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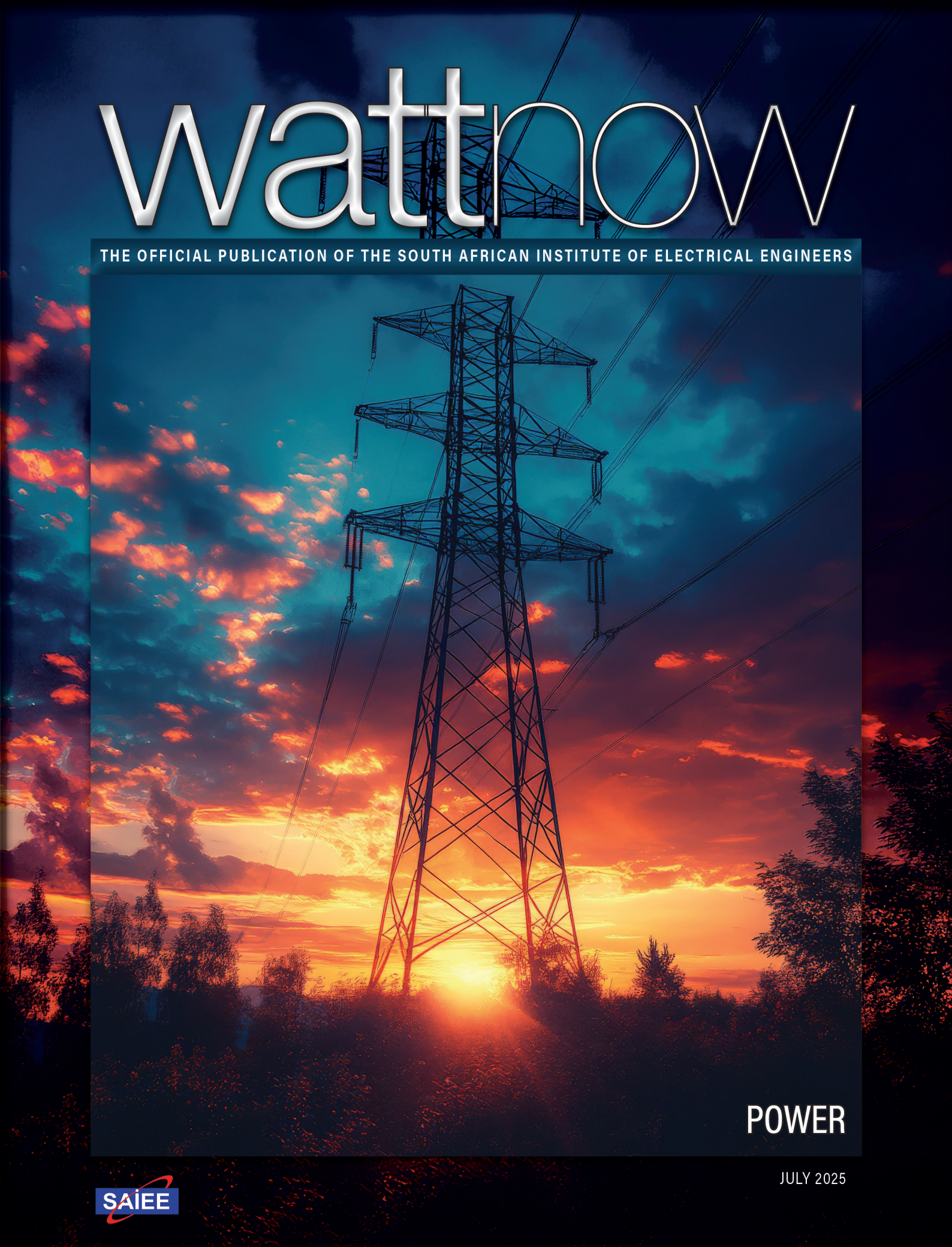
THE OFFICIAL PUBLICATION OF THE SOUTH AFRICAN INSTITUTE OF ELECTRICAL ENGINEERS



POWER

JULY 2025

SAIEE

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CONTENTS

4 SAIEE President's Message

6 Industry News

20 Student News

30 Tertiary Education Facilities in South Africa

32 **Smarter Grids, Cleaner Power**
Virtual Power Plants and AI forecasting are reshaping South Africa's Energy system

36 **Migration from SDH to meet Technological Advancements**
Telecommunications is the bloodline of smart grids and the evolution of power grids.

40 **Global Energy Review 2025**
A comprehensive depiction of energy trends

64 **The Critical Role of Dynamic & Transient Simulations**
Stability is now more challenging than ever before

68 Opinion

82 Legal Matters: When Seconds Matter

84 SAIEE Membership

86 SAIEE Council

88 SAIEE Centres

89 SAIEE Events Calendar

Dear **watt**now Reader,

Electric power is a fundamental component of modern life, powering everything from our homes and businesses to the devices we rely on daily. As a versatile and efficient form of energy, electricity plays a crucial role in various sectors, including transportation, healthcare, and communication.

In this edition, we explore the principles of electrical power, including generation, distribution, and consumption. We will delve into the technological advancements that have revolutionized the way we harness electrical energy and discuss the ongoing challenges and innovations in the field.

From renewable energy sources to innovative grid technology, understanding electrical power is essential for both professionals and consumers alike. We aim to provide insights that not only enhance awareness but also inspire further exploration and understanding of this vital subject.

Join us as we illuminate the world of electrical power and its significance in shaping our future.

The August issue features Lightning, and the deadline is July 14. Please email your contributions to minx@saiee.org.za.

Herewith the July issue - enjoy the read!

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M Avrabos

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EVENTS
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SAIEE HEAD OFFICE
18A Gill Street, Observatory, JHB
T 011 487 3003
www.saiee.org.za
Office hours: 8am - 4pm

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Strengthening Connections - Advancements and Collaborations within the SAIEE

Veer Ramnarain
2025/6 SAIEE President

The formation of the first centres of the South African Institute of Electrical Engineers (SAIEE) demonstrated the importance of the work undertaken at a centre level in contributing to the SAIEE's success. It has been my goal to visit as many centres as possible during my term of office and to complement these visits with engagements at the local universities close to the centres.

In my inaugural address, I emphasised the importance of the Centre Chairs organising a Chairman's business breakfast to enable us to engage robustly and constructively with academia, inviting captains of industry as well as members. The KZN Centre and Gauteng Centre fulfilled this mandate by hosting these events in June 2025. These have already had the positive spin-off of us reconfirming our relevance as an institute to these very important stakeholders.

In continuing with my message that 'The relevance of our institute will only be appreciated if our members and partners see themselves as growing and contributing to the development of South Africa', it was another proud occasion for SAIEE, with the Independent Communications Authority of South Africa (ICASA) announcing the new councillors on 3 June 2025. The new councillors will serve a four-year term. The chair of the SAIEE Computing Section, Dr Joshua Tshifhiwa Maumela and Senior Member Andrew Dibi Matseke were announced as new councillors. The ceremony was presided over by former acting High Court of South Africa judge Professor JCW van Rooyen SC. We are honoured to have these esteemed individuals serve on the fully constituted nine-member council, in line with the Electronic Communications Act, and contribute to the development of South Africa. Dr Maumela is an AI and Economics specialist known for creating Africa's first AI algorithm rooted in Ubuntu philosophy. Matseke is an experienced engineer and project manager with a strong track record in ICT and infrastructure delivery.

In my last article, I wrote of my visit to the University of Cape Town (UCT), with an effort to promote the value that SAIEE can add to the tertiary institutions in the form of assistance with external examiners, assisting the academics with Pr Eng experience, input to Industry Advisory Board, proving the link to IEEE, linking students to employers and finally SAUPEC. Engagements have already begun with creating the link to IEEE via the SAIEE MOU, as requested by the university. We have also started

E: president@saiee.org.za

engaging with one of our corporate partners for assistance in equipping one of the university's research laboratories.

I am confident that we will create similar relationships between our corporate partners and the tertiary institutions so that we can make a reality of Past President Elsdon-Dew's words in 1914 that 'In this Institute's prosperity lies the success of Electrical Engineering in South Africa.'

At a corporate level, the CEO has been busy engaging other partners. During the month, a corporate partnership agreement was signed with FESTO. We are currently in the process of signing the Memorandum of Understanding (MOU) with the Institute of Information Technology Professionals South Africa (IITPSA NPC).

On a regulatory matter and after years of effort, SAIEE has finally received SARS PBO status, granting income tax and donation tax exemptions. This will have a positive impact on the institute's financials. It has been a very successful month at both the centre and corporate levels, for which I would like to thank the respective Centre Chairpersons, the Honorary Vice President, and the head office staff under the leadership of the CEO. wn

Veer N. RAMNARAIN – Pr Eng
2025 SAIEE PRESIDENT
BSc Electrical Eng, GCC, Dip EBM, MBA, MFMP

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KZN Centre Leadership Conference 2025

The SAIEE KwaZulu-Natal Centre's Leadership Conference 2025 was a triumph of collaboration, innovation, and purpose-driven engineering. More than just an event, the conference became a platform for meaningful dialogue, strategic insight, and leadership transformation. From AI discussions to critical conversations on the energy transition, the day was packed with inspiration, action, and powerful ideas.

Thought Leaders Who Ignited the Room
The audience was privileged to hear from some of South Africa's most influential voices in energy and engineering leadership:

- **Dr Thabo Hlalele**, Head, CSIR Energy Centre - A stalwart in energy systems innovation, Dr Hlalele shared insights into South Africa's evolving energy landscape and the transformative role of research and policy in ensuring energy resilience.
- **Hilton Baartman**, Director, Digital Energy, Schneider Electric - With a bold vision for the digital future of energy, Hilton championed the role EQ and AI in driving sustainable growth and operational excellence.
- **Dr Kavisha Nandhlal**, MBA, DBA, Innovation for Strategic Growth - A dynamic force in leadership and transformation, Dr Nandhlal offered a compelling narrative on using innovation as a tool for strategic progress across sectors.
- **Veer Ramnarain** Pr Eng, FSAIEE, President, SAIEE - Leading with humility and purpose, Veer Ramnarain reinforced the values of inclusivity, excellence, and the SAIEE's mission to be a beacon of transformation and growth in the engineering profession.

LEADERSHIP THAT INSPIRES

The conference created space for real-world learning through interactive discussions and high-impact presentations. Attendees gained practical tools on decision-making, communication, conflict resolution, and team dynamics — all essential traits for today's agile leader. It was not just about gaining knowledge, but about building confidence, fostering networks, and nurturing a culture of mentorship and innovation.

ACKNOWLEDGEMENTS

None of this would have been possible without the tireless dedication of the SAIEE KZN Centre team, whose behind-the-scenes efforts ensured a seamless and impactful event.

We also extend our gratitude to our generous sponsors for investing in the future of engineering:

- ACDC Dynamics
- Conlog
- Rhythm Power Solutions
- Aberdare Cables
- Investec

And a special thank you to SAIEE CEO, Leanetse Paul Matutoane, whose steadfast leadership continues to inspire and unite our engineering community.

A CALL TO ACTION

In a world of change, one thing remains constant — the need for visionary, ethical, and courageous leadership. As we reflect on this unforgettable day, one message rings clear:

We're not just imagining the future — we're engineering it. Together. wn

"What is Solar I-V Curve?"

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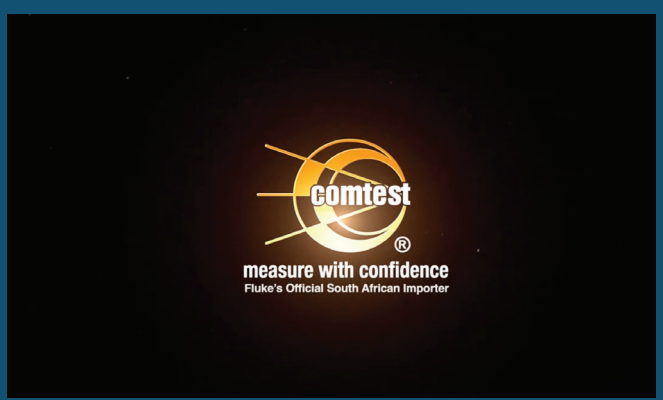
WATCH THE VIDEO HERE



SAIEE partners with Festo to introduce a digital learning portal to its professional members

The South African Institute of Electrical Engineers (SAIEE) fosters technical knowledge, professional development, and innovation within South Africa's electrical engineering sector.

As technology evolves and industries move towards smarter, more automated solutions, continuous learning has become essential for engineers to remain at the forefront of industry advancements. Through this transformation and a comprehensive technical needs analysis, Festo and SAIEE forged a groundbreaking partnership to introduce SAIEE professionals to digital learning via the Festo Learning Experience platform.

Festo, a pioneer in industrial automation, launched this e-learning platform to equip professionals with in-demand technical skills, enhance workforce efficiency and support lifelong learning with flexible, high-quality courses that can be accessed anytime and anywhere.

This innovative portal offers didactically prepared learning content for many technical areas, such as electrical engineering, power grids, digital technology and electric drive technology. Through the intelligent combination of eLearning courses and practical exercises, professionals are able to elevate their knowledge and ensure their employability in the high-tech industries.

HOW DOES THIS PLATFORM WORK?

Professionals can select a course they are interested in, complete the registration, and the course will be assigned to them. Festo LX is a user-friendly web-based learning portal that allows users to access their courses at their leisure. All that is needed is a tablet, laptop, or smartphone with an internet connection. Upon completion, users receive certificates for completing all the learning paths on Festo LX, which can boost the credibility of engineers in the job market. These certifications demonstrate technical proficiency and help professionals stand out in a competitive industry. Register today and experience the power of digital learning and enhance your expertise with the latest skills and knowledge in the technical field.

HOW TO REGISTER

Learning made easy in 5 easy steps:

Step 1: Visit SAIEE Training Academy e-Learning
Step 2: Select your course of choice
Step 3: Make payment for the course
Step 4: Register to log into your Festo LX profile
Step 5: Start learning once the course is assigned

The collaboration between SAIEE and Festo unites two industry giants, each committed to driving technical excellence and innovation.

Festo, a global pioneer in industrial automation, leverages decades of expertise in engineering education. As a leader in professional development, SAIEE empowers electrical engineers with the knowledge and skills needed to stay at the forefront of industry advancements. Together, they are transforming the future of engineering education by delivering world-class digital learning opportunities. This partnership will empower industry professionals and strengthen the

workforce, fostering a more skilled, competitive, and future-ready industry.

If you need further assistance or have any questions about this platform, our team at SAIEE is here to help. Contact us at training@saiee.org.za.

We are committed to providing the support you need to maximise your learning experience.

Click here: Festo Learning Experience - Digital Learning as individual as you are to explore the future of learning and the innovative experience that awaits you! wn

LH Marthinusen launched new Fan Division

From left: Mr Abiel Mohlahlo, DTIC; Advocate Tebogo Makube, DTIC; Andries Mthethwa, ACTOM; Minister Mpho Parks Tau and Mervyn Naidoo, ACTOM.

From left: David Sullivan, Divisional CEO of LH Marthinussen; Mpho Parks Tau, Minister of Trade, Industry and Competition; Mervyn Naido , CEO of ACTOM; and Andries Mthethwa, Chairman of ACTOM.

LH Marthinusen, a Division of the ACTOM Group, launched its new industrial fan manufacturing and services factory in Ekurhuleni on the 29th of May. The event established a major milestone for South African energy infrastructure growth and was attended by representatives from government agencies, Eskom, and industry partners. The facility, which is a major investment by ACTOM, will expand over the following three years to fulfil Eskom contracts.

The newly established factory not only manufactures industrial fans and their components but also offers maintenance services for essential fan systems that support Eskom's air pre-heater infrastructure. These fans are crucial for Eskom's power generation facilities, as they play a key role in managing airflow and regulating temperature levels.

David Sullivan, Divisional CEO of LH Marthinusen, highlights the strategic significance of this facility: "The launch of this facility underscores our dedication to fulfilling Eskom's infrastructure needs with local products and innovative solutions. Our fans play a pivotal role in the successful operation of Eskom's essential air pre-heater systems. This facility not only boosts our manufacturing capabilities but also fosters employment growth and industrial development in the region."

While the project aims to create 50 new positions throughout the first three years, the company envisages an additional 120 job openings to meet Eskom's and general industries' infrastructure demands. The production of each industrial fan requires 49 tons of steel along with two tons of stainless steel. The substantial demand for local steel used in quadrifuge (four-stage) fan stations drives growth in domestic manufacturing and supply chain development.

CEO of The ACTOM Group, Mervyn Naidoo, notes: "Our investment and expansion aligns perfectly with the goals of South Africa's National Development Plan (NDP). This supports industrial development while strengthening local manufacturing operations and establishing employment opportunities.

This facility supports both energy security for the nation and the NDP's mission to drive economic transformation and skills development and modernise infrastructure.

It further helps us construct an enduring economy which serves South Africa's long-term development purposes." wn

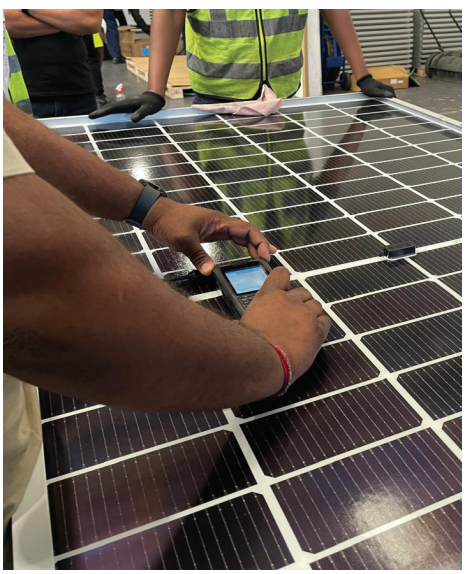
KZN Centre visits ArtSolar

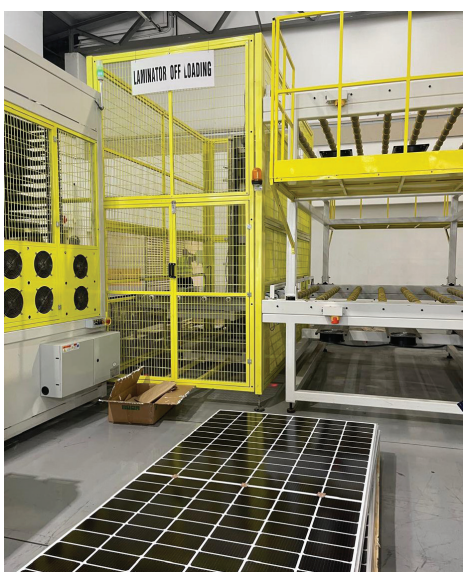
At the beginning of June, members of the SAIEE KZN Centre, along with Leanetse Paul Matutoane, CEO of The South African Institute of Electrical Engineers (SAIEE), had the honour of visiting ARTsolar, South Africa's leader in locally manufactured solar PV solutions.

During the visit, they observed state-of-the-art production lines and engaged with passionate engineers and innovators. This experience reaffirmed the belief in the power of local innovation to drive South Africa's energy transition.

A heartfelt thank you to the ARTsolar team for their warm hospitality and for demonstrating what it means to combine excellence, sustainability, and local impact.

Together, we can engineer the future. wn





Mzansi Energy Consortium and Palabora Mining Company Sign Landmark 12-Year Green Energy Supply Agreement

In a significant boost for sustainable mining and South Africa's clean energy ambitions, Mzansi Energy Consortium has signed a 12-year Power Purchase Agreement (PPA) with Palabora Mining Company (PMC). Together, the two will develop one of the country's most significant private renewable energy projects and the first grid-forming project in South Africa.

Itumeleng Ngoae

Wessel Wessels

The Marula Green Power initiative will deliver 132 MWp of solar photovoltaic (PV) capacity, a 360 MWh battery energy storage system (BESS), and a dedicated 132 kV transmission line to wheel clean power to PMC's mining operations in Ba-Phalaborwa. The grid-forming solution will provide stable, dispatchable electricity while supporting South Africa's broader energy transition.

PMC COMMITS TO SUSTAINABLE ENERGY

"This strategic partnership with Mzansi Energy Consortium marks a significant milestone in PMC's commitment to sustainable operations and energy security," said Itumeleng Ngoae, PMC's Executive Manager for Asset Management, Safety, Health, Environment and Quality (AMSHEQ). "Wheeled solar power coupled with battery storage aligns with our goals to reduce carbon emissions and operating costs while strengthening community development and sustainable mining in Ba-Phalaborwa."

The facility will comply with all regulatory requirements, including the Environmental Impact Assessment (EIA), Eskom grid connection protocols, and approvals from the National Energy Regulator of South Africa (NERSA).

ONE OF SA'S MOST SIGNIFICANT IPP INITIATIVES

"This will be South Africa's first grid-forming renewable project and one of its largest private-sector IPP initiatives," explained Wessel Wessels, Chief Operations Officer at Mzansi Energy Consortium and CEO of Journey2Green. "We're building a dedicated 132kV line to enable wheeling via Eskom's grid while incorporating advanced energy management systems and significant battery storage capacity. Partnering with Huawei, we've adopted an integrated

Tumi Mogoera

factory-to-field model that shares technology risk across the lifecycle—from design through to operations."

The solar site was carefully located outside PMC's operational area to avoid interference with the Kruger National Park's protected wildlife.
A comprehensive EIA has been completed to ensure environmental compliance and system efficiency, addressing the high levels of soiling in the region.

OPERATIONS TO COMMENCE IN EARLY 2027

"Rand Merchant Bank has been appointed Mandated Lead Arranger for the project's debt financing," added Tsatsi Mahlatsi, Chief Executive Officer of Mzansi Energy Consortium.

"We expect financial close in Q4 2025, construction to begin shortly thereafter, and commercial operations to commence in early 2027. This project supports our long-standing commitment to South Africa's energy transition and will deliver significant carbon reduction and grid stability benefits."

Beyond environmental impact, Marula Green Power is designed to leave a lasting legacy in the Ba-Phalaborwa region.

"Matching this project to applicable socio-economic needs was key," said Tumi Mogoera, Chief Marketing Officer at Mzansi Energy Consortium. "Our localised development model ensures inclusive benefits during all project phases—feasibility, construction, and operation. We're committed to equity ownership for five tribal communities, creating up to 750 short-term jobs and over 30 permanent roles, with strong support for local SMMEs."

COMMUNITY ENGAGEMENT VITAL

Since 2023, community engagement has been a core focus, ensuring alignment with PMC's social investment priorities and the development needs of Ba-Phalaborwa.

The Marula Green Power project highlights how renewable energy can support South Africa's industrial backbone while benefiting local communities and preserving natural ecosystems.

As PMC advances its sustainable mining journey, the Mzansi Energy Consortium remains committed to delivering innovative, scalable, and clean energy infrastructure that benefits both people and the planet. wn

Celebrating Women in Engineering at ABB

In celebration of International Women in Engineering Day 2025 (INWED) on 23 June, ABB is proud to highlight the stories of two inspiring women shaping the future of engineering through innovation, resilience, and a commitment to inclusivity. Held annually, INWED is a global awareness campaign that celebrates the work and achievements of women engineers, promotes greater opportunities, and addresses the skills shortage in the field. This year's theme, #TogetherWeEngineer, is a powerful call to action for collaboration, diversity, and unity in the engineering field.

Meet Divine Mutebu and Beauty Bele, two dynamic engineers at ABB Electrification, whose journeys into the world of STEM are as impactful as the roles they now hold.

DIVINE MUTEBU: ENGINEERING WITH PURPOSE

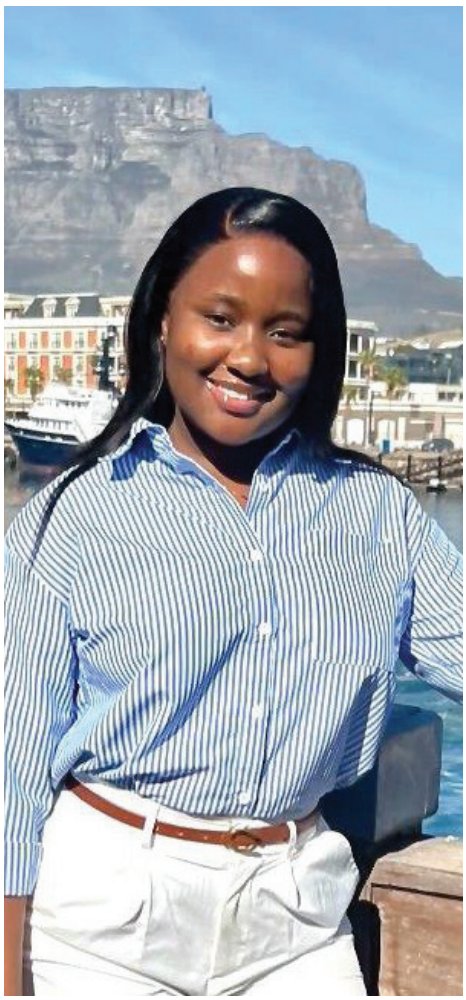
With an honour's degree in engineering, Divine found herself at the intersection of two passions, namely technical problem-solving and strategic communication. Today, she applies both as part of ABB Electrification's marketing and technical development team, helping to bridge the gap between complex engineering solutions and client needs. "I have always loved understanding how things work," says Divine. "Engineering gives me the tools to create smarter, more sustainable solutions that can improve everyday life."

But her path was not without challenges. Early in her career, Divine had to juggle full-time work with her academic commitments. "It required a lot of discipline, but I was fortunate to have a strong support system in my family and my manager, Ettienne Delport, who guided me through it all," she shares.

That experience reinforced her belief in the value of teamwork and mentorship, principles she sees reflected in this year's INWED theme. #TogetherWeEngineer speaks to the strength of community, she says. "The best solutions are born from shared ideas and inclusive teams."

Divine's career highlights include her technical contributions to complex wiring systems and her involvement in ABB's Encompass network, which promotes employee resource groups (ERGs), including Women, Pride, Black Professionals, and Young Professionals. "These spaces are vital for fostering inclusion and creating a sense of belonging," she adds.

Looking ahead, Divine sees herself stepping into leadership roles, mentoring young engineers and advancing innovative product strategies. For girls considering STEM careers, her message is clear: "Believe in your potential. Stay curious and persistent. Your voice matters, and you belong in this space."



BEAUTY BELE: DRIVING CHANGE THROUGH POWER SYSTEMS

For Beauty, engineering was a calling from a young age. After earning her honours degree in electrical engineering from the University of Johannesburg, where she majored in power electronics and systems, she knew ABB Electrification was the perfect fit. "I have always been drawn to power distribution systems," she explains. "That is what led me to this role."

The journey has not been without its hurdles. "At first, the rapid pace of new technologies and tools was overwhelming," she admits. "But staying curious, being proactive, and learning from my mistakes helped me adapt. Taking ownership changed everything." Her tenacity has paid off. One of her proudest moments came when she contributed to a significant project as a junior electrical engineer, working across teams to develop innovative solutions.

Professionally, Beauty is driven by her passion for emerging technologies, from AI to the Internet of Things, and their potential to revolutionise engineering systems. "Integrating these trends into our work will be a game changer for accuracy and connectivity," she notes.

Beauty also emphasises the need to dismantle persistent biases in the industry. "Imposter syndrome and stereotypes are real challenges," she says. "But I have seen meaningful change. More women are entering the field, support networks are growing, and role models are stepping forward."

Mentor Rutendo Mapapiro has been instrumental in her growth. "She always encourages me to aim higher and believe in my capabilities," she says. Beauty hopes to become that source of encouragement for others, particularly in five years when she envisions herself as a technical lead or project manager actively involved in DEI initiatives. Her advice to young girls? "Be creative, be curious, and believe in yourself. Engineering is about solving problems and making an impact. You have the power to shape the future." wn

BIBC Supports Strengthening of EPWP

Danie Hattingh
Spokesperson, BIBC

The Building Industry Bargaining Council (BIBC) has reaffirmed its support for the Expanded Public Works Programme (EPWP) and its goal of promoting temporary job opportunities and skills development. However, based on ongoing engagement with contractors and workers in the building industry, the BIBC believes there are opportunities to strengthen the programme's impact through more straightforward guidelines, improved awareness, and a more consistent approach to compliance.

"We fully support the intent of the EPWP and recognise the positive role it plays in addressing unemployment," says Danie Hattingh, spokesperson for business at the BIBC. "Our experience in the sector shows that with a few practical enhancements—particularly around wage classification and exemption processes—the programme can work even more effectively for everyone involved."

While the EPWP plays a crucial role in expanding access to economic opportunities, the BIBC has observed that misunderstandings or inconsistent applications of the programme's criteria can sometimes have unintended consequences. There have been instances where skilled workers are classified under the EPWP wage structure rather than receiving industry-standard compensation.

"The inclusion of a 'Local Content' clause in public sector procurement and proposed set-asides under the new Public Procurement Act of 2024 are intended to prioritise community participation," explains Hattingh. "However, when skilled roles are remunerated at EPWP rates—currently R15.83 per hour, well below the National Minimum Wage of R28.79—it can create challenges for workers and risk non-compliance for contractors."

In some cases, workers performing skilled tasks on construction or building projects may not receive any employment benefits, such as contributions to pension or holiday funds, due to this misclassification.

As a result, the intended benefits of upskilling and development can be diluted, and communities may become reliant on successive EPWP projects instead of progressing into longer-term, secure employment.

The BIBC notes that uncertainty around which projects formally qualify as EPWP initiatives further complicates efforts to ensure fair pay and proper worker protections. "Clearer criteria and improved communication can go a long way in ensuring the programme delivers on its promise of secure, decent work," says Hattingh.

One of the mechanisms available to contractors working on legitimate EPWP projects is the exemption process, which allows for temporary variations from collective agreement provisions as outlined in the Labour Relations Act 66 of 1996. This process ensures EPWP conditions do not unintentionally conflict with broader industry standards.

"Unfortunately, many contractors are either unaware of this exemption process or unsure how to navigate it," Hattingh says. "Without a formal exemption, they may inadvertently breach compliance requirements – something we're eager to help prevent."

To address this, the BIBC regularly engages with government departments, municipalities, and industry stakeholders to promote awareness and encourage proper use of the exemption framework.

These collaborative efforts aim to support fair labour practices while safeguarding the industry's integrity.

"By working together to strengthen the implementation of the EPWP, we can ensure that it remains a powerful tool for poverty alleviation and the creation of temporary job opportunities – without compromising on fairness or legal compliance," Hattingh concludes. "Structured guidelines, transparent processes, and open dialogue are essential to this shared success." wn

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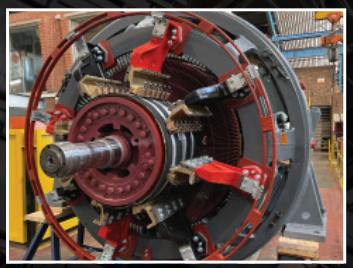

Marthinusen & Coutts
A division of ACTOM (Pty) Ltd

+27 (0) 11 607 1700 | support@mandc.co.za
53 Hospital Street, Cleveland 2094, JHB
www.mandc.co.za

Maintenance And Health Of Battery Storage Systems

We all know lead-acid batteries – they're in our cars and start our generators. Solid workhorses are cheap and reliable, yet they do require a lot of maintenance.

One of the newest commercial battery types is the lithium-ion battery. Lithium-ion batteries account for the largest share (59%) of operational installed capacity according to the International Renewable Energy Agency (IRENA) 2017 report, Electricity Storage and Renewables: Costs and Markets to 2030. They are lightweight, have a high energy density and can be fully depleted without issue. This is particularly important with variable solar energy, which may not always be able to charge the battery.

HOW TO MAINTAIN BATTERIES

Batteries are sensitive. They work best between 15 °C and 35°C and require a charge controller to receive a specific amount of current. At low temperatures, the electrochemistry is slowed, and at high temperatures, internal corrosion is increased.

You probably have experienced a car not starting in cold temperatures – that's because the battery cannot deliver as much current. In cold climates, use a battery heater or thermal insulation, and in hot climates, store them in shaded, well-ventilated spaces.

Another issue is terminal corrosion. This occurs when hydrogen gas is released from the acid in the battery, reacting with other substances, or when the electrolyte leaks from overfilling with water or overcharging. To remove corrosion, use an antioxidant material as recommended by the manufacturer.

For lead-acid batteries, maintaining a high state of charge (SOC) is crucial. Lead-acid batteries have a low depth of discharge, meaning a small amount of their total capacity should be used. A too-low State of Charge (SOC) can lead to sulfation, a buildup of small sulfate crystals on the terminals, which reduces performance. To handle sulfation on the terminals, technicians need to maintain a high State of Charge (SOC) level. If the SOC becomes too low, a desulfating battery charger can be used to dissolve the sulfates with high-frequency electronic pulses. Also, an alarm can be used with a visual and audible indication to alert a low battery state of charge (50% for lead acid).

HOW TO DIAGNOSE BATTERY HEALTH

Techs need to know the internal health of the battery to maintain them. Using the Fluke 500 Series Battery Analyser, connect the leads to the negative and positive terminals and turn the switch to milliohms (mΩ). The display will simultaneously read battery voltage and internal resistance. Low voltage indicates a low state of charge, and high internal resistance means internal deterioration. It is essential to test the battery in an open-circuit state (after 24 hours for lead-acid batteries). The Analyser corrects for temperature to ensure accuracy, saves up to 10 thresholds, and sends the readings to the Fluke Battery Management Software for viewing trends.

Capacity loss refers to the battery storing less charge. Techs can determine the capacity loss using the Analyser in discharge mode, where the battery voltage is read multiple times until it

The Fluke 500 Series Battery Analyzer is the ideal test tool for maintenance, troubleshooting and performance testing of individual stationary batteries and battery banks used in critical battery back-up applications.

drops below the cut-off voltage, which can cause damage.

A hydrometer, which measures the relative density of liquids, can also be used to measure electrolyte-specific gravity, an indicator of a battery's state of charge.

EVOLUTION OF ENERGY STORAGE TECHNOLOGY

Although more expensive than lead-acid batteries, lithium-ion batteries represent a significant improvement in terms of maintenance. While you need to regularly check their SOC and keep them as close to 25 degrees C as possible, they have higher energy density, making them lighter. They also have a higher depth of discharge, meaning much of their charge can be depleted before recharging, which is excellent for variable solar and wind power.

Thermal runaway, in which overcharging, a short circuit, or high temperature creates a feedback loop that rapidly accelerates temperatures until explosion, is an issue. Using a cathode with a higher temperature tolerance, such as iron phosphate (FePO4), mitigates thermal runaway.

New battery technologies, such as salt water and liquid metal batteries, which promise both low maintenance and cost, are emerging on the market.

IMPORTANCE OF BATTERY MAINTENANCE

The answer to whether batteries are worth it for your facility depends on your priorities and costs. Lead-acid batteries have low upfront costs but high ongoing maintenance costs, including weekly cleaning, testing, and top-up tasks. On the other hand, lithium-ion batteries have high upfront costs but low ongoing maintenance costs.

Regardless, as the costs of lithium-ion and other non-lead-acid batteries decline and the adoption of solar and wind energy increases, batteries will become an increasingly essential part of a facility. wn

For more info, contact COMTEST on sales@comtest.co.za or visit www.comtest.co.za

Why Engineering Students should join the SAIEE

Engineering students in South Africa are highly encouraged to consider joining the South African Institute of Electrical Engineering (SAIEE). This prestigious organisation offers numerous benefits that significantly enhance their academic and professional development.

ABOUT THE SAIEE

Formed in 1909, the SAIEE has ±6000 members professionally engaged in various engineering activities, including academic research, manufacturing, electronics, telecommunications, measurement and control, mining, and power infrastructure services. Members make meaningful contributions to the quality of life in communities and the steady advancement of technology. Their efforts are acknowledged in many countries worldwide.

One key advantage of joining the SAIEE is access to a network of experienced professionals in the engineering field.

As members, engineering students have the opportunity to connect with industry experts who can provide valuable mentoring and career guidance. These connections can help students gain insights into the latest trends and developments in the industry, as well as potential job opportunities and internships.

Furthermore, SAIEE membership provides exclusive events, workshops, and seminars tailored to help engineering students enhance their skills and knowledge.

These events offer valuable opportunities for students to learn from experts in the field, collaborate with peers, and stay updated on the latest advancements in engineering.

The SAIEE Student membership is free from 1 December 2024, and with that, the SAIEE Student member (StM) receives the following benefits:

- **Jobs portal for WIL**
  SAIEE Student Members receive preferential placing for their Work Integrated Learnership (WIL) with our SAIEE Corporate Partners
- **Mentorship**
  The SAIEE has a cohort of mentors who are willing and eager to assist our student members with their studies and career guidance
- **Exclusive Networking Events**
  StMs attend all SAIEE events for free and are exposed to industry decision-makers
- **CPD training discounts**
  To maintain your continuous development, the StM receives significant CPD training discounts
- **Charge Reward Programme earnings**
  As a StM, when attending SAIEE events, you earn Charge Reward Points, which can be claimed against paying for training courses, etc.
- **Bursary programme**
  StMs receive preferential treatment when they apply for a SAIEE Bursary
- **Publication access**
  Student members have access to all SAIEE publications since its inception in 1909, which include the monthly online wattnow magazine and the peer-reviewed Africa Research Journal
- **Site visits**
  SAIEE Student members are invited to site visits free of charge, which is CPD accredited, where you can learn hands-on how manufacturing facilities operate
- **SAIEE Centres**
  SAIEE has nine centres nationwide, and we encourage students to get involved at their local SAIEE Centre and represent your student chapter on the Centre EXCO committee.

The South African Institute of Electrical Engineering is a valuable investment for students from all engineering disciplines and tertiary establishments who are serious about advancing their careers in engineering. To learn more about joining the SAIEE, click here. wn

Serving Since 1909

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

Why Join Us

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

Student Bursaries

Our bursaries are for candidates who have completed a first-year study for a degree or diploma in Electrical, Electronic or Computer Engineering at an accredited South African tertiary institution.

Skills Development

One of our core objectives is to harness and foster the growth of students to study Science, Technology, Engineering, and Mathematics (STEM) subjects.

Student Activities

Becoming involved in a Student Chapter and participating in meetings can teach a student member valuable business skills. SAIEE offers mentorship, coaching and vacation work.

SAIEE

Our Purpose

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

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Why Electrical Engineering is Important in South Africa

Electrical Engineering is a distinct profession with roots in the 19th century, during the Industrial Revolution. The study of electricity and its applications began to gather momentum, with scientists such as Alessandro Volta, Michael Faraday, and James Clerk Maxwell contributing to the understanding of electrical phenomena. The first practical applications of electricity emerged, including the development of telegraph systems and electric motors.

By: Minx Avrabos

Fast forward two hundred years, and we have realised that without electricity and electrical engineers, we would be unable to switch on the lights, boil a kettle, or even use our mobile phones to enjoy our daily dose of YouTube videos.

Becoming an electrical engineer starts at the grassroots level – in school. To pursue electrical engineering, secondary school students usually need to take a combination of subjects that provide a robust foundation in mathematics, science, and problem-solving. Here are the key subjects required for studying engineering:

Core Subjects

- **Mathematics:** Algebra, geometry, trigonometry, and calculus are essential for electrical engineering.
- **Physics:** Understanding physics principles, including mechanics, electromagnetism, and thermodynamics, is crucial.
- **Chemistry:** Knowledge of chemistry, particularly in areas like electrochemistry and materials science, is essential.

Computer Science, Engineering, Graphics, and Electronics are suggested subjects. Furthermore, it is advisable to develop problem-solving skills and take part in science fairs and competitions. This will assist you in building research and innovation skills.

Now that you know what to look out for at school, the question remains: "What type of electrical engineer can I become?" The answer is straightforward – you can be anything you want! Engineering is diverse, and various engineering disciplines have become integrated in recent years. One cannot exist without the other, leading to numerous career opportunities across different industries. Here are some of the many career paths available to engineers:

TRADITIONAL ENGINEERING DISCIPLINES

- **Aerospace Engineer:** Designs and develops aircraft, spacecraft, and missiles.
- **Biomedical Engineer:** Develops medical devices, equipment, and procedures.
- **Chemical Engineer:** Designs and operates plants that produce chemicals and other products.
- **Civil Engineer:** Plans, designs, and constructs infrastructure projects, such as roads, bridges, and buildings.
- **Electrical Engineer:** Designs and develops electrical systems, including circuits, electronics, and electromagnetism.
- **Mechanical Engineer:** Designs and develops mechanical systems, including engines, machines, and devices.

Artificial intelligence is the new buzzword, bringing emerging technologies and creating careers that were unheard of 50 years ago.

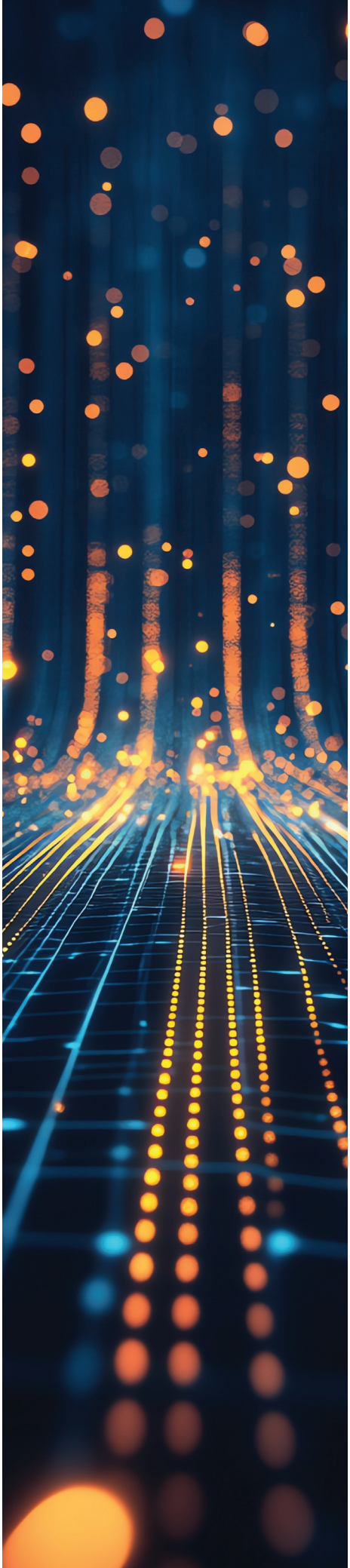
Careers in Emerging and Interdisciplinary Fields include:

- **Artificial Intelligence/Machine Learning Engineer:** Develop intelligent systems to learn and adapt.

- **Cybersecurity Engineer:** Protect computer systems and networks from cyber threats.
- **Data Scientist:** Extract insights and knowledge from data using statistical and computational methods.
- **Environmental Engineer:** Develop solutions to ecological problems like air and water pollution.
- **Geographic Information Systems (GIS) Engineer:** Designs and develops spatial data systems.
- **Internet of Things (IoT) Engineer:** Develop connected systems integrating physical and digital components.
- **Nanotechnology Engineer:** Designs and develops materials and systems at the nanoscale.
- **Renewable Energy Engineer:** Develops sustainable energy systems, including solar, wind and hydroelectric power.
- **Robotics Engineer:** Designs and develops intelligent robots that can perform complex tasks.

Now that we see what type of engineering careers there are, you might ask – How do I get there? First, decide what interests you, and then take it from there. Curiosity, enthusiasm, and willingness to learn and experiment are the keys to getting started.

To prepare yourself for tertiary studies in engineering, it is suggested that you work on a few DIY projects. Getting a starter kit like the Arduino starter kit where you build interactive projects using Arduino boards, sensors, and actuators. The Raspberry Pi Projects assists you in creating innovative projects such as home automation, robotics, or media centers. A Robotics Kit helps you to build and program robots using Lego Mindstorms, Dash, or Sphero kits. For electrical engineering enthusiasts, a Solar-Powered System aids you in designing and building solar-powered systems like chargers or lighting systems.



To further enhance your exposure to the future of engineering, join or form a STEM club, like a Robotics Club, where you build and compete with robots. A coding club is where you will learn programming languages and work on projects. Participate in engineering clubs to work on projects, attend workshops, and network with peers.

You can prepare yourself for online learning classes. Wherever your interests lie, there will be a foundation course to get you started. Many of the foundation courses are free, so give it a try.

At Coursera, you can take a foundation class such as "Introduction to Robotics" or "Electrical Engineering." At edX, you can enrol in online courses like "Circuits and Electronics" or "Robotics." Udemy offers online courses such as "Arduino Programming" or "Robotics with Python."

The engineering industry recognises a significant difference between a "textbook engineer" and a "practical engineer." Practical experience is crucial

 continues from page 21

in electrical engineering for several reasons:

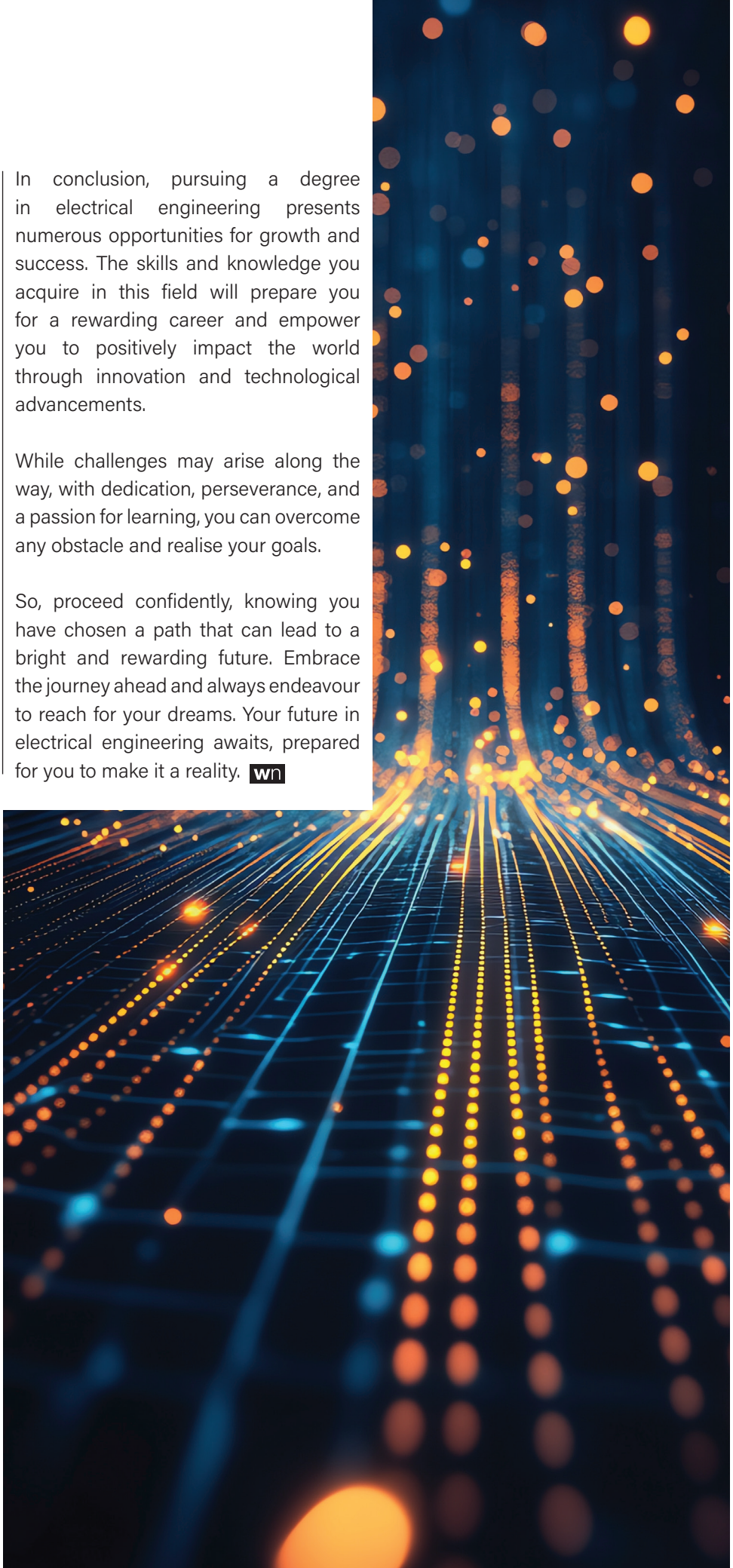
1. **Application of Theory:** It effectively helps engineers apply theoretical concepts to real-world problems.
2. **Troubleshooting Skills:** Hands-on experience is vital for quickly identifying and resolving issues in complex electrical systems.
3. **Familiarity with Standards:** Practical work exposes engineers to industry standards and best practices for safe, effective system design and maintenance.
4. **Critical Thinking:** Real-world projects enhance problem-solving and critical thinking skills.
5. **Collaboration:** Teamwork in practical settings fosters essential communication and interpersonal skills.
6. **Emerging Technologies:** Practical experience informs engineers about the latest technologies, such as renewable energy and IoT devices.
7. **Networking:** It provides opportunities to build professional relationships to advance your career.
8. **Soft Skills Development:** Practical work nurtures crucial soft skills like time management and adaptability.
9. **Certification Preparation:** Many regions require practical experience for professional certification, which is essential for career progression.
10. **Career Prospects:** Employers value practical experience, enhancing job opportunities and leadership potential.

Integrating theoretical knowledge with practical experience equips electrical engineers with the skills and confidence needed to thrive in this dynamic field.

In conclusion, pursuing a degree in electrical engineering presents numerous opportunities for growth and success. The skills and knowledge you acquire in this field will prepare you for a rewarding career and empower you to positively impact the world through innovation and technological advancements.

While challenges may arise along the way, with dedication, perseverance, and a passion for learning, you can overcome any obstacle and realise your goals.

So, proceed confidently, knowing you have chosen a path that can lead to a bright and rewarding future. Embrace the journey ahead and always endeavour to reach for your dreams. Your future in electrical engineering awaits, prepared for you to make it a reality. wn



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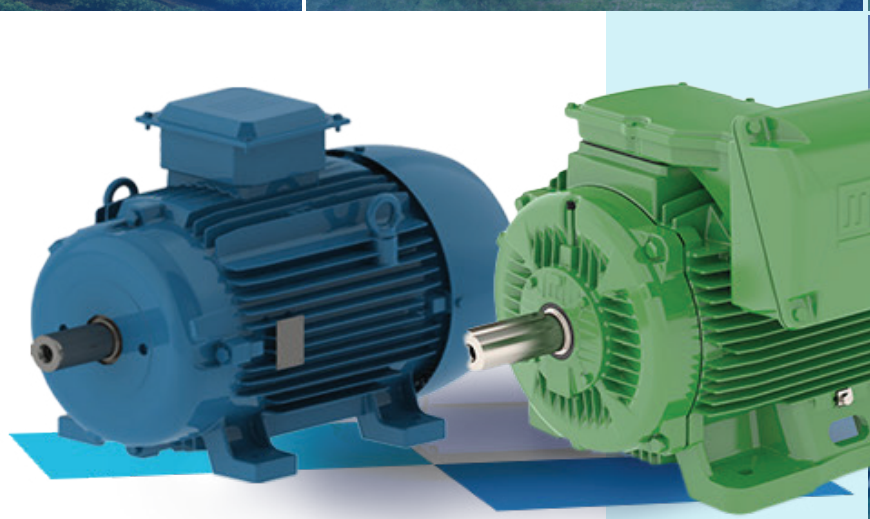

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Driving efficiency and sustainability

UKZN & Youtility Sign Groundbreaking Joint Venture to Transform SA's Energy Landscape

In a bold leap toward redefining South Africa's energy future, the University of KwaZulu-Natal (UKZN) has signed a pioneering Joint Venture Agreement (JVA) with Hong Kong-based tech company Youtility. This game-changing partnership will introduce cutting-edge, AI-driven technology set to transform how electricity is managed and distributed, with payments handled through an intelligent, next-generation blockchain billing platform.

This JVA marks a key milestone in UKZN's vision to become South Africa's first predominantly renewable green university while also marking a significant step forward in developing a blueprint for future national energy distribution. Eskom Distribution, recognising the potential of this innovation, will participate in an observational and advisory capacity, positioning UKZN as a national test bed for this next-generation energy technology.

Speaking at the Launch event and Signing Ceremony held at UKZN's Westville campus, Acting Deputy Vice-Chancellor for Research and Innovation at UKZN, Professor Anil Chuturgoon, welcomed the initiative, calling it a "defining moment" in addressing South Africa's longstanding energy challenges "This concept of green energy is going to transform the energy landscape in South Africa," he said.

Acting Director of the UKZN Eskom Power Engineering Program, Professor Leigh Jarvis, echoed this sentiment, saying that the partnership embodies visionary leadership, innovative thinking and a shared commitment to meaningful transformation, "At its core is the recognition that the future of electricity lies in disruption networks and decentralised energy systems, Microgrids underpinned by solar energy, storage and advanced operating systems. These are emerging as key pillars in building a resilient, flexible, and inclusive energy landscape."

Youtility Director Wayne Mostert spoke of the genius of Youtility's technology in its next-generation Cloud-based, sentient operating system, Wizdom, which is touted to be more than just a software suite – "Wizdom is an evolving, AI-driven utility brain with enhanced capabilities which include real-time, decentralised decision-making and smart discharge of power into micro and macro grids," he explained.

Drawing parallels with past tech revolutions, Mostert likened Youtility's ambitions to the digital disruption of entertainment media, "Where Blockbuster failed to adapt, Netflix scaled using data, agility, and customer-centricity. Similarly, Youtility is poised to revolutionise the utility sector through sentient, decentralised, and user-empowered infrastructure, creating a new global standard," he said.

Professor Jarvis further highlighted the far-reaching benefits of the pioneering initiative, "The resolution of the data and real-time nature will open up insight into electricity use and enable unparalleled control to power flow in relation to solar, storage and grid," he said.

The project will roll out in phases across UKZN's five campuses (Westville, Howard, Edgewood, Medical School, and Pietermaritzburg campuses), beginning at the Westville campus.

Students will also play a crucial role in establishing this transformation, from

(Back Row) From Left: Professor Leigh Jarvis (Acting Director of the UKZN Eskom Power Engineering Program), Professor Neil Koorbanally (Acting Dean of Research at UKZN), Dr Nhlanhla Msomi (Director of Innovation at UKZN). (Front Row) From Left: Wayne Mostert (Director: Youtility) & Professor Anil Chuturgoon (Acting Deputy Vice-Chancellor for Research and Innovation at UKZN) signing the Joint Venture Agreement between UKZN and Youtility. Photographer: Sethu Dlamini

assisting with hardware maintenance to contributing to research and optimisation projects.

"Through this JVA, we envision student-led spin-off companies and a direct link between academic learning and the industries shaping our energy future," said Jarvis. wn

IEEE PES & IAS PowerAfrica Conference

IEEE Smart Village Student Paper Competition 2025

As an aspiring electrical engineer, what does sustainable energy mean to you, and why is it crucial for Africa's future?

The 12th IEEE PES & IAS PowerAfrica Conference (PAC 2025) invites you to submit a full paper on sustainable energy in Africa. IEEE Smart Village seeks to explore how your ideas can impact underserved communities and improve access to education and income-generating activities through affordable, sustainable energy.

Click here to learn more.

SABS

IEC YP Programme

IEC Young Professionals Competition

Stand a chance to win an exciting trip to New Delhi, India, and also an opportunity to win a bursary worth R50,000 to pursue a postgraduate degree related to development, application standards, and conformity assessment.

Two Young Professionals have the opportunity to attend the IEC Young Professionals Workshop to be held in conjunction with the IEC General Meeting in New Delhi, India : 15 - 19 September 2025.

INVITATION

South African young professionals, Engineers, Technologists from the Electrotechnical discipline are invited to participate in the 2025 IEC Young Professionals Workshop by writing an essay on the following topic.

TOPIC

"The integration of robots in sectors like manufacturing, healthcare, and service industries in South Africa has the potential to drive significant economic growth and improve the quality of life. However, to ensure that robots are safe, reliable, and effective, clear standards and conformity assessments are crucial. These measures help maintain the quality and reliability of robotic technology, ensuring it meets safety requirements and operates as intended.

What should be the Role of Standards in Scaling-up the Robotics Industry in South Africa: Ensuring Safety, Interoperability, and Performance?"

GUIDELINES

1. Essays must be typed using (Arial,11 point) and should consist of +/- 3500 words (5 - 6 pages excluding the cover sheet provided).
2. Essays must be original and unpublished; plagiarized entries will be rejected.
3. Essays must be written by the entrant; co-authored essays will not be accepted.
4. Copyright of the essay entered will be assigned to the South African Bureau of Standards.

SABS

IEC YP Programme

ARE YOU

- A young and dynamic manager, engineer or technician aged between 20 – 35?
- Are you interested in working with or developing standards or conformity assessment schemes?
- Working for a company, business, industry or studying at an institution that uses or benefits from IEC International Standards or conformity assessment systems?
- Wanting to become more involved in IEC-related activities?

WHY ATTEND

- Participate in the only annual workshop dedicated to the next generation of experts and leaders on IEC stan dardization and conformity assessment activities
- Experience the IEC General Meeting: a key annual event that brings together the IEC technical and management community
- See how international standards are managed and developed by having the opportunity to attend management and technical meetings
- Benefit from increased opportunities to get involved in IEC work after the workshop

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- Exceptional networking opportunities with more than 2 500 international key players
- Build knowledge and expand professional networks
- Participate in sessions and events where you can interact with peers
- Have your voice heard: your ideas are communicated to IEC Management
- Gain prominence and influence in the industry

BENEFITS FOR YOUR COMPANY

- Be ahead of the technological developments in your field
- Help to ensure technology transfer
- Foster a culture of innovation
- Access to world-class experts
- Cultivate long-term involvement in the international arena
- Gain a global perspective on industry challenges and opportunities

ENTRY REQUIREMENTS

1. This competition is only open to South Africans citizens aged between 20 – 35
2. All essay entries must be submitted to iec@sabs.co.za no later than 10th June 2025

FOR MORE INFORMATION

Please contact Mr Johnson Marema at: johnson.marema@sabs.co.za

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Join us for our quarterly forum meetings and be part of the conversation that addresses critical issues in South Africa. As a valued SAIEE Corporate Partner, your input and perspective will help drive meaningful solutions. Don't miss this opportunity to collaborate and make a difference.

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FEATURE

Smarter Grids, Cleaner Power

- HOW VIRTUAL POWER PLANTS AND AI FORECASTING ARE RESHAPING SOUTH AFRICA'S ENERGY SYSTEM

Years of load-shedding, ageing infrastructure, and climate imperatives are forcing a rethink of how power is generated, distributed, and consumed. The urgency to integrate renewable energy has never been greater—but just as wind and solar projects accelerate, they encounter a serious roadblock: a grid that was never designed for this new energy era.

By: Omaira Jajbhay, Renewable Energy Engineer

Amid these constraints, digital innovations like Virtual Power Plants (VPPs) and AI-based forecasting are emerging as game-changers—offering agility, coordination, and intelligence where traditional systems fall short.

South Africa's energy challenge is often framed as a trilemma: achieving energy security, affordability, and sustainability simultaneously. Currently, over 80% of electricity still comes from coal, exacting a high environmental price and leaving the system vulnerable to breakdowns. The Integrated Resource Plan (IRP) 2019 outlines a cleaner energy vision, but progress has been sluggish.

What makes South Africa's energy transition particularly unique—and complex—is that it must also be just. This means addressing not only the environmental imperative to move away from coal but also the profound social and economic inequalities rooted in the country's energy system. Regions like Mpumalanga, where livelihoods are closely tied to coal mining and power generation, face significant disruption as plants are decommissioned.

A just transition must go beyond simply replacing megawatts; it must prioritise reskilling workers, creating sustainable local jobs, and investing in new industries that support long-term community development. Equally important is the need to expand access to energy. Millions of South Africans still lack reliable electricity, and the transition must ensure that cleaner, decentralised energy solutions reach underserved and rural areas. A truly just energy transition, therefore, is one that delivers both climate resilience and social equity—powering not only the grid but also the people.

Thanks to initiatives like the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) and rising private sector investment, solar and wind capacity are growing steadily. Yet, much of this clean energy is being developed in places like the Northern Cape, where the grid is already congested.

In 2023, Eskom imposed a moratorium on new grid connections in several high-resource regions, including parts of the Northern Cape, Eastern Cape, and Western Cape, due to severe capacity constraints on the transmission network. This grid bottleneck has emerged as one of the most significant threats to South Africa's renewable energy ambitions. While these regions boast some of the country's best solar and wind resources, the inability to transmit electricity from generation sites to demand centres undermines the effectiveness of new project development.

However, there is a pathway forward. Eskom, through its newly established National Transmission Company of South Africa (NTCSA), has begun outlining plans to expand and modernise the transmission grid. These plans

include building thousands of kilometres of new high-voltage lines and upgrading substations to unlock constrained areas. The NTCSA's role is pivotal in enabling a more flexible and reliable grid that can accommodate decentralised, variable energy sources and improve regional energy balance.

Accelerating grid expansion through the NTCSA is essential to unlock constrained renewable zones and support future demand growth. However, even with these upgrades, physical infrastructure alone will not solve the complex challenges of a modern, decentralised energy landscape. The grid of the future must be not only larger—but also smarter and more dynamic.

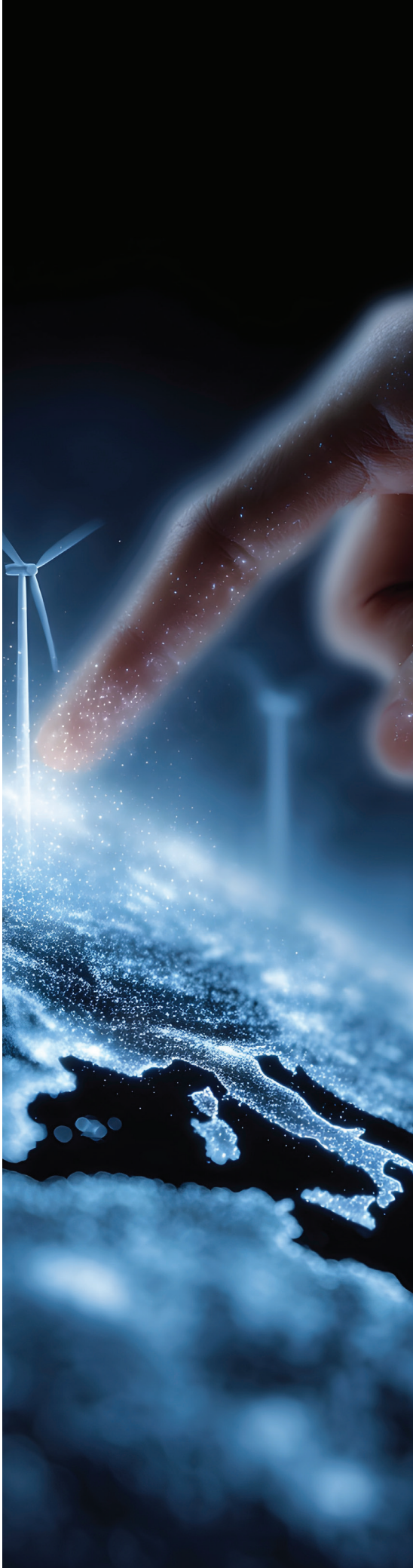
This is where Virtual Power Plants (VPPs) play a transformative, long-term role. Far from being a temporary workaround, VPPs offer a digital solution to the grid's physical limitations. A VPP aggregates distributed energy resources (DERs)—such as rooftop solar PV, wind farms, battery energy storage systems (BESS), electric vehicles, and flexible industrial loads—into a single, dispatchable energy entity.

The Umoyilanga project is a first-of-its-kind VPP initiative in South Africa. By linking wind, solar, and battery storage assets across provinces, it provides dispatchable, firm power to the grid, illustrating how coordinated, decentralised systems can substitute or supplement centralised generation.

Key advantages of VPPs include improved grid stability and enhanced demand response capabilities, which enable the system to better manage fluctuations in supply and demand. They also offer increased flexibility for system operators by enabling real-time coordination of distributed resources. Furthermore, VPPs facilitate greater market participation by prosumers and commercial and industrial entities, unlocking new revenue streams and promoting decentralised energy trading. Importantly, they reduce the need for costly infrastructure upgrades by maximising the use of existing assets and deferring traditional grid expansion investments.

In effect, VPPs provide a platform to unlock latent energy capacity already embedded in the system. Variable renewable energy sources such as wind and solar are inherently intermittent. Forecasting their output accurately is vital to maintaining grid stability and making informed dispatch decisions.

Recent advancements in machine learning (ML)—specifically Long Short-Term Memory (LSTM) neural networks—offer significant improvements over traditional forecasting techniques. These models analyse vast datasets of historical generation, weather, and system behaviour to deliver accurate, short-term and medium-term forecasts. When integrated into a VPP, these predictive insights enable optimised asset scheduling by aligning generation



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with demand patterns more effectively. They help minimise curtailment and oversupply by providing accurate, real-time forecasts that support better operational decisions. Additionally, forecasting improves bidding accuracy in energy markets, allowing participants to make more competitive and reliable offers. It also facilitates better planning of ancillary services by anticipating system needs and coordinating distributed resources accordingly.

In the long run, smarter forecasting supports grid reliability while enabling higher penetration of variable renewable energy. For technologies like VPPs and AI-based forecasting to scale effectively, South Africa's regulatory frameworks must continue to evolve. The policy landscape is gradually shifting, marked by encouraging reforms such as the unbundling of Eskom, which supports greater third-party access and the implementation of wheeling agreements. Additionally, regulations now permit private generation and self-use installations of up to 100 MW without the need for a generation licence, reflecting a growing openness to decentralised solutions. There is also increasing interest in enabling peer-to-peer trading and broader participation in distributed energy markets.

However, several critical gaps remain. The long-awaited update of the Integrated Resource Plan (IRP) has been delayed, leading to uncertainty for project developers and investors. Moreover, existing grid codes have not kept pace with the requirements of a decentralised, two-way power system and must be modernised to accommodate bi-directional energy flows and distributed energy resources (DERs). Compounding these challenges is the absence of clear regulatory guidelines for the operation, aggregation, and market settlement of VPPs, which continues to slow innovation and limit the full potential of digital energy solutions.

To unlock private sector investment, policy must move beyond risk-averse, centralised models and embrace decentralisation and digitalisation.

The future is not just about building more infrastructure but building smarter infrastructure. South Africa must invest in digital grid technologies—such as smart meters, remote sensors, and real-time communication systems—that can support a dynamic, decentralised energy system. This also means investing in human capital. The energy transition will require a new generation of technicians, engineers, and data scientists fluent in both digital tools and clean energy systems.

Communities and businesses alike should be empowered to generate, store, and trade energy—turning passive consumers into active participants in the energy system.

South Africa's energy future won't be defined by technology alone—but by how we deploy it, regulate it, and ensure its benefits are shared. Virtual Power Plants and AI-powered forecasting are not silver bullets—but they are critical enablers of a cleaner, more reliable, and more inclusive energy system.

By embracing these tools, closing regulatory gaps, and accelerating investment in digital infrastructure, South Africa has the opportunity not just to transition—but to transform.

A SMARTER GRID ISN'T JUST POSSIBLE—IT'S ESSENTIAL.

South Africa's energy future depends not only on how much renewable energy is built—but on how intelligently it is integrated. Virtual Power Plants and advanced forecasting are not fringe concepts; they are critical enablers of a flexible, modern grid.

To fully realise their potential, stakeholders must address infrastructure constraints, streamline regulation, and foster innovation through partnerships. By doing so, South Africa can transform its energy system—not just transition from coal to renewables, but build a future that is resilient, inclusive, and digital by design. wn

- Watch the recording of this webinar here.

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FEATURE

Migration from SDH to meet Technological Advancements in Power Grids

Telecommunication is the bloodline of smart grids and the evolution of power grids. As power grids become more advanced and automated, it is essential to ensure that network technologies do not become a bottleneck for the energy transition. Telecommunications enable end-to-end communication solutions that are multi-tiered, ranging from backhauling or backbone networks to consumer or low-voltage (LV) tiers.

By: TN BIYELA
CIGRE D2 SAG, CIGRE D2 Taskforce Member

These multi-tiered networks support a wide range of applications and services, encompassing both Information Technology (IT) and Operational Technology (OT). Many documents from various organisations, such as CIGRE, IEC, IEEE, ITU, and IETF, already include detailed descriptions of the communication and performance requirements for individual applications.

Operational services supported by telecommunication in smart grids are extensive. These include tele-protection, outage management systems, network access management, SCADA services, energy management systems, energy metering, event recorders, service switchover between control centres, disturbance recorders, real-time phasor measurement units (PMUs), polling telemetry operational communications, and operational telephony. Additionally, maintenance and support, private mobile radio, general site alarms, supervision and video surveillance, time distribution, video services, physical site security using electronic access control mechanisms, smart metering communications, IEC 61850-based communications, dynamic line rating, and weather monitoring and lightning detection are all critical functions that require robust telecommunications.

On the corporate side, telecommunications facilitate a range of essential services. These include the corporate IP network, corporate fixed telephony, corporate mobile telephony, corporate voicemail, integrated security systems and corporate video conferencing. The integration of these operational and corporate services ensures that both the technical and administrative aspects of smart grid management are efficiently supported, enabling the seamless flow of information and reliable operation of modern power systems.

Over the past decade, the migration from Synchronous Digital Hierarchy (SDH) as a transport technology, especially for Operational Technology (OT), has been a central topic of discussion in the electricity sector. SDH has been widely adopted because it is TDM-based, providing high reliability and deterministic performance for mission-critical services such as teleprotection. However, some new applications and use cases demand a level of flexibility that SDH cannot provide. As a result, flexible packet-based mechanisms have been extensively evaluated for migration. Meanwhile, advanced optical transmission technologies, such as fine-grain OTN (fgOTN), have emerged, offering a new option for SDH migration. Advanced optical transmission technologies are TDM-based and built on the strengths of both traditional SDH and Optical Transport Networks (OTN), offering features such as timeslot-based physical isolation, high reliability,

deterministic low latency, and flexible transmission for small-granularity services.

As electric power utilities plan the migration from SDH networks, it is crucial to consider both packet-based technologies and advanced optical transmission solutions as suitable replacements. Packet-based technologies, such as IP/MPLS and MPLS-TP, have been documented, with some utilities still on a journey to replace their SDH networks with these technologies. In contrast, Advanced optical transmission technologies are a relatively recent development in the market, offering a promising evolution path based on SDH principles and with enhanced capabilities tailored for modern power networks.

Standards and recommendations from organisations such as IEC, CIGRE, and IEEE comprehensively address network technologies for grid operations. These standards and recommendations cover a wide range of communication requirements essential for reliable and efficient electricity network management. For each technology under consideration, several key factors are evaluated to determine suitability and performance. These include the technology's life cycle, its scalability to accommodate future growth, and its capability to support critical Electric Power Utility (EPU) services. Ease of

continues from page 37

implementation and operation is also a significant consideration, ensuring that utilities can deploy and maintain the technology effectively. Interoperability with other services and technologies is crucial for enabling seamless integration within the broader network. Redundancy, availability, and reliability are assessed to guarantee continuous operation and fault tolerance. Quality of Service (QoS) requirements are examined to ensure that communication performance meets the strict demands of grid applications. Finally, the presence of a robust Network Management System (NMS) and overall manageability are crucial for monitoring, controlling, and optimising network performance. Together, these criteria provide a structured framework for evaluating and selecting communication technologies that meet the complex demands of modern grid operations.

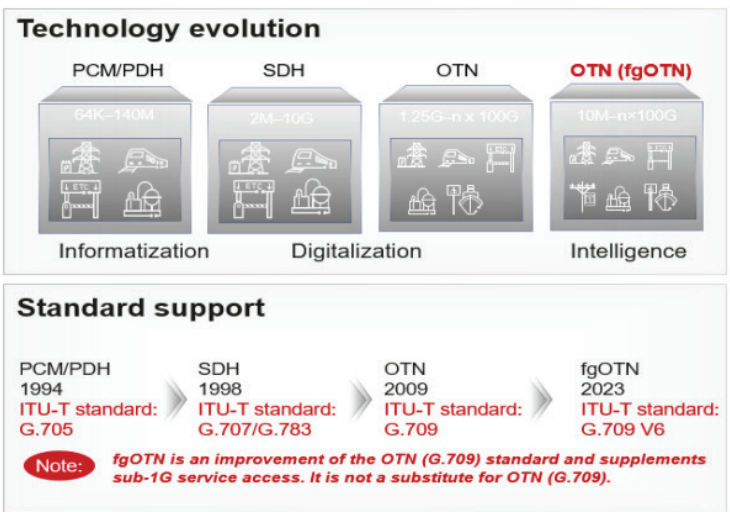
The following paragraphs will focus on two leading organisations: the International Telecommunication Union - Telecommunication Standardisation Sector (ITU-T) and the Internet Engineering Task Force (IETF). The ITU-T provides detailed standards for TDM-based technologies such as SDH, OTN, and the latest advanced optical transmission technologies, including fgOTN. Among these modular technologies, fgOTN is the most recent and is primarily used as a transport technology.

fgOTN is an extension of the existing OTN standards (G.709 series) to support the transport of services with smaller bandwidth requirements over OTN. Traditionally, the minimum service granularity supported by OTN is 1.25Gbps, which wastes bandwidth when carrying small-granularity services. However, fgOTN enables OTN infrastructure to efficiently carry sub-1 G services and high-rate services such as 10MB, 1G, 10G, and 25 G, which is increasingly important for power grid communication, modern data centre interconnections, and enterprise applications. This makes fgOTN an excellent transport technology for long distances and well-suited for carrying a variety of network services.

The Internet Engineering Task Force (IETF) plays a key role in developing and standardising Multiprotocol Label Switching (MPLS) technologies. IETF covers MPLS in two primary forms: traditional IP/MPLS and MPLS Transport Profile (MPLS-TP). IP/MPLS is widely used for routing and forwarding data packets efficiently across IP networks, supporting a broad range of services and scalability requirements. Packet switching-related technologies isolate different services by adding labels to the packet header and setting SLA.

When network utilisation increases, there is a possibility of mutual interference between services. MPLS-TP, on the other hand, is a specialised profile designed to provide the reliability and operational simplicity of traditional transport networks, such as SDH and OTN, while leveraging the flexibility of MPLS. MPLS-TP offers features such as Operations, Administration, and Maintenance (OAM) and performance, enabling it to support carrier-grade transport networks and critical infrastructure applications.

This article will briefly share some of the tables that indicate the performance of SDH, MPLS and advanced optical transmission technologies (OTN/ fgOTN).



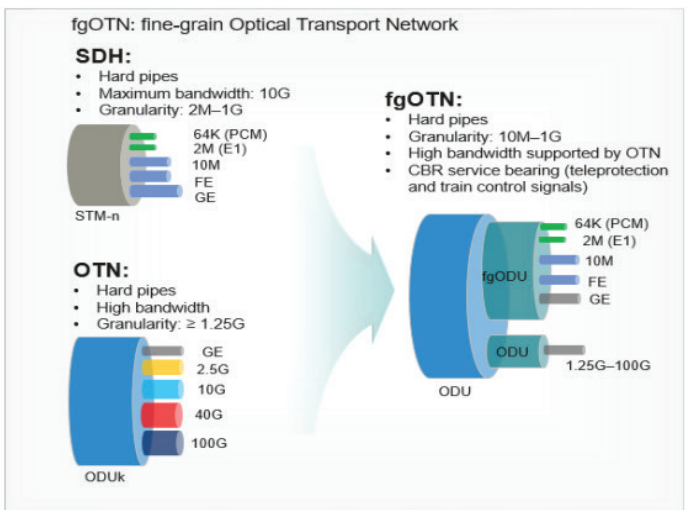


Figure 1: Evolution of Modular Technologies

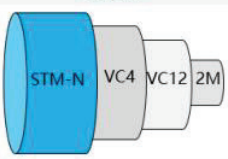
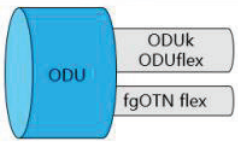
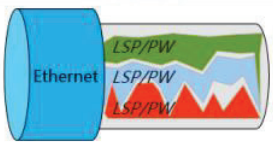
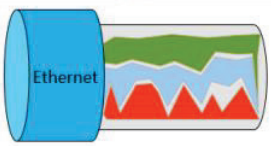
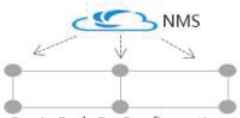
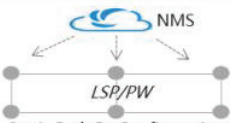
Features	(TDM-Based)	(TDM-Based)	(Packet-based)	(Packet-based)
Data	VC/STM 	ODU Flex 	Static Tunnel 	QoS 
Control Plane	Static	Static 	Static 	Dynamic
Users	Utilities	Utilities and telecom operators	Telecom operators	Telecom operators
Reliability	Hitless or <50ms protection switching time Protection time = N	Hitless or <50ms protection switching time Protection time = N	<50ms protection switching time Protection time = 1	<50ms protection switching time Protection time = 1
Latency	<10ms Deterministic latency	<10ms Deterministic latency	<10ms Unstable as utilization increases	<10ms Unstable as utilization increases
Evolution (bandwidth & distance)	Medium 10G & 80km	Easy 800G & 400km	Medium 100G & 80km	Easy 400G & 80km

Figure 2: Network Technologies Comparison

Electric Power Utilities have options to migrate from SDH to more widely supported technologies such as packet-based MPLS and TDM-based advanced optical transmission technologies. Different technologies have their own advantages, and Electric Power Utilities can select the most suitable technologies based on their specific application scenarios.

As a way forward, new CIGRE D2 working groups are examining these developments in detail, such as D2.65, "Optical Transport Communication Networks for Electric Power Utilities." In addition, IEC 61850, which initially focused on substations, has now expanded its scope beyond the substation to cover communication between substations and control centres, among other applications. This progress reflects the ongoing evolution and modernisation of electric power communication networks.

CIGRE D2, in collaboration with the South African Institute of Electrical Engineers (SAIEE), will host a joint webinar titled "Migration from SDH to Meet Technological Advancement in Power Grids" as part of the CIGRE Taskforce.

The webinar will feature presentations based on this article, including an introduction to telecommunications with a special focus on migrating from legacy systems.

Presenters will discuss packet transport and modular transport technology in the form of fgOTN. This will be followed by a panel discussion led by Thuthukani Biyela and Kgomotso Setlhapelo, where the panel will engage in conversations based on the presentations given by the guests.

Stay tuned for more information on CIGRE D2 and SAIEE digital platforms. wn

Global Energy Review 2025

This edition of the Global Energy Review is the first comprehensive depiction of the trends that took place in 2024 across the entire energy sector, covering data for all fuels and technologies, all regions and major countries, and energy-related carbon dioxide (CO_2) emissions.

This report is courtesy of:
International Energy Agency
www.iea.org

The latest data show that the world's appetite for energy rose at a faster-than-average pace in 2024, resulting in higher demand for all energy sources, including oil, natural gas, coal, renewables and nuclear power. This growth was led by the power sector, with demand for electricity rising almost twice as fast as wider energy demand due to higher demand for cooling, rising consumption by industry, the electrification of transport and the growth of data centres and artificial intelligence.

Nearly all of the rise in electricity demand was met by low-emissions sources, led by the record-breaking expansion of solar PV capacity, with further growth in other renewables and nuclear power. Gas demand also picked up substantially, while oil and coal consumption increased more slowly than in 2023.

CO_2 emissions from the energy sector continued to increase in 2024 but at a slower rate than in 2023. A key driver was record-high temperatures: if global weather patterns in 2023 had repeated in 2024, around half of the increase in global emissions would have been avoided. At the same time, the continued rapid adoption of clean energy technologies is limiting emissions growth, according to new analysis – avoiding 2.6 billion tonnes of additional CO_2 emissions per year.

KEY FINDINGS

- Global energy demand grew by 2.2% in 2024 – faster than the average rate over the past decade. Demand for all fuels and technologies expanded in 2024. The increase was led by the power sector as electricity demand surged by 4.3%, well above the 3.2% growth in global GDP, driven by record temperatures, electrification and digitalisation. Renewables accounted for the largest share of the growth in global energy supply (38%), followed by natural gas (28%), coal (15%), oil (11%) and nuclear (8%).
- Emerging and developing economies accounted for over 80% of global energy demand growth. In China, growth in energy demand slowed to under 3% in 2024, half the rate in 2023 and well below China's average annual growth of 4.3% in recent years. Nevertheless, China still saw the largest demand growth in absolute terms of any country in 2024. India saw the second-largest rise in energy demand in absolute terms – more than the increase in all advanced economies combined.
- Advanced economies also saw a notable return to growth in energy demand after several years of declines, with demand rising by almost 1%. The United States saw the third-largest absolute demand growth in 2024 after China and India. The European Union returned to growth for the first time since 2017 (aside from the post-Covid rebound in 2021).
- Global oil demand growth slowed markedly in 2024, in line with the IEA's forecast. Oil's share of total energy demand fell below 30% for the first time ever, 50 years after peaking at 46%. Demand for oil rose by 0.8% in 2024, compared with a

1.9% increase in 2023. However, trends varied between sectors and regions. Oil demand from global road transport fell slightly, driven by declines in China (-1.8%) and advanced economies (-0.3%). Oil demand from aviation and petrochemicals grew.

- Natural gas saw the strongest demand growth among fossil fuels. Demand increased by 2.7% in 2024, rising by 115 billion cubic metres (bcm), compared with an average of around 75 bcm annually over the past decade. China had the largest absolute growth in gas demand in 2024 of over 7% (30 bcm), with growth also strong in other emerging and developing economies in Asia. Gas demand expanded by around 2% (20 bcm) in the United States. Consumption grew modestly in the European Union, notably for industrial use.
- Global coal demand rose by 1%. Power generation was the main driver of growth as high temperatures pushed up electricity consumption for cooling. Intense heatwaves drove coal use higher in both China and India, which together represented the large majority of the global demand increase of around 65 million tonnes of coal equivalent (Mtce). China remained the largest coal consumer globally, accounting for a record 58% of global coal use.
- Global electricity consumption rose by nearly 1 100 terawatt-hours (TWh) in 2024, more than twice the annual average increase over the past decade. The increase – more than Japan's annual electricity consumption – was the largest ever, outside of years when the global economy rebounded from recession. China made up more than half of the global increase in electricity demand, but the rise was broad-based, with growth of 4% in other emerging and developing economies. Electricity demand reached a new high in advanced economies.
- Rising global electricity use was driven by factors such as increasing cooling demand resulting from extreme temperatures, growing consumption by industry, the electrification of transport, and the expansion of the data centre sector. Electricity use in buildings accounted for nearly 60% of overall growth in 2024. The installed capacity of data centres globally increased by an estimated 20%, or around 15 gigawatts (GW), mostly in the United States and China. Meanwhile, the continued growth in the uptake of electric vehicles resulted in a rise in electricity use in transport. Global sales of electric cars rose by over 25%, surpassing 17 million units and accounting for one-fifth of all car sales, in line with the IEA's projections for 2024.
- In 2024, 80% of the growth in global electricity generation was provided by renewable sources and nuclear power. Together, they contributed 40% of total generation for the first time, with renewables alone supplying 32%. New renewables installations hit record levels for the 22nd consecutive year, with around 700 GW of total renewable capacity added in 2024, nearly 80% of which was solar PV. Generation from solar PV and wind increased by a record 670 TWh, while generation from natural gas rose by 170 TWh and coal by 90 TWh. In the European Union, the share of generation provided by solar PV and wind surpassed the combined share of coal and gas for the first time. In the United States, solar PV and wind's share rose to 16%, overtaking that of coal. In China, solar PV and wind reached nearly 20% of total generation.
- In 2024, over 7 GW of nuclear power capacity was brought online, 33% more than in 2023. The new capacity added was the fifth-highest level in the past three decades. Electricity generation from nuclear in 2024 rose by 100 TWh, equalling the largest increase this century outside of the post-Covid rebound. Construction starts for nuclear power plants grew by 50% in 2024, exclusively using Chinese and Russian designs.
- Growth in energy-related carbon dioxide (CO_2) emissions continues to decouple from global economic growth. Emissions growth slowed to
- 0.8% in 2024, while the global economy expanded by more than 3%. The global increase of 300 million tonnes of CO_2 was influenced by record high temperatures. If weather in 2024 had remained consistent with 2023, itself the second-hottest year on record, about half of the increase in global emissions would have been avoided. Still, the deployment of solar PV, wind, nuclear, electric cars and heat pumps since 2019

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now prevents 2.6 billion tonnes of CO_2 annually, the equivalent of 7% of global emissions. Most emissions growth in 2024 came from emerging and developing economies outside China.

- Emissions growth in China slowed in 2024, though per-capita emissions are now 16% higher than in advanced economies and nearly twice the global average. Emissions in advanced economies fell by 1.1% to 10.9 billion tonnes in 2024 – a level seen 50 years ago, when their GDP was more than three times smaller.
- Energy intensity improvements continued to slow in 2024. After improving at an average rate of around 2% annually between 2010 and 2019, energy intensity improvements slowed to 1.2% per year between 2019 and 2023 and only 1% in 2024. Key reasons for this recent slowdown include investment- and manufacturing-intensive post-Covid growth in major emerging and developing economies such as China and India; higher energy demand due to extreme temperatures; and a trend of poor growth in hydropower output that was only partially reversed in 2024, leading to more consumption of less- efficient fuels in some regions.

GLOBAL TRENDS

Energy demand accelerates, with electricity leading the way

Different elements of the world's energy system saw very different rates of growth in 2024, reflecting both the impact of short-term factors and deeper structural trends. Global energy demand grew by 2.2% in 2024, a notably faster rate than the annual average of 1.3% seen between 2013 and 2023. This uptick was partly due to the effect of extreme weather, which we estimate added 0.3 percentage points to the 2.2% growth. Despite this, energy demand grew more slowly than the global economy, which expanded by 3.2% in 2024, close to its long-term average.

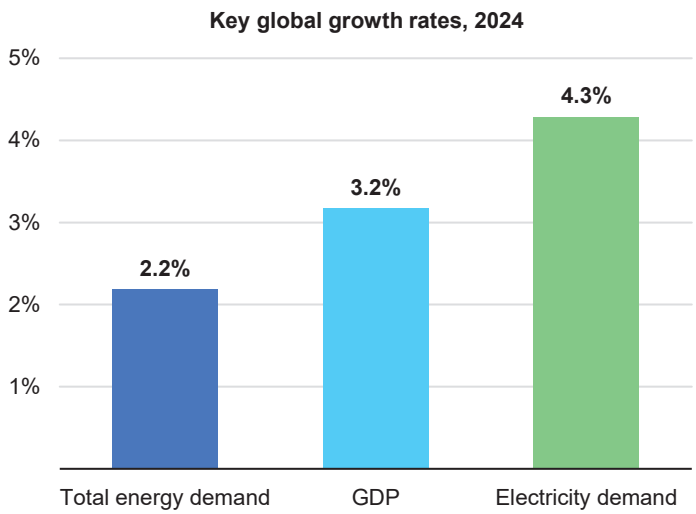
Electricity demand grew more rapidly than both overall energy demand and GDP, increasing by 4.3% in 2024. The absolute increase in demand was the largest ever recorded (excluding the jumps in years when the global economy recovered from recession). This reflects structural trends such as growing access to electricity- intensive appliances like air conditioning and a shift towards electricity-intensive manufacturing, as well as increasing power demand from digitalisation, data centres and AI, and the increasing electrification of end-uses. In all, the power sector made up three-fifths of the total increase in global energy demand.

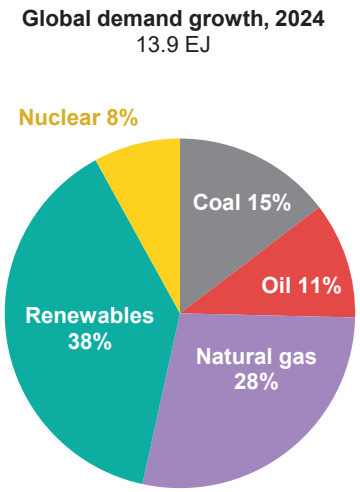
Renewables accounted for the largest share of the growth in total energy supply (38%), followed by natural gas (28%), coal (15%), oil (11%) and nuclear (8%). The energy intensity of the global economy improved by a mere 1%, continuing the slowdown seen in recent years. The rise in energy-related CO_2 emissions slowed to 0.8%, compared with 1.2% in 2023.

The global economy saw moderate growth in 2024

After the upheaval of the Covid-19

Key global growth rates and the share of energy demand growth by source, 2024





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pandemic and the subsequent global economic recovery, the world economy saw further moderation in growth trends in 2024. Global growth averaged 3.2%, close to its pre-pandemic average of 3.4% from 2010 to 2019. Inflation continued to decline in 2024 following sharp post-pandemic price spikes and the impact of the war in Ukraine. Global energy prices have also moderated, with oil prices on a downward trend after the highs of 2022. Yet geopolitical risks persisted, and some markets remained exposed to volatility. The main European gas price benchmark, the TTF, doubled by December 2024 from its lows in February 2024.

GDP growth in advanced economies slowed slightly to 1.7% in 2024. Continued stronger growth in the US was bolstered by healthy sentiment and consumer confidence. By contrast, the European Union saw weaker growth, amid competitiveness concerns. In emerging market and developing economies growth remained robust but slowed slightly to 4.4%. People's Republic of China (hereafter, "China") reported growth at 5%, supported by strengthening manufacturing output and exports, while the real estate contraction continued. The rate of growth in India slowed to 6.5%. Brazil saw improved economic performance in 2024, with GDP expanding 3.7%.

Energy demand growth varied sharply by region, with the largest growth coming from China

Global energy demand rose by 2.2% in 2024, reaching nearly 650 EJ. This was led by a notable shift back to growth in advanced economies where demand grew by almost 1% (+2 EJ), after declining 2% in 2023. Demand in the European Union returned to growth for the first time since 2017 (aside from the post-Covid rebound in 2021), aided by easing energy prices and a lower base after reductions in recent years. In the United States, demand grew by 1.7%, while demand in Japan continued its long-term decline, falling 1.2%.

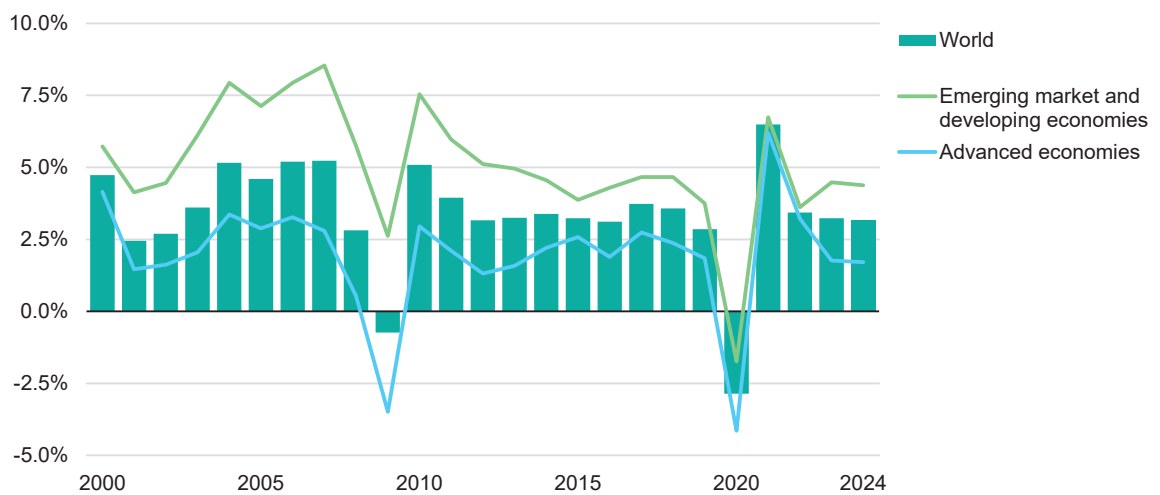
The rate of energy demand growth in emerging market and developing economies slowed in 2024, falling to below 3%, down from nearly 4% in 2023. This was led by the slowdown in demand growth in China, which halved from 2023 – in part reflecting the last effects of the country's post-Covid reopening in early 2023. Growth also decelerated in India, falling to below 5%.

Nevertheless, despite this deceleration, four-fifths of total global energy demand growth still took place in emerging market and developing economies, with three-fifths of the total in Developing Asia. Growth in India alone was more than the increase in demand in all advanced economies combined.

Demand for all fuels and technologies grew in 2024, but non-fossil sources increased the most

Across the energy system, all fuels and technologies saw growth in 2024, although at different speeds. Among fossil fuels, natural gas grew the fastest, with demand rising by 2.7% to reach a new all-time high in 2024. Higher demand was focused in fast growing Asian markets, with growth of over 7% in China, and over 10% in the smaller

Annual rate of change in world GDP, 2000-2024



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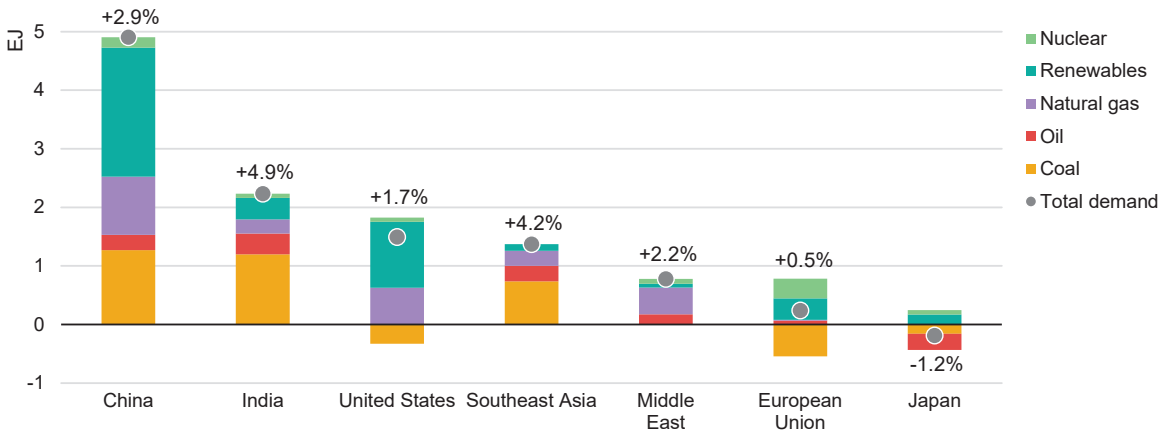
Change in energy demand, selected regions, 2023-2024



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Indian market. Advanced economies saw a return to growth in 2024 after two years of declines linked to higher prices. Globally, demand growth was driven by higher industrial use, and by increased gas use in power generation (in part due to the impact of extreme weather).

Global oil demand growth slowed in 2024, rising by 0.8%, after increasing by 1.9% in 2023. This reflected the end of the post-pandemic mobility rebound, slower industrial growth and the increasing growth of substitutes like electric vehicles. Demand was largely flat in advanced economies (down by 0.1%). Oil demand growth saw a sharp deceleration in China (+0.8%), and grew around 1% in other emerging market and developing economies. In terms of sectors, growth was led by petrochemicals and aviation, while demand from road transport fell marginally.

Coal demand increased by just over 1% in 2024 to reach an all-time high, but the growth rate has slowed in recent years after a strong post-Covid rebound. Increased use in power generation supported growth, but metallurgical coal demand was undermined by the decrease in steel production. Coal demand growth is driven by markets in Developing Asia, with China alone now consuming nearly 40% more coal than the rest of the world combined. Consumption in advanced economies continued to decline, falling by over 5% in 2024.

Other non-fossil fuel energy sources (including nuclear and renewables, bioenergy and waste) grew by over 5% in 2024, and made up nearly half the total growth in global energy demand in the year. Nuclear power rose by nearly 4%, while renewables grew at nearly 6%, led by the accelerated expansion of solar PV and wind. Energy supply from hydropower increased by 4.4%, posting a recovery from the record drop seen in 2023 due to droughts in major hydro markets.

High temperatures helped drive higher energy demand

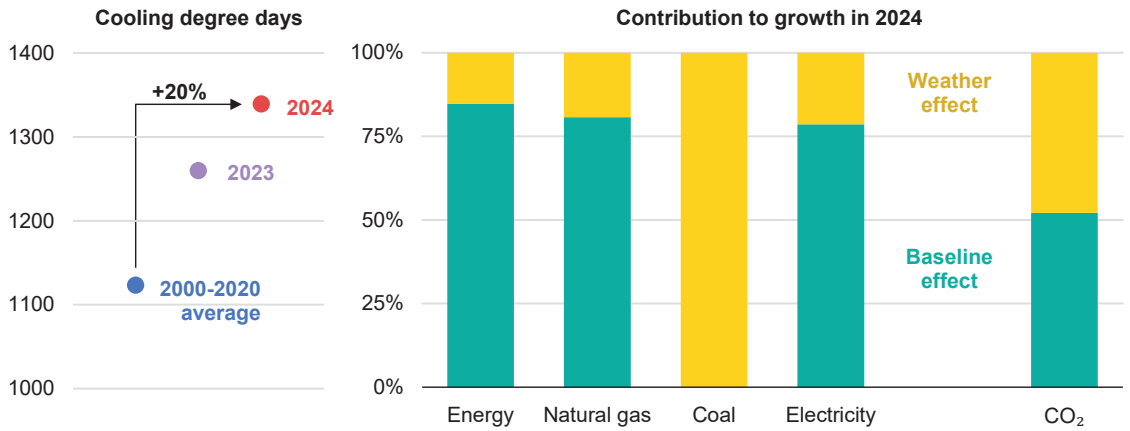
Global energy demand was impacted by extreme temperatures in 2024 – the warmest year recorded, surpassing the previous record set in 2023. Global cooling degree days (a measure of cooling needs) were 6% higher in 2024 than in 2023, and 20% higher than the long-term average between 2000 and 2020. Regions with high cooling demand were particularly affected, including China, India and the United States.

In addition to driving cooling demand, temperature trends can also impact electricity generation, including from hydropower. In all, we estimate that weather effects contributed about 15% of the overall increase in global energy demand. The effects were higher for electricity, coal and natural gas consumption, as electricity demand is directly impacted by cooling, while coal and gas stepped in to meet higher electricity demand in several regions. We estimate that temperature effects contributed around 20% to the increase in electricity and natural gas demand and drove the entire increase in coal demand. For CO2 emissions, weather effects contributed around half of the 2024 increase.

Energy intensity improvements slowed further

The primary energy intensity improvement of the economy, a key

Cooling degree days in 2023 and 2024 compared with long-term average and contribution of total weather effects to change of energy demand and emissions, 2024



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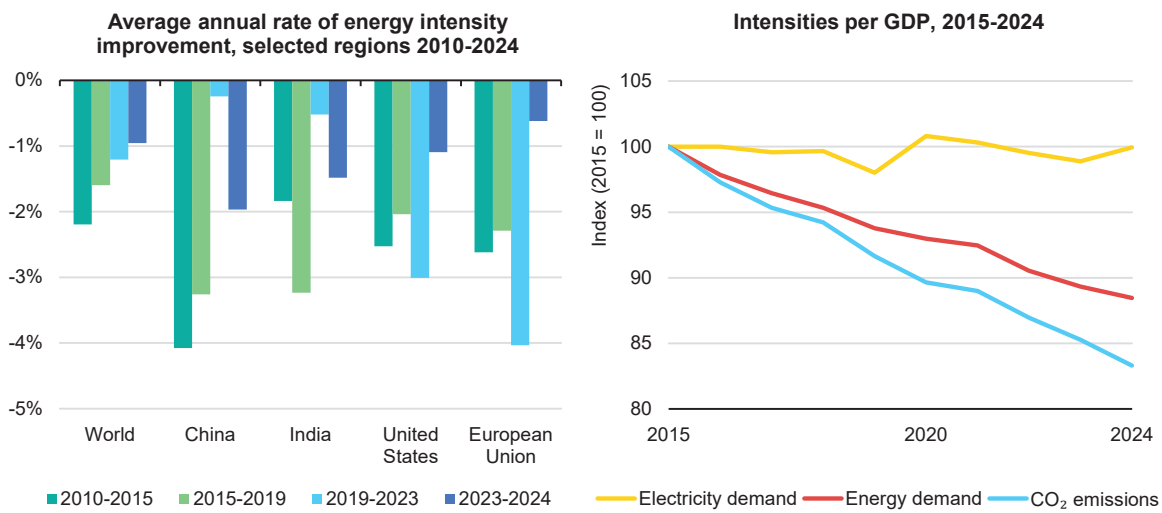
metric of energy efficiency, continued to slow in 2024. After improving at an average rate of around 2% annually from 2010 to 2019, the measure declined to 1.2% in recent years (2019-2023) and fell to around 1% in 2024. Key reasons for this slowdown in recent years include investment- and manufacturing-intensive economic recoveries in major emerging market and developing economies such as China and India; high energy demand due to extreme temperatures; and a trend of poor growth in hydropower output that was only partially reversed in 2024, leading to greater consumption of less-efficient coal power in some regions.

In 2024, energy intensity improvements slowed in advanced economies after several years of rapid progress due to high energy prices and weaker economic conditions in energy-intensive sectors. In contrast, China and India saw faster energy intensity improvements, although still below pre-Covid-19 rates.

The carbon intensity of global economic activity is the product of two factors: the energy intensity of GDP and the carbon intensity of total energy supply. As noted above, the energy intensity of GDP improved by around 1% in 2024. The carbon intensity of total energy supply improved by 1.1% in 2024. Combining these factors gives an improvement in the CO_2 intensity per

Rates of improvement in energy intensity



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unit of economic activity of 2.1% in 2024. This is slightly slower than the average improvement seen over the last decade and was caused by the slowdown in the improvement in energy intensity.

Electricity consumption growth has – amid wider electrification trends – remained broadly in line with GDP growth over the last decade. In 2024, the electricity intensity of GDP increased by 1%, as electricity demand growth exceeded the increase of GDP.

OIL

Oil demand growth loses momentum

Growth in global oil demand slowed markedly in 2024, with consumption rising by 0.8% (1.5 EJ or 830 kb/d) to 193 EJ after jumping by 1.9% in 2023. This reflected the end of the post-pandemic mobility rebound, slower industrial growth and the increasing impact of electric vehicles. This 0.8% increase in demand – below the pre-pandemic growth rate of over 1% in the decade to 2019 – was closely in line with the IEA's first forecast for 2024 set out in June 2023, which noted that structural macroeconomic trends would reassert themselves as Covid pandemic effects eased. Oil's share of total energy demand fell below 30% for the first time ever, 50 years after peaking at 46%.

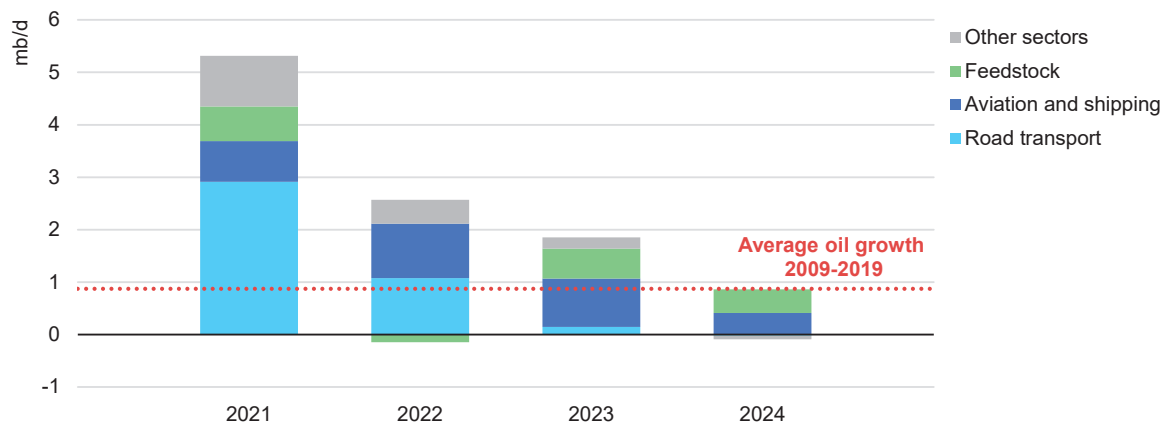
In 2024, chemical feedstocks and aviation each accounted for around half of oil demand growth in energy terms (in volumetric terms, the share of feedstocks was higher, at around 70%). After rebounding strongly following the end of Covid-19 lockdowns in many countries, growth in oil demand from the road transport sector has slowed markedly in recent years. Since 2022, it has accounted for just 5% of growth in global oil demand in energy terms.

The 2024 deceleration in demand growth was most visible in China. In 2023, the country's oil use surged by 8.7% after lockdowns were lifted, but in 2024, it rose by 0.8% – well below the average annual growth rate prior to the Covid-19 pandemic. Most of this growth was recorded in 1Q24, owing to the residual impact of lockdowns in 1Q23. The slowdown was driven by a mix of factors, including the very rapid deployment of electric vehicles, growth in natural gas-powered trucks, the huge expansion of high-speed rail, and the ongoing downturn in the property sector. In 2023, oil demand had also been boosted by a major year-on-year oil price decline, with benchmark Brent crude prices falling by 18% compared with 2022 (and product prices falling further). In 2024, average prices fell only marginally year-over-year and the absence of a comparable boost contributed to the more muted demand uplift.

As a result, while global oil consumption in 2024 recovered to 1.3% above 2019 levels, this was almost entirely due to higher demand for petrochemical feedstocks, which climbed by over 12% over the previous five years. This growth is highly concentrated in China, where feedstock use rose by more than the total net increase in world oil demand. Feedstock demand growth has remained strong – principally due to the absence of efficiency improvements or widespread substitution impacting plastic production or demand.

Non-feedstock uses of oil remain dominated by transport applications in road, aviation and shipping. In 2024, these non-feedstock uses were virtually equal to 2019 levels, despite aggregate

Global oil demand growth by sector, 2021-2024



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- Energy conversion for information technology and communication systems
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global GDP growth of about 14% over this five- year period. This highlights the impact of factors such as electric vehicles and high-speed rail, efficiency improvements and remote working.

Liquid biofuel demand increased by 0.2 EJ in 2024 compared with 2023, reaching over 4% of global transport fuel consumption. Brazil, India, Indonesia and the United States accounted for 90% of this growth. Brazil alone contributed nearly half of the expansion, driven by continued policy support for biofuel blending and rising transport fuel demand. In the United States, which accounted for one-fifth of global demand growth, the increase was supported by federal and state-level policy measures. India and Indonesia together contributed a further 20%, reflecting higher blending mandates and increased fuel consumption.

Oil demand: regional and sectoral oil demand trends

Oil demand was largely steady in advanced economies in 2024, falling by 0.1%, compared with the 0.7% decline recorded in 2023. Nevertheless, demand remained 5.4% below its 2019 level. This drop was concentrated in oil products for road transport, with tighter vehicle efficiency standards, the higher share of EVs and more prevalent remote working, outweighing modest underlying economic growth.

US oil demand was flat in 2024 after ticking up in 2023. It remained 4.3% lower than in 2019, with non-feedstock uses down by 7% but petrochemical use nearly 18% higher. Teleworking has had a particularly large impact on US gasoline consumption, especially given the importance of driving for US commuters. In contrast, rising feedstock demand for export-focused polymer production has been supported by a sharp rise in domestic natural gas liquid (NGL) supplies.

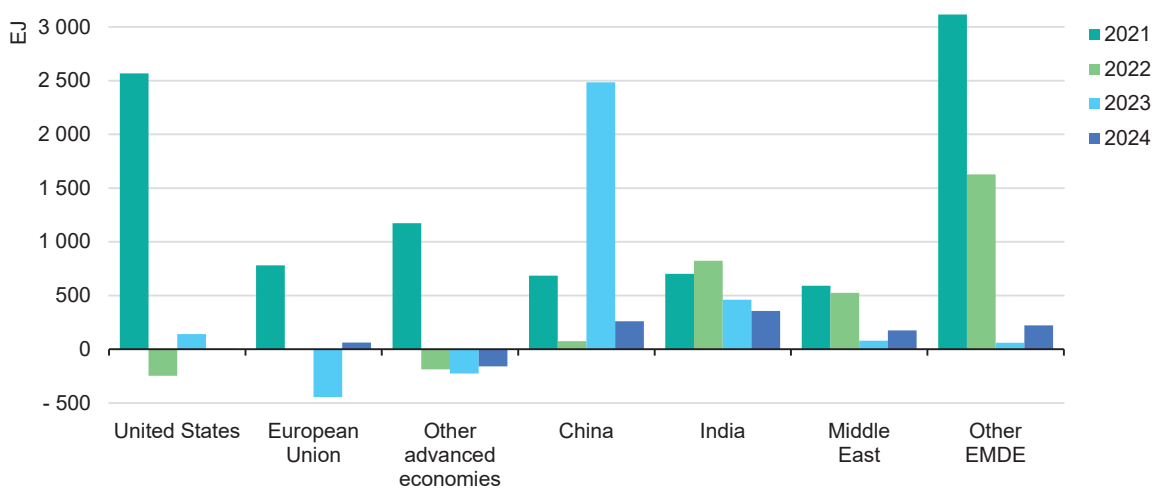
Transport fuel use in the European Union and Japan has been constrained by similar factors. While demand was flat in 2024, difficult industrial conditions helped push EU oil consumption to 7.0% below 2019. Japan posted an 11.8% fall compared with pre-pandemic levels after 2024 demand dropped by 4.4%.

In 2023, China saw demand growth rise to a record 1.4 mb/d, as it emerged from a year of lockdowns, with surging mobility and the release of pent-up demand, especially for air travel. This coincided with a vast wave of petrochemical plants ramping up. Consumption for petrochemical feedstocks therefore increased by 900 kb/d, while demand for jet fuel/kerosene rose by 320 kb/d. In 2024, this shifted, with non-feedstock growth stalling.

In other emerging market and developing economies in Asia, fuel demand continues to rise. India (+3.4%) was the largest single global oil demand growth source in 2024, while demand in Southeast Asia (+2.6%) also rose significantly. India's dynamic economy has underpinned the advances of recent years, with urbanisation and rising car ownership lifting oil demand 11.6% higher in 2024 than 2019. Gasoline use in the world's most populous nation increased by 41.7% (+310 kb/d) from 2019 to 2024.

Across Africa and Latin America, rises in demand across 2023 and 2024

Change in oil demand by region, 2021-2024



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were much more uneven. A period of relatively high oil prices and a strong US dollar created challenges for importers, with several emerging market and developing economies seeing acute disruptions to fuel use. This is often connected to wider economic difficulties – as in Argentina and Sri Lanka – and the withdrawal or reduction of government subsidy schemes – as was the case in Egypt, Nigeria and Pakistan. As a result, demand in Africa declined in both 2023 and 2024, while the increase in Latin America was overwhelmingly due to growth in Brazil.

NATURAL GAS

Natural gas demand returned to structural growth in 2024

Following the supply shock of 2022 and 2023, natural gas markets moved towards a gradual rebalancing and returned to structural growth in 2024. Global gas demand reached a new all-time high, with over three-quarters of growth coming from emerging market and developing economies. Preliminary data indicate that gas demand increased by 2.7%, or 115 billion cubic metres (bcm) (equivalent to around 4 EJ) in 2024. This was above the around 2% annual average growth rate from 2010 to 2019 and well above the rate of around 1% between 2019 and 2023, amid the Covid pandemic and global energy crisis. Emerging market and developing economies in Asia accounted for around 40% of additional gas demand in 2024 on the back of continued economic expansion.

Industry and power sectors drove higher consumption

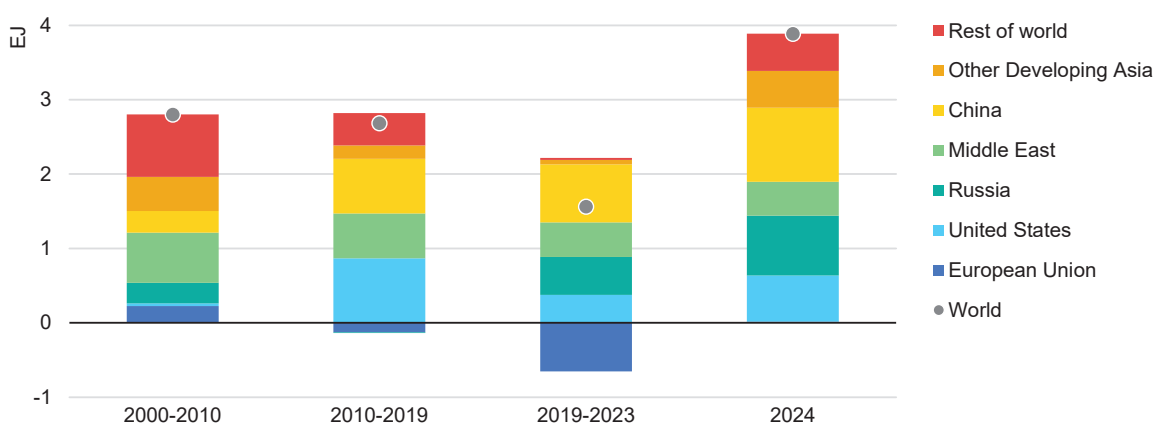
From a sectoral perspective, global gas demand growth was largely supported by industry and electricity generation, which accounted for around 75% of incremental gas demand in 2024. This was bolstered by continued economic expansion in fast-growing markets in Asia, as well as some recovery in Europe's industrial gas demand, though it remained well below its pre-crisis level. Gas demand for electricity generation grew by near 2.8% year-on-year, as strong increases in North America, fast-growing Asian markets and Eurasia were partially offset by lower gas-fired power generation in Europe. Extreme weather conditions, particularly heat waves in China, India and the United States, contributed to higher gas burn in the power sector in 2024. Extreme temperatures alone accounted for around one-fifth of the increase in global natural gas demand. Natural gas demand in the residential and commercial building sectors grew by around 1% in 2024.

Natural gas continued to displace oil and oil products in various sectors, supported by policies, regulations and market dynamics. In the Middle East, oil-to-gas switching in the power sector continued in 2024. In road transport, the rapid scaling up of natural gas-powered trucks in China – with record sales in 2024 – contributed to lower diesel demand there. The use of LNG as a bunkering fuel is also expected to increase amid more stringent emissions regulations for shipping.

Gas demand grew across regions

Natural gas demand in emerging market and developing economies in Asia expanded by around 6% in 2024, accounting for nearly 40% of incremental global gas demand. This strong increase

Change in natural gas demand by region, 2000-2024



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was primarily driven by China and India. Both gas markets displayed high growth rates, supported by relatively low LNG prices during the first half of the year and widespread heatwaves in the second and third quarter of 2024. China's natural gas demand increased by over 7%, although demand growth turned negative in the last two months of the year. In India, natural gas demand increased by 10%, supported by a healthy macroeconomic environment, expanding natural gas grids and higher gas-based power generation needs due to high temperatures.

Natural gas consumption in North America rose by close to 1.8% (or around 20 bcm) in 2024. This growth was primarily supported by gas demand for electricity generation. Natural gas use in the residential and commercial sectors was below its 2023 level, as higher consumption in the fourth quarter could not compensate the demand decline recorded in the first quarter of 2024. Natural gas demand from industry increased marginally compared with 2023. In the United States, natural gas demand increased by an estimated 1.9% in 2024, primarily driven by the power sector, where the gas share rose to an all-time high of 43%.

Natural gas consumption in Latin America rose by 1.6% (or around 2 bcm) in 2024, driven by increased usage for power generation. This demand growth led to a 17% rise in LNG imports, although trends varied between countries.

Natural gas demand increased particularly strongly in Brazil and Colombia. Both countries were hit by severe droughts, which limited hydropower availability and increased reliance on gas-fired power generation.

Natural gas consumption in the European Union rose by around 1% in 2024. The bloc's gas demand for power generation fell by around 5% in 2024 despite the increase of about 1.5% in total electricity demand. The steep decline in gas-fired power output was primarily driven by the strong increase in renewable electricity generation. Natural gas consumption in industry continued to recover in 2024, benefiting from the lower price environment, but it remained nearly 15% below its 2019 level. Natural gas demand in the Middle East grew by an estimated 2%, supported by stronger gas use by the power and industry sectors. In Africa, depressed upstream activity limited natural gas demand growth to below 1%.

COAL

Global coal demand growth slows

Global coal demand grew by 1.2% in 2024 in energy terms, rising by around 67 million tonnes of coal equivalent (Mtce) (or in physical terms by 1.4% or 123 million tonnes). The growth rate has been declining since the strong rebound in 2021 following the end of Covid-19 lockdowns in many countries.

The electricity sector continues to drive coal demand, accounting for two-thirds of global consumption. In 2024, global coal power generation grew by nearly 1% to 10 700 TWh, a new high. A key driver was record temperatures, which pushed up electricity demand for cooling (especially with intense heatwaves in China and India). The estimated effect of higher temperatures on coal demand in 2024 covers the entire annual increase in coal use. While coal remains the world's largest source of power generation, its share in the electricity mix is falling: its current share (35%) is the lowest since the IEA was founded in 1974.

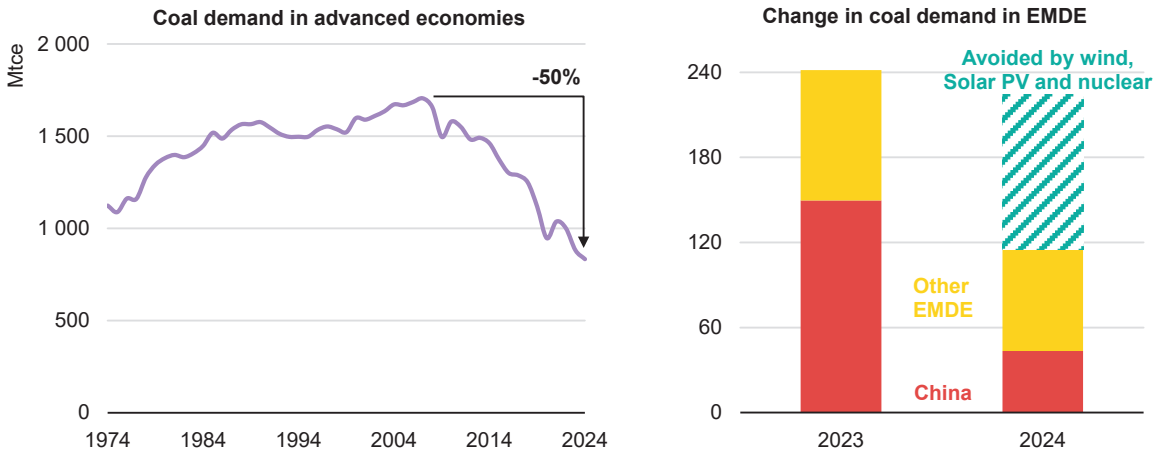
Consumption of metallurgical coal fell by around 0.5% in 2024, driven mainly by the decline in global steel production. However, overall coal demand for non-power uses grew very slightly, driven by the growth and strong performance of coal-intensive sectors such as nickel mining in Indonesia and chemical production in China.

Developing Asia leads increasing coal demand

The share of global coal demand consumed in Developing Asia rose again in 2024, reaching nearly four fifths, up from below two fifths in 2000. In China, coal demand grew by 1.2% (43 Mtce) in 2024, reaching a new all-time high. The country now consumes nearly 40% more coal than the rest of the world combined, largely for power generation. Over one-third of all the coal consumed globally is burned by power plants in China. China's influence in global coal market trends is unparalleled by any country for any type of fuel, with China's share of global coal consumption now standing at 58%.

In 2024, electricity demand in China was very strong, rising by 7% (or over 550 TWh). Despite huge solar PV and wind capacity additions in recent years – as well as a recovery in hydropower output in the first half of the year due to higher rainfall, plus increases in nuclear, biomass and gas power generation – there was still a gap between the additional electricity demand and supply. Coal generation filled this gap, increasing by 1.2%. Coal consumption in China's iron and steel sector – larger than total coal consumption in any country except India – shrank by around 2%, as steel production declined by 1.7%. Cement production declined by around 9.5%, and we estimate a similar decline in the sector's coal consumption.

Coal demand in advanced economies, 1974-2024, and change in coal demand in emerging market and developing economies in 2023 and 2024



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However, strong growth in coal used for chemicals and other products partially offset the wider drop in non-power coal consumption.

In India, the world's second-largest coal consumer, demand grew by around 5.5% or 40 Mtce in 2024, also reaching a new all-time high. Strong economic growth pushed up coal consumption in both the power and industry sectors. Coal power generation – which makes up nearly three-quarters of coal demand in India – grew by 5% in 2024 mirroring growth in electricity demand. Steel production grew by 6.3% in 2024. Coal-based sponge iron production increased by 10% and hot metal production increased by 4.4%, boosting industrial coal use.

In Southeast Asia – which in 2023 became the third-largest coal consuming region in the world, overtaking the United States – coal consumption continued to grow in 2024, rising by almost 8% (25 Mtce). The increase was mainly driven by three countries. In Indonesia, use by metallurgical industries – in particular, nickel producers – was the main growth driver. In the Philippines and Vietnam, coal power generation was the main driver.

In advanced economies, coal demand has halved from the peak seen in 2007 and 2024 saw another decline. In the United States, coal consumption fell by 4% (around 10 Mtce), though this is a significant slowdown compared with the 17% drop recorded in 2023. Total electricity demand, which switched from decline in 2023 to growth in 2024, was the main driver of this trend; in the United States, coal is used almost exclusively for power generation.

In the European Union, coal demand continued its decline as an increasing number of countries closed coal power plants. The United Kingdom, where the world's first coal power plant was set up in 1882, joined the list of countries without coal power capacity in September 2024. EU coal power generation fell 15% in 2024 and total coal demand fell by over 10% or 21 Mtce.

In 2024, global coal-based electricity generation grew by 90 TWh, while generation from wind, solar PV and nuclear grew 770 TWh. We estimate that without the increase in output from these three technologies in 2024, the increase of global coal demand would have been nearly two times higher.

ELECTRICITY

Electricity demand growth surged in 2024

Global electricity demand increased by 4.3% in 2024, a step change from the 2.5% growth seen in 2023. The average pace of electricity demand growth from 2010 to 2023 was 2.7%, double the rate of total energy demand growth over the same period. Electrification picked up across sectors, raising electricity demand in most major economies in 2024.

China accounted for the largest share of electricity consumption growth, but increases were seen globally

Almost all regions saw an acceleration in the rate of electricity consumption growth in 2024 compared with the annual average from 2012 to 2022. Globally, electricity consumption increased by 1,080 TWh, nearly two times the annual average of the past decade.

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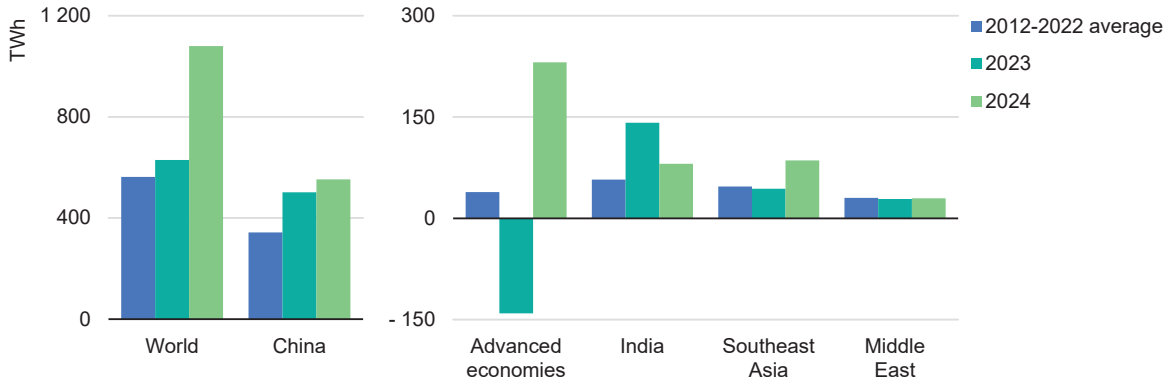
Change in total final consumption of electricity for selected regions, 2012-2024



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Note: Total final consumption excludes own use for power plants and industry, and transmission and distribution losses.

In China, electricity consumption increased by more than 550 TWh (7%), almost as much as the average annual global increase in electricity consumption over the previous decade (2013-2023) and well above the China's own average increases during this period.

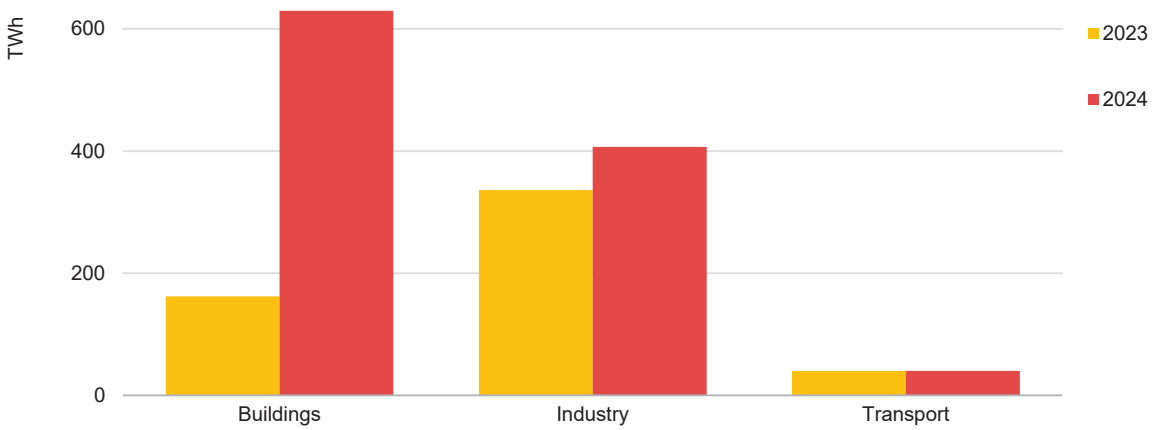
In 2023, advanced economies saw a 140 TWh decline in electricity consumption due to soft industrial output in some countries and milder weather conditions. In 2024, this reversed dramatically, with electricity consumption increasing by 230 TWh, led by growth in the United States. Strong demand for cooling, growth in the data centre sector and a pickup in industrial production were important factors behind this trend. The European Union's electricity consumption grew by about 1.5% in 2024, compared with near-zero growth on average from 2003 to 2023. Other advanced economies, including Australia and Korea, also saw upticks in the pace of electricity demand growth.

In India, the pace of electricity consumption growth slowed in 2024 compared with 2023, representing a normalisation after extremely unfavourable weather drove up demand in 2023. In Southeast Asia, on the other hand, consumption jumped by over 7% in 2024, compared with about 4% in 2023.

The buildings sector drove higher electricity demand in 2024, growing four times faster than in 2023

Global electricity consumption in buildings increased by more than 600 TWh (5%) in 2024, accounting for nearly 60% of total growth in electricity

Annual change in electricity consumption by sector



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consumption. Key drivers included rising demand for air conditioning, which was bolstered by severe heatwaves in countries such as China and India, and demand for power from new data centres.

The industry sector made up nearly 40% of total growth in electricity demand in 2024. Electricity use in industry grew by nearly 4% in 2024, a step up from the pace in 2023, driven by increased activity in electro-intensive manufacturing and industrial growth more broadly. The continued uptake of electric vehicles raised electricity consumption in the transport sector by over 8% in 2024.

TECHNOLOGY: ELECTRIC VEHICLES

Electric car sales continued to rise globally in 2024, increasing by more than 25% to more than 17 million units, up from below 14 million units in 2023. This aligns with the IEA's preliminary estimate for annual sales in the 2024 edition of the Global EV Outlook publication. EV sales accounted for over 20% of all car sales in 2024.

China was the leading driver of growth, accounting for almost two-thirds of global electric car sales in 2024. The country's electric vehicle sales experienced an impressive annual growth rate of nearly 40%.

A large share of this growth came from plug-in hybrid electric vehicles (PHEVs), where sales saw an 80% increase, compared with a nearly 20% rise in battery electric vehicles (BEVs). Growing demand for extended-range electric vehicles (EREVs) has supported this trend; the configuration is currently most prevalent in China. The country's market has been further supported by its vehicle trade-in scheme, which includes subsidies of up to nearly USD 3,000 to encourage consumers to replace older, less efficient cars with new energy vehicles.

The United States experienced sales growth of over 10%, largely driven by the release of new electric vehicle models and availability of EV tax credits, which provided financial aid to consumers.

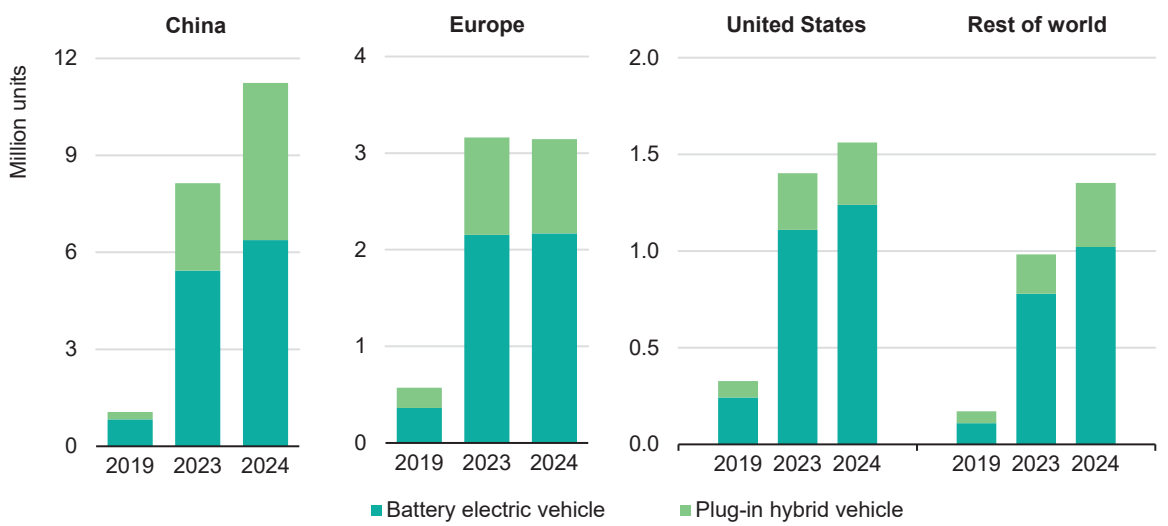
Electric car sales in the European Union fell by 6%, in large part due to decreased sales in Germany, where purchase subsidies were removed at the end of 2023. In contrast, EV sales in the United Kingdom surged, driven by the Zero-Emission Vehicle (ZEV) mandate. As a result, in 2024 the United Kingdom emerged as the leader in battery electric car sales among European countries, surpassing Germany for the first time.

Emerging market and developing economies outside China witnessed a significant 80% annual increase in EV sales, although this growth came from a relatively lower base compared with more mature markets. Markets such as Brazil and Indonesia saw sales increase by 140% and 190%, respectively.

TECHNOLOGY: HEAT PUMPS

Global heat pump sales fell by 1% in 2024, recovering most of the decline recorded in the first half of the year, when global sales were down by 10% year-over-year.1 Some markets, notably Japan and the United States, showed a strong

Electric car sales in selected car markets



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Note: Europe includes the European Union, Iceland, Israel, Norway, Switzerland, Türkiye, United Kingdom, Albania, Belarus, Bosnia and Herzegovina, Kosovo, North Macedonia, Republic of Moldova, Montenegro, Serbia and Ukraine.
Source: IEA analysis based on data from ACEA, EAFO, EV Volumes and Marklines.

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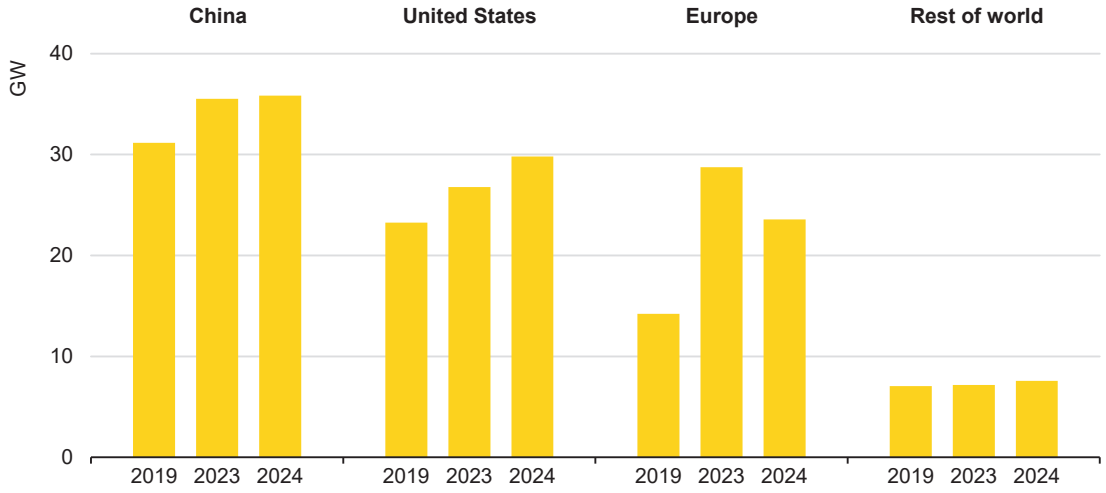
Heat pump sales for selected regions



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Source: IEA analysis based on the European Heat Pump Association (EHPA); the Air-Conditioning, Heating and Refrigeration Institute (AHRI); the Japan Refrigeration and Air Conditioning Industry (JRAIA), and ChinaIOL.

recovery in demand in the second half of the year, but it was not enough to offset the sharp annual decline in Europe and stagnation in China.

In China, annual capacity additions in 2024 remained at similar levels to 2023, with sales in some heat pump segments slowing down towards the end of the year. China remains the largest heat pump market globally, and it holds the largest share of manufacturing capacity for heat pump units and certain key components such as compressors.

In the United States, the second-largest heat pump market, sales rose by around 15% in 2024 on the previous year. This was driven by a 30% increase in the second half of the year compared with the same period in 2023, which compensated for the slight decline in sales in the first half. Throughout the year, heat pumps continued to gain market share over heating systems powered by fossil fuels. In 2024, heat pumps outsold natural gas furnaces by 30%, the largest gap ever recorded.

In Europe, the third-largest heat pump market, sales fell by a record 21%, seeing the largest decline ever recorded in the region both in relative and absolute terms. This drop was largely driven by Germany, where sales fell by almost 50%, and by France, where they declined by 25%.

Several factors contributed to this trend, including high prices for electricity compared with natural gas (which in 2024 was well below its 2022 peak) and an uncertain political and regulatory landscape. A slowdown in the construction sector also had an impact on heat pump installations, since a large share are in new buildings.

In Japan, the fourth-largest heat pump market, sales increased by over 5%, recovering after a weak start to the year. Sales of both air-to-water systems (which are mainly used for domestic hot water in Japan) and air-to-air systems (which are typically used for space heating) increased on an annual basis.

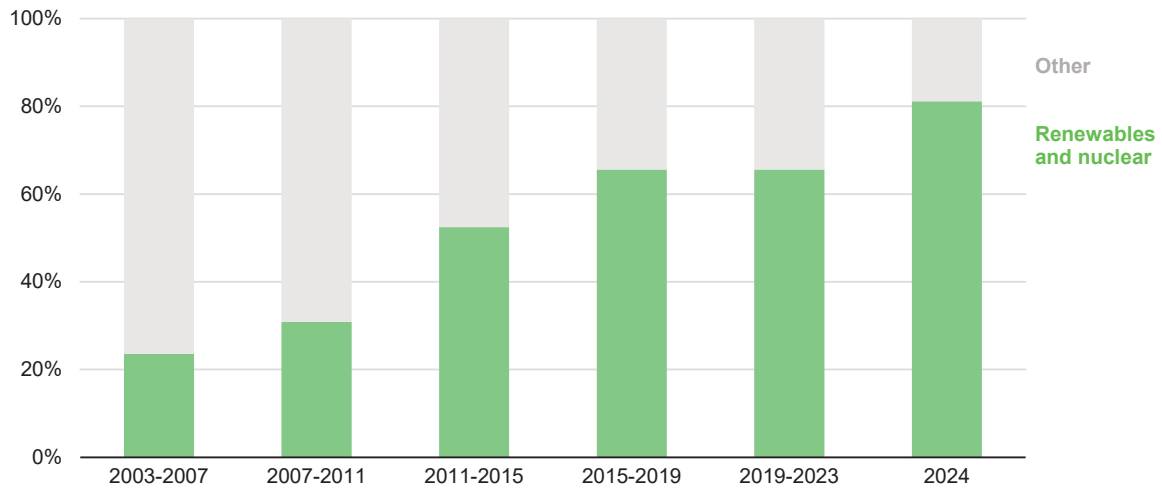
ELECTRICITY GENERATION

Clean energy accounted for over 80% of total growth in electricity generation in 2024

Global electricity generation grew by over 1 200 TWh in 2024. Mirroring the rise in electricity demand, this annual increase of 4% represents a significant acceleration from the average growth rate of 2.6% seen between 2010 and 2023. Rising generation from renewables and nuclear power made up over 80% of global growth – a step up from 2023, when they accounted for two-thirds of total growth.

In 2024, renewables alone made up almost three-quarters of the overall increase in power generation. Solar PV led the way, increasing by about 480 TWh – the most of any source and far exceeding the previous year. Global generation from solar PV has been doubling approximately every three years since 2016, and it did so again between 2021 and 2024. Wind expanded by about 180 TWh in 2024 as new projects were brought online. However,

Share of increase in global electricity generation, 2003-2024



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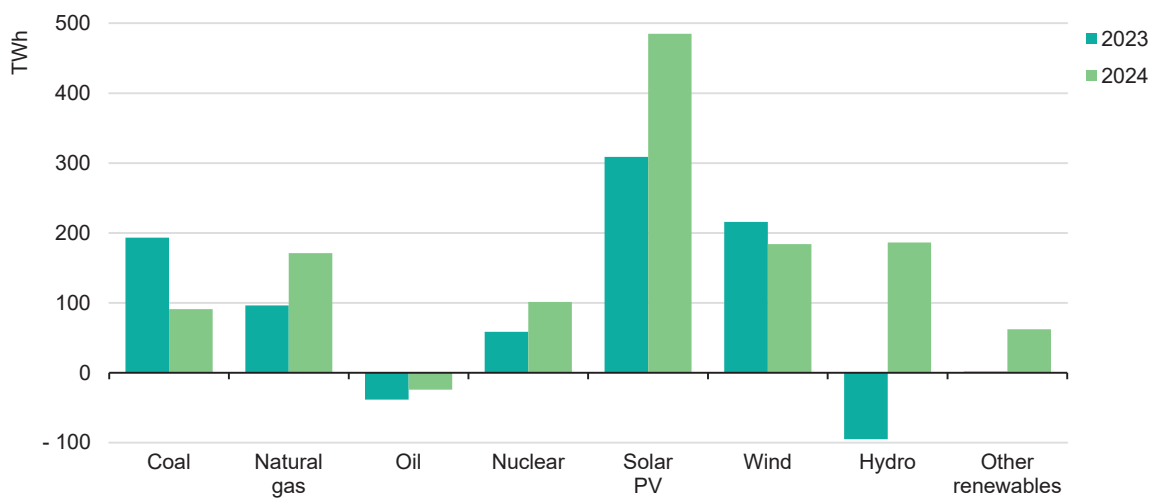
the annual growth rate of 8% was the lowest in the last two decades due to a high base, as well as permitting and licensing challenges in several regions. Hydropower generation also increased by 190 TWh in 2024, mainly due to wet weather in several major markets. Nuclear power output increased by nearly 4%, boosted by new projects and restarted operations at several reactors in France and Japan.

Electricity generation from fossil fuels increased by just over 1% in 2024, making up less than one-fifth of global growth in electricity generation. Natural gas generation increased by about 2.5% year-on-year, significantly more than in 2023, with reductions in natural gas prices in most major markets and hot weather in some regions delivering a boost. Output from coal-fired power plants increased by less than 1% in 2024, half the rate of growth seen the year before.

Fossil fuels made up nearly 60% of 2024 electricity generation, but the power mix is evolving

Coal remained the largest source of electricity generation in the world, a position it has held for more than 50 years. In 2024, it accounted for 35% of total power generation. Natural gas was

Annual change in global electricity generation by source



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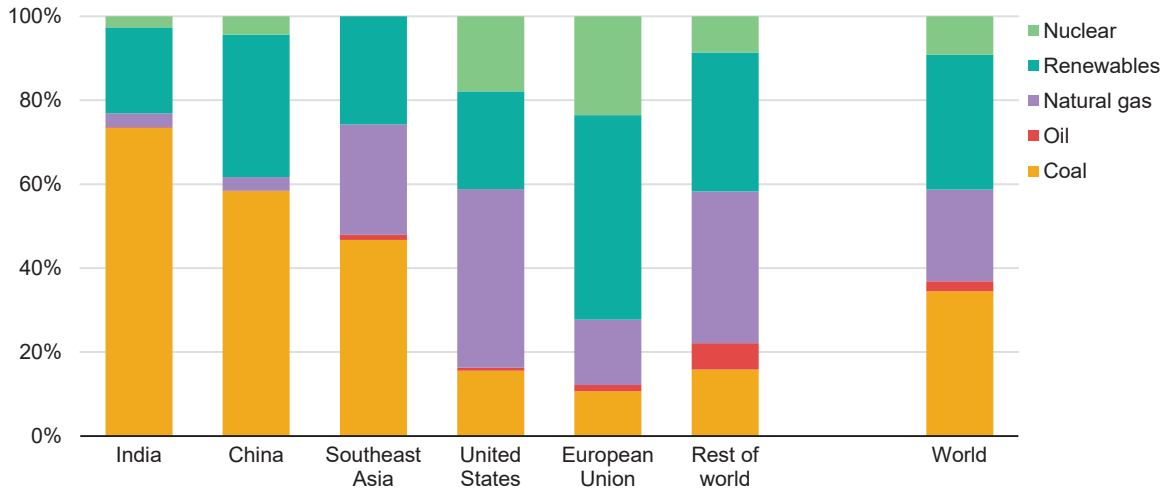
Electricity generation mix for selected regions, 2024



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the second-largest source of electricity, marking more than two decades in which it has provided over 20% of global electricity. Oil-fired power plants generated just a few percent of the total. However, the global power mix is evolving. For the first time ever, power generation from renewables and nuclear covered two-fifths of total global generation in 2024. Renewables collectively accounted for one-third of electricity generation, led by hydropower (14% of total electricity generation), wind (8%), solar PV (7%) and bioenergy and waste (3%). Nuclear power covered 9% of global electricity generation.

In emerging market and developing economies, coal is often the primary source of electricity. In China, the largest electricity system in the world, coal provided almost 60% of generation, followed by about 35% from renewables, with smaller roles for nuclear and natural gas. In India, coal provided nearly three-quarters of electricity supply, complemented by over 20% from renewables, with smaller contributions from nuclear power and natural gas. Southeast Asia got almost half of its electricity from coal and about one-quarter each from natural gas and renewables.

In advanced economies, renewables and natural gas play larger roles in electricity generation. In the United States, natural gas accounted for over 40% of all electricity generation in 2024, followed by renewables (23%), nuclear (18%) and coal (16%). In the European Union, renewables made up nearly half of electricity supply, well above the world average. The region also continued to rely on nuclear (23% of the total), with lower shares for natural gas (16%) and coal (11%).

TECHNOLOGY: SOLAR PV AND WIND

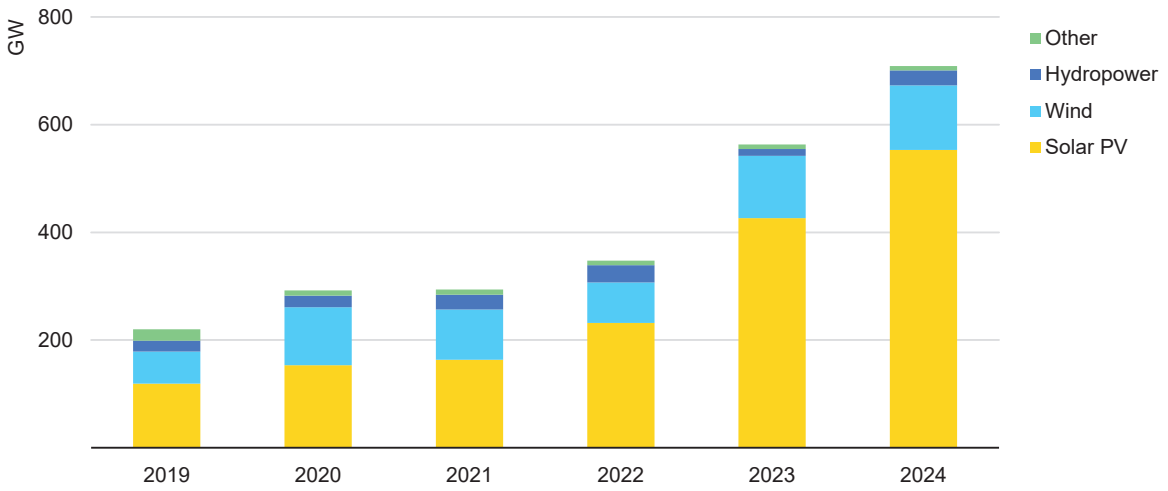
In 2024, global annual renewable capacity additions surged by an estimated 25% to around 700 GW – marking the 22nd consecutive year that renewables have set new records for expansion. Solar PV accounted over three-quarters of renewable capacity additions, followed by wind (17%) and hydropower (4%), with bioenergy, geothermal, concentrating solar power and marine making up the remainder.

Solar PV additions in 2024 rose by almost 30% year-over-year, totalling about 550 GW. With this growth, installed solar PV capacity worldwide reached an estimated 2.2 terawatts (TW). Annual wind additions remained stable at around 120 GW. Together, solar PV and wind accounted for 95% of overall renewable capacity growth in 2024. Hydropower installations more than doubled to over 25 GW thanks to large projects commissioned in China, Africa and Southeast Asia.

China continues to drive renewable capacity additions

China once again saw record expansion, making up almost two-thirds of all renewable capacity connected to the grid in 2024. Solar PV capacity additions (DC, direct current) reached over 340 GW, a 30% increase compared with 2023. Utility-scale plants drove over 60% of China's PV expansion, followed by distributed commercial and industrial installations. Incentives targeting

Total renewable capacity additions by technology, 2019-2024



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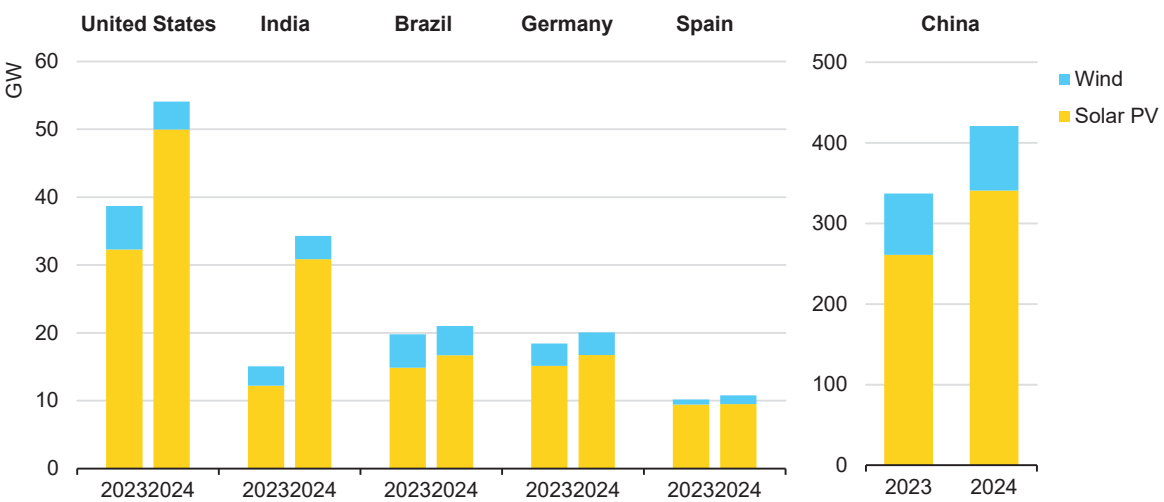
Note: 2024 values are based on both actual and estimated additions.

rural economic development have significantly boosted the installation of residential solar systems in China since 2019, with these systems accounting for approximately one-fifth of the country's annual PV additions on average. However, last year, China's residential PV market (30 GW) accounted for less than 10% of the country's solar PV additions as incentives phased out. Meanwhile, wind growth remained stable but strong at 80 GW. The country surpassed its 2030 ambition of 1 200 GW of combined solar PV and wind capacity six years early, in mid-2024.

The European Union installed around 60 GW of solar PV capacity in 2024, similar to in 2023. This was more than double the annual capacity added in 2021, before the energy crisis sparked by Russia's full-scale invasion of Ukraine in 2022. However, outside of three large markets (Germany, Italy and Spain), newly installed PV capacity declined year-on-year in over 15 EU member states.

While high electricity prices – and new incentives that increased the economic attractiveness of residential and commercial systems – accelerated the expansion of solar PV in 2022 and 2023, lower energy prices in 2024 and declining policy support led to a slowdown in growth in many markets.

Solar PV and wind net additions in selected markets



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Note: United States solar PV values are based on Renewables 2024 data.

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At the same time, three major solar PV markets saw record levels of expansion in 2024: the United States, India and Brazil. In the United States, almost 50 GW of new solar PV capacity was added to the grid, shattering the previous record in 2023. India installed around 30 GW, almost tripling the previous year's solar PV growth, while Brazil added over 16.5 GW thanks to large utility-scale additions, which supplemented the continued roll-out of distributed resources driven by a net metering scheme.

For wind, while China's additions increased slightly in 2024, EU wind additions were 20% lower compared with 2023. Long permitting timelines, supply chain challenges and auction schedules were key factors. Wind capacity additions in India exceeded those seen in 2023, while the United States and Brazil saw a decline compared with last year.

TECHNOLOGY: NUCLEAR

In 2024, over 7 GW of nuclear power capacity was brought online – 33% more than in 2023. That brought the total installed nuclear capacity to 420 GW. Of the six nuclear projects completed, all of which were large-scale reactors: two were in China, while France, India, the United Arab Emirates and the United States each finished one. New nuclear capacity added in 2024 was the fifth-highest in the last 30 years.

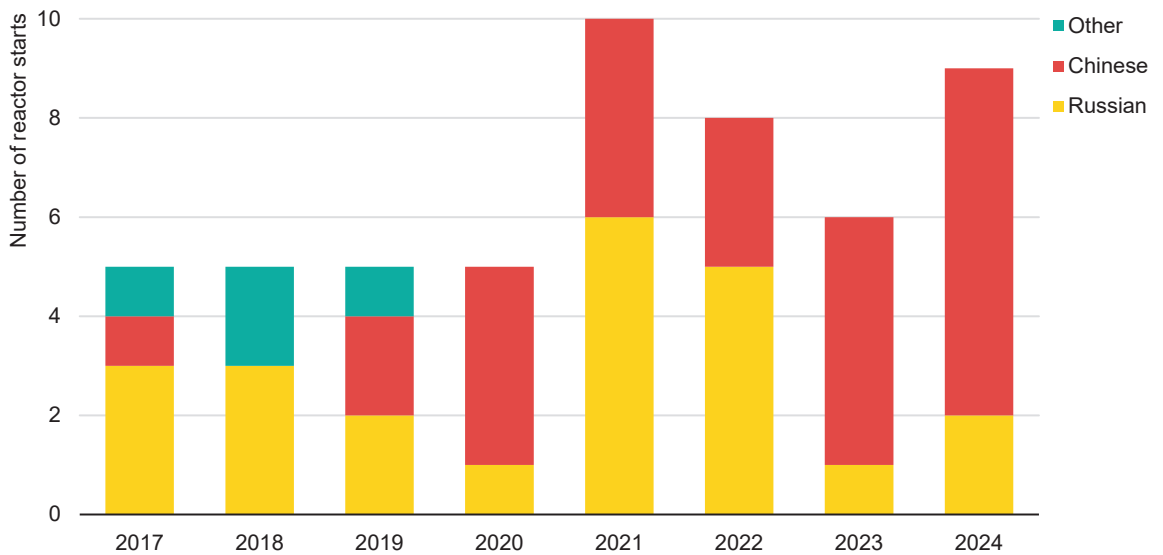
Nuclear construction starts increased 50% in 2024, exclusively using Chinese and Russian designs

Globally, there were nine construction starts of nuclear reactors in 2024, 50% more than in 2023. When completed, they are expected to have a total capacity of 11 GW. China began construction of six nuclear reactors in 2024 (all of Chinese design) – one of the highest number of starts in the country ever and extending its market leadership in terms of construction. Pakistan began construction of one reactor in 2024, the first Generation III+ design of Chinese origin used outside of China. Egypt and Russia each began constructing one nuclear reactor in 2024, both of Russian design. Over the past five years, all nuclear construction starts have used either Chinese or Russian designs.

As of February 2025, there were a total of 62 nuclear reactors under construction in 15 countries around the world with a total capacity of nearly 70 GW. China accounted for nearly half of all nuclear capacity under construction in the world. Egypt, India and Turkey each have about 5 GW under construction.

Across advanced economies, a total of 9.5 GW is under construction, including two reactors in Japan, two in Korea, two in the United Kingdom and one in Slovakia.

Nuclear reactor construction starts by national origin of technology, 2017-2024



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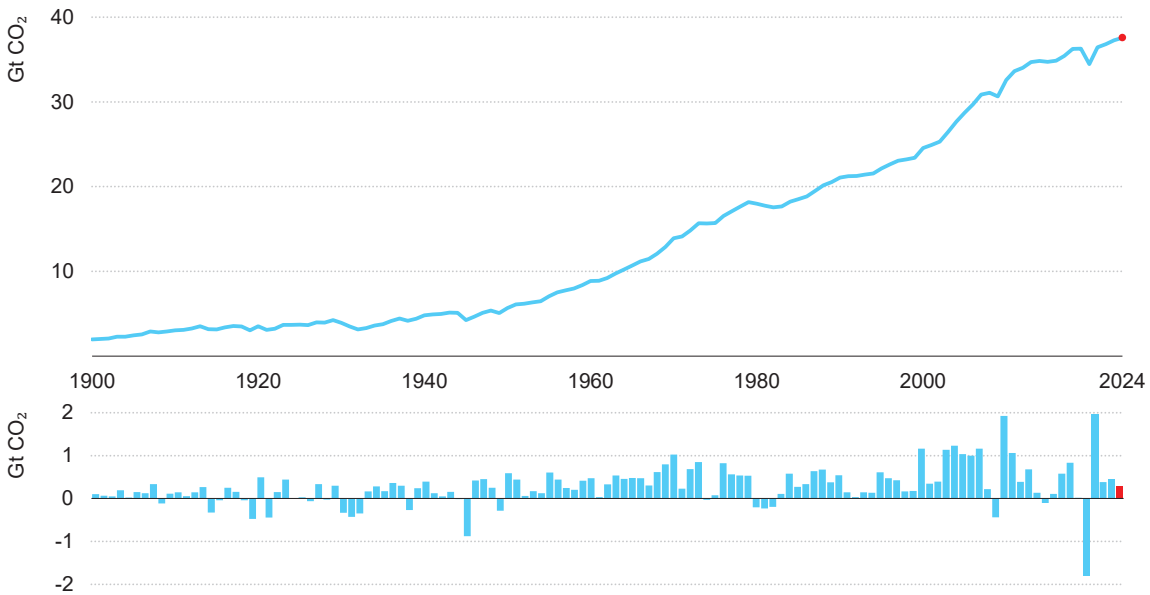
Note: Capacity is reported in gross terms.
Source: IEA analysis based on IAEA PRIS database (Accessed 6 February 2025).

Global energy related CO_2 emissions and their annual change, 1990-2024



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CO_2 EMISSIONS

Energy sector carbon emissions reached a new record in 2024

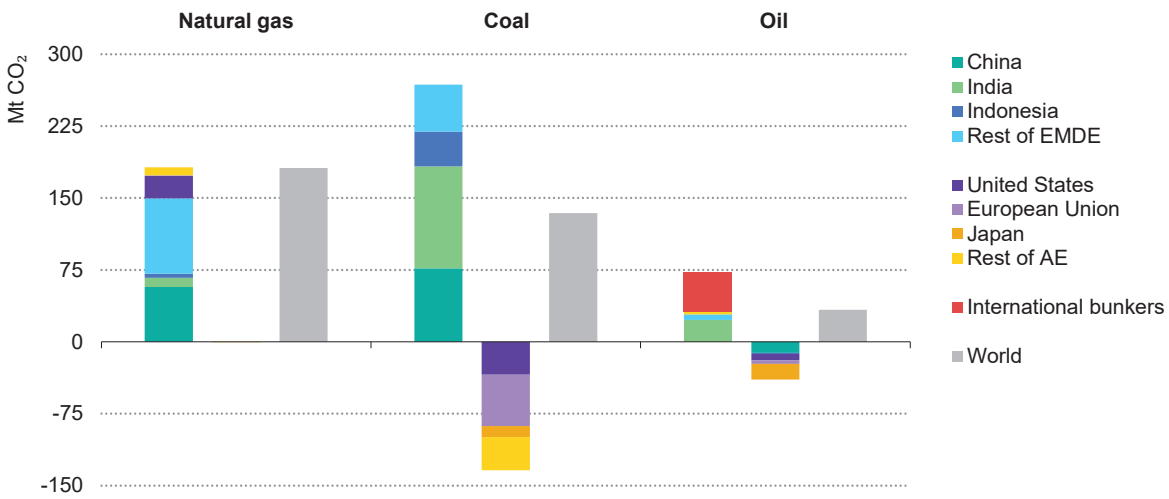
Total energy-related CO_2 emissions increased by 0.8% in 2024, hitting an all-time high of 37.8 Gt CO_2. This rise contributed to record atmospheric CO_2 concentrations of 422.5 ppm in 2024, around 3 ppm higher than 2023 and 50% higher than pre-industrial levels. In 2024, CO_2 emissions from fuel combustion grew by around 1% or 357 Mt CO_2, while emissions from industrial processes declined by 2.3% or 62 Mt CO_2. Emissions growth was lower than global GDP growth (+3.2%), restoring the decades-long trend of decoupling emissions growth from economic growth, which had been disrupted in 2021.

Natural gas and coal drove the increase in emissions

Natural gas emissions rose by around 2.5% (180 Mt CO_2) in 2024, making it the largest contributor to global carbon emissions growth.

This increase was driven by higher consumption in China, the United States, the Middle East, and India.

Change in CO_2 emissions from combustion by fuel and region, 2023-2024



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Notes: AE = advanced economies; EMDE = emerging market and developing economies. International bunkers include the demand for fuels for international aviation and international maritime transport.

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Global coal emissions rose by 0.9% (135 Mt CO_2) in 2024. The increase was primarily fuelled by growing coal consumption in China, India and Southeast Asia, while demand declined in advanced economies, particularly in the United States and the European Union.

While global oil consumption rose by 0.8% in 2024, oil-related emissions increased by only 0.3%. This was despite aviation emissions surging by approximately 5.5% amid record global air passenger demand.

The modest overall rise in emissions from oil use is largely due to the fact that petrochemical feedstocks accounted for 70% of the total volumetric increase in oil use.

Carbon emissions trends varied widely across regions

Emissions trends between regions diverged in 2024. CO_2 emissions grew in emerging market and developing economies and international aviation and marine bunkers, outweighing reductions from advanced economies led by the European Union, Japan and the United States.

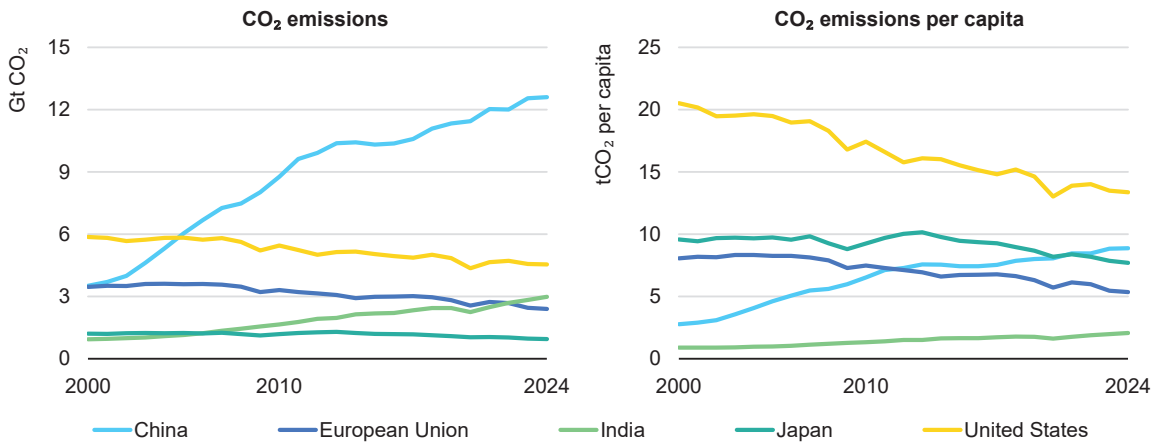
In emerging market and developing economies, energy-related CO_2 emissions increased by 1.5% (375 Mt CO_2) in 2024, driven by rising energy demand associated with rapid economic and population growth. Emissions from coal rose by 2%, while natural gas emissions increased by 3.7% and oil emissions rose by 0.3%, reflecting the continued reliance on fossil fuels to meet expanding industrial activity and improve energy access.

China's energy-related CO_2 emissions grew by an estimated 0.4% year-on-year in 2024, with most of the growth occurring in the first quarter due to the residual impact of lockdowns in early 2023. Energy demand surged throughout the year, driven by record-breaking heatwaves, economic stimulus measures, industrial growth and a strong rebound in the residential and service sectors. Despite these pressures, the expansion of clean energy – particularly in wind and solar PV – helped mitigate emissions growth. Hydropower generation also increased by 11% compared with 2023, partially rebounding from the droughts of 2022/2023. Abundant spring rainfall, particularly in southern China, contributed to record-high hydro generation during the season. However, persistent droughts in the northern regions and extreme summer heatwaves limited further gains. Additionally, industrial process emissions declined by over 5%, largely due to a nearly 10% contraction in cement production caused by weak demand from a struggling real estate market and reduced infrastructure investment.

India's energy-related CO_2 emissions rose by 5.3% in 2024, the highest rate among major economies, driven by rapid economic growth, infrastructure development and surging energy demand. Severe and prolonged heatwaves further boosted electricity consumption, which rose by 5%, straining power systems despite record-breaking additions of nearly 35 GW in solar PV and wind capacity. However, the growth in renewables could not keep pace with rising demand, leaving fossil fuels dominant in the electricity mix.

In advanced economies, energy-related CO_2 emissions decreased by 1.1% (120 Mt CO_2) in 2024, driven by a 5.7% decline in coal emissions and a 0.5% drop in oil emissions. Natural

CO_2 total emissions and CO_2 per capita emissions by region, 2000-2024



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gas emissions increased by 0.9%. The reduction reflects advanced economies' continued deployment of low-emissions energy sources, with renewables and nuclear power accounting for over 50% of electricity generation, led by strong growth in wind and solar.

The United States' energy-related CO_2 emissions decreased by 0.5% (20 Mt CO_2) in 2024, reflecting mixed trends across fuel sources. Emissions from coal dropped by 4.5% as the country registered the lowest coal power generation levels in nearly 60 years, while oil emissions fell by 0.3%. However, natural gas emissions increased by 1.3%, driven by its role as the largest US electricity source, accounting for almost 43% of the generation mix. For the first time, solar and wind surpassed coal in electricity generation.

The European Union's energy-related CO_2 emissions decreased by 2.2% (55 Mt CO_2) in 2024. Emissions from coal dropped by 11%, while oil emissions declined by 0.3%. Natural gas emissions remained flat. Power sector emissions fell by almost 10% year-on-year, driven by a record-low fossil fuel share of 28% in electricity generation. Renewables accounted for almost 50% of electricity production, led by wind and solar, which reached a record share of 28%, for the first time surpassing the combined share from coal and gas. Above-average rainfall in the European Union also contributed to increased hydropower generation.

Several factors played a key role in the emissions increase

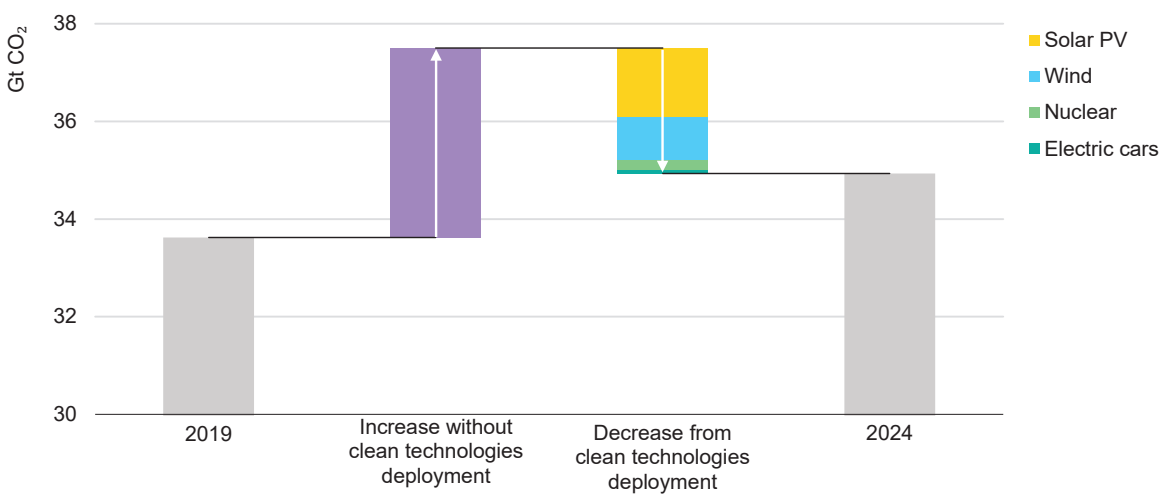
A series of factors shaped the change in CO_2 emissions between 2023 and 2024. Extreme temperatures around the globe and poor wind conditions in Europe drove up fossil fuel use in the power sector. However, a partial recovery from the severe droughts of 2023 allowed for increased hydropower generation, in part offsetting the impact of temperature and wind conditions. Aviation continued its recovery from the Covid-19 pandemic, contributing to higher emissions. Additionally, 2024 was a leap year, meaning an extra day of emissions – an impact that remains hard to quantify but could be up to 100 Mt CO_2. The cumulative net impact of these effects accounts for more than 90% of the overall increase in emissions, or around 275 Mt CO_2 of the observed increase of 295 Mt.

Despite the increase in emissions, clean energy technologies are making a difference

The rapid deployment of five key clean energy technologies – solar PV, wind power, nuclear power, electric cars and heat pumps – from 2019 to 2024 avoided annual fossil fuel energy demand of more than 30 EJ. This is equivalent to 6% of total global fossil fuel demand in 2024, or more than the combined total energy demand of Japan and Korea last year.

While this progress was not sufficient to halt the rise in global emissions – which have increased by 1.3 Gt CO_2 since 2019 – it has initiated a structural slowdown in energy-related CO_2 emissions. Collectively, these technologies now prevent around 2.6 Gt of emissions annually, equivalent to 7% of global energy-related CO_2 emissions. Without them, the increase in global CO_2 emissions over the same period would have been three times larger.

Change in CO_2 emissions from fuel combustion and avoided emissions from deployment of selected clean technologies, 2019-2024



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The impact is even more pronounced in some markets. In Australia, China, the European Union and New Zealand, the deployment of these five technologies over the past six years prevented the equivalent of more than 10% of total energy- related emissions in 2024.

At the global level, the deployment of solar PV over the last six years is now avoiding around 1.4 Gt of annual emissions, equivalent to the combined annual emissions of France, Germany, Italy and the United Kingdom. Avoided annual emissions from wind power amounted to around 900 Mt of CO_2; from nuclear 190 Mt of CO_2; and from electric cars and heat pumps, 80 Mt and 65 Mt of CO_2, respectively.

Although the reductions from electric cars and heat pumps are lower than from the other technologies studied, they are set to increase in coming years as stock turnover raises the share of these technologies not just in terms of annual new sales, but also in the overall stock of equipment in use.

DATA AND METHODOLOGY

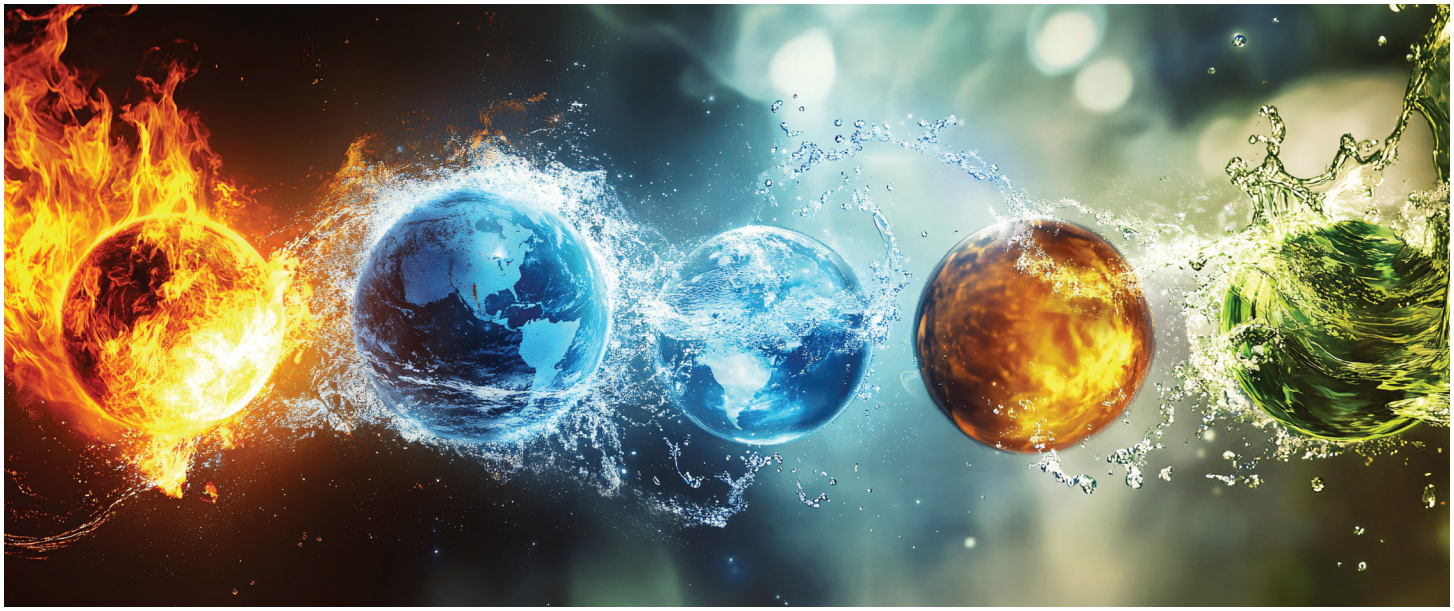
The IEA drew upon a wide range of statistical sources to construct estimates of energy demand and energy-related CO_2 emissions for 2024.

Sources included the latest monthly data submissions to the IEA Energy Data Centre, real-time data from power system operators across the world, statistical releases from national administrations, and recent data from IEA market reports, which covers coal, electricity, energy efficiency, natural gas, oil and renewables. Data on technology deployments come from a wide range of sources, including national statistics, industry associations, and commercial data providers.

The scope of CO_2 emissions in this report included emissions from all uses of fossil fuels for energy purposes, including the combustion of non-renewable waste, as well as emissions from industrial processes such as cement, iron and steel, and chemicals production. Estimates of industrial process emissions drew upon the latest production data for iron and steel, clinker for cement, aluminium and chemicals. CO_2 emissions from international aviation and marine bunkers were included at the world level only.

Economic growth rates underlying this analysis were those published by the International Monetary Fund's January 2025 World Economic Outlook Update. All monetary quantities are expressed in USD (2024) in purchasing power parity (PPP) terms. wn

Download the full report here.



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The Critical Role of Dynamic and Transient Simulations in Modern Power Systems

Electricity has become as fundamental to modern life as water and air. At the heart of this invisible infrastructure lies the concept of power system stability—the grid's ability to maintain a continuous, secure supply of electricity even in the face of disturbances. This stability is now more challenging to achieve than ever before.

By: David Sevsek,
Chief Technical Officer
Power Grid Engineers (PGE) , and
Aki Leinonen
Chief Operating Officer
Power Grid Engineers (PGE)
www.pge.fi

With the rapid growth of renewable energy sources, particularly wind and solar power, the grid is becoming more dynamic, less predictable, and increasingly reliant on complex control systems.

To navigate this evolving landscape, power system engineers and operators depend heavily on dynamic and transient simulations. These simulations are essential not only for identifying potential vulnerabilities but also for designing systems and controls that can ensure a stable, compliant, and efficient grid.

UNDERSTANDING DYNAMIC AND TRANSIENT SIMULATIONS

Dynamic and transient simulations serve distinct but complementary purposes in power system analysis.

Dynamic simulations examine how a power system responds over time to gradual changes, such as variations in demand, generation ramping, or automatic control actions. They are particularly useful for evaluating the effectiveness of system-wide control strategies, assessing long-term voltage and frequency stability, and ensuring that the power system can return to equilibrium after routine fluctuations.

Transient simulations, on the other hand, focus on the immediate, short-term response of the system to sudden events. These could include electrical faults, switching operations, or the loss of a major generator. Transient analysis is crucial for understanding how the system responds to these shocks—how quickly protection systems react, whether the frequency remains within acceptable limits, and whether voltage collapses or instabilities are triggered.

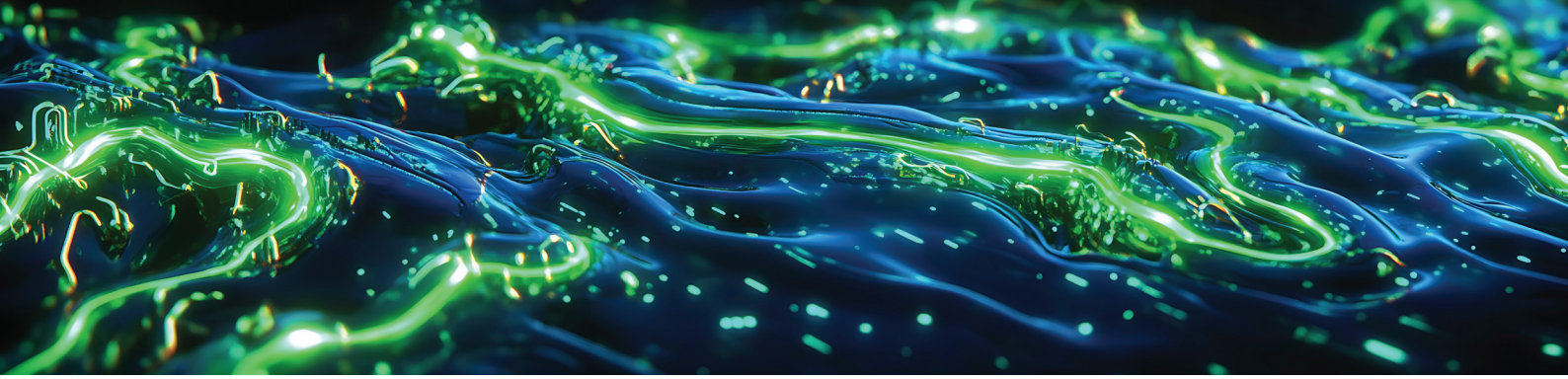
Together, these simulation types form a comprehensive approach to studying the power system across different time scales, enabling engineers to design grids that can withstand both gradual shifts and sudden disturbances.

SIMULATION TOOLS: PSCAD™, PSS®E, AND POWERFACTORY

To carry out these simulations, engineers rely on specialised tools. Three of the most prominent tools in the field are PSCAD™ (Power Systems Computer-Aided Design), PSS®E (Power System Simulator for Engineering), and PowerFactory.

PSCAD excels in detailed electromagnetic transient (EMT) simulations, making it well-suited for analysing fast-acting phenomena such as the behaviour of power electronic converters and inverter-based resources. Its strength lies in its high-fidelity, time-domain modelling, which allows engineers to capture the nuanced behaviour of components operating at microsecond intervals.

PSS®E, by contrast, is widely used for dynamic stability studies on a system-wide scale. It focuses on longer time horizons, offering powerful capabilities for simulating large interconnected networks and evaluating how the overall system responds to disturbances over several seconds or minutes.



PowerFactory adds another dimension to this toolkit, as it specialises in power system analysis, modelling, and simulation across various domains, including steady-state and dynamic analysis. Its user-friendly interface and comprehensive data management capabilities make it particularly effective for analysing transmission, distribution, and renewable energy systems. PowerFactory's ability to handle large datasets and complex models enhances its suitability for optimising power flows and conducting reliability assessments.

When used together, PSCAD, PSS®E, and PowerFactory provide a robust toolkit for engineers, allowing for detailed component-level studies and broad system-level analyses. Their effectiveness, however, depends heavily on the quality of the input data and the validity of the models used. Realistic parameters, often derived from manufacturer specifications or field measurements, are essential for producing trustworthy results.

GRID COMPLIANCE: SIMULATIONS AS A REGULATORY REQUIREMENT

As more renewable generators seek to connect to the grid, the role of grid compliance becomes ever more significant. Transmission and distribution system operators enforce grid codes—technical standards that all connecting facilities must meet to ensure the grid remains stable and reliable.

Simulations play a central role in this compliance process. Before a new solar or wind plant is allowed to connect, it must demonstrate—through simulations—that it can meet requirements such as fault ride-through capability, voltage control under disturbance, and frequency response support. These simulations help grid operators verify that even under faulted or extreme conditions, the generator will not endanger the wider power system.

Without accurate simulation studies, compliance becomes a guessing game. With them, it becomes a predictable and manageable part of project development.

THE CHALLENGE OF INVERTER-BASED RENEWABLE INTEGRATION

One of the most significant shifts in power systems today is the rise of inverter-based resources (IBRs), including solar

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photovoltaic (PV) and wind turbines. Unlike conventional synchronous generators, these systems interface with the grid via power electronics, which do not inherently contribute to system inertia or provide traditional voltage and frequency support.

This lack of inertia can lead to more rapid and severe frequency deviations during disturbances. Similarly, maintaining voltage stability becomes more challenging as IBRs respond differently from traditional generation during faults and fluctuations.

To accurately assess and mitigate these impacts, simulations must accurately reflect the actual behaviour of inverters, including their internal control algorithms, protection schemes, and response times. Developing these models requires close cooperation with equipment manufacturers and validation against real-world operational data. Only then can simulations provide meaningful insights into how IBRs will behave on the grid.

STAKEHOLDER COLLABORATION: A SHARED RESPONSIBILITY

Ensuring grid stability in this new era is not the responsibility of any single entity. Power plant operators must supply accurate models and data for their facilities. Investors need to understand the value of thorough simulation studies—not just as a compliance step but as a means of reducing technical and financial risk. Grid operators play a crucial role in defining the standards and reviewing simulation results to ensure they reflect real operating conditions.

In addition, equipment manufacturers provide the technical detail needed to accurately model complex systems, while regulators establish the rules that guide this collaborative process. The future of grid stability depends on how effectively these stakeholders collaborate to align technology, policy, and practice.

ECONOMIC AND RELIABILITY ADVANTAGES

Beyond compliance, dynamic and transient simulations offer clear economic and operational benefits. They help identify potential problems early—before equipment is installed or systems are commissioned—avoiding expensive redesigns or retrofits. They also enable planners and operators to test different scenarios, from routine disturbances to rare extreme events, thereby improving the resilience and flexibility of the grid.

In a world where electricity demand is increasing, and the energy mix is changing, simulations help pave the way for higher levels of renewable penetration without compromising system security. In the long term, they are a cornerstone of both economic efficiency and sustainable reliability.

LOOKING AHEAD: SIMULATIONS IN THE FUTURE GRID

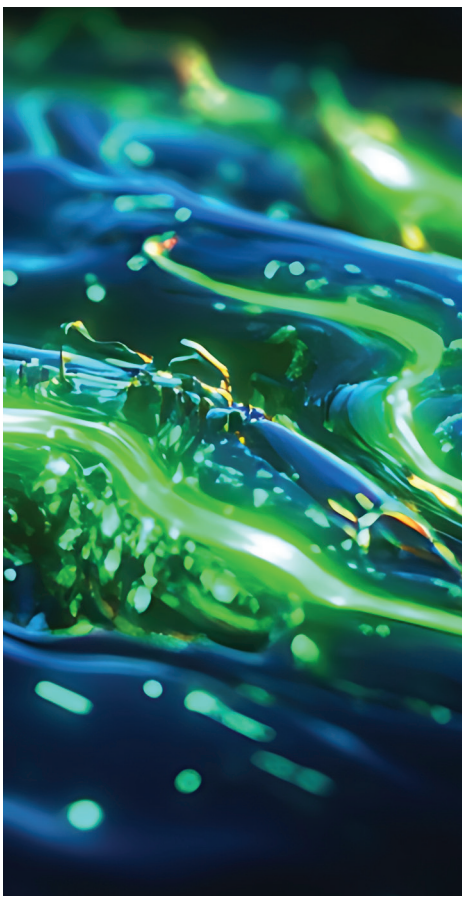
The field of power system simulation is itself evolving. Real-time simulators now allow hardware-in-the-loop testing, where physical devices are connected to digital models for validation. Digital twins—virtual replicas of entire systems—are being developed to monitor grid performance in real-time and forecast future issues. At the same time, grid codes are being updated to better accommodate the unique behaviours of inverter-based technologies and distributed energy resources.

Simulations will also play a key role in the development of decentralised and smart grids, helping integrate not just large-scale renewables but also electric vehicles, energy storage, and demand-side resources. The complexity of these systems means that planning and operating them without high-quality simulation tools will be increasingly impractical.

CONCLUSION

Dynamic and transient simulations are no longer optional—they are fundamental to modern power system engineering. They provide the clarity and foresight needed to integrate renewable energy, comply with grid codes, and build a resilient electricity network for the future.

In the race toward a decarbonised grid, simulation tools are not just analytical instruments—they are strategic enablers. For stakeholders across the power sector, investing in simulation capabilities means investing in stability, sustainability, and success. wn



A single flaw can break an entire system

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Jodi Poswelletski
DIRECTOR
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Phone: +27 11 593 3724
Mobile: +27 71 224 4665
Email: jodi.p@fwblaw.co.za

Keitumetse Khutsoane
CANDIDATE ATTORNEY

Phone: +27 11 268-0250
Mobile: +27 76 268 0250
Email: keitumetse.k@fwblaw.co.za

Winter Is Coming and So Are Higher Electricity Bills

10 SMART WAYS TO STAY WARM AND SAVE

As temperatures drop, electricity bills rise. With the average person using about 3,229 kWh annually and household consumption spiking by at least 20% in colder months due to heating, the season can come with a hefty price tag.

By: Dr Andrew Dickson, Engineering Executive CBI Electric

Dr Andrew Dickson, engineering executive at CBi-electric: low voltage, warns that Eskom's 12.74% tariff increase means the average family of 3.4 people could pay an extra R300 per month, and that's just under the Homelight and Homepower flat-rate tariffs. Homeflex users face even steeper hikes, with winter peak rates topping R7/kWh. Being proactive about energy use now can save money and ease pressure on the grid, especially with load shedding on the cards if outages exceed 15GW."

To help households stay warm without burning through their budget, he offers 10 smart home tech tips:

1. Understand Your Energy Habits: If you don't know how much electricity your appliances are using, you won't know where to cut back. Take an oil heater, for example. Running a 2,000W heater for eight hours a night could use up to 16 kWh per day, costing around R260 a week at current rates. Over three months, that's more than R3,000 for one room. Smart devices help track usage so you can cut back where it counts.

2. Avoid Energy Overload: Some smart home systems offer load management, which ensures that only one high-energy appliance runs at a time, reducing the peak demand. Smart automation can stagger appliance use, ensuring each runs at optimal times without straining the system.

3. Set Smart Time Limits: Users can specify the operating duration of appliances, like running the geyser for only two hours to save electricity while ensuring a hot bath.

4. Time It Right: Smart home technologies give users the ability to schedule when appliances turn on or off. This tip applies mainly to Homeflex customers, who pay different rates depending on the time of use. For example, a washing machine programmed to run during off-peak hours (10pm–5am) could cost as little as R1.01/kWh, compared to over R7/kWh during winter peak times. While flat-rate customers won't benefit from time-based savings, smart scheduling can still help reduce overall load or shift usage to when demand is lower on the grid.

5. Watch the Winter Spike: Even with flat rates, household consumption climbs during winter as heaters, underfloor systems and electric blankets work overtime. Smart home devices can help by setting on/off schedules and limiting how long appliances run. For example, you can programme a heater to switch on 30 minutes before your alarm goes off in the morning, warming your bedroom just in time, without it running all night.

6. Let the Weather Decide: Smart home technologies can respond to real-time environmental conditions,

like temperature drops, reduced daylight, or even changes in humidity, to automatically control appliances. For instance, if the sun sets earlier on a gloomy winter afternoon, lights can be set to turn on.

7. Control Energy from Anywhere: Worried you left a device switched on? Smart home technologies allow users to turn connected appliances off from their smartphone and/or tablet from anywhere in the world.

8. Stop Paying for Sleep Mode: When in standby mode, electronic goods like microwaves, computers, televisions and coffee machines can consume even more electricity than when they are in use, as they are only active for relatively short periods. While the obvious solution would be to unplug all non-essential appliances when inactive, smart home tech lets users switch off any items that are pulling power unnecessarily.

9. Safeguard Your Solar Investment: As more South Africans invest in rooftop solar, not only for backup but to reduce reliance on the grid and cushion the impact of rising electricity costs, smart home technology can play a role in protecting that investment. Smart power indicators, for example, help solar PV users manage energy more effectively when grid power is unavailable, by disconnecting non-essential appliances and preserving battery life until the system recharges. They can also automate other smart devices to keep essential infrastructure, such as security systems, operational. By allowing users to switch off high-consumption appliances like geysers and pool pumps, smart indicators help prevent system overload and extend battery performance.

10. Protect Your Appliances: Even though load shedding has largely eased, occasional voltage fluctuations and power surges still pose a risk to household appliances, especially in areas with ageing infrastructure or after storms. Smart home technologies can help protect your devices by allowing you to set a safe operating voltage range. If the voltage falls outside this range, the system can automatically switch off the flow of electricity until it stabilises, reducing the risk of damage to costly items like fridges, TVs, and Wi-Fi routers.

"Contrary to popular belief, homeowners won't need to rewire their homes to enjoy the benefits of smart home technologies. Devices like smart plugs, isolators and controllers can easily be installed by an electrician without the need for additional wiring or hubs," points out Dr Dickson. "Additionally, with the latest smart adaptors, tenants can enjoy the same benefits as homeowners and easily take their setup with them when they relocate or travel."

He concludes by saying, "As we head into the colder months, even small changes can make a big difference.

By using smart technology to manage our energy use, South Africans can stay warm, save money, and feel more in control of their electricity bills." wn

The AI Skills Revolution

WHY SOUTH AFRICA MUST ACT NOW TO COMPETE GLOBALLY

Generative AI is no longer a future concept or a speculative technology. It is here now, rapidly reshaping industries and rewriting the rules of competitiveness.

By Ntsako Baloyi
Senior Manager
Accenture, Africa

In South Africa, the potential for generative AI to drive inclusive economic growth, boost productivity, and unleash entrepreneurial innovation is enormous. However, to realise this potential, we must confront a critical and growing challenge: the skills gap. Without a workforce that understands how to leverage, manage, and innovate with generative AI, South Africa risks being left behind in a technology revolution that is already accelerating globally.

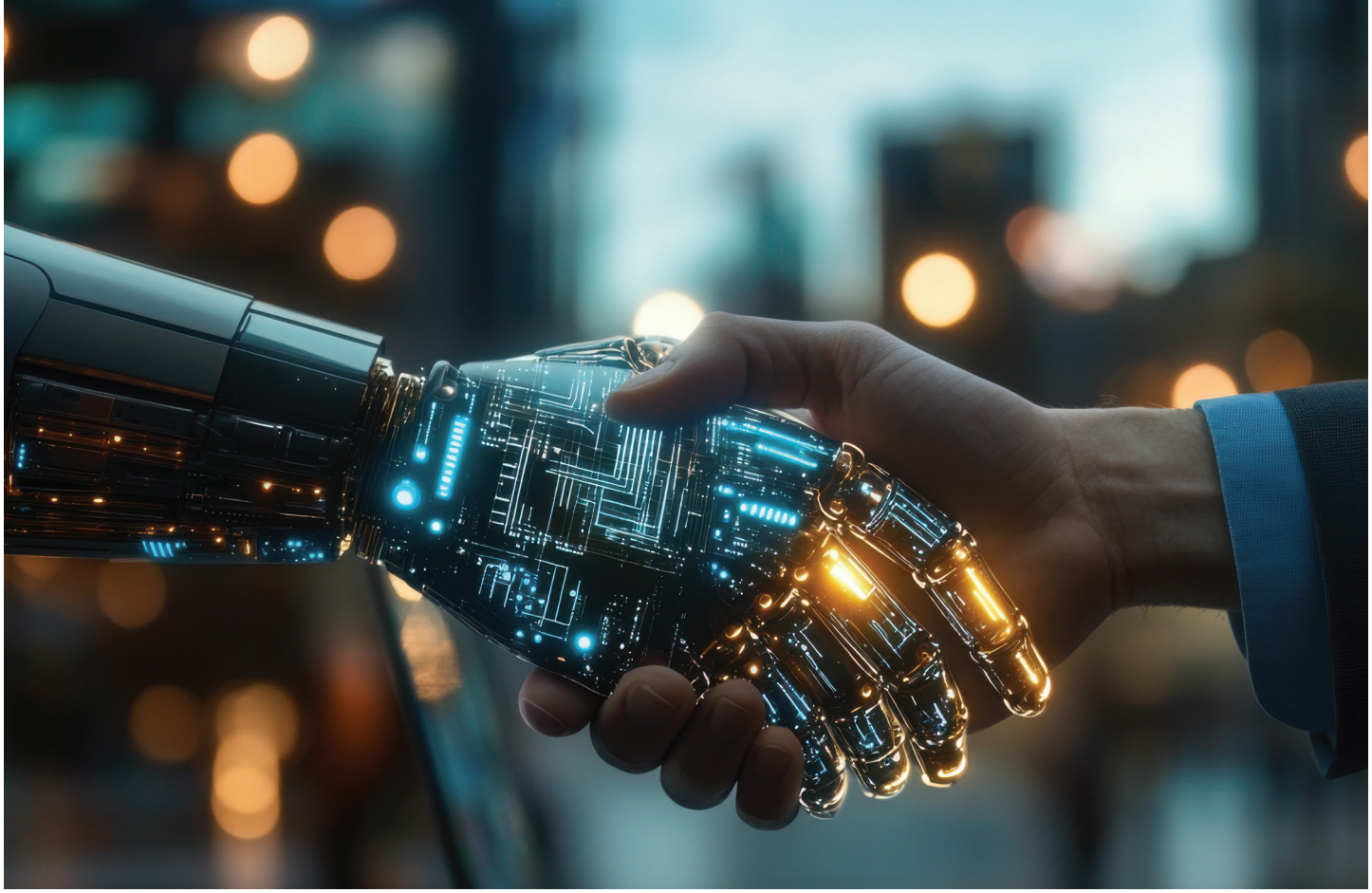
The time to act is now. South Africa urgently needs a coordinated national strategy to build generative AI skills at every level of society. Businesses must take the lead in upskilling employees, while educational institutions must modernise curricula to include AI literacy as a core competency. Government must foster enabling policies and incentives that support continuous skills development. South Africans cannot afford to wait for global trends to pass us by. We must equip our people with the tools and knowledge needed to shape, rather than merely react to, the AI future.

The skills needed are broad and varied. Beyond data science and machine learning expertise, there is growing demand for prompt engineering, model fine-tuning, AI system auditing, ethical risk management, and AI governance capabilities. Importantly, non-technical skills such as critical thinking, creativity, and problem-solving are becoming even more valuable in an AI-augmented economy. Organisations must therefore adopt a holistic approach, nurturing both hard technical skills and the human skills that make AI collaboration productive and responsible.

At present, South Africa's AI skills pipeline remains alarmingly thin. According to numerous studies, the country is producing fewer AI specialists per capita than many of its emerging market peers. This shortage is compounded by the global demand for AI talent, leading to a brain drain that sees many of our brightest minds leaving for opportunities abroad. If we fail to address this, South Africa will find itself trapped as a consumer of AI technologies developed elsewhere, rather than a creator and innovator.

Companies that wait for fully trained talent to appear on the market will fall behind. Instead, leading organisations are building internal AI academies, running targeted bootcamps, partnering with universities, and encouraging cross-functional learning. By identifying business areas where generative AI can have an immediate impact and investing in training employees to use these tools effectively, businesses can unlock new efficiencies and innovations while building long-term capability.

Educational reform is equally critical. South African universities and technical colleges must ensure that AI literacy is introduced across all disciplines, not only within computer science faculties. Future lawyers, marketers, doctors, engineers, and public administrators will all need to understand the basics



of how AI works, its limitations, and its ethical implications. Schools should also begin teaching foundational concepts in AI from an earlier age, normalising a generation of students who view AI as an everyday tool rather than an intimidating mystery. An interesting trend emerging in the country is the production of educational content for young children, targeting 4IR related skills such as AI and cybersecurity to ensure that children are intentionally prepared from a young age for the AI driven economy.

Moreover, generative AI offers an opportunity to democratise access to economic opportunity if skills development is inclusive.

South Africa must ensure that rural communities, township entrepreneurs, and historically disadvantaged groups are not left behind. Public-private partnerships, mobile learning platforms, and community-driven upskilling initiatives will be essential to bridging the urban-rural digital divide.

Government has a key role to play in creating an enabling environment. Tax incentives for businesses that invest in AI training, grants for research and development, and funding for AI centres of excellence are all tools that can accelerate South Africa's transition into a generative AI-enabled economy. Clear regulatory frameworks that address data privacy, model accountability, and AI ethics will further encourage responsible innovation.

The benefits of investing in AI skills are tangible. Companies that upskill employees in generative AI are seeing faster innovation cycles, improved customer experiences, and better decision-making. On a national level, closing the AI skills gap can drive GDP growth, reduce unemployment, and position South Africa as a regional leader in the digital economy. This need is more accentuated now than ever as South Africa is growingly being seen as a preferred outsourcing destination by global first world economies.

Conversely, the costs of inaction are steep. Countries that fail to build AI skills risk losing competitiveness, widening inequality, and becoming increasingly dependent on imported technologies that may not align with their societal values or needs.

South Africa has a proud tradition of resilience, adaptability, and innovation. We have navigated seismic economic and technological changes before, from the rise of mobile telecommunications to the growth of fintech.

We can do it again with generative AI, but only if we invest decisively in our most valuable asset our people.

The generative AI revolution is already underway. South Africa's opportunity is not just to participate, but to lead.

By closing the skills gap, we can turn AI from a distant technological trend into a tool that empowers every South African to shape their future. wn

Transforming smart grids with AI

The global market for artificial intelligence (AI) in the energy and utilities sector was valued at $10.56 billion in 2023 and is projected to surge to $45.78 billion by 2030, signalling the critical role AI will play in reshaping the future of power systems. At the same time, African cities are at a pivotal point in their energy transformation journey.

Satyajit Dwivedi
Regional Director
EMEAP, Energy Utilities, Mining & Metals, Public Sector, SAS

With nearly 600 million people across the continent still lacking access to electricity, the goal of building inclusive and sustainable smart cities remains out of reach without first modernising the foundational grid infrastructure. As efforts intensify to upgrade ageing assets and extend electricity access to underserved communities, AI is fast emerging as a catalyst for this transformation.

Africa's evolving energy landscape—driven by rising demand, the growth of decentralised renewable generation, and rapid digitalisation—highlights the urgent need for smarter, more responsive grid systems. AI will be central to this shift, offering the intelligence, agility, and real time decision-making capabilities required to manage increasingly complex and dynamic electricity networks.

THE URGENT NEED FOR SMARTER GRIDS IN AFRICA

Traditional power grids were built for a simpler, one-directional world—where electricity flowed from centralised power plants to passive consumers. That linear model, which served the industry for over a century, is no longer sufficient. Today, the power network has become inherently multi-directional. Urban centres are witnessing a surge in prosumers—consumers who also generate energy, such as households or businesses with rooftop solar panels feeding electricity back into the grid. Simultaneously, rising electrification, extreme weather events, ageing infrastructure, and the integration of renewable energy sources are making the grid more volatile and complex.

This dynamic environment requires more than just physical upgrades—it demands network intelligence. A modern smart grid is not defined solely by sensors and automation, but by its ability to interpret, adapt, and act on vast streams of real time data. And that intelligence must be managed intelligently. This is where AI becomes indispensable: enabling predictive analytics, autonomous decision-making, and seamless coordination across a decentralised, digital, and multi-directional energy landscape.

AI: THE INTELLIGENT ENGINE OF MODERN GRIDS

When combined with the Internet of Things (IoT), AI effectively gives the electrical grid a functional brain—empowering it to sense, analyse, and act in real time. AI algorithms process enormous volumes of data from smart meters, grid sensors, weather feeds, and even social media to detect patterns and generate actionable insights far beyond the reach of manual systems. This evolution enables utilities to shift from reactive operations to predictive and proactive grid management.

For instance, AI-driven forecasting models leverage historical consumption patterns, weather forecasts, and live sensor inputs to accurately anticipate electricity demand. This foresight allows operators to optimise generation and storage planning, mitigating the risk of blackouts. In countries like South Africa, where sudden demand spikes or generation shortfalls have historically led to severe load shedding, such predictive capabilities are game-changing—

facilitating a shift from crisis response to long-term grid resilience.

Furthermore, smart meter data plays a crucial role in enhancing peak load management and operational efficiency. AI systems can analyse granular consumption data to identify high-demand periods, enabling the implementation of Time-of-Use (ToU) tariffs that incentivise off-peak usage and smooth demand curves. Integrated Demand Response Management (DRM) strategies can autonomously signal non-critical appliances—like air conditioners or water heaters—to cycle down during peak times, reducing strain on the grid without compromising user comfort. This real time coordination helps stabilise the grid and reduces the need for costly infrastructure upgrades.

AI also supports outage prediction and planning, using anomaly detection on grid parameters to forecast potential failures before they occur. In case of disruptions, intelligent systems can reroute electricity flows to minimise impact and accelerate restoration.

As African communities expand the use of distributed energy resources—such as rooftop solar, wind, and battery storage—AI plays a vital role in integrating these assets into a cohesive system. Machine learning models can dynamically determine the optimal mix of local and grid-supplied energy, ensuring efficient utilisation of renewables.

The result is a self-optimising, multi-directional smart grid that not only balances supply and demand in real time, but also adapts to an increasingly decentralised, data-rich, and consumer-driven energy landscape.

FROM RELIABILITY TO SUSTAINABILITY

The promise of AI in smart grids is not abstract; it translates into very tangible benefits for utilities and citizens alike. Key AI-driven interventions for smart grids include several benefits.

Intelligent analytics can detect anomalies in equipment behaviour (like unusual vibrations in a transformer or voltage fluctuations) that often precede a failure. Utilities have begun installing IoT sensors on critical assets such as turbines, transformers, and transmission lines to enable this.

AI systems analyse the sensor data in real time and can alert engineers to impending issues or even trigger automatic preventative actions. This predictive maintenance avoids catastrophic failures and widespread outages.

Power theft and non-payment are persistent challenges in many regions. In fact, utilities worldwide lose an estimated $89.3 billion every year due to customers who bypass meters or do not pay bills. Africa is no exception – electricity theft in Nigeria or illegal connections in South Africa's townships directly affect utility finances and service quality.

AI can help here by analysing consumption patterns to flag suspicious anomalies. Advanced image recognition and drones equipped with AI can also patrol power lines to spot illegal taps or vandalism. By pinpointing where losses are occurring, utilities can take targeted action, improving revenue collection and reducing wastage. This ultimately benefits honest consumers as well, by strengthening the utility's ability to invest in better infrastructure instead of writing off losses.

Perhaps one of the most significant impacts of AI-driven smart grids is how they enable greater use of clean energy. Renewable sources like solar and wind are abundant across Africa, but they are intermittent by nature.

AI comes to the rescue by forecasting renewable energy output (predicting a drop in solar generation when a storm is coming, for example) and balancing it with other sources or stored energy. Intelligent control systems can decide when to charge battery banks, when to draw from them, and how to smoothly blend renewable power with traditional generation to maintain a steady flow.

This means cities can reliably incorporate higher percentages of green energy without jeopardising stability.

For a continent heavily impacted by climate change, the ability to build low-carbon, sustainable energy systems that are also reliable is a huge win. Smart grids with AI are thus not only about keeping the lights on – they are about doing so in a way that supports long-term sustainability and climate goals.

- Article continues on page 75

Unlocking youth potential to boost South Africa's energy sector

The renewable energy industry is booming in Southern Africa and beyond. However, we face a growing challenge in making the transition to a more sustainable energy future: the talent pipeline. The sector has typically relied on older, experienced professionals from the legacy power sector, but they are ageing and retiring, and young people are not entering the sector in meaningful numbers, leaving us without future talent to continue driving the industry forward.

By Viren Sookhun
Managing Director
Oxyon People Solutions

Fixing this gap to enable real transformation and long-term success will require collaborative action from both industry and the youth themselves, as well as a new approach to how we educate, inspire, and involve the next generation.

THE IMPORTANCE OF STARTING EARLY

One of the issues we currently face is that education initiatives and recruitment drives into the sector are targeting people who have already completed high school. The reality is that this is already too late. To build a sustainable workforce, the journey into the energy sector needs to start as early as Grade 10, when students begin to make subject and career choices.

More technical qualifications relevant to the energy industry should be introduced at this stage, not just at the post-matric level. These should not necessarily be limited to engineering, as project management and other technical energy-specific roles are also in demand, and they all require relevant skills. South Africa's many TVET colleges could play a key role here by offering more targeted, industry-aligned courses from the outset.

MORE THAN JUST JOBS

Addressing the readiness of the youth to take up jobs within the energy sector is only one piece of the puzzle. The industry itself has a crucial role to play in creating opportunities and pathways toward career growth, including bursaries, internships, and apprenticeships. Increased visibility of the renewable energy sector should also be a priority, to ensure that there is greater awareness of renewable power and the energy transition as career options. Career days, company visits and open days, as well as partnerships with schools and tertiary institutions, can help bridge the knowledge and access gap, providing clearer direction and exposure to real opportunities.

GETTING YOUNG PEOPLE IN THE ROOM

Many young people still do not know the full range of careers available in the energy space, and without that knowledge, they cannot pursue these paths. Schools, colleges and universities, supported by industry, need to be proactive in advertising where growth sectors are, what skills are needed and how students can get involved. Once students are studying related fields, it is also important that they be given insight into the industry to further their understanding of the requirements.

Conferences and high-level industry events are becoming increasingly frequent, but they remain largely inaccessible to students. Opening some of these spaces to youth by waiving the delegate pricing for students, particularly those in their second or third year of technical or engineering studies, could be hugely transformative. Listening to strategic discussions, networking with senior professionals, and simply being in the room could shape career ambitions and offer much-needed motivation.

FROM TICK-BOXES TO TRANSFORMATION

To address our growing skills pipeline challenges, youth development cannot simply be a CSI project or a tick-box

exercise. Real transformation and a strong future for our renewable energy sector will require a strategic, long-term and effectively resourced approach. This needs to include commitment from industry as well as input and involvement from government and education, as well as active engagement with young people. Without a deliberate, coordinated effort to engage and develop young talent, we risk building an industry that cannot sustain itself.

This is not just about filling job vacancies. We need to shape a future workforce that is skilled, motivated, and has the skills to succeed in the society it will be serving. This in turn requires earlier interventions, alongside more strategic investment in education, as well as sector visibility and career accessibility. To build a sustainable talent pipeline for our renewable energy sector, South Africa needs early interventions, targeted training, youth-focused outreach, and inclusive access to industry spaces. wn

Transforming smart grids with AI

continues from page 73

TOWARDS A SMARTER, BRIGHTER FUTURE

The benefits of AI-driven grid modernisation extend to both urban and rural settings. In cities, a stable, responsive power grid underpins smart mobility, digital services, and industrial growth. In rural areas, AI-managed microgrids and mini-grids enable decentralised electrification using local renewable resources. These systems optimise every watt of available energy, ensuring reliable access in regions previously off the grid. The broader social impact is profound—improved healthcare, education, and economic opportunity through reliable electricity access.

As African nations invest in smart infrastructure, the electric grid becomes the critical enabler for all other smart city systems. To fully realise the potential of AI in smart grids, policymakers, regulators, and utility leaders must invest in digital infrastructure, advanced analytics platforms, cybersecurity protocols, and workforce reskilling. Strategic partnerships and regulatory alignment will be crucial to scale these innovations sustainably.

The transformation of African power systems through AI is not just a technological upgrade—it is a foundational step toward energy security, socio-economic development, and climate resilience. Smart grids empowered by AI offer a pathway to a future of fewer outages, better-managed resources, expanded energy access, and greener power generation. By embedding intelligence into grid operations today, African nations can leapfrog into a new era of sustainable and inclusive energy systems. wn

5G - The catalyst for a smarter, more connected South Africa

The rollout of 5G networks in South Africa marks a transformative milestone in the evolution of connectivity. With the promise of faster speeds, ultra-low latency, and unprecedented device density, 5G opens up remarkable opportunities for the country's growing urbanisation and industrial aspirations. It paves the way for a future where Internet of Things (IoT) applications and autonomous systems can thrive, to bring about a wave of innovation and progress

By Avinash Gupta
Head of Centre of Excellence
In2IT Technologies

ENHANCED CONNECTIVITY FOR REAL-TIME DATA PROCESSING

The ability to support real-time data processing is at the heart of 5G's value proposition. Unlike its predecessor, 4G, which struggled with latency and bandwidth limitations, 5G enables ultra-reliable low-latency communication (URLLC). This feature is critical for applications where delays can have serious consequences, such as autonomous vehicles or industrial automation.

For instance, autonomous vehicles rely on real-time data from sensors to make split-second decisions. A delay in processing this data could result in accidents. With 5G, latency drops to under one millisecond, ensuring that vehicles can communicate with each other and the infrastructure in near real-time.

In South Africa, where traffic congestion is a growing concern in cities like Johannesburg and Cape Town, 5G-enabled smart traffic systems could dynamically adjust traffic lights based on real-time conditions, significantly reducing bottlenecks.

The symbiosis of 5G and edge computing
One of the most exciting synergies emerging from 5G is its integration with edge computing. Edge computing brings data processing closer to the source - a factory floor or a smart city sensor - reducing the need to send data back and forth to centralised cloud servers. When combined with 5G's high-speed connectivity, this approach minimises latency while optimising bandwidth.

Consider the potential in industrial automation: factories equipped with IoT-enabled machinery can use edge computing to process operational data locally while leveraging 5G to transmit critical insights to central systems for broader analysis. This setup not only improves efficiency but also reduces downtime through predictive maintenance. For industries like mining or manufacturing, which are pivotal to the economy, such advancements could lead to safer operations and higher productivity.

TRANSFORMING IOT CONNECTIVITY

IoT devices are proliferating at an unprecedented rate, from smart home appliances to industrial sensors. However, many current networks struggle to handle the sheer volume of devices. Enter massive machine-type communication (mMTC), another key feature of 5G that supports up to a million devices per square kilometre.

In practical terms, smart cities can deploy thousands of IoT sensors for applications ranging from environmental monitoring to public safety without overloading the network. For example, IoT sensors could monitor air quality in urban areas like Durban or detect structural weaknesses in bridges before they become safety hazards. These capabilities are particularly relevant in South Africa, where infrastructure development often lags urban growth.

THE ROLE OF EXPERT IT COMPANIES

The immense potential of 5G technology can only be fully realised through expertise in network deployment,

IoT integration, and cybersecurity. Third-party IT companies are pivotal in bridging the gap between technological possibilities and practical implementation.

Deploying 5G networks presents significant technical challenges, including the need for new infrastructure tailored to specific industries or regions. However, the expertise of IT Companies can help overcome these hurdles. Unlike previous generations of cellular technology, 5G requires a dense network of small cells and antennas, particularly for high frequency mmWave bands. IT companies can assist telecom providers in overcoming these hurdles by designing and deploying infrastructure that meets the unique demands of urban environments or industrial applications.

Another critical area is IoT integration. Many businesses lack the in-house expertise to seamlessly incorporate IoT devices into their operations. Third-party IT providers can design customised solutions that leverage 5G's capabilities, enabling businesses to optimise processes and unlock new efficiencies.

Cybersecurity is another pressing concern, as increased connectivity brings greater risks. Third-party IT firms can provide robust security solutions to safeguard sensitive data transmitted across 5G networks. This is particularly important for sectors like healthcare or finance, where data breaches could have severe consequences.

Finally, adopting new technologies often requires workforce training and ongoing support. IT companies can offer these services, ensuring businesses maximise their investments in 5G-enabled systems while minimising disruptions during the transition.

CHALLENGES AND OPPORTUNITIES IN SOUTH AFRICA

South Africa's socio-economic landscape presents a unique blend of challenges and opportunities for 5G adoption. While urban areas like Johannesburg and Cape Town are starting to benefit from 5G deployment, rural regions face delays due to infrastructure limitations. The lack of fibre backhaul in many areas is a significant barrier, as 5G networks require high-speed connections to function effectively. This disparity could exacerbate the digital divide unless deliberate efforts are made to include underserved communities.

Cost barriers also pose a challenge. Upgrading devices and systems to be compatible with 5G can be prohibitively expensive for smaller businesses or low-income households. However, innovative financing models or public-private partnerships could help mitigate these costs, ensuring broader access to the technology.

On the flip side, the widespread adoption of 5G can spur economic growth by enabling new industries and improving efficiency across existing ones. For example, smart city initiatives powered by 5G could address urban challenges like traffic congestion or energy management. Similarly, in agriculture—a vital sector for South Africa—IoT sensors connected via 5G could optimise irrigation and crop monitoring, boosting productivity while conserving resources.

By addressing these challenges head-on, South Africa has an opportunity to harness 5G as a catalyst for inclusive growth and innovation across multiple sectors.

Third-party IT companies have a vital role in this transformation by providing the expertise needed for successful implementation.

As South Africa continues its journey toward digital transformation, embracing the full potential of 5G will be essential for unlocking a smarter, more connected future. wn

Watts next

- CAN IT SAVE THE PLANET (AND YOUR BOTTOM LINE)?

The digital age's insatiable demand for computing power has collided with an urgent and pressing need for sustainability. As data centres and AI workloads consume unprecedented energy, IT providers are pivotal in redefining how technology intersects with environmental stewardship.

By Vishal Barapatre,
Group Chief Technology Officer
In2IT Technologies

From optimising algorithms to reimagining infrastructure, the path to energy-efficient computing is both a technical challenge and a strategic imperative—especially in markets like South Africa, where energy constraints and sustainability goals converge.

THE ENVIRONMENTAL COST OF LEGACY SYSTEMS

Traditional computing infrastructure presents a significant environmental challenge. Data centres, the backbone of the digital economy, consume an estimated 1–1.3% of global electricity, a figure projected to double by 2026 as AI adoption accelerates and more businesses move their data and operations to the cloud. This substantial energy consumption contributes significantly to carbon emissions, often relying heavily on fossil fuels to power these facilities. The carbon footprint of data centres is now comparable to that of the aviation industry, raising concerns about their impact on climate change. Furthermore, these facilities often rely on extensive cooling systems to prevent overheating, which consumes vast amounts of water and contributes to potential water pollution. Ageing hardware also contributes to the problem of generating electronic waste (e-waste)—a growing concern globally, particularly in regions like South Africa, where improper disposal can lead to environmental contamination and damage to the ecosystem. Legacy systems, therefore, present a multifaceted environmental challenge that demands innovative solutions.

RISING ENERGY DEMANDS MEET SMARTER SOLUTIONS

The exponential growth of Artificial Intelligence (AI) further intensifies the strain on energy resources. Training a single, large machine learning model can emit as much CO_2 as five cars produce over their lifetimes. This highlights the substantial energy requirements of developing and deploying complex AI algorithms. However, the good news is that AI itself offers a potential path toward more sustainable computing.

Energy-efficient techniques, such as model pruning (trimming redundant neural networks to reduce computational complexity) and quantisation (reducing the precision of data used in calculations), can slash computational demands by up to 50% without significantly sacrificing accuracy. IT providers are increasingly deploying these and other innovative strategies to help their clients strike a balance between the ever-growing demand for performance and the critical need for sustainability. They are helping businesses optimise their AI workloads to minimise energy consumption while achieving their desired outcomes, offering a beacon of hope in the quest for sustainable computing.

THREE LEVERS FOR SUSTAINABLE TRANSFORMATION

To drive meaningful change, IT providers are focusing on three key areas:

1. Architecting Green Infrastructure

Transitioning to renewable energy sources is no longer a choice but a necessity. Forward-thinking IT

providers are partnering with data centres powered by solar, wind, or other renewable energy sources, drastically reducing their Scope 2 emissions. Scope 2 emissions refer to indirect emissions resulting from the purchase of electricity, and by reducing these, companies can significantly lower their overall carbon footprint. Virtualisation, a technique that allows multiple virtual machines to run on a single physical server, also reduces hardware needs. By consolidating workloads onto fewer physical machines, organisations can lower energy consumption, reduce cooling costs, and minimise their overall environmental footprint by up to 70%. In countries like South Africa, where load-shedding and grid instability are persistent challenges, hybrid solutions that combine renewable energy sources with battery storage are gaining significant traction, providing a reliable and sustainable power supply for critical computing infrastructure.

2. Optimising AI for efficiency

Beyond implementing algorithmic tweaks, IT providers are actively redesigning AI workflows to maximise energy efficiency. For example, a South African financial institution successfully reduced the energy consumption of its fraud-detection model by an impressive 40% by employing knowledge distillation. Knowledge distillation is a technique that involves training a lightweight "student" model to replicate the behaviour of a larger, more complex model. This approach aligns with broader global trends, where sparse AI models that prioritise critical data points demonstrate the potential to reduce training energy consumption by as much as 30%. By optimising AI algorithms and workflows, IT providers can significantly reduce the environmental impact of AI-driven applications.

3. Circular IT Practices

Electronic waste (e-waste) is a growing global problem, with a significant portion estimated to end up in landfills, contributing substantially to toxic waste. To combat this challenge, IT providers are implementing circular IT practices, such as hardware refurbishment programmes and modular server designs, which extend the lifespan of equipment and reduce the need for frequent replacements. In Cape Town, for example, a tech startup is now repurposing decommissioned Graphics Processing Units (GPUs) from cryptocurrency mining operations for AI training. This innovative approach not only diverts e-waste from landfills but also provides a cost-effective solution for AI developers. By embracing circular IT practices, IT providers can minimise waste, conserve resources, and contribute to a more sustainable digital ecosystem, underscoring the necessity of these practices.

Navigating legal and market pressures

Regulatory pressures are increasing globally, pushing organisations to adopt more sustainable practices.

For instance, South Africa's draft Climate Change Bill mandates emission reporting for large enterprises, creating a strong incentive for businesses to seek out IT partners that prioritise Environmental, Social, and Governance (ESG) compliance. At the same time, consumers are increasingly favouring brands with verifiable green credentials, creating market demand for sustainable products and services. IT providers offering carbon tracking integrated into their cloud platforms, enabling clients to monitor their emissions in real-time, are gaining a significant competitive advantage. By helping their clients meet regulatory requirements and appeal to environmentally conscious consumers, IT providers are positioning themselves as essential partners in the transition to a more sustainable digital economy.

The future of computing depends on finding a sustainable balance between innovation and environmental responsibility. For IT providers, this means embedding sustainability into every aspect of their service delivery model, from advocating for open-source energy-efficient frameworks to designing AI-as-a-Service platforms powered by renewable energy. In countries like South Africa, where energy poverty and digital transformation coexist, these strategies are not simply ethical considerations but also pressing economic imperatives.

By proactively marrying cutting-edge computing technologies with circular economy principles, IT providers can transform sustainability from a perceived cost centre into a powerful catalyst for growth and long-term value creation. The industry has a vital role in ensuring a sustainable and equitable digital future for all. wn

Leading with Courage and Conviction to shape the Future of CX

In a world saturated with buzzwords and fleeting trends, authenticity is becoming one of the most powerful currencies a leader can possess. At Helm - a proudly South African customer experience (CX) solutions provider that has helped over 500 million users connect, converse, and convert across global markets - authenticity isn't just a value; it's how we lead.

By Jeané van Greunen
Chief Client Officer at Helm

Over the last two decades, Helm has established a reputation for developing intelligent products and services that deliver measurable impact. But behind every successful client story is a team led with integrity and purpose. As Chief Client Officer, I've learned that courage and values aren't just ideals; they're the tools that drive performance, build loyalty, and, ultimately, shape a sustainable legacy.

My leadership journey began with a simple yet powerful philosophy I adopted at 23 after reading The 7 Habits of Highly Effective People: "Grow by growing others." At Helm, I live by what I call being H.I.P. - Honesty, Integrity, and Passion. These aren't just aspirational traits; they guide how I show up, how I lead teams, and how I engage with clients.

At a previous employer, a pivotal moment came when one of the company's largest clients crossed a line that threatened the well-being of my team. The easy route would've been to comply. But strong values don't bend under pressure; they stand tall. I backed my team, navigated the conflict with empathy and resolve, and walked away not only with a stronger client relationship but with my team's trust intact. That's the power of principled leadership.

Today, courageous conversations have become an integral part of the job and are no longer viewed as a bonus. That may mean pushing back on a client, questioning a team decision, or calling out behaviour that crosses the line. Your voice matters. But real courage comes from being thoughtful and prepared. I always urge my team not only to raise issues but also to come up with ideas. Speak up, but do so with intention and respect.

At Helm, we foster an environment where open dialogue is open and constructive. That's how we've created a culture of resilience and innovation, even in the face of pressure, because clarity is what prevents the gossip, assumptions, and corridor whispers that could erode trust.

Throughout my career, I've been privileged to learn from a handful of exceptional mentors. These leaders have shaped my thinking and helped me grow and develop. From Clelland Kruger's insight on where to focus your energy with teams to Dawood Patel's reminder to "eat last" and put people first to Alan Knott-Craig's advice to always match talent to task, the lessons have been many and impact and profound.

Now, I like to think I pay that forward. I give my team the freedom and room to make decisions, take risks,

and, of course, be allowed to fail at times. Growth doesn't happen in safe, predictable environments. It occurs when people are trusted, supported, and held accountable with empathy and understanding.

When working with high-profile clients, it's easy to be dazzled by titles and status. But what I've learned at Helm is that integrity isn't about who's watching. It's about how you treat everyone - from the CEO to the intern. Our most successful client relationships are rooted in mutual respect, honesty, and a shared belief in doing the right thing, even when it's hard.

At Helm, it's never about the tech but rather about the people behind it. We believe in building trust one conversation at a time, so we're creating a company where people lead with their values, speak up with courage, and are empowered to make a difference.

After all, leadership isn't about knowing everything; it's about being willing to ask those tough questions, creating space for others to rise, and learning as we go. wn

When Seconds Matter

- ANTON PILLER ORDERS AND THE RACE TO RESCUE LOST DATA

Imagine finishing a late-night commissioning run only to learn that a disgruntled engineer has copied your SCADA databases, sensor calibrations and client contact lists onto a personal drive.

By: Jodi Poswelletski
Fairbridges Wertheim Becker

By the time you gather proof, that data could be encrypted, deleted or sitting on a server in another jurisdiction. Under the Protection of Personal Information Act (POPIA), you now face a statutory duty to protect personal information and to notify the Information Regulator of a breach. Delay is no longer an option.

For scenarios like these, the courts have developed a powerful - if drastic - remedy: the Anton Piller order. An Anton Piller order authorises a search-and-seizure operation without warning to the respondent. It is, in effect, a civil law "search warrant" executed by the sheriff and supervised by an independent attorney to preserve evidence before it disappears.

Because the remedy intrudes on constitutional privacy rights, the evidential bar is high. An applicant must show A prima facie cause of action – a legitimate underlying claim (for example, misuse of confidential information or breach of copyright); possession of vital evidence – the respondent holds specific documents, devices or credentials essential to prove that claim; and a real danger of destruction or concealment – by the time normal discovery arrives, the evidence will likely be gone.

Courts balance the potential harm to the respondent against the harm the applicant will suffer if relief is refused, ensuring the order is no more onerous than necessary.

Why are engineering businesses uniquely exposed? Data in modern electrical, electronic and ICT projects is simultaneously high-value and highly volatile:

Weightless & wipeable – One command can purge a Git repository or overwrite years of CAD work.

Mobile workforces – Remote access and BYOD blur the edge of the corporate perimeter; ex-employees can leave with terabytes on a flash drive.

Third-party integrations – Cloud SCADA, outsourced analytics and contractor VPNs enlarge the circle of potential evidence holders.

POPIA penalties – Projects often contain personal information (such as staff IDs, access logs, and supplier details). Mishandling that data risks fines of up to R10 million and criminal liability.

For the engineering sector, therefore, Anton Piller orders are not an IP luxury - they can be the only practical way to secure digital evidence and demonstrate a good-faith compliance response.

In a classic cautionary precedent, after the 2020 Experian breach, the credit bureau obtained an Anton Piller order within days to seize the hacker's hardware and cloud credentials. Although not an engineering firm, the case underlines the principle: speed preserves evidence, speed limits regulatory fallout. In the engineering context, a delayed response could result in the loss of vital schematics for a tender dispute and a separate POPIA investigation for failing to stem the leak.

How can you integrate Anton Piller's relief into your incident-response plan?

Map your evidence hot spots. Identify which teams and contractors hold live project files, source code, PLC backups or client records. Awareness shortens decision time when a breach surfaces.
Retain external counsel early. Courts expect precise affidavits and strict procedural safeguards. Engage legal advisers with Anton Piller's experience before the emergency. They will also arrange the neutral supervising attorney required to execute the order.

Assemble a forensics team. Digital imaging, hash verification and chain-of-custody protocols must be ready to roll. Ill-handled evidence can be ruled inadmissible.

Coordinate with POPIA obligations. Seizing devices is only half the story. You must still assess the scope of personal data exposure, notify the Information Regulator and affected data subjects, and address any remaining security gaps.

Rehearse the drill. Table-top exercises - much like an electrical safety-switch test - highlight bottlenecks and clarify who signs off on urgent court papers at 2 a.m.

In an industry where intellectual capital is often a .zip file away from vanishing, Anton Piller relief gives engineering companies a fighting chance to secure crucial evidence and mitigate POPIA exposure. Think of it as deploying a digital SWAT team: a last-resort tactic, yes - but one you would rather have rehearsed than improvised. wn

MEMBERSHIP FEES EFFECTIVE 1 DECEMBER 2024

The Council meeting held on 6 September 2024 approved subscription & entrance fees as from 01 December 2024 as per schedule indicated below.

PLEASE NOTE: In terms of Bylaw 3.2 annual subscriptions are due on 1st December 2024

MEMBERSHIP FEES CAN BE PAID IN MONTHLY RECURRING PAYMENTS

Council agreed to a discount for fees paid before 31 March 2025. Members are therefore encouraged to pay promptly to minimize increase impact.

Grade of Membership	Annual Subscriptions paid before 31 March 2025		Annual Subscriptions paid after 31 March 2025		New Members FEES * see Notes 1 & 4 below.	
	RSA incl VAT (R)	Outside RSA excl VAT (R)	RSA incl VAT (R)	Outside RSA excl VAT (R)	RSA incl VAT (R)	Outside RSA excl VAT (R)
Student	nil	nil	nil	nil	nil	nil
After 6 yrs study	1 890	1 644	2 268	1 972	2 268	1 972
Associate	1 890	1 643	2 268	1 972	2 268	1 972
Member	2 089	1 816	2 507	2 180	2 507	2 180
after 6 years	2 441	2 122	2 929	2 547	2 929	2 547
after 10 years	2 555	2 221	3 065	2 666	3 065	2 666
Senior Member	2 555	2 221	3 065	2 666	3 065	2 666
after 6yrs/age 40	2 768	2 407	3 322	2 889	3 322	2 889
Fellow	2 768	2 407	3 322	2 889	3 322	2 889
Retired Member (By-law B3.7.1)	1 174	1 021	1 409	1 225	n/a	n/a
Retired Member (By-law B3.7.3)	nil	nil	nil	nil	n/a	n/a

1. The fee for all new applications is R3457.00 which includes an entrance fee of R950.00. On election to the applicable grade of membership the new member's account will be adjusted accordingly and refunds/additional payment made on request.

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

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

4. Members elected after May 2025 pay a reduced subscription fee.

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

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

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

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

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

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

11. Members who wish to pay their membership fees in recurring payments should activate the payments on their banking portal. Members will receive the early bird discount only if their fees are fully paid by 31 March 2025.

2025 SAIEE MEMBER BENEFITS

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

MEMBERSHIP UPGRADE DISCOUNT STRUCTURE

LENGTH OF MEMBERSHIP	DISCOUNT UPON UPGRADE
10 - 19 years	5%
20 -39 years	10%
40+ years	15%

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SECTION CHAIRPERSONS:

Building Services	A Chivaurah	bssection@saiee.org.za
Electronics & Software	M Taljaard	essection@saiee.org.za
Historical Section	C Mohloki	hs@saiee.org.za
Power & Energy	M Soni	pesection@saiee.org.za
Rotating Machines	F Steyn	rmsection@saiee.org.za
Systems	T Ramagofu	systemsection@saiee.org.za
Telecommunications	TBA	telsection@saiee.org.za

CHAPTER CHAIRPERSONS:

Cybersecurity Chapter:	M Taljaard	csc@saiee.org.za
Entrepreneurship Chapter:	Y Mabuto	entrepreneurchapter@saiee.org.za
Financial Chapter	M Mdala	financialchapter@saiee.org.za
Lightning Chapter	H Hunt	lightningchapter@saiee.org.za
Load Research Chapter:	M Dekenah	lrchapter@saiee.org.za
Nuclear Chapter:	D Nicholls	nuclearchapter@saiee.org.za
Railway Chapter	R Kopa	railwaychapter@saiee.org.za
Renewable Energy Chapter	T Mhondiwa	re@saiee.org.za
Women in Engineering:	M Phoshoko	wie@saiee.org.za

Eastern Cape Centre
Chairman | Philip Nicholson
E | ecc@saiee.org.za

Free State Centre
Chairman | Motoloki Lephoi
E | fsc@saiee.org.za

Central Gauteng Centre
Chairman | Keith Katyora
E | cgc@saiee.org.za

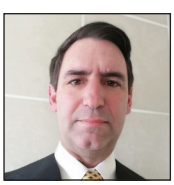
Kwa-Zulu Natal Centre
Chairman | Krystle Nageshar
E | kznc@saiee.org.za

Mpumalanga Centre
Chairman | Vacant
E | mpc@saiee.org.za

Northern Cape Centre
Chairman | Vacant
E | ncc@saiee.org.za

Southern Cape Centre
Chairman | Vacant
E | scc@saiee.org.za

Vaal Centre
Chairman | Vacant
E | vc@saiee.org.za



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Chairman | Heinrich Rudman
E | admin.wcape@saiee.org.za

JULY 2025

01/07/2025	Current developments in lightning data
09/07/2025	High Voltage Testing and Measurement
15/07/2025	Technical Report Writing
16/07/2025	Writing Good Technical Specifications
16/07/2025	Introduction to 5G Communication Networks
17/07/2025	SAIEE President's Invitational Lecture | JHB
17/07/2025	Arc Flash: Managing Electrical Risk from System Design to Personal Protection - KZN
17/07/2025	New Engineering Contract (NEC)
22/07/2025	Partial Discharge
23/07/2025	Anatomy of Wind Turbines
29/07/2025	Operating Regulations For HV/MV Systems - ORHVS

AUGUST 2025

05/08.2025	Photovoltaic Solar Systems
12/08/2025	Design Thinking and Innovation for Engineering Professional
13/08/2025	Earthing & Lightning Protection
13/08/2025	An Introduction to Artificial Intelligence for Professionals
19/08/2025	Lightning Protection of Structures, Low Voltage and Signal Systems
19/08/2025	LV/MV/HV Switch gear Operation, Safety, Maintenance and Management
26/08/2025	Professional Registration with ECSA for Mature Candidates
27/08/2025	Writing Good Technical Specifications

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