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SAIEE THE OFFICIAL PUBLICATION OF THE SOUTH AFRICAN INSTITUTE OF ELECTRICAL ENGINEERS | **JUNE 2015**

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Aa at 08/05/2015

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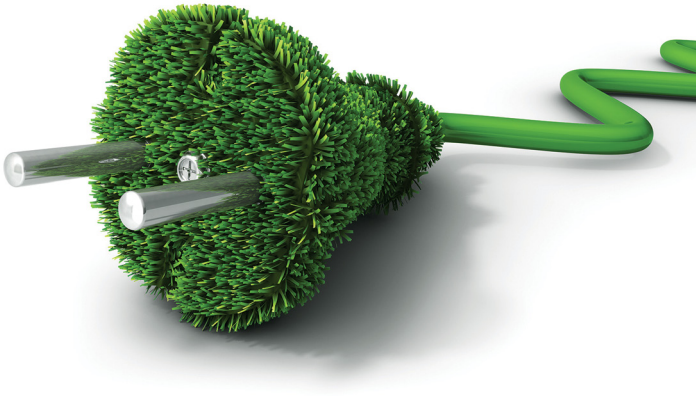

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After a very strenuous and busy May, I'm happy to declare that the June issue is extremely informative. With everyone gearing up for living 'greener' – especially to adapt to bouts of load shedding – we have no alternative.

This issue of **watt**now, the 40th issue under my management, focuses on Renewable & Energy Storage. Our first feature article on page 24 informs us how critical Independent Power Producers (IPPs) are for South Africa's energy security. We follow that up with how 'Prosumers' leverage technology for a sustainable economy. Read more about that on page 28. The storage part of our feature takes a closer look at thermal versus battery energy storage (38).

Dudley Basson wrote another beautiful interest story on Astronomy, which you will find on page 46.

Page 58 features our Opinion Piece, which was aptly written by Viv Crone, and he poses the question "Is renewable energy truly a solution?" Find the article on page 58.

The July issue features Transport Engineering and I urge you to send me any article or paper you might have on this subject. You can earn CPD credits.

To all my 'Father' readers, where ever you might find yourself in the world - here's wishing you an amazing Father's Day on the 21st. We might not be able to be with you, but you are always the pillar of strength in our lives.

Herewith the June issue, enjoy the read!

Minx

Visit www.saiee.org.za to answer the questions related to these articles to earn your CPD points.

The switchboard your installation deserves

Blokset is the low voltage switchboard for electrical distribution and motor control

Blokset switchboards have long guaranteed the durability and availability of several tens of thousands of installations the world over. Tried and tested reliability, overall performance and an attractive TCO (Total Cost of Ownership) have caused Blokset to become, the reference switchboard for a large number of panel-builders, industrial site managers and maintenance managers, in a few years.

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André Leo Hoffmann
2015 SAIEE President

Warm greetings from the desk of the President.

I am halfway through my regional centre visits and I am encouraged by the level of enthusiasm and commitment from the members in the grass-roots of this institute. That said there is always room for improvement in bridging the gap between the interests and activities in the regional centres and what is happening at the SAIEE Head Office. I would encourage all Centre Chairs and Committee / Section chairs to embrace technology or whatever means at their disposal to be more inclusive in discussions and activates that have a common interest.

The unfortunate turbulence that erupted in the country during April as xenophobia threatened to spiral out of control across many centres in the country has set us back somewhat in the eyes of an increasingly sceptical investor community. Coming on the back of weak economic growth and already constrained job opportunities this was a really disappointing series of events. It is however symptomatic of a deeper challenge, that of weak economic growth which is not helped by service delivery inefficiency and weak ethics in government departments which should be leading by example.

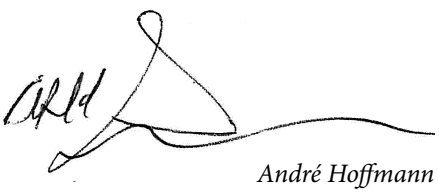
Of course no one told me when I signed up for this job that we would be in the midst of an electricity supply crisis in the country. That said we can take comfort that within our institute there is residual capacity and skill to assist in managing the constraint, therefore reducing the possibility that the country might have to deal with a worst case scenario such as National Blackout situation. As quoted in the poem written by Dylan Thomas, *'Do not go gentle into that good night'* - your institute is cognisant of its role in bringing a balanced view forward of the current situation.

To this end we have embarked on a series of events and workshops which have the objective of empowering our members. First of all by providing the information necessary to form an informed opinion. Secondly to convey a responsible message to the public about where we are, optimal coping mechanisms and the medium and long term prognosis. This series aims to lay a sound foundation of the current situation thereby allowing for some responsible debate and discussion that will allow us to articulate a position that is responsible and balanced.

On a positive note Elon Musk's launch of Tesla Energy and the Tesla Power Wall in May, holds much promise to change the way energy is delivered in the future. He demonstrated the viability of using mostly rooftop solar PVs covering a relatively small area, and an even smaller area for the storage batteries required. Scalable to gigawatt class installations, he was confident that all of the planet's energy requirements could be met by solar energy insteadof fossil fuel. I would encourage you to watch his Keynote address announcing Tesla Energy. It is an inspirational presentation. Watch this space. This is going to make a difference to our future on this planet!

Of course the issue raises another challenge in terms of the future viability of the national and municipal electricity supply utilities - that of Net Zero Energy Buildings, but that is a discussion for another day. There was some interesting debate on this subject in the SAIEE LinkedIn group. I encourage all of you to embrace more of the debate and discussion going on in the Social Media, I know for some of you it will be a whole new world, but one well worth investigating.

Looking forward to the next month and wishing all of you a safe and warm mid-winter.



André Hoffmann
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2015 SAIEE President

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University of Johannesburg hosts SAIEE President's Invitation Lecture

From left: Gift Mphefu (SAIEE Chairman: Electronics & Software Section), Prof Bheki Twala (HoD Dept of Electrical & Electronic Engineering Science, UJ), Prof Alexander Ferrein (Lecturer) & André Hoffmann (2015 SAIEE President).

The 2015 SAIEE President's Invitation lecturer was Prof Alexander Ferrein from Aachen University in Germany. His lecture, "Robots: Challenges, Chances and Risk for Solving 21st Century Problems" was well received across South Africa.

The automation of production has had a major influence to productivity, efficiency, market chances, and, of course, to society. Some say that we are right in the middle of another industrial revolution with integration of more and more cyber-physical systems into the automated production environment. This includes the integration of mobile robots in the smart factories. Besides new manufacturing techniques such as additive manufacturing, robots are believed to be a key driver for the future in automation. Robot technology is also deployed in other fields ranging from health care to self-driving cars. This new technology brings new chances, but also certain risks and will definitely change tomorrow's societies.

In this lecture, Prof Ferrein reviewed a number of current robot systems and he outlined some of the challenges and risks that this new technology brings, in particular, with a focus to the African context.

Prof Bheki Twala, HoD: Department of Electrical & Electronic Engineering Science, UJ, hosted André Hoffmann and Prof Ferrein in Johannesburg.

Grade 10 & 12 pupils from Westbury Secondary School were guests at the Johannesburg event and were totally enthralled with Prof Ferrein's video's on robotics and peppered him with questions.

From left: Dr Pat Naidoo, Prof Saurabh Sinha & André Hoffmann.

From left: A scholar with Prof Alex Ferrein.

From left: Gerhard Erasmus, Calvin La Camera (SAIEE) and Michael Ettershank (RobotScience)

Prof Alexander Ferrein (front left) with André Hoffmann (2015 SAIEE President) having fun with some of the scholars from Westbury Secondary School.

From left: Prof Saurabh Sinha (Dean FEBE) & Stan Bridgens (CEO, SAIEE).

From left: Angus Hay & André Hoffmann.

From left: Gerda Geyer, Sybrand Botes & Sybrand Botes Jr.

From left: Mike Barker & George Debbo.

From left: Prof Bea Lacquet & Maureen Naidoo.

From left: Prudence Madiba, Stan Bridgens & Amelia Mtsali.

WATTSUP

SAIEE Charity Golf Day 2015

The winners of the SAIEE Charity Golf Day 2015 is Vanesh, Siva, Patrick & Siva from Conference Zone.

Winner "Nearest to the Pin on 8th hole" Rynard Potgieter.

Rod Lesar, winner of the "Nearest to the Pin on 15th hole".

Team GEP Electrical

The 2015 SAIEE Charity Golf Day took place at Glenvista Golf Course recently. The Charity Beneficiary of this Golf day, and the choice of the 2015 SAIEE President, André Hoffmann is the Johannesburg Children's Home. It was a day enjoyed by all our avid golfing members and associates. We would like to thank the following sponsors for their valuable contributions, in no particular order: Cummins, Diesel Electric, Comtest, Legrand Concept Store, Zest, Powertech, LH Martinussen and Powertech Transformers.

Team Zest

Team Diesel Electric

Team WPI Power Solutions

Team LH Martinussen

VA Executives meet at Eskom Head Office

The Photograph of some of the guests are standing from left: Stan Bridgens, CEO SAIEE; Pat Naidoo, IPP SAIEE Eskom Board Member; Abe Thela, President CESA.
Seated: Sipho Madonsela, CEO ECSA; Brain Molefe, Acting CEO Eskom.

Dr Pat Naidoo, Immediate Past president of SAIEE (who is also serving on the Eskom Board), is very keen, given the current energy challenge, to promote open discussions between industry, professionals, individuals and Eskom.

Recently, Pat arranged a meeting with Representatives of the Professional Voluntary Associations (VAs) Electrical (SAIEE), Mechanical (SAIMechE), Civil (SAICE) and Industrial (SAIIE), as well as the Engineering Council of South Africa (ECSA), to meet with Eskom Board Members and Senior Eskom Executives at the Eskom Head Office.

Acting Chairman of the Eskom Board, Dr Baldwin Sipho Ngubane welcomed everyone.

After an update on the state of generation, a very valuable few hours of "getting to know each other", and informal discussions were held in an atmosphere of camaraderie, but there was also serious discussions on what could and should be done going forward.

The free and open atmosphere engendered a secure environment for some very pertinent and thought provoking statements and comments.

It was generally agreed that registration with ECSA as a Professional Technician, Technologist or Engineer is highly desirable, if not essential.

Mentorship to increase the competency of young Engineers is essential to enable them to take management and ownership of the expensive assets used to meet the ever-increasing demands of the energy consuming public. One Board Member was interested in how foreign professionals are being integrated into the engineering arena in South Africa. The CEO of ECSA explained the assessment and evaluation process to all.

A very constructive dialogue prevailed which augers well going forward in addressing the electricity capacity challenge. It is understood that this meeting was the start of more to come.

By all accounts the professional societies welcomed this opportunity.

WATTSUP

Schneider Electric announces new company strategy at annual media forum

Global specialist in energy management, Schneider Electric introduced its new company strategy to South Africa's online and traditional media representatives at its annual Media Forum.

Called "Schneider is On", focuses on five key priorities to follow in order to achieve the company's 2020 vision. These are: Do More, Digitise, Innovate, Step Up, and Simplify. *"Our ambition is to serve our customers better by listening more closely to them, thus understanding their challenges and aligning our actions with their needs accordingly,"* said Eric Leger, Country President for southern Africa at Schneider Electric.

He highlighted that the organisation's new strategy was all about doing more for customers by connecting with them digitally; being a leader in technology and business innovation; raising the bar of expectations on every single Schneider Electric employee - starting with management, in order to become a high performance organisation; and making it easier for customers to trade with the business, so as to understand Schneider Electric complexity and collaborate more effectively. *"With this programme, we start a new chapter in the evolution of our organisation,"* added Leger.

He listed the five enablers of the strategy as Schneider Electric's transactional business, field services business, regional expansion, mining segment, as well as utility segment.

Leger also used the opportunity to point out the successes it has achieved in its role as sustainable development facilitator, especially the role it plays in creating access to energy for those living in rural areas; and its strong focus on conducting business in an ethical manner.

Back from left: Wilhem Swart, Marc Ramsay, Jeremy Thomas & Sihle Maake. Front from left: Eric Léger, Ntombi Mhangwani & Geoff Gregson.

Mention was also made of Schneider Electric's South African headquarters building and moving into a "green" building in the Waterfall City district in the near future.

Pasternack makes new appointment

Pasternack Enterprises, Inc., a leading manufacturer and supplier of RF, microwave and millimeter wave products, announced the appointment of Mr. Bruce Yolken as the company's Quality Assurance Manager.

Mr. Yolken joins Pasternack with more than 30 years of Quality Assurance experience in the aerospace and defense sector. Mr. Yolken holds a Bachelor's Degree in Industrial Technology with a Quality Assurance Option and two Master's Degrees, one in Quality Assurance and one in Systems Management.

"We look forward to Bruce using his extensive experience and knowledge of quality processes and procedures to bring our company ever closer to our goal of unequalled product quality and service," explains Brian MacDonald, President at Pasternack.

Mr Bruce Yolken

ESI Smart Sensor Can Measure One Of 15 Different Gases From Single Controller

The ESI Smart Sensor, available from Booyco Electronics, offers users the ability to measure one of 15 different gases from a single controller. This feature sets the instrument apart from other such units while its modular configuration makes the calibration of the gas sensing instrument simple and easy.

Gases that can be monitored using this locally manufactured gas sensing instrument include oxygen (02), carbon dioxide (CO_2), flammable gases such as methane (CH_4) and combustible gases such as carbon monoxide (CO).

The ESI Smart Sensor is certified as EXia T4 Intrinsically Safe, carries SANS IEC 60079 Part 0:2005, SANS IEC 60079 Part 11: 2007 and IEC 60529 (IP code) approvals and offers ingress protection to IP56. The sensor is compact weighing only 1.8 kg and its dimensions are 265 x 150 x 60 mm. It has a localised information display making it simple to read, and it can also accommodate other sensors with analogue outputs, such as air velocity sensors or smoke detectors. In addition, the ESI Smart Sensor can easily be connected to a fire detection system with reporting and display on SCADA package.

The Booyco Electronics range of reliable accurate warning, locating and monitoring systems is engineered to operate in the harsh African conditions.

The ESI Smart Sensor offers users the ability to measure one of 15 different gases from a single controller.

CBI Authenticates Distributors Protecting Customers

CBI-electric: Low Voltage is an established global supplier of world class products and solutions and continues to develop their extensive expertise through the application of the latest technologies and trends.

In line with this, CBI's Channel Partnership Campaign aims to empower and develop their Distributors through training programmes that ensure that end-users not only receive a world class value added service, but are also protected through the correct use of products as required by their respective application. Only Distributors that attend CBI Training Programmes are certified as an Authenticated Distributor.

ABC Electrical

Charl Osborne, CBI-electric Commercial Manager believes that, *"It is imperative that Distributors of CBI-electric products are properly trained to enable them to differentiate between product technologies, identify the dangers associated with incorrect product application and the cost savings achievable due to energy efficiency over the life cycle of a product".*

Two levels of training are currently being presented to all CBI partners and upon completion of this training, their employees receive a CBI certificate and the organisation receives CBI Accreditation, which is displayed at their premises. A full list of authenticated distributors can be obtained by visiting www.cbi-lowvoltage.co.za

Haslop & Mason

WATTSUP

Get ready for the POWER-GEN Africa and DistribuTECH Africa Event

DistribuTECH Africa is set to become sub-Saharan Africa's premier and leading event dedicated to the power transmission & distribution industry, focusing on the current and future trends, needs and resources.

POWER-GEN Africa is dedicated to the power generation industry and will explore issues relating to channeling spending towards infrastructure investment and other development needs, safeguarding social safety nets to encourage more inclusive growth, and improving the business climate.

These events present the opportunity to meet high-level industry professionals in one place at one time, allowing networking, business and sales opportunities with key industry buyers and influencers from around the globe.

Over the course of 3 days, POWER-GEN Africa and DistribuTECH Africa 2015 will feature:

- 40+ conference sessions as part of a multi-track conference programme
- 145+ African and international speakers
- Hot topic presentations and panel discussions
- Guided technical tours
- 100+ leading exhibitors from the region and world-wide showcasing their latest technologies
- Informative training workshops

TARGET AUDIENCE

These events target those who work in:

- Utility and private power sectors
- Engineering
- Commercial personnel from the equipment manufacturing and consulting fields.
- Professionals from utilities and energy intensive industries with responsibility for ensuring power supply
- Officials and ministers from the national and regional political spheres who are tasked with energy policy
- Financiers and funders

POWER-GEN Africa and DistribuTECH Africa, organised by PennWell Corporation will provide comprehensive coverage of the power needs, resources and issues facing the electricity generation industries across sub-Saharan Africa.

POWER-GEN Africa focusing on all aspects of the conventional and renewable power generation industry and DistribuTECH Africa focusing on transmission and distribution sectors within sub-Saharan Africa, the events will brings together the world's leading power equipment suppliers along with companies developing power infrastructure in Africa.

For more information and to register visit www.powergenafrica.com or www.distributechafrica.com

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Intelligent Cheat Sheets for Engineers

"Currently available software solutions in the range of knowledge management are barely fitting the needs of modern engineering offices regarding efficiency and usability. It was our goal to offer an easy-to-understand solution for compiling digital documents and templates," says Veit Christoph, founder and CEO of Veit Christoph GmbH.

Incorporated into its smart engineering software VCmaster, Veit Christoph GmbH, an independent software developer based in Germany, offers a simple and easy-to-understand opportunity to compile technical documents thematically as well as describe them individually. *"The engineer is empowered to make notes quickly and comfortably and link them to various other data already created"* says Veit Christoph.

"The innovation lies in the fact, that not only the data format, but also the storage location can be selected without any restrictions" explains Veit Christoph.

The Wikis are based on the well-known word-processing technology. So-called hyperlinks connect the various compiled documents. A VCmaster Wiki can create links to any given file format. The program allows for several storage options for the created pieces of information, e.g. hard drive, local network or a cloud.

"Using a Vcmaster Wiki to compose all this information helps engineers to optimize their time and energy for more complicated tasks" states Veit Christoph.

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Western Cape Centre active in Open Days

The SAIEE Western Cape Centre in the month of April and May participated in the Open Day for UCT and CPUT respectively. The SAIEE takes a 5-year view in ensuring the sustainable "production" of more engineers. We encourage them and assist to provide proper career guidance to learners that are interested in electrical engineering.

The Open Day at the University of Cape Town took place during April at Upper Campus. The SAIEE, represented by Bruce Thomas (Chairman of SAIEE Western Cape Centre), Larry Khuvutlu, Phumelelo Ngxonono and Sam Mille, occupied two tables.

The learners came in great numbers; some were accompanied by their parents and had a wide range of questions, such as: -

- What is electrical engineering?
- What is the demand for electrical engineers in the job market?
- What subjects do they need to achieve at grade 12 to be accepted for electrical engineering?
- Where can they get bursaries for electrical engineering studies?
- Is electrical engineering work interesting; is it hard?
- Do electrical engineers earn lots of money?

The SAIEE Western Cape's presence at this Open Day was to bring in the perspective from qualified and practicing electrical engineers who brought with them, experiences from Eskom, City of Cape Town, Telkom, PV Enterprises and Caltex. Mr Thomas and Mr Khuvutlu both studied electrical engineering at UCT in the late 90's and had full bursaries from Eskom and Telkom, respectively. This gave the learners confidence in their dreams of becoming electrical engineers.

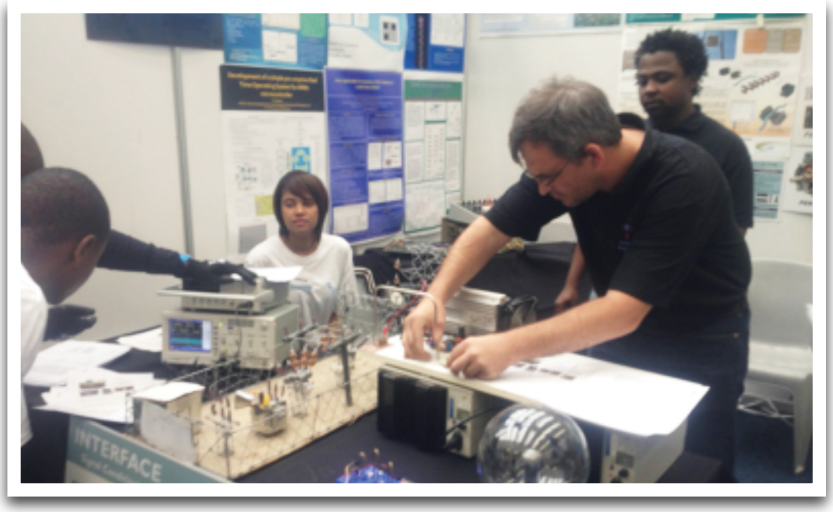
The SAIEE Western Cape Centre wishes to thank Ms Rachmat Harris for her assistance with the arrangements for the Open Day.

CAPE PENINSULA UNIVERSITY OF TECHNOLOGY (CPUT) OPENDAY

The Open Day at CPUT was held at the Cape Peninsula University of Technology's Bellville Campus during May.

CPUT arranged tours for future tertiary students showcasing the various departments where they visited facilities like laboratories, computer rooms, etc.

The SAIEE, represented by Mr. Bruce Thomas and Mr. Larry Khuvutlu set up the Electrical Engineering Department's stand. At this stand they displayed intricate electrical engineering circuitry, dome, sparks and models. This assisted the team in explaining some of the concepts in electrical engineering, for example; a model of a substation explained power engineering. It was exciting to see a number of electrical



engineering students and staff assisting with enthusiasm.

CPUT had more than fifty schools visiting the Open Day. The questions posed by the children were similar to those at UCT. We explained the studying process for electrical engineering can be done at a FET College, University of Technology or University and one can get to be a technical, technologist or engineer. All these practitioners are important in the value chain in order to implement and operate an electrical engineering project.

The SAIEE would like to express its gratitude to Mr. Thomas van Breda (Head of Electrical Engineering) and Christopher Wills for assisting with the arrangements. Special thanks to the students and members of staff that assisted on the day.

The SAIEE Western Cape Centre will make participation at the Open Days for UCT, CPUT and SUN as part of its activities for the year. This is one of the ways the SAIEE can influence the sustainability of the production of electrical engineers. wn

CORPORATES, the solution is here....

Powertech System Integrators (PTSI), a subsidiary of Powertech and the JSE listed Altron Group, introduced a fully funded, off balance sheet solar rooftop photovoltaic (PV) solution for South Africa's rapidly expanding renewable energy sector.

The offering, aimed at corporates, allows customers access to a hybrid energy solution that utilises both grid power and solar energy, resulting in long-term savings.

This grid-tied system is placed on a rooftop or shaded carpark and is based on two major components: PV modules that are able to convert sunlight into current, and an inverter (or multiples thereof) that is able to convert the Direct Current (DC) power generated by the PV modules, into usable Alternating Current (AC) power.

The electrical supplies from both the rooftop PV system and the municipal network are joined at the electrical distribution board.

This robust solution is designed with, and backed by, world class manufacturers and all products utilised have UL, IEC and TUV certifications. PTSI currently has a rooftop solar PV rooftop system at its head office in Pretoria, generating 60 kW of DC power, converted to 50kW of AC power.

The offering will be best suited for corporates with large roof space and constant base loads seven days a week, such as mining companies, commercial property owners and industrial facilities.

PTSI's model allows for the system to be built, maintained and owned by PTSI, and the electricity generated to be provided through a power purchase agreement (PPA).The price of electricity produced by the PV system will be equal to the tariff currently in place, less a nominal discount. Customers will also have "buy-back" options during the contract period.

"A large number of the system's components are manufactured in South Africa or have the potential to be manufactured in-country," says Kobus Morgan, Executive for Strategic Projects at PTSI. *"This is a local, viable solution for South Africa's large energy users who are subject to high electricity tariffs that are increasingly pushing up operating costs and impacting the bottom line. In fact, solar PV has become one of the fastest growing sources of energy in the world, with the local commercial rooftop industry (excluding the Renewable Energy Independent Power Producer Procurement, REIPPP programme) generating approximately 15MW in 2014; a figure which is set to increase in the coming years."*

Rooftop PV can also form part of a smart or micro grid where electricity usage automatically switches between power sources (diesel or gas generators and batteries) as and when needed; ensuring a consistent supply of energy during outages. wn

Kobus Morgan, Executive for Strategic Projects at PTSI

2014 set the pace for digital banking services and new solutions to come

The extent to which South Africans are embracing digital banking technology became clear through recently released Standard Bank statistics. These show that customers conducted digital transactions worth more than R4.5 billion a month using bank-driven Internet and mobile banking applications during 2014. To do so, the average user logged on about 20 times each month.

These figures reveal that the average Standard Bank customer is becoming increasingly active in the digital arena. People in the metropolitan areas of Gauteng, Cape Town and Durban are the quickest to adopt new banking services and applications, but usage across the country is increasingly steadily, according to Vuyo Mpako, Head of Innovation and Channel Design at Standard Bank.

"Standard Bank increased its digital and Internet offerings significantly in 2014. These enabled our customers and others to use our facilities regardless of where they bank. Subsequent to launch, Internet banking has adopted a responsive design that makes banking on all devices a seamless experience with the site adapting to the device from which it's accessed."

The most used functions related to 'traditional' banking with most people opting to use tablets or phones to:

- make account transfers and beneficiary payments;
- upload new beneficiaries for payment purposes; and
- pay electricity and other prepaid purchases.

Users also demonstrated that they value app customisation. Research conducted via physical user testing and through e-mails with users indicated that:

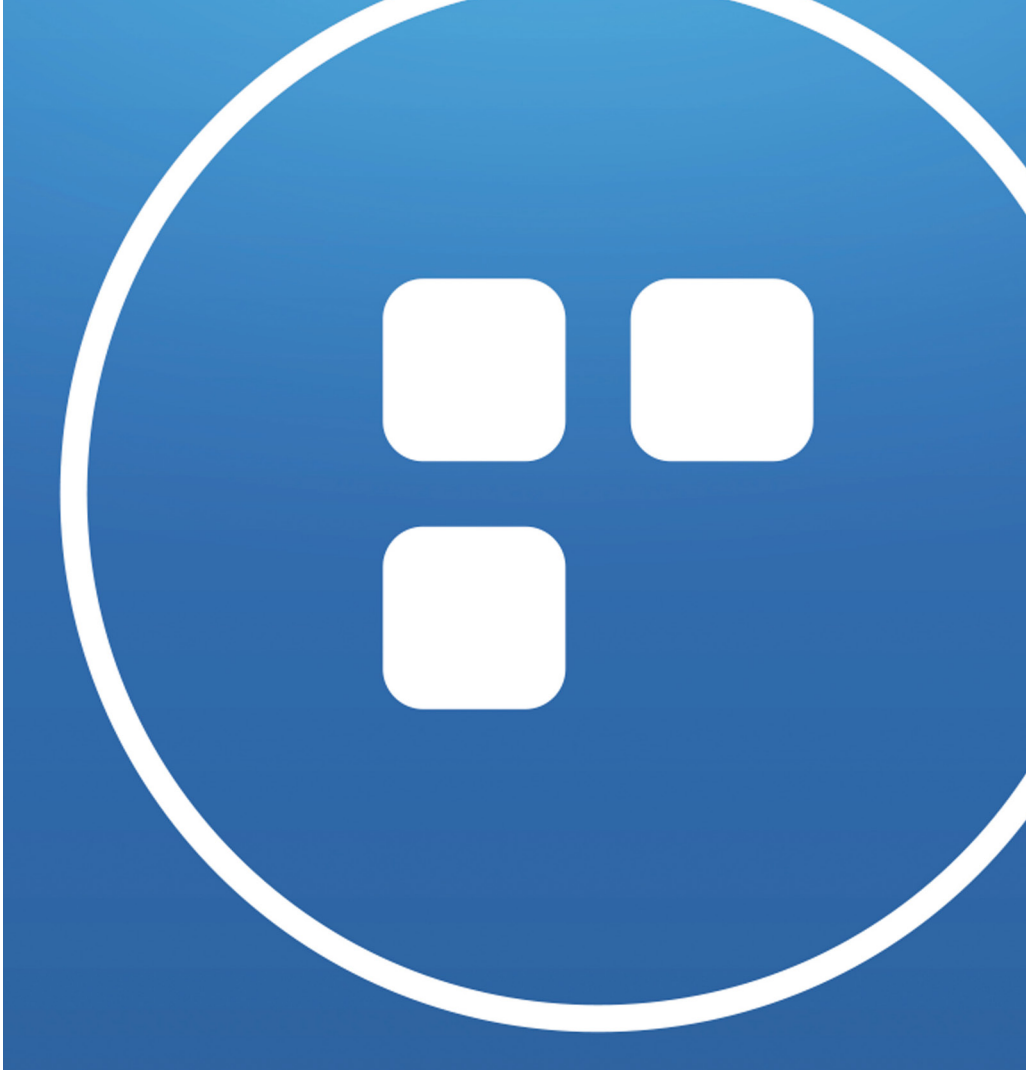
- Users enjoy customising their dashboards and creating multiple dashboards to manage their affairs, as well as uploading pictures for each dashboard.
- They have strongly adopted the chance to pay beneficiaries without having their banking details, but simply their cellphone numbers.
- The ability to create instant money vouchers to withdraw cash from various points without using bank cards is one of the most popular options.
- Having an 'Impulse Save' function to save towards a specific goal or to a nominated account by clicking on a button is appreciated.
- Quick Buy functionality with pre-paid data, voice, sms and electricity are well supported.

"Security has always been a concern to users of digital banking solutions," says Mr Mpako. *"A recent MasterCard Online study indicated that 90% of South Africans see security as their major concern, with 42% stating that they would not shop online because of it. However, major strides in technology have positively impacted on the use of the apps and digital media transactions."*

One of the factors driving increased usage of digital payments during 2014 was the introduction of solutions that transcended 'bank specific services' and the requirement that people be customers of a bank before being able to use a solution.

For Standard Bank, one of the leading indicators of this change was the SnapScan app, introduced in 2014. Less than a year after its launch, over 17 000 merchants and more than a hundred thousand users across South Africa have registered to receive and make payments using the app.

Using SnapCodes (two-dimensional barcodes) technology to process payments, SnapScan eliminates the need for cash and cards, and has been particularly popular with merchants who do not have access to conventional Point-of-Sale (POS) infrastructure or credit card machines. SnapScan has also provided a useful alternative to accepting cash for services such as street parking or church donations.



The recently introduced SnapBeacons technology also allows customers to pay at beacon-enabled merchants without scanning a SnapCode. Instead of scanning, the mobile application automatically detects a merchant's beacon and allows the user to initiate a payment directly by tapping "Pay Here" in the app. The new functionality is already available at a select group of merchants in Cape Town and in Johannesburg.

Of course, safety is maintained throughout both these processes with secret customer PIN numbers. For further security and ease of use, Standard Bank also integrated the Standard Bank ID into all of its mobile and tablet devices, meaning customer login information will be available across all their smart devices, from cellphones to laptops.

The second significant innovation was the introduction of the MasterPass virtual wallet service in South Africa which facilitates secure transactions in an online environment. Customers can store all their credit, debit and cheque card information, and shipping and billing address details, securely in one place in the MasterPass wallet. Through the MasterCard acceptance network, secure online payments can then be made using MasterPass, without having to enter card and address details for each purchase. MasterPass is available free of charge in Android, BlackBerry app, Windows and Apple stores.

What is determining the solutions and apps offered are the identified needs of customers. Customer-centricity demands that financial institutions deliver channels seamlessly, and integrate technology and data so customers can move easily from one channel to another, or from one device to another.

"Customers want a consistent experience no matter what device they use, and demand that digital solutions are intuitive and uncomplicated," says Mr Mpako. *"According to the 2014 Internet Banking SITEisfaction survey results, 96% of Internet banking users in South Africa use a laptop or desktop computer to access online banking services.*

"What is being demanded of banks is that Internet banking solutions align with the changing nature of e-commerce, and that we optimise our offerings so they meet customer needs and simultaneously give users a better experience.

"The next level of convenience in digital banking and security has been provided through the recently launched Biometric Banking app for iPhone and iPad users, using Apple's Touch ID technology. With the latest upgrade to our banking apps, customers with Touch ID enabled smartphones and tablets have the option to use Apple's fingerprint identity sensor to sign into our mobile banking apps." wn

SA's Future Water Crisis Linked to the Current Energy Crisis

Within 35 years, South Africa will be short of fresh water which will be linked to the energy crisis. The preferred way to address this is through desalination. But unless the energy crisis is addressed, SA is destined for long-term power and water shortages primarily because power will be need to produce clean water.

Trevor Blench, Chairman of Steenkampskraal Thorium Limited (STL), said the solution lies in developing small thorium-based nuclear power stations, which are far safer than uranium-based power stations and more affordable. Thorium reactors use dry cooling or minimal water, either inland fresh water from rivers and dams or sea water along SA's coastline to create energy and desalinate water.

Mr Blench said, while many parts of Africa are dry, the thorium reactor could desalinate sea-water for human consumption and produce water for irrigation. *"Millions of people die every year in Africa from water-borne diseases. Our reactor could produce clean drinking water."*

"Thorium represents an emerging and safe technology that is more efficient than uranium, produces significantly less hazardous waste and cannot easily be used for nuclear proliferation purposes," he said. *"The solution to the energy and future water crisis is to develop small thorium-based nuclear power stations deployed at these strategic locations."*

"SA has sufficient thorium reserves to supply all SA's energy needs for the next 100 years, which can also be used for desalination plants and for the safe production of electricity," he said.

Mr Blench said that thorium fuel is being tested in Norway. STL owns the rights to the thorium of the Steenkampskraal mine in the Western

Cape. He said that the Steenkampskraal mine has the highest known thorium and rare earth grades in the world.

"Thorium does not produce plutonium in its nuclearwaste, neither does it produce trans-uranic actinides. It is therefore a much cleaner fuel than uranium. Our associate company in Norway, Thor Energy, has manufactured thorium fuel and is now qualifying this fuel for use in commercial reactors. We will be able to use thorium fuel in our reactor," he said.

Steenkampskraal was mined by Anglo American during the 1950s and 1960s for its thorium. About a dozen reactors were built in Germany, England and America at that time that used thorium and we believe that most of that thorium came from this mine.

"We are designing a nuclear reactor that is appropriate for Africa. Typically, African countries have a total annual electricity production of between 1 000 and 5 000 MW per year. They do not have well-developed grids to distribute electricity and currently generate a lot of their electricity with diesel generators, at very high cost."

"These countries cannot afford to spend billions of dollars buying big expensive reactors, up to ten years building such a reactor or plug a 1 000 MW nuclear reactor into their tiny grids," he said.

Mr Blench said the reactor being developed will be suitable for African and remote conditions. *"The reactor will be small. It will have a rating of 100 MWth (35 MW electric) and will be the right size for many African countries such as Namibia, Botswana, Ghana, Kenya and many others. It will be suitable for distributed generation, so that countries that do not have good grids could build several of these small reactors in different parts of the country. It will produce electricity more cheaply than the diesel generators being used today."*

"It will also be affordable for the small countries that make up most of Africa and it will cost a fraction of the cost of large nuclear Light Water Reactors (LWRs). It will be modular and quick to build," he said.

Mr Blench believes that if Africa is going to embark on a nuclear future, it should leap-frog over the Generation 3 reactors and go straight to Generation 4 reactors. *"The technology is available. It has been tried and tested over many years. Our reactor is a Gen 4 design. What does that mean? It means that our reactor is intrinsically safe and meltdown-proof."*

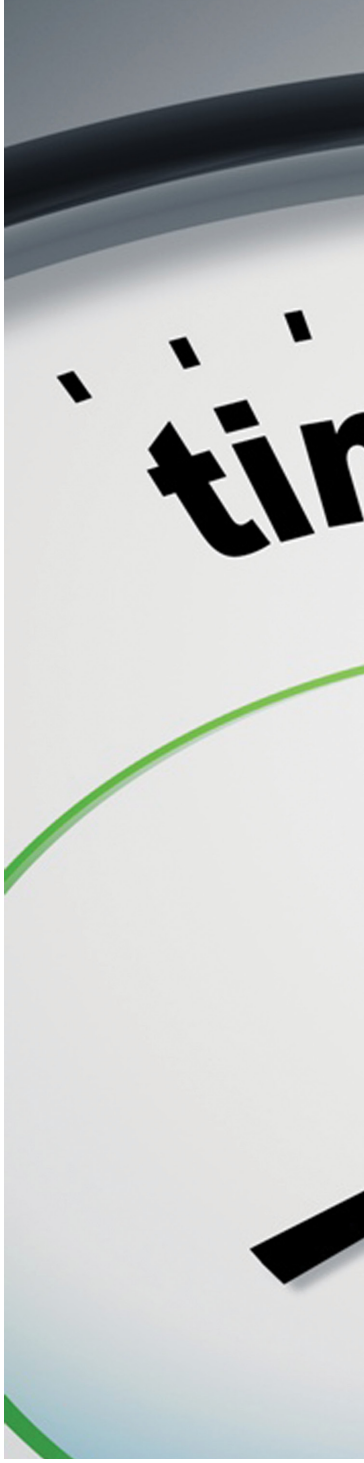
"It cannot melt down under any circumstances. The world over it is agreed that safety is the most important consideration in the nuclear industry. High Temperature Gas-cooled Reactors (HTGRs) have been demonstrated on several occasions, under the supervision of the IAEA, to be intrinsically safe and meltdown-proof. Another big advantage is that they are multi-purpose and capable of co-generation."

"There are many problems in Africa. Three of the biggest problems are food, water and power. Our plant can produce hydrogen in the form of ammonia. This 'hydrogen' could be used to make fertilizers to improve agricultural yields."

"Most parts of Africa suffer from power shortages that retard their rates of economic growth and hold down their living standards. Our small plant could provide electricity for remote towns and villages all over the continent." wn

Earn CPD Credits

IPPs critical to South Africa's energy security



Energy infrastructure is a critical component that underpins economic activity and growth in South Africa. Electricity needs to be reliable, affordable and sustainable to meet the energy needs of the industrial, commercial and domestic sectors.

BY | DR CLINTON CARTER-BROWN | POWER SYSTEMS EXPERT | AURECON

Present power generation constraints in South Africa are severe and debilitating. Independent Power Producers (IPPs), in partnership with Eskom, provide a sustainable and complementary solution to our electricity generation requirements.

This offers multiple benefits, including; diversifying both the supply and nature of energy production, introducing of new skills and in new investment into the industry, and benchmarking of performance and pricing.

A significant share of South Africa's electricity generation is already produced by IPPs. The Independent Power Producer Procurement Programme (IPPPP) is a key vehicle for securing electricity capacity from the private sector for both renewable and non-renewable energy sources, as aligned with national policy.

In 2014 approximately 2.2 TWh of renewable energy was generated from IPPs in South Africa, avoiding the release of 2.3 million tons of carbon dioxide, and powering the equivalent of 700 000 typical South African homes.

Furthermore this sustainable renewable energy saved South Africa an estimated R800 million in coal and diesel fuel costs and economic savings due to reduced load shedding.

IPP Procurement in South Africa is managed by the "IPP Office", a

specialised procurement office established under the leadership of the South African Department of Energy, National Treasury and the Development Bank of South Africa.

The IPP Procurement Programme, as developed by the IPP Office, has been designed with a rolling bid-window programme format whereby procurement of energy from IPPs is done in a cyclic manner, with a procurement cycle typically being completed in a year.

The bid-window format attracts continued market interest, induces increased competitive pressure amongst bidders to offer reduced pricing, allows for improvements and and uses standard contracts that avoid negotiations and enables consistency. Lessons learnt with each bid window are incorporated in the refinement of procurement documentation in the bid-windows *(See Table 1)*.

The design of the programme aligns with the South African National Development Plan to set in motion a virtuous cycle of development growth by recognising the inter-dependency between the desired Vision 2030 outcomes and the socio-economic commitments made by the IPPs in relation to job creation and skills development, economic interest participation by previously disadvantaged persons and local communities, localised spend and procurement, and the general improvement of the lives of people, for example through access to health and education.

IPPs critical to South Africa's energy security

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DETAILS	BW 1	BW2	BW 3	BW 3.5	BW 4
Submission Date	4 November 2011	5 March 2012	19 August 2013	31 March 2013	18 August 2014
Preferred Bidders	28	19	17	2	TBA
Contracted Capacity	1425 MW	1040 MW	1456 MW	200 MW	TBA

Table 1: Bid Windows (BW)

As of March 2015, a total of 4.1 GW of renewable energy (66 projects) has been contracted by the IPP Office, and 1.5 GW (32 projects) are already in commercial operation. The capital cost of this investment is R145.5 billion, with R45.6 billion being procured from local suppliers. The construction phase of the procured generation is creating more than 60 000 job years, with significant benefits flowing to the local communities where these projects are located.

RENEWABLE ENERGY PLAYS A KEY ROLE IN THE ENERGY MIX

The South African Renewable Independent Power Producer Procurement (REIPPP) programme is a delivery mechanism for the Government's 2010 Integrated Resource Plan (IRP2010), which calls for the development of approximately 17.8 GW of renewable energy capacity by 2030.

To date there have been five bid windows (BW) of the REIPPP programme (Table 1).

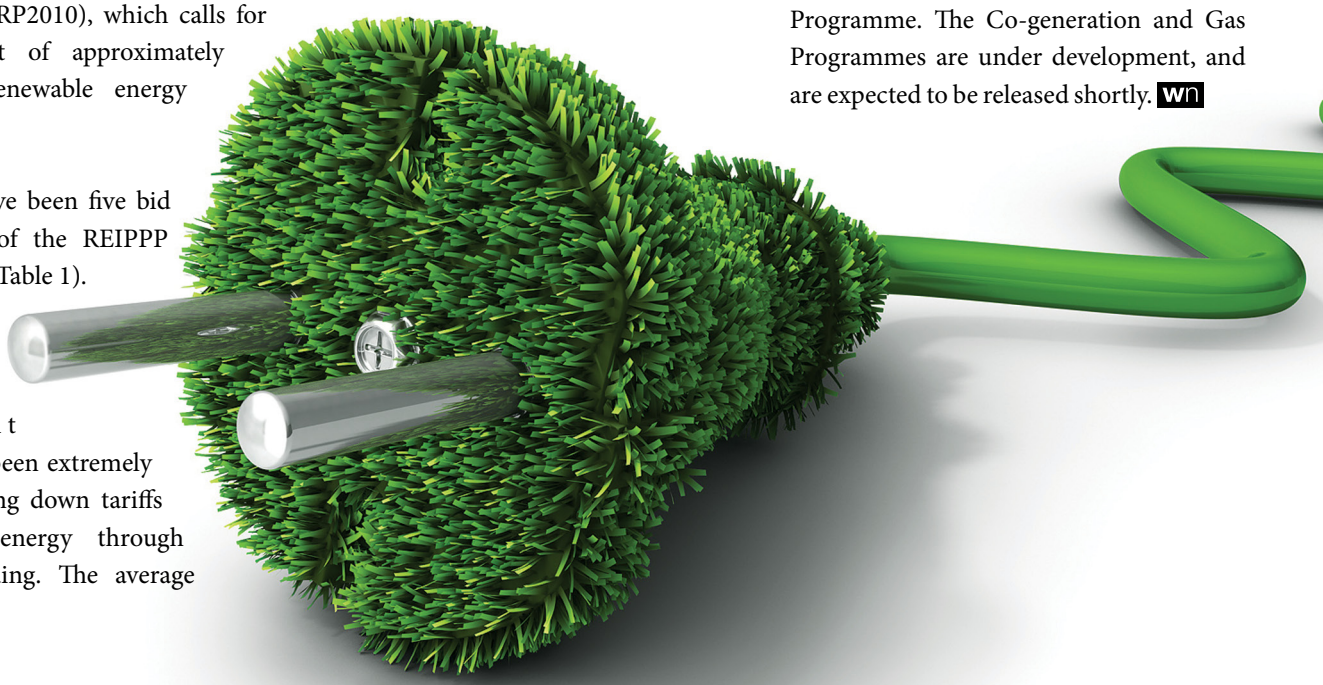
The rolling IPP procurement programme has been extremely effective in driving down tariffs for renewable energy through competitive bidding. The average price (April 2013 Rands) for the first Bid Window was R2.15 per kWh. This dropped by 34% to R1.42 per kWh in Bid Window 2, and dropped by a further 19% to R1.14 per kWh in Bid Window 3. This equates to an almost halving in prices over a three year period, as driven by reducing renewable energy equipment costs and the market forces induced by the highly competitive bidding process.

Renewable energy already provides a cost competitive solution to traditional fossil fuel based generation. Given that prices are anticipated to fall even further, it is clear that renewable energy will form a significant part of South Africa's future energy mix.

NON-RENEWABLE IPPS

In addition to the procurement of renewable energy from IPPs, the May 2011 New Generation Regulations also capacitate a role for IPPs in the traditional thermal generation technologies, whereby 2.5 GW of coal fired power, 800 MW of cogeneration based power, and 3.1 GW of gas fired power stations will be procured from the private sector. Pending the successful implementation of these programmes it is anticipated that there will be further determinations for additional IPP procurement.

The IPP base-load coal programme was released in December 2014, and follows the successful bid window approach implemented in the Renewable Programme. The Co-generation and Gas Programmes are under development, and are expected to be released shortly. wn



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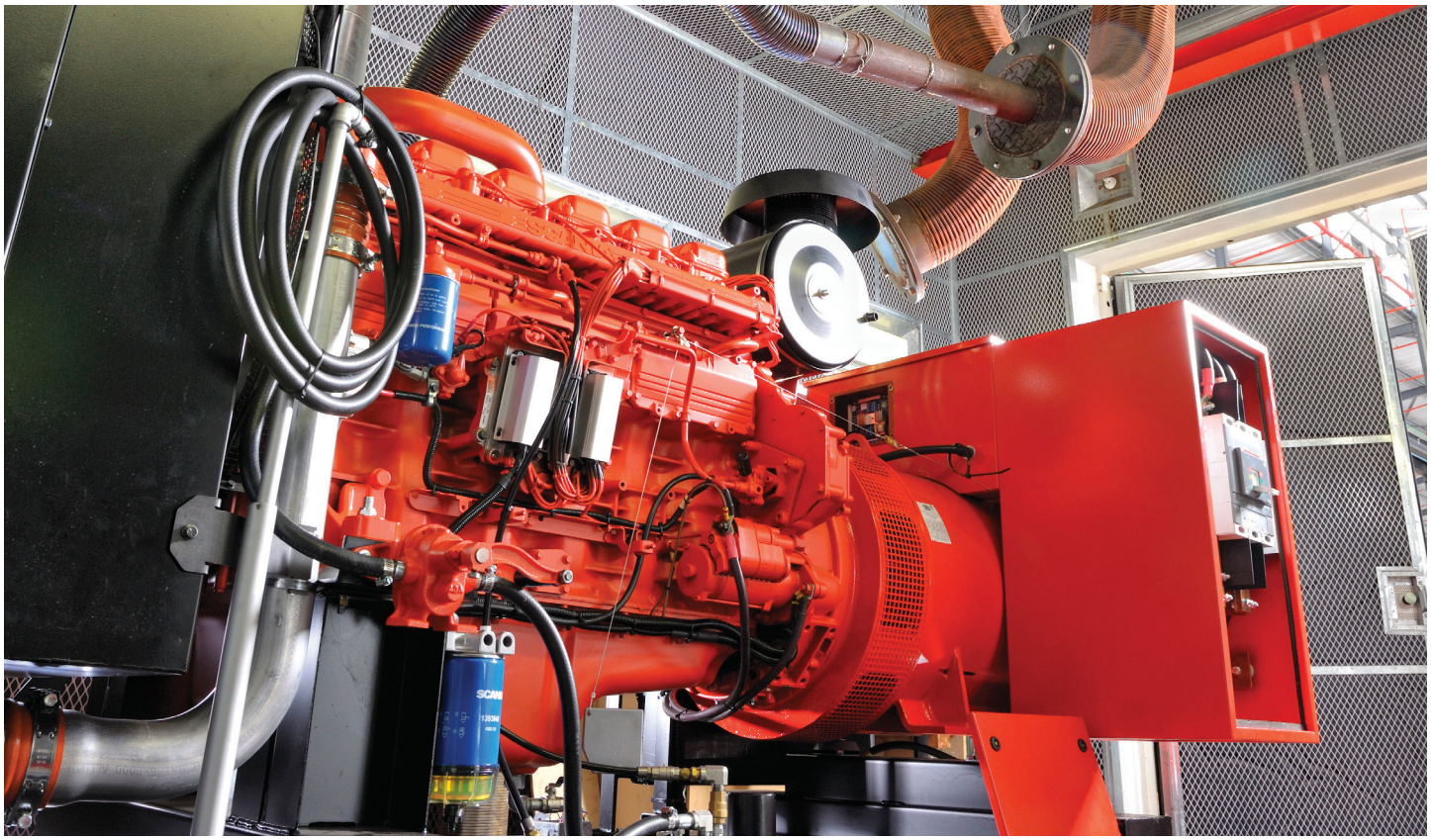

Open type diesel generator set

Range includes:

- 15 kVA to 250 kVA standard units (in stock)
- 250 kVA to 2 500 kVA custom built units
- Multiple set synchronisation
- Energy management system (peak load lopping etc.)
- BMS interface

Six 2 000 kVA open type synchronising generator sets

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Diesel generator set housed in a sound attenuated container

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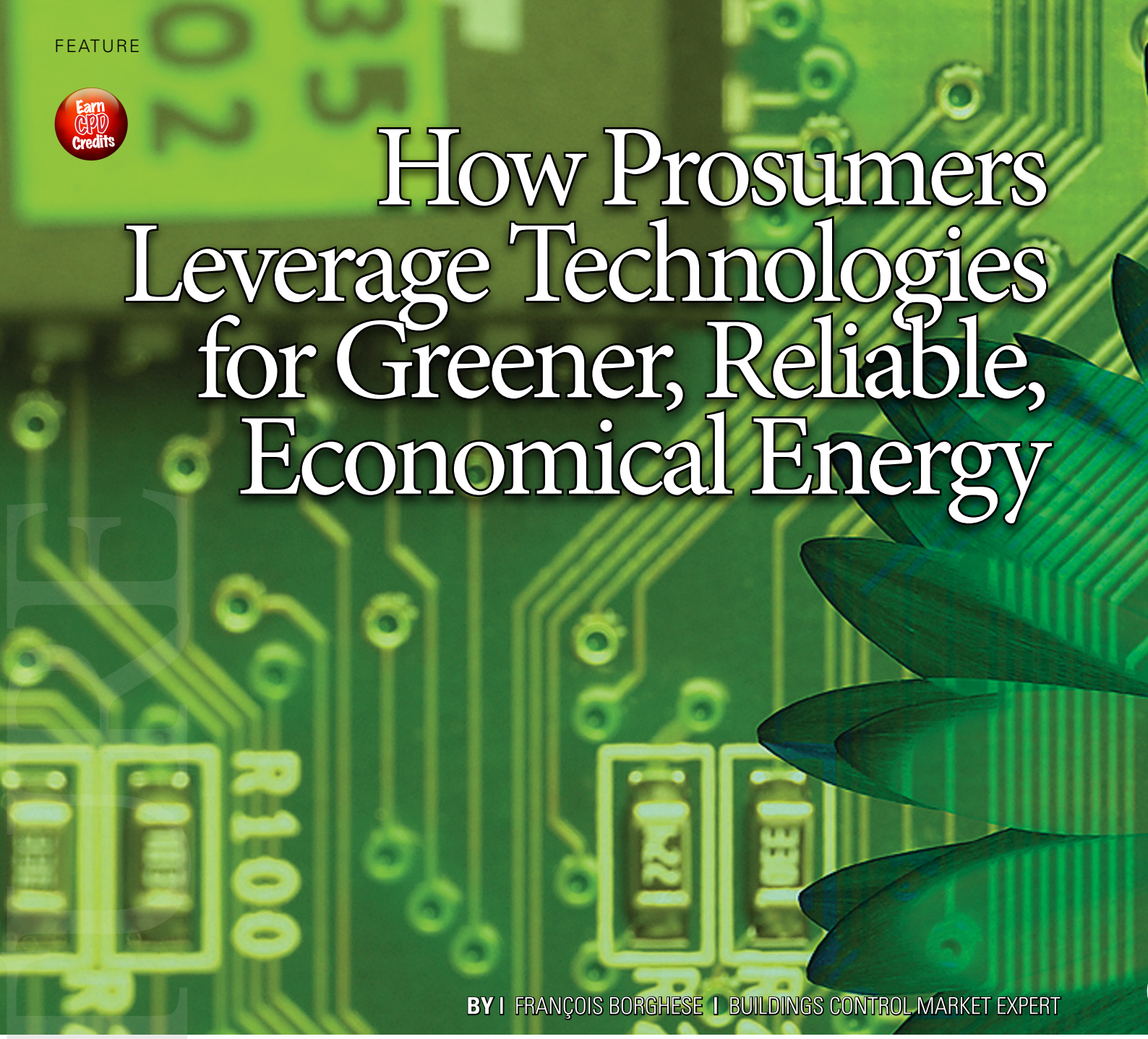
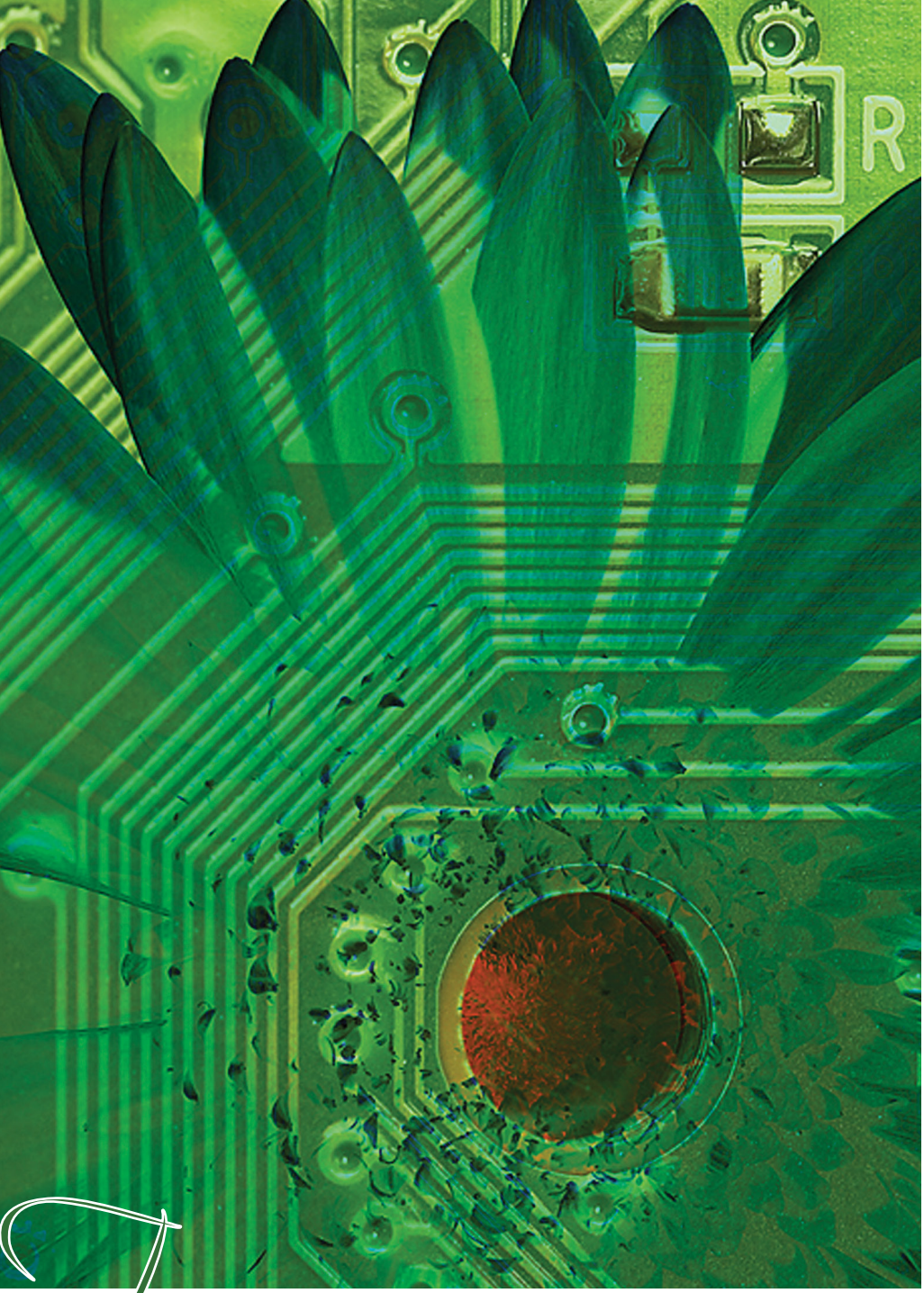
How Prosumers Leverage Technologies for Greener, Reliable, Economical Energy



BY | FRANÇOIS BORGHESE | BUILDINGS CONTROL MARKET EXPERT

As the global energy landscape continues to evolve, the proactive energy consumer, or 'prosumer', is emerging. Campuses, institutions, businesses, and homeowners are beginning to use new technologies to take direct control of energy sustainability, reliability, and cost. Local microgrids are being formed by dynamically managing a variety of distributed energy resources, including loads, onsite renewable energy production, and energy storage. And by connecting the prosumer to the smart grid, new information and control platforms are enabling participation in programs that fully monetize the flexibility of these assets.



Imagine a world where green, renewable sources are supplying most or all of the energy needed for every purpose: lighting, heating, processes, and transportation. Imagine that energy customers are able to proactively choose which energy source they want to consume. Imagine an electricity supply that is completely reliable. Imagine a typical business or home spends much less on their energy consumption, or actually generates revenue.

This scenario is becoming possible today with the marriage of new technologies and operational strategies on both sides of the electricity meter.

Over the past many decades growing energy consumption, the addition of intermittent renewable energy generation, and severe weather events have all contributed to electrical grid instability and energy price volatility. Electricity grid operators and utilities are taking steps to address these challenges in a variety of ways, including looking to the demand side for help.

As part of smart grid modernisations, remunerative programs are being launched or expanded that encourage energy customers to adjust their consumption in response to pricing signals, penalties, or curtailment requests. Due to this potential flexibility, a customer's energy-consuming loads and any onsite energy generation capabilities are now considered important distributed energy resources (DER), critical to helping balance the grid.

At the same time, many customers have begun taking more direct control of the

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cost, reliability, and green mix of their energy supply. City districts, educational campuses, military bases, hospitals, commercial buildings, factories, and residential homes are becoming proactive energy consumers, or 'prosumers'. They are enabled on this journey by a convergence of four widely available technologies that can automate and fully monetize their energy resources:

1. Energy management systems
2. Onsite renewable energy production
3. Electrical energy storage systems
4. Intelligent, interactive connections to the smart grid

This paper explains how these technologies are contributing to the smart, new energy prosumer paradigm. Armed with these tools, organizations and families are managing energy resources in a more dependable, economic, and environmentally sustainable way.

The way energy is generated, distributed, and consumed around the globe is evolving quickly. A number of operational, financial, and social factors are influencing these changes.

GROWING POPULATIONS NEED MORE ENERGY

A majority of the world's population now lives in cities, consuming about 75 percent of our resources and emitting most of the greenhouse gases. The United Nations estimates that by 2050 an additional three billion people will move into these dense, resource-intense urban environments.

As a result of these trends the increase in worldwide energy demand is estimated to grow by 37 percent by the year 2040, based on planned policies.[1] A percentage of this demand will be due to new kinds of loads, such as electric vehicles.

THE PROS AND CONS OF GREEN ENERGY

Utilities in many regions are being driven by new environmental regulations to gradually close their central fossil-fired generating plants. Some are also phasing out nuclear plants in response to public anti-nuclear sentiment.

Those plants will be partly replaced by renewable energy production means, such as large-scale wind and solar farms, which have both continued to growth at a rapid pace in recent years. For example, in Germany more than 35 percent of energy consumption is targeted to come from renewables by 2020, and 80 percent by 2050.[2]

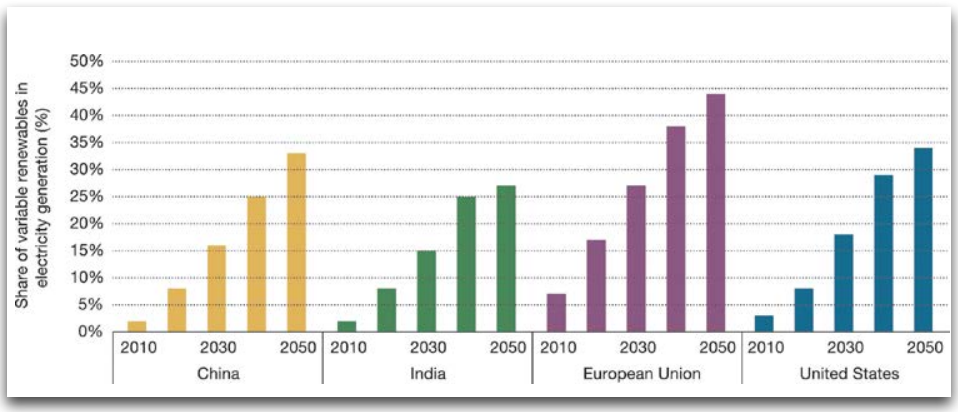


Figure 1
Share of electricity generated from variable renewables (per cent) by region, within the IEA Energy Technology Perspectives 2 Degree Scenario.
Source: IEA Technology Roadmap - Energy Storage

But there are challenges to integrating large amounts of renewable energy production with the grid due to the inherent intermittency of wind and solar power. One of the options for keeping the grid properly balanced is for grid operators is to implement demand-side management programs.

OPEN ENERGY MARKETS ADD COMPLEXITY

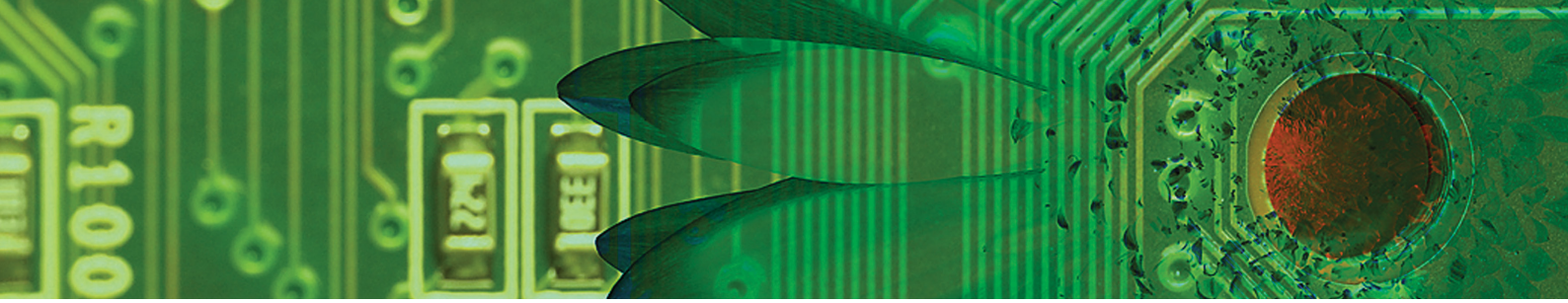
Deregulation of energy markets is a trend already occurring in many regions of the world.

Prior to this, network operators were often integrated with the power production companies. This meant they had full control over the majority of the power generation, matching production to the demand.

When the opening of power markets began in the 1990s, the grid operator's activities were unbundled from generation activities. Energy trading produced a far more complex paradigm for grid operators to manage. This has heightened the need for solutions that will help ensure the balance between energy supply and consumption.

AN AGING GRID INFRASTRUCTURE CAN'T KEEP UP WITH DEMAND

Some of the world's electrical infrastructure dates back to the late 1800s. In the U.S., 70 percent of the grid's transmission lines and power transformers are now over 25 years old and the average age of power



plants is over 30 years[3]. Globally, the majority of nuclear power plants have been operating an average of 27 years, with the oldest operating about 43 years.[4] Most will need to be rebuilt or replaced. In fact, one recent report warns that by 2050 nuclear power could disappear altogether.[5]

Most power grids have been designed for answering peak demand, with 25 percent of distribution and 10 percent of generation and transmission assets used less than 400 hours per year.[6] Even with this additional capacity built in, most grids were not designed for today's loads.

In terms of performance, older transmission lines dissipate more energy than new ones, constraining supply during periods of high energy demand.[7] Further, the current model of large, centralized generation plants means that about 70 percent of electricity is lost in generation, transmission and distribution. This equates to a global annual cost of energy loss estimated at about $4.1 trillion.[8]

To address its aging grid, EDF, the largest European utility, plans to invest up to 120 billion euros over 10 years.[9] However, most companies do not have the capital to invest large amounts in upgrading. This limits increases in generation capacity and the expansion of transmission and distribution networks. Demand-side management strategies, including the integration of distributed energy resources, can help lower this required investment by reducing the peak demand across the grid.

ENERGY PRICES ARE BECOMING MORE VOLATILE

Electricity is becoming more and more expensive in most parts of the world. In Germany, average electricity prices for companies have jumped 60 percent over the past five years because of costs passed along as part of government subsidies of renewable energy producers. Prices are now more than double those in the U.S.[10]

In the U.S. retail residential electricity prices for the first half of 2014 are on average 3.2 percent above the same period last year, the highest year-over-year growth since 2009. One state saw an increase of 11.8 percent.[11]

SEVERE WEATHER INCREASES THE RISK OF BLACKOUTS

Power outages due to severe weather events are on the increase in some regions. In August 2003, a widespread blackout caused an estimated 55 million people to lose power across the U.S. as well as northeast and eastern Canada, while later that year a major power outage across most of Italy and part of Switzerland affected 56 million people. Many more were affected by the world's biggest power failure in India in July 2012 that left half of the country without electricity. Soon after, Superstorm Sandy lashed the eastern U.S., cutting power to 8 million customers.

Severe weather is the leading cause of power outages in the United States. Between 2003 and 2012, an estimated 679 widespread power outages occurred due to severe weather. Thunderstorms, hurricanes and blizzards account for 58 percent of outages observed since 2002, with 87 percent of outages affecting 50,000 or more customers[12]. A recent Congressional Research Service study estimates the inflation-adjusted cost of weather-related outages at $25 to $70 billion annually.[13] Demand-side management can help limit the propagation of a 'cascading' outage by significantly reducing the demand on the grid outside the immediately affected areas. On the delivery-side, many critical-power energy customers are gaining partial autonomy from the grid to help ride through such events.

In response to these continuing challenges, grid operators and power utilities in most regions have joined forces to more efficiently balance demand and supply over an increasingly complex network, while also improving response to critical events. Collectively known as the smart grid, new strategies combine electricity and IT infrastructure to integrate and interconnect all users: generators, operators, marketers, and consumers.

Smart grid encompasses several different domains, from smarter energy generation methods to smarter homes and enterprises. Whereas many of the first smart grid programs focused on the supply side of energy, programs and technologies are now being introduced to allow all parties to work together to balance product and consumption, improve grid reliability, stabilize pricing, and reduce emissions.

Some smart grid initiatives have been in place for many years in some regions, such as variable energy pricing. Some initiatives are more recent, such as smart meters and automated meter reading (AMR), advanced network automation, and the installation of distributed energy generation.

In the past, smaller generation assets, including renewable energy sources, have typically been used for remote communities far from central plants. But more recently, these assets are being added throughout the grid, for purposes such as helping to reduce

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peak power demand on extremely hot or cold days. Such distributed generators have the added benefit of being closer to where the energy consumed, which reduces line losses.

Grid operators are also starting to invest in large-scale energy storage systems, located on the main grid. These can be used to level loads, help reduce the amount of generating capacity needed to supply customers at times of high demand, or to provide frequency regulation. Energy storage also supports a smoother integration of intermittent energy from large-scale solar or wind farms.

ACCESSING ENERGY FLEXIBILITY THROUGH MORE SUPPLIER-CONSUMER PARTNERSHIPS

Grid operators are increasingly looking to energy consuming districts, institutions, businesses, and homes as a potential source of energy flexibility. If an energy customer has the ability to selectively increase or decrease some portion of their energy use when required, that variability can be used to offset stresses and balance the grid. In this way, energy-consuming loads are considered distributed energy resources on the smart grid.

To access this energy flexibility, grid operators are joining with other entities, such as commercial aggregators, to develop a variety of demand-side management (DSM) programs. These are remunerative programs that can financially benefit energy users, as well as helping improve the reliability of the grid.

Depending on the region, different types of programs may be offered. In some regions, such programs have been offered for many years, dating back as early as the 1970s. But in most regions, these are more recent initiatives.

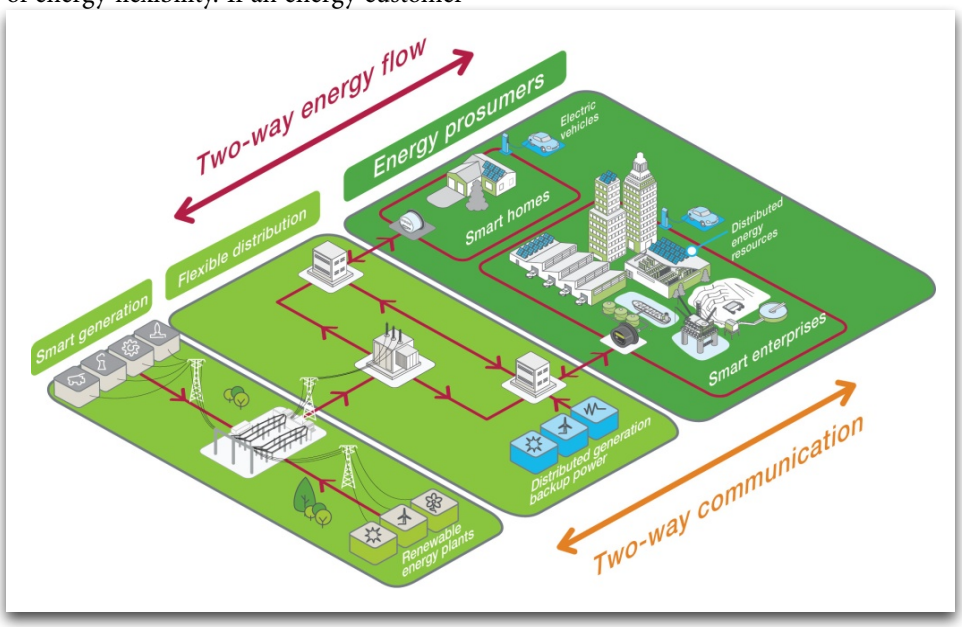


Figure 2

A smart grid connects energy suppliers and consumers together over communication networks, enabling them to work together to improve reliability by dynamically balancing energy demands.

VARIABLE TARIFF PROGRAMS

Energy price-based incentive programs encourage consumers to adjust their electricity usage, typically by increasing the price during peak periods of high demand on the grid.

The energy manager or homeowner can then respond by shedding (turning off) one or more loads, shifting (rescheduling) loads to another time of day, consume energy from an energy storage system, or start producing energy onsite.

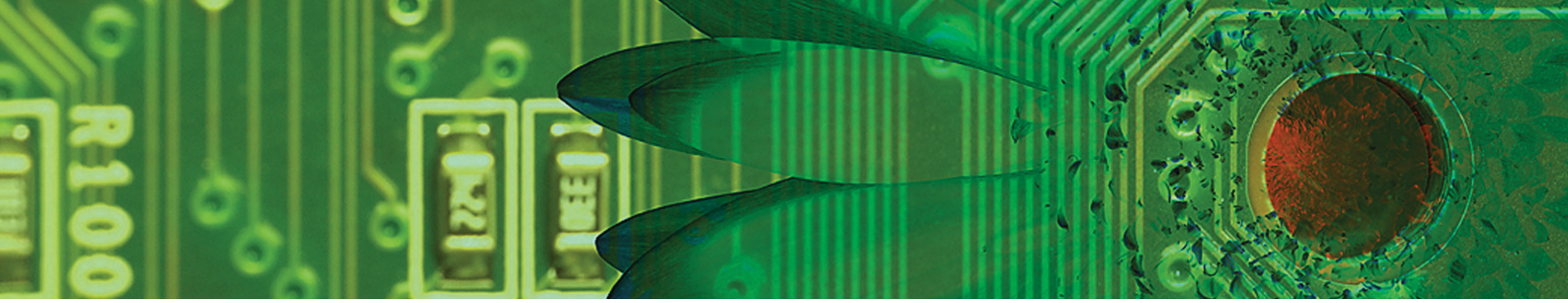
As an example, an industrial factory might shift a non-critical process to run during the night instead of mid-day. Other demand management options are discussed later in this paper.

The most common types of variable tariff programs are:

1. **Critical peak pricing (CPP) or peak demand surcharge.** A higher energy price or penalty is charged for using excessive amounts of energy at a peak time of day.
2. **Time-of-use (TOU) pricing.** Different blocks of time in a 24-hour day are given different pricing levels based on the cost of producing energy.
3. **Real-time pricing (RTP).** The rate for electricity follows dynamic wholesale market prices.

DEMAND RESPONSE PROGRAMS

Sometimes referred to as interruptible rates, Demand Response (DR) programs have been offered to Commercial and Industrial (C&I) customers for many years in some regions, primarily in the U.S. However, many other regions are starting pilot phases, intending to eventually build out full-scale markets or programs. In fact,



the global amount of flexible capacity in the commercial and industrial energy user segments addressed by DR programs is expected to grow from 26.8 GW in 2014 to 132.3 GW in 2023.[14]

By aggregating the available load flexibility of many energy-consuming customers, a virtual power plant is created, helping the utility avoid buying comparable levels of generation.

DR programs come in two main variations:

1. **Committing to reduce load when demand is high.** In this scenario, the customer agrees to reduce a portion of their energy consumption when the supply of electricity on the grid is threatened. Load reduction typically needs to be exercised within two or less hours of notice from the grid operator. Participants receive upfront payments for the amount of load capacity they can reduce.

2. **Allowing direct control of loads.** Usually applicable only for residential or small commercial businesses, this program allows the system operator to remotely shut down a specific customer load, such as an air conditioner or water heater, in exchange for an incentive payment or bill credit.

Faced with continued price volatility and grid instability in some regions, as well as increasing competitive and financial pressures, many businesses, institutions, and homeowners want to have more control over their electricity supply.

Enterprises are always seeking to minimize operating budgets and ensure no interruptions to service or processes. Many are now looking at their energy supply for ways to cut costs and boost reliability. Energy also represents a major expense for residential households, while any extended power outages are considered a threat to a family's security.

There is also a growing movement in environmental awareness that is encouraging consumers to seek out greener energy alternatives. Most businesses are starting to consider their 'carbon footprint' as an important key performance indicator. All of these factors have contributed to the emergence of the new energy prosumer.

And with this shift, four important categories of technology are converging to enable their goals: energy management, microgrid, energy storage, and connectivity with the smart grid. These technologies are giving prosumers direct control over a sustainable and reliable energy supply. They are also creating a larger, more dynamic set of distributed energy resources to help strengthen the main grid. And all of these technologies can augment existing facilities, or be integrated as part of new 'greenfield' projects.

ENERGY MANAGEMENT FOR ENERGY EFFICIENCY

Energy management systems have existed for many years, in a number of different forms. Most of these have been developed for use by large enterprises such as industrial plants and commercial buildings. However, in more recent years, such solutions are becoming available for smaller buildings of all kinds.

Typically comprising a network of digital energy meters connected to central analysis and control software, these systems are designed to accurately detail the consumption profiles of various loads and processes to help identify inefficiencies, and to provide early warning of potential risks to power quality or reliability.

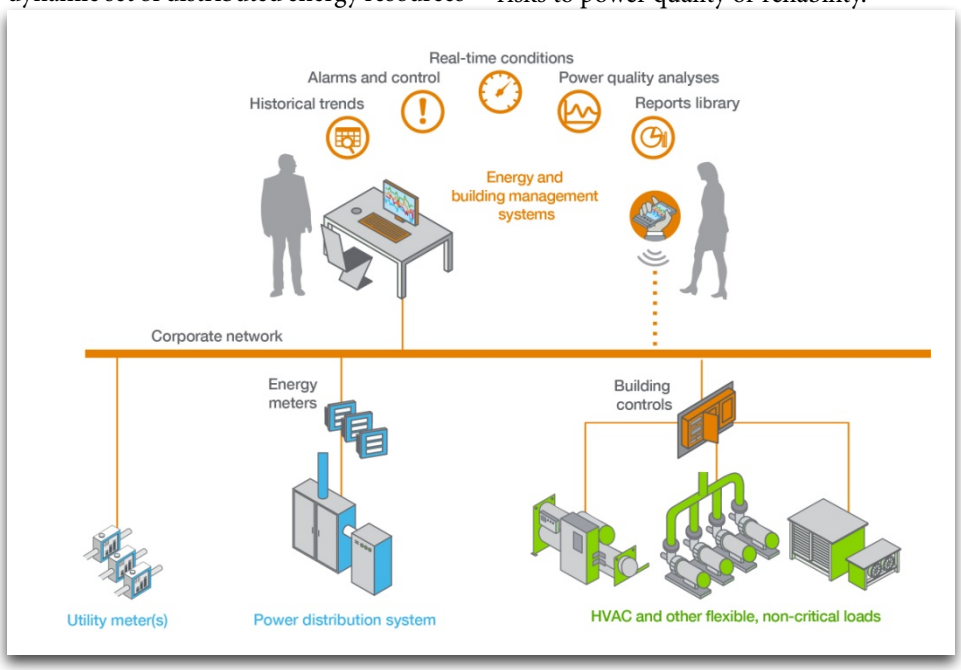


Figure 3
A typical energy management system for a commercial building.

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Through integration with building or process management systems, or other types of control devices, intelligent schemes can be used to perform automated load management. Controllable loads would typically include heating, cooling and ventilation (HVAC) systems, as well as any non-critical process systems.

If a prosumer has access to energy pricing data from their local utility, a system can also be configured to respond directly to variable pricing signals. For example, cooling could be reduced and building temperature allowed to rise by a degree during a period of high energy pricing. With an energy management system in place, a wider range of strategies can be planned and executed, such as predicting energy needs, revealing unused power distribution system capacity, and isolating sources of problems.

ONSITE GENERATION CREATES A GREEN, RELIABLE MICROGRID

Microgrids are essentially miniature versions of the traditional electric grid. They consist of local energy generation resources, as well as a microgrid controller, the power distribution system, and connected loads. Many types of energy resources can be used, including renewable energy generation (solar, wind, water, biomass, etc.), fuel cells, natural gas or diesel-powered engines, or combined-heat-and-power (CHP) systems. Such systems can operate independently, in parallel with the main grid, or connected to it.

There are now more than 388 remote microgrid projects in operation, under development, or proposed worldwide, in remote locations such as islands and isolated communities that are not connected to a grid. However, as natural gas prices and the cost of solar panels have fallen dramatically in recent years, grid-connected microgrids in urban areas are becoming more common.

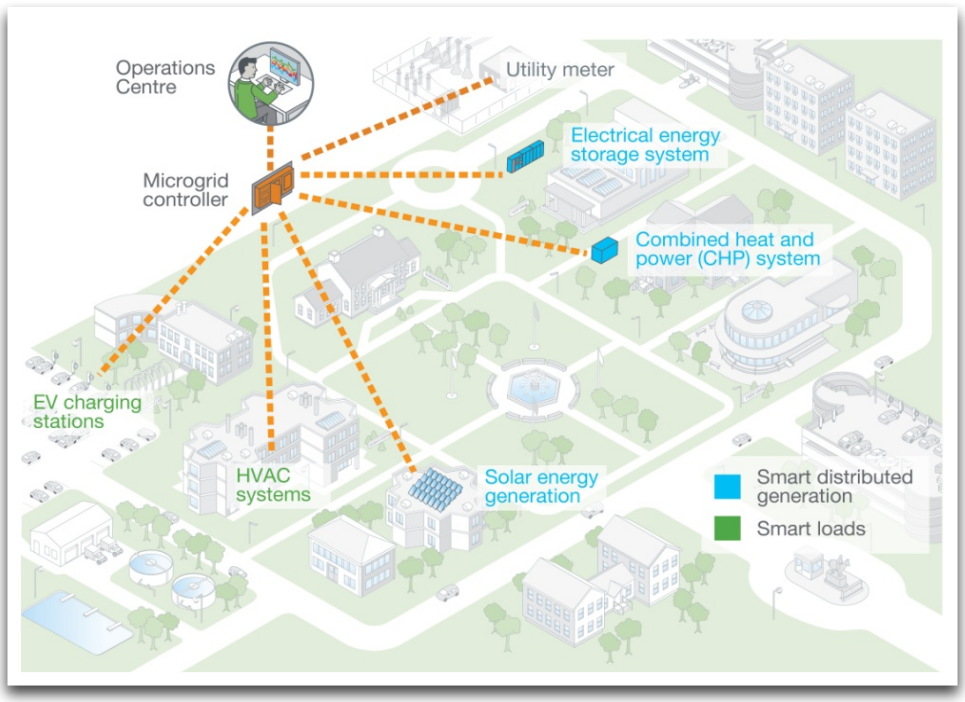


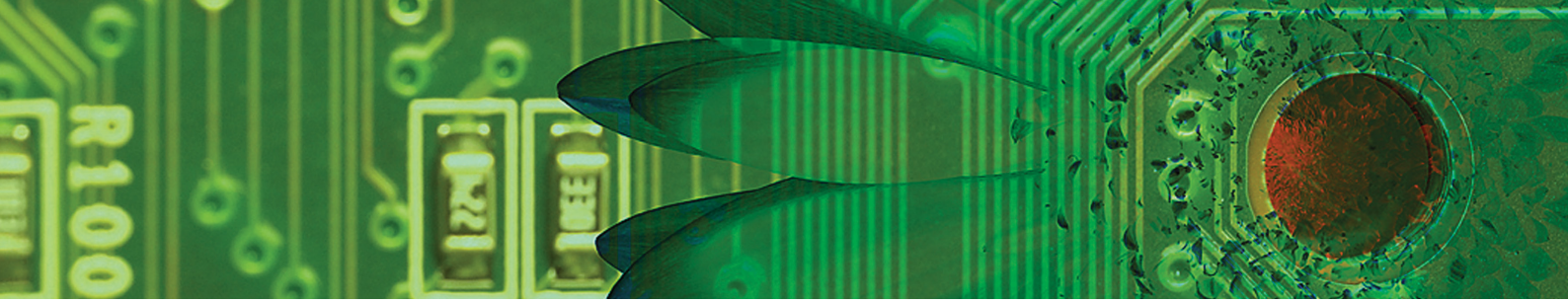
Figure 4

A typical microgrid for a large university campus, showing microgrid controller and distributed energy assets.

Benefits of microgrids for the prosumer include:

1. Using onsite generation as a flexible distributed energy asset. This can optimize participation in a demand response program by providing a choice of using local generation or load management to comply with a curtailment request. In some regions, feed-in tariffs enable customers to be paid for feeding renewable energy back to grid, typically without the option for self-consumption.
2. Enabling self-consumption of green energy. Local renewable sources can be used to displace part or all of the energy consumed from the main grid, helping reduce energy-related greenhouse gas emissions. Adding local energy storage can help further maximize the use of this resource. This is discussed in the next section.
3. Mitigating the economic impacts of power disruptions. A microgrid can operate in grid-connected mode, or island-mode in the event of blackouts. Going beyond the short- term capabilities of a typical emergency back-up system, microgrids have the potential to run indefinitely off locally generated power or battery energy reserves.

Prime candidates for microgrids include eco-parks and large commercial or industrial facilities. They are also ideal for enterprises where power continuity is critical to success, such as hospitals, military bases, police and fire services, and university campuses. Many colleges and



universities have already gained experience using microgrids to supply mission-critical users such as laboratories, research centres, surgeries, and data centres.

Microgrid solutions are also becoming available for individual, smaller buildings. These are often solar-based generation, and may often be packaged with energy storage systems. In some regions, adoption is being strongly encouraged by governments through attractive financial incentives.

Though some power utilities may view microgrids as a threat[15], they can help improve grid resilience and power reliability, reduce line losses, and enhance integration of renewables.

In recognition of these benefits, the U.S. DOE Office of Electricity Delivery and Energy Reliability has allocated funding for microgrid R&D16 and the U.S. microgrid market is expected to reach $40 billion annually by 2020, with capacity growing to 4.1 GW.[17]

ENERGY STORAGE SUPER-CHARGES THE MICROGRID

According to Navigant Research, advanced energy storage will represent the single largest investment category among 'microgrid enabling technology' options by 2023.[18] For example, in the U.S., California is targeting 1,325 megawatts of energy storage capacity by 2020, requiring around $3 billions of investment with subsidies program. In Germany, encouragements to adopt onsite energy include subsidies for energy storage.

Advanced microgrid systems will often include thermal or electric energy storage. Energy storage effectively extends the value of renewable energy sources by enabling self-consumption to be increased by up to 100 percent. It allows locally produced energy to be consumed when it's needed, produced when it's relevant, and to be sold back to the grid when it's most economically advantageous to do so.

Storing energy onsite also helps to increase energy flexibility. For example, if a prosumer is taking advantage of a variable tariff program, stored energy can be consumed during peak hours when grid energy prices are highest.

Storage batteries can then be recharged during gap hours, either from onsite energy sources or from grid power at lower pricing.

To optimize participation in demand response programs, stored energy can be consumed to respond to load curtailment requests, to effectively consume less energy from the grid. If the grid operator asks for increased consumption, batteries can be charged from the grid. Stored energy can also be used to provide ancillary services to the grid, such as frequency or voltage support.

Finally, a microgrid designed to provide critical power during and after disruptive events such as storms will often use energy storage as a 'green' backup supply. This can replace the need to maintain a spinning reserve of energy, typically from fossil fuel based generators.

A SMART CONNECTION TO THE SMART GRID

For the new prosumer to fully monetize the value of their energy flexibility, it's crucial to optimize how their distributed energy resources are managed. It requires tight coordination of loads, generation, and storage. It also requires knowing the best times to offer 'negawatts' (curtail load) or 'posiwatts' (provide energy) to the grid, all while ensuring comfort and maintaining productivity.

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Advanced information, communication, and control platforms are now becoming available to enable these goals. Prosumers are given an intelligent, transparent way to manage their distributed energy resources, as well as a simple, automated way to participate in smart grid programs. These are typically cloud-hosted SaaS (Software as a Service) platforms, with a modem and smart gateway installed at the prosumer's location that provides access over a secure Internet connection to a remote server.

The platform takes into account the energy, environmental, and economic needs of the enterprise or homeowner. It then automatically proposes the optimal arbitrage between the different opportunities: demand response, variable tariffs, peak demand management, maximizing self-consumption, selling energy back to the grid based, or supporting ancillary services.

The most comprehensive of these platforms will integrate all energy-relevant drivers. This will include weather forecast data, energy market pricing, load profiles and forecasts of the prosumer's energy needs, and any constraints on their operations. This is crucial in order to predict the most advantageous opportunities to consume, store, or produce energy.

The platform also manages all two-way communication between the grid actors and the prosumer. For example, a utility or aggregator will request curtailment tenders from many energy users, analyzing and monetizing those responses.

The prosumer will then use the platform to access the status of the curtailment orders, and view the synthesis of past curtailments. They will also be able to monitor the status of their generation, storage, and load assets that are being offered as flexibility to the grid. Curtailment actions can be simplified using automation; however, the prosumer's participation is always voluntary. At any time conditions are not ideal for a business or homeowner, they can decline an opportunity or override a pre-programmed control sequence.

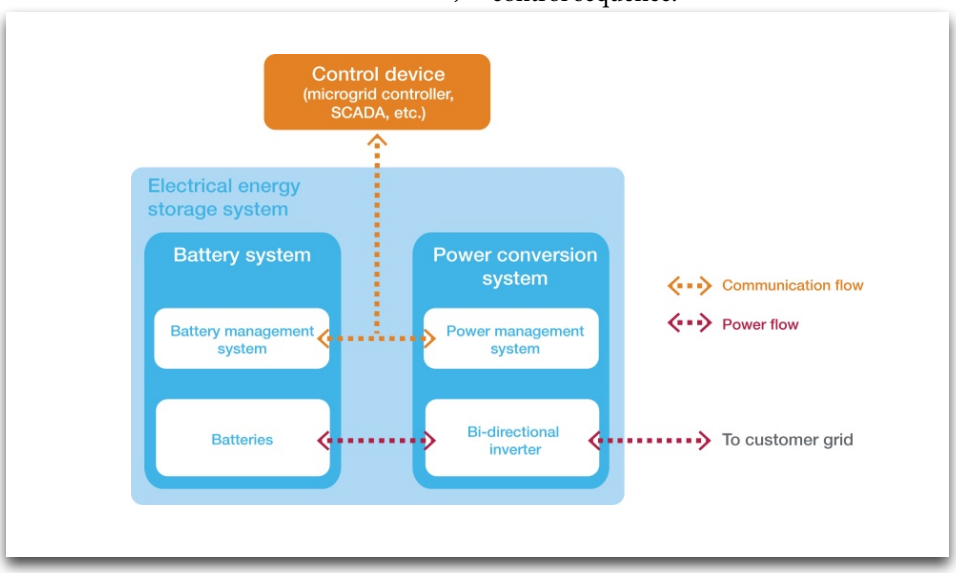


Figure 5
Energy storage system components

To enable the exchange of data between the platform and the prosumer, the smart gateway enables:

1. Acquisition of relevant status and performance data from all distributed energy resources
2. Sending of curtailment commands to distributed energy assets, including load controllers, microgrid controllers, building management systems, or process automation systems
3. Daily backup of all time-stamped load curves and curtailment actions

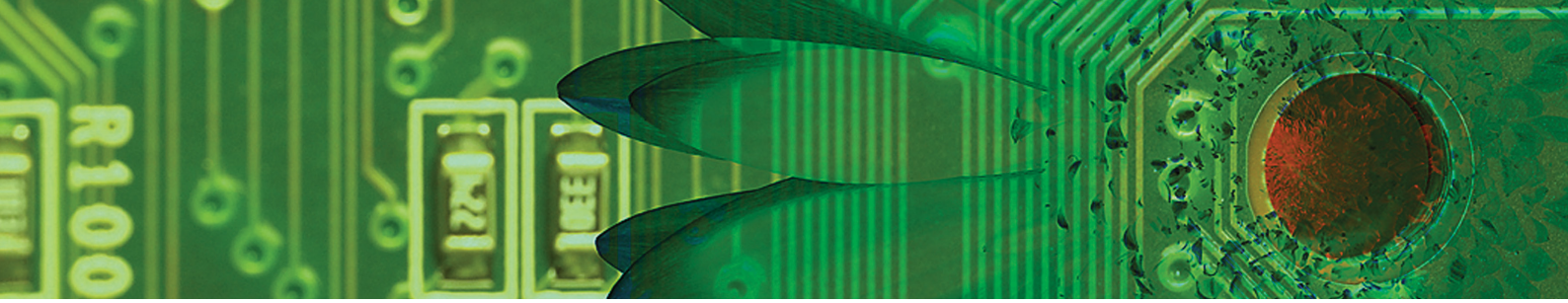
The level of intelligence and automation provided by such platforms offers a comfortable means to manage all energy resources and program participation.

CONCLUSION

The emergence of the energy prosumer heralds a significant shift in how energy will be generated, distributed, and consumed in the future. Energy management systems, microgrid technologies, energy storage, and intelligent information and communications platforms are converging. This is enabling a green, locally controlled, reliable energy supply, while maximizing the financial benefits of participating in the smart grid.

Intelligent algorithms that accurately track and project energy needs will ensure that comfort and productivity are maintained. And by providing an automated approach to controlling onsite generation, storage, and consumption, local energy needs can be met while enabling a two-way energy exchange that supports the resiliency of the larger grid.

An evolution from energy consumer to energy prosumer promises financial, operational, environmental, and societal benefits.



NEXT STEPS

To begin building a prosumer strategy, it is important to plan carefully to ensure return on investment is maximized and risks are reduced.

1. Consult with an expert to help determine the local regulatory situation, electricity tariff structure, smart grid programs availability, and all available government incentives.
2. Calculate the potential financial, environmental, and reliability benefits of installing one or more of the primary components of a prosumer solution: load management, onsite generation, energy storage, and a platform for interaction with smart grid programs.
3. Find a solution provider that can offer a complete range of services, including: site audit to determine the most optimal solution for the prosumer's business, design, project management, installation, commissioning, and lifecycle support.
4. Consider complementary services, such as utility contract optimization and energy efficiency upgrades. wn

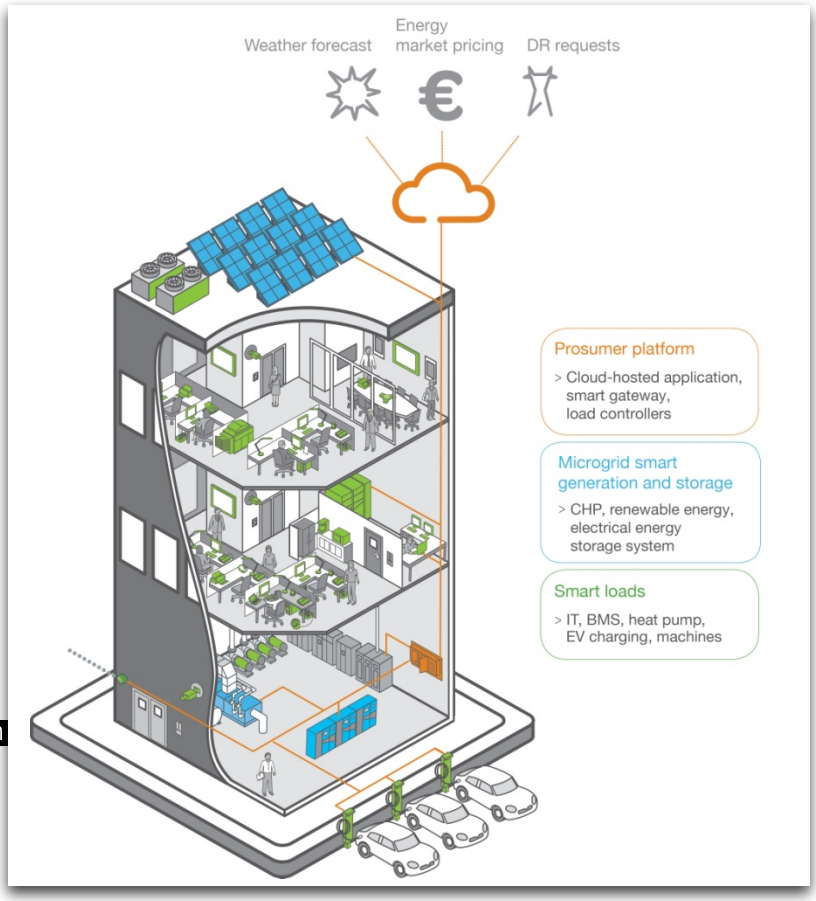


Figure 6

Commercial building running a microgrid and interacting with the smart grid through a typical cloud-hosted prosumer platform.

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A Closer Look at Thermal vs Battery Energy Storage

Energy storage technologies have unique nuances that make them better suited for performing a specific task in a particular vertical market with unique energy consumption needs. That's why Facility Managers consider energy storage as a solution to help curb commercial energy costs, but they need to be educated about the types of energy storage technologies available.

COMPILED BY | MINX AVRABOS

Being able to differentiate between the perks of battery and thermal energy storage, two of the most common solutions available, is especially vital for facility managers considering a deployment in the near future. Choosing the right technology will ensure the installation helps a commercial facility to consume electricity in as cost-effective manner as possible.

BATTERIES SHOW PROMISE FOR RENEWABLES AND VEHICLES

Bloomberg pointed out that the biggest demands for battery energy storage revolved around its use to offset the limitations of renewable generation. Energy generated by wind and solar is intermittent. Inconsistent breezes and sunlight obscured by cloudy days limit the usefulness of renewable generation throughout the year, and energy storage via batteries is becoming an increasingly popular solution to this problem.

Battery technology is also becoming increasingly accessible thanks to an innovation push from the automobile industry. Electric vehicles are closer than ever to matching the performance and cost of traditional fossil fuel vehicles, and these developments are pushing battery production to new heights. According to The Energy Collective, the same factories being used to develop EV batteries for vehicles are also ramping up production of storage solutions that are intended for applications beyond electric cars. It's no surprise that the success of battery storage in one highly lucrative, visible sector has led manufacturers to consider

where the technology could be lucrative elsewhere. Not all energy storage scenarios, however, call for a battery installation.

THERMAL ENERGY STORAGE DELIVERS WHEN IT COMES TO FACILITY MANAGEMENT

Though batteries are certainly receiving plenty of attention for their benefits, there are many other proven energy storage technologies that are better suited for tasks such as managing a commercial facility's energy costs. Storage mediums like ice, for example, are extremely effective for storing and releasing large amounts of energy with minimal waste, making ice an ideal solution for helping companies take advantage of off-peak electricity.

Typically this strategy is achieved by supplementing a chiller-based cooling system with thermal energy storage tanks that form and store ice, according to Buildings.com. Furthermore, companies would have to make a far larger investment to match the storage and discharge capacity of a thermal energy storage installation with batteries, and this cost difference is typically what pushes facility managers toward thermal.

There are a few other reasons why thermal energy storage is the right choice over batteries for commercial buildings. First and foremost is long-term ROI. While batteries may last for up to 15 years, businesses can get at least three decades worth of reliable performance from thermal installations. Choosing thermal storage over batteries for commercial application also saves businesses the hassle of finding a way to safely dispose of lithium-ion waste materials once the service life of a battery comes to an end.

PERKS OF ENERGY STORAGE

Being able to differentiate between the perks of battery and thermal energy storage, two of the most common solutions available, is especially vital for facility managers considering a deployment in the near future. Choosing the right technology will ensure the installation helps a commercial facility to consume electricity in as cost-effective a manner as possible.

Batteries are great for providing back up power for lighting, elevators and computers whereas thermal energy storage is the building's low hanging fruit for reducing peak electric demand.

Air-conditioning makes up a third of energy costs in summer months and it would be highly inefficient and costly to store energy in a battery only to have it transformed yet again to create instantaneous cooling.

In contrast, you cannot back up the entire building load with just thermal storage. All forms of energy storage are needed for a low carbon future. wn

BY | ANTONIO RUFFINI | MSAIEE

SAIEE's members play a prominent role in society by providing electricity and electrical energy. amongst other things. It is of critical importance to equip our members (but also others) with a suitable understanding of what the electrical-grid risks are, and what effects it has on the economic-matrix of activities of the SA society. More importantly to equip them to play their required leadership role should any of the unlikely but possible scenarios materialize.

The SAIEE leadership wishes to do this in a responsible and proactive way. Herewith the first in a series of articles from the first Power Discussion, which took place during May 2015.

Blackouts and their prevention in SA

Load shedding is not a weasel term intended to minimise the seriousness of the effects of the electricity problems South Africa faces. Collateral damage – is a weasel term which originates from military spin doctors to deflect and soften the reality of the death and destruction of people whose only failing is to be in the wrong place at the wrong time.

Because of fears that politicians and their agents are trying to trivialise South Africa's electricity crisis, there have been calls by various people to name the forced power outages almost everyone in the country is experiencing rolling blackouts on a regular basis.

However, Eskom is using the correct terminology. Load shedding in line with the International Electrotechnical Commission (IEC) definition is the controlled rotational interruption of supply in order to prevent a complete blackout of a power system. Load shedding takes place to avoid blackouts.

A total blackout of South Africa's national power system has never occurred. It is an unlikely catastrophic event, a one in fifty or hundred year event, where it will be necessary to cold-start the whole system. In such a circumstance it could take two weeks or longer before power is restored in certain areas (some areas would see power returned sooner). General Manager of the national electricity System Operator, Eskom's Robbie Van Heerden, says a total blackout would be a disaster akin to civil war breaking out in the country.

Consider the following scenario: Darkness with minimal or no telecoms, water reticulation schemes will start running dry within days, so will food supplies and cold storage is affected, banking systems will be affected, and there will be the potential for wide-scale social unrest. This is illustrated by the looting and arson that happened during the New York Blackout of 1977.

In spite of protocols put in place in the USA following that incident, during 2003 another blackout covered much of North-Eastern and Mid-Western America and extended into Canada.

Because it is impossible to guarantee a blackout will not occur, and because such an event could happen with little or no warning, South Africa has formulated (and continues to formulate) a disaster management scheme that extends well beyond Eskom. South Africa, being effectively a large isolated power system, does not have the luxury of other regions such as Europe where if a major incident happens in one country it can rely on its neighbours for grid support.

While households can have their responses in place fairly easily Van Heerden suggests that all companies should have plans in place to cope with a two week blackout.

Currently, South Africa's electricity grid is experiencing a tight operating regime where reserve capacity is absent and the system is being operated at its maximum to undertake necessary maintenance on the country's middle aged power

Blackouts and their prevention in SA

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SAIEE Executive with two Eskom Executives at the successful first in the series of talks with Eskom. From left: Dr Hendri Geldenhuys (SAIEE Junior Vice President), Max Chauke (Chairman Power & Energy Committee), Robbie van Heerden (General Manager, Systems Operator, Eskom), Robert Koch (Enterprise Resilience Manager, Eskom) and André Hoffmann (SAIEE President).

stations. With the national power reserve margin non-existent, replaced by supressed demand, the use of expensive emergency turbines run on diesel for extended periods, and regular load shedding, the intuitive deduction would be that we are closer to a blackout disaster than ever before.

While South Africa has never experienced a total blackout, major regions such as the Western Cape have experienced regional blackouts in the past. In addition, those whose memories go back far enough may recall an incident on the fourth of December 1975 which put some 45% of South Africa into darkness.

A busbar fault at the 400 kV Vulcan substation led to that incident. In those days the 400 kV grid in South Africa was nascent and relied on one main substation. The first 400 kV line in the country had only been established in 1971. The power stations at the time were not divided into separate units as is the case today (Eskom has 87 separate generating units now).

The country's transmission network is much more robust than it was four decades ago, and the circumstances where a single busbar fault could lead to such an incident are extremely unlikely. If anything, the risks of a total blackout in South Africa may be lower than they were a decade ago, according to Van Heerden, since the transmission network has been strengthened, which also ensures regions such as KwaZulu-Natal are at lower risk of being isolated. More importantly there is heightened awareness, and plans are in place at Eskom's National Control Centre to avoid a blackout scenario. Even the lack of reserve margin in South Africa is somewhat compensated for with the interruptible load agreement Eskom has in place with BHP Billiton's aluminium smelters in southern Africa. These account for over 2,000 MW.

It would require the electricity system frequency to drop from 50 Hz to about 47 Hz for the various turbines in the grid to trip and create the blackout event, and in recent years the lowest under-frequency occurrence has been above 49.1 Hz.

Roughly, the effect required to move the system by 0.1 Hz is 120 MW, and taking into account the various protections in place, typically the likelihood of an event that brings the frequency to below 49.2 Hz is typically about once a year. The last time this happened was an incident on the 6th of March 2014 when the majority of units at Kendal power station tripped out. Frequency stability was restored within 45 seconds. At 49.5 Hz there is an instantaneous 700 MW that is called into play to provide ten minutes of reserve, to keep the frequency up. The first steps implemented under such circumstances see power supply from some generators pushed up by 10%. Interruptible loads are invoked as is are unscheduled hydro and the gas turbines. If the country's pumped storage schemes are not operating they start up automatically.

Eskom has installed capacity of some 43 GW, not all of which is available at any time, with peak demand in summer of about 32 GW, going up to 36 or 37 GW during winter peaks. National Control has protocols and plans in place to shed load, and the system can withstand load being shed down to about 10,000 MW before islanding starts happening in an attempt to avoid a black start scenario.

In case of the grid reaching the stage where it becomes unstable, it will shrink into five limited islands to protect its integrity. These islands take into account the location of key generation units, and that the longer the coal fired generators are shut down, the longer it takes for them to restart.

If the system were to go down to 15,000 MW – 7,000 MW it is possible for it to remain operational and start breaking up into islands. At 7,000 MW – 2,500 MW it remains possible to sustain system islands, thus maintaining enough generation to initiate restoration, though the blackout scenario has effectively occurred. Should a total blackout occur it will be necessary to reboot the electricity system by means of a black start (this is the process of restoring a power station without relying on the external transmission network).This would be followed by the systematic re-energisation of the power system by connecting generators to customers via the transmission system.

The power stations would be restarted sequentially, taking into account that the large coal fired generators do not like small variable loads. They like to run at full load. Some of the facilities, such as the pumped storage schemes, have black start capability, this being the ability of a generator to start up without the assistance of an external supply and which then can be used to start a base load power station.

Van Heerden describes the process of starting up the power system from scratch as a tricky one. *"Until we can get it up to 7,000 MW – 8,000 MW where it stabilises, we would liven up parts of the system and pick up bits of load. This must be done in the most stable way to bring the network back. One line trip, and it would all trip out and we would have to start again. To get first load up takes seven or eight hours. It is a long process, but it is not true that everyone will be without power for two weeks. We will look at resistive loads which are most controllable, and some of these could be up within 12 hours of the restart."* Restoration of the national power system would begin in Gauteng, Kwa-Zulu Natal and Mpumalanga. A lot has to go wrong before a blackout occurs. The first priority of day-to-day operations by the national operator is the security of the system. At the next level Eskom has contracted with various customers to manually and automatically reduce demand in response to incidents in the power system. Then there is scheduled demand reduction which includes load shedding and mandatory curtailment by large customers to balance supply and demand when all other options are exhausted. The National Code of Practice for Emergency Load Reduction (NRS 048-09) has been developed to minimise the impact of emergency load reduction of up to about 4,000 MW.

Should greater levels of reduction be required to protect the national power system the System Operator will instruct unscheduled demand reduction in accordance with the National Code of Practice. Should an incident happen so quickly that this load reduction in terms of the code of practice cannot be implemented in time the System Operator will interrupt supply to some areas as required, until the load reduction in terms of the National Protocol can be implemented.

Should the manual interventions just described be too slow, or inadequate, the national power system has a further seven layers of automatic protection. In recent years only the first layer has been triggered at a national level, this referring to the approximately once a year incident alluded to previously. wn

Winning the talent war must be HR's top priority

After years of strong economic growth across the continent, African organisations face an enormous demand for skills to keep expanding their businesses.

BY I ANJA VAN BEEK
HR DIRECTOR I SAGE VIP

A RECENT SURVEY FROM ERNST & YOUNG (EY) shows that 70% of African firms are recruiting - yet many report that they are taking longer to fill vacancies and experiencing higher staff turnover. Technical and professional skills are in particularly high demand as African countries race to build out their infrastructure.

Many Human Resources (HR) departments in South Africa and other parts of Africa are not well prepared for an escalating war for talent that sees people with key skills and expertise able to pick and choose between employers.

All too many HR directors are tied up in red tape rather than spending their time on strategic talent management, skills development and performance management.

That puts their businesses in a weak position to respond to a changing workplace and workforce. Today's employees are ambitious, connected, and demanding global thinkers. They're more mobile within the borders of their own countries and industries than ever, and they're also increasingly open to global opportunities. These factors demand that HR departments become more flexible and focused.

IT'S NOT JUST ABOUT THE MONEY

Research from the likes of EY indicates that competitive remuneration is important, but it is not the sole factor in securing the best talent. It's as important to provide a quality workplace and a good employee experience - thus, companies that have a strong employer brand are best placed to attract and retain high-calibre employees.

Employees seem to value learning and development opportunities, job security, benefits, and good management nearly as much as they do pay. And that means companies need to rethink their approach to talent management.

They need to take an integrated approach that spans better recruitment processes, develop more thoughtful approaches to performance management and rewards, and have a tighter focus on employee engagement, career pathing and succession planning. Getting all of this right demands that HR departments transform themselves - they need to change by focusing on the employee experience and building the employer brand. They need to automate routine processes (so they're spending less time on paperwork and compliance) and gain better access to data to improve strategic decision-making.

WEAPONS IN THE WAR FOR TALENT

Organisations can turn around the war for talent by making the right strategic choices and making use of today's technologies to streamline operations. Cloud-based solutions give companies the perfect opportunity to automate manual processes, replace legacy platforms with more efficient solutions, and achieve higher levels of integration across their processes from recruitment to an employee's exit from the organisation.

One first step is to look closely at recruitment processes and ensure they're as smooth and automated as they should be. Is the organisation making optimal use of online recruitment platforms to attract skills?

Another important step is to look at how effectively the company is using technology to engage employees. Tools such as employee self-service can reduce paperwork for the HR department while delivering better service to the workforce. When people can apply for leave, fill in expense claims and pick up pay slips online, everyone wins from the gains in efficiency and convenience.

BETTER TALENT MANAGEMENT

On the talent management side, HR systems can help organisations to automate processes like performance management reviews and consolidation of performance related data. This frees up the HR department's resources and time for more strategic matters.

What's more, capturing data in a HR system opens the way for HR leaders to use talent analytics to boost performance. They can get better insight into trends such as staff churn, the costs of training and development, and the skills they may need to attract and develop to support the business's future growth. wn

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Earth's geographical South Pole may seem a desolate and inhospitable place for humans, but it presents several unique and exceptional opportunities for astrophysics, to be found nowhere else on Earth.

BY | DUDLEY BASSON

The high altitude (2835 m) and dry air make the site ideally suited for studies of the Cosmic Microwave Background Radiation (CMB) of the universe. Sub-zero temperatures may seem freezing to humans but 0^0C is a sweltering 273,16 kelvins to telescopes. The coldest temperatures to be found in intergalactic space are about 3 kelvins so that detection instruments must frequently be cooled to less than this. The coldest spot anywhere in the universe will be in the Cold Atom Lab of the International Space Station – cooled to 100 pico-Kelvins. Gases at this temperature and in microgravity present bizarre properties.

A useful feature in having a telescope at the pole is that astronomical targets can be tracked for months on end. At the pole there is no difference between altazimuth and equatorial telescope mounts.

The American South Pole Station has been

Cool Astronomy down South

continuously occupied since 1956 and has been named the Amundsen-Scott Base after the explorers who undertook expeditions to the South Pole early in the 20th century. The population rises from about 50 in the winter months to about 200 in the summer. Possibly the most striking feature of the site is the absence of a daily day-night cycle. The sun remains above the horizon for half of the year and sinks below for the other half. Humans do, however, need to function on a circadian cycle, so New Zealand time is used for a notional day and night cycle.

The various buildings at the site have been disassembled and re-erected from time to time when they have become too deeply embedded in the snow. The precise position of the South Pole must occasionally be re-surveyed as the glacial ice can move a few metres in a year.

The Cosmic Microwave Background Radiation has been under intense study since 1981 with the launch of COBE (Cosmic Background Explorer), first in a high altitude balloon and then in 1989 as an orbiting satellite. This was followed by WMAP (Wilkinson Microwave Anisotropy Probe) in 2001 and then in the Planck satellite in 2009.

A vast wealth of data has been gathered for advanced studies of the formation of the early universe. Studies of polarization anisotropies of this radiation can give

Cool Astronomy down South

continues from page 47

information of gravitational waves, gravitational lensing and even reveal invisible early universe galaxies.

In 1969, the astrophysicists Rashid Sunyaev and Yakov Zel'dovich discovered that the CMB radiation would be distorted by hot cosmic gas causing a change of brightness of the CMB towards clusters of galaxies where electrons should be abundant, revealing the large scale structure of the universe and cosmological parameters.

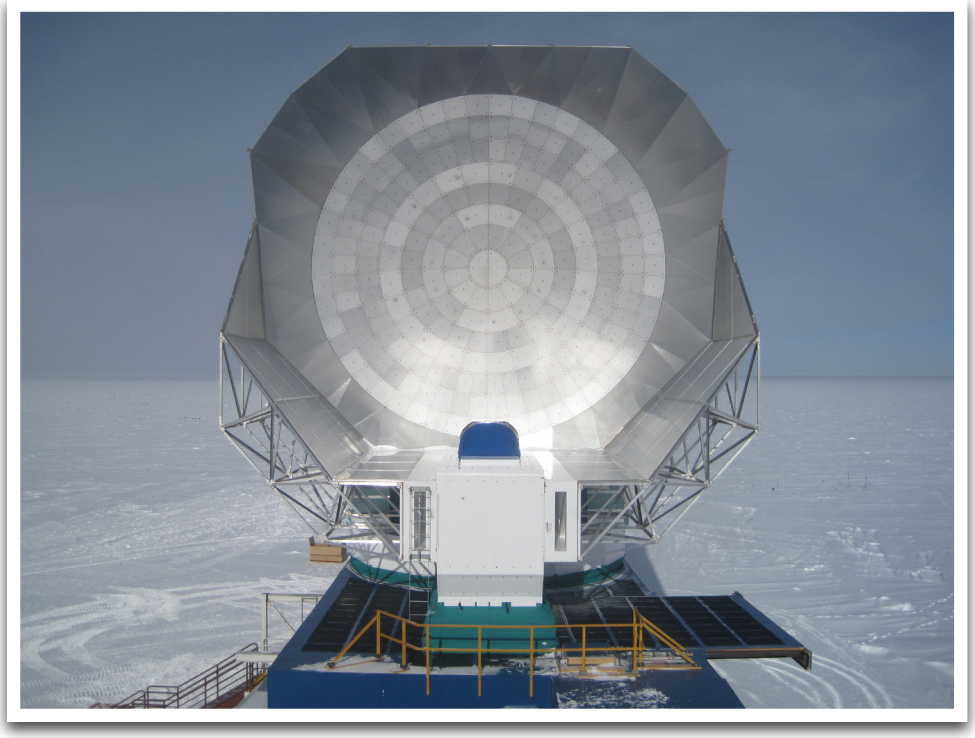
The effect, now known as the Sunyaev-Zel'dovich effect (SZE), was first noticed in 1978, and later confirmed after much searching, using instruments including the Planck satellite and the South Pole Telescope (SPT).

On 5 February 2015, the Kavli Institute for Cosmology, Cambridge (KICC), the Planck Consortium and the Cambridge Planck Analysis Centre (CPAC) issued the second release of data and scientific papers based on the superb Planck observations of the CMB - the fossil light resulting from a time when the Universe was hot and dense, only 380 000 years after the Big Bang.

A number of astronomical instruments have been deployed at the Amundsen-Scott base over the years. Let us take a brief look at some instruments currently in operation.

SOUTH POLE TELESCOPE (SPT)

The SPT collaboration is made up of over a dozen, mostly American, institutions and is funded by the National Science Foundation with additional support from the Kavli Foundation and the Gordon and Betty Moore Foundation. The telescope was built at a cost of $19,2 million and the running expenses are projected at $16 million per year. Science observations began in March 2007.



South Pole Telescope

The instrument is a 10 m off-axis Gregorian telescope with a surface accuracy of 25 microns. The secondary mirror is cooled to 10 kelvins, the lens to 6 kelvins and the detectors to 280 milli-Kelvins.

The SPT-SZ camera contained a 960 element bolometer array of superconducting transition edge sensors. The focal plane was split into wedges much like a six-slice pizza. For the majority of the life of the camera the camera had one wedge detecting at 95 GHz, four at 150 GHz and one at 220 GHz.

The currently installed SPTpol camera, even more sensitive than the SPT-SZ, has the ability to detect the polarization of the incoming signals.

The first key project of the SPT was a 2500 square degree survey to search for clusters of galaxies using the Sunyaev-Zel'dovich effect, which distorts the CMB. By the time that this was completed in October 2011 hundreds of galaxy clusters had been found. The main science goal of the SPT is advanced studies of the CMB.

ICE CUBE

This University of Wisconsin-Madison project is located deep beneath the ice at the South Pole Station. It is designed to look for point sources of neutrinos in the TeV range and to explore the highest energy astrophysical processes. Researchers from 44 institutions in 12 countries are engaged in Ice Cube projects.

The thousands of sensors are distributed in a cubic kilometre of ice deep below the surface. The optical sensors called Digital Optical Modules (DOMs), each with a photomultiplier tube and a single board acquisition computer, send digital data

Ice Cube Obervatory

to the counting house on the surface. The DOMs are suspended on 86 strings, sixty to a string, at depths from 1450 m to 2450 m, which were lowered into hot water drilled holes in the ice. The Ice Cube Observatory was completed on 18 December 2010. Compared to a cubic kilometre, the Eiffel Tower looks quite insignificant.

The Ice Top Array consists of 80 stations each with 2 Cherenkov detector tanks, each tank with two optical sensors.

Ice Top is used as a cosmic ray shower detector, for cosmic ray composition studies and coincident event tests.

Ice Cube can detect positrons, gamma rays and neutrinos and should be able to detect neutrinos that are produced by dark matter annihilations in the Sun. It is also hoped that Ice Cube will provide evidence of the extra dimensions of string theory. There is many other neutrino observatories scattered around the world.

The flux of neutrinos from the Sun passing through the Earth is immense. This is estimated at 7 x 10^{10} particles per second per square centimetre. Practically all of this flux passes through the Earth as if there were nothing in the way. Neutrinos are almost without mass, about a millionth of that of an electron.

BICEP AND KECK ARRAY POLARIZATION EXPERIMENTS

The BICEP (Background Imaging of Cosmic Extragalactic Polarization) experiments involved a large number of academic institutions. BICEP1 starting in January 2006 ran until 2008. This instrument had 98 detectors giving 49 polarization sensitive pixels working at 100 and 150 GHz (3mm and 2mm wavelengths).

BICEP2 (2010 to 2012) had a TES (Transition Edge Sensor) bolometer array of 256 pixels.

These instruments produced much material for advanced research into gravitational waves and gravitational lensing of the early universe.

The Keck array consists of five polarimeters similar to BICEP2 operating at 150 GHz of which two were converted to 100 MHz. The Keck array utilises a disused telescope mount, the DASI (Degree Angular Scale Interferometer). Each polarimeter consists of a refracting telescope cooled to 4 kelvins and a focal plane array of 512 transition edge sensors cooled to 250 milli-Kelvins giving 1280 dual-polarization pixels.

A $2,3 million grant from the W.M. Keck Foundation as well as funding from the National Science Foundation, the Gordon and Betty Moore Foundation, the James and Nelly Kilroy Foundation and the Barzan Foundation funded the Keck array. BICEP3 will consist of a single telescope with the same 2560 detectors as the Keck array.

The most prominent observatory funded by the Keck Foundation is the pair of visible/infrared Keck telescopes with ten metre mirrors situated on Mauna Kea, Hawaii. These giants are modern marvels of optics, physics, engineering and computer science. The telescopes are equipped with magnificent suites of specialised detection instruments. In addition to the Cassegrain focal point, instruments can also be mounted at the Nasmyth focal points. This is particularly useful when using bulky instruments.

The two telescopes can be used together as an interferometer. The telescopes use adaptive optics to greatly improve image clarity by compensating for currents in the atmosphere. A flexible mirror is adjusted 2000 times per second according to disturbances detected by means of a reference star, which is created 90 km high in the upper atmosphere by a laser beam.

Cool Astronomy down South

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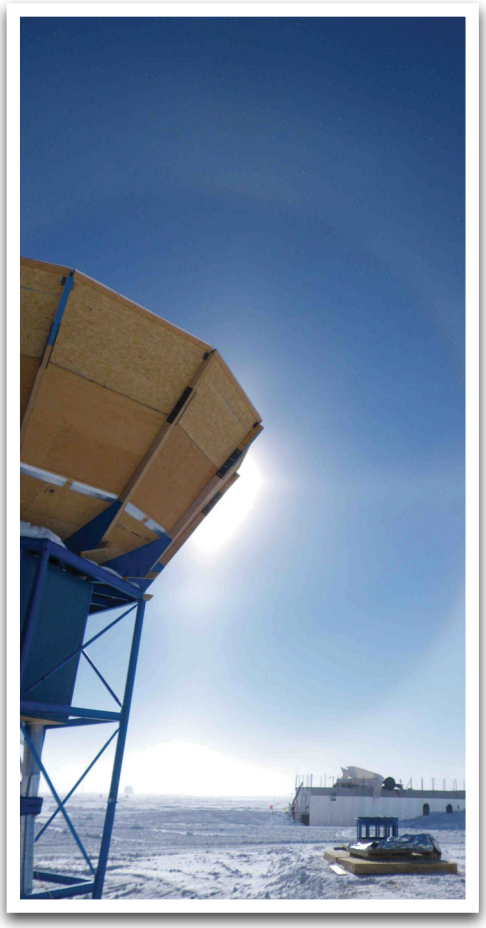

The Keck Array

The laser beam excites sodium atoms, which have conveniently been left by passing meteors. The adaptive optics mirror is in addition to the Ritchie Chrétien Cassegrain optics. The giant primary mirror has active optics to adjust the segments twice per second to keep the hyperboloidal surface accurate to within 4 nanometres. (A sheet of copier paper has a thickness of 100 000 nanometres).

The designer of the revolutionary segmented-mirror Keck telescopes was awarded the prestigious $1 million Kavli prize for 2010, jointly with two other winners.

Norwegian physicist, business leader and philanthropist Fred Kavli established the Kavli Foundation in 2000. The Foundation has endowed a number of prestigious research institutes and professorships at major academic institutions around the globe. The focus of Kavli research is on astrophysics, Nano-science, neuroscience and theoretical physics.

KIPAC (Kavli Institute for Particle Astrophysics and Cosmology) is an independent joint laboratory of Stanford University and the SLAC National Accelerator Laboratory. A large number of KIPAC scientists are engaged in projects at the South Pole Station.

On 13 April 2015, scientists of the Dark Energy Survey released an astonishing map of the dark matter distribution of the cosmos. This shows a predominance of dark matter in dense regions of galaxy clusters. Dark matter remains a tantalizing problem of astrophysics. Although it represents the major component of matter in the universe, it is completely transparent to light but is subject to gravitation.

The philanthropic funding of research projects has come into more prominence at a time when worldwide financial austerity measures have brought cutbacks in several major scientific enterprises.

In February 2015 the founding of the Science Philanthropy Alliance was announced. The founding members are: the Gordon and Betty Moore Foundation, the Howard Hughes Medical Institute, the Kavli Foundation, the Research Corporation for Science Advancement, the Simons Foundation, and the Alfred P. Sloan Foundation.

MIT Dean, Professor Marc Kastner, the founding President, declared:

"This is a critical time for basic science, with federal support declining in real terms, even as the need for this research is more important than ever for providing the basis of new advances in medicine and technology, providing a deeper understanding of our place in the universe, and attracting young people to study mathematics and science. While philanthropy can never replace federal support for basic research, its role has always been key to progress in science, and that role is now growing. I deeply appreciate this extraordinary opportunity to fulfil the Alliance's goal of both broadening and deepening the nation's philanthropic support for science."

Instruments previously used at the South Pole station:

- Python Telescope (1992-1997) for CMB temperature anisotropies;
- Viper Telescope (1997-2000) for CMB temperature anisotropies and (2000-2008) with ACBAR bolometer array;
- AMANDA (1997-2009) neutrino detection experiment. (Forerunner to Ice Cube); and
- the QUaD (2004-2009) for detailed CMB polarization observations using the DASI mount.

In 2001 a 33 m Foucault pendulum was erected at the South Pole. At the poles a Foucault pendulum will swing full circle in 24 hours. At the equator it will not turn at all. At other latitudes it will take more than 24 hours to swing full circle.

The mathematical calculation of the flower pattern swing of a Foucault pendulum is surprisingly complex. A well-known Foucault pendulum is the one swinging in the Paris Pantheon – which takes 32,7 hours to swing full circle.

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Cool Astronomy down South

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To the general public, the South Pole is probably better known for the explorers who first set foot there, than for the advanced scientific observations and experiments which have been taking place for more than half a century. It may be instructive to take a brief look at the two expeditions, which illustrate a tragic lesson in planning and project management.

Roald Amundsen

Norwegian explorer Roald Amundsen initially intended to go to the North Pole by drifting through the pack ice in a specially designed ship, but decided to go to the South Pole instead after the North Pole had been reached by Cook and Peary. He put himself at risk of financial ruin by mortgaging his house to finance the expedition, as sufficient sponsorship was not forthcoming.

For transport Amundsen chose 100 well trained North Greenland sledge dogs.

Amundsen party with sled dogs

These powerful Husky type dogs are one of the oldest dog breeds in the world. Their stocky build and double fur coat make them ideally suited for work in the snow. They love to run in the snow and even seem to enjoy pulling sledges. When sleeping in the snow they are able to cover their noses with their furry tails. Amundsen ordered the large stock of pemmican to be made to his own recipe including oats and berries for extra energy and nourishment.

Amundsen's party of 19 men used the vessel 'Fram' designed by explorer Fridtjof Nansen for work in pack ice, to set out from Kristiania (later renamed Oslo) for the Antarctic on 3 June 1910 and arrived at the Antarctic on 14 January 1911.

Depots were laid at one degree intervals starting at 80^0 latitude giving a spacing of 111,1 km.

While the depot laying was in progress, Amundsen sent a team to search for a route to the high altitude of the polar plateau. They discovered a 56 km long glacier with a gentle slope which they named the Axel Heiberg Glacier. The dog teams had no difficulty ascending the glacier. The dogs were well fed on the highly nutritious seal meat to keep them in top condition for their mission-critical role in the enterprise.

In order to relieve the lengthy ennui of several months, after depot laying and waiting for the sun to reappear, Amundsen included in the supplies a library of 3000 books as well as gramophone records and musical instruments (as well as a stock of wines and spirits).

The polar team of five men set out on 20 October 1911 with 56 dogs.

On arriving at the summit of the glacier, in accordance with the original plan, a butchery camp was set up for providing fresh meat for the thrust to the pole and return. Dogs, which had become surplus due to the lightening sledge loads and end of the glacier ascent were slaughtered. This was a sad time for the men who had become fond of their four legged friends.

Amundsen took great care to mark the route to the pole with flags, snow cairns and empty containers which had been painted black. Each cairn carried information of the direction and distance to the next depot.

On arriving at the South Pole on 14 December 1911, Amundsen's team used a box grid of sextant measurements to determine the exact position of the pole. They pitched a tent flying the Norwegian flag and left letters for Scott to deliver in case Scott arrived safely home and they did not. The tent remains in its original position, now buried beneath the snow and ice. A ceremonial pole, looking much like a barber's striped pole topped by a metallic sphere, has recently been erected for use in photo shoots.

The return journey was a frolic in the snow with the doggies. All of the team members were skilled skiers and were able to make swift progress down the snow-covered glacier. Champion skier Olav Bjaaland was appointed as front-runner. The ship's carpenter had made the sledges lighter for speed and fitted brakes to make them more manageable down the steeper slopes. The depots were well stocked with food, chocolate and paraffin so that the men were able to enjoy hot meals cooked on their Swedish Primus stoves. Amundsen had arranged for the caps of the paraffin containers to be soldered to ensure that there was no leakage. A full-unused container found fifty years later showed no leakage. They used a notional 24-hour day with the sun behind them for day, and in front for night, in order to avoid direct glare from the sun which could cause snow-blindness. The polar team arrived safely at the base camp on 25 January 1912 without loss or hardship. In all, the polar team had travelled nearly 3000 km in 99 days. The Norwegians set off in the 'Fram' on a five-week voyage to Hobart, Tasmania, where there were telegraph facilities available. Amundsen announced his achievement to the world, which was received with much acclaim. In Hobart, Amundsen received congratulatory telegrams from, among others, former US President Theodore Roosevelt and King George V of England. In Britain, the response was muted, as it was not known what had become of Scott.

Amundsen ascribed his success to the meticulous planning, equipping and provisioning of the expedition. A quote from Amundsen: "*Victory awaits him, who has everything in order - luck we call it. Defeat is definitely due for him, who has neglected to take the necessary precautions - bad luck we call it.*"

The British expeditionary team was under the command of Naval Captain Robert Falcon Scott. Scott's party of 65 men set out for the Antarctic aboard the 'Terra Nova' on 16 June 1910 from Cardiff to arrive at the Ross Ice Shelf on 4 January 1911. For transport, Scott chose to take ponies and three motorised sledges, as he had no previous experience with handling dog teams. Some Siberian Huskies were however taken for backup. Scott ignored the advice given by the famous explorer Nansen to take "dogs, dogs and more dogs". The man sent to purchase the ponies unfortunately did not notice the animals' poor condition. They should have been well fattened before being taken to a freezing climate. Of the 19 ponies, 9 were lost to various mishaps soon after arrival in the Antarctic. The motorised 'sledges' were long tracked vehicles with the engine at the centre covered with a wooden box.

Captain Robert Falcon Scott

The British and Norwegian ships moored at opposite sides of the Ross Ice Shelf. There was some cordial communication between the competing expeditions.

One of the vehicles was lost when it fell through the ice while being unloaded from the ship. Amundsen was dumbfounded by Scott's reluctance to use dog teams. The ponies and vehicles were used for depot laying on the Ross Ice Shelf. Working ponies sweat through their skins, which made them unsuitable for work in freezing conditions (dogs do not sweat).

The ponies could not walk on soft deep snow without snowshoes – they would simply sink down to their bellies. They could also not eat the plentiful seal and penguin meat available and had to be fed with fodder brought from the ship. They were simply the wrong animals for the job. When the supply of fodder ran out they were worked to exhaustion and then slaughtered for fresh meat. Scott chose to reach the high altitude of the polar plateau by ascending the Beardmore Glacier previously used by Shackleton. This gave a longer and in places a steeper route to the pole than that used by Amundsen. It was agreed that the ascent up the glacier was too steep for either ponies

Cool Astronomy down South

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Scott's expedition party

or dogs. The polar team did not use the vehicles. It seems doubtful that they could have carried sufficient fuel to be of much use on the polar attempt. The only man with expertise in the use of the vehicles was excluded from the polar team for naval rank and seniority reasons.

The five man polar team had to laboriously man-haul the heavy sledges themselves. Man-hauling heavy sledges for thousands of kilometres, and ascending to an altitude of almost 3000 metres, seems a superhuman task of horrendous proportions. It was much later determined that the calorific value of the men's rations was not commensurate with the effort of hauling the sledges and that they were in fact on slow starvation diets. None of the men had any ski experience and had to plod wearily both up and down the snow slopes.

On arriving at the South Pole, the men were dismayed to see the tent flying the Norwegian flag, and to find that Amundsen had been there 34 days before. Their expedition of extreme hardship had ended in failure. In his diary, Scott expressed misgivings about surviving the return journey – which turned out to be an extreme ordeal ending in tragedy. The weather soon changed to blizzard conditions and the temperature plummeted.

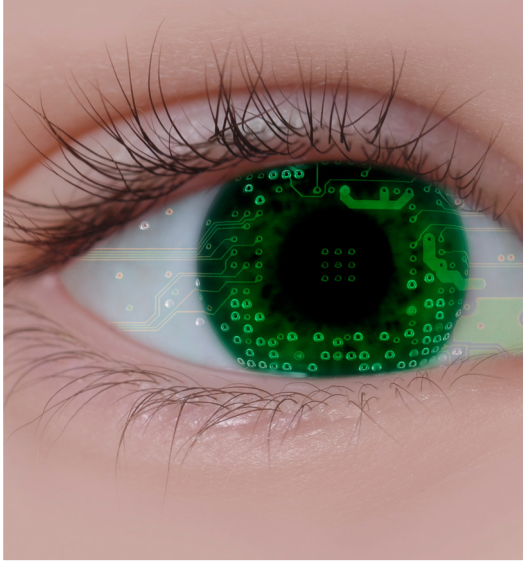
A major setback at the depots was the loss of paraffin due to inadequately sealed containers. The men were under-nourished and some had frostbite which was so severe, that had they survived, would have required amputations. Some also suffered from snow-blindness.

Water was in short supply as there was insufficient paraffin for melting snow. On stopping for their last camp they had to endure the horror of not knowing whether they had overshot the next depot or whether it lay further ahead. All of the men died horribly from starvation and hypothermia, the last three of them, 18 km before the next depot which had been placed 50 km further north than planned. In his diary, Scott remained heroic to the last, and also wrote a plea for the Government to provide for the widows and children of the team members.

The frozen remains of the Scott polar team were discovered on 12 November 1912. The 'Terra Nova' left the Antarctic on 26 January 1913 and sailed to Oamaru, New Zealand. When news of the tragedy reached Britain, Scott was hailed as the hero and martyr who gave his life seeking to bring honour to his country. Amundsen was denounced for using professional methods to gain an unfair advantage over Scott. When Amundsen heard of Scott's fate he remarked: "*This is horrible, horrible*".

The 'Heroic Scott' myth persisted for more than half a century, after which time Scott came to be perceived as the negligent irresponsible bungler who led his men on a foolhardy mission to their deaths.

Roald Engelbregt Gravning Amundsen died on 18 June 1928 while taking part in the rescue of the survivors of the 'Italia' airship disaster. wn



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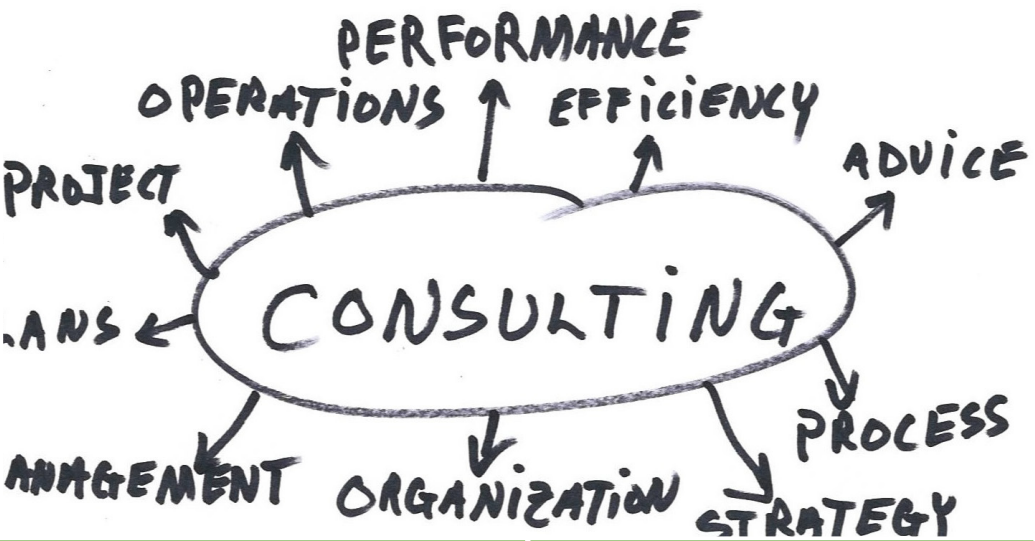

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WATT?

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We hope that this section of the magazine not only becomes a regular feature, but that it is widely read and distributed among your peers. Remember, it can only become a success with the full participation of our readers! Send your burning questions to minx@saiee.org.za - subject 'WATT?'.

We look forward to hearing from you.
- Ed

QUESTION ONE

What is a harmonic load and how does it affect the sizing of a transformer i.e. (Converter Transformer or VSD Transformer)?

ANSWER ONE

Historically most of the loads were distribution type and hence the term Distribution Transformer but in todays industry, this has to be analysed before sizing the transformer. Most types of loads these days are based on power electronics and contain higher harmonics in the load current due to the distorted waveform. These harmonics tend to cause the transformer to heat up more and see higher losses than specified. If the type of load is not considered at design stage, this could lead to transformer overheating hence insulation failure, shorter lifespan of the transformer or even transformer failure. The type of load that a transformer is going to experience is very critical in the modern day we live in. Examples of some of the types of loads are

- Electric discharge lighting
- Welding Equipment
- Induction heating equipment
- PLCs and solid state controls
- Telecommunications equipment (e.g.. PBX
- Multiwire receptacle circuits in general care areas of health care facilities and classrooms of schools, etc
- Mainframe computer loads
- Solid state motor drives (variable speed drives)

With the examples mentioned, one can clearly see that most of the loads in malls, factories and houses are electronic in nature and have to be considered as harmonic type loads. K-factor rating is a weighting of the harmonic load currents according to their effects on transformer heating, as derived from ANSI/IEEE C57.110. A K-factor of 1.0 indicates a linear load (no harmonics). The higher the K-factor, the greater the harmonic heating effects. When a non-linear load is supplied from a transformer, it is necessary to de-rate the transformer capacity to avoid overheating and subsequent insulation failure. The K-Factor is used by transformer manufacturers and their customers to adjust the load rating as a function of the harmonic currents caused by the load(s).

Transformers tends to cost more than a distribution transformer rated at the same kVA although the benefits are that a correct design transformer will not fail nor overheat. The K-Factor rating is an index of the transformer's ability to withstand harmonic content while operating within the temperature limits of its insulating system.

QUESTION TWO

What is a low loss transformer and how does it affect today's world?

ANSWER TWO

Transformer losses are categorized as no-load losses (iron losses) and load losses (copper losses). Iron losses include losses

due to no-load current, hysteresis losses and eddy current losses in core laminations, stray eddy current losses in core clamps and bolts, and losses in the dielectric circuit. Load losses include losses due to load currents, losses due to current supplying the losses, and eddy current losses in conductors due to leakage fields. The difference between the two component costs, Load and No Load Loss, is the loading factor. This is because No Load Losses are there as long as the transformer is energised.

Transformer losses are very important to the end user because they have huge cost implications and everyone is very cautious of costs these days. To compare costs fairly they require information such as the guaranteed losses and provide you with a capitalisation formula as an incentive to offer transformers that are optimised in line with the cost of electricity. A cost is given for each component loss as a Rand per Kilowatt (R/kW) factor.

The cost of losses, from the factors multiplied by the transformer losses, is added to the sales price of the offered transformer to calculate the associated lifecycle cost of the transformer.

The typical formula is as follows:

Total cost = A + (FNL x PNL) + (FL x PL)

Where:

A = Cost of purchasing the transformer, R

PNL = No-load losses, kW

PL = Load loss, kW

FNL = No-load Loss Factor, R/kW

FL = Load Loss Factor, R/kW

There is a clear need to reduce transformer losses although it increases the initial sales price of the transformer. This can be achieved in one or more of the following ways:

- Use of more conductor area,
- Use lower loss conductor materials or winding methods,
- Decrease current path length.
- More core area,
- Decrease core flux density,
- Decrease flux path length,
- Lower loss core material,
- Better quality materials and
- Improved manufacturing techniques needed to ensure the transformer loss is reduced.

However, all of this could lead to increasing the size of the transformer and could have other implications like upgrading the poles or plinths needed to hold the new transformers. This would incur even more costs and these have to be considered as well. wn

Answers provided by Zest WEG Group

IN MY OPINION : VIV CRONE

Is renewable energy truly a solution?

It is almost appropriate that I am writing this by the light of a battery driven camping lantern having been load shed between 18:30 and 22:00 this evening. This issue of **watt**now focuses on renewable energy, touted by many as the solution to the ongoing electrical energy shortages. But is renewable energy truly a solution?

BY I VIV CRONE I PR ENG I FSAIEE

In this fossil-fuel powered world that we live in, renewable energy can be defined as,"any naturally occurring, theoretically inexhaustible source of energy, such as biomass, solar, wind, tidal, wave, and hydroelectric power, which is not derived from fossil or nuclear fuel."

These sources of energy typically range from sunlight, wind, rain, tides, waves and geothermal heat. Of these wind and solar are the sources that have been exploited the most.

The promise of low-cost electricity produced from the above 'inexhaustible' and free sources is alluring and seductive and has been the focus of attention worldwide and particularly in South Africa for the last 5 or so years.

The South African Renewable Energy Independent Power Producer Procurement (REIPPP) Program was kicked off in August 2011 and has resulted in over 5 000 MW of installed capacity being allocated to IPPs from a total ministerial determination of 6925 MW up to the end of window 4 of the bidding process. By far the majority of these allocations are solar, PV and onshore wind which total over 90% of the allocated capacity.

When the currently allocated projects are implemented, this will result in an additional ~12% of the current installed capacity. Will this solve our problems?

Current solar PV and wind energy however, have a number of characteristics, which degrade their effectiveness as power generators. These characteristics include the capacity factor, intermittency and dispatchability.

In general, the capacity factors of wind and solar range between 25% and 30% for the best projects. This means that for every 100 MW of installed solar PV or wind capacity, the average power generated will only be between 25 MW to 30 MW.

Tesla Motors Inc. Chief Executive Officer Elon Musk Unveils New Generation of Batteries

This compares to base-load plant such as nuclear, coal and gas-fired installations that typically have capacity factors of over 90%.

In addition, although this installed renewable energy capacity will help the current South African energy shortage situation, the characteristics of wind and solar mean that the energy produced by the renewable facilities is intermittent in nature. Energy is only produced when the sun shines and the wind blows.

One of the biggest challenges from current renewable energy plants is that they generally generate energy during the day when the demand for energy is moderate compared to the typical early morning and evening peak demand.

This leads us onto the dispatchability, the ability to generate and dispatch this energy into the grid when dictated by the demand. The renewable power generated cannot be controlled in the same way as a conventional fossil fuelled system, where the power output is controlled by changing the fuel input.

Experience has shown that countries that rely on large scale wind generation have been becalmed, requiring large-scale energy importation from adjacent countries. Also the widely reported German home rooftop solar PV project has resulted in an excess of electricity energy being generated during the day!

So where does this leave the promise of effective, low cost and abundant electrical energy?

It has long been recognised that the 'Holy Grail' of renewable energy is the ability to store electricity produced by renewables for later use. The implementation of cost effective energy storage would change the face of renewable energy forever!

Many different technologies have been suggested and trialled; from molten salt to store solar heat, to spinning flywheels to batteries to the electrolysis of water and conversion of the resulting hydrogen to methane for later use.

All of the above storage technologies have significant challenges however, including the amount of energy storage, the cost, service life, etc.

Recent, widely advertised announcements of the Tesla Powerwall storage battery for households appears to be a breakthrough in the cost of storage. Could this be the Holy Grail for homes living under the load-shedding 'sword'?

If energy gathered during a normal day, while the family is away at work and school, could be stored for use when household energy demand normally peaks, this would have a significant effect on reducing the stress on a national energy system, especially during the evening peak demand period.

Most moderate households could live comfortably with a 3 kW peak power solar PV system with storage if different loads are scheduled appropriately. This assumes that a household would reschedule large loads like clothes washing, dishwashing, etc. to take place during the sunny hours. To make this system effective, approximately 5kWh of storage would be required. This would ensure comfortable living in the evening hours and provide power for refrigeration and other 24 hour loads.

Although detailed technical specifications seem not to be available as yet, it appears that a PowerWall 7kWh daily cycle system is suitable for home use giving the many advantages of lithium technology batteries. The above moderate home would require one of these units at an advertised price of $3000 each.

A quick phone-around reveals that the total cost of such a home system is still high once one adds the solar panels, inverter and installation and would have a minimum payback period of more than 10 years, not taking into account that the batteries would probably have to be replaced at least once.

So the Holy Grail appears to be closer but still out of reach!

In the end I think that renewable energy, in its present form, has its place in our society and should be intelligently exploited. However, until the Holy Grail of renewable energy storage becomes freely and economically available, it will remain as just an adjunct to a country's electrical energy system. wn

June

COMPILED BY | JANE BUISSON-STREET
FSAIEE | PMIITPSA | FMIITSPA

Geminis are known as eternal students, always wanting to learn—and they don't mind what the subject is. They are good at assembling a multitude of facts and then turning them into their next 'great idea'.

1 JUNE

1495 Friar John Cor, a Tironensian monk based at Lindores Abbey in Fife, is referred to in the first written reference to a batch of Scotch whisky.

2 JUNE

1993 A district court judge dismissed Apple's suit against Microsoft and Hewlett-Packard for stealing the "look and feel" of its Macintosh interface. Apple had sued the two companies in 1989 for copying its point-and-click interface.

3 JUNE

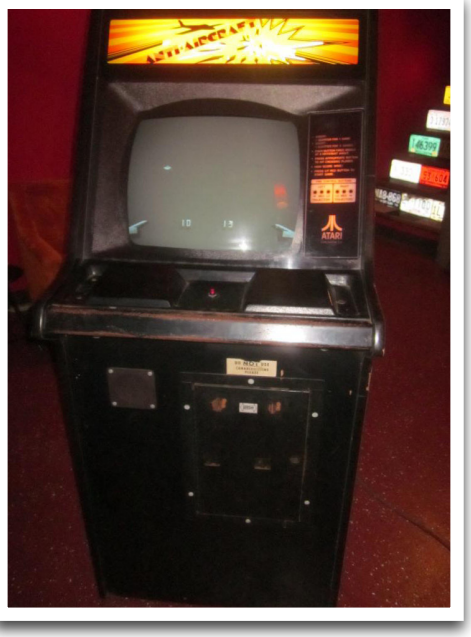
1880 Alexander Graham Bell, and his assistant Charles Sumner Tainter, transmitted the first wireless telephone message using the Photophone.

4 JUNE

780 BC Chinese scholars noted the first record of a total solar eclipse.

5 JUNE

1927 The 'Society for Space Travel' (Verein für Raumschiffahrt), known as 'VfR' was formed in Breslau, Germany (now Wroclaw, Poland). It was the first organisation whose purpose was to develop rockets to send into space.



6 JUNE

1975 Atari introduced their Anti-Aircraft coin-operated arcade game.

7 JUNE

1968 The first LEGOLAND Park, featuring expansive cityscapes modelled in Lego bricks, was opened in Billund, Denmark.

8 JUNE

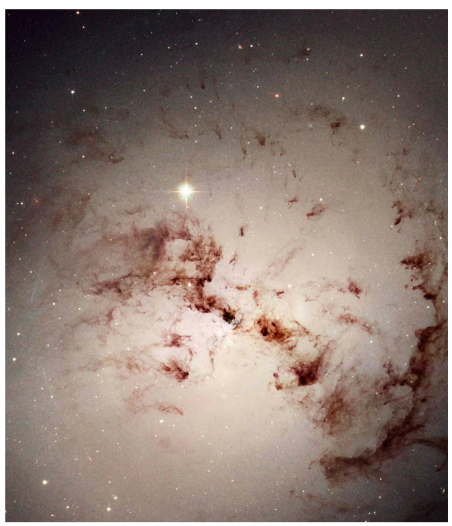
1887 Herman Hollerith received a patent for his punch card calculator that rapidly tabulated statistics from millions of pieces of data. He was the founder of the Tabulating Machine Company that later merged to become IBM.

9 JUNE

2004 The Washington Post reported that the White House had lost an entire year's worth of Vice President Al Gore's emails. The loss was blamed by "a technical configuration error".

10 JUNE

1999 ESA and NASA announced that the Hubble Space Telescope had spotted a cluster of newborn stars in the Large Magellanic Cloud (LMC), 170 000 light-years away. The Hubble image showed a view of a turbulent cauldron of star birth, unromantically called N159.



11 JUNE

1982 E.T. the Extra Terrestrial – was released to 1103 US theatres.

12 JUNE

1923 Harry Houdini frees himself from a straight jacket while suspended upside down, 40 feet (12 m) above ground in NYC.

13 JUNE

1970 The Beatles' last U.S. number one single, "The Long and Winding Road", charted.

14 JUNE

1901 The first golf championship is played.

15 JUNE

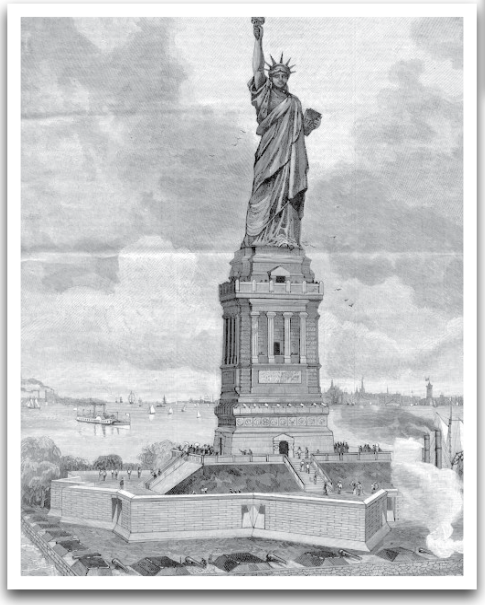
1785 Two French balloonists die in the world's first fatal aviation accident when their hot air balloon exploded during their attempt to cross the English Channel.

16 JUNE

1884 Coney Island opened the first gravity-powered roller coaster - the "Thompson switchback" railway. The car went just over 9.7 km/h.

17 JUNE

1885 The Statue of Liberty was delivered to New York Harbour from France.



18 JUNE

Today is Phi Day! Like Pi, Phi, also known as the Golden Ration, is an irrational number, equal to approximately 1.618033988749894 84820458683436564.

19 JUNE

2008 Apple iTunes sold its 5 billionth download.

20 JUNE

1840 Samuel F.B. Morse received a patent for his "Telegraph Symbols," known as Morse code. (US No. 1,647)

21 JUNE

1893 The first Ferris wheel opened at Chicago's Columbian Exposition, America's third World's Fair.

22 JUNE

1978 Pluto's satelite Charon is discovered

23 JUNE

2000 The bulk ore carrier MV Treasure sinks off the western coast of South Africa, soiling more than 19 000 penguins; this resulted in the world's largest ever rescue of birds from an oiling event.

24 JUNE

1901 The first exhibition by Pablo Picasso, 19, opens in Paris.

25 JUNE

1903 Marie Curie announced the discovery of Radium.

26 JUNE

1974 The First Barcode (Universal Product Code), on a pack of Wrigley's chewing gum, was scanned.

27 JUNE

1929 The first telephone was installed in the Oval Office on President Hoover's desk. Prior to the installation, President Hoover used a telephone in a booth outside of his executive office.

28 JUNE

1995 Nelson Mandela sets up the Truth and Reconciliation Commission of South Africa to investigate human rights abuses of the Apartheid era.

29 JUNE

2012 15,000 Japanese anti-nuclear protesters blockade the Japanese Prime Minister's office in Tokyo.

30 JUNE

1879 California Electric Light Company, the first electric company in the U.S. to produce and sell electricity, was established in San Francisco, California. wn

Renewable Energy Storage

Renewable energyand how to store it. The million dollar question. The stakes for finishing first in this race are high. I am not sure if it is a one horse race but Elon Musk and his Tesla battery certainly seem to have just taken the lead.

BY I ANGELA PRICE

However with the R 42 000 price tag I am quite happy to sit on the side line and watch the contenders fight it out until I can buy a Teezla battery from Chinamart around the corner.

Whilst Elon Musk and the rest of the Tony Starks of the world scramble for new energy sources and storage devices, this Home Exec is trying to solve a renewable energy crisis on a smaller, more personal level. Being a mom with 2 young kids means that most days my batteries are running on empty, my circuit board has overloaded and there has likely been an explosion of some sort leading to a melt down and (worst case scenario) complete system failure (often preceded by a sense of humour failure).

Although I may be able to charge my cell phone, toothbrush and tablet (possibly even one day my car) at night - no one has had the foresight or courtesy to think of something that a flatmom/parent can plug into to recharge (bottles of wine don't count).

In the absence of any scientific breakthrough in this department, many of us have come up with some of our own renewable energy supply and storage options.

Without a doubt, the quickest and most proven source of renewable energy comes in the form of a little roasted bean; all crushed up, blended and brewed into a magical, lifesaving cuppa coffee - sometimes (if you are lucky) topped off with a cute cappuccino-foam-smiley-face-artwork that looks better than your high school artwork final did.

This little bean delivers bang for its buck (@ approx. R 23 a cup it better had!) and it soon fires you up for the day.

However as your engine revs and you start tearing around the race track/school run playing dodgem cars with taxis and other similarly half crazed city dwellers, you quickly start burning up your energy supply and realise that you need to recharge your batteries.

So whilst Elon Musk and his minions have not yet come to our rescue, our fellow frazzled friends have as they conveniently schedule a pit stop at a friend's house/ coffee shop. Here you are able to enjoy Mother Nature's renewable energy in a cup (caffeine) whilst indulging in the other well-loved form of renewable energy. Food. Yes food - food is the next best renewable energy source. We buy/grow it, consume it, convert it into energy, expend it, and then begin the cycle again at the next meal time/ coffee date. But whilst the issue of storing renewable energy still has some of the world's leading scientists searching - the good Lord pre-empted our need and made provision for a built in battery pack to store our energy reserves.

Many of us are the unsuspecting (and possibly not so proud) owners of our very own renewable energy storage devices. Where you wonder?

Stand in front of the mirror.....there they are!

Affectionately referred to as love handles, or muffin tops by some, the sight of them reduces many to despair and depression. But take heart, comfort yourself with the fact that you have succeeded where many of the best scientists have failed - you have a cheap, fully portable, renewable energy storage device on hand (waist).

I'd say that deserves a reward or pat on the back, wouldn't you? So, how about that chocolate croissant you have had your eye on then.... wn

Calendar of events

If you want to see your function or event listed here, please send the details to Minx Avrabos at minx@saiee.org.za

JUNE 2015

10	Power Transformer Operating & Maintenance	Johannesburg	www.saiee.org.za
10-11	Fundamentals Of Power Distribution	Johannesburg	www.saiee.org.za
10-11	Mastering Power System Harmonics	Johannesburg	www.saiee.org.za
12	Hydropower & Rural Electrification Conference	Johannesburg	www.prodimensions.co.za
18-19	Effective Technical Document Writing For Engineers	Johannesburg	www.saiee.org.za
18-19	NEC (New Engineering & Construction) Contract Course	Johannesburg	www.saiee.org.za
23-26	Insulating Oil Management	Johannesburg	www.saiee.org.za
25-26	Radio Theory, Calculation And Practice	Johannesburg	www.saiee.org.za

JULY 2015

1-2	SABC Education African EduWeek 2015	Johannesburg	www.educationweek.co.za
8-9	Photovoltaic Solar Systems	Johannesburg	www.saiee.org.za
15-16	Understanding Transact Sql, Db Optimisation & Database Design	Johannesburg	www.saiee.org.za
15-16	Core Financial Management Skills For Engineers	Johannesburg	www.saiee.org.za
15-17	PowerGen Africa & Distributech Conference	Cape Town	www.powergenafrica.com
15-17	MediaTech Conference & Exhibition	Johannesburg	www.mediatech.com
22-23	Design Of Economical Earthing Systems For Utility Electrical Installations	Johannesburg	www.saiee.org.za
22-23	Electrical Engineering Explained To Non-Electrical Engineers	Johannesburg	www.saiee.org.za
22-23	Leadership & Management Principles & Practice In Engineering	Johannesburg	www.saiee.org.za
23	Electric Arc Flash Safety	Johannesburg	www.saiee.org.za

AUGUST 2015

12-13	Microsoft Project Professional 2013	Johannesburg	www.saiee.org.za
18-21	Managing Projects Effectively	Johannesburg	www.saiee.org.za
27-28	Fundamentals Of Power Distribution	Johannesburg	www.saiee.org.za

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