FEATURES:

- Industry 4.0 + IIoT
- Energy management + the industrial environment
- Measurement + instrumentation
- Transformers, substations + cables

Transforming Tomorrow, Today

12/2024

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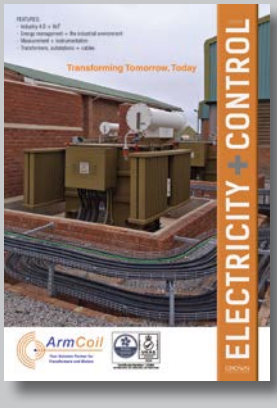

ArmCoil's next generation transformers, incorporating advanced monitoring capabilities, robust safety features and enhanced operational efficiency, are designed to deliver a smarter, more efficient energy future.
(Read more on page 3.)

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Resilience has become a key resource

What a year this has been! Many encouraging developments, some surprises and, of course challenges, which we always need to keep us on our toes.

Challenges seem to have moved from energy to water, but we can conclude with some certainty that this, too, shall pass. The reason being that I see many remarkable examples of resilience out there that are truly worthy of celebration.

And we see regular citizens making a difference.

It is concerning though that, at the same time, there are more news reports regarding unpaid municipal services accounts and the threats to cut users off. This is understandable, of course. The worry is how ordinary individuals and organisations – who are not indebted – may inadvertently be affected by actions driven by frustration built up over many years.

It is fair to ask why the matter has not been strenuously dealt with up to now. My experience is that if one misses any deadline, one is immediately in the line of fire (rightly so!) and of course one must immediately resolve the matter.

It is not clear how, for instance, we find municipalities owing quite so much to the energy utility. At the latest stated sum, municipal debt owed to Eskom amounts to around R90 billion rand. That is astounding. But for now, the most pressing issues seem to have been kicked into touch.

Back to that word – resilience. Here I think of all the challenges facing every one of our readers and their organisations – the resilience this demands and the resilience they demonstrate.

I realise that many of you could find it easier elsewhere – and yet – here we are. Committed to making a real difference on the greatest continent, and in best country on the planet.

As the year draws to a close, this is the time to reflect on the past, and plan for the future. To consider the achievements of the past year, to balance those against your own goals and targets. And then to develop a strategy for the next year – understanding the obstacles that we are likely to encounter.

As is always the case, our December edition is full of information and good reading. Enjoy it!

It is also my opportunity to thank the team at *Electricity + Control* – the Editor Leigh Darroll, the Design and Layout Artist Darryl James, Advertising Manager Paul Engelbrecht, Circulation Manager Karen Smith – and our Publisher and Deputy Publisher, Karen Grant and Willhelm du Plessis. This is an excellent team, and I find it a real privilege to work with them.

At this time of the year, it is my pleasure to wish each and every one of you – and your families and colleagues – all the very best over the Festive Season. If you are travelling, please do so safely.

Ian

Ian Jandrell

PrEng IntPE(SA), BSc(Eng) GDE PhD,
FSAAE FSAIEE SMIEEE

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INDUSTRY 4.0 + IIOT

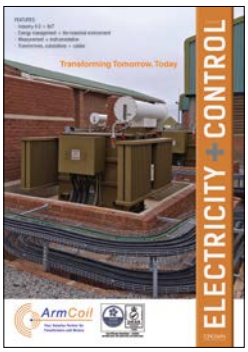
ENERGY MANAGEMENT + THE INDUSTRIAL ENVIRONMENT

MEASUREMENT + INSTRUMENTATION

TRANSFORMERS, SUBSTATIONS + CABLES

REGULARS

Powering the future with smart transformers



ArmCoil is proud to introduce its cutting-edge Smart Transformers, designed to meet the evolving demands of the modern power industry. With a focus on innovation, precision and safety, these transformers are the solution for a smarter, more efficient energy future. Combining advanced monitoring capabilities, robust safety features, and enhanced operational efficiency, ArmCoil's transformers provide superior performance, minimise downtime, and guarantee long-term reliability for your power infrastructure.

At the heart of the Smart Transformers is the NERPRO (neutral earthing resistor monitoring panel) – a state-of-the-art monitoring device engineered to protect your electrical network from the dangers of earth faults. Earth faults can cause severe damage to electrical equipment due to the high fault currents that occur, leading to costly repairs and system failures. Traditionally, addressing this issue has been reactive, with action taken often only after the damage has been done. However, with ArmCoil's proactive approach, NERPRO provides continuous, real-time monitoring that prevents damage before it occurs, giving you peace of mind and safeguarding your infrastructure.

The NERPRO is a critical component, continuously tracking vital metrics such as:

- Neutral earthing resistor integrity
- Neutral voltage
- Earth fault current.

This data is communicated through a user-friendly 7-inch HMI touchscreen, providing operators with instant access to key system information. The intuitive interface allows for real-time fault analysis, the ability to review fault logs, perform essential safety tests, and configure fault parameters. The system's precision and efficiency drastically reduce the risk of damage, minimise downtime, and lower operational costs – while enhancing the overall safety of your power network.

Built for the toughest demands

ArmCoil's next-generation transformers are designed with durability in mind. We understand that power infrastructure must be reliable under the harshest conditions, which is why we've integrated features that set the transformers apart:

- Lockable, tamper-proof enclosures ensure your system remains secure and safe from unauthorised access
- Silicon sand-immersed neutral earthing resistors effectively dissipate heat during prolonged faults, preventing potential failures
- Durable, powder-coated stainless-steel panels are built to withstand the toughest environmental conditions, ensuring that your system performs in the most demanding situations.

Moreover, even under extreme undervoltage conditions – as low as 40% of the nominal voltage – the transformers continue to deliver consistent, high-quality performance. Integrated harmonic filters contribute to precise and reliable operation, making ArmCoil's intelligent transformers an invaluable asset for mission-critical operations across various industries.

Customisable to meet your needs

At ArmCoil, we understand that every project has its unique requirements. Our transformers are fully customisable so they can be tailored to meet the specific demands of your application. The modular design makes retrofitting into existing systems seamless, offering an easy upgrade path to a smarter, safer, and more efficient future. Whether you're modernising your infrastructure or building a new system, ArmCoil's transformers can be designed to fit your exact specifications.

Transforming tomorrow, today

ArmCoil's next-generation transformers represent a paradigm shift in the power industry. With cutting-edge monitoring, unrivalled safety, and exceptional durability, they are the perfect choice for organisations looking to stay ahead of the curve in today's rapidly changing energy landscape.

Discover the future of energy management with ArmCoil. Together, let's build the energy solutions of tomorrow, today. □

Central to ArmCoil's Smart Transformers is the NERPRO, which continuously monitors key parameters to protect equipment and prevent system failures.

For more information contact ArmCoil.
Tel: +27 (0)11 763 2351
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Visit: www.armcoil.co.za

Kobus Vermeulen, Schneider Electric.

Moving to faster connectivity in industry

Worldwide, there has been a strong drive to phase out older network technologies like 2G and 3G. The radio spectrum is finite and, although difficult to imagine, these older mobile technologies are taking up valuable space. Kobus Vermeulen, Direct Sales Executive, Process Automation at Schneider Electric, says, "To place this into perspective, groundbreaking for its day, 2G and its subsequent standards GPRS and EDGE are almost obsolete; offering download speeds of around 114 Kbps, which is way slower than today's 5G connections."

However, we are still using the radio spectrum. In place of 2G and 3G, 4G and 5G offer much faster speeds of between 10 and 20 Gbps, and wireless telemetry and radio communication systems are becoming essential tools in today's industrial settings.

In context

Advanced wireless telemetry today offers a range of benefits that go beyond cost savings to include greater flexibility and mobility, remote monitoring capabilities, and enhanced safety.

It also allows for real-time data transmission, which improves decision-making processes and enables faster responses to operational changes. These features have made wireless telemetry systems readily scalable and adaptable to customers' needs, further increasing its adoption in industries.

Radio-based systems, when compared to 2G, support enhanced data rates, offering faster and more efficient communication. Additionally, radio-based systems provide improved coverage, especially in challenging environments where the reliability of connectivity is critical for smooth operations.

The interoperability of modern radio systems – with various devices and protocols – also makes it a preferred option for industrial operators looking to future-proof their communication networks.

Advanced wireless telemetry offers numerous benefits including cost savings, greater flexibility and mobility, remote monitoring capabilities, and enhanced safety.

The transition to radio telemetry

The move to radio-based telemetry, however, presents its own challenges. Infrastructure redesigns are often required to facilitate line-of-sight communication, which may involve significant reconfiguration of network layouts and installation of new radio masts.

This process therefore requires careful planning to address potential interference and ensure comprehensive signal coverage across industrial facilities.

At the same time, the transition offers exciting opportunities: industrial operators can leverage the flexibility of radio systems to design tailored solutions that meet specific requirements.

Furthermore, the deployment of new radio infrastructure allows for scalability to accommodate future expansion and integrate advanced features like mesh networking and improved data rates.

4G and LTE in industrial settings

The adoption of LTE and 4G networks in industrial communication is expected to deliver significant benefits, particularly in terms of operational efficiency.

High-speed data transfer and improved bandwidth enable real-time transmission of large volumes of data, enhancing monitoring capabilities and supporting time-sensitive applications. The reliability and scalability offered by these advanced networks ensure that industrial systems remain adaptable to future demands, reducing downtime and operational disruptions.

Moreover, LTE and 4G networks facilitate remote access and control, allowing industrial operators to manage equipment and processes from off-site locations. This reduces the need for on-site monitoring and maintenance which, as well as being cost-effective, also improves overall operational flexibility.

Real-world solutions

Schneider Electric's Datalog A-4G Datalogger has been designed to overcome the limitations of outdated bandwidths, providing a robust solution for modern industrial communication needs.

The Datalog A-4G offers higher data transfer speeds, remote monitoring capabilities, and advanced security features, all of which are essential to ensuring the reliable and secure operation of industrial systems.

Looking at telemetry solutions, Schneider Electric offers Foxboro SCADA RTUs (remote terminal units) which are designed for efficient, cost-effective process automation. The modular construction of the units and advanced features make configuration and operation reliable, even in

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Using AI for smarter water management

Making it easier for water utilities to benefit from artificial intelligence, technology company Siemens has expanded its software portfolio for the water industry. New AI-based apps linked to the Xcelerator platform enable customers to optimise digital plant operations – without needing extensive technical expertise. These self-service solutions enable users to address the most pressing issues in water and wastewater operations: reducing water loss, preventing pollution from sewers, and ensuring the reliability of treatment assets. The effect of these applications is also a contribution to greater sustainability more broadly, as they provide for the world's water resources to be better protected.

"Digital technologies have not yet been widely adopted in the water sector," says Anja Eimer, General Manager Global Water Business at Siemens. "The existing OT and IT device landscape is complex, skilled workers are in short supply, and in many cases the business benefits of digital applications have often been unclear. With our new software offerings, we are addressing these conditions and enabling water companies to perform AI-based operational analyses."

With the Siemens Water (SIWA) applications designed specifically for the water and wastewater industry, operators can optimise energy efficiency, prevent water losses, reduce water pollution, and improve predictive maintenance measures, among other things. The new offerings include digitalisation solutions with pre-integrated hardware and software. This means AI-based analytics applications have been combined with corresponding sensors from Siemens to make the installation processes as easy as possible and to achieve analytics results faster. The new SIWA Leak Finder and SIWA Blockage Predictor apps are available on the Siemens Xcelerator Marketplace.

Combatting leaks and pipe blockages

The SIWA Leak Finder app uses data from smart flow meters to reduce water losses from pipe leaks by up to 50%. AI in the app analyses flow data and identifies leaks as small as 0.2 litres per second. While data from any flow meter can be used for the app, the integration of the Siemens Sitrans FM Mag8000 sensor eliminates the need for specialised knowledge or Siemens services for installation.

Clogged pipes in sewer systems present another common challenge and can lead to pollution that also affects households and the environment. Inflow and infiltration (I&I) reduce the effectiveness of the wastewater network and can lead to expensive investments. Siemens' SIWA Blockage Predictor application applies AI to water level data from sewers collected by sensors, such as the Sitrans LR110 radar level transmitter, to detect blockages, inflow and infiltration. Based on a single sensor installation, the app can be used in the event of network overflows or in manhole chambers. The application finds nine out of ten blockages and saves users time by automatically generating performance reports for regulators.

As well as its new AI-based applications, Siemens offers an extensive portfolio of solutions for the water and wastewater industry.

Both the SIWA Leak Finder and SIWA Blockage Predictor apps can easily process and analyse operational data from smart sensors via a connection to the cloud – without the need for additional IT expertise. In this way, the sensor data is available in the respective application within two hours. The apps' AI is automatically trained and implemented with the sensor data from the day of installation. Cybersecurity is also taken into account in the design of the apps. Additionally, Mendix, Siemens' low-code platform, can be used to create interfaces to the respective company's IT, making it possible to connect the data from the SIWA apps to ERP systems. Siemens expects these applications to pay for themselves typically within less than 36 months.

In addition to AI-based applications and their integration with smart sensors for the more efficient and sustainable operation of water infrastructures, Siemens has an extensive portfolio of automation and digitalisation solutions for the water industry.

It also offers a standardised approach to groundwater well monitoring from a single source. Designed as an end-to-end solution, this includes instrumentation, communication, remote control, and intelligent data analysis to meet current and future regulatory requirements and enable scalable and efficient water management. Siemens also offers a range of technologies for utilities seeking to improve their energy efficiency, from the Digital Process Twin to multimodal energy optimisation.

For more information visit:
https://xcelerator.siemens.com/global/en/

Continued from page 4

demanding applications.

Schneider Electric's Triodata radios provide licensed and license-free wireless solutions for SCADA and remote telemetry applications. And its EcoStruxure Geo SCADA Expert is optimised to manage remote assets across geographically dispersed infrastructure. □

For more information visit: www.se.com

Integrating IoT technologies into HVAC systems

With more than twenty years' experience in electrical engineering, electronics and systems integration, Iritron has partnered with leading HVAC (heating, ventilation and air-conditioning) suppliers, Toshiba and the AHI Carrier Group, to provide users of HVAC equipment with a full suite of IoT integration options from a single source.

"Whether the application is for an underground mine or a specialised surface mining environment, a food processing and distribution network, pharmaceutical or medical facility, a complex cool room or chiller installation, or simply creating and maintaining a climate-controlled work environment, Iritron has the technical expertise to provide an integrated HVAC solution," says Rudolph Schonborn, Quality & Service Manager at the company.

Using the latest technical innovations and proprietary hardware from industry leaders, Iritron can integrate AI, internet-based communications, remote monitoring, activation and alarm and alert functions with Binary Runtime Format (BRF) and Infrared Thermography (IRT) technologies, for any complementary HVAC application.

Typically, these include VRF (variable refrigerant flow) gas installations, hybrid package units, split unit installations, refrigeration and specialised HVAC solutions.

The latest Toshiba and the AHI Carrier Group HVAC hardware is designed to offer leading solutions that provide performance matched with low energy requirements and environmental compliance in line with the latest international EuroVent standards.

Coupling these technologically advanced units with Iritron's integration systems further enhances energy savings, smooth control – with pinpoint accuracy, high levels of efficiency and low energy consumption, resulting in consistently low operating costs. The integration of the latest technical innovations supports remote operation, monitoring and troubleshooting, online status analysis and alarm alerts, all bundled in intuitive software dashboards that can be easily read and understood by plant personnel.

Hybrid package units

Hybrid systems are usually specified for critical applications, including Iritron's own containerised products for remote mining sites where temperature control is crucial and a careful humidity balance must be maintained. Typical examples include substations where personnel access is limited. Packaged hybrid systems are also available with remote condenser location and operate with smooth, precise control and lower noise levels compared to traditional installations.

VRF – variable refrigerant flow technology

This advanced refrigeration gas technology allows for the temperature and flow of refrigerant gas to be varied for different areas of a building or facility, cooling only the areas required and reducing refrigeration load, with a commensurate reduction in energy consumption and costs. The system can be programmed for seasonal variations or for daily conditions where different parts of a building are warmed as the sun 'travels' from east to west through the day. By programming and monitoring differences between indoor and outside temperatures, ideal capacity ratios can be achieved.

Iritron is working with leading HVAC suppliers to offer customers a full suite of IoT integration options for HVAC systems.

In addition to providing significant cost savings over traditional air-conditioning systems, VRF supports a longer component lifespan due to advanced oil management, preventing over-compression, and by making use of higher quality materials it enables reduced noise levels during operation. Experts point out that noise is a waste of energy!

Specialised applications

Capturing waste heat generated in HVAC systems is also a focus for Iritron, where the inclusion of hot water modules can reduce hot water heating costs by as much as 73%.

"In a specialised application, we have developed a trailer-mounted biltong drying room, where precise climate control ensures just the right amount of moisture is removed from the meat to achieve the right taste. This system can be adapted wherever some form of precise temperature and humidity control is required – such as for flower markets," says Schonborn.

Iritron's integrated systems can be installed in new HVAC systems or retrofitted to existing systems to provide control and monitoring of performance, environmental compliance and lowest energy and operating costs for the HVAC system.

For more information visit: www.iritron.co.za

The right connectors for high-speed data transmission

Data protocols are constantly evolving to enable interoperability and reliable transfer of increasing amounts of data at the highest speeds between more and more connected devices. To address this technological challenge, Fischer Connectors is expanding its platform capabilities to meet the most demanding connectivity requirements for high-speed data transfer using the USB 3.2 Gen 2 protocol up to 10 Gbit/s.

The Swiss-based company has developed new USB 3.2 connectors and cable assembly solutions in three of its flagship product lines to meet signal integrity and harsh environment requirements for medical, defence, industrial and instrumentation applications.

Designing high-speed interconnect solutions requires expertise in cable assembly, high-performance connectors, and signal integrity simulation, testing and design. During the design and characterisation process, engineers must address a complex combination of parameters such as impedance matching, line delay, insertion/return loss, crosstalk and EMC shielding.

High-quality cable assembly is critical to ensure reliable and efficient data transmission, signal integrity and overall system function. "To achieve successful high-speed data transfer from a device's transmitter to its receiver, connectors and cables must be cross-optimised and undergo a series of compliance tests at the system level," says Ameny Chaabani, Signal Integrity Engineer at Fischer Connectors. "USB 3.2 is a stringent protocol. Connector design, cable length, cable performance

[© Conextivity Group 2024]

Fischer Connectors' high-speed solutions, from left: Core Series, MiniMax™ Series, UltiMate™ Series.

(loss), and the controlled and repeatable cable assembly and potting processes above 1 Gbit/s are some of the influencing parameters to consider. We also need to study the full physical layer of a link as a whole, what we call system-level testing."

Fischer Connectors produces solutions for ecosystems requiring local transfer and management of data, signals and power. Its electronic solutions, connectors and cable assemblies are trusted globally for their reliability, durability and precision in demanding environments such as the medical, defence and security, instrumentation, robotics and industrial sectors. It is part of the Swiss-headquartered global Conextivity Group, which offers high-performance connectivity solutions to manage power and data flows from sensors and devices to the cloud and AI, enabling the emergence of new transverse and scalable ecosystems. The group comprises Fischer Connectors and Wearin', which creates IoT wearable solutions that enhance safety and efficiency by improving situational awareness and coordination among work teams, including lone workers, security personnel, firefighters and first responders. □

High-capacity chillers for high-density AI and ML data centres

Global provider of critical digital infrastructure Vertiv recently introduced the high-capacity models of its Vertiv™ Liebert® AFC inverter screw chiller range with low global warming potential (GWP) refrigerant. Available in Europe, the Middle East and Africa (EMEA), the new models provide up to 2.2 MW of cooling capacity in a single frame, resulting in a smaller carbon emission footprint, requiring fewer units to be installed for capacity, and reducing installation and maintenance time and costs for data centre operators.

The newest Liebert® AFC models are high-density, outdoor, free cooling chillers and provide the industry's highest capacity in a single frame. These future-ready chillers enable hybrid operation for data centres deploying AI and HPC liquid cooling applications and are compliant with current regulatory requirements in the EU.

The chiller is an integral part of the overall Vertiv solution to simplify data centre deployment and management. By pairing the Liebert AFC chillers with chilled water solutions such as the Vertiv™ Liebert® PCW perimeter air handler system, Vertiv™ Liebert® XDU coolant distribution unit, Vertiv™ Liebert® CWA thermal wall system, and Vertiv™ Liebert® iCOM™ CWM smart control, operators can address the cooling needs of colocation and cloud data centre applications efficiently.

Vertiv has introduced new high-capacity models in its Liebert AFC inverter screw chiller range.

"As the demand for AI and HPC deployments grows, customers are increasingly seeking solutions that provide higher cooling capacity within a compact footprint," said George Hannah, Senior Global Director for Chilled Water Systems at Vertiv. "Our latest Liebert AFC low-GWP chillers reach up to 2.2 MW, in a form factor that significantly reduces the time, cost, and complexity of deploying the systems. This solution supports our commitment to environmental responsibility and compliance with the latest regulatory standards, and aligns with our aim to continue our industry-leading expertise in air and liquid cooling applications."

Vertiv™ Liebert® AFC offers up to 20% lower annual energy consumption compared to fixed screw solutions. The inverter-driven compressor allows for the reduction of energy consumption and, in particular, the electrical power required during peaks, which in turn allows more power availability for the IT equipment. □

Andrew Crackett, Yaskawa Southern Africa.

Robotics for SMEs

As industries increasingly integrate robotics and automation into their operations, South Africa's small and medium enterprises (SMEs) are beginning to recognise the benefits they offer. Smaller businesses have generally considered robotic integration to be too complex for their needs and more appropriate for companies operating on a larger scale, mainly due to the initial cost and the complexity of adoption. Yaskawa South Africa acknowledges this and is addressing these concerns to create solutions that simplify the installation and operation process, making robotics accessible and suitable for businesses of all sizes and in diverse industries. This includes offering flexible financial models and investing in skills development to help smaller businesses optimise productivity and growth in a competitive market.

The South African SME sector

The adoption of robotics and automation in South Africa, particularly among SMEs, has been slower than in some other parts of the world. This is for a number of reasons, such as financial constraints, integration complexities, lack of technical expertise and accessible training, and the perception that automation is better suited for large-scale industries. However, Andrew Crackett, Managing Director of Yaskawa Southern Africa, believes these challenges can be overcome with the right approach. "When working with SMEs, we take the time to understand their needs and objectives. This enables us to provide tailored robotic systems and end-of-arm tooling that are adaptable and scalable, helping businesses grow sustainably," Crackett says. Yaskawa's robotics solutions can be adapted to various applications and industries, and this versatility is key for SMEs that often operate with limited budgets and need systems that can grow as their business does.

For many SMEs, integrating robotics into existing operations can be daunting. Yaskawa simplifies the process by offering interfaces that enable easy communication between robots and other equipment and, more importantly, with operators. In addition, flexible system configurations allow businesses to expand their robotic capabilities as their needs evolve. "We also offer extensive support and training, to assist a smooth transition as businesses adopt new technologies," says Crackett.

Overcoming financial constraints

Of all the perceived barriers to robotics' adoption, the initial investment costs of robotics are often a significant concern for SMEs. Crackett says, "In this regard, we've partnered with system integrators that offer leasing plans, helping SMEs afford robotics and automation by spreading the costs over time." These solutions open the doors for smaller businesses that may not have the capital for a large upfront investment. This approach also optimises the return on investment, making automation a feasible option for more businesses.

Yaskawa's robotics solutions can be adapted to various applications and this versatility is key for SMEs.

Additionally, Crackett says, "By working closely with local integrators across specialised industries we're helping to cultivate a robotics ecosystem in South Africa. We also provide a comprehensive set of training programmes, from basic programming and maintenance to more advanced troubleshooting and operator-specific skills," he adds.

The focus on training is crucial, as one of the biggest challenges facing SMEs in the country is the shortage of workers with any background in operating and maintaining robotic systems. Yaskawa is helping to build a workforce that can manage the technologies and contribute to the broader industrialisation goals of South Africa.

Driving economic growth and job creation

Acknowledging the concerns that the adoption and integration of automation will lead to job losses, Yaskawa has a different view. It sees robotics as a potential driver of economic growth and job creation in South Africa.

"Automation can boost productivity and efficiency, and help businesses stay competitive. It's not just about cutting costs, robotics open up opportunities for employees to upskill and reduce physical strain from repetitive tasks," Crackett says.

Yaskawa's business model is in line with South Africa's National Development Plan 2030, which aims to improve industrialisation, address the need for job creation, and stimulate economic growth. By investing in local manufacturing and helping businesses adopt advanced technologies, Yaskawa aims to play a role in supporting the country's industrialisation goals.

The company is committed to continuing innovation in robotics solutions for the South African market. With this focus, it aims to ensure South African businesses have access to the latest advances in robotics and automation, enabling them to remain competitive in a rapidly evolving global economy. □

Building sustainable battery gigafactories

Peter Hodgkinson, WSP in Africa.

Peter Hodgkinson, Director for Strategic Growth and Major Projects: Property & Buildings, WSP in Africa

Battery gigafactories have a critical role to play as more countries and industries embark on meeting net zero targets and transitioning to renewable energy sources. Access to more efficient, scalable, and environmentally sustainable battery manufacturing capabilities can assist stakeholders to achieve these objectives faster.

Three core markets are driving the growth of battery manufacturing – battery energy storage solutions (BESS); electric vehicles (EVs), and consumer electronics (rechargeable appliances).

Battery manufacturing boom

Currently, there are reportedly 369 gigafactories[1] in the pipeline around the world, to be completed by 2030. Not too long ago this number was 115.

According to statista.com, the global demand for batteries is expected to increase[2] from 185 GWh in 2020 to over 2 000 GWh in 2030. Furthermore, the value of the lithium-ion battery market worldwide is projected to top $193 billion by 2028[3] reflecting a 23.3% compound annual growth rate from 2021. This has proven to be the catalyst for the construction of sustainable and efficient battery gigafactories.

Research by EVMarketsReports.com[4], shows investments in battery gigafactories reached $131 billion in 2022, a 24% increase over the previous year. These were led by China – showing a 65% year-on-year increase – and North America with its manufacturing capacity expanded by 49% in 2022.

Modifying existing facilities

From new builds to refurbishing and converting previously used manufacturing facilities or expanding existing traditional battery manufacturing facilities to gigafactories, securing these investments requires a holistic approach that encompasses construction, optimisation, power supply, site selection, feedstock sourcing, sales strategy, regulatory compliance and a sustainability lens.

Existing facilities can be retrofitted to transform them into battery gigafactories by adopting an integrated approach that looks to reuse as much of the existing buildings, services and equipment at the facility as possible, even though there may be limitations. However, the plants are technically complex, requiring deep knowledge in the new generation of gigafactories, as well as specialist expertise in clean and dry room design and implementation.

Minimising risk

Managing the risks in retrofitting facilities to become battery gigafactories requires thorough studies. These may include geotechnical and environmental assessments, evaluating flood risks, considering climate change, and checking for ground contamination. Identifying materials such as asbestos and conducting concrete integrity testing are critical to gauge the effects of age and chemicals.

Battery energy storage for renewable energy plants is one of the core markets driving growth in battery manufacturing.

A documentation search should include existing drawings, reverse engineering, and reviewing maintenance records by consulting with on-site personnel and third-party vendors. Ensuring safety not only in the structural and civil aspects of the construction but also in mechanical and electrical services, is essential. Building Information Modelling (BIM) enhances upfront planning and coordination in modelling the space, which is key to reducing risks and ensuring an efficient project timeline.

Improving energy efficiency

How to improve the energy efficiency of an existing factory is a fundamental question. This is where developing sustainable battery gigafactories requires a combination of international experience and local insights.

Working with the permitting and local authorities on establishing site boundaries and zoning rights and maintaining compliance with national and local regulations is also required. So too is an understanding of the environmental conditions of where the existing facility is situated. Factors such as the humidity, the climate, the potential impact of climate change, need to be considered.

Decision makers should be aware that the building typically accounts for less than one third of construction CAPEX, and services and utilities constitute most of the

balance. Understanding the cost implications of alterations may make greenfield projects potentially more cost-effective.

Enabling a sustainable future

Keeping circular economy principles in mind is important in ensuring battery manufacturing plants support the business's environmental, social and governance (ESG) goals. This includes, for example, looking at solutions to design out waste and pollution, keeping products and materials at their highest possible value, and regenerating natural systems. It helps to drive clean growth, preserve natural capital and reduce waste, achieve net zero goals, reduce cost and improve industrial resilience. Whether it's a new build or the retrofit of an existing facility to establish a gigafactory, an overarching goal is to eliminate value leakage across the resource lifecycle, creating industrial symbioses and regenerating natural capital.

Additionally, looking at the lifecycle of gigafactories through a sustainability lens means targeting efficiencies in the design and building of the facilities as well as ensuring they continue to operate efficiently and sustainably. Continuous monitoring, identifying opportunities to improve the lifecycle management of the factories, keeping track of evolving technologies and market demands all support these aims.

Battery design, and the design of battery gigafactories, are part of a rapidly evolving industry. Embracing innovation and preparing for the changing landscape, the development of battery gigafactories can help the world reach a more sustainable future. □

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For more information visit: www.wsp.com

SA can become a manufacturing hub for clean tech

South Africa is well placed to become a manufacturing hub for components and equipment in the clean technology value chain, including battery technologies for energy storage, electric mobility, materials handling equipment and a range of other applications.

This was highlighted by Deputy Minister of Trade, Industry and Competition, Andrew Whitfield, speaking recently at the opening of Balancell's new R150 million state-of-the-art battery gigafactory in Ndabeni, Cape Town.

Balancell is a future-focused, innovative technology business that develops smart batteries designed to manage and protect themselves, and report their use and condition remotely.

"The South African government is working closely with the industry to identify opportunities to deepen the battery technology value chain and to position South Africa as a manufacturing hub on the African continent.

"A recent benchmarking study, supported by the World Bank Group, shows that South Africa is a competitive manufacturing destination and offers a compelling value proposition for companies in this sector, as demonstrated here," Whitfield said.

Balancell's new battery gigafactory in Cape Town provides for increased production of battery energy storage systems in South Africa.

He also highlighted that there are a number of policies and incentives in place to support the growth of this key sector. Demand for smart battery storage technologies will only increase as the renewable energy sector continues to grow and South Africa opens up to new energy vehicles.

"Witnessing the investment from homegrown companies in this sector is inspiring," Whitfield said. "Balancell's investment of R150 million in this factory is directly in line with the strategic priorities of the Government of National Unity and demonstrates the innovative and entrepreneurial spirit that defines many South African businesses

"We are motivated by the company's prospects for growth and further job creation in the coming years. The 75 existing jobs created in this gigafactory, supporting more than 1 500 indirect jobs, is a clear indication of the multiplier effect that can be achieved by strengthening and growing the manufacturing sector," Whitfield said.

He highlighted the importance of building a strong base of skilled South Africans. "Expanding industry partnerships with leading universities and research institutions to enhance local research, development and testing of components is critical to the industry. I am encouraged that Balancell is already working with the Nelson Mandela and Stellenbosch Universities, as well as the Council for Scientific and Industrial Research," the Deputy Minister said.

He described the opening of the gigafactory as an affirmation of the importance of building industrial capacity and working together to achieve the shared vision of South Africa becoming a global player in the battery value chain.

For more information visit: www.sanews.gov.za and https://balancell.com/

Regular energy assessments help optimise efficiency

Brenainn Cross, Associated Energy Services.

When a production or manufacturing facility is built, everything is new and operating optimally. Over time, equipment deteriorates – or modifications are made with the best intentions, but not always with energy efficiency in mind. Brenainn Cross, Technical Director at Associated Energy Services, says that is why it's good practice to do regular energy assessments, to ensure, for example, that steam traps are working correctly, and there are no steam piping 'dead legs'.

"Someone may move a machine, and the line which used to provide steam energy is not properly isolated but is still receiving energy. This is what we term a 'dead leg' and it is extremely inefficient," Cross explains.

Detail is in the data

Associated Energy Services (AES) is a specialist operations and maintenance service provider to the steam and boiler sector. In conducting energy assessments, AES engages clients regarding precisely what equipment is on site, and how the steam process operates. This also entails requesting data from their systems. Where reliable data cannot be provided – as is sometimes the case – AES uses data capturing equipment to fill in the gaps.

To conduct an accurate energy assessment, Cross says understanding a company's steam offtake is key. "We need to know what the process looks like, how much energy they use, how they use it and when. Some companies, where there is a consistent offtake (such as a tissue manufacturer) have a very flat energy usage profile; others, running batch-driven processes (such as a tyre or a food manufacturer) reflect peaks and troughs in the steam offtake cycle.

"Many businesses do not realise that different production processes use steam differently. They see steam use as a linear process, and do not appreciate that the product type and mix have a big influence on usage. There is great value for clients when they start understanding their own energy usage-related data – and AES starts implementing energy optimisation, once it has the correct data," he says.

An energy assessment enables AES to gauge whether or not the client's thermal energy plant is fit for purpose.

Finding the energy blind spots

Cross maintains that a lack of data – and analysis – around the conversion rate of fuel into energy is a common blind spot for many manufacturing or processing companies. Most focus on fuel consumption versus product output quantities – a process known as 'fuel to product out' costing – rather than monitoring how efficiently fuel is converted to steam energy and, thereafter, how much steam energy is used to produce the product.

However, he says, there is no single 'silver bullet', and energy assessments must be carried out on a case-by-case basis: "In instances where we see a mismatch between energy plant or equipment installed on site and the client's energy usage profile, we will raise this with the client. What we can achieve in terms of energy optimisation may be constrained by the incorrect or inadequate equipment. We then need to assess whether capital investment is required for us to meet our energy optimisation commitments."

[Source: AES]

An accurate energy assessment needs to take account of the equipment on site, the operations process, how much energy is used, where and when.

In this regard, AES's advice may extend beyond the boiler to issues such as water treatment and asset care. "One of our clients recently needed to consider additional feed water treatment to address a hard water challenge and remove total dissolved solids which can affect overall boiler energy efficiency and, in the worst case, damage equipment," Cross adds.

While data collected regarding pressures, flow rates and temperatures is essential, it is often difficult to access and

complete a full and detailed risk assessment of all equipment while the system is operational. For this reason, boilers need to be taken offline for inspection. AES can then raise any problems with the client and discuss ongoing asset care and maintenance as well as their impact on the energy usage and optimisation process.

The power of metrics

Cross describes an energy assessment as a "conversation that continues throughout AES's relationship with the client". Ongoing assessments are also important when there are staff and management changes. "We know the baseline situation when we take over the boiler operations and maintenance, but incoming staff and management may not. The client always needs to be aware of the implications if no energy assessments or optimisation are done – and how important these are to the long-term productivity and sustainability of the facility," he says.

Energy savings speak for themselves. Examples can be seen in the 21% and 38% savings registered respectively at two food processing plants where AES is responsible for energy optimisation.

For Cross, initial assessments usually identify the 'low-hanging fruit' or potential early energy saving gains. Insulation, for example: AES can cite countless cases where it has advised clients to insulate heated surfaces as a quick way to recover otherwise wasted energy. Insulating steam lines to save energy also has the benefit of reducing CO_2 emissions, where coal is used as the fuel source.

"Uninsulated steam lines result in energy losses through radiant heat transfer. For a steam line with the specific parameters set out in the table below, insulating the piping would see a reduction in CO_2e of ~620 tonnes per annum," he says:

Nominal pipe size	150 mm
Steam pressure	10 bar (g)
Ambient temperature	20 °C
Equivalent length of pipe	100 m

Assessing different fuels

"Over the past three years, we have seen increased interest from larger clients in having a more direct line of sight into energy efficiencies in their operations, specifically with a view to environmental or carbon tax concerns," Cross notes.

He says AES has also been asked to assess various prospective fuel types, including the use of process byproduct streams as potential fuels. However, he adds, the assessment often shows that the potential energy generation does not warrant the capital expenditure required to make the fuel change.

The key indicator is the baseline cost of the energy, Cross says, citing a recent energy assessment where a fuel switch for a client has the potential to unlock significant operational savings.

"Throughout the process, input from specialist engineers allows us to fully assess – and convey to the client – the real value of fuel (or other) changes. In manufacturing or processing facilities, the focus is on the process but not on the conversion of energy – and often not sufficiently on its cost, quality or efficiency. Regular, accurate energy assessments focus clients' attention on the insights gained, which AES can then use to make the changes required to achieve energy efficiencies and cost-savings, as well as improved environmental and operational sustainability," Cross says. □

For more information visit: www.aes-africa.com/

MEP upgrade for Africa Data Centres CPT1 facility

Stan Rudman, Zutari.

Leading consulting engineering and infrastructure advisory practice, Zutari, has completed the mechanical, electrical, and plumbing upgrade for the 6 MW capacity expansion at the Cape Town 1 (CPT1) facility of Africa Data Centres.

The fast-track project posed a challenge in that it is a brownfield site with existing structures. "We had to work around the existing live facility. We used 3D modelling and had to explore the use of existing underground tunnels to aid in drainage under the existing building," says Stan Rudman, Technical Director, Mechanical Engineering at Zutari.

"We evaluated the tunnels for reticulation of electrical cables as well. Because we were working on a live facility, there were many strict safety procedures we had to follow.

"We also completed a new fan wall cooling unit installation, which was a first for the client," says Rudman. He adds that the facility is currently fully operational.

Looking at some of the current trends in data centre design, Rudman points to the need to address higher temperatures, lower water usage, increased load density, and future fit-out for liquid cooling technologies. These are all aimed at improving efficiency, he says.

The latest expansion at Africa Data Centres, a long-standing client of Zutari, has added 1 000 racks of white space available for customers to lease. It included three state-of-the-art halls – two colocation halls and a hyperscale hall built using a cutting-edge modular design which allows for rapid scalability – and added another 6 MW of critical IT load, effectively doubling the facility's capacity. □

Making a difference in energy security

Although industry and society today are still, to a large extent, dependent on fossil-fuelled power generation, the push towards carbon reduction and meeting the commitments initiated with the Paris Agreement adopted at the UN Climate Change Conference (COP21) on 12 December 2015, are shifting the focus to increasing use of renewable energy and improving energy efficiency to minimise climate change.

The effects of the climate crisis, felt globally, impact Africa hard, the second largest continent on our planet and home to more than a billion people, around 20% of the world's population. The continent is also rich in renewable energy resources which, with investment, can serve a rising demand for electricity, help mitigate climate impacts, and support sustainability.

As industries are increasingly adopting renewable energy, ensuring a stable, affordable, and uninterrupted electricity supply is equally important to securing Africa's energy sector.

Edith Kikonyogo, Local Division Manager, Southern Africa Cluster, ABB Process Automation, Energy Industries, says ABB's Energy Industries division is making a difference in helping industries across Africa automate, digitalise, and electrify their operations – to optimise productivity and ensure operational efficiency, and drive sustainability at the same time. Here she outlines some of the work the division is doing and the solutions and technologies it offers.

ABB's integrated automation and digital solutions support customers worldwide in developing new and renewable energy models. enabling energy-efficient and low-carbon operations across diverse industries. Ongoing projects with customers extend from the oil and gas industry to chemicals, power generation, life sciences, and water industries.

"We understand that energy is essential for society to progress, and the entire energy mix, including hydrocarbons, has a role to play. By prioritising the efficient production and processing of resources, with their responsible use, we can assist industries to reduce emissions, as part of the transition to net zero by 2050. Our experience over many years enables us to support customers in Africa and other regions to meet their commitments and maximise the value of their operational investments, reducing carbon emissions, waste, and costs on the energy transition journey."

Edith Kikonyogo, ABB Process Automation, Energy Industries.

Kikonyogo highlights an example of how ABB makes a difference in the gas sector. "The technology we use for gas pipelines helps suppliers meet the world's needs, and our analytical equipment detects leaks, signalling the need for remedial action. We also worked on developing dual-fuel propulsion for liquefied natural gas ships, enabling them to use electric power as they deliver LNG fuel to where it's needed.

"Some of our customers on the African continent struggle with delivering an uninterrupted energy supply due to various factors. ABB's expertise in integrating power and process automation helps to stabilise energy supply, particularly when incorporating renewables. The ABB Ability™ 800xA® distributed control system plays a central role in ensuring a secure, stable, and affordable energy supply for industries.

"Another solution that enables the balancing of energy demand with availability is the ABB Ability™ OPTIMAX® energy management system. It provides operators with insights on energy consumption and consolidates data from various sources. When customers consider new energy projects, minimising risk and optimising expenditure are essential. With ABB's Adaptive Execution™ methodology, the traditional project approach evolves to deliver results faster and with CAPEX savings of up to 40%."

As new energy projects are built, reducing energy demand to increase availability remains key. Kikonyogo says ABB's digital solutions deliver performance insights and enable industries to optimise energy use. These solutions include asset condition monitoring, asset health and management, predictive maintenance, energy management, simulation, virtual commissioning, remote support, and collaborative operations.

"In sub-Saharan Africa, we have an established footprint backed by our skills, customer focus, products, and solutions. Whether customers are looking at new energy sources or struggling with older power generation technologies, we can work with them to make a difference in progressing to a net zero future."

For more information visit: go.abb/processautomation

Africa is rich in renewable energy resources which, with investment, can extend energy access and help meet the growing demand for electricity.

Lithium-ion battery fire extinguishers now available

SafeQuip's 9L, 6L, 2L and 1L Lith-ex fire extinguishers are bsi KITEMARK™ approved.

SafeQuip, a leading distributor and manufacturer of fire safety solutions, has launched the SANS 1910-2022 approved, Lith-Ex fire extinguisher range, which carries NTA 8133:2021 (KIWA/POOO55865) test approval. This confirms the products' lithium-ion battery fire extinguishing capability.

In today's tech-driven world, lithium-ion batteries are used to power various devices, such as mobile phones, power tools, and electric bikes. However, these energy-dense batteries present a potential risk for catastrophic lithium-ion battery fires.

Conventional fire extinguishing agents like water, powder, and foam often fall short when they are used to deal with lithium-ion battery fires, frequently leading to re-ignition. To combat this issue, SafeQuip, in partnership with AVD Lith-Ex, has introduced the groundbreaking Aqueous Vermiculite Dispersion (AVD) solution.

AVD is a new fire extinguishing agent developed in response to the growing demand for effective lithium-ion battery fire solutions. It consists of naturally occurring vermiculite combined with water and delivers better performance than traditional agents.

AVD is applied as a mist of fine water droplets which contain vermiculite platelets. On contact with the burning fuel, AVD suppresses flames and cools the fuel source, instantly bringing the fire under control. As the mist evaporates, the vermiculite platelets overlap and bind together, forming a barrier film that extinguishes the fire. This barrier serves three critical functions: preventing thermal propagation, isolating the fuel source, and providing an oxygen barrier to prevent re-ignition.

SafeQuip's Lith-Ex fire extinguishers, powered by AVD, are designed for high-risk, limited-size fires and are available in various sizes, ideal for tackling fires in their early stages.

SafeQuip and AVD Lith-Ex are committed to raising fire safety standards in South Africa and worldwide and ensuring the effective mitigation of lithium-ion battery fire risks. □

Growing manufacturing skills in SA's renewable energy sector

With a constrained national power grid and a global move towards greener energy, many South Africans are considering installing solar electricity solutions – for their businesses and at home. However, they are often faced with the tough choice of paying a premium for high-quality products, or opting for more affordable products, and compromising on quality.

In both cases, when something goes wrong, recourse to the supplier is often unavailable, as the customer usually deals with a local agent – not the manufacturer that issues the warranty.

However, local manufacturer Ener-G-Africa (EGA) has found a way to bridge the gap, providing high-quality, certified, renewable energy products at a lower price point, and offering product warranties.

EGA's innovative solutions, supporting energy access, are designed and built in Africa for African needs. They include solar panels (TÜV certified), biomass stoves and 100% locally made stainless steel clean-cooking stove components.

Training South African workers to manufacture solar panels locally, EGA aims to strengthen the renewable energy sector.

Combining local expertise and manufacturing and a focus on sustainability, the company provides high-quality cost-effective, products that are making an impact in African markets. EGA Chief Production Officer, Charlie Leaper shares some lessons for other local manufacturers.

Invest in first rate equipment; minimise supply chain costs

"High-quality production often requires advanced technology and equipment, which can be expensive and difficult to acquire for local manufacturers. Without modern machinery and tools, it's hard to meet international quality standards while keeping costs low," Leaper says.

He explains that the EGA business started in Malawi and is now headquartered in South Africa. "We are an African company that understands the local markets, so we know what people are looking for and we focus on delivering that, rather than trying to retrofit products from overseas markets. We also understand how to do business here. We manufacture our products in Africa for Africans, which reduces shipping costs and avoids import tariffs."

By equipping its facilities with custom-made metal forming machines and cutting-edge precision tools, EGA achieves high production efficiency. These tools enable the company to produce the metal parts it requires, controlling quality and costs through in-house capabilities.

The company has also engaged with several education

Electricity 2.0: a virtual power solution for businesses

SolarAfrica, an independent power producer and a leader in renewable energy solutions, recently launched Electricity 2.0, a suite of virtual power options that offers South African businesses a cost-effective and greener alternative to traditional utility power. It offers companies in the commercial and industrial sectors a route to mitigate rising electricity prices and accelerate their progress towards their sustainability goals.

Addressing rising energy costs

With utility tariffs climbing by almost 34% over the past two years (and 450% since 2008) – and set to increase further – businesses face growing pressure to manage energy costs and meet local and international demands for carbon reduction. SolarAfrica's Electricity 2.0 addresses these challenges by giving businesses more control over where they source their power, providing them with access to cheaper and 100% green energy.

"We're seeing a lot of uncertainty in the energy sector," says Brandon Horn, Head of Commercial at SolarAfrica. "Volatile tariff hikes and fluctuating loadshedding or load reduction make it difficult for businesses to forecast their electricity spend. Electricity 2.0 offers South African businesses certainty. With this solution, they can know what their power will cost over the next 20 years, and they have more control of how quickly they can reach their sustainability goals."

With Electricity 2.0, businesses have more options to source an energy mix that helps them save money and fast-track carbon reduction.

Electricity 2.0 includes a range of virtual power solutions with wheeling as the first option available for sign-up. Wheeling allows businesses to receive power generated from several of SolarAfrica's solar farms, including the 1 GW SunCentral project in the Northern Cape, without the need for on-site solar installations or construction.

The suite also introduces enhanced energy trading options, consolidated billing (across multiple sites, if required), and AI-driven innovation for metering data – streamlining how businesses manage and optimise their energy usage.

"For SolarAfrica, it's important to give business owners the power to choose where they get their power from – whatever that source may be," Horn says. "With Electricity 2.0, businesses have more options to create an energy mix that helps them save money and go green in a sustainable way."

Maximising savings and sustainability

By integrating virtual power with SolarAfrica's existing solar and battery solutions, businesses can reduce their electricity bills significantly. For instance, a company using electricity 24 hours a day, with a monthly bill of R16 million, can cut its energy costs by R4.5 million per month and reduce its utility power use by 60%, equating to yearly savings of nearly R55 million. Thus, businesses that embrace Electricity 2.0 will see immediate cost reductions and fast-track their carbon reduction targets – an increasingly critical factor in today's market," Horn adds.

SolarAfrica's Electricity 2.0 can change the energy outlook for businesses across South Africa, providing a scalable, flexible, and green energy solution for those looking to achieve energy independence and sustainability in the face of growing energy challenges. □

institutions and training providers to upskill employees, develop leadership capabilities, and meet technical requirements for its product lines.

Find a balance

Leaper says creating a sustainable business in Africa requires balancing production efficiency, including automating aspects of the manufacturing process, and socio-economic considerations such as job creation and skills development.

"EGA is a Proudly South African member. We are committed to local socio-economic progress, and to making a meaningful contribution to building South Africa's economy and alleviating unemployment," he says.

EGA recruits its workforce primarily from the communities in which it operates. For example, in 2024, when EGA launched its new solar panel manufacturing facility in Paarl, it invested in upskilling a previously unemployed member of the community, Shane Swaartbooi, training him to operate its state-of-the-art laser cutting machine.

Swaartbooi, who had no prior experience, says he had always wanted to work for an organisation like Ener-G-Africa, "because they do not just manufacture their products in quantities – it is about manufacturing quality products that make a positive impact in people's lives."

He now manages the EGA laser cutting machine, worth $1 million, and is proud to work for the business. "Our products are good for the environment, but more than that, they help address South Africa's energy shortfall, and the high unemployment rate. Local manufacturing also means customers do not have to pay more for quality products because they are made here, at home." □

Li-Ion batteries, used in mobile phones, tablets, laptops and many other devices, can be recycled to extract the valuable materials for reuse.

Tackling lithium-ion battery waste

Desco Electronic Recyclers is addressing the challenges posed by the disposal of lithium-ion (Li-Ion) batteries, implementing sophisticated, effective recycling processes, to ensure that valuable materials are recovered safely and efficiently. It uses an advanced mechanical processing system.

The process involves grinding the batteries to separate materials such as steel, copper, and plastic, resulting in a black mass that contains lithium, cobalt, nickel, and other valuable elements. While these procedures recover essential resources, the black mass is not exposed or recovered locally. Additionally, strict safety protocols are followed to mitigate environmental hazards.

Notwithstanding the critical need for recycling Li-Ion batteries and the valuable materials they contain, it is reported that, globally, 90% of these batteries are not recycled, leading to millions of tonnes of waste each year. In South Africa alone, an estimated 18 000 tonnes of lithium-ion batteries reach the end of their life annually, with most ending up in landfills or being incinerated.

As well as causing significant environmental harm, this results in the loss of the valuable materials that could otherwise be recovered and reused.

According to Desco, the recycling of Li-ion batteries is costly and requires a significant volume to be viable; South Africa lacks the effectively channelled volume for an in-house refinery.

Nonetheless, Desco is using advanced recycling technologies to process tonnes of Li-Ion batteries each year and the company recovers key materials, including steel, copper, and plastic. The remaining black mass, containing critical elements like lithium and cobalt, is sent to specialised facilities overseas for further extraction. This approach helps mitigate environmental impacts and supports a sustainable, circular economy by reducing the need for new raw material extraction.

Giulio Airaga, Director of Desco, says the company is committed to processing Li-Ion batteries and sending the resulting materials overseas for extraction and reuse.

"We prioritise safety, as mishandling these batteries can be hazardous. We employ special vehicles and handling teams to ensure safe logistics before processing," Airaga adds.

Desco's operations comply with the Extended Producer Responsibility (EPR) regulations, ensuring that all recycling activities are traceable and environmentally responsible. This compliance underscores the company's commitment to transparency and sustainability, providing clients with detailed reports on the recycling process and its environmental impact.

"We urge businesses and individuals to adopt responsible recycling practices. The proper disposal of Li-Ion batteries and electronic waste is crucial to protecting the environment and conserving resources," Airaga says □

AECI moves closer to energy independence

Global explosives and chemicals solutions company, AECI, recently commissioned its Modderfontein Solar Park, a key project in the company's ongoing commitment to move towards operational sustainability. The 4 MW facility is now fully operational, playing a pivotal role in AECI's larger vision to reduce its reliance on traditional energy sources across its operations.

Additionally, the company's Sasolburg Solar Park, with a total capacity of 1.5 MW, has been commissioned for testing. Together with the already operating Chempark Solar Park (1 MW capacity), this means AECI now has an installed solar PV capacity of 6.5 MW, positioning it among the top five mining entities in South Africa with the largest solar energy installations. It reinforces the company's standing as a leader not only in the explosives and chemicals sector but also in driving sustainable energy solutions in the mining industry.

AECI has successfully commissioned the 4 MW solar park adjacent to its Modderfontein facility.

AECI's investment in solar capacity aligns with its aims to move towards economic resilience. Looking at the anticipated 'gas cliff' and the projected increase in conventional energy costs, transitioning to renewable energy sources positions AECI for long-term self-sufficiency. Its continued investment in solar energy is based on its understanding that while renewable energy costs are expected to decline, reliance on traditional energy sources will only become more expensive.

"Our renewable energy initiatives represent a major shift in the way we power our operations, particularly in the manufacturing sector. With the Modderfontein Solar Park now online, AECI strengthens its ability to deliver energy-efficient products and services as well as its commitment to reducing its carbon footprint. This is a critical step in supporting the broader sustainability goals of South Africa's industrial and mining sectors," says Holger Riemensperger, Chief Executive Officer at AECI.

The projects completed to date form part of AECI's four-phase solar programme, launched in 2021, through which it aims to generate 14.3 MW of solar power annually across various operational sites in South Africa.

AECI is also working towards enabling green energy supply through PV electrolysis and green ammonia production, using available land. □

First three battery energy storage projects reach financial close

Awarded preferred bidder status in the first round of South Africa's Battery Energy Storage Independent Power Producer Procurement Programme (BESIPPPP), the three Oasis 1 battery energy storage systems (BESS) projects reached financial close in November 2024. The projects are expected to be commissioned within 24 months and will contribute to the security of supply and stabilising the electricity grid in the country.

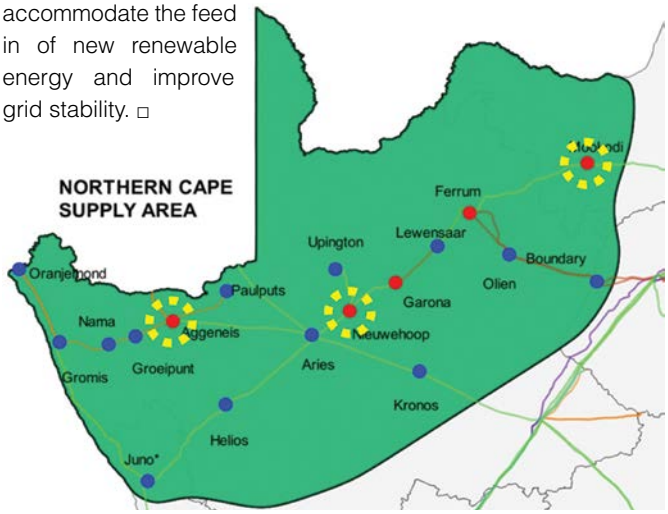
In Round 1 of the BESIPPP, the Department of Mineral Resources and Energy (DMRE) awarded preferred bidder status to five projects in November 2023. The Oasis consortium, which was awarded three of the five projects, is led by EDF Group and includes co-sponsor Mulilo, and equity partners Pele Energy Group and Gibb-Crede. Each project includes a 5% ownership interest for local communities through a Community Trust.

The Oasis 1 portfolio includes: Oasis Mookodi (77 MW capacity with 308 MWh storage), Oasis Aggeneis (77 MW capacity with 308 MWh storage), and Oasis Nieuwehoop (103 MW capacity with 412 MWh storage). Together the three projects are set to provide 257 MW of capacity and 1 028 MWh of storage. All the projects are located in the Northern Cape Supply Area.

Oasis Mookodi was the first project within the Oasis portfolio to achieve financial close on 15 November 2024, followed by Oasis Aggeneis and Oasis Nieuwehoop, on 20 November 2024. The consortium has raised R7 billion in debt funding from the Standard Bank of South Africa and ABSA, to finance the projects. The Oasis projects will operate under a 15-year Power Purchase Agreement with South Africa's national utility Eskom.

Oasis Mookodi will be located at Mookodi, Oasis Aggeneis will be located at Aggeneis Substation, close to the town of Aggenys, and Oasis Nieuwehoop will be located at Nieuwehoop Substation, close to Kenhardt.

Minister of Electricity and Energy Dr Kgosientsho Ramokgopa signed the agreements and the Department of Electricity and Energy said in a statement that construction of the BESS projects within 24 months will see the storage capacity come online by November 2026. The BESIPPPP is key to supporting South Africa's electricity infrastructure as the system needs more flexibility to accommodate the feed in of new renewable energy and improve grid stability. □



The national grid's Northern Cape Supply Area highlighting (in yellow) the location of the three Oasis 1 BESS projects.

Strategic reach into Africa for supplier of industrial sensors

Pepperl+Fuchs recently hosted its Channel Partner Conference, uniting partners from South Africa, Kenya, Nigeria, Botswana, and Namibia. Under the theme 'Together, Breaking ground in Africa', the conference served as a celebration of partnerships and a strategic forum focused on future growth.

It provided a platform for partners to share insights, discuss market trends, and align on goals for 2025, with sessions focused on innovation, resilience, and local market strategies. The event marked 10 years of partnerships that are making an impact on the market and set a bold vision for the decade ahead. Pepperl+Fuchs and its Channel Partners will continue working together to drive growth and opportunity across the continent.

For more information visit: www.pepperl-fuchs.com

Pepperl+Fuchs recently hosted its Channel Partner Conference, bringing together partners from around the continent.

High accuracy transmitters for temperature measurement

Senseca's HD 48 and HD 49 passive and active transmitters measure temperature, relative humidity and dew point temperature and, according to Jan Grobler, Managing Director of Senseca, South Africa, they are favoured in the market for their cost-effectiveness, high-accuracy measurement and reliability.

"Both series of transmitters are designed for temperature and humidity control in air conditioning and ventilation applications (HVAC/BEMS) across sectors such as blow-drying plant, industrial and specialised processing plant, in pharmaceutical facilities, clean rooms, and ventilation ducts in industrial and civil sectors. The transmitters are factory calibrated, so no further adjustments are required on installation," says Grobler.

The HD 48 Series transmitters are active transmitters and accept both direct and 24 Vac alternating power supplies. The transmitters have standard 4 - 20 mA, or voltage (0 - 10 V) outputs, or a serial RS485 output. All models have screw type terminal block electrical connections, a standard PBT and 10 µm stainless steel grid protection (P8) and a probe working temperature of between -20°C and +80°C. The units have an ingress protection rating of IP66.

The HD 48 Series with RS485 output allows several instruments to be connected to form a network. The instruments are connected in sequence through a shielded cable with twisted pair for signals and a third wire for the ground.

The HD 49 Series transmitters are passive transmitters and suitable to be inserted in a 4 - 20 mA current loop. They have a 12 - 40 Vdc electrical connection and a stainless steel 10 µm filter to protect the sensor against dust and particles, also classified as IP66 for ingress protection.

Various HD 49 models include a horizontal probe for duct mounting (TO), a vertical probe for wall mounting (TV), a probe with 2 or 5 m cable (TC), and a fixed contact Pt100 probe for solar panels (TFP). The different models cover different temperature ranges from the standard -20 to +80°C to an extended -40 to +150°C.

Both series of transmitters measure relative humidity with a well-proven temperature-compensated capacitive sensor that provides precise and reliable measurements over time.

Grobler says, "Senseca is recognised as a provider of high-quality measurement instrumentation. The HD 48 and 49 are lightweight transmitters that offer the high accuracy and precision that industry requires, and they deliver a competitive lifespan." □

The HD 48 and HD 49 transmitters, designed for industrial applications, measure temperature, humidity and dew point temperature.

A universal temperature controller

TME (Transfer Multisort Elektronik) now offers a new universal temperature controller by Lumel, a supplier specialising in efficient solutions for industrial automation.

The RE12S Controller is designed for temperature control processes across a wide range of industrial applications. It features a universal input adaptable for measurements using various sensor types and is compatible with almost all popular thermocouple types. The outputs are configured with SPST-NO relays, which are programmable. For additional installation convenience, the RE12S Controller includes adaptive and automatic control modes as well as a self-tuning function.

A key advantage of the RE12S controller is that it supports the RS485 interface and Modbus protocol, which means it can be used in SCADA systems. Simplified integration with existing master systems makes Lumel products ideal for upgrading installations in factories, processing plants, warehouses, and similar facilities. The modular construction also makes it suitable for use in HVAC systems, central heating, liquid level control, and other automation applications.

The RE12S temperature controller.

The controllers are enclosed in a panel-mounted housing. The rubber control buttons are placed below a white-green LED display with large, clear digits which make monitoring device status easier, even from a considerable distance.

For more information visit: www.tme.eu/en/

Transforming field data into actionable information

As part of its ongoing commitment to enhancing industry connectivity, Teledyne Gas & Flame Detection (Teledyne GFD) is making its new and proprietary Teledyne GDCloud™ available with the company's GS700, GS500 and Shipsurveyor portable gas leak detectors, as well as its PS200 portable four-gas monitor for personal safety and confined space applications. The integration of cloud connectivity enhances the gas leak detection process by visualising all instrument data, turning it into actionable business insights.

Teledyne GDCloud™ is a comprehensive cloud solution that advances gas detection measurement by recording hazardous events, ensuring regulatory adherence, and streamlining safety programmes.

The ability to visualise detailed gas sensor readings from field sessions is a valuable advantage. Users can trace the route taken by each technician during investigations with the advanced location mapping functionality, enabling 'breadcrumb' mapping to show the precise locations that correspond to all gas readings logged in the GS700 detector. When looking to pinpoint leaks, analyse hazards and document sources of emissions, this location intelligence is especially helpful. Additionally, users can interact with dynamic charts and tabulated data displays to reveal further insights into field activity and events.

With powerful tools that track and analyse data, Teledyne GDCloud™ can also support a cost-effective, efficient, condition-based fleet management programme. Functions include equipment status, fault reporting and remote diagnostics from Teledyne experts. Notably, alarm prioritisation allows for 'important and urgent' data to be actioned before lower-level risks.

With its intuitive and customisable dashboard, Teledyne GDCloud™ provides total visibility into the operational and compliance status of all gas detectors in a user's fleet. Configurable widgets facilitate the organisation of key information in line with user preferences, and colour-coded indicators immediately highlight significant field events. These indicators point to instruments that require imminent calibration or functional bump testing to maintain instrument performance and guarantee the ongoing capture of accurate readings.

Teledyne GDCloud™ offers an informative user-friendly cloud solution for gas detection programs.

"Strict record-keeping is crucial to demonstrating regulatory compliance with gas safety protocols," says Nick Wood, Global Marketing Director, Teledyne GFD. "Teledyne GDCloud™ securely stores comprehensive calibration data records for every detector. Users can quickly access and document an instrument's recent operational history, including all past calibration readings, bump test status, the technicians involved and any relevant service notes, providing a meticulous audit trail with simple reporting."

Teledyne GDCloud™ offers a user-friendly cloud solution for gas detection programs, featuring comprehensive compliance monitoring, visualisation of field events, and projected gaseous hazards based on location-mapped readings. It also includes detailed record-keeping and intelligent fleet tracking. The secure and reliable cellular solution operates independently of the end user's IT infrastructure and can be quickly retrofitted to existing GS700, GS500, Shipsurveyor or PS200 instrument fleets. Teledyne GFD has rolled out Teledyne GDCloud™ globally with many customers and is committed to supporting future advances in this field. □

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Dr Fabian Assion, Product Manager I/O at Beckhoff Automation. "The increasing proportion of renewable energies requires more measurement and control-integrated measurement technology at all grid levels."

Measurement and control in smart grids

The proportion of renewable energies – solar, hydropower, and wind – has increased significantly in recent years and in 2023 already accounted for more than half of Germany's electricity feed. In this in-house interview, Dr Fabian Assion, Product Manager I/O at Beckhoff, explains what this high share of highly fluctuating energy means for grid operation and for the required smart grids from a control technology perspective.

What role do smart grids play in the energy transition and what does this mean for grid management?

The increased proportion of renewable energies is making supply grids more unstable for two reasons. The first is that this energy is generated in a much more distributed manner. It is no longer distributed as centrally as has traditionally been the case with large power plants. This means the existing physical grid structure is not as suitable as it used to be. The change in current flow sometimes leads to grid instabilities and overloads.

The second reason is that traditional power plants are usually operated by synchronous generators. This is ideal for grid operation, for instance, providing optimal grid support in the event of a ground fault. Renewable energies, however, are controlled by power inverters. Therefore, they can only provide the very high currents required in such cases to a limited extent, which also leads to grid instabilities. Today's energy supply grids are consequently more complicated to control overall. And this is exactly why smart grids are used. They have significantly more information on the current grid status and are therefore much easier to control.

© DeWind Inc

The measurement data of renewable energies, such as those generated by DeWind's wind turbine for Argentina's Veladero gold mine at an altitude of 4 300 m, needs to be recorded in as much detail as possible.

What are the technical requirements of smart grids in terms of extended measurement technology?

Additional measurement technology has to be installed at all grid levels. To date, this has primarily been implemented in the ultra-high and high voltage sectors, but hardly – if at all – in the medium and low voltage sectors. The lower grid levels in particular need to be upgraded, and this is especially important from an investment perspective. These levels are much more extensive than the higher sectors and, accordingly, require many more measuring points. Hundreds of thousands of measuring points are needed even for a reasonably comprehensive approach.

For example, taking the local substation as the lowest link in the supply grid, this is where the medium voltage is transformed into low voltage, usually using a transformer with eight or more low voltage outputs. These voltage outputs should all be equipped with measurement technology for a wide range of measured variables. And, in Germany, that's the case for some 100 000 local substations.

Which metrics are relevant?

The current is of course the most important single value, but it doesn't go far on its own. If possible, all types of power – reactive, apparent, and active power – should also be recorded at each outgoing feeder to make statements about the grid status. This is particularly important as most loads now use a power supply unit and therefore generate undesirable harmonics. This means it is almost essential for the grid operators responsible for grid quality to collect detailed data on harmonics and even on the level of each individual harmonic from each voltage output in order to take targeted measures if necessary.

What advantages does PC- and EtherCAT-based control technology offer?

PC-based control from Beckhoff, with its integrated measurement technology, provides for measurements to be performed using comparatively little technical effort and requiring relatively low financial expense. The measurement technology is high quality and easy to use. It is based on EtherCAT with its distributed clocks and is therefore suffi-

© IEH/KIT

Operation and monitoring of the grid simulation at the Institute of Electrical Energy Systems and High Voltage Technology (IEH) at the Karlsruhe Institute of Technology (KIT) created with TwinCAT HMI.

© Beckhoff

With the distributed clocks of EtherCAT, only one EL3443 measurement terminal is needed to achieve detailed high-quality power measurements in distributed power measurement, together with any number of EL3446 measurement terminals distributed in the grid.

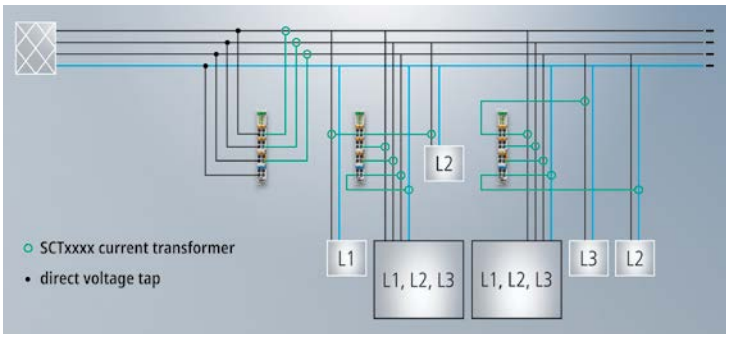
ciently fast and precise to respond appropriately to short-term events in the grid.

With our concept of distributed power measurement, high-quality measurement data can be generated cost-effectively.

What is behind the concept of distributed power measurement?

A key feature here is that all relevant electrical data from the supply grid, including real measured values for power – without local voltage measurement – can be determined with the EL3446 EtherCAT Terminal used only as a current measurement terminal. However, the EL3446 terminals distributed in the system as required receive the voltage values needed for calculating the power data via EtherCAT from a separate EL3443 power measurement terminal. This needs to be installed only once and is precisely synchronised in time by the distributed clocks function in EtherCAT. Hardware and installation costs are minimised and the technology reliably monitors the grid quality with a high-quality harmonic measurement at each outgoing voltage feed and the resulting power quality factor.

Solutions with PC-based control have proven their worth, in the wind energy sector, for example. What are the main advantages?



© Beckhoff

The Beckhoff concept of distributed power measurement minimises the material and installation costs for comprehensive energy data acquisition.

© Siemens Energy

As a manufacturer of systems for energy transmission and stabilisation of the power grid, Siemens Energy puts its trust in PC-based control technology from Beckhoff (in this case: a system for high-voltage direct current transmission).

Worldwide, more than 100 000 wind turbines up to a size of 16 MW have already been automated with Beckhoff's PC-based control technology. EtherCAT demonstrates its advantages here, as it enables fast and precisely synchronisable control processes, allowing for operation and energy yield to be optimised. This applies to individual wind turbines, even on a larger scale, and to networking within a complete wind farm. In offshore turbines, high voltage direct current (HVDC) transmission is one of the most sophisticated elements in a supply grid. PC-based control from Beckhoff has been successfully implemented in this sector, in solutions developed by Siemens Energy, for example

Beckhoff technology demonstrates its advantages in power generation as well as in the distribution of energy via regional supply grids. Does this offer efficiency potential?

In addition to the system-integrated measurement technology, users benefit from the broad range of Beckhoff I/O solutions for all application areas and environmental conditions. This means all necessary data can be recorded and merged in the control system – for power measurement,

© Beckhoff

Romande Energie SA, one of the five biggest energy suppliers in Switzerland, is using system-integrated measurement technology from Beckhoff in its substations. It implements the EL3453 power measurement terminals and other EtherCAT Terminals to ensure grid availability (in this case: a high-voltage installation).

as well as for integrating telecontrol protocols, switch positions, signal messages, and transformer and ambient temperatures. The case of *Romande Energie*, an energy supplier in western Switzerland, shows how much this can contribute to secure grid management.

Recording performance data is one aspect, stabilising performance is another. What solutions does PC-based control offer in terms of frequency control and stabilisation?

Frequency control and stabilisation in the energy supply grid is a very elaborate and complicated task. It requires comprehensive grid data and an extremely fast system response – in the millisecond and, at times, even in the microsecond range. The Korean company Power 21 successfully implemented this in 2015 for energy supplier KEPCO with a high-precision frequency measurement using Beckhoff's EL3773 grid monitoring terminal with oversampling function. Another example is where the Institute of Electrical Energy Systems and High Voltage Technology (IEH) at the Karlsruhe Institute of Technology (KIT) is researching ways to ensure system stability in transmission grids, which are changing as a result of the energy transition. In addition to investigative simulations, the behaviour of power plants and inverter-based generation systems in an island grid is being simulated in a dedicated test environment. For this purpose, innovative new control methods are being carried out using Beckhoff Embedded PCs with TwinCAT to validate their application in realistic scenarios.

What savings on power consumption can regional consumers – and larger industrial plants with their own supply grids – gain?

At Beckhoff, our own energy management system enables us to track loads and minimise costs by avoiding peak loads. This is particularly important when establishing an in-house energy supply grid. And it applies not only to large industrial groups, but also to SMEs. As soon as a company has installed its own generation system, in the form of photovoltaics, for example, it should consider energy management as a next step. If storage systems and controllable loads are also in the mix – for example, together as a bidirectional charging point – energy flows can be controlled in a targeted way.

How important is integrated control technology in controlling both the building and production operations, and coordinating them in terms of energy?

An integrated Beckhoff solution makes it easy to determine comprehensive energy data. Together with a corresponding energy management system, these form the basis for considering possible process optimisations in terms of energy, and for enabling a response to increasingly dynamic electricity prices. Both offer considerable potential for reducing energy costs. The process and building automation from a single source at pharmaceuticals manufacturer *Engelhard Arzneimittel* and the building and production automation connected via PC-based control at Austrian mechatronics manufacturer Pollmann International GmbH, present examples.

The growing proportion of renewable energies also requires the expansion of decentralised storage capacities. What control options does PC-based control offer for battery-powered storage systems, biogas power plants, or hydrogen storage systems?

The application areas for Beckhoff's control and measurement technology are as diverse as the storage systems. In the battery-powered sector, an example with huge future potential is the use of electric vehicles as energy storage systems in parking garages. With TwinCAT 3 IoT OCPP (Open Charge Point Protocol) and the EL6761 EtherCAT Terminal, Beckhoff offers a complete solution for ISO 15118 communication between charging stations and electric vehicles, between existing charging points, and between charging points and/or the associated central management systems.

Reverion's biogas power plants in a compact container design and GKN Hydrogen's low-pressure, metal hydride hydrogen storage systems demonstrate how PC-based control can be used to implement flexible process control and seamless data monitoring for other storage technologies.

As a final word?

We are all facing several major challenges and one of them is the restructuring of our energy supply. Beckhoff is doing what it can to stay true to the owner and company founder's motto: 'Engineers must save the world!'. But we can't do this on our own. So, I would like to offer all our existing and future customers the opportunity to help us tackle this task together! □

For more information visit: www.beckhoff.com

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NTCSA shares its Transmission Development Plan 2024

The National Transmission Company of South Africa (NTCSA) shared its updated Transmission Development Plan, TDP 2024, at a public forum, as required, on 30 October 2024.

Segomoco Scheppers, Interim Chief Executive Officer of the NTCSA.

In his opening address Segomoco Scheppers, Interim Chief Executive Officer of the NTCSA, reminded all in attendance that Eskom did not host a TDP Public Forum in 2023, as it had applied for and was granted an exemption for that year by the National Energy Regulator of South Africa (NERSA). This decision was made due to the ongoing development of the new Integrated Resource Plan (IRP) by the Department of Mineral Resources and Energy (DMRE). Additionally, the generation capacity assumptions outlined in TDP 2022 extended beyond the IRP 2019 period, so no major changes were anticipated for the five-year planning horizon in transmission infrastructure.

In place of the usual TDP Public Forum, Eskom last year held a Transmission Development Plan Implementation Forum to update stakeholders and interested parties on the progress made to date and to address the accelerated rollout needed for South Africa's energy security and the energy transition.

Scheppers highlighted upfront that TDP 2024 was being presented by the newly established National Transmission Company South Africa, which began operating from 1 July 2024 as an independent, wholly owned subsidiary of Eskom Holdings. He flagged this in itself as a significant milestone in the country's electricity supply industry, following a long and complex unbundling process that involved collaboration with the government, lenders, and other key stakeholders.

"As we embark on this new chapter for South Africa's electricity supply industry, the NTCSA will play a pivotal role in maintaining and ensuring the reliability of the transmission network, expanding and modernising the network, and ensuring non-discriminatory access to all market participants. With the recent enactment of the Electricity Regulation Amendment Act (ERAA), NTCSA is fulfilling a legislative requirement and enabling the rollout of critical transmission infrastructure to connect new generation capacity and secure South Africa's energy future.

At the official launch of the NTCSA on 7 October 2024, the company shared its vision: to be a world-class enabler for a thriving power market benefitting people, the economy and the environment. This vision is anchored by four strategic objectives:

- Delivering reliable and sustainable access to affordable power
- Creating an inclusive and competitive electricity market
- Ensuring a financially sustainable business
- Achieving digital transformation for efficiency and effectiveness.

These objectives will be supported by building strong relationships with key stakeholders, clear internal governance, world-class talent, and a high-performance culture.

Recapping TDP 2022

Before outlining the scope of work envisaged in TDP 2024, which looks at the next decade, 2025 to 2034, Scheppers recapped some of the key points of TDP 2022. It anticipated 53 GW of new generation capacity by 2032, with nearly 39 GW expected from renewable sources such as solar PV and wind. It pointed to the need for 14 200 km of extra-high voltage transmission lines and 170 transformers, providing 105 000 MVA of capacity, to strengthen existing infrastructure and in new build.

He also set out further progress made since the 2023 TDP Implementation Forum. He noted that there are 61 projects now in the execution phase, which will unlock about 30 000 MW of new generation connection capacity by 2030. Of these 61 projects, 31 projects are currently under construction and will deliver 1 445 km of transmission lines and 16 945 MVA of transformer capacity to enable the safe and reliable connection of nearly 16 000 MW of generation by 2028. The remaining 30 projects in the execution phase are in procurement and will enable nearly 14 000 MW of new generation connection by 2030.

Scheppers highlighted that the NTCSA has also identified 47 priority projects that can be fast-tracked to accelerate delivery on the TDP. These projects are expected to unlock 37 GW of new generation capacity by FY2033.

TDP 2024, the first TDP from the newly established independent National Transmission Company, sets ambitious targets to expand and strengthen South Africa's national electricity grid.

TDP 2024 looks towards integrating 56 GW in new generation capacity by 2034, requiring 14 500 km of new transmission lines and 210 new transformers, providing 133 000 MVA of capacity.

Notably, the number of projects in the definition phase – the last stage before execution – increased from five in FY2022 to 22 in FY2023. "This reflects our commitment to advancing these projects," he said.

And he added further: "I want to take this moment to thank the NTCSA team for their hard work and dedication in safely expediting the implementation of the TDP."

A closer look at TDP 2024

One of the main changes in TDP 2024 is that it projects an increase in new generation capacity, to 56 GW, that will need to be integrated into the transmission network between 2025 and 2034, a step up from the 53 GW projected in TDP 2022. This will need 14 500 km of new transmission lines and 210 transformers, providing 133 000 MVA of capacity. It points to a fivefold increase in delivery over the next 10 years compared to the previous decade. To date, the NTCSA has approved R112 billion in capital expenditure for delivery of the TDP programme over the next five years.

"We recognise the magnitude of the challenge," Scheppers said "and delivering on these targets requires a fundamentally new approach. We are working closely with the government, private sector, and stakeholders to implement a hybrid delivery model that includes in-house delivery, Engineering, Procurement and Construction (EPC), Procurement and Construction (PC), and Independent Transmission Projects (ITP). This hybrid model is aimed at maximising capacity without overburdening our balance sheet or the fiscus."

Supply chain challenges

He said a key challenge is overcoming local supply chain constraints as the industry ramps up to meet these increased demands. In August 2024, the NTCSA signed 19 long-term agreements with local EPC companies to expedite transmission line construction (see *Electricity + Control September 2024*).

"We also launched an incubation programme to build local high voltage line construction capacity, with two contractors having already completed the programme. This initiative, supported by the Ministry of Electricity and Energy, the Industrial Development Corporation (IDC), and the Department of Trade, Industry, and Competition (DTIC), is helping expand local expertise in high voltage line construction. We will continue with this initiative to ensure we have the capacity to meet the requirements of TDP 2024," Scheppers said.

The NTCSA is also addressing global supply chain challenges for key equipment such as transformers. As reported previously, a panel of transformer suppliers has been appointed to compete for 101 upcoming contracts. Contracts for 26 large transformers, expected to be delivered within 12 to 36 months, have already been placed, to ensure delivery stays on track despite potential global constraints. The NTCSA is working to secure contracts for the remaining transformers needed in terms of TDP 2024.

Local economic development

"While we explore new initiatives, we remain committed to local economic development," Scheppers emphasised. "TDP 2024 presents a unique opportunity for localisation and industrialisation. The NTCSA's infrastructure demands over the next five to ten years offer a critical window to develop local industries and supply chains. Collaboration with local industry associations will be key to maximising the benefits of localisation and contributing to broader economic growth. This must be done without inhibiting the required speed of execution," he said.

In addition to delivering on the planned expansion of the transmission grid, the NTCSA is committed to operating, maintaining and renewing its existing assets. With the necessary expertise and resources, it aims to ensure the continuing reliability of the grid, as it invests in its long-term resilience.

"We are committed to deliver on this ambitious plan, mindful of the imperative for the safety of people and the environment, compliance, and ethical conduct. We expect the same of all our partners," Scheppers said.

In closing he said, "The NTCSA's success will not be determined solely by the infrastructure we build or the systems we establish. It will depend equally on the relationships we foster, the talent we cultivate, and the innovation we embrace.

"Open dialogue, mutual understanding, and shared responsibility will be essential as we work together to build a grid that not only meets current needs but is also flexible enough to accommodate future demands and emerging technologies."

He acknowledged the input of all stakeholders, saying: "Together, we can create an electricity supply industry that best meets South Africa's power needs.

"The NTCSA's purpose is to connect Southern Africa to its power and potential. As we move forward, we trust that we can count on your unwavering support to make this a reality." □

For more information visit: www.ntcsa.co.za

Ethiopia-Kenya electricity highway – shaping regional connectivity

The African Development Bank reports that the electricity highway between Ethiopia and Kenya, officially opened in 2023 after more than 10 years of planning and construction, is redefining energy connectivity in the East Africa region. It represents a significant technological advance in infrastructure, connecting power grids and, more broadly, nations, populations and economies.

Supporting a shared energy future, the electricity transmission interconnection runs for 1 045 km between Wolayta-Sodo in Ethiopia and Suswa in Kenya. It enables both countries to pool resources, hydroelectricity from Ethiopia, and geothermal and wind power from Kenya.

John Mativo, Managing Director of the Kenya Electricity Transmission Company (Ketraco), says this project is all about collaboration. "Around 2010, countries in East Africa, as an energy pool, decided it was essential to have an interconnected hub so that everyone could use and exploit energy and support each other."

One of the project's important aspects is the use of HVDC (High Voltage Direct Current) technology, which makes it easier to transport electricity with long distance transmission lines. Tewoderos Ayalew, the Site Manager at Ethiopian Electric Power explains.

"We have used HVDC technology to minimise energy wastage and reduce power losses in the transmission line. HVDC technology also has the benefit of reducing the costs of construction. It is easy to operate and improves grid stability in managing the interconnection from the power grids of different countries."

Energy from Ethiopia's hydroelectric plants is produced in the form of alternating current, which is transported via the Ethiopian grid to the converter station in Sodo. There, it is converted to direct current (dc) and leaves Ethiopia for Kenya, via the 1 045 km overhead transmission line. Once it arrives at the Suswa converter station, it is converted back to alternating current to be integrated into the Kenyan power grid.

This high voltage dc infrastructure is the only such interconnection in the region and forms the foundation of East Africa's aim to enable regional power exchange and allow cross-border trade in energy.

The total cost of USD 1.26 billion was funded partly by USD 338 million from the African Development Bank. The World Bank, the *Agence Française de Développement (AFD)*, and the governments of the two countries involved also contributed.

Economic benefits

The project has brought significant economic benefits to both countries. For Kenya, where 95% of electricity comes from renewable sources, the connection is increasing its competitiveness. Kipkemoi Kibias, General Manager at Ketraco, endorses the development.

"Using clean, renewable energy brings numerous advantages not only to Kenyans, but to the whole world... It allows us to attract investors, especially in light and heavy industries, that are looking for green energy."

The HVDC electricity interconnection between Ethiopia and Kenya represents a technological advance for electricity transmission in the region.

The project also creates jobs. The development of business zones close to energy infrastructure, like the one near Suswa, creates thousands of jobs and boosts local economic activity. Moreover, the project includes a significant social dimension, involving local communities. Of the 100 employees at the Suswa power station, 70 come from the region, an indication of the opportunities for local development.

For Sylvia Kinaiya, an engineer from the region, the project is also a source of personal pride. "I am Masai, so for me, it's a way of giving back to my community," she says. She also emphasises that the project has shown others that it is possible to be a mother and an engineer, as she is, helping to break down gender barriers in technical occupations.

As well as its economic and social impacts, the project supports sustainability, allowing for better integration of intermittent renewable energy sources, such as wind and solar, into regional networks. According to John Mativo, the infrastructure ensures that, "Kenya has enough green energy to support its industrial development while maintaining a small carbon footprint."

Kenya is already on the way to self-sufficiency in clean energy, with the aim of moving to 100% renewable energy by 2030. By connecting its grid to Ethiopia, Kenya can stabilise its energy supply and attract more investment into green energies. This vision is shared by investors, who see the new electricity interconnection infrastructure as a safeguard of energy and environmental security.

The Ethiopia-Kenya electricity highway looks towards green energy as a driver of stronger regional cooperation and sustainable development. With this connection, East African countries can share their energy resources efficiently and meet growing demand in their populations and industries. □

For more information visit: www.afdb.org/en

On show at Electra Mining Africa, the compact, safe, GELPAG 12 kV SIS panel.

Solid insulated switchgear – compact, safe and environmentally friendly

Among the various products and equipment it presented at Electra Mining Africa this year, ACTOM showcased its medium voltage GELPAG solid dielectric insulated switchgear (SIS). The switchgear is designed to suit medium voltage installations, from 6.6 kV to 11 kV distribution substations. Development is in progress to cover operating voltages up to 33 kV in the near future. SIS introduces advantages in its compactness, safety and the environmental benefits of using SIS rather than gas-insulated switchgear (GIS), or air-insulated switchgear (AIS).

Electricity + Control spoke to Rhett Kelly, Design and Development Manager, and Johan Jordaan, Technology Development Specialist of ACTOM's MV Switchgear division at the show.

They say that ACTOM MV Switchgear has seen growing demand for the GELPAG solid dielectric insulated switchgear since it was introduced to the local market. The division has quite recently arranged with its overseas-based OEM partner to start manufacturing some of the product's ancillary components locally.

"This means we can shorten the production lead times substantially," Kelly says, "as we can now manufacture the agreed locally produced components in parallel with the OEM's production of the main product module. This speeds up final assembly of the product in our plant and delivery to the end user."

Environmental benefits

Kelly highlights that a key advantage of the dielectric epoxy resin insulated switchgear is that it offers an alternative to gas-insulated switchgear – where SF_6 (sulphur hexafluoride) has traditionally been the most commonly used gas. SF_6 is now recognised as one of the most potent greenhouse gases in terms of its climate changing impacts in the atmosphere. Several countries and regions around the world, including Europe, the USA and China, have already put measures in place to phase out the use of SF_6.

Because it excludes the use of gas, SIS switchgear is a more environmentally friendly technology. It also means the switchgear does not require any gas monitoring in maintenance.

Safety

Safety is always a priority in the design and development of switchgear and the GELPAG SIS switchgear scores on this front. The individually earthed screened epoxy resin poles in which the switchgear is embedded means there is practically no risk of live contact nor phase to phase arc flashover within the switchgear.

Together with the metal enclosure, the solid epoxy resin also excludes the risk of external damage to the switchgear. It is therefore ideal for use in harsh environments – and is fully protected from the effects of environmental pollution and moisture. Before it released the new switchgear locally, the OEM tested a 12 kV panel through four days submerged under water and the system surfaced unaffected.

Kelly notes that SIS switchgear has been used before, but what differentiates the GELPAG 12 kV SIS offered by ACTOM is that it can now handle up to 4 000 A (previously limited to 1 250 A) and it is, he says, the only solid insulated switchgear that is rated up to 40 kA and 4 000 A. This is the result of the specialised epoxy resin used – which has been developed by ACTOM's partner GELPAG. One of the features of the material is that it has a higher thermal conductivity than other epoxy materials in use, increasing its current carrying capacity. This allows the switchgear insulation to transfer the heat generated by the higher currents more effectively.

Jordaan points out that the earthed screen on the outside of the epoxy resin also makes the equipment safe to touch, although the HV compartments are either interlock controlled or not accessible to operators.

Solid dielectric insulated MV switchgear is designed and manufactured to support a stable power network and to minimise the risk of internal arcs. Although in the GELPAG SIS, the risk of an arc flash is minimal, the equipment has nevertheless been type tested in terms of internal arc classification according to standards IEC 62271-200 and SANS 1885 for up to 40 kA for 1 second.

Compact design

A further key advantage of the GELPAG SIS switchgear is its compact design. This makes it especially suitable for use in confined spaces, in mining applications for example. It has recently been applied in projects for underground mines, water treatment plants, and in hybrid renewable energy plants combining solar PV power generation and battery energy storage systems.

The 12 kV panel ACTOM had on display at Electra Mining, which handles 1 250 A, is just 500 mm wide and about 2.5 m tall. Its compact footprint makes it especially suitable for use in applications where space is limited – and safety is critical. □

Regulating the use of SF_6

The move to regulate the use of SF6 and other harmful gases has been led by the European Union. The EU's F-gas Regulation 2024/573 supersedes the earlier regulation and was adopted on 7 February 2024, taking effect from 11 March 2024.

The new EU F-gas Regulation in 2024 restricts the use of harmful, planet warming fluorinated gases, including SF_6. Key measures of the new F-gas Regulation include additional prohibitions on F-gas equipment, products and use of F-gases going forward. The regulation covers additional equipment and gases, expanding measures to prevent leakage during transportation, installation, servicing, and disposal of equipment and products.

Similar restrictions are being implemented in the USA and other countries around the world to phase out the use of fluorinated gases, including hydrofluorocarbons.

Reference: https://climate.ec.europa.eu › eu-action › eu-rules_en

A new training centre for electro-mechanical apprentices

As the largest manufacturer and supplier of electro-mechanical equipment in sub-Saharan Africa, ACTOM has opened a new training centre, offering various apprenticeship programmes, at its premises in Germiston, east of Johannesburg.

Kobus Swanepoel, Technical Training Manager at Actom Training Centre, highlights that the relocation of the 30-year-old training centre to its new and bigger premises enables the facility to make use of new state-of-the-art equipment and provides space for more apprentices per intake.

"The training centre is accredited to train apprentices in eight different trades. These are: Mechanical Fitter, Fitter and Turner, Metal Machinist, Tool, Jig and Die Maker, Millwright, Electrician, Boilermaker and Welder," he says.

Swanepoel adds that the new centre is in the process of obtaining its new accreditation from the Quality Council for Trades and Occupations (QCTO). The centre's legacy certification expired in November 2024, and it is therefore obliged to apply for accreditation in line with the recently amended occupational qualifications.

International recognition

"The apprentice programmes we offer are completed over three years and include theoretical, practical and work-based training components. At the end of the training, apprentices must pass a trade test to obtain a Red Seal certificate, which confirms that they will be recognised internationally as artisans," Swanepoel says.

He says although the Actom Training Centre has not historically been a trade test centre, the new venue and additional space will enable the training centre to do trade testing now internally and it is currently applying for accreditation for this function.

"At present, we take in 150 candidates per year. We could accommodate more but we instead want to focus on delivering quality training to those enrolled," Swanepoel says.

He notes that when ACTOM initially established the training centre, the idea was to train artisans specifically for the company. However, about three years ago, ACTOM expanded this mandate to extend training to apprentices from other companies.

New intakes

This year, he says, Actom Training Centre received a grant from a SETA for 50 apprentices and it is also training 38 apprentices from other companies. These apprentices started their training programme on 1 June. The cohort currently in training includes 32 apprentices from ACTOM divisions, 50 from Actom Training Centre and 38 from other companies.

"By training apprentices for the wider industry, we are looking at the bigger picture, using the training centre to develop skills for the industry and to make a difference in reducing the unemployment crisis. Over time this will benefit the broader economy. We are planning to position our training centre as one of the best in the country," Swanepoel says.

"ACTOM has invested a considerable amount of money to ensure we can produce quality apprentices with sound skills to work in the industry. There are so many unemployed people in South Africa and there is a great need for people to be trained in trade skills. We can make a huge difference in the industry and people's lives by giving them more opportunities," he says.

ACTOM has opened a new training centre for apprentices training in electro-mechanical skills.

For more information visit: www.actom.co.za

Dr Clinton Carter-Brown, ENERTRAG South Africa.

Local collector grids can relieve transmission constraints

Just ahead of Windaba 2024, the wind energy conference held in October in Cape Town, Dr Clinton Carter-Brown, Head of Technical at ENERTRAG South Africa, emphasised the need for a fresh, comprehensive approach to tackling the challenges of the national grid in order to fast-track progress and enable the country to achieve its renewable energy and energy security goals.

He highlighted that the National Transmission Company of South Africa's (NTCSA's) Transmission Development Plan (then TDP 2022) points to the need for construction of 14 000 kilometres of new transmission lines, "which means we need to build 1 400 kms of transmission lines each year for the next decade. This is essential for the connection of new power generation, to provide energy security and enable South Africa to decarbonise the power system," he said.

Carter-Brown supports a dynamic approach that includes greater private sector involvement to manage risks and implement innovative financing mechanisms in expanding and strengthening the electrical grid. He sees the possibility to bolster key transmission corridors, develop local grids at the sub-transmission level, and foster collaboration among developers, to optimise the grid and integrate combined power plants to create a more resilient and efficient energy system.

"We need to develop local collector grids that integrate power from multiple projects and, when combined with energy storage systems, provide dispatchable green energy. Leveraging private capital in grid development will strengthen power corridors and create local grids, which evolve into combined power plants. These plants can also include new loads and support deeper decarbonisation through green hydrogen production," Carter-Brown said.

The transition from individually connected renewable facilities to combined power plants will enhance the integration of various generation sources, energy storage, and new technologies, optimising grid use and offering additional services.

"Developers in South Africa need to collaborate on shared grid infrastructure, moving beyond traditional competition to collectively finance and build these systems equitably. Optimising current and future grids to maximise new generation connections through smart market mechanisms is essential," he said.

The combined power plant model offers several advantages.

- Hybridisation effects: Interconnected generators reduce grid capacity needs by basing grid connection capacity on combined and diversified requirements rather than individual plants.
- Reduced complexity: Fewer connection points simplify grid management, lower costs, and streamline ancillary services.
- Incorporating additional technologies: Energy storage and other technologies can mimic traditional thermal power plant performance, providing on-demand dispatchability, for example.
- Shared grid assets: Projects share infrastructure, leading to more effective collective action.

Learnings from ENERTRAG's international experience where the company has integrated 646 MW of wind, solar, biomass, battery storage and hydrogen production systems, and those of third parties into a collector grid connecting directly to the main transmission system can inform new and collaborative pathways to relieving South Africa's current grid constraints. □

Doble's Calisto® cable condition monitoring solution provides insights into cable systems and connected assets to inform predictive maintenance.

New insights on critical cables

Doble's Calisto® cable condition monitoring solutions are pushing the boundaries of condition monitoring and helping the electric power industry operate cable systems, medium and high voltage, more reliably, safely and securely. Using near real-time asset health and condition data, Calisto® cable condition monitoring solutions help protect critical power cables and connected assets, to ensure uptime and reduce traditional operating costs.

Built on the same core technology used for manufacturing and commissioning acceptance testing, Doble's Calisto® solution helps customers prevent major faults in transmission and distribution cables by identifying:

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- Surface PD on cable terminations
- Corroded shield
- Broken jacket
- Temperature anomalies
- Cable movement.

The Doble Calisto® cable condition monitoring solution provides information on cable systems beyond insulation and accessories' health. It allows for virtual asset inspections and predictive data-driven maintenance programmes, both of which can reduce the total cost of ownership for HV cables substantially. It is a flexible platform that integrates multiple monitoring parameters. These can include PD monitoring, tracking sheath currents, cable displacement, vibration, temperature and more. It can be delivered as a turnkey solution and is supported by Doble's expert engineering team.

Incorporating proprietary TF Map™ technology it enables cable operators to track PD signals that might otherwise be overlooked and offers advanced partial discharge analysis. It is an OEM agnostic solution providing for independent data interpretation and support. □

Private power generation from steam turbines for the grid

As South Africa's energy grid evolves towards using more privately generated power, there are growing opportunities for companies employing steam turbines for their own sites to boost revenue through electricity sales. Staying ahead of the trend, WEG Africa provides a full service offering to support this move.

Steam turbines represent mission critical equipment for companies across a range of industries, from sugar and paper to steel and petrochemicals. WEG Africa suggests that there is now greater opportunity for these sectors to generate more energy to sell into the national grid.

Traditionally, companies using steam turbines have consumed all the energy they produce in their processes – taking advantage of benefits such as supply reliability and cost savings. As South Africa struggles to keep up with power demand, however, there are more opportunities for the private sector to produce excess electricity for sale into the grid.

Alastair Gerrard, Executive Energy Systems at WEG Africa, says this trend is already advanced in Brazil – the home of holding company WEG. Many steam turbine users in Brazil have capitalised on the opportunities there by increasing their boiler efficiency.

"Although it may be common in South Africa's sugar industry, for example, to use medium pressure boilers, the Brazilian market uses high pressure boilers – up to 140 bar – and companies gain significant efficiencies with these higher pressures," he says. "This allows the sugar producers, and other users, to upgrade their facilities and grow their revenues through the sale of electricity. In parallel, they are paying off their capital investments much more quickly."

Gerrard points to the establishment of the National Transmission Company of South Africa as a key step in transforming the country's electricity industry. This will open doors for more private companies to 'export' excess electricity into the grid, helping to stabilise supply and strengthen the foundation for economic growth.

"This has been successfully achieved in countries like Brazil, and it is exciting to see that we are making progress on this journey in South Africa," he says. "WEG Africa can play an important role in this endeavour – with our long experience in this field and our full service offering for steam turbine users."

Cobus van Eeden, WEG Turbine Services Manager at WEG Africa, highlights that the company offers customers a turnkey capability. It sizes steam turbine solutions according to the specific operating parameters of the customer's application, and supplies a bespoke thermal power system. The service also includes installing the machines, commissioning and ongoing after-sales servicing and maintenance.

"As an OEM of steam turbines, gearboxes and generators, we can also help customers to assess their current equipment – whether these are WEG products or from other OEMs – and provide strategic options and recommendations," says van Eeden. "In addition to our depth of engineering expertise for repairing such equipment, we can analyse the potential for enhancing operational efficiency and increasing power output of the equipment."

The company provides long-term service level agreements, including contracts for preventive maintenance. WEG Africa also works with customers on their forward planning, which may include considering the transition to electricity exporting.

Gerrard says this approach is built on WEG's commitment, as an OEM, to stand alongside customers throughout the lifecycle of the equipment supplied. He notes that, while there has in the past been some acceptance of third-party support in this field, WEG Africa favours in-house OEM support for its solutions, managed through service level agreements that give customers confidence in the total lifecycle cost of their purchase.

"Our field service technicians – active in many African countries and offshore – work on-site with customers to understand their equipment and requirements, and in turn deliver the most appropriate response and guidance on maintenance scheduling," he says.

For more information visit: www.weg.net

Alastair Gerrard, Executive Energy Systems at WEG Africa.

Modelling of rotor aerodynamics could improve wind turbine design

David L Chandler at the MIT News Office, Massachusetts Institute of Technology, recently reported how engineers at MIT have developed a new model of rotor aerodynamics that could improve the way turbine blades and wind farms are designed and how wind turbines are controlled and operate.

The blades of propellers and wind turbines are designed based on aerodynamics principles that were first described mathematically more than a century ago. But engineers have long realised that these formulas don't work in every situation. To compensate, they have added ad hoc 'correction factors' based on empirical observations.

Now, engineers at MIT have developed a comprehensive, physics-based model that accurately represents the airflow around rotors even under extreme conditions, such as when the blades are operating at high forces and speeds or are angled in certain directions. The model could improve the way rotors are designed, and the way wind farms are laid out and operated. The new findings were first described in the journal *Nature Communications, August 2024*, in an open-access paper[1] by MIT postdoctoral student Jaime Liew, doctoral student Kirby Heck, and Michael Howland, the Esther and Harold E. Edgerton Assistant Professor of Civil and Environmental Engineering.

"We've developed a new theory for the aerodynamics of rotors," Howland says. This theory can be used to determine the forces, flow velocities, and power of a rotor, whether that rotor is extracting energy from the airflow, as in a wind turbine, or applying energy to the flow, as in a ship or an aeroplane propeller. "The theory works in both directions," he says.

Because the new understanding is a fundamental mathematical model, some of its implications could be applied right away. For example, operators of wind farms constantly have to adjust a variety of parameters, including the orientation of each turbine as well as its rotation speed and the angle of its blades, in order to maximise power output and maintain safety margins. The new model can provide a simple, speedy way of optimising those factors in real time.

"This is what we're so excited about, that it has immediate and direct potential for impact across the value chain of wind power," Howland says.

[Image credit: By courtesy of the researchers]

MIT engineers have developed a new theory that could improve the way turbine blades and wind farms are designed and how wind turbines are controlled.

Modelling the momentum

Known as momentum theory, the previous model of how rotors interact with their environment – air, water, or otherwise – was initially developed late in the 19th century. With this theory, engineers can start with a given rotor design and configuration, and determine the maximum amount of power that can be derived from that rotor – or, conversely, if it's a propeller, how much power is needed to generate a given amount of propulsive force.

Momentum theory equations "are the first thing you would read about in a wind energy textbook and are the first thing that I talk about in my classes when I teach about wind power," Howland says. From that theory, physicist Albert Betz calculated in 1920 the maximum amount of energy that could theoretically be extracted from wind. Known as the Betz limit, this amount is 59.3 percent of the kinetic energy of the incoming wind.

But just a few years later, others found that the momentum theory broke down "in a pretty dramatic way" at higher forces that correspond to faster blade rotation speeds or different blade angles, Howland says. It fails to predict not only the amount, but even the direction of changes in thrust force at higher rotation speeds or different blade angles: Whereas the theory said the force should start going down above a certain rotation speed or blade angle, experiments show the opposite – that the force continues to increase. "So, it's not just quantitatively wrong, it's qualitatively wrong," Howland says.

The theory also breaks down when there is any misalignment between the rotor and the airflow which, Howland says, is "ubiquitous" on wind farms, where turbines are constantly adjusting to changes in wind directions. In an earlier paper[2] in 2022, Howland and his team reported their findings that deliberately misaligning some turbines slightly relative to the incoming airflow within a wind farm significantly improves the overall power output of the wind farm by reducing wake disturbances to the downstream turbines.

In the past, when designing the profile of rotor blades, the layout of wind turbines in a farm, or the day-to-day operation of wind turbines, engineers have relied on ad hoc adjustments added to the original mathematical formulas, based on some wind tunnel tests and experience with operating wind farms, but with no theoretical underpinnings.

Instead, to arrive at the new model, the team analysed the interaction of airflow and turbines using detailed computational modelling of the aerodynamics. They found that, for example, the original model had assumed that a drop in air pressure immediately behind the rotor would rapidly return to normal ambient pressure just a short way downstream. But it turns out, Howland says, that as the thrust force keeps increasing, "that assumption is increasingly inaccurate."

And the inaccuracy occurs very close to the point of the Betz limit that theoretically predicts the maximum performance of a turbine – and therefore is just the desired operating regime for the turbines. "So, we have Betz's prediction of where we should operate turbines, and within 10 percent of that operational set point which we think maximises power, the theory completely deteriorates and doesn't work," Howland says.

Through their modelling, the researchers also found a way to compensate for the original formula's reliance on one-dimensional modelling that assumed the rotor was always precisely aligned with the airflow. To do so, they used fundamental equations that were developed to predict the lift of three-dimensional wings for aerospace applications.

They derived their new model, which they call a unified momentum model, based on theoretical analysis, and validated it using computational fluid dynamics modelling. In follow-up work not yet published, they are carrying out further validation using wind tunnel and field tests.

Fundamental understanding

One interesting outcome of the new formula is that it changes the calculation of the Betz limit, showing that it's possible to extract a bit more power than the original formula predicted. Although it's not a major change – of the order of a few percent – "it's interesting that we now have a new theory, and the Betz limit that's been the rule of thumb for a hundred years is actually modified because of the new theory," Howland says. "That is immediately useful." The new model shows how to maximise power from turbines that are misaligned with the airflow, which the Betz limit cannot account for.

The aspects related to controlling individual turbines and arrays of turbines can be implemented without requiring any modifications to existing hardware in place at wind farms. This has already happened, based on earlier work from Howland and his collaborators two years ago which dealt with the wake interactions between turbines in a wind farm, and was based on the existing, empirically founded formulas.

"This breakthrough is a natural extension of our previous work on optimising utility-scale wind farms," he says. In doing the earlier analysis, they saw the shortcomings of the existing methods for analysing the forces at work and predicting power produced by wind turbines. "Existing modelling using empiricism just wasn't getting the job done," Howland says.

In a wind farm, individual turbines will sap some of the energy available to neighbouring turbines, because of wake effects. Accurate wake modelling is important for designing the layout of turbines in a wind farm, and for the operation of the farm, determining moment to moment how to set the angles and speeds of each turbine in the array.

[Image credit: By courtesy of the researchers]

The engineers have developed a comprehensive model that accurately represents the airflow around rotors even under extreme conditions, such as when the blades are operating at high forces and speeds or are angled in certain directions.

Until now, Howland says, even the operators of wind farms, the manufacturers, and the designers of the turbine blades had no way to predict how much the power output of a turbine would be affected by a given change, such as its angle to the wind, without using empirical corrections. "There was no theory for it. So, that's what we worked on here. Our theory can tell you directly, without any empirical corrections, for the first time, how you should actually operate a wind turbine to maximise its power," he says.

Because the fluid flow regimes are similar, the model also applies to propellers, whether for aircraft or ships, and for hydrokinetic turbines such as tidal or river turbines. Although they didn't focus on that aspect in this research, "it's in the theoretical modelling naturally," he says.

The new theory exists in the form of a set of mathematical formulas that a user could incorporate in their own software, or as an open-source software package that can be freely downloaded from GitHub[3]. "It's an engineering model developed for fast-running tools for rapid prototyping and control and optimisation," Howland says. "The goal of our modelling is to position the field of wind energy research to move more aggressively in the development of the wind capacity and reliability necessary to respond to climate change."

The work was supported by the National Science Foundation and Siemens Gamesa Renewable Energy.

References:

[1] https://www.nature.com/articles/s41467-024-50756-5
[2] https://news.mit.edu/2022/wind-farm-optimization-energy-flow-0811
[3] https://github.com/Howland-Lab/Unified-Momentum-Model freely downloaded from GitHub.

For more information visit: MIT News

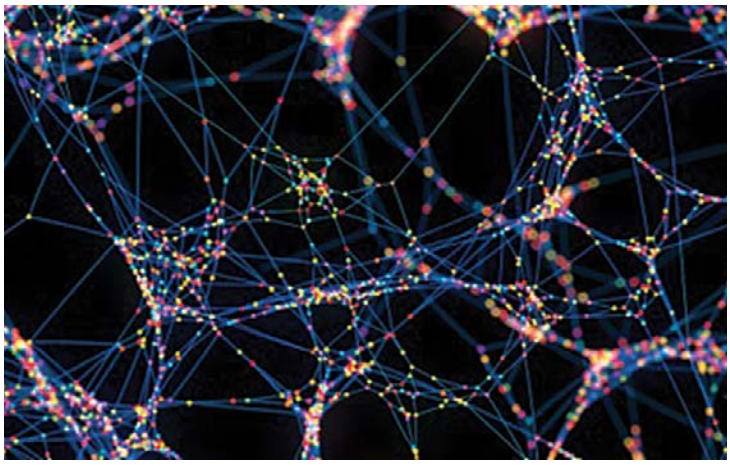
Manufacturing to meet the growing market for green energy technologies

The rapid uptake of clean energy technologies globally offers major opportunities for countries looking to manufacture and trade them. It also presents challenging decisions for governments, which face tensions and trade-offs based on the industrial and trade policies they opt to pursue.

The recently released IEA report: *Energy Technology Perspectives 2024 (ETP-2024)* – the latest instalment of the IEA's flagship technology publication – focuses on the outlook for the top six mass-manufactured clean energy technologies: solar PV, wind turbines, electric cars, batteries, electrolysers and heat pumps. Based on today's policy settings, the global market for these technologies is set to rise from $700 billion in 2023 to more than $2 trillion by 2035 – close to the value of the world's crude oil market in recent years. Trade in clean technologies is also expected to rise sharply. In a decade's time, it is forecast to more than triple to reach $575 billion, more than 50% larger than the global trade in natural gas today.

The report, which also looks at key materials like steel and aluminium, provides a first-of-its-kind analytical framework for policymakers as they consider the dynamic and complex landscape of clean energy manufacturing and trade. Built on a newly assembled bottom-up dataset and quantitative modelling based on countries' policies, *ETP-2024* maps out the current state of clean energy manufacturing and trade and how they are expected to evolve. In doing so, it explores how countries at different stages of development can capture the benefits of the emerging energy economy as they seek to ensure secure and cost-effective clean energy transitions.

IEA Executive Director, Fatih Birol said: "The market for clean technologies is set to multiply in value in the coming decade, increasingly catching up with the markets for fossil fuels. As countries seek to define their role in the new energy economy, three key policy areas – energy, industry and trade – are becoming more interlinked. While this presents governments with tough and complicated decisions ahead, this groundbreaking IEA report provides a strong, data-driven foundation for their decisions. Clean energy transitions offer a major economic opportunity, as we have shown, and countries are seeking to capitalise on that. However, governments should strive to develop measures that also foster continued competition, innovation and cost reductions, as well as progress towards their energy and climate goals."



The IEA's analysis of this growing market shows the complex interplay between energy, industrial and trade policies as countries seek to secure supply chains and economic opportunities.

The increase in the global clean technology market has been accompanied by a record wave of investment in the manufacturing of clean technologies as countries look to bolster their energy security, maintain their economic edge and reduce emissions. Most of this spending is concentrated in the countries and regions that already have established a clear foothold in the sector and are looking to build on their positions: China, the European Union and the United States, and increasingly India. However, despite the strong impact of the Inflation Reduction Act and Bipartisan Infrastructure Law in the United States, the EU's Net-Zero Industry Act and India's Production Linked Incentive Scheme, China will likely remain the world's manufacturing powerhouse for the foreseeable future. Under today's policy settings, its clean technology exports are on track to exceed $340 billion in 2035, which is roughly equivalent to the projected oil export revenue this year of Saudi Arabia and the United Arab Emirates combined.

Today, countries in Southeast Asia, Latin America and Africa account for less than 5% of the value generated from producing clean technologies. However, *ETP-2024* emphasises that the door of the new clean energy economy remains open to countries at different stages of development. It identifies key opportunities for emerging and developing economies based on a country-by-country assessment of more than 60 indicators, such as the business environment, infrastructure for energy and transport, resource availability and domestic market size.

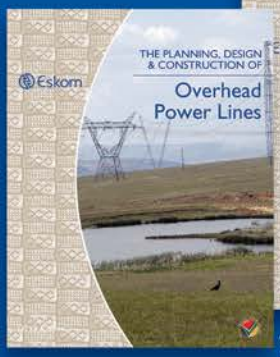
The report finds that beyond the mining and processing of critical minerals, emerging and developing economies could draw on their competitive advantages to move up the value chain.

"Growth in the manufacturing and trade of clean energy technologies should be for the benefit of many economies, not just a few," Dr Birol said. "This report shows that countries in Southeast Asia, Latin America, Africa and beyond have strong potential to play important roles in the new energy economy. And it finds that with sound strategic partnerships, increased investment and greater efforts to bring down high financing costs, they can achieve this potential."

For more information visit: www.iea.org.za

Eskom

The Eskom Power Series was conceived in response to the continuing worldwide loss of critical technical skills and experience. The aim of the series is to promote international best practice, including experience acrued by Eskom over the years, as a guide and legacy and to serve as a source of reliable, reputable and highly technical information.



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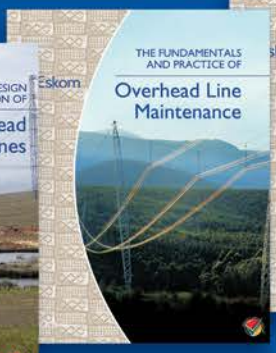

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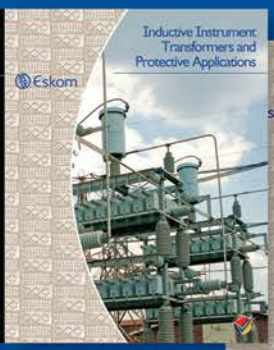

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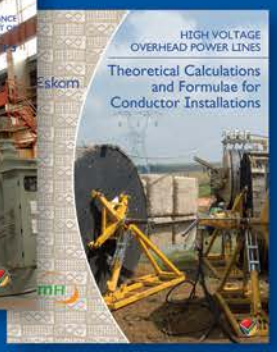

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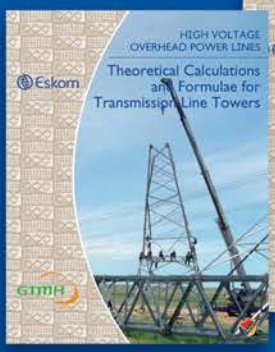

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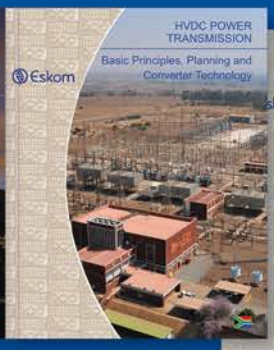

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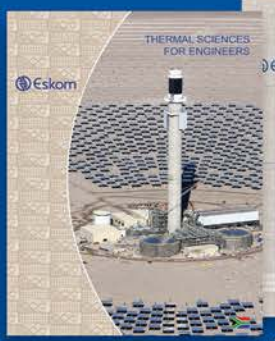

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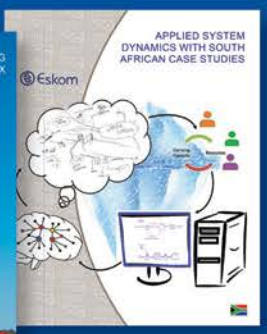

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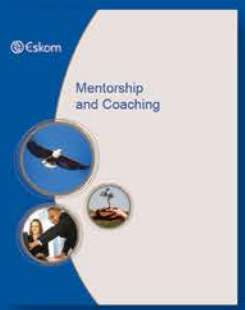
The Eskom Leadership & Management Series was introduced by Eskom at the request of readers and stakeholders of the Power Series who felt that the series should be expanded to include non-technical topics. These topics are often not well understood by technical practitioners and can pose a risk to the sustainability of their businesses. To date, the Power Series team, with assistance from experts in the various fields, has produced two volumes.



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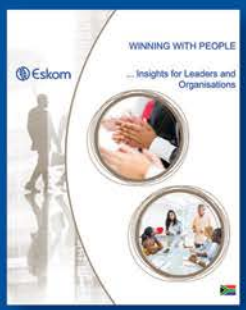

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Based on the success of the Eskom Power Series and the Eskom Leadership & Management Series, the Professional Development Series was created. It aims at developing various professions within South Africa so that large state-owned enterprises and the private sector can grow and facilitate job creation in the country. Unlike the Power Series, both the Eskom Leadership & Management Series and the Professional Development Series have a broad readership, including those residing in the private sector, State Owned Companies (SOCs) and academic institutions.

Eskom has also published: GENERATION, TRANSMISSION AND DISTRIBUTION: A large Southern African utility. This is an introduction to the technology that has developed, over time, in response to growing demand in the electricity utility industry in South Africa. It provides a 'soft-landing' for those who need, or want, to engage with the technology in a large electricity utility.

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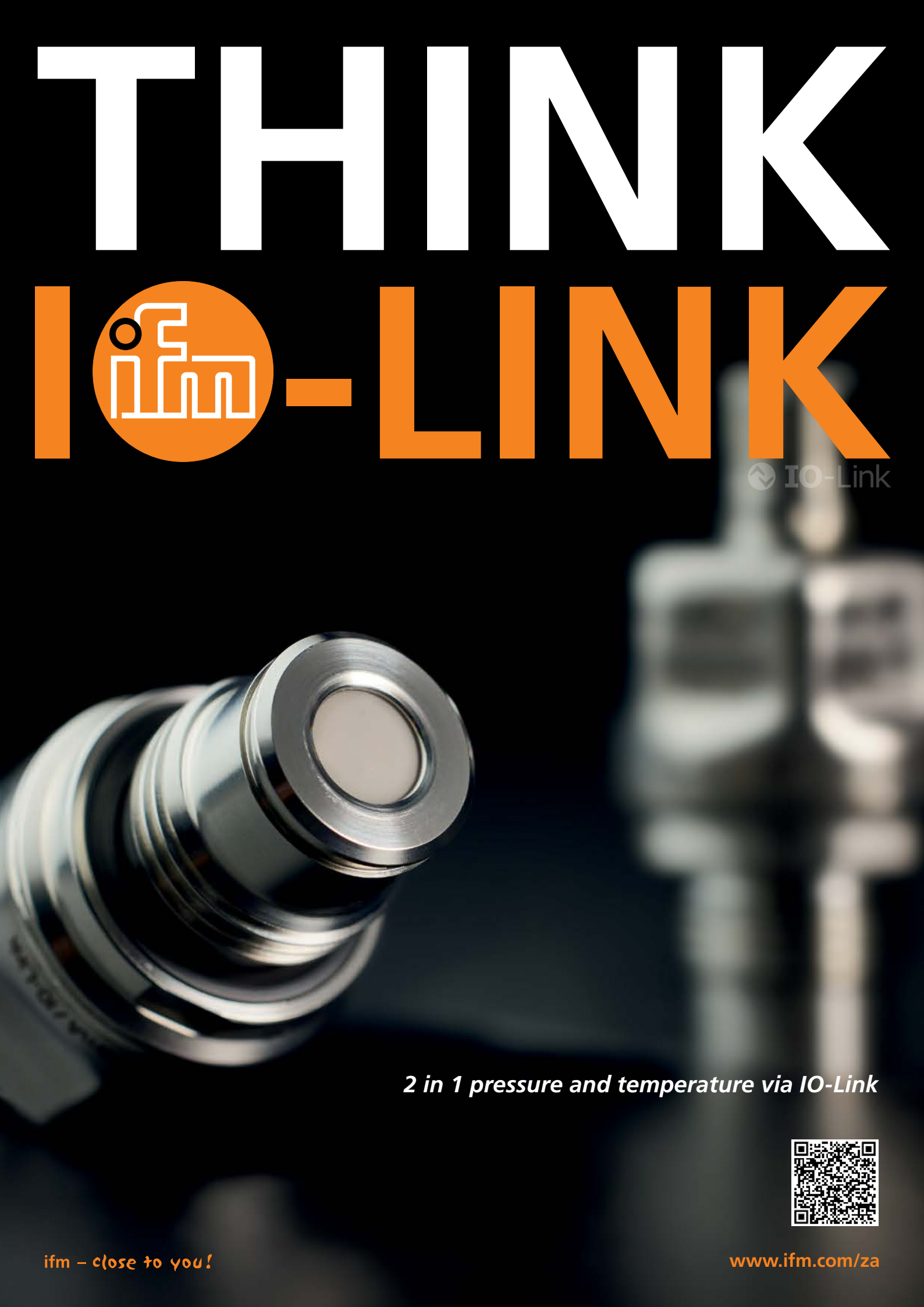

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