchmark for cost-effectiveness, but other technologies may compete in specific scenarios.

Applications: BESS technologies are chosen based on their suitability for specific applications. For example, lithium-ion batteries are prevalent in consumer electronics and electric vehicles, while flow and sodium-sulphur batteries are favoured for grid storage.

Resource Availability: The availability of raw materials for battery production can be a limiting factor. Lithium, for instance, is a critical resource, while others, like sodium and sulphur, are more abundant.

These parameters collectively influence the choice of BESS technology for a given application and contribute to the versatility and adaptability of energy storage solutions in addressing the diverse needs of modern energy systems.

The popular types of BESS available, their significant properties (advantages/limitations) and applications are tabulated in Table 1.

Lithium-ion batteries are known for their high power density and rapid response capabilities. They can quickly inject or absorb power into the grid to stabilise frequency and voltage during sudden changes in demand or supply. Flow batteries can provide long-duration grid support and adjust power and energy independently. They are well-suited for applications requiring sustained energy output. NaS batteries can deliver high power output, making them suitable for grid stabilisation. They can also operate at high temperatures, which can be advantageous in some situations. Despite their limitations compared to newer battery technologies, lead-acid batteries can still find valuable applications in grid stability, particularly in specific scenarios and use cases, as given in Table 1.

Note that regardless of the specific BESS technology, advanced BESS energy control systems and algorithms powered by AI are crucial for effective grid stabilisation. These systems optimise the operation of BESS and enable them to respond to grid disturbances with precision.

COMPETITIVE ENERGY STORAGE TECHNOLOGIES

As a mass energy storage system that can mainly be used for grid stability, BESS has to compete with several other popular energy storage techniques. A comparison of a few of these energy storage techniques and the two most popular BESS is given in Table 2. While pumped storage is favourable for large-scale applications (extendable to the TWh range), their geographical locking limitation still gives BESS an advantage. The same restriction makes CAES less favourable than BESS. Thus, the closest competitor to BESS remains hydrogen storage systems even at large-scale applications (similar to the competition at small-scale applications such as powering EVs).

In summary, these large-scale energy storage techniques offer various advantages and disadvantages, making them suitable for different applications and environmental conditions. The choice of technology depends on factors such as the local grid's needs, resource availability, geographic constraints, and project economics. These technologies' continued development and integration

TYPE	ADVANTAGES	LIMITATIONS	APPLICATIONS
Lithium-Ion Batteries (Li-ion)	High energy density, long cycle life, rapid response time, and scalability. They are the most commonly used battery type in large-scale BESS.	Limited resource availability, potential safety concerns (thermal runaway), and high initial costs.	Frequency regulation, voltage support, grid balancing, and short-duration energy storage for grid stability.
Flow Batteries (Vanadium Radox, Zinc-Bromine, etc.)	Long cycle life, high scalability, and the ability to decouple power and energy ratings.	Lower energy density, larger physical footprint, and higher maintenance requirements compared to Li-ion batteries.	Grid stability, peak shaving, and load shifting
Sodium-Sulfur (NaS) Batteries	High energy density, long cycle life, and suitability for high-temperature applications.	High operating temperatures, limited scalability, and potential safety concerns due to high flammability.	Frequency regulation, load following, and grid support during peak demand.
Lead-Acid Batteries	Low cost, wide availability, and reliability for specific applications.	Limited cycle life, lower energy density, and environmental concerns due to lead content.	Backup power and UPS, frequency regulation, voltage support and grid resilience, islanded microgrids, energy arbitrage, renewable energy integration

Table 1. Types of BESS and their advantages/limitations

are essential for achieving a more reliable, resilient, and sustainable energy grid.

SUCCESS AND FAILURE STORIES

There are several successful Large Battery Energy Storage Systems (BESS) around the world that have demonstrated the capabilities and benefits of this technology. Here are a few notable examples:

Hornsdale Power Reserve, South Australia: This Lithium-ion BESS with a capacity of 150 MW/194 MWh is often called the "Tesla Big Battery." It is one of the largest lithium-ion battery installations in the world. It was built by Tesla in collaboration with the South Australian government. The facility has successfully stabilised the grid, reduced frequency fluctuations, and provided rapid response during peak demand or supply shortfalls. It has saved millions of dollars in grid stabilisation costs and has contributed to a more reliable energy supply in the region.

Moss Landing Energy Storage Facility, California, USA: This is also a Lithium-ion BESS with a 400 MW/1.6 GWh capacity located in California. This massive BESS, developed by Vistra Energy, is one of the largest in the world. It provides grid support, helps integrate renewable energy, and contributes to California's goal of transitioning to a cleaner energy system. It can respond quickly to electricity demand and supply fluctuations, ensuring grid reliability and stability.

Hekinan Thermal Power Plant, Japan: This is a Sodium-Sulfur (NaS) BESS with a 300 MW/ 1,200 MWh capacity. This energy storage facility in Japan is one of the largest sodium-sulfur battery installations globally. It helps balance the grid by storing excess electricity during periods of low demand and supplying it during peak hours. The high energy density and reliability of NaS batteries make them well-suited for this application.

Hazelwood Battery Energy Storage System, Victoria, Australia: This is another Lithium-ion BESS with a

ENERGY STORAGE TECHNIQUE	CAPACITY	APPLICATION	PROS	CONS
Lithium-Ion Batteries	Several MWh to GWh	Grid stabilization, renewable energy integration, peak shaving, and backup power	High energy density, rapid response time, long cycle life, ability to move and scalability	Limited resource availability, potential safety concerns (thermal runaway), and relatively high initial costs
Flow Batteries	Hundreds of kWh to multiple MWh	Grid stability, load shifting, and renewable energy integration	Long cycle life, scalability, ability to decouple power and energy ratings, and suitability for both stationary and non-stationery applications	Lower energy density compared to lithium-ion batteries, larger physical footprint, and higher maintenance requirements
Pumped Hydro Storage	Several GWh to TWh	Grid balancing, energy storage, and peak shaving	High capacity, long life span, and proven technology	Geographically limited to specific topographies, requires significant water resources, and substantial infrastructure investment
Compressed Air Energy Storage (CAES)	Hundreds of MWh to GWh	Grid support, renewable energy integration, and peak shaving	Large-scale capacity, long cycle life, and relatively lower environmental impact	Limited geographic applicability, energy losses during compression and expansion, and infrastructure requirements
Hydrogen Storage	MWh to TWh	Grid balancing, transportation, and industrial processes	High energy density, long storage duration, and potential for renewable hydrogen production	Energy conversion losses (electrolysis and fuel cell efficiency), challenges in hydrogen transport and storage, and evolving technology

Table 2. Comparison of BESS with other popular energy storage techniques

20 MW/34 MWh capacity. This BESS, located in Victoria, Australia, has been pivotal in stabilising the local grid and supporting the integration of renewable energy. It enhances grid reliability and reduces the need for fossil fuel-based backup power, contributing to a cleaner and more sustainable energy system.

Hawaii Energy Storage Project, USA: This hybrid energy storage system constitutes a Lithium-ion BESS, Flow Batteries and a pumped hydro system. It has a capacity of over 400 MW. Hawaii has several BESS installations designed to address the unique challenges of its island grid. These projects, including the Kauai Island Utility Cooperative's lithium-ion system and Hawaiian Electric's grid-scale battery projects, have significantly improved grid stability and accommodated the growing share of solar and wind power in Hawaii's energy mix.

These successful BESS installations demonstrate the capacity of large-scale energy storage to enhance grid reliability, integrate renewable energy sources, and provide rapid response to fluctuations in electricity supply and demand. They serve as models for other regions looking to deploy similar systems to create more resilient and sustainable energy grids.

Whereas there have been many successful large-scale energy storage systems worldwide, some projects have faced significant challenges or failed to deliver on their intended objectives. Below are a couple of examples:

Schwerin Battery Park, Germany: This 5 MW/5 MWh Lithium-ion BESS project in Germany was intended to provide grid stabilisation services and support the integration of renewable energy. However, it faced several challenges, including technical issues and insufficient revenue generation. The project struggled to meet revenue expectations due to changes in market conditions and regulatory constraints. The project reportedly incurred losses of approximately USD 2.7 million. These losses were attributed to the project's inability to generate sufficient revenue to cover operational costs and repay its financing.

Crescent Dunes Solar Energy Project, Nevada, USA: While not a traditional BESS, this 110 MW/1.1 GWh Concentrated Solar Power (CSP) with molten salt energy storage in Nevada deserves mention due to its energy storage component. It used molten salt to store thermal energy for power generation. The project faced numerous technical and operational challenges, including issues with the molten salt storage system, leading to prolonged downtime. These problems resulted in the facility's failure to deliver the expected energy output. The project faced significant financial difficulties, incurring over USD 1 billion in estimated losses. These losses were primarily due to construction and operational issues, making it unable to fulfil its power purchase agreements.

It's important to note that the failures of these projects were due to a combination of factors, including technical issues, regulatory changes, and market dynamics. Battery energy storage projects can face challenges related to technology reliability, insufficient revenue streams, or changing energy market conditions. These cases highlight the importance of thorough planning, adequate risk assessment, and adaptability in deploying large-scale BESS to ensure long-term success and viability.

Please note that the financial losses mentioned are approximate figures based on available information, and the actual losses may vary depending on specific project circumstances and contractual agreements.

GLOBAL MARKET POTENTIAL OF BESS

The combination of several factors, including expansion of energy access, the pace of renewable energy adoption in different regions, industrial and commercial applications including EVs, residential energy storage, grid modernisation, policy support, advancements in technology and environmental concerns suggests a vast and rapidly expanding global market potential for BESS. While providing a precise figure is challenging, various industry reports and market analyses project substantial growth in the coming years. Estimates often vary, but a few years ago, the global BESS market was expected to reach tens of billions of dollars in the next decade.

In recent years, the worldwide market for BESS experienced notable growth, escalating from $4.34 billion in 2022 to $5.53 billion in 2023, marking a robust compound annual growth rate (CAGR) of 27.4% according to the Battery Energy Storage System Global Market Report-2023. However, the Russia-Ukraine conflict has overshadowed global economic recovery efforts following the COVID-19 pandemic, particularly in the near term. This ongoing war has triggered economic sanctions imposed on several nations, a sharp upswing in commodity prices, and disruptions in supply chains, culminating in inflationary pressures across both goods and services sectors, with ripple effects observed across multiple global markets. Despite these challenges, the battery energy storage system market remains poised for substantial expansion, with projections indicating growth to reach $13.8 billion by 2027, underpinned by a steady CAGR of 25.7%.

ESKOM'S PERSPECTIVES ON BESS

South Africa's energy landscape is heavily dependent on coal for electricity generation. Eskom, the country's largest electricity producer, operates numerous coal-fired power plants, which have been the backbone of the energy supply for decades. However, these ageing plants are prone to breakdowns and require extensive maintenance, contributing to the energy crisis.

The crisis has not only disrupted industrial processes but has also hampered economic growth and social development. Recognising the need to transition to a more reliable and sustainable energy system, Eskom has begun exploring alternative energy sources and grid technologies, including BESS.

As per the documentation and press release by ESKOM during the last few years and the media experts' views on the subject, Eskom's Perspective on BESS could be modelled as below.

Stability of the national grid: Eskom acknowledges that BESS can be crucial in grid stabilisation. The intermittent nature of renewable energy sources like wind and solar can create imbalances in the grid. BESS provides a means to store excess energy when it's available and release it when needed, helping to maintain grid frequency and stability.

Management of renewable integration: Eskom recognises the importance of integrating renewable energy into the grid to reduce greenhouse gas emissions and diversify the energy mix. BESS can complement renewable sources by storing surplus energy and smoothing out fluctuations, ensuring a consistent power supply.

Peak load management: Eskom sees BESS as a valuable tool for managing peak electricity demand. BESS can be deployed to shave peak loads, reducing the strain on the grid during high consumption and potentially delaying the need for expensive peaker plants.

Reduction of unscheduled outages: Eskom acknowledges that BESS can help mitigate the impact of unscheduled outages. By providing fast response times and acting as a backup power source during grid disturbances, BESS contributes to improved grid resilience.

Rural electrification: Eskom recognises the potential of BESS in rural electrification projects. Remote areas without access to the primary grid can benefit from microgrids powered by renewable energy sources and backed by BESS for a reliable electricity supply.

While Eskom acknowledges the potential benefits of BESS, there are challenges to its widespread adoption. These include:

Cost: BESS deployment can be costly, and Eskom faces financial constraints. Finding cost-effective solutions and financing mechanisms is a significant consideration.

Infrastructure: Eskom needs to upgrade its grid infrastructure to accommodate BESS installations, which requires investment and planning.

Regulatory Framework: Developing a regulatory framework that encourages private investment in BESS while ensuring grid stability is complex.

Resource Availability: Securing a sustainable supply chain for batteries and ensuring responsible disposal or recycling are essential considerations.

THE POTENTIAL OF VANADIUM REDOX FLOW BATTERIES IN SOUTH AFRICA

Among many types of BESS, Vanadium Redox Flow Batteries (VRFBs) have a high potential in South Africa to excel as a viable commercial product. The future of VRFBs in South Africa holds significant promise, particularly in the country's evolving energy landscape and its sustainability and grid reliability goals. Thus, it is worth discussing some critical considerations for the future of VRFBs in South Africa in this article.

As previously discussed, South Africa is actively expanding its renewable energy capacity, primarily through wind and solar power projects. VRFBs are well-suited to complement these intermittent energy sources by providing energy storage and grid stabilisation capabilities. VRFBs can store excess energy generated during periods of high renewable output and release it during peak demand or when renewable generation is low, thus reducing the need for fossil fuel-based peaker plants. VRFBs can play a crucial role in grid stabilisation by providing fast response times and helping to maintain grid frequency and voltage within acceptable limits. These batteries can contribute to grid reliability, reducing the risk of blackouts and disruptions.

VRFBs can support rural electrification efforts in remote and off-grid areas. By pairing VRFBs with renewable energy sources, mini-grids can be established to provide reliable electricity to communities not connected to the primary grid. This can contribute to improved living conditions and economic development in underserved regions.

South Africa's mining industry, a significant contributor to the country's economy, often operates in remote locations with unreliable grid access. VRFBs can provide mining operations with a stable and continuous power supply, reducing downtime and enhancing productivity.

VRFBs can provide long-duration energy storage, making them suitable for applications requiring extended discharge periods, such as supporting critical facilities during grid outages or providing continuous power to remote installations.

On top of all the above points, South Africa has a marked edge over other countries as a prominent VRFB manufacturer on a global scale. The country is known for its rich vanadium deposits, a key component of VRFBs. The availability of vanadium resources within the country could make VRFBs an economically attractive energy storage option.

Despite these opportunities, there are challenges to consider, such as the initial capital costs of VRFB installations, the need for appropriate regulatory frameworks, and competition from other energy storage technologies. Additionally, continued investment in infrastructure and grid modernisation will be necessary to realise the potential of VRFBs in South Africa fully.

In conclusion, Vanadium Redox Flow Batteries have a promising future in South Africa, aligning with the country's sustainable energy supply, grid stability, and rural electrification goals. As South Africa continues to develop its energy sector and address its energy challenges, VRFBs will likely play a significant role in transitioning to a cleaner, more reliable energy future.

FUTURE R&D IN SOUTH AFRICA

Several South African institutes and universities in the country have shown interest in advancing energy storage technologies, including VRFBs. Research and development efforts and collaboration with international partners could further enhance the performance and cost-effectiveness of manufacturing and utilising large-scale BESS in the country.

Before planning R&D, it's crucial to understand the unique characteristics of South Africa's energy landscape, which we have already detailed in this article. In summary, they are energy challenges, renewable energy potential, resource availability, and grid constraints.

To effectively plan R&D for BESS in South Africa, several key steps and considerations must be taken into account:

Needs Assessment: Identify specific energy challenges, including grid stability, rural electrification, and industrial power needs, to determine where BESS can provide the most value. Goal Setting: Set clear objectives for R&D efforts, such as improving BESS performance, reducing costs, and increasing local manufacturing capacity.

Resource Allocation: Allocate financial and human resources to support R&D activities, including funding research projects, establishing testing facilities, and fostering collaboration with academic institutions and industry partners.

Technology Selection: Determine which BESS technologies best suit South Africa's needs. Consider VRFBs, lithium-ion batteries, and other emerging technologies based on their suitability for various applications.

Regulatory Framework: Work on developing or revising regulations and standards to support the integration of BESS into the energy system, ensuring safety, reliability, and fair market participation.

Infrastructure Development: Invest in the necessary infrastructure, such as grid enhancements and testing facilities, to accommodate the deployment of BESS and promote research and testing activities.

Market Incentives: Implement incentives, subsidies, or tax benefits to encourage private sector participation and investment in BESS projects.

Skills and Capacity Building: Promote education and training programs to develop local expertise in BESS technology and systems, creating a skilled workforce to support the industry.

Collaboration: Foster collaboration among government agencies, research institutions, industry players, and international partners to leverage expertise, share knowledge, and accelerate R&D progress.

Monitoring and Evaluation: Continuously evaluate R&D initiatives to assess their impact, adjust strategies as needed, and ensure alignment with national energy goals.

Once the above essential concerns are addressed, there are a few primary areas that the researcher may concentrate on:

Advanced Battery Chemistries: Developing safer and more sustainable battery chemistries to reduce resource constraints and enhance safety.

Energy Density Improvements: Increasing the energy density of batteries to reduce their physical footprint and improve storage capacity.

Materials Innovation: Research alternative materials like solid-state electrolytes to improve battery performance and safety.

Grid Integration Technologies: Advancing control systems and grid integration techniques to maximise the value of BESS in supporting renewable energy integration and grid stability.

Cost Reduction: Continuing efforts to reduce large-scale BESS manufacturing and installation costs to make them more economically viable.

Effective R&D planning for Battery Energy Storage Systems in South Africa is essential to address pressing energy challenges, promote renewable energy integration, and strengthen the country's energy infrastructure. By setting clear goals, allocating resources, developing the proper regulatory framework, and fostering collaboration, South Africa can position itself as a BESS technology and application leader, contributing to a more reliable, sustainable, and inclusive energy future.

CONCLUSIONS

In conclusion, Large-Scale Battery Energy Storage Systems have emerged as indispensable tools for a sustainable energy future. Their application versatility and ongoing research and development efforts promise to revolutionise the energy landscape, making it more reliable, resilient, and environmentally friendly. As technology advances, large-scale BESS will be vital in transitioning to a greener and more sustainable energy grid.

Eskom's perspective on Battery Energy Storage Systems reflects a growing recognition of their potential in addressing South Africa's energy challenges. By providing grid stability, supporting renewable energy integration, and enhancing overall reliability, BESS can be a valuable addition to the nation's energy landscape. However, integrating BESS into the grid requires careful planning, investment, and collaboration with various stakeholders. Eskom's evolving approach to BESS reflects its commitment to navigating the transition to a more sustainable and resilient energy future. wn

REFERENCE:

- Battery Energy Storage System Global Market Report-2023, Research and Markets, ID: 5744278, February, 2023
- Dugan, J., Mohagheghi, S., Kroposki, B., Application of Mobile Energy Storage for Enhancing Power Grid Resilience: A Review, Energies, 14, 6476, 2021. https://doi.org/10.3390/en14206476
- Hameed, Z., Trætholt, C., Hashemi, S., Investigating the participation of battery energy storage systems in the Nordic ancillary services markets from a business perspective, Journal of Energy Storage, Volume 58, 106464, February 2023. https://doi.org/10.1016/j.est.2022.106464
- Olabi, A.G., Onumaegbu, C., Wilberforce, T., Ramadan, M., Abdelkareem, M.A., Al—Alami, A.H., Critical review of energy storage systems, Energy, 214, 118987, 2021. https://doi.org/10.1016/j.energy.2020.118987
- Pathak, P. K. and Gupta, A. R., "Battery Energy Storage System," 2018 4th International Conference on Computational Intelligence & Communication Technology (CICT), Ghaziabad, India, pp. 1-9, 2018. https://doi.org/10.1109/CIACT.2018.8480377.
- Wei, P., Abid, M., Adun, H., Kemena Awoh, D., Cai, D., Zaini, J.H., Bamisile, O., Progress in Energy Storage Technologies and Methods for Renewable Energy Systems Application. Appl. 13, 5626, Sci. 2023. https://doi.org/10.3390/app13095626

Requirement of Standards and their Mandatory Implementation

In the latest development, a Tesla lithium battery pack at Genex Power-owned Bouldercombe Battery Project in Queensland, Australia, caught fire on the 25th of September, 2023. Residences in the neighbourhood have reported several loud bangs and massive fire flames of many flashing colours with a smell of burning plastic.

By Prof Chandima Gomes
Former Chairman of SAIEE Energy Storage Chapter and Distinguished Professor, University of the Witwatersrand

It was the first large-scale battery storage site in Queensland. It is strongly believed that the emissions from the burning site could be highly toxic and pose health risks to the residents. The battery is one of the 40 lithium Megapack 2.0 units supplied by Tesla, which developed the 50MW/100MWH battery nicknamed 'Big Bessie.' Big Bessie was estimated to supply power to 4,000 homes in the neighbourhood. When this article is being written, the fire is still burning, and the police believe it will take a few days for the fire to subside.

This is not an isolated incident reported so far. There were several such incidents, even from the developed countries. The incident reemphasizes that more stringent standards should be implemented as we go for large-scale BESS. Against this backdrop, knowing about the existing International and National Standards is essential.

IEC 62933 Series: The International Electrotechnical Commission (IEC) has developed a comprehensive series of standards under IEC 62933. This series covers various aspects of BESS, including safety, performance, and testing. IEC 62933 standards set the groundwork for ensuring the interoperability and reliability of BESS across different regions, fostering global consistency in technology deployment.
The parts of the series of high significance to the safety of BESS are IEC 62933-2-1:2017, IEC TS 62933-2-2:2022, IEC TR 62933-2-200:2021, IEC TS 62933-3-1:2018, IEC TS 62933-3-2:2023, IEC TS 62933-3-3:2022, IEC TS 62933-4-1:2017, IEC TS 62933-5-1:2017, IEC 62933-5-2:2020.

ISO 50001: 2018 -Energy management systems. Requirements with guidance for use:

This standard, developed by the International Organization for Standardization (ISO), focuses on energy management systems. While not exclusive to BESS, it provides guidelines for organizations to improve energy performance, which is pertinent to BESS operations, as they often involve energy-intensive processes.

UL 9540 and UL 9540A: 2020/21 - Energy Storage System (ESS) Requirements - Evolving to Meet Industry and Regulatory Needs: The Underwriters Laboratories (UL) developed these standards to ensure the safety and performance of energy storage systems, including BESS.

These standards are widely recognized in North America and are essential for product certification and regulatory compliance.

Article 706: 2017- Energy Storage Systems: In the United States, the National Electrical Code (NEC) Article 706 specifically addresses installing energy storage systems, including BESS. This code ensures safe and code-compliant installations crucial for fire safety and electrical integrity.

AS/NZS 5139:2019 - Electrical installations - Safety of battery systems for power conversion equipment: Developed in Australia and New Zealand, this standard offers guidelines for BESS's safe installation and operation. It addresses critical aspects such as battery chemistry, thermal management, and electrical safety.

SANS 56005:2022 Ed 1: Specifies requirements and tests for the safe operation of portable sealed secondary lithium cells and batteries containing non-acid electrolytes under intended use and reasonably foreseeable misuse. It also Specifies requirements and tests for the safe operation of portable sealed secondary lithium cells and batteries containing non-acid electrolytes under intended use and reasonably foreseeable misuse.

SANS 62133-2:2022: Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells and batteries made from them for mobile applications - Part 2: Lithium systems.

International and national Battery Energy Storage Systems standards are essential in advancing clean energy technologies adoption. In many countries, including South Africa, BESS installations typically need to comply with a combination of existing electrical and safety standards. These may include standards related to electrical systems, energy storage, safety, and environmental regulations.

It's essential to consult with relevant authorities, such as the South African Bureau of Standards (SABS) or the Department of Mineral Resources and Energy, for the most up-to-date information on BESS regulations and standards in South Africa.

International standards may also be applicable and considered in the absence of specific national standards. These international standards can provide valuable guidance and best practices for designing, installing, and operating BESS systems in South Africa or any other country. It's crucial to work closely with local authorities, industry experts, and regulatory bodies to understand and adhere to your project's relevant standards and regulations to ensure compliance and safety when planning a BESS project in South Africa.

Standards on BESS, available at present, focus on four critical aspects of the technology to ensure the reliability of BESS, promoting their integration into the global energy landscape.

Safety: Safety is paramount in the deployment of BESS. International and national standards provide manufacturers, installers, and operators with clear guidelines for mitigating risks associated with energy storage, such as fire, thermal runaway, and electrical hazards.

Interoperability: Consistent standards promote interoperability among different BESS components and systems. This ensures that BESS can seamlessly integrate with various power grids and renewable energy sources, enhancing grid stability and reliability.

Regulatory Compliance: Adherence to standards is often a prerequisite for regulatory approval and permits. Meeting these requirements facilitates the deployment of BESS, streamlining the regulatory process and expediting project implementation.

Market Growth: Standards provide confidence to investors and consumers alike, fostering a conducive environment for investment in BESS technologies. As adoption grows, economies of scale are achieved, making BESS more affordable and accessible. wn

How battery energy storage can power us to net zero

Across the globe, power systems are experiencing a period of unprecedented change. Low-cost renewable electricity is spreading, and there is a growing urgency to boost power system resilience and enhance digitalisation.

This requires stockpiling renewable energy on a massive scale, notably in developing countries, which makes energy storage fundamental.

Against swift and significant cost reductions, battery energy storage in power systems is increasing. Not that energy storage is new; pumped hydro-storage has seen widespread deployment for decades. There is no doubt we are entering a new phase full of potential and opportunities.

In 2022, approximately 192GW (gigawatts) of solar and 75GW of wind were installed globally. However, only 16GW/35GWh (gigawatt hours) of new storage systems were deployed. A recent International Energy Agency analysis finds that although battery energy storage systems have grown enormously, grid-scale storage capacity needs to be scaled up to reach Net Zero Emissions by 2050.

While battery electricity is no silver bullet that can solve the myriad challenges facing 21st-century power systems, it can substantially contribute to cleaner and stronger power networks. Importantly, it is particularly well-suited to the needs of developing countries where power grids are often weak.

HOW MUCH OF OUR PRIMARY ENERGY COMES FROM RENEWABLES?

Challenges for developing countries abound, including poor security of supply, insufficient generation capacity, underdeveloped or non-existent grid infrastructure, a lack of adequate monitoring and control equipment, and skilled human resources.

In this context, energy storage can help enhance reliability and is crucial in transitioning from thermal to hybrid projects. It allows excess electricity generated from variable renewable energy (VRE), such as solar and wind, to be stored during high demand or low sunlight, increasing reliability and availability. A hybrid project – combining VRE with a battery energy storage system – helps create a more sustainable and stable energy system by reducing reliance on fossil fuels.

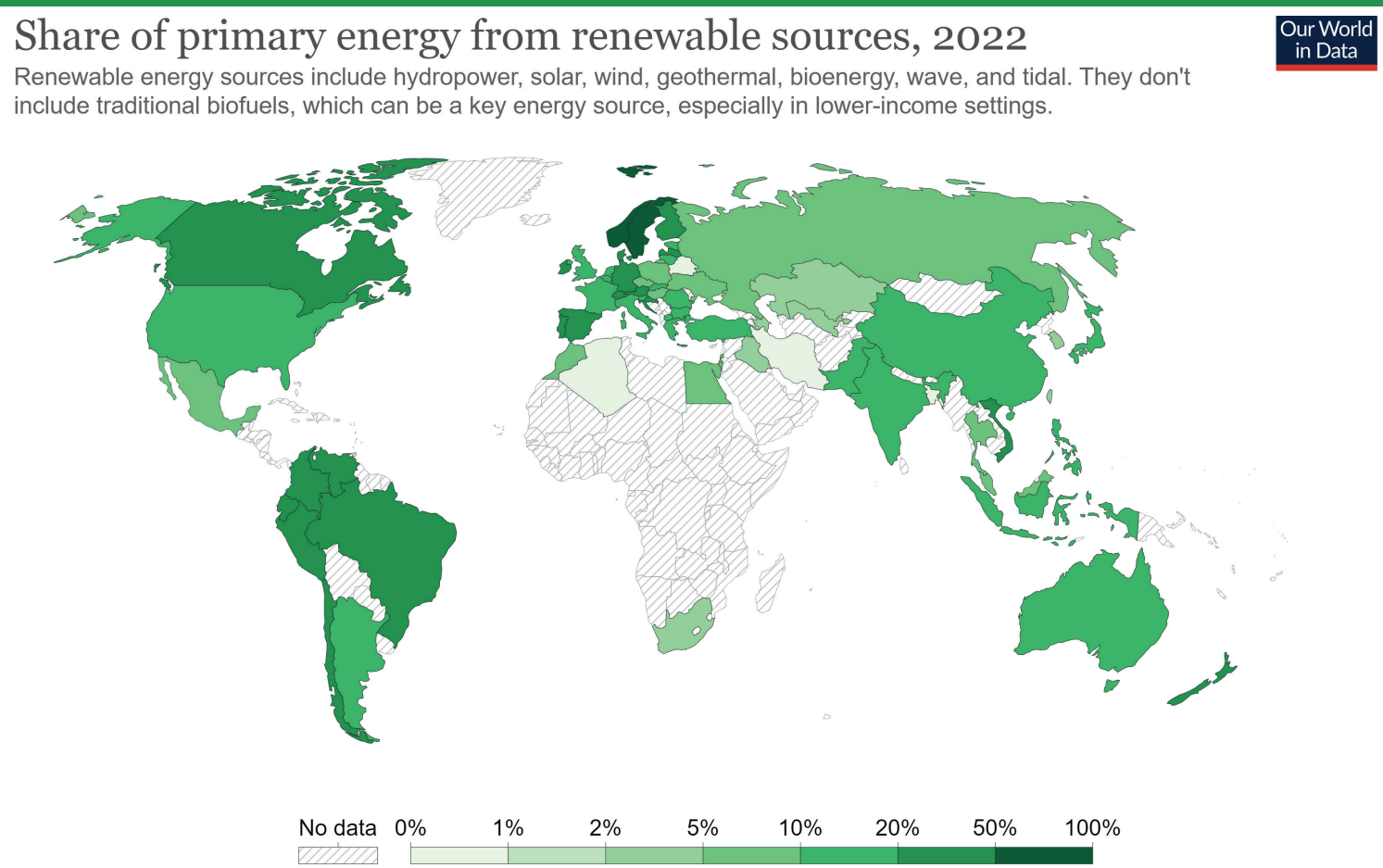


Figure 1: How much of our primary energy comes from renewables? Image: Our World in Data

Yet, current regulations and policies in developing countries do not incentivise the adoption of battery energy storage systems, making it difficult for hybrid projects to compete with traditional energy sources. Revenue streams in these markets are often limited, making it challenging to justify their high upfront costs. Several business models can enable the monetisation of hybrid projects incorporating battery energy storage systems.

The World Bank, through its Energy Sector Management Assistance Program (ESMAP), is actively working on mobilising concessional funding for battery energy storage projects in developing countries. So far, the Bank has rallied about $850 million in concessional financing from several climate funds and has 5.5GWh in battery energy storage capacity commitments in active projects, including 3.7GWh of identified capacity in the pipeline.

ESMAP supports developing countries deploying energy storage by providing access to concessional finance and technical assistance and addressing critical knowledge gaps through an international Energy Storage Partnership (ESP). Hosted by ESMAP, the partnership looks at all forms of energy storage, including but not limited to batteries. With its 50 partners, the ESP is developing a knowledge base in energy storage solutions tailored to the needs of developing countries.

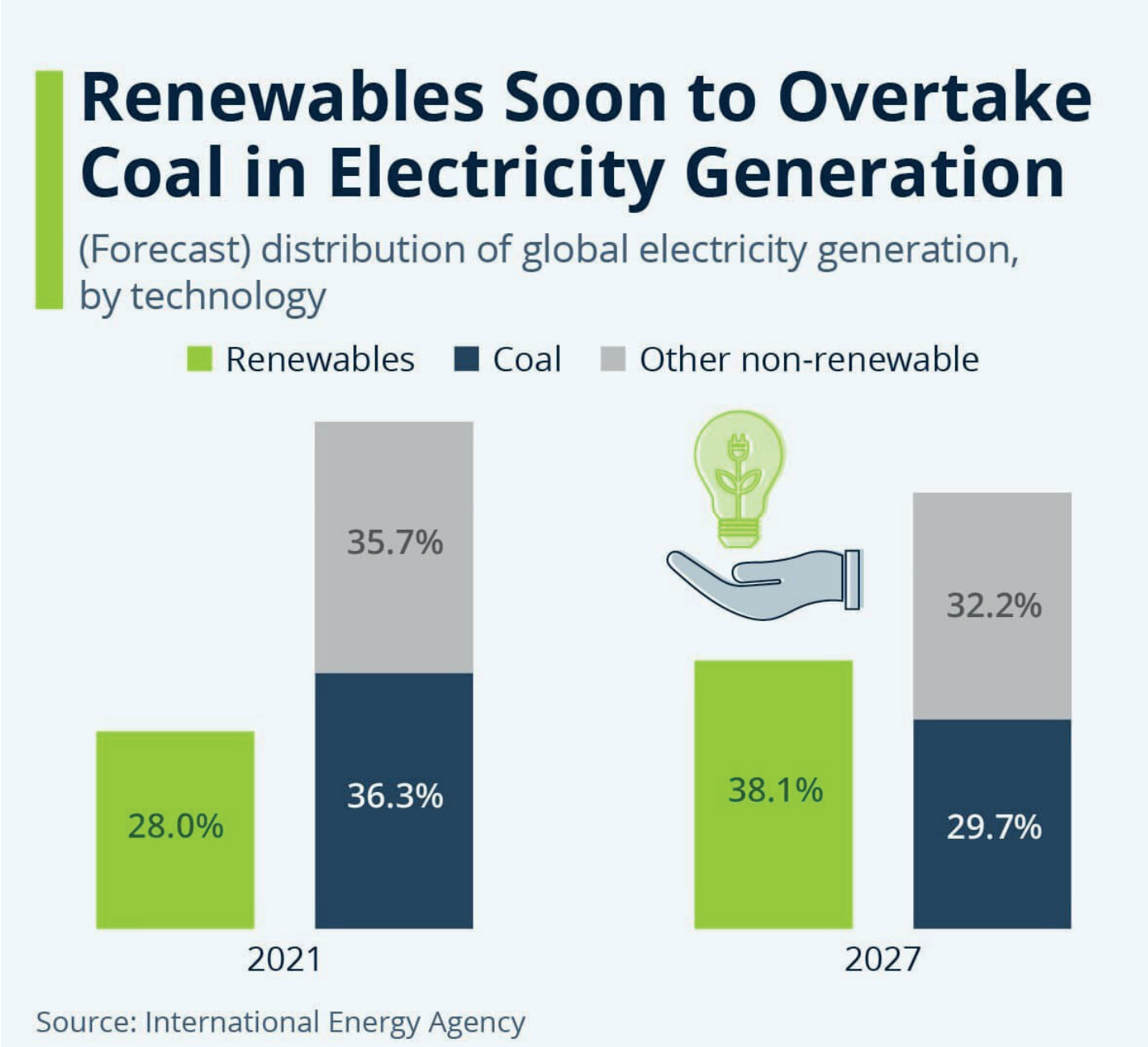


Figure 2: The (forecast) distribution of global electricity generation, by technology in 2021 and 2027
Image: Statista

Despite the increasing popularity of hybrid projects across continents, there remains a gap in the market for a comprehensive framework and guide for power purchase agreement (PPA) structures in the sector. A PPA is a long-term contract between an electricity producer and a client, commonly a utility, government entity, or company. Within this agreement, the buyer of electricity acquires energy at a predetermined price previously discussed and agreed upon. The lack of such a PPA framework makes it difficult for organisations to make informed decisions about the best business models for their needs and make accurate financial calculations.

The ESP has developed a hybrid power purchase agreement framework that aims to monetise the benefits of energy storage to ensure a sustainable payment mechanism. The framework helps incorporate battery energy storage systems into renewable energy auctions where governments call for tenders to install a specific capacity of renewable energy-based electricity. It seeks to assist countries in implementing hybrid renewable energy projects comprising solar plus battery energy storage systems as integral parts of their sustainable renewable energy programmes.

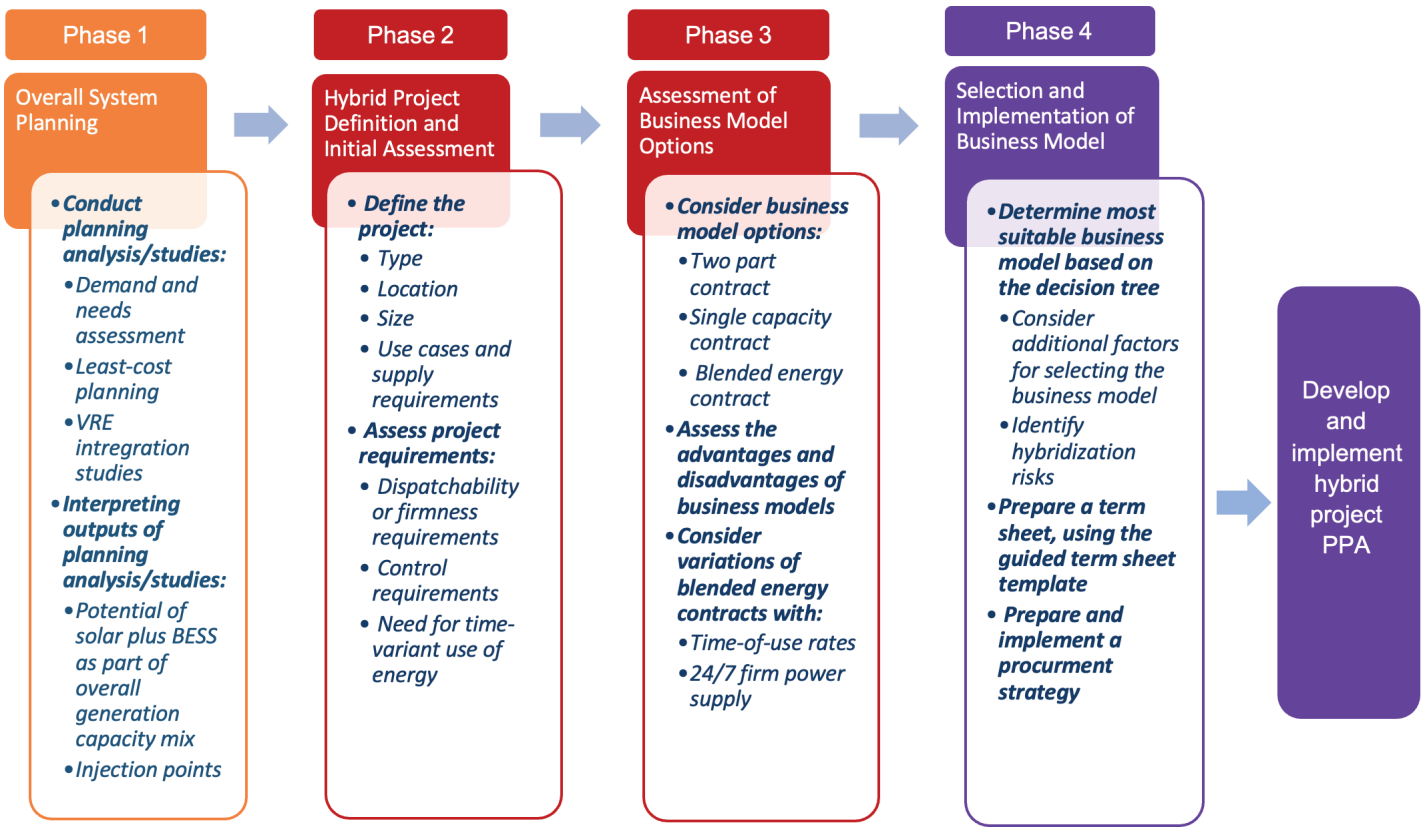


Figure 3: How to plan a hybrid project Image: World Bank

The goal is to unlock private capital and reduce dependence on public finances, helping practitioners make well-informed decisions about the business models that best meet their needs. The proposed framework can be further developed and enhanced in the future, considering other emerging business models and their variations and more in-depth knowledge and best practices adapted from different models across the globe.

TRANSFORMING THE DREAM INTO REALITY

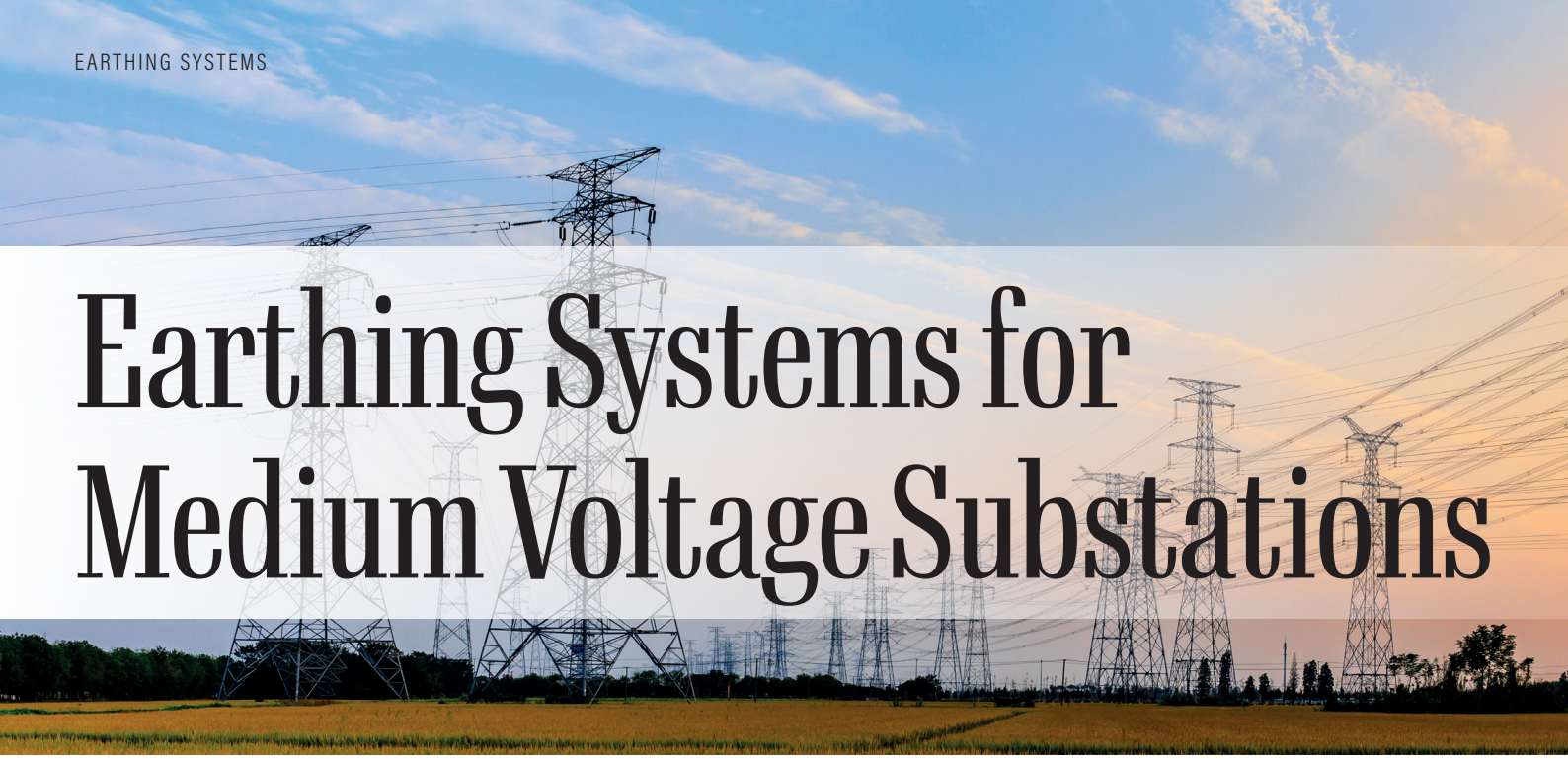
Making energy storage systems mainstream in the developing world will be a game changer. Deploying battery energy storage systems will provide more comprehensive access to electricity while enabling much greater use of renewable energy, ultimately helping the world meet its Net Zero decarbonisation targets.

International organisations and development institutions are leading the way forward to enable this decarbonisation, but collaboration is critical.

The World Bank has recently partnered with the Long Duration Energy Storage (LDES) Council and the Global Energy Alliance for People and Planet (GEAPP) to finance battery energy storage projects in developing countries and take a step towards the energy transition.

The deployment of energy storage systems in developing regions holds the potential to revolutionise the energy landscape.

Still, combined efforts between different institutions are pivotal in driving this essential shift towards sustainable energy solutions. wn



Earthing Systems for Medium Voltage Substations

Electrical earthing is an essential element in the design and operation of electrical substations. It is the foundation for safety, protecting personnel, equipment, and the electrical grid. Earthing ensures the reliable and stable operation of substations, reduces the risk of electrical accidents, and safeguards valuable assets by creating a deliberate electrical connection between the equipment and the earth.

By Prof Chandima Gomes
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As our dependence on electricity grows, maintaining and improving earthing practices in substations remains critical to sustaining a safe and resilient electrical infrastructure. Earthing is not just a technical necessity but a cornerstone of electrical system reliability and safety. Substations are critical components of the electrical grid, serving as hubs for transmitting and distributing electrical power. Medium Voltage (MV) to Low Voltage (LV) substations are crucial in distributing electrical power to end-users. There are a few key reasons why a substation should be earthed.

Safety and Personnel Protection: Earthing in substations is primarily about safety for personnel and the general public. Electrical substations often contain high-voltage equipment and components, posing severe risks without proper earthing. Earthing provides a low-resistance path for fault currents to flow safely into the earth, preventing electric shock hazards and reducing the likelihood of electrical accidents.

During regular operation, substation personnel are protected from electrical faults because earthing helps maintain equipment at a safe voltage level relative to the earth. In the event of a defect, earthing allows fault currents to dissipate harmlessly into the earth, minimising the risk of fires, explosions, and electric shock.

Equipment Protection: Earthing plays a vital role in protecting expensive substation equipment. Electrical faults, such as short circuits or lightning strikes, can introduce excessive voltage and current surges into the substation. These surges can damage transformers, circuit breakers, switchgear, and other critical components without proper earthing, leading to costly repairs and downtime. Earthing allows fault currents to flow away from sensitive equipment, diverting them safely into the earth. This protective measure helps ensure the longevity and reliability of substation assets, reducing maintenance costs and minimising service interruptions.

Grid Reliability and Stability: A well-earthed substation contributes to the overall reliability and stability of the electrical grid. Earthing helps control and dissipate fault currents, preventing cascading failures and disturbances that could impact a broader grid area. It

aids in the rapid detection and isolation of faults, enabling faster fault clearance and minimising the duration of power outages.

Furthermore, earthing helps reduce voltage fluctuations and electromagnetic interference in substations. By maintaining stable reference points for voltage levels, earthing contributes to grid stability, improving the quality of power delivered to consumers.

Lightning Protection: Substations are susceptible to lightning strikes due to their exposed structures and extensive electrical equipment. Earthing systems, including lightning rods and earthing electrodes, help dissipate the energy from lightning strikes safely into the earth, reducing the risk of equipment damage and fires. Effective earthing enhances the resilience of substations against unpredictable natural events.

THE GOOD PRACTICE FOR A SUCCESSFUL SYSTEM

International standards such as the IEC 60364 series, IEC 61936, IEEE 80 and NFPA 70 - National Electrical Code (NEC) provide comprehensive guidelines for substation earthing. Local standards and regulations may also apply, depending on the region. Compliance with these standards is essential to ensure the effectiveness of earthing systems.

Profiling of soil resistivity testing: Before designing an earthing system, soil resistivity testing should be conducted to determine the resistivity of the soil at the substation site. This data is crucial for selecting appropriate earthing electrodes and designing the earthing grid. For designing a tailor-made, well-appropriate earthing system for a given substation using modern software such as CDEGS, it is necessary to measure the soil resistivity distribution of the site both horizontally and vertically.

Earthing system design: The layout should ensure uniform earthing potential across the substation area. Proper spacing and arrangement of conductors and electrodes are critical. The selection of the electrode configuration and the application of any conductivity enhancement techniques should be made after considering several factors such as soil resistivity profile, land stability, and space limitations.

Selection of earthing electrodes: High-quality earthing electrodes, suitable for the chemical and physical characteristics of the soil, play a vital role in the earthing system's performance and durability. Landscapes with low soil resistivity due to various dissolved ions and salts occurring naturally or deposited due to man-intervened processes provide low earth resistance for a given electrode configuration. However, these soil conditions will usually be aggressive towards most types of metals commonly used for earth electrodes. This is a factor to be considered in material selection.

Bonding of various conducting parts: Effective bonding between all metallic structures and equipment within the substation ensures they are at the same potential. This minimises the risk of dangerous touch and step potentials. However, the bonding should comply with the relevant local or international standards. The designer should have a thorough knowledge and awareness of the regulations of local authorities and power utilities to determine the bonding or separation of various metallic components of the system and environment. Experienced in working on substation design in one part of the

world may not help much, sometimes, in doing the same in another part of the world unless the designer consults local engineers who are well aware of local regulations.

Lightning Protection: The substation may need a comprehensive lightning protection scheme depending on the earth flash density of the region. A risk assessment according to local or international standards should be conducted to determine the appropriate level of protection for a given substation. Lightning protection measures are comprised basically of two components: air-termination and down conductors to protect from direct strikes and surge arresters to protect the equipment from surges that come through the power lines (both due to direct attachments and induced effects).

FAILURES OF SUBSTATION EARTHING SYSTEMS

Earthing failures can have severe consequences, including equipment damage, electrical hazards, and power outages. Common causes of earthing failures include:

Inadequate Soil Resistivity Assessment: Incorrect soil resistivity data can lead to the selection of inappropriate earthing electrodes and electrode configurations, resulting in high-resistance earthing systems. On the other hand, with wrong soil resistivity profiling, the designer may also end up with over-design, which may increase the cost of the earthing system many folds higher than what is necessary.

Inappropriate Design: It is recommended to design the earthing system and simulate it in suitable software (e.g. CDEGS) or at least manually estimate its performance before the installation to confirm that the system provides the desired outcomes in the event of an earth fault or lightning surge.

Corrosion: Corrosion of earthing electrodes and conductors can increase their resistance over time, reducing the effectiveness of the earthing system. A good assessment should be done on the chemical structure of the soil, especially if the substation is close to a polluting site (chemical industries, cement industries, oil refineries and other sulphur-rich processes, solid and liquid waste dumps, seashore, etc.)

Poor Maintenance: Neglecting routine maintenance, such as cleaning and inspecting earthing components, can lead to degradation of the earthing system. The relevant authorities should follow a standard maintenance and record-keeping procedure from the beginning.

MAINTENANCE PROCEDURES

Maintenance of medium voltage substation earthing systems ensures their continued effectiveness. Key maintenance procedures include:

Visual Inspection: Regular visual inspections to identify signs of corrosion, damage, or loose connections in earthing electrodes and conductors.

Resistance Testing: Periodic resistance testing of the earthing system to ensure it meets specified requirements.

Corrosion Mitigation: Addressing corrosion issues promptly by cleaning, reconditioning, or replacing earthing components as needed.

Documentation: Maintaining comprehensive records of maintenance activities, including test results and repairs, for reference and compliance verification.

EARTHING SYSTEMS OF AN MV SUBSTATION

In a medium-voltage transformer installation, there are typically three primary earthing systems (Figure 1):

Equipment (Body) Earthing: This system is designed to ensure the safety of personnel and protect equipment within the substation. It involves earthing metal enclosures, frames, and other conductive parts of transformers and associated equipment. The purpose is to prevent electric shock hazards and provide a path for fault currents to flow safely to the earth.

Neutral Earthing: In medium voltage transformers, the neutral point of the transformer winding is often earthed. The purpose of neutral earthing is to stabilise the system voltage and provide a path for fault currents in case of an earth fault. Neutral earthing methods, including solid earthing, resistor earthing, or reactor earthing, can vary depending on system requirements.

Lightning Protection Earthing: A lightning protection system (LPS), including earthing, is essential for safeguarding medium voltage transformers from lightning strikes. These systems typically involve installing a distributed electrode network to safely dissipate lightning-induced surges as quickly as possible to prevent damage to the transformer and associated equipment.

These three earthing systems work together to ensure the safety and reliability of medium-voltage transformers and the overall electrical system. Proper design, installation, and maintenance of these earthing systems are critical to their effectiveness in protecting personnel and equipment.

BONDING AND SEPARATION OF EARTHING SYSTEMS

The interconnection of the three earthing systems in a medium voltage substation (equipment earthing, neutral earthing, and lightning earthing) depends on the specific design and requirements of the substation, as well as local electrical codes and standards.

There is no one-size-fits-all answer, and the decision should be made based on

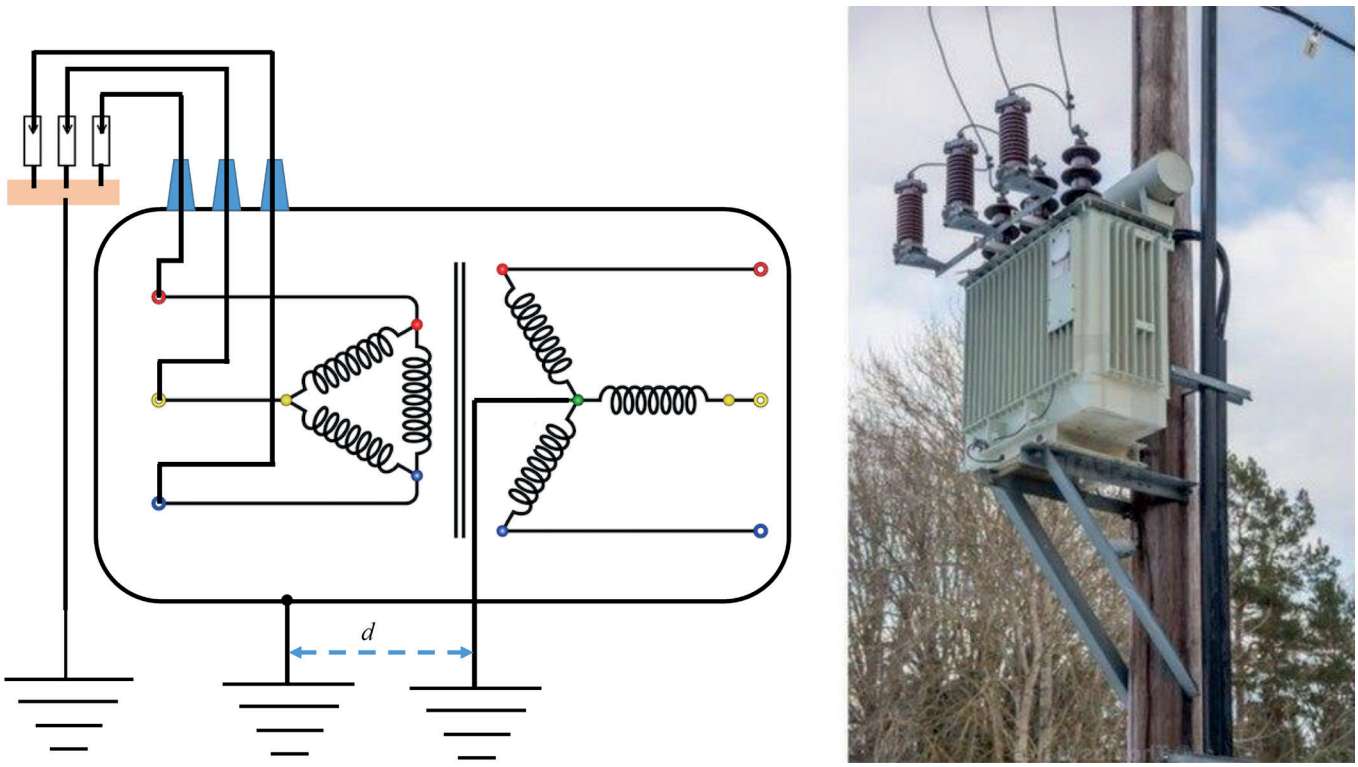

Figure 1: In a medium-voltage transformer installation, there are typically three primary earthing systems.

engineering considerations and safety requirements. Maintaining separate and well-designed earthing systems within a medium voltage distribution substation is generally advisable, each serving its specific purpose. Qualified professionals should carry out any changes or modifications to the earthing systems and adhere to relevant electrical codes and standards to ensure safety and system reliability. Mixing or interconnecting different earthing systems without understanding the potential hazards and consequences should be avoided.

As a result, one should consider the following factors when bonding different earthing systems in a medium voltage distribution substation.

Safety Hazards: The primary purpose of earthing systems is to ensure the safety of personnel and the proper operation of equipment. Different earthing systems may have distinct characteristics and purposes. Interconnecting them can create safety hazards, as the combined system may not provide the intended protection.

Voltage Differences: Earthing systems are designed to maintain all earthed equipment and conductive surfaces at the same electrical potential to prevent electric shock hazards. If you interconnect different earthing systems, you may introduce voltage differences. These voltage differences can create dangerous touch and step potentials, increasing the risk of electric shock.

Inadequate Fault Clearing: Earthing systems are designed to provide a low-resistance path for fault currents to flow and clear faults quickly. Interconnecting different earthing systems can disrupt the intended fault-clearing paths, potentially leading to slower fault clearance or inadequate fault protection.

Equipment Damage: Different equipment within a substation may have different earthing requirements. Interconnecting earthing systems may result in excessive fault currents flowing through equipment not designed to handle them, leading to equipment damage and downtime.

Non-Compliance with Standards: Electrical codes and standards provide specific guidelines for designing and installing earthing systems to ensure safety and compliance. Interconnecting different earthing systems may not meet these standards and could lead to non-compliance, potentially resulting in legal and regulatory issues.

Complexity and Maintenance: Interconnected earthing systems can be complex to design and maintain. Ensuring that the combined system functions as intended and meets

safety requirements over time may be challenging.

Lack of Coordination: Different earthing systems may have been designed independently to meet specific needs. Interconnecting them without careful coordination can lead to their operation and effectiveness conflicts.

Loss of System Integrity: Earthing systems are integral to the electrical distribution system's overall integrity. Interconnecting different systems can compromise the integrity and safety of the entire distribution system.

In most cases, power utilities allow interconnection of surge arrester (lightning protection) earthing directly or via a cross arm to the body of the transformer to avoid difficulties in maintaining a significant separation between the two systems, especially at higher elevations. However, due to the reasons listed in the following section, many authorities specify the isolation of this combined earthing system and the neutral earth as a mandatory recommendation. Establishing a minimum separation value d in such cases is challenging since it is affected by various parameters, including soil resistivity, lightning current distribution in the region, anticipated faults and neutral currents, soil surface conditions, electrode configuration, etc. However, many utilities specify a value as a rule of thumb (e.g. ESKOM specifies 5 m).

HAZARD SCENARIOS

Ground Potential Rise (GPR) of Neutral Earth: In the event of an earth fault current or large neutral current (in the event of a severe phase unbalance) injected into the neutral earthing system, it will give rise to a ground potential rise, commonly referred to as GPR. This GPR will transfer to the vicinity through the conductivity of the soil and also via conducting parts of the electrical system (Figure 2) (Adopted from ENA Technical Specification 41-24, Issue 2, November 2018). The most dangerous case is the transferred GPR, which usually happens through the protective earth in a TNS wiring system. In this case, the GPR transfers without attenuation, sometimes to distances of a few hundred meters; thus, the potential difference to which a person or equipment may subject (due to touch or step potential) will be significantly high (it should be noted that the local ground potential at such far away point is essentially zero compared to the transformer earth.

Suppose the body of the transformer is integrated with the neutral earth in the above scenario. In that case, the whole transformer body and its mounting will be live (reaches the neutral voltage), posing a significant safety threat to those approaching the substation. In most cases, the GPR may transfer into the protective fence of the transformer site, which may elevate the risk of shock even to outsiders.

Transfer of Lightning-caused GPR: When lightning strikes the MV line, a large current is injected into the line. This charge of this current is dispersed into the soil by the earthing system of the lightning protection scheme.

In a typical lightning strike, irrespective of the earth resistance of the earthing system, its potential rises instantaneously to a significantly significant value, which could be several tens of kilovolts. This is due to the inherent impedance of the earthing network contributed by the inductance of the electrodes.

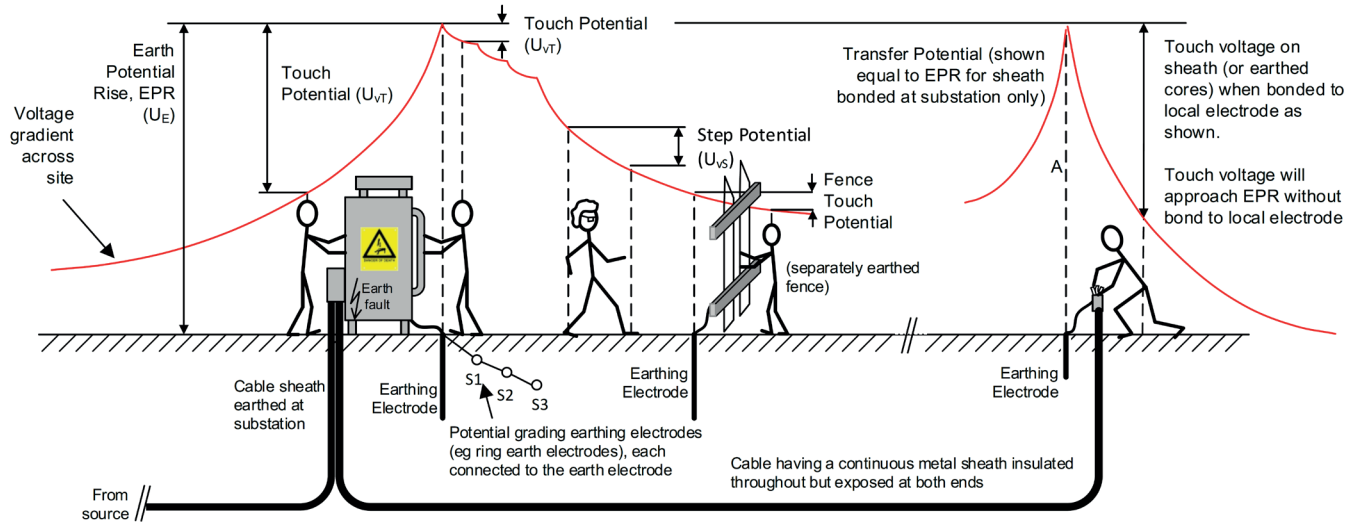

Figure 2: In the event of an earth fault current or large neutral current (in the event of a severe phase unbalance) injected into the neutral earthing system, it will give rise to a ground potential rise, commonly referred to as GPR. This GPR will transfer to the vicinity through the conductivity of the soil and also via conducting parts of the electrical system

If the lightning protection earthing system is connected to the equipment earthing, this transient GPR will also be transferred to the body of the transformer. Someone is unlikely to approach a substation under overcast conditions, so GPR may not pose a high personal risk. However, suppose the lightning protection earthing is integrated with neutral earthing. In that case, there may be a serious threat to every subscriber that is supplied power from the transformer, especially if the wiring system practised is TT. In this case, arcing may occur from neutral to earth at a distribution panel, socket/plug point or inside equipment, causing fires, explosions or equipment damage. In a TNS wiring system, the transient GPR will appear in the equipment bodies of the subscribers' buildings, posing a human threat. If the wiring system is TNCS with neutral earthed at either the subscribers' main panel or a kiosk, then large transient loop currents may flow through the neutral.

EARTHING ELECTRODES

The selection of the appropriate earthing electrode and material depends on site-specific conditions, including soil resistivity, available space, and environmental factors. Proper design and installation and compliance with local codes and standards are essential to ensure an effective and safe earthing system in substations. Here are some common types of electrodes and performance-enhancement materials used for substation earthing:

Earth Rods: Typically made of copper or steel, are one of the most common earthing electrodes used in substations. Copper earth rods are preferred for their excellent conductivity and resistance to corrosion. Steel earth rods are less expensive but may require galvanisation or special coatings to prevent corrosion. Multiple earth rods can be installed in parallel to reduce earthing resistance.

Earth Plates: Earth plates, also known as earth disks or earth grids, are flat metal plates buried horizontally in the earth. They are often made of copper, stainless steel, or galvanised steel. Earth plates provide a larger surface area for earthing and are particularly useful in areas with high soil resistivity.

Earth Rings: Earth rings are circular conductors, typically made of copper or copper-clad steel, that encircle a substation. They are buried in a circular trench and connected to the earthing system. Earth rings help distribute fault currents evenly and reduce step and touch potentials.

Concrete-encased Electrodes: Concrete-encased electrodes consist of a metal conductor encased in concrete. The metal conductor can be a copper or galvanised steel rod, and the concrete encasement helps improve the electrode's durability and conductivity. These electrodes are often used in areas with rocky or difficult-to-drive soil conditions.

Chemical Electrodes: Chemical electrodes, such as chemical earth rods or backfill compounds, can enhance the conductivity of the surrounding soil. They are used to lower earthing resistance in areas with poor soil conductivity. Chemical electrodes often contain compounds like bentonite or salt to improve soil conductivity.

Earthing Grids: Earthing grids are interconnected conductors in a grid pattern buried beneath the substation. They are typically made of copper or aluminium conductors. Earthing grids effectively reduce earthing resistance and minimise step and touch potentials.

Natural Electrodes: In some cases, natural features like water bodies or buried metal pipelines can serve as earthing electrodes. These natural electrodes can be combined with artificial electrodes to create effective earthing systems.

Grounding Conductivity Enhancement Materials (GCEM): Earthing enhancements, both natural and manufactured, are used to improve the conductivity of the surrounding soil. They are applied to earthing electrodes or the surrounding soil to enhance the earthing system's performance. Ground enhancement materials are not conductive on their own but are used to improve the conductivity of the surrounding soil. Bentonite, graphite, and salt-based GEMs are commonly used to reduce earthing resistance. The selection of materials should be based on a comprehensive evaluation of site-specific conditions, soil resistivity, and environmental factors.

A combination of materials may often optimise the earthing system's performance. It's essential to adhere to local electrical codes, standards, and industry best practices when designing and installing earthing systems in substations to ensure safety and compliance. These materials can be applied to existing earthing electrodes or added during installation to reduce earthing resistance. Note that ground enhancement materials should comply with IEC 62561-7: Requirements for grounding-enhancing compounds.

ELECTRODE MATERIALS

Selecting the best materials for earthing substations is crucial for ensuring the earthing system's effectiveness, reliability, and safety. The choice of materials should consider factors such as electrical conductivity, corrosion resistance, durability, and cost-effectiveness.

Here are some of the best materials suitable for earthing substations:

Copper: Copper is one of the most preferred materials for earthing applications due to its excellent electrical conductivity. It offers low resistance to

the flow of electrical current, which is essential for quickly dissipating fault currents into the earth. Copper has high corrosion resistance, making it suitable for long-term outdoor exposure to various environmental conditions. Copper earthing conductors, earth rods, earth plates, and earth grids are commonly used in substations.

Copper-Clad Steel (CCS): Manufacturing Process: CCS is produced by encasing a layer of copper into a steel core through a process known as cladding. This results in a uniform copper layer encasing the steel core. CCS consists of a steel core that provides structural strength and a layer of copper that offers high electrical conductivity. CCS is often used in applications with essential electrical conductivity and mechanical strength. Typical applications include earthing rods, antenna wires, and electrical conductors for power transmission and distribution. CCS combines copper's high electrical conductivity with steel's strength and durability. It offers good corrosion resistance and is cost-effective compared to pure copper.

Copper-Bonded Steel (CBS): Manufacturing Process: CBS is manufactured using a high-temperature, high-pressure process to create a metallurgical bond between a thin layer of copper and a steel core. The copper layer fuses with the steel core. CBS consists of a steel core with a copper layer bonded at the atomic level, resulting in a robust and integral bond. CBS is commonly used in earthing systems, such as earth rods and earth plates, where electrical conductivity, corrosion resistance, and mechanical strength are essential. CBS offers excellent electrical conductivity due to the metallurgical bond between copper and steel. It provides superior corrosion resistance compared to other materials, making it suitable for long-term outdoor exposure.

Copper-Plated Steel (CPS): CPS involves applying a thin layer of copper to the surface of a steel substrate through electroplating or other plating methods. Composition: CPS consists of a steel core covered by a relatively thin layer of copper, which may vary in thickness depending on the application. CPS is used in applications requiring electrical conductivity but is not the primary consideration. It is often used in decorative and functional applications, such as architectural elements, automotive parts, and consumer goods. CPS provides a decorative copper finish while retaining the strength and cost-effectiveness of steel. However, due to the thinner copper layer, it may not offer the same level of electrical conductivity as CCS or CBS.

Stainless Steel: Stainless steel is known for its corrosion resistance and durability, especially in harsh environments. It is often used for earthing hardware, connectors, and earthing electrode components. Stainless steel earthing materials are ideal for coastal or industrial areas and other highly corrosive situations requiring greater corrosion resistance and strength. The primary disadvantage of stainless steel is cost. It is also less conductive than most alternatives, although the variance is relatively small.

Galvanised Steel: Galvanised steel offers good corrosion resistance due to its zinc coating. It is commonly used for earthing rods, earth plates, and concrete-encased electrodes. Galvanised steel is characterised by its relatively low cost and ready availability worldwide. However, galvanised rods are an inferior material choice in terms of service life longevity. Regular maintenance, including periodic inspection and re-galvanising if needed, is essential to ensure long-term performance. Also, choosing a material based solely on its upfront cost does a disservice to the earthing system's users and their safety and will likely cost more in the long term. In South Africa, due to the extensive number of incidents involving copper theft, copper-coated (clad, bonded or plated) and zinc-coated (galvanised) steel rods could play a vital role in electrical safety. Among them, copper-bonded steel may be regarded as the best because of several physical and chemical properties that make it last long while performing effectively as an earthing electrode.

Relevant industry standards typically specify the thickness and purity of copper in copper-bonded steel rods. These standards ensure that the copper layer on the steel rod meets specific criteria for electrical conductivity and corrosion resistance. Two commonly referenced standards for copper-bonded steel rods are IEEE Std 837 and UL 467. It's important to note that while these standards do not explicitly specify a minimum copper thickness or purity level for copper-bonded steel rods, they emphasise the importance of meeting specific electrical conductivity and corrosion resistance criteria. These criteria ensure that the copper layer performs adequately in earthing and bonding applications. However, as a rule of thumb, many experienced engineers and consultants in the field consider the acceptable level of condition as a bonded coating of thickness 250 microns or more of copper with a purity of 99.9%

When sourcing copper-bonded steel rods for specific projects, it is advisable to work with reputable manufacturers and suppliers who can provide products that meet the relevant industry standards and specifications. Additionally, consulting with a qualified engineer or earthing specialist can help ensure that the chosen materials and components are suitable for the intended application and compliant with local regulations. wn

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Creating a hydrogen economy in South Africa is about more than just energy transition

- THE 'JUST' TRANSITION IS ABOUT MORE THAN ENERGY

By Viren Sookhun, Managing Director at Oxyon

The recently held DEVAC HYDROGEN-H Conference highlighted the opportunity for Africa to lead in developing green hydrogen for energy transition. However, in the greater context and the South African market in particular, green hydrogen is about more than just replacing fossil fuels.

Building a hydrogen economy in South Africa presents a significant opportunity for skills development, local content, and social upliftment. A just energy transition requires more than moving away from fossil fuels; it also requires a concurrent social change that uplifts the people of South Africa and Africa.

There is an opportunity to use the funding, loans and grants available to invest in the future and ensure that the standard of living of even the poorest in our society is far higher than today.

One of the best ways to do this is to expand the definition of local content beyond just using local people for employment and procurement. We can create a broader economic and social impact by opening the parameters and allowing for a portion of the total contract value of green hydrogen projects to be used for people's development. Investing in people beyond those directly involved in projects, training them and skilling them to enable upliftment will facilitate their growth and ripple effect to wider communities.

MOVING UP THE VALUE CHAIN

One area funds can and should be used for is to set up component manufacturing facilities for the various parts of renewable energy production, from wind turbine blades to solar panels and batteries. If these are set up in Special Economic Zones (SEZs), the surrounding communities can also have a stake. At the same time, the country moves up the value chain, and locally manufactured components can decrease cost, add value, and reduce carbon footprint.

Engaging with the communities to determine and prioritise their development needs is also essential. Often, community development initiatives are not conducted in consultation with the communities, and the result is not necessarily of excellent use – for example, constructing a sports stadium when a hospital or a school would be more beneficial. In addition, community leaders must be upskilled to understand the investment, use financial grants wisely and grow the money for continuous development.

South Africa has many unemployed youth who are ideal candidates for skilling in skills around the fourth industrial revolution (4IR) and science, technology, engineering, and mathematics (STEM) subjects.
This knowledge is essential for hydrogen and renewable energy technologies and a host of essential future endeavours. We must also focus on skills development around 4IR from the ground up, even as early as Early Childhood Development (ECD) centre education.

A MOVE TOWARD SELF-SUFFICIENCY

Africa cannot be a developing economy forever; we need to use the fund inflows that are part of the just energy transition to invest wisely to become self-sufficient in the future. Expanding the definition of 'local content' will allow for investment into community development, skills development and transfer of skills, education, training and establishing component manufacturing factories locally, creating jobs and value down the line.

It is also essential for corporate social investment (CSI) to move beyond a tick-box exercise – it must be meaningful, thoroughly thought through, sustainable, and centred on giving back to communities. CSI is not just about building and equipping schools in rural communities. CSI opportunities can also be found in value chains such as transport and logistics, ports, green hydrogen refuelling networks, and construction and civils.

By creating local component manufacturing, investing in innovative skills development, and focusing on creating value through effective CSI and community initiatives, we can move the continent forward and become more globally competitive. wn

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Waste Not, Want Not

By Andrew Cooper Pr.Eng, MBA, B.Sc, B.Comm, CEM, CPEnMS, CMVP
Strategic Energy Management Consultant

Waste not, want not! This was a value we lived by growing up in Zimbabwe many years ago.

According to Merriam-Webster, "... if a person never wastes things, he or she will always have what is needed". For example, even during the drought periods, we had the water we needed because we did not waste what we had.

I want to paraphrase this to say that "waste not, want not" means that we will always have the energy we need if we do not waste energy.

I have often said that people are the key to successful energy management. Taking this further, I believe people are the key to successfully combating climate change. Besides people coming up with creative solutions to generate and store energy, capture carbon and design technology to help minimise energy use, we also need people to minimise the energy they waste.

I do not have the statistics for how much energy we waste globally daily. I can only imagine it is a staggering amount. When you are next out and about, take the time to look around and observe where energy is being wasted.

Once you become aware, you will see it everywhere.

From the small and seeming insignificant, like lights left on unnecessarily, to the larger and ludicrous, like lines of cars stopped and idling in traffic jams or at drive-throughs, to the innocent and ignored, like pilot lights burning on a furnace or heater throughout the summer when that furnace or heater is not required. In almost any building, city street or industrial facility, energy waste hides in plain sight.

Eliminating, or at least minimising, this energy waste serves a few purposes:

- The purpose which will speak to many of us is reducing energy costs. All the energy we use costs someone money. The less we use, the less we spend, which equates to more money in your pocket.

- There is the greenhouse gas (GHG) emissions reduction benefit. As fire, floods, and famine have become more prevalent, most of us are acutely aware of the negative impact of these GHG emissions on climate change. Eliminating, or at least minimising, energy waste will contribute significantly to a global reduction in GHG emissions.

- Eliminating, or at least minimising, energy waste will "free up" capacity on an already constrained electrical infrastructure to allow for increased electrification. The added benefit is that energy waste can be minimised quickly, allowing time to upgrade and build the infrastructure for the much-needed longer-term solutions.

The key to achieving this is, as I mentioned earlier, people. People to be aware, take action, and only use the energy they need to use. There are two ways to achieve this: the stick or the carrot.

- The stick - People can be forced to change through legislation, taxation or necessity.

- The carrot - People can want to change because they know and appreciate the benefit of minimising wasted energy.

Necessity will undoubtedly increase awareness as more and more people worldwide are affected by climate change's impacts.

This stick is not as effective as the carrot, but it is forcing a global shift in awareness, hopefully accelerating the process of people wanting to change.

Maya Angelou said, "When you know better, you do better".

You can start to change today by being aware of where energy is wasted. When you become aware, you know better; you can begin to take action to minimise waste and only use the power you need.

Waste not, want not. It is not up to one of us. It is up to all of us to do whatever we can to minimise wasted energy.

Not only will it help to ensure that we always have the power we need, but it may also help address the climate change crisis we are facing. wn

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114 YEARS 1909-2023 SAIEE

MEMBERSHIP FEES EFFECTIVE 1 DECEMBER 2023

The Council meeting held on 1 September 2023 approved subscription & entrance fees as from 01 December 2023 as per schedule indicated below.

PLEASE NOTE: In terms of Bylaw 3.2 annual subscriptions are due on 1st December 2023

MEMBERSHIP FEES CAN BE PAID IN MONTHLY RECURRING PAYMENTS

Council agreed to a discount for fees paid before 31 March 2024. Members are therefore encouraged to pay promptly to minimize increase impact.

Grade of Membership	Annual Subscriptions paid before 31 March 2024		Annual Subscriptions paid after 31 March 2024		New Members FEES * see Notes 1 & 4 below.	
	RSA incl VAT (R)	Outside RSA excl VAT (R)	RSA incl VAT (R)	Outside RSA excl VAT (R)	RSA incl VAT (R)	Outside RSA excl VAT (R)
Student	173	150	208	180	208	180
After 6 yrs study	1 800	1 565	2 160	1 878	2 160	1 878
Associate	1 800	1 565	2 160	1 878	2 160	1 878
Member	1 989	1 730	2 387	2 076	2 387	2 076
after 6 years	2 325	2 021	2 789	2 426	2 789	2 426
after 10 years	2 433	2 116	2 919	2 539	2 919	2 539
Senior Member	2 433	2 116	2 919	2 539	2 919	2 539
after 6yrs/age 40	2 637	2 293	3 164	2 751	3 164	2 751
Fellow	2 637	2 293	3 164	2 751	3 164	2 751
Retired Member (By-law B3.7.1)	1 118	972	1 342	1 167	n/a	n/a
Retired Member (By-law B3.7.3)	nil	nil	nil	nil	n/a	n/a

1. The fee for all new applications is R3337.00 which includes an entrance fee of R950.00. On election to the applicable grade of membership the new member's account will be adjusted accordingly and refunds/additional payment made on request. Entrance fee for Students is free and new Student applicants require payment of R208.00.

2. Transfer fee to a higher grade is free for all grades of membership.

3. Members are encouraged to transfer to a higher grade when they qualify. It will be noted that the fees of Member and Senior Member grades after 10 and 6 years respectively are equal to the fees of the next higher grade.

4. Members elected after May 2024 pay a reduced subscription fee.

5. By-law B3.7.1 reads “Where a member in the age group of 55 to 70 years has retired from substantive employment in the engineering profession, such member may make written application to Council for recognition as a retired person and a reduced membership fee".

6. By-law B3.7.3 reads “any member complying with the conditions of B3.7.1 but who has been a member of the Institute for not less than 25 consecutive years, shall be exempt from the payment of further subscriptions.” Members who comply with the requirements of By-Law B3.7.3 may make written application to Council for exemption from paying subscriptions".

7. By-law B3.9 reads “any member in good standing who has been a member for fifty (50) consecutive years shall be exempt from the payment of further subscriptions.”

8. Members not in good standing by failing to pay their subscriptions by end of June of each year will, subject to Council decree, be struck-off the SAIEE membership role.

9. Members in good standing and no longer in substantive employment and do not receive payment or salary for work done may apply to Council for a reduction in their annual subscriptions.

10. The members monthly magazine ("wattnow") is available on line and members who require a hard copy may acquire same on request and for a nominal fee subject to minimum uptake numbers.

11. Members who wish to pay their membership fees in recurring payments should activate the payments on their banking portal. Members will receive the early bird discount only if their fees are fully paid by 31 March 2024.

2023 SAIEE MEMBER BENEFITS

STUDENT MEMBER	ASSOCIATE MEMBER	MEMBER	SENIOR MEMBER	FELLOW
Jobs portal for WIL	Jobs portal access	Jobs portal access	Jobs portal access	Jobs portal access
Mentorship	Mentorship	Mentorship	Services Directory	Services Directory
Exclusive Networking Events	Exclusive Networking Events	Exclusive Networking Events	Mentorship	Mentorship
CPD training discounts	CPD training discounts	CPD training discounts	Exclusive Networking Events	Exclusive Networking Events
Charge Reward Programme earnings	Charge Reward Programme earnings	Charge Reward Programme earnings	CPD training discounts	CPD training discounts
Bursary programme	Bursary programme	Long standing member gifts	Charge Reward Programme earnings	Charge Reward Programme earnings
Publication access (**watt**now & ARJ)	Publication access (**watt**now & ARJ)	Bursary programme	Long standing member gifts	Long standing member gifts
Site visits	Site visits	Publication access (**watt**now & ARJ)	Bursary programme	Bursary programme
SAIEE Centres	SAIEE Centres	Site visits	Publication access (**watt**now & ARJ)	Publication access (**watt**now & ARJ)
		SAIEE Centres	Site visits	Site visits
			SAIEE Centres	SAIEE Centres
			Eligibility for nomination as Center Chair	Eligibility for nomination as Center Chair
				Eligibility for nomination as an Office Bearer

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OCTOBER 2023

01/10/2023	Smart Mobility Africa Summit | Gallagher Convention Centre | Midrand | JHB
03/10/2023	New Engineering Contract (NEC)
04/10/2023	Power Systems Protection
04/10/2023	Transformer Construction, Operation, Maintenance, Testing and Protection
10/10/2023	Hack Lab
10/10/2023	Legal Liability: Mine Health and Safety Act
17/10/2023	KZN Centre presents: Augmenting drones and Artificial Intelligence for powerline inspections
17/10/2023	SANS 10142-1 -Edition 3
24/10/2023	Substation Design and Equipment Selection
24/10/2023	Project Management for Engineers
25/10/2023	SAIEE Nuclear Chapter webinar
31/10/2023	Technical Report Writing

NOVEMBER 2023

01/11/2023	Introduction to Artificial Intelligence for Professionals
01/11/2023	Finance Essentials for Engineers
02/11/2023	Road to Registration
07/11/2023	Fundamentals of Financial Evaluation for Projects
08/11/2023	Earthing And Lightning Protection
14/11/2023	Anatomy of Wind Turbines
27/11/2023	Gaining an insight, understanding, and application of the Protection of Personal Information Act 4 of 2013 (POPIA)
28/11/2023	Introduction to 5G Communication Networks
28/11/2023	Substation Design and Equipment Selection
28/11/2023	SAIEE Lightning Chapter presents: Lightning Protection of Solar PV Systems - lessons learnt
29/11/2023	SAIEE Eastern Cape Centre ST-Talk: Lightning Protection of Solar PV Systems

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