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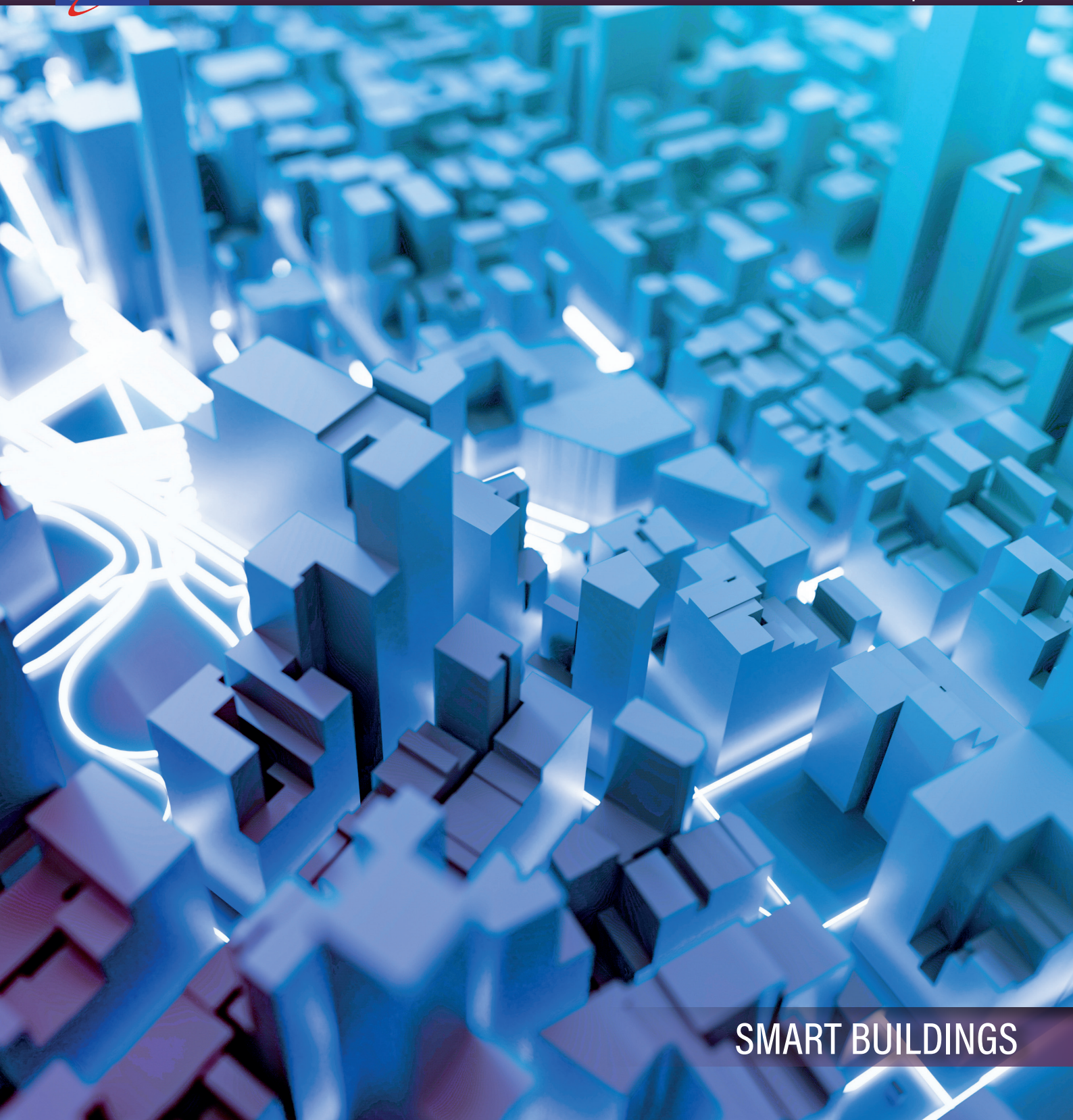
SAIEE THE OFFICIAL PUBLICATION OF THE SOUTH AFRICAN INSTITUTE OF ELECTRICAL ENGINEERS | MARCH 2023



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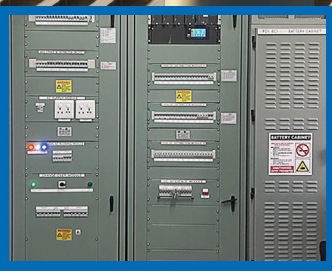


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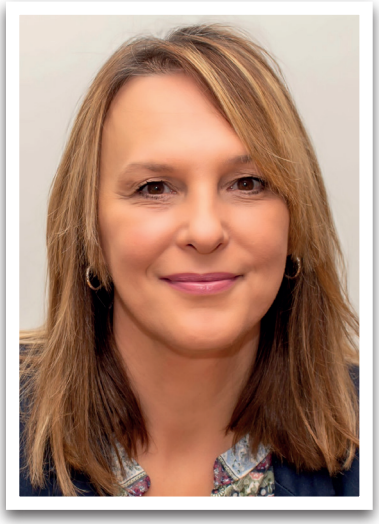

Dear **watt**now reader,

The SAIEE recently hosted its Annual Awards, and we are proud to showcase these remarkable achievements. Read the story on page 6.

This issue features Smart Buildings, and our first feature article, on page 20, discusses how technology enabling data capture and analysis, connectivity, monitoring, and control is becoming the new baseline for smart buildings of tomorrow. Understanding what it is and where it's headed is critical.

It's said that Rome wasn't built in a day, and there's a good reason. Cities are the most complex human-designed system on the planet. Today, 55% of the world's population lives in urban areas, with 68% projected to live in urban areas by 2050. In the United States, the number is already at 83% and is projected to reach 89% by 2050. Read "3 steps to build 'adaptive' smart cities of the future" on page 24.

Page 30 discusses "10 things to consider in planning and building a smart city". Technology has changed how we live our lives, and smart city technology is about to change that even more.

The April issue features Rotating Machines, and the deadline is The 31st of March. Please send your paper/article to: minx@saiee.org.za.

Herewith the March issue; enjoy the read!

PS: The SAIEE Annual General Meeting takes place as a hybrid event on the 23rd of March 2023 at 17h30. RSVP to Gerda Geyer for physical attendance or join the online meeting via Zoom here.

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2022 SAIEE Annual Awards

The South African Institute of Electrical Engineers (SAIEE) hosted their 2022 Annual Awards recently at an auspicious event at the Indaba Hotel and Conference Centre in Johannesburg.

This event was well-attended with decision makers, movers and shakers in the engineering fraternity, with entertainment by Russel Fox – magician insane and a lucky draw for an Advance Driving course valued at R7 500.

The Master of Ceremonies, Maanda Ramutumbu, introduced the SAIEE President, Mr Prince Moyo to welcome all our guests. "It is my honour and privilege to welcome all of you here tonight, and I hope you are as excited as me to see who our winners are," he said.

The winners of the 2022 SAIEE Annual Awards are:

SAIEE PRESIDENT'S AWARD:
PROF KUMAR VENAYAGAMOORTHY

Prof Kumar Venayagamoorthy - winner SAIEE President's Award

This prestigious award, sponsored by Revive Electrical Transformers, recognises significant contributions in any sector of electrical, electronic, telecommunications and computer engineering in South Africa. Prof Kumar Venayagamoorthy is an Honorary Professor of the University of Kwa-Zulu Natal (UKZN), Durban, South Africa, since 2014 and the Duke Energy Distinguished Professor of Power Engineering and Professor of Electrical and Computer Engineering at Clemson University since January 2012.

Over the last 25 years, his contributions have primarily emphasised the development and implementation of advanced computational methods and artificial intelligence-based algorithms for smart grid applications (e.g. nonlinear modelling and control of power systems, power system optimisation, predictions and forecasting of wind and solar energies, energy management systems, wide area monitoring and control systems, dynamic optimal power flow, electric vehicles, micro-grid systems, demand-response management).

He works on developing synchrophasor applications and situational awareness and intelligence systems for electric power control centre operations and management.

Prof Venayagamoorthy has received several awards for faculty, research and teaching excellence from universities, professional societies, and organisations, including the 2005 South African Institute of Electrical Engineers Young Achiever's Award presented by ABB PowerTech Transformers.

He is a Fellow of the South African Institute of Electrical Engineers (SAIEE), IEEE, IET (UK), and Asia-Pacific Artificial Intelligence Association (AAIA), and a Senior Member of the INNS.

SAIEE ENGINEER OF THE YEAR AWARD:
PROF FULUFHELO NELWAMONDO

From left: Lee Mbenge (ACTOM), Prof Fulufhelo Nelwamondo (Engineer of the Year Award winner) and Prince Moyo (SAIEE President).

This award, sponsored by ACTOM (Pty) Ltd, recognises an SAIEE member who has energetically and voluntarily worked towards promoting electrical science and its applications for the benefit of its members and the Southern African community.

Prof Nelwamondo is an electrical engineer by training and holds a Bachelor of Science and a PhD in Electrical Engineering in Computational Intelligence, both from the University of the Witwatersrand in South Africa. He is a registered Professional Engineer, a Member of the SAIEE and a Council member.

He is a senior member of the IEEE. He served as Executive Director for the CSIR Modelling and Digital Science Unit and a visiting professor of Electrical Engineering at the University of Johannesburg. He previously was a post-doctoral fellow at the Graduate School of Arts and Sciences of Harvard University.

Prof Nelwamondo has research and practical experience in software engineering, computational intelligence

and optimisation in various applications. He is the youngest South African to receive the Harvard-South Africa fellowship. He has been awarded many national and international research accolades, the latest being Order of Mapungubwe in Silver, which he received in 2017.

He received other accolades from organisations such as the IEEE, SAIEE, National Science and Technology Forum, and Springer, among others.

SAIEE KEITH PLOWDEN YOUNG ACHIEVERS AWARD:
BONGUMSA MENDU

Bongumsa Mendu, SAIEE Keith Plowden Young Achiever Award winner.

This award is dedicated to the most outstanding young achiever of the year in Electrical/electronic engineering. What counts in this person's favour is their spirit of achievement, creativity and leadership in the workplace. Innovative, entrepreneurial actions and infectious enthusiasm for success are the qualities exhibited by young achievers.

Bongumsa Mendu started practising as an electrical technician in 2013 at Eskom Holdings SoC Limited. Since 2016, he has been the chairperson of power system technical investigations of Northern Cape Eskom. Currently, he is a Power System Plant Data Analyst and Special Investigator and acting as a line Manager for Plant Sector Engineering & Specialized Investigations in Plant Management, Maintenance and Operations in Northern Cape Eskom.

In collaboration with the University of South Africa, under the department of Electrical and Mining Engineering, he has successfully supervised ten students for Design Project III and Industrial Project (EIP3701) during the 2022 academic year. In addition, he is currently a judge for Eskom Expo for Young Scientists in the Northern Cape.

SAIEE ENGINEERING EXCELLENCE AWARD
ZWELANDILE MBEBE

From left: Leanetse Matutoane (SAIEE CEO) and Zwelandile Mbebe (SAIEE Engineering Excellence Award winner).

The SAIEE Engineering Excellence Award is awarded to a person who has excelled in Electrical Engineering and their personal capacity that supports and mentors those with whom they interact in the workplace.

Zwelandile Mbebe has been a superb performer in each role he has played at the office and within the workgroups at fraternal organisations (e.g., SAIEE, UTC, Cigre, SABS) and has far exceeded any expectations for efficiency and productivity. The nominee stands out as one of the very, very best.

He is loyal and flies the Eskom flag very high despite the current challenges facing Eskom. His unique talent and skillset in utility telecoms make him a sought-after human asset that also plays an ambassadorial role in promoting Eskom within our fraternity and pays credence to Eskom's engineering prowess. He has served on the SAIEE Council for a few years.

SAIEE WOMEN IN ENGINEERING AWARD
SY GOURRAH

From left: Leanetse Matutoane (SAIEE CEO), Sy Gourrah (SAIEE Women in Engineering Award winner) and Vladimir Milovanovic (Schneider Electric).

The SAIEE Women in Engineering Award, sponsored by Schneider Electric

recognises a female SAIEE Member, Senior Member, Fellow or Council Member who has excelled in Electrical Engineering. She demonstrates above-average involvement in supporting the SAIEE with her aims and objectives and her capacity to support and mentor colleagues. Her peers and competitive counterparts have high regard for her integrity in all her engineering business dealings. This woman is a role model of the highest calibre.

Ms Gourrah has been part of the energy industry in South Africa for over 25 years. She holds several qualifications, including a Bachelor's in Engineering (Electrical & Electronics), a Master's in Business Administration and a Government Certificate of Competency. She served as the President of the Association of Municipal Utilities (AMEU) and has been on the AMEU executive council. She was the first female President of the AMEU. She was instrumental in changing the AMEU constitution to include more women on the executive, thus paving the way for the next female President.

She has served as the SAIEE President and chaired and participated in various Committees. She recently launched the SAIEE Women in Engineering Chapter, which will strive to promote women's interests and champion empowerment programs within the SAIEE and the broader electrical engineering fraternity. She is registered with the Engineering Council of South Africa (ECSA) as a professional engineer.

She was also part of the advisory team to the Deputy President on the Eskom turnaround strategy.

SAIEE CENTRE OF THE YEAR AWARD
CENTRAL GAUTENG CENTRE

SAIEE Centres are evaluated against a set of agreed KPIs, including events organised, membership increase, centre membership activity as gauged by the attendance of events organised, monthly reporting to head office, and corporate social investment initiatives. This centre submitted reports to head office on time for 7 out of 12 months, had several CSI initiatives, amongst which are Career

Day, Spelling Bee and collection of 2nd hand clothing for donation to schools. It scored a total of 22 points on the KPI's, with the nearest Center coming at 17. It is one of the most vibrant Centres of the SAIEE with a clear agenda to make things happen.

OUR SPONSORS
The SAIEE Annual Awards would not have been possible, without the outstanding support from our sponsors. They are:

- Revive Electric Transformers
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- Schneider Electric
- Proconics
- LEDVANCE.

SAIEE Central Gauteng Centre – winner of the 2022 SAIEE Centre of the Year Award.




















The power of forgetting

– WHY UNLEARNING IS CRITICAL TO BUILDING DATA SKILLS IN 2023

As part of our New Year's resolutions, we all have habits we wish we could eliminate, just as there are others we'd like to establish. It might be swapping a tendency for procrastination for productivity after lunch, exchanging nightly 'doom scrolling' for a book before bed, or going to the gym rather than watching the motivational clips that tell you to do so.

By Kevin Hanegan, Chief Learning Officer, Qlik; Chair, Data Literacy Project Advisory Board

Whatever it is, we know at the back of our minds there is often a better or aspirational way of doing things. But there is a reason so many resolutions fail: we often aren't aware just how ingrained the unwanted habits are, which makes it harder to learn new ones. Replacing them requires a conscious commitment to change.

Developing professional skills is just the same. Whether acquiring a specific certification or developing less tangible (but no less important) attributes, we need to deliberately learn and make clear plans for acquiring new skills – it's important to be proactive, not passive.

In the world of tech and data, this mantra is even more fundamental. If society and business are evolving quickly, it's because innovation is driving it, meaning digital skills can become obsolete almost as soon as they have been learned. Continuous learning is something of a prerequisite for most job roles, but is even more essential when technology is involved. The art of 'learning your craft' and applying it well still holds some sway, but adaptability is the name of the game when it comes to data skills.

IT'S TIME TO LEARN HOW TO UNLEARN

However, if we revisit the notion of committing to change, note that change is a two-way street. Developing professional skills, particularly in a fast-moving world such as data, doesn't necessarily mean adding new skills indefinitely to build the biggest portfolio possible. It's just as important to unlearn redundant ones.

It might seem counterintuitive to deliberately remove skills, but no one has infinite capacity to develop new ones while maintaining high standards of performance elsewhere. What's more, the new can sometimes conflict with, if not outright contradict, the old. In times of stress, particularly if new skills haven't fully become habits, it's easy to fall back on previous, outdated but familiar, ways of working.

UNLEARNING IS CORE TO DATA LITERACY

In a professional context, data literacy is one of the most important areas to learn and unlearn skills quickly. Again, this might seem counterintuitive. After all, data is primarily made up of facts and numbers – while we certainly need to learn how to use new tools to better access and derive insights from data,

surely once we have achieved a level of data literacy, we are equipped to understand and use data effectively.

Unfortunately, even for seasoned data practitioners, it's more complicated than that. New data sources are being created and integrated into businesses all the time, with their own patterns and behaviors that require learning. Existing data sources also evolve, showing new trends or losing importance altogether. Where does unlearning come in? If we assign the same status to new sources or ignore what they show us because they don't conform with what we've come to expect, those observing it will miss new opportunities and threats.

Ultimately, data literacy is a constant process of learning and unlearning, of putting aside assumptions while still applying our experience and understanding to get to the heart of what data tells us. So how do you learn how to unlearn?

THREE STEPS TO UNLEARNING

Broadly speaking, there are three steps to unlearning:

1. Know when it's time to unlearn: Be conscious of whenever something we've learnt no longer applies. Sometimes that's easy – there might be a tangible rule change. Typically, it's more challenging than this, as many skills (like habits) become unconscious. In data literacy, that means having a process in place that can highlight when something isn't working.
2. Learn independently: If the need to change has been identified, we first need to acquire the new skill. But it needs to be done independently from the existing approach. Acquiring a new skill is a fragile process and lacks the body of evidence that established capabilities have to prove value, so can't overlap with current skills – just as outdated and updated ways of looking at data shouldn't be used simultaneously. This is crucial to unlearning the previous skill.
3. Break the habit then make it again: To truly master a skill, it needs to become second nature so it can be deployed unconsciously, even when under pressure. However, that's not easy if experienced team members used to doing things a certain way are influencing those around them. Less experienced colleagues might follow their lead as best practice, even if there is a more productive solution trying to be instilled by leadership. It could be beneficial to allow them time to make new habits without being impacted by experienced colleagues who might find change more difficult.

All organisations need their employees to have the skills to thrive in the future of work, and data literacy is a key foundation on which they should be built. But even the capabilities at the cutting edge need to be replaced at some point.

After all, it's all very well becoming an expert in a particular field, but sometimes, the field itself changes. So, if professional skill development is part of your New Year's resolutions, consider what current experience needs to be acknowledged or forgotten, before you build new skills and challenge yourself accordingly to avoid falling back into old habits. wn

Calling all South African social innovators

APPLICATIONS FOR THE SAB FOUNDATION SOCIAL INNOVATION AND DISABILITY EMPOWERMENT AWARDS 2023 ARE NOW OPEN

Applications for the 13th annual SAB Foundation Social Innovation Awards and the eighth annual Disability Empowerment Awards are now open for applications.

Prizes range from R200 000 to R1.3 million in grant funding, and each award winner will receive valuable business skills development coaching, mentorship, and technical support.

The Social Innovation Awards are aimed at innovators, entrepreneurs, institutions and social enterprises with prototypes or early-stage businesses that can solve social issues in our country. These products, services, business models and processes should directly address the social challenges faced by low-income women, youth, or people living in rural areas while simultaneously creating a sustainable business model.

The Disability Empowerment Awards are awarded to entrepreneurs or social enterprises that have developed an innovation that improves access to the economy and provides solutions for persons with disabilities while generating enough revenue to become sustainable over time.

Online applications open at midday on 17 February 2023 and close at midday on 27 March 2023. Only applications submitted on the SAB Foundation web portal will be accepted. Apply here.

"We are excited about the 2023 applications and look forward to meeting our finalists this year," says Itumeleng Dhlamini, Social Innovation and Entrepreneurship Manager at the SAB Foundation. "Over the years, we have been so inspired by ordinary individuals doing extraordinary things."

"These awards allow us to support and encourage talented innovators who drive change and improve the lives of people in their communities," says Dhlamini. "Through the funding, training and mentorship that we provide, we enable them to grow and scale their businesses and ultimately achieve self-sustainability."

Social innovations awarded in 2022 included a low-cost utility vehicle that assists emerging rural farmers in performing their daily tasks. Another was a polymer-based, non-pressurised, recyclable and reusable fire extinguisher designed to combat the threat of fires in informal settlements.

In the Disability Empowerment Awards category, equally innovative solutions were awarded, such as technology that produces high-quality, affordable prosthetics and orthotics for amputees and persons with disabilities.

Through this prestigious awards programme, the SAB Foundation has invested over R90 million in grant funding and business support to support 176 entrepreneurs. Between 2011 and 2021, these individuals have created 1 638 new jobs since winning an award and employed 3 174 people.

"Building sustainable businesses in underserved communities is a key priority for us at the SAB Foundation because we know that each business creates employment opportunities for locals, which enables them to put food on the table for their families," concludes Dhlamini.

Applications are open to all South African citizens of 18 years or older with evidence that before applying, they have spent time and money developing the innovation. The Awards are not open to NGOs fully dependent on grant income. Early submissions are strongly encouraged. Apply now wn

JODI POSWELLETSKI

Director, Fairbridges Wertheim Becker.

Jodi was admitted as an attorney in 2012 and specialises in corporate and commercial law. Her practice has specific focus on the following areas:

Expertise

- Data Privacy and Protection and its practical application; *(Jodi has appeared on National Radio to engage with this subject and has also presented internationally on the subject on Terralex forum);*
- Commercial and Corporate litigation; *(inclusive of drafting and vetting of lease agreements and commercial contracts as well as conducting commercial due diligences and providing commercial legal opinions);*
- Business rescue and liquidations;
- Mediation through the auspices of L.E.A.D;
- Chairing at disciplinary enquiries;
- Prosecuting at an internal government department.

She acts for a variety of clients ranging from individuals to private companies within the property, auditing, manufacturing of beverages, steel, and corporate sector.

Qualifications

- Bachelor of Arts degree in Industrial Psychology and Law (University of the Witwatersrand) (2007)
- Post Graduate Bachelor of Laws degree (University of the Witwatersrand) (2009)
- Masters in Corporate Law (University of the Witwatersrand) (2019)
- Accredited Mediator (L.E.A.D) (8 February 2021)
- Recently completed an intensive 8-week practical data protection online course through the University of Cape Town (23 August 2021 to 19 October 2021).

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More than Just the Energy Transition...

ENLIT AFRICA LAUNCHES 2023 PROGRAMME

Enlit Africa (formerly known as African Utility Week and POWERGEN Africa) proudly presents its 2023 programme, which will run from 16 to 18 May at the CTICC in Cape Town.

Enlit Africa 2023 returns with a world-class exhibition showcasing the latest technology and services on offer in the power and energy sector, under the theme The multi-dimensional, multi-sectoral energy transition.

Known for its compelling content and speakers, Enlit Africa includes a live conference, exhibition, roundtables, co-located events and exclusive one-on-one interviews with leaders in the energy sector. All this plus product launches, innovative technology showcases, site visits, networking, and more.

VIEW THE ENLIT AFRICA 2023 PROGRAMME

THE MULTI-DIMENSIONAL, MULTI-SECTORAL ENERGY TRANSITION

In 2022, Enlit Africa focused on Africa's just energy transition, and how the $8.5 billion Just Energy Transition Partnership (JETP) intended to contribute to the early retirement of coal plants, build cleaner energy sources and support the transition of coal-dependent regions. This year, the lens adjusts to Just Energy Transition Investment and South Africa's JET Investment Plan, which sets out the investment roadmap for transitioning South Africa — the world's 12th biggest carbon emitter — to an energy transition that attracts investment, creates new industries and jobs and achieves energy security and climate resilience. Understanding this plan gives context to the multi-sectoral elements that make up the overall roadmap to a low carbon future.

The Investment Plan indicates that South Africa will require approximately R1.5 trillion over the next five years to enable a just transition and achieve the country's Nationally Determined Contributions. The question is: where will this financing come from? And what are the capacity requirements to make this plan a reality?

"We are excited to explore the various elements of Just Energy Transition investments, not only in South Africa, but across the continent as a whole. Understand where the money is coming from, and how it will be invested will give us a clear picture of the challenges and opportunities the transition will bring. Because each country's transition will be unique, this is an opportunity to be innovative in the way we plan Africa's future," says Claire Volkwyn, Head of content for Enlit Africa.

Join our expert panel as we discuss these questions and more in the opening Keynote session on Day 1 of Enlit Africa. Additional topics of discussions include the practical energy transition, energy access and affordability, implementation of storage, and a number of practically focused, technical presentations.

REGISTER YOUR INTEREST FOR ENLIT AFRICA 2023

AFRICA'S JUST ENERGY TRANSITION INVESTMENT

Day 2 explores Africa's energy transition ambitions which are currently being tested in the face of a global recession, rising poverty, unemployment and falling utility revenue.

In addition to the staggering sums of investment that have been identified for the technology and headline achievements of the energy transition, Africa is facing the reality that it will likely not meet SDG7 (energy access for all by 2030). How do we bring together the combined need for a transition with the promise of access - while ensuring that productive use of energy and long-term employment and economic development opportunities are part of the delivery strategy?
Join us as we discuss not only the financial requirements, but the requirements for skills and economic development too.

On Day 3, the programme delves into renewables and the new landscape facing IPPs, shining a light on regional energy developments. The democratisation of energy in Africa is also a hot topic on Day 3, as the programme explores how communities can become part of the solution through equitable access and ownership of energy, thereby building

a vibrant, inclusive energy democracy model for Africa. Technical presentations will also provide participants with possible solutions to improving delivery, deployment and operation of transmission assets in Africa.

Says Volkwyn: "We look forward to welcoming the industry back to Cape Town for our first event with no COVID-19 restrictions. We had a wonderful event in 2022 despite the restrictions under which we operated and know that 2023 will exceed expectations."

DOWNLOAD THE ENLIT AFRICA 2022 POST EVENT REPORT

ABOUT ENLIT AFRICA 2023

The energy transition is more than just a transition to cleaner energy - it is a journey to a completely new energy landscape in which generation, transmission and distribution networks evolve and adapt to bi-directional electricity flows, distributed energy, intermittent renewable energy and new grid technologies. However, this transition is not just about embracing the new — it is about understanding the role that more traditional infrastructure will play in the future and considering the role a multitude of technologies are going to play.

At the beginning of 2021, African Utility Week and POWERGEN Africa rebranded as Enlit Africa, transitioning to embrace the new dynamic and welcome the step change in Africa's power and energy industry. Our programme reflects the entire power and energy landscape, asks the hard questions and provides the answers to the most challenging questions.

Enlit Africa runs from 16-18 May 2023 at the CTICC in Cape Town. This year marks the 23rd anniversary of this annual gathering of energy industry professionals. We believe that the collaborative efforts of civil society, government and all impacted stakeholders are necessary to ensure a just, sustainable, affordable and timely energy transition for Africa.

Click here for more information.

FOLLOW ENLIT AFRICA ON LINKEDIN FOR THE LATEST UPDATES wn

THE SCHNEIDER ELECTRIC POWERLOGIC™ P5 PROTECTION AND CONTROL RELAY REDEFINES MV PROTECTION WITH ADVANCED RELIABILITY IN A FUTURE PROOF DESIGN

In the rapidly changing world of energy management, electrical system owners and operators expect their critical power systems to run flawlessly to minimize the impact on their operations.

This demanding level of operation is achieved using products which combine salient aspects of being reliable and sustainable whilst achieving safety and security and simultaneously being flexible and easy to deploy and manage.

Schneider Electrical has used its more than 100 years of experience with protection relays to develop a platform that provides advanced reliability whilst satisfying a future proof design that addresses the ever-changing challenge driven by new technologies and standards.

The PowerLogic™ P5 Protection and Control relay is part of the Powerlogic™ range of power monitoring and control solutions that has been developed in close cooperation with our valuable customers to ensure that all aspects of the critical nature of power system operation is met.

ENHANCED SAFETY

Power system operators face daily challenges with the risk of fire and explosion that compromises safety of human life. Schneider Electric understand that safety should never be compromised and have developed built in technology enabling nearby control using a mobile application allowing for monitoring and control via smart phones and tablets. Fires and explosion are the direct result of an Arc flash whilst operating switchgear. The Powerlogic™ P5 can be equipped with built in Arc flash protection functionality that eliminates this risk.

ADVANCED DATA SECURITY

In the age of the 4th industrial revolution, there is an increasing demand to have devices connected to leverage the ability to monitor and control whilst using valuable data to perform analytics that help power system owners and operators to make the right decision at the right time. This however requires a resiliency with the resultant threat associated with unauthorised access to this valuable data. The Powerlogic™ P5 is one of the first protection relays to be third-party certified according to IEC 62443 4-2 standard at Security Level 1. This certification addresses the threat of cyber attacks.

RELIABLE AND SUSTAINABLE

The Powerlogic P5 provides a best-in-class warranty of 10 years which demonstrates Schneider Electric's confidence in the product. The withdrawable design with a replaceable back up memory modules enables the quickest MTTR of the market of less than 10 minutes in the unlikely event of device failure.

The constant measurement of the internal temperature of the device allows for condition-based monitoring which extends to switchgear using separate wireless temperature and humidity sensors thereby reducing the risk of a power outage. The device low energy consumption and green premium manufacturing process demonstrates our strive for sustainability.

FLEXIBLE AND EASY

The user experience was critical during the development process to ensure an unequally experience throughout the entire life cycle. The requirement for a flexible product to adapt to the different applications was also a major consideration for the development team. Support for low power sensor inputs (LPCT/LPVT) or traditional CT/VT allow for investment optimization at the onset. Communication interfaces (both serial and Ethernet) were developed to be modular, thereby facilitating plug in capability. A device is therefore always able to be upgraded with additional communication modules post-installation allowing for minimal upfront investment and being adaptable for upgrades as needs change.

Out of the box support of 8 communications protocols including IEC 61850 (Edition 1 and 2) and up to 3 x IP addresses ensure that traditional and future architectures can easily be accommodated. This is further enhanced with support for dual redundancy and multiple time synchronisation mechanisms. Native IEC 61850 compliance ensures end to end IEC 61850 engineering.

The built-in application for injection testing and setting tool simplifies the deployment process into the critical power system whilst still allowing powerful automation and control ability necessary for operations.

QR codes on every device allows for simple and efficient access to product technical documentation for operators. wn

Life Is On | Schneider Electric

PowerLogic™ P5

Protection and Control Relay

A major step forward for protection relays

se.com/za

Top 7 Smart Cities in the World in 2023

Smart cities worldwide have made huge strides in their smart city initiatives and in adopting innovative smart technologies to make their home cities more sustainable and energy efficient, as well as minimise carbon emissions. Here's how seven cities are doing it.

The United Nations predicts that 70% of the world's population will live in cities and urban areas by 2050, meaning emissions and energy usage will continue to rise with every passing year. The need for smarter urban transport networks, environmentally-friendly water disposal facilities, and buildings with high energy efficiency is more critical than ever.

This is where smart city programmes and initiatives come in. Incorporating smart technology, including the Internet of Things (IoT) – objects embedded with sensors for data exchange – in urban cities improves not only the quality of life of its citizens but also the overall public safety.

As more international cities join the movement in investing in smart technology, seven smart cities are leading the pack with their smart city projects. Singapore, Helsinki and Zurich have topped the list of the world's smartest cities in the 2020 Smart City Index. The annual report, conducted by the Institute for Management Development with Singapore University for Technology and Design (SUTD), ranks cities based on economic and technological data, along with their citizens' perceptions of how "smart" their cities are.

1. SINGAPORE

Topping most lists when it comes to smart cities is often Singapore. Since launching its Smart Nation initiative in 2014, Singapore has introduced a wide range of smart technologies in both its public and private sectors. Contactless payment technology has been widely adopted to efficiently direct movement and payments for Singapore's 7.5 million public transport passengers. To help elevate the pressure of an ageing population, a digital health system was introduced – normalising video consultations simultaneously – and wearable Internet of Things devices to monitor patients. Moreover, Singapore announced in 2021 its plans for a new eco-smart city that is entirely vehicle-free. To be located in Tengah in the western region of Singapore, the planned forest city will be home to five residential districts with 42,000 houses and safe zones for both pedestrians and cyclists.

2. HELSINKI, FINLAND

Helsinki has set itself an aim of going carbon neutral by 2035, and they are proving to be on its way to reaching the goal. Even in 2017, the city managed to lower emissions by 27% than in 1990. Another goal Helsinki is working towards is reducing traffic emissions by 69% within three decades by 2035, with measures like transitioning the entire city bus fleet to electric and expanding its Metro and electric car charging networks. Since heating accounts for more than half of Helsinki's emissions, the city is focused on implementing energy-efficiency measures during renovations, which could reduce emissions from buildings by 80% and incorporate more renewable energy use in the city's buildings.

3. ZURICH, SWITZERLAND

For Zurich, it all started with a streetlight project. The city introduced a series of streetlights that adapted to traffic levels using sensors, which increased their

brightness or dimmed accordingly. The project enabled an energy saving of up to 70%. Since then, Zurich has expanded its smart streetlights across the city and established a greater range of sensory technologies that can collect environmental data, measure the flow of traffic and act as a public WiFi antenna. A smart building management system, which connects the city's heating, electricity and cooling, has also been shown to be highly effective.

4. OSLO, NORWAY

The Norwegian capital is going all in with electric cars and plans for all vehicles in the entire city to go electric by 2025, which is impressive considering its population of approximately 670,000 citizens. Incentives for zero-emission cars have already been implemented, including free parking, bus lanes, and lower taxes and prices at tolls. As part of the city's target for becoming carbon neutral by 2050, other smart projects are also well underway in Oslo, including zero-emission construction sites and retrofitting existing buildings to develop circular waste management and green energy systems.

5. AMSTERDAM, THE NETHERLANDS

Amsterdam's smart city project started in 2009 and featured more than 170 different operations across the city. What stood out for Amsterdam is its ability to stay innovative, whether it's using renewable energy for electric garbage trucks, installing solar-powered bus stops, billboards and lights, or constructing floating villages to combat overcrowding and provide an alternative to land reclamation. Thousands of operating businesses and households have already been modified throughout the city with energy-efficient roofing insulation, automatically dimming light switches, smart meters, and ultra-low energy LED lights.

6. NEW YORK, UNITED STATES

Hundreds of smart sensors and technologies have been tested and placed through the different districts in New York City as part of its smart city pilot programme in 2020. The programme amasses data to help manage services like waste management and collection more efficiently. New York has also seen the introduction of smart hubs with contactless technology, WiFi capabilities, and online charging stations in place of phone booths. Car-sharing services are also huge in the Big Apple, which helps reduce total emissions and traffic congestion. To culminate more local perspectives and creativity, New York City holds an annual contest – with a generous cash prize – for apps that best utilise the city's open data sets.

7. SEOUL, SOUTH KOREA

Home to Songdo, also known as the world's first smart city, Seoul's smart technology campaigns has only gone from strength to strength since launching its initiatives as early as 2014. Data is at the heart of Seoul's smart city projects. The accumulation and analysis of urban patterns, such as traffic flow, speed and air quality measured by sensors and CCTV deployed across the city, form a strong basis for smart infrastructure and services. Focusing the technology towards the city's ageing population, a safety initiative was launched to aid seniors living alone.

When there's no movement detected over a certain period or if environmental sensors pick up abnormal temperature, humidity, or lighting, relevant case workers and emergency services would be contacted immediately. Likewise, Seoul is looking into using the data platform to create an AI detective to flag potential crime patterns. At the moment, thanks to the 5G network, the Korean capital is also amongst the first cities to utilise 5G technology in mobility and transportation. wn

New Criteria for a New, Smart Building Era

Technology enabling data capture and analysis, connectivity, monitoring and control is becoming the new baseline for smart buildings of tomorrow. Understanding what it is and where it's headed is critical.

Progress in building science, making structures better for users and their physical environment, has long been defined by advancements in the hard and the tangible: architectural design, structural integrity, building materials, mechanical components and the like.

Those priorities remain as vital as ever, but now there's a new wrinkle when creating structures that meet modern standards and expectations. Today, the qualities of a building's digital infrastructure, the information and operational technology network embedded in everything that enables its routine functioning, easily rival the physical infrastructure in importance.

Digital technology, it's safe to say, has been revolutionising buildings for some time, just as it has been upending so many aspects of the human experience over the last several decades. More controllable, better monitored and increasingly responsive, technology-aided and enhanced buildings deliver a better user experience and operate more efficiently.

But the future of buildings is still being written. Present now, but still very much in the process of refinement, is the smart building, one characterised by the presence of a digital infrastructure robust enough to collect and amass building operational data, provide the connectivity needed to analyse, learn from it and share it; and ultimately leverage it for the benefit of the broad roster of stakeholders.

Those capabilities are being exploited in many new buildings designated as smart. But just as there's no ceiling on human intelligence, there's yet no evidence that smart buildings are nearing their full capacity in terms of functionality. While many technologies that make building intelligence possible are now robust and capable and delivering on their promise, more advancements are possible and bear watching, just as all stakeholders must closely follow new technologies in their embryonic stages. In various states of build-out, a few core technologies and technology applications should be on the radar of those interested in monitoring and evaluating smart building progress.

DATA CONNECTIVITY AND ANALYSIS

Building self-learning, which enables high-level automation and control, relies on effective data capture, sharing and crunching. Data captured from sensors in a building's complex web of systems that keep it running must be accessible and capable of being interpreted and leveraged. Networks, in turn, are elemental to smart buildings, which are fast becoming an offshoot of the rapidly spreading and maturing Internet of Things (IoT) – an environment in which individually addressable devices communicate via the Internet using a set of

commonly understood communications standards and protocols, sharing data, responding to commands and even acting autonomously.

With the rise of smart buildings, the Building Internet of Things (BIoT) is taking shape. It aggregates data from a building's connected systems, devices and assets, which may be separate from or incorporated into a building automation system (BAS). The BIoT comprises several basic building blocks: sensors to capture data; actuators that use data and analytics to respond; network standards that allow hardwired or wireless transmission of data; application platforms that provide the language for communication; and data storage and analytics that form the brains of the system and the functionality needed for automation.

Many elements of the BIoT are well in place, but progress is still needed in meshing and merging different technologies and systems. Common standards and the availability of flexible, open architecture for data networks are vital to seamless communication.

DIGITAL TWIN

Planning is essential to developing smart buildings that utilise technology effectively, work as intended, and benefit users. An important emerging element of the planning process is the virtual fashioning of the structure utilising building information modelling (BIM).
One product of the process is a "digital twin," a virtual computer model of the structure that permits simulating, testing and correcting design options before construction. The twin simplifies coordination with multiple design and engineering disciplines, sidestepping possible design conflicts that can be costly to correct during or after construction.

In the context of designing a smart building's features, the twin would enable an analysis of a structure's response to changes based on such variables as occupancy levels or different energy supply sources. The effect of adding a door or window could be analysed in the twin in the context of different building evacuation scenarios and the impact on heating and cooling costs. Post-construction, a digital twin can incorporate live data from the building, allowing constant comparisons with the original design. Serving as a central repository for all information associated with the building, the twin becomes a platform for testing and optimising building control scenarios as needed.

CYBER-SECURITY

Connected devices are the foundation of smart buildings, and little could be accomplished without them. But their presence also poses a security risk that technology must be capable of addressing.

With critical building systems networked to allow remote management and monitoring and IT and OT communicating with each other, a cross-contamination risk is real. An Internet of Things configuration offers multiple points of entry for potential hacking. That exposes both building information and operational technology systems.

To limit the potential security threat, smart building technologies must address physical and cyber-security risks. On one layer, occupancy

monitoring and control systems must monitor physical building access for anomalies that could indicate a cyber-attack. On another, digital networks must be safeguarded with firewalls and data encryption. Thirdly, system integrity must be ensured with individual systems and terminals protected from access by an unauthorised individual and unauthorised changes.

In short, the trend to extensive building digitalisation, and increased reliance on it, can be a double-edged sword regarding security. Utilising the full range of security features a smart building system offers can limit the potential for a cyber attack that could put building operations and users at risk.

SPACE MANAGEMENT

Gaining a better understanding of how occupants use a building is a central component of the smart building approach. Data captured through sensors is the foundation of programming a building's operational system, aligning with usage patterns and responding appropriately to needs. Tracking and logging user movements, monitoring building area occupancy levels and trends, and providing real-time information to occupants, smart building technology helps improve space utilisation to the benefit of both users and the building's energy requirements.

Space under-utilisation is one of the biggest inefficiency problems buildings present. Some research suggests that traditional assigned-desk configurations in office buildings leave those desks unused for up to half the day and that meeting rooms and other shared areas are often empty. That means significant areas of a building, for significant periods, are likely being lit and heated/cooled when no one is present.

Activity-based working (ABW) approaches have consequently begun to blossom. They move workers away from a single desk and toward a setup where workers can congregate in more defined but less restrictive workspaces. The approach offers more flexibility and potentially reduces the need to extend the power and a working environment across large building areas.

With real-time desk and room occupancy monitoring via sensors embedded in a desk or lighting systems, workers alone or in groups could quickly locate available work areas tailored to their needs. The information would be accessible via mobile phones, or live CCTV video feeds analysed by facial recognition software. The smart building configuration could go a long way to making that more feasible for employers. Occupancy detection will become a central feature of smart buildings as efforts to improve space utilisation advance. By extension, building users stand to benefit through enhanced productivity and better overall interaction with the building environment.

PREDICTIVE OPERATION AND MAINTENANCE

Digitalisation can transform the approach to operation and maintenance by providing an integrated platform for all building management elements. Typically, the current approach involves reliance on a mix of control and management systems. That's long been achieved with an expert operations staff capable of managing troubleshooting, inspection, repair and replacement as needed. But even top-notch building operations and maintenance staff often must make guesses about the source of system problems and the timing of service cycles and replacement; actual performance data has played a limited role in decision-making.

In a smart building configuration, sophisticated sensoring technology enables deep monitoring of building physical plant operations that can supplement knowledge and expertise held in human hands. With digitalisation, system performance can be monitored and tracked, servicing and maintenance needs can be predicted and planned, and costs can be better compared and estimated based on multiple variables. They can include the age and service record of the plant and equipment, its level of usage and how critical it is to building functions, and the investment needed to repair or replace.

The result is more efficient and cost-effective system maintenance and movement toward a predictive or "just-in-time" approach to maintenance. That means less unplanned downtime or outages, with necessary replacement or repair optimally scheduled. Additionally, money is saved by reducing unneeded or premature parts replacements and minimising the impact on building operations.

The energy needed to run building systems also can be better managed with smart building technology. In some buildings, energy management has become completely digitalised, with facilities managers able to review and optimise the building's energy performance using a mix of real-time and historical data to adjust or upgrade equipment such as the HVAC system. Thus, facilities managers can adopt a more strategic stance informed by data provided by new technologies aimed at improving facility performance.

MONITORING AND CONTROL

Reduced energy consumption in smart buildings is a savings opportunity concerning money and the environment. Reduction of a building's energy footprint translates to reduced energy production, much of which is still dependent on the burning of carbon dioxide-emitting fossil

fuels. The smart building, equipped with technology that closely monitors and controls energy consumption based on needs and resources, is well-situated to become another type of structure increasingly sought after: the green building.

The smart technology that enables improved operational efficiency and energy savings positions enables the smart building to be more environmentally friendly and sustainable. Buildings increasingly designed to have on-site renewable energy to supplement or even replace grid-supplied energy are edging toward "zero energy building" status, which will likely become the next meaningful marker for a new generation of buildings.

The sustainable building model has long revolved around a building materials and equipment approach that ties energy reduction to better physical infrastructure design. That remains important, but the other emerging dimension relates to better building systems management. A more proactive and ongoing effort to discover areas of energy waste in operations using smart technology may prove equally consequential. Improvements acquired through digitalisation could translate into a new target for building energy savings and reducing the environmental footprint.

CONCLUSION

Mass digitalisation is a game changer for buildings – from how they're initially conceived and designed to how they're built and ultimately utilised. The possibilities for using digital technology to create a broadly defined, overall better building stakeholder experience are only beginning to be understood and appreciated, more so with the help of those with proven expertise in configuring smart buildings that perform. Both new and modernised buildings will likely have far more native intelligence than their analogue predecessors.

The trick for these smart buildings, though, just as it is for the book-smart human, will come in translating that capability to the real world. Indeed, the challenge that confronts all would-be smart building developers is mistaking the presence of raw capabilities for the ability to achieve clear, meaningful results. But those are attainable when human intelligence and know-how intersect with smart digital technologies. In the end, that's what will produce buildings that truly work – for people – in the demanding 21st century. wn

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3 steps to build 'adaptive' smart cities of the future

It's said that Rome wasn't built in a day, and there's a good reason. Cities are the most complex human-designed system on the planet. Today, 55% of the world's population lives in urban areas, with 68% projected to live in urban areas by 2050. In the United States, the number is already at 83% and is projected to reach 89% by 2050.

By Nicholas D. Evans, Gregory Sauter, Ibrahim S Odeh

As such, cities represent perhaps the most important opportunity for innovation and digital transformation for our entire society and the planet. Through this transformation, we can deliver an urban future that is more sustainable, resilient, and adaptive.

In this article, we explore why the smart cities concept is necessary but not sufficient and three steps for achieving the adaptive city of the future – one which works for everyone.

WHY SMART CITIES ARE NOT ENOUGH

While the smart city concept has long been the future vision for cities, even this is necessary but not sufficient. Tech firms have long pitched the notion of intelligent sensors capturing billions of real-time data points to help cities become smart and able to respond to their surroundings. Use cases have included self-driving cars, smart lighting, and even smart trash cans. Sensors and data are indeed the building blocks, like cement, air, water, sand, and gravel are for concrete, but they represent raw ingredients, not the ultimate solution.

WHY ADAPTIVE CITIES ARE THE FUTURE

The smart cities concept is a helpful start, but the city of the future needs to go one critical step further. It needs to become an adaptive city that responds dynamically to continuous change and disruption.

In recent years, disruption – in all its forms – has moved from the exception to the norm. Today's continuous disruption comes in the form of both technological disruptions such as 3D printing, artificial intelligence (AI), machine learning (ML), autonomous vehicles, and digital twins, as well as business disruption such as pandemics, extreme weather events, climate change, unforeseen circumstances, and even wildly fluctuating governmental policies.

The smart city concept worked well for steady-state conditions, but in a world of continuous disruption, a key requirement for the city is to respond to change and do so with intrinsic agility across both digital and physical aspects of its operating model. Agility in the digital ecosystem is nothing if the city remains brittle in its physical infrastructure.

An adaptive city balances lives and livelihoods, resilience and sustainability, and all the political, economic, social, technological, legal, and environmental conditions that must be continuously analysed.

THREE STEPS FOR IMPLEMENTING THE ADAPTIVE CITY

The path to the adaptive city is a multi-year journey. Like digital transformation, it can gain quick wins, so benefits are realised every step of the way.

Three key steps to implementation relate to establishing the vision, designing for adaptability, and building for intrinsic agility.

ESTABLISH THE VISION FOR THE ADAPTIVE CITY

The vision for the adaptive city starts with its goals (figure 1). These are clearly different for each city. For example, in the United States, Miami's needs in terms of resilience are far different from those of Dallas. Adaptability is key since it becomes an enabler to support all goals better. It means you can hit more of your goals more of the time for more of your stakeholders.

Dynamic curb management is one solution that enables city planners to smoothen the flow of traffic and deliveries at the curbside using dynamic, data-driven curb management policies to make roadways more efficient and equitable. Two-hour parking spaces can become three-minute loading zones or dynamically priced delivery zones based on the time of day or other factors.

Since the business goals for the city are continuously changing, the adaptive city will need to support dynamic optimisation of the goals themselves so that goals in mutual tension, such as traffic volume and CO2 emissions, can be proactively managed minute-by-minute.

Figure 1. Adaptive city goals: dynamically optimised for all stakeholders—source: WGI Inc.

DESIGN FOR ADAPTABILITY

To design for adaptability, it is important to focus the design on both digital and physical elements of the city's architecture. Software adaptability can be accomplished with approaches such as cloud computing, AI, ML, digital twins, software-defined networks, smart contracts, and platform business models.

Physical adaptability can be accomplished with approaches such as modular design and construction, multi-functional design, robotics and drones, and techniques which support rapid integration and interoperability or dynamic provisioning (table 1).

Digital Enablers for Adaptability	Physical Enablers for Adaptability
AI/ML	Robotics & Drones
Cloud Computing	Modular Design & Construction
Smart Contracts	3D Printing
Digital Twins	Intelligent Sensors
Software-Defined Networks	Dynamic Provisioning
Platform Business Models	On-Demand Services
Open Innovation & Open Data	Adaptive Governance

Table 1. Digital and physical enablers for the adaptive city.

Examples include Ample's robotic battery swapping stations, which can swap out an electric vehicle's battery modules and packs in 10 minutes. Then there is "plug and play urbanism", which takes elements such as pedestrian bridges and makes them moveable as needed. The City of Fort Worth improved the streetscape with a moveable bridge across an 80-foot-wide creek. On a larger scale, Qatar's shipping-container football stadium can be removed and reassembled after matches.

Operational optimisation in parking facilities means not only doing more with less (e.g. during the pandemic when demand was down by as much as 90%) but in finding alternative approaches such as converting garage levels to work-out facilities, providing space for pop-up retail, or staging areas for restaurant take-out and food deliveries.

This physical adaptability extends to specific assets in the built environment and entire structures. Multi-functional streetlights, such as those in the New Haven planned development community in Ontario, California, are equipped with USB charging ports, environmental sensors, Wi-Fi, and wayfinding.

BUILD FOR INTRINSIC AGILITY

These digital and physical enablers will provide much-needed intrinsic agility to build or renew city infrastructure. By utilising them during the construction or renovation process, there is adaptability by design for their entire operational lifetime. A timely example is microgrids that can react to shocks, like a self-healing organism, if part of the grid is damaged.

Regarding integration, it will be important to pursue a platform business model where intellectual property from startups and other constituents can plug and play into the platform's services, much like the Apple app store. The adaptive city may own and operate this platform as a public service. Still, it also enables permissionless innovation so that others, including citizens, can easily innovate and build on top.

It's time to redefine the role of each asset from the buildings, roads, cars, and even the human role in the adaptive city.

As part of this journey, the natural environment must blend more with the hard-built environment: blending green and grey. As a society, we have relied almost entirely on grey infrastructure for too long without leveraging the benefits of the natural processes of green infrastructure, which has natural attenuators built in.

The adaptive city as a software company

With so many technical building blocks enabling so many use cases for the adaptive city of the future, perhaps the main challenge will be in the governance and orchestration of the platform business model which brings all this to life. At this point, the adaptive city will become its own software company – quite literally helping to improve the world.

It is said that "every company is a software company", and perhaps now is the time for every city to become a software company as well. wn

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HUMAN-CENTRIC LIGHTING

THE FOCUS ON PEOPLE IN LIGHTING DESIGN

Lighting solutions for modern work environments must be designed to promote creative thinking and high concentration levels at desks, on computers and in factories. Human-centric lighting places the focus on people and their need for natural light. Flexible, healthy and effective.

WHAT CAN HUMAN-CENTRIC LIGHTING DO?

With the right light at the right time, human-centric lighting (HCL) creates a working environment that simulates the changes in natural daylight with its visual, biological and emotional effects. To achieve this, the luminaires are controlled by an intelligent control system with appropriate light profiles.

Through colour temperatures and illuminance levels, human-centric lighting (HCL) can simulate the course of natural daylight in such a way that it provides positive support for the human circadian rhythm (our "inner clock"). For example, a neutral or cold white light colour can energise the morning. Warm white light is relaxing and ideal for the evening. HCL supports health, well-being and performance.

THE LEDVANCE BIOLUX SYSTEM

The BIOLUX HCL system from LEDVANCE automatically adapts artificial light to changes in daylight thanks to an intelligent, patent-pending algorithm – allowing users to choose the right dynamics for them at any time.

INTELLIGENT AND POWERFUL WITH HCL

The heart of our innovative, biologically effective lighting system is the BIOLUX HCL control unit. In combination with the BIOLUX HCL Downlight and BIOLUX HCL Panel luminaires, it always provides the right light at the right time of day. To adapt the system even more to your individual needs, you can also choose different lighting mood profiles, such as "RELAX" and "BOOST".

A real highlight – the BIOLUX HCL control unit is so easy to install and use:

- Wireless communication between the control unit and luminaires
- Easy switching between different lighting moods using an intuitive rotary switch
- Artificial light based on changes in natural light accurate for the day and location - with the best possible biological effect

The BIOLUX system from LEDVANCE is ideal for single-room solutions with up to 20 luminaires[1], such as meeting rooms or offices with little or no daylight.

LEDVANCE BIOLUX SYSTEM

THE FIVE LIGHT PROFILES

These five HCL light profiles are available:

BOOST - Highest concentration for highly detailed and particularly demanding tasks.

FOCUS - Enhanced concentration, e.g. in meetings.

NATURAL - Default setting

CREATIVE - Creativity in workshops, e.g. in brainstorming sessions.

RELAX - During breaks in meetings. wn

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1 Higher number of luminaires on request

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10 Things to Consider in Planning and Building a Smart City

Technology has changed how we live our lives, and smart city technology is about to change that even more.

by Martin Jones

Many modern businesses are focused on digital transformation, using technology to reshape long-standing business processes and remove inefficiencies. Even in traditional trades like landscaping, auto-repair, etc., businesses can leverage tech to make themselves easier to find, streamline billing, and grow their business.

There are myriad ways that cities can transform the way they operate. Increasingly, cities are setting their sights on how they can use technology to streamline and automate all the processes that come from urbanization. From bringing WiFi and wireless networks to new places to collecting data via IoT-enabled devices that can help make real-time decisions.

However, making these kinds of changes isn't as easy as setting up a network, adding some IoT devices at key intersections, and calling it a day. It would be best if you were smart about building a smart city. It requires serious thinking about the scope, implementation, and inter-department collaboration. Here are the ten keys to consider if you're planning and building a smart city.

1. DATA IS THE FOUNDATION

The most important thing to keep in mind as you consider any smart city project is that your decisions are only going to be as good as the data you have coming in. Taking advantage of advances in processing and analytics, therefore, means figuring out what data you need, how to get it, how to transfer it to where it needs to be, and how to store it.

Historical trends are particularly important to urban planning and development, so whatever solution you use needs to be resilient, meaning you've taken all necessary measures to ensure it will survive no matter what happens. That means redundant backups, both off-site and in the cloud. It also means you must be selective about what data you need to hang onto and for how long.

Data like HD footage will only get larger. A modern smart car, for example, can generate up to four terabytes of data per day. You probably don't need to keep all of that data in perpetuity. So, setting up local storage and periodically sorting through it for longer-term use on the cloud network is key. It will be important to focus on what's necessary (and for how long) to make the most of cloud resources.

2. THE NETWORK IS THE STRUCTURE

If data is the foundation on which smart cities are built, then the network is the structure that lets you build off it. Your data, after all, is only going to be as useful as your ability to manipulate it, and that means being able to pull information from across the network at a moment's notice.

To understand how a network should operate at the kind of scale we're talking about, it's helpful to look at other implementations that approach the kind of complexity a smart city will require. As Julie Song, President at Advanced RF Technologies writes for Forbes: "Sports stadiums, or any venue that hosts thousands of people in one area at the same time, aren't inherently capable of supporting adequate cellular connectivity to send a picture, text, or even a phone call. To improve cellular coverage and capacity, most of these venues install distributed antenna systems (DAS), with many strategically 'hidden' remotes and antennas for all major U.S. carriers in the venue."

These network node placements must be close to the action when it comes to connectivity, distance and architecture matter, as do materials. Most of us have experienced that one room of our house where the WiFi signal can be demanding, and usually, that has to do with what materials your signal has to pass through on its way from the router to your device.

The same is true for your urban network. Working with a provider like Cox Business, who understands the ins and outs of networking and can account for those issues, is key.

3. FACILITATING IOT CONNECTIVITY

On top of the physical demands of your network, there are digital requirements as well. The biggest priority is creating a low-latency environment that allows your decision-making processes to keep up with the blistering pace of 21st-century urban life.

Think through which IoT devices need to connect and how. For example, a sensor that reports the water level of a well once a day probably has vastly different requirements than a traffic camera at a busy intersection.

For devices that need to run on batteries, because it's difficult to run power to them, a low-power wide-area network (LPWAN) protocol is key. This allows them to continue to report information without requiring constant replacement. On the other hand, a camera needs the bandwidth to support moving large files around as quickly and seamlessly as possible.

4. MODULAR INFRASTRUCTURE

If you've spent any time reading or working on network security, you know it's vital to keep your devices up to date. New vulnerabilities are always discovered, and you need to be able to patch, update, or replace any device on the network without disrupting daily operations. A modular infrastructure enables you to keep everything updated while giving you the flexibility to make upgrades or scale up as needed.

5. SECURITY

It should go without saying that digitizing civic infrastructure carries some pretty significant risks with it. A coordinated cyberattack where a hacker gains control of IoT-connected devices could potentially wreak havoc in the physical world.

These concerns are fairly common in any conversation around the Internet of Things, but it becomes amplified when

we're talking about the scale of a smart city. Because of its civic infrastructure, attackers could be motivated by any number of reasons, from financial gain to political reasons.

The Microsoft Research NExT Operating Systems Technologies Group published an excellent and thorough whitepaper, "The Seven Properties of Highly Secure Devices." They outline them like this:

- The hardware-based root of trust: Does the device have a unique, unforgeable identity that is inseparable from the hardware?
- Small, trusted computing base: Is most of the device's software outside the device's trusted computing base?
- Defence in depth: Is the device still protected if the security of one layer of the device software is breached?
- Compartmentalization: Does a failure in one component of the device require a reboot of the entire device to return to operation?
- Certificate-based authentication: Does the device use certificates instead of passwords for authentication?
- Renewable security: Is the device's software updated automatically?
- Failure reporting: Does the device report failures to its manufacturer?

Answering these questions can point you toward where your network may be vulnerable. Security is a constant battle, so starting to think like an attacker is important to understand where to shore up your defences.

6. PRIVACY FROM THE GROUND UP

Another major concern to keep in mind as you ramp up connectivity and data collection is privacy. For all of the benefits that analytics, AI, and big data have granted us, there are some serious issues with how much the government could potentially know about its citizens. The picture isn't quite clear yet on how to best find a middle ground, but with regulations like the European's Union's General Data Protection Regulation (GDPR), expect conversations about privacy to continue to evolve. The best thing you can do right now is to keep it top-of-mind in any planning you're doing.

7. SENSORS AND DATA CAPTURE

It can be easy to find your head in the clouds when talking about smart cities. We talk a lot about data capture without being specific about what you want.

One of the reasons why it can get vague is because this kind of data could include virtually anything. Weather, wind direction and intensity, road surface temperatures and conditions, soil moisture, wildlife, noise pollution, sewage flow rates, valve pressure, water quality, pollen and more are just some examples of the data you could collect.

Philadelphia is implementing an app to notify drivers when there's an empty parking spot, reducing traffic and pollution. Boston is looking at all sorts of traffic data to protect bikers and pedestrians.

New York has automated its water meter reading system to streamline usage monitoring and billing. As part of its preparation to host the Olympics, Los Angeles has installed smart street lights that save money and electricity and serve as nodes for LGE connectivity, utility monitoring, air quality sensors, and more.

8. DISTRIBUTED DATA PROCESSING

Data processing is just as important as data collection. As discussed earlier, not everything you collect will be useful for your entire network. It's important to whittle down what you pass along to the cloud.

In the meantime, it's useful to have local data processing resources. Distributed processing allows systems like dynamic traffic management to respond much faster. This reduces the need to check in with HQ to make every decision.

9. FOCUS ON SMALL WINS FIRST

Rolling out a smart city plan at the scale we're talking about is a big project that can widen endlessly. It can start to feel like the entire project isn't worth starting if you can't overhaul several departments at once. The truth is that for a lot of people, talk is cheap.

The trick is to drive bigger transformation by starting with small, tangible wins as proof of concept for your larger goals. Start with one or two doable projects that provide real value to departments and the citizens they serve.

Focus on making people's jobs easier, and you'll have their support. It's local engagement that drives change in the larger ecosystem.

At the same time, that doesn't mean you can't design these projects according to your larger goals. You can still bake in principles for building a larger network and infrastructure, making it easy to use your early wins as a stepping stone to bigger and bolder things. Think of implementation as a snowballing process, starting small and building up momentum along the way.

10. A SMART CITY IS DE-SILOED

When trying to implement a large-scale change of any type, people can get territorial. Each department has its unique way of operating. Teams are understandably sensitive to any changes that might disrupt their routine.

The problem that many digital transformation projects run into is different departments within the same

organization solving the same problem in different ways. This makes collaboration harder, not easier.

Any smart city initiative needs to make de-siloing a priority. Departments must share data and agree upon formatting standards and procedures so everyone can get the most out of it.

This goes double for any new equipment or other infrastructure. It makes sense to pair a traffic sensor with an air quality monitor, for example. However, that can only happen with effective inter-department communication. Think big, and get everyone involved.

WHAT YOU CAN DO RIGHT NOW

Chances are your city already incorporates numerous IoT and networking solutions to improve operations. However, the difference between that and a smart city comes down to vision and planning.

Can you think holistically and connect systems to get a complete picture of municipal life at any given moment? Do you have the infrastructure to analyse that data and then take the appropriate actions? Are you thinking about privacy and security from the start? These keys can help you make the vision of a smart city a reality.

- Data is the key, but you need the infrastructure to sort, store, and analyze it effectively.
- Connectivity puts insights in the right hands at the right time.
- Security is of the utmost concern when connecting urban systems to a network.
- Consider privacy issues from the very start.
- Look at what other cities are doing to understand what kind of data you should collect.
- Focus on small wins to get your smart city project off the ground.
- Executing a big vision means de-siloing and getting all departments to come to the table. wn

Connectivity: The fundamental ingredient of a successful s

Smart cities and smart city ideals are emerging as the bedrock of sustainable urban planning, offering high standards of living to residents. Smart mobility plays a central role in this emergence, delivering sustainable transportation and improving lives. Yet its success depends upon rapid, secure, reliable methods of connectivity.

By Frank Stoecker, EMnify

Despite the expectations of the twentieth century, with the technological promise of The Jetsons, and the hit-and-miss prophecies of the BBC's Tomorrow's World, we're not yet travelling around in flying cars or riding bicycles across bodies of water[1]. Yet, with the accelerated rate of digitisation and the development of new technologies, some futuristic expectations are starting to crystallise on a citywide scale.

Smart cities are beginning to arrive in force, originating through trials and testing in Europe in the late 1980s and throughout the 1990s. From early forays focused on information and communications initiatives, sustainable spaces, grid energy solutions and data capture using geographical information systems (GIS), a more cohesive smart infrastructure has emerged.

Singapore's Smart Nation vision aims to capture information throughout the city, using sensors linked to aggregation boxes to deliver services based on traffic volumes and pedestrian activity. Its National Research Foundation is leading the development of Virtual Singapore, a dynamic 3D city model and collaborative data platform.

Oslo is addressing climate change with the wide use of sensors to control lighting, heating and cooling, to cut emissions by as much as 95% by 2030, and to develop a smart grid with widespread electric vehicle charging technologies.

Connected London is delivering full-fibre connectivity across the city, combining buildings with street assets such as lighting columns and bus stops to create a comprehensive grid of smart sensors and charging points. Small mobile transmitters for 5G are also being deployed to deliver citywide improvements to connectivity and future growth.

THE THREE LAYERS OF A SMART CITY

The future of the smart city is almost here. In many urban locations, the foundations have been poured into place. New development now depends upon three specific layers working together to make a smart city operate. According to McKinsey[2], the first layer is the technology, which requires a critical mass of smartphones and sensors connected by high-speed communication networks. The second layer is the applications, translating the constant stream of raw data into alerts, insights and action. And the third layer is all about getting buy-in and participation from members of the public.

For example, applications that show accurate traffic volume in real-time allow drivers and pedestrians to better plan travel routes and adapt at a moment's notice. Being able to access insights like this builds bigger efficiencies as well as prevents further backup in the congested area. When the benefits can be conveyed to the population at large, all three layers are satisfied.

mart city

THE ROLE OF CONNECTIVITY

And it all begins with connectivity. Without connectivity and rapid, secure, reliable data transmission methods, everything else begins to fall away. Secure, reliable connectivity also feeds into the third layer, ensuring buy-in and participation from the public. Without trust in the networks, rollouts will be compromised, and projects will be prone to uncertainties. Smart cities can only work if their inhabitants can trust them.

That's why availability, integrity, confidentiality and accountability must be at the forefront of any network infrastructure. It's the only way all ecosystem partners can cooperate within a transparent digital environment to achieve widely accepted solutions. A sustainable network infrastructure needs:

- Availability - to ensure actionable, real-time data access, allowing information to be collected, analysed and shared at the speeds necessary for decision-making.
- Data integrity - to inform the smooth operation of a smart city. Without accurate and reliable data, decision-making becomes compromised.
- Confidentiality, to protect and anonymise inhabitants' personal details and actions, preventing unauthorised access to confidential information.
- Accountability, to ensure system administrators and users at all levels are held responsible for their actions.

Built on these four data principles, the smart city becomes an economically sustainable urban development, delivering a high standard of living to its residents. And because the standard of living directly influences the quality of life, inhabitants can enjoy healthier, more fulfilled existences. From the air quality to the time spent commuting, smart cities allow for a humanitarian approach to inhabitants' welfare.

CONNECTIVITY AS THE SOLUTION TO URBAN MOBILITY

Many cities are in a transitional state, moving towards becoming smart cities. And many have implemented solutions to improve urban mobility for their inhabitants. That's because mobility issues have been a major challenge in recent years. That could be due to high population densities, the difficulties of a pre-existing built environment, or simply for resource allocation reasons. Smart mobility can alleviate much of the pressure. Also known as micro-mobility, smart mobility focuses on using small, lightweight personal vehicles with top speeds usually below 15mph. This includes privately owned and communal bicycles, e-bikes, electric scooters and electric pedal-assisted bicycles.

When inhabitants choose micro-mobility, there's less reliance on cars, mopeds and motorcycles. This feeds directly into the smart city ideals of improved air quality and reduced commuting times. And for those without access to motor vehicles, it unlocks more of the city, making the world more enjoyable.

Although technological advances in batteries and lightweight motors are forming the foundations of affordable, accessible micro-mobility, it's still illegal to use a privately-owned e-scooter on public land in the UK. However, several e-scooter trials are taking place across the UK, including London, where a 12-month trial began in June this year.

Micro-mobility for hire underlines the need for a smart connectivity infrastructure that allows potential users to locate and hire the closest vehicle. Connecting micro-mobility devices to the Internet of Things (IoT) allows the creation of this smart infrastructure, developing a system of interconnected elements that function

within an ecosystem. The beginnings of an integrated traffic flow management and inhabitant mobility strategy begin to emerge. Micromobility's two tangible components are the connected device and a smartphone. But the critical invisible component is connectivity.

A lot is riding on connectivity. Network coverage, quality and reliability issues can prevent inhabitants from connecting to scooters and other connected devices. Cellular connectivity is vital to the end-user and allows operators to manage their fleets more effectively, collecting data points such as origin and destination alongside the duration and distance of the trip. When these are combined with vehicle diagnostic data, it not only allows for tracking and availability but charging and predictive maintenance, too.

BEYOND MICRO-MOBILITY

Cellular IoT connectivity is the only choice for today's micro-mobility solutions. It brings together connected transportation devices and smartphones within an ecosystem that can be harnessed for much more. It is a critical and fundamental building block of the smart city. When harnessed correctly, the data gathered and acted upon has the potential to profoundly improve the quality of life for all inhabitants and create tangible economic opportunities through a wide range of beneficial projects.

From decreasing traffic congestion and improving air quality to refining energy distribution and enhancing communal spaces, the connectivity at the heart of micro-mobility can influence the future direction of the smart city as a whole. Over the longer term, connectivity can reshape the built environment, positively influencing town planning and urban development to maximise the smart city opportunity. wn

(1) The Guardian (2003) Tomorrow's World: from breathalysers to paper pants

(2) McKinsey (2018) Smart cities: Digital solutions for a more livable future

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Urban connectivity is being bolstered worldwide to enable new services and applications for citizens, authorities and industry alike, generating waves of new data for cities to capture, analyse, and use to launch new services and improve existing ones.

To enable this transformation, new telecom technologies are being rolled out to make infrastructure smarter, and the footprint of infrastructure and street furniture is being maximised to enable more data collection from existing urban space to deliver further insights to city authorities.

With this comes next-generation communication for authorities and agencies throughout cities to monitor and respond to situations effectively and efficiently, particularly in public safety scenarios where any time saved in response can be critical. As the digitisation of public services and data-enabled urban analytics continues, authorities must also be aware of the cybersecurity risks that exist, balancing the need for technological advancement with strong mitigation plans for worst-case scenarios.

In tandem with these changes in connective technologies is the abundance of data generated, with cities often wondering how it can best be used. This report considers whether the creation of digital twins is one of the most promising answers to that question, with several case studies presented and theories on achieving connected digital twins.

In the first annual Connectivity and Data Trend Report, SCW looks into the use cases that cities benefit most from in each of these areas, as well as analysing the technologies that make a difference.

NETWORK CONNECTIVITY

While the step forward in cellular network technology from 4G to 5G benefits consumers, it's in industrial applications where there has been a real step change. The built environment is now better connected than ever regarding connectivity for the public and industry within our cities. The technology has introduced more seamless, always-on connectivity and enabled the quicker transfer and processing of data. In turn, the urban Internet of Things (IoT) has grown exponentially, and the connected devices themselves have become more capable, introducing edge computing into sensor networks, and enabling smarter video technology through the use of AI and computer vision, leading to cameras becoming part of the sensor network itself.

The adoption rate of such IoT devices has been rapid and shows no signs of slowing. Projections from Statista show that IoT devices in cities in the EU alone are projected to rise to more than 53 million installations by 2025 – up from just over a million devices in 2016. These figures demonstrate that while the smart city concept may have shifted to focus more on equity, inclusivity, sustainability and overall liveability for citizens, city authorities recognise that connected – and connective – technology is still the tool they must utilise to achieve their goals.

5G TESTBEDS

Building solutions that rely on 5G for real-world use without testing them in that environment is a risky strategy for both the public and private sectors. Local authorities and city governments have tended to be risk-averse organisations, typically moving at a slower pace of innovation to ensure the reliability of new technology as part of their services.

To speed up these testing processes and establish a clearer and quicker

Connectivity & Data

· URBAN CONNECTIVITY, IOT AND 5G · PUBLIC SAFETY AND SECURITY · NETWORK SECURITY · CONNECTED DIGITAL TWINS

path to full adoption, many cities have established testbeds within their communities and downtown areas. The testbeds demonstrate to citizens the benefits of new technology as part of smart cities and show industries that cities have economic development at the front of their minds.

At scale, 5G testbeds coordinated across authorities can simultaneously demonstrate several use cases throughout different regions with differing industries at their heart. One such example is the UK government's Industrial 5G Testbeds and Trials programme (I5GTT), which began in 2020 to illustrate the real-world benefits of industrial 5G across manufacturing, transport and logistics. The programme was coordinated by Digital Catapult and put several technologies to the test, including:

- Real-time process monitoring and analytics and closed-loop control to reduce waste
- Connected automotive logistics (CAL)
- Using artificial intelligence to reduce congestion and pollution and improve traffic flow.

The programme's connected automotive logistics project provides an excellent example of the kind of collaboration that can be required to make a success of these types of testbed setups, bringing together nine partners from across local government (e.g. Sunderland City Council), the automotive sector (e.g. Nissan), research institutions (e.g. Newcastle University), technology experts (e.g. Vantec), and more.

One of the use cases explored in this project covers the potential for vehicle-to-infrastructure communication, specifically heavy goods vehicles. It used 5G-enabled cameras and LiDAR to create an external view of the vehicle. It also utilised 5G to support communication between the vehicle and traffic control centre, which helped change operations at the centre to prioritise traffic lights and junctions. The outcomes were made possible by the use of 5G technology, where low latency and a larger bandwidth capacity enabled the cameras to transmit what a real driver would see to the remote operator.

As aforementioned, establishing testbeds for technology like 5G can show cities, citizens and industry alike what the real-world benefits of innovation can be and enable local governments to make decisions on adoption more evidence-based. In Digital Catapult's report on the IG5TT programme, Dritan Kaleshi, director of 5G technology for Digital Catapult, explains: "Exploration of the opportunities that industrial 5G presents require starting the adoption journey before the technology is fully matured or the infrastructure fully in place.

"The next stage, as the technology matures and some of the technology barriers are overcome, is to understand better what the blueprint for a 5G-enabled advanced digital infrastructure for industrial enterprises will be and to create the supply chain that can meet its requirements."

The need to test these technologies is paramount. Still, as testbeds can be pushed into the public realm, it is just as important to clearly communicate intentions, progress and outcomes to the public – especially regarding 5G. As Rick Robinson, director of smart places for Jacobs and a UK5G steering group member during the programme's operation, warned in a SmartCitiesWorld's panel discussion on the subject, the 5G rollout in the UK has received significant backlash following misinformation about the technology.

"There's been campaigning against 5G in the UK because it was said to bring health dangers, which it doesn't, but people got very worried as a consequence – masts were set on fire and local authorities threatened with legal action," says Robinson. "Local

authorities learned a lot through that process about engaging with their communities and sharing what they've learnt, and they've learnt to get on the front foot and talk about the benefits of the technology, what the use cases are, and that there are no health risks involved with its deployment."

PUBLIC WI-FI AND DIGITAL INCLUSIVITY

It's arguably more straightforward to make these points as a local authority when the technology rollout can directly benefit users, as is the case with public wireless networks for consumer use. With 5G connectivity on our phones and super-fast fibre in our homes, seamless connectivity has become something much of the public takes for granted, but it is not the reality for everyone.

This makes public wi-fi networks an important part of urban life for many, ensuring free and fast connectivity in places the public most needs them. This is also the mission of the Wireless Broadband Alliance (WBA), a non-profit association of 170 members from across the telco ecosystem. One of its areas of activity is connected cities, which is home to its Connected Communities Forum.

"The public wi-fi experience is very fragmented," explains Tiago Rodrigues, CEO of WBA. "When you go to a hotel, a coffee shop or a restaurant, you're never sure what you'll find. There might be no network, an open network, or a network where hundreds of people are connected using the same password."

Naturally, completely open networks and those with widely shared passwords lack the security consumers seek when connecting to the internet, which is where WBA's open roaming standard comes in. The standard prioritises security, with users authenticating their connections through unique identifiers. The standard also seeks to ensure interoperability and continuity so that users don't need to log in multiple times to new networks regardless of where they are, as long as an open roaming network covers that area. "We want to create that experience across several hotspots and create a roaming wi-fi network, so whether you're in a different street or country, you don't need to register every time – just connect using the same credentials."

Through the Connected Communities Forum, WBA began working with Dublin City Council to create a roaming network pilot and improve upon the experience already offered through the European Wifi4EU scheme.

"We've been prototyping and piloting open roaming on a couple of sites, and it's been working well, so now it's about scaling up," says Jamie Cudden, smart city lead for Dublin City Council. "There's a lot of wi-fi in cities, and the idea is to prove out this technology, working with public and private entities, to make the experience for citizens that much better."

These types of public networks can also play a significant role in closing up the digital divide in communities. Still, as in the case of 5G rollouts, communication is key to enabling citizens to realise the benefits and use the services to their advantage. "We have to tie in with education and awareness programmes that exist within the city and other partners that will show people how it works," explains Cudden. "Just because the technology exists doesn't mean people will know it's there or how to use it – we must be very proactive."

PUBLIC SAFETY AND SECURITY

There is a public side to security when securing networks and data in cities, but beyond that is the use case of bolstered connectivity in public safety applications. For years, public safety agencies and authorities have relied on two-way radios to keep lines of communication open as part of the incident and emergency response. Still, new technology like VoIP and 5G have introduced new possibilities.

Critical communications and infrastructure must have consistent, tamperproof connectivity at their heart, and digital technology can provide it. It's essential that cities and public safety authorities keep pace with innovation in this area to ensure citizen safety and security remain front of mind and that emergency response can be more accessible.

DIGITAL EMERGENCY RESPONSE

For these reasons, New York City's Office of Technology and Innovation has been leading changes to the city's 911 service, transitioning from analogue phone-based infrastructure to an all-digital system to futureproof what is the United States' largest 911 system.

The service receives around 9 million calls every year. Still, it requires modernisation to support current and future technologies better, making it more accessible, able to provide a service beyond standard voice calls, and preventing any disruption to the answering and processing of calls. Among the benefits the new digital service will introduce are:

- The ability to accept different types of data, such as text, video and photo
- Better interoperability between public safety agencies that share a 911 system
- Improved call routing between neighbouring jurisdictions
- Improved location technology to identify callers' positions more accurately.

Threats	Sub-threats	What to be aware of
Policy and standards	Open standards	The potential for standards to include proprietary untrusted technologies and equipment that are unique to systems developed by adversarial nations, creating a lack of interoperability for trusted technologies through a closed-off 5G market.
	Optional controls	Some security controls in mobile telecoms protocols are optional, meaning that network operators that do not enable them could have more vulnerable networks open to cyberattacks.
Supply chain	Counterfeit components	More vulnerable to attack and more likely to break or malfunction due to inferior build quality. Could be compromised by a malicious actor to impact confidentiality, integrity or availability of potentially sensitive data moving through the network.
	Inherited components	Could come from extended parts of the supply chain or from third-party suppliers, opening up opportunities for malicious actors to interfere in the extended supply chain (e.g. those further down the chain, such as suppliers to suppliers, may have weaker security controls).
5G systems architecture	Software and configuration	Unauthorised access to software/network components could provide potential attackers with opportunity to modify configurations to reduce security controls or install malware.
	Network security	The vastness of 5G networks having millions of connected devices introduces potential weak points to network security.
	Network slicing	Can be difficult to manage network slicing, with each slice adding to network complexity. Relating back to standards, while they exist to define specs for how to build 5G networks, the industry still currently lacks specific specs for developing and implementing security for splicing.
	Legacy communications infrastructure	5G network infrastructure is designed to be more secure, the security specs and protocols from its predecessor are still largely supported, containing the same vulnerabilities as before for potential attackers.
	Multi-access edge computing	Any untrusted 5G components at the edge could expose core elements of the network to risks, for example vulnerabilities in software/hardware, including those mentioned in the above supply chain entry.
	Spectrum sharing	Could provide opportunities for potential attackers to interfere with non-critical communication paths, in turn adversely affecting more critical communications networks.
	Software defined networking (SDN)	Opportunities for potential attackers to embed code in SDN controller apps to constrict bandwidth and impact operations.

Table 1

Providing an update on the progress of Next Generation 911's (NG911) implementation, which is set to be completed in 2024, New York's CTO, Matthew Fraser, explains that the system is part of the city's commitment to using technology to improve the lives of citizens.

"Next Generation 911's all-digital network will revolutionise how callers, call-takers, and first responders share and receive information in emergencies and will ensure that the nation's busiest 911 service is accessible to all."

In the 12 months from December 2021 to December 2022, NG911 took significant strides forwards, with the Public Safety and Emergency Management Division in the city's technology and innovation office hitting milestones in several projects. These include progress in establishing the emergency services IP network and core services, logging and recording, and the geographic information system.

Combined, these parts of the system will enable 911 call handlers to take and process voice calls and provides IP-based native NG911 functionality, such as the ability to receive text and multimedia in compliance with National Emergency Number Association standards.

Alongside its work on NG911, the Public Safety and Emergency Management Division is also responsible for managing existing infrastructure and technologies that support public safety efforts across the city, including data centres and radio communication facilities. While new technology provides solutions to long-standing problems, it can also bring with it new opportunities for threat actors to look to exploit. Securing critical infrastructure like this is essential to keeping new services like NG911 disruption-free.

UNDERSTANDING NEW CONNECTIVE TECHNOLOGY THREATS

It's with this in mind that we look to the ways that new digital network technology can be secured, beginning with the US Department of Homeland Security's Cybersecurity and Infrastructure Security Agency (CISA) and its work on identifying threats to 5G infrastructure, and to 5G network slicing.

In its 2021 report 'Potential threat vectors to 5G infrastructure', CISA identifies several potential threats to 5G networks based on system architecture and setup, the hardware components procured through the supply chain, and the potential for open standards to be infiltrated by adversarial actors (Table 1).

DIGITAL TWINS

Digital twins are one of the most exciting emerging trends in smart city technology today, providing local authorities with a real-time holistic view of their data and operations and delivering actionable insights that can save them precious time and money while improving the citizen experience across city verticals from transport to energy use.

In the first instance, however, it is likely to be privately owned and -operated infrastructure and services – those that feel and act like cities, such as airports and stadia – that will benefit most from the adoption of digital twins, with the procurement process in the public sector typically takes a longer time. However, there are already instances in which cities and public authorities are already working to deploy digital twin technology.

EXISTING DIGITAL TWIN USE CASES

The digital twin market is building up a head of steam in the public sector based on the results seen in the private sector, and some have already taken the plunge to pilot new use cases to improve the management and maintenance of important public infrastructure assets.

One such example is in Cologne, Germany, where a digital twin solution has been deployed to help streamline wastewater operations. Using imagery and LiDAR-based data collection, the digital twin technology can automatically detect changes in paved surfaces that could affect drainage, allowing the city's municipal wastewater authority to calculate wastewater taxes on private land more efficiently. This data was previously collected and recorded manually since land and property owners would rarely report the removal or addition of paved areas. The new solution, implemented at the end of 2022, also utilises AI-enabled analysis to reduce further the number of human resources the authority needs to commit to the task.

Another timely example of the potential of digital twins is also active in Ukraine, where the national government established a public-private partnership in December 2022 to help rebuild bomb-damaged cities following the Russian invasion. The project will have two phases: one to diagnose damages and forecast reconstruction costs; and a second to optimise how to rebuild, which is where digital twin technology enters the equation.

The project's second phase will utilise the technology to build a virtual twin of the city of Chernihiv and focus on optimising how the city will be rebuilt, including the design of new buildings and the organisation of city transportation, infrastructure and other services. The Chernihiv example demonstrates not only the value that the technology can bring to cities but also the value of effective public-private partnerships, with stakeholders from across different sectors set to use the

twin to collaboratively test different scenarios and parameters, such as accessibility and flood risks.

Outside of infrastructure and public services, there are good examples of urban digital twins in cultural spaces, such as Madinah's holy mosque. As with other authorities that have to manage large crowds, the city's government is designing a digital model of the mosque to be able to both monitor and simulate crowd and people flow. This model is the beginning of Madinah's plans for digital twin technology, without being a fully-fledged digital twin, as acknowledged by Abdulmajeed Mangarah, smart city programme director at the Madinah Regional Authority: "This won't necessarily be a full digital twin of the mosque, but will be a mirror for the movement within and around it, including parts of the city infrastructure and operations that have an impact on movement and crowding.

"We have recently signed an agreement to build a full-scale digital twin of Madinah using satellite imagery, becoming the first city in the Middle East to do so. We'll use the 3D model digital twin for urban planning, traffic management, crowd management and urban analytics across the entire city, not just the centre and the holy mosque."

To use digital twin technology in this way, data must flow between different systems and authorities to replicate the city accurately – and in some cases, between different sectors. That is where the concept of a connected digital twin becomes necessary for cities to operate as efficiently as possible.

CONNECTED DIGITAL TWINS

It's where data can be shared between the public and private sectors, helping connect one digital twin to another to create broader twins that will bring the most significant benefits to all parties. This will create a single digital twin from several sources to help authorities and operators with maintenance, monitoring, and modelling. However, as in many scenarios where data sharing must come into play to achieve the desired result, several hurdles must be cleared before better-connected digital twins can become a widespread reality.

"To be successful, we must be able to share data in an interoperable way," explains Dr Alison Vincent, chair of the Digital Twin Hub strategy board at Connected Places Catapult. "In the past, there's been real risk aversion from infrastructure asset owners around creating the conditions to have digital twins using live data. Much of that is down to valid information security concerns, but there are things we can do technically to overcome some of those concerns. Essentially, data sharing needs to be handled through appropriate legal agreements between parties – those are the things we have to work through to make connected digital twins a reality."

"The market for digital twins is taking off and doesn't need an awful lot of encouragement, but to get the twins to talk to each other, leading to an ecosystem of connected digital twins, is more challenging because organisations using digital twins will need to be convinced to do the same thing in the same way," explains Mark Enzer, CTO for Mott MacDonald and vice chair of the Digital Twin Hub strategy board at Connected Places Catapult.

Despite this, the opportunity is clear for digital twins to support those in both the public and private sectors to play their part in solving some of the cities' most pressing challenges.

"The biggest challenges we face as humanity at the moment are systems-level challenges – climate change is affecting all systems, not just part of them. Achieving net zero, building the circular economy or achieving climate resilience all demand systems-based solutions," continues Enzer. "These issues cannot be solved in silos – we need to have this systems view, which also means we need to understand the systems. Digital twins are among the most valuable tools we have to help understand these systems – it certainly isn't a silver bullet, but it can be part of the solution."

SUMMARY

Cities are complex, constantly moving, and forever growing, with ageing infrastructure built to support a fraction of the population they currently house. By leveraging digital network technology across smart city verticals, from transport to safety, public and private sector participants are finding new ways to run and support city operations to ensure they are as efficient as possible with precious resources.

New ways of using data to simulate and model changes or disruptions to services remove risk from the decision-making process, providing local authorities with the evidence they need to make decisions more quickly and improve the citizen experience in myriad ways more efficiently.

What's more, these technologies can provide cities, local authorities, and the public sector, more broadly, with the opportunity to build more flexibility and transparency into their planning processes and build stronger relationships with the public, providing that the lines of communication remain clear and open. wn

Building an Efficiency Business Case during load-shedding

South Africa is experiencing energy supply challenges which, at best, can be summarised as having catastrophic implications for the economy. Loadshedding has come and gone, only to remain for the interim. The interim, in this case, is potentially the next 5 - 10 years. From an electricity supply perspective, the country will need to bolster its generation capacity to support energy security using alternative technology options as a matter of economic urgency and swift deployment.

By Songo Didiza & Sumaya Mahomed

In the economic realm, the South African Reserve Bank has already reduced its economic growth forecast for this year to 0.3%, from 1.1% previously, with South African Reserve Bank anticipating power disruptions to shave two percentage points off economic growth in 2023 (SARB, 2023).

From a business perspective, operational implications need to be considered. There's the cost of downtime and business disruption – up to five times daily- and many businesses are at high risk with their equipment, so maintenance costs also escalate. These operational challenges drive many businesses and households to explore and implement alternative energy supply options.

Pressure to shift away from Eskom has also mounted with a recent electricity price hike authorised by the National Energy Regulator of South Africa (Nersa), allowing the utility to hike prices by 18.65% from 1 April 2023, which further drives the need to look for alternatives. These often come in the form of solar, diesel and battery options or a combination to reduce the financial implications and thus ensure business continuity. However, these alternative energy supply technology options often come at an additional and high capital expenditure. These rising alternative costs now require the business sector to view their planned energy investments more holistically, with the starting point being energy efficiency fundamentals for all building portfolios (industrial, commercial and retail).

ENERGY EFFICIENCY AND ENERGY PERFORMANCE CERTIFICATION

Energy Efficiency is "The first fuel of a sustainable global energy system" as it represents the cleanest, cheapest and fastest way of meeting our immediate energy needs (IEA). With the property and building services sector now required to obtain Energy Performance Certificates (EPC) for their buildings, the next step is to use the findings of the EPC to implement energy efficiency initiatives to save on energy costs and limit carbon emissions. As much as load-shedding is placing pressure on property asset owners to invest in alternative energy technology, this should not dissuade them from applying oversight in the energy management response planning process. Energy Efficiency remains the cornerstone of an

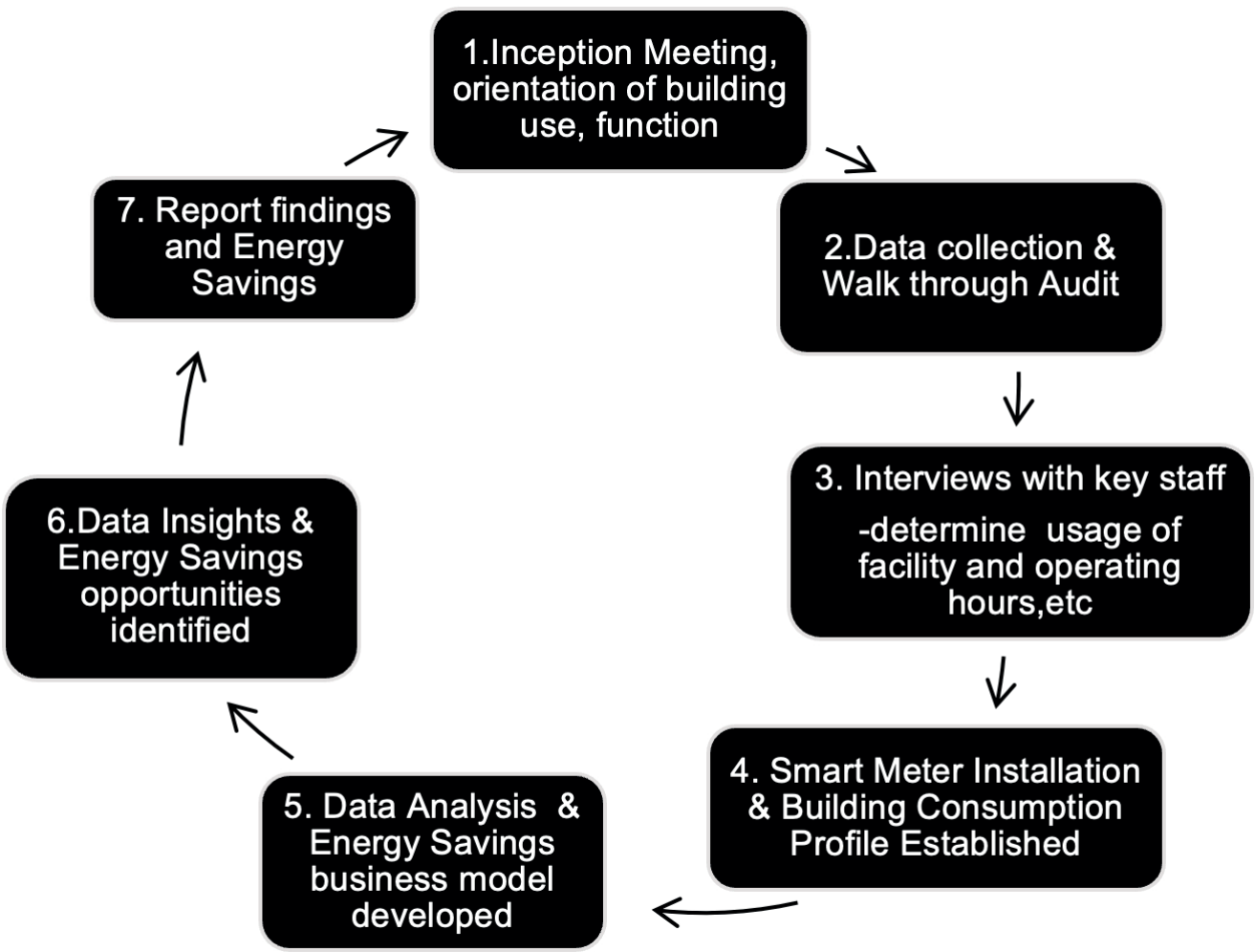

Figure 1: Energy Savings Business Model process cycle.

effective energy management strategy, and perhaps more appropriately, when executives are surrounded by renewable energy cacophony to add to their rising concerns.

FINANCIAL PERSPECTIVE

The Energy Savings Business Model planning process is best explained using the graphic (figure 1) to illustrate the 7-step process:

The 7-step integrated approach enables business owners to understand the real costs of managing their operational energy usage, optimising its usage for business growth. This energy planning can only happen with building occupants in mind.

The outcome of looking at these alternative energy technology options has proven financial savings results as observed by the diversified client portfolio comprising commercial and industrial buildings between 2000 sqm and 15 000 sqm (as shown in table 1).

The table carefully highlights some of the targeted energy efficiency interventions readily available to business consumers as they strive to stave off the operational challenges that have resulted from the energy supply shortage issues.

CONCLUSION

On the demand side, business and residential consumers can play a significant role in supporting energy security by reducing how much power they use. Energy Efficiency is the approach where no costly interventions may be required to achieve the results, such as using only what you need, i.e. switching off non-essential loads results in immediate savings and increases the country's energy supply capacity. This can be guided greatly through implementing cost-effective smart metering technology and targeted Behavioural Change campaigns aimed at building occupants, which are considered low-cost interventions. These integrated interventions reflect that the load-shedding problem can not only be solved through placing a CaPex-intensive solar panel on the roof, however, but the response measures also require an integrated energy management solution for the long-term benefits to be realised by all the stakeholders. The business case of Energy efficiency is that it reduces the cost of solar by supporting fit-for-purpose system sizes, thereby maximising the solar investment. Therefore, energy efficiency remains critical in our integrated response to the load-shedding challenge. wn

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Targeted Intervention	Energy Savings	Investment Cost (per building)	Payback Period (Per Building)
HVAC Optimisation	5-10%	R10-R15m	2-4 years
Smart Metering & Behavioural Change	5 – 10%	R35k<	< 6 months
Efficient Lighting	20%	R 6-7m	1-3 years
Solar PV & Smart Energy Monitoring	20%	R10m – R15m	3,5 years

Table 1 Energy Efficiency Investment Savings Options (Source: Green Building Design Group, 2022),

Motors I Automation I Transmission & Distribution I Energy Systems I Electrical Construction

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