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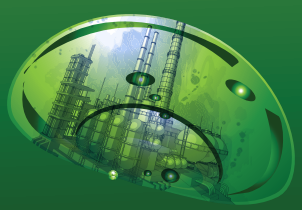

hydraulic COMPROMISE

Official Magazine of

SAIEE

May 2011

Kristy Myers dares to ask.
At Siemens, she can work on the cutting edge and still raise a family.

Kristy Myers works on the frontier of manufacturing technology. The virtual humans she and her team develop help factories design more efficient processes and safer working environments. The software development requires a lot of commitment. But thanks to benefits like flexible hours, Kristy still has plenty of time for her 1-year-old son. How could a career at Siemens help you balance work and family? **Dare to ask.**

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SIEMENS

Time for Africa to become responsible for itself

If Africa were to focus on what it is naturally capable of doing then it would be supplying an abundance of food to its people and to the rest of the world. At the same time, its resident farmers would be making money and creating jobs through a sophisticated logistics network that could pack products and distribute them throughout the world.

Instead, we have an impoverished continent with a farming infrastructure that is all but destroyed, with only a few countries (South Africa, Kenya, Uganda) exporting some of their agricultural products to other parts of the world. And that is really criminal.

If we look at countries like Zimbabwe, which was once exporting food all over the world, and then we look at the political interference that has destroyed that country then surely, I would have thought, we would have learned from this abysmal mistake.

Not so – because in terms of land reform programmes in South Africa, we might be going much the same way. In Limpopo and Mpumalanga, for instance, farms have been fragmented to the point where they are no longer commercially viable and some of these have been reclaimed by the Department of Agriculture. South Africa is producing enough food, at the moment, to feed its own population and to export some of its surplus to neighbours but it should be doing much better than that and so should its neighbours, Mozambique, Swaziland, Zimbabwe and the other members of the Southern Africa Development Community.

But it's not doing so primarily because it has not got the money to empower farmers and provide them with the fundamental elements they need. In truth, I think the picture is bleaker than that: the problem in Africa is that the infrastructure in each country has gradually collapsed through a lack of maintenance and a dearth of investment. So while farmers might be able to grow considerably more food than they currently do, the reality is that they have no way of getting it to market before it rots. Roads are impassable; packing sheds non-existent; railways non-functioning and the airline services concentrated in the main centres only: a dismal picture that paints a scene of agricultural decay up and down the face of Africa.

While it would be wonderful to think that things might change, in truth nothing will unless there is a huge and concerted investment in infrastructural development. And sadly, I don't see foreign aid organisations achieving much in this regard: not because they don't understand the desperate need that Africa has for improved infrastructure but because, over the past 40 or 50 years, they have ploughed billions into creating an infrastructure that has systematically been destroyed anyway.

I believe that the only way this will improve, is if Africa starts rebuilding itself. Forget foreign aid; forget the easy hand-outs that come with all sorts of strings attached. Africa must take responsibility for itself and must act accordingly.

Personally, I think it is high time that the respective leaders of Africa start devoting much of their time and energy to rebuilding the agricultural sector – and the logistics needed to support it – because that way, meaningful wealth creation will follow. If only the many ears of the many leaders were not quite so deaf.

Paddy Hartdegen - Editor
paddyh@crown.co.za

WATTnow

Editor
Paddy Hartdegen
paddyh@crown.co.za

Design & Layout
Duncan Stevens

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e-mail: crownmag@crown.co.za

Publisher
Jenny Warwick

Deputy Publisher
Karen Grant
crownmag@crown.co.za

Technical Advisor
Ian Jandrell, PrEng, PhD

Advertising Manager
Veronica Breedt
veronicab@crown.co.za

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P O Box 751253
Gardenview, 2047
s.bridgens@saiee.org.za

SAIEE
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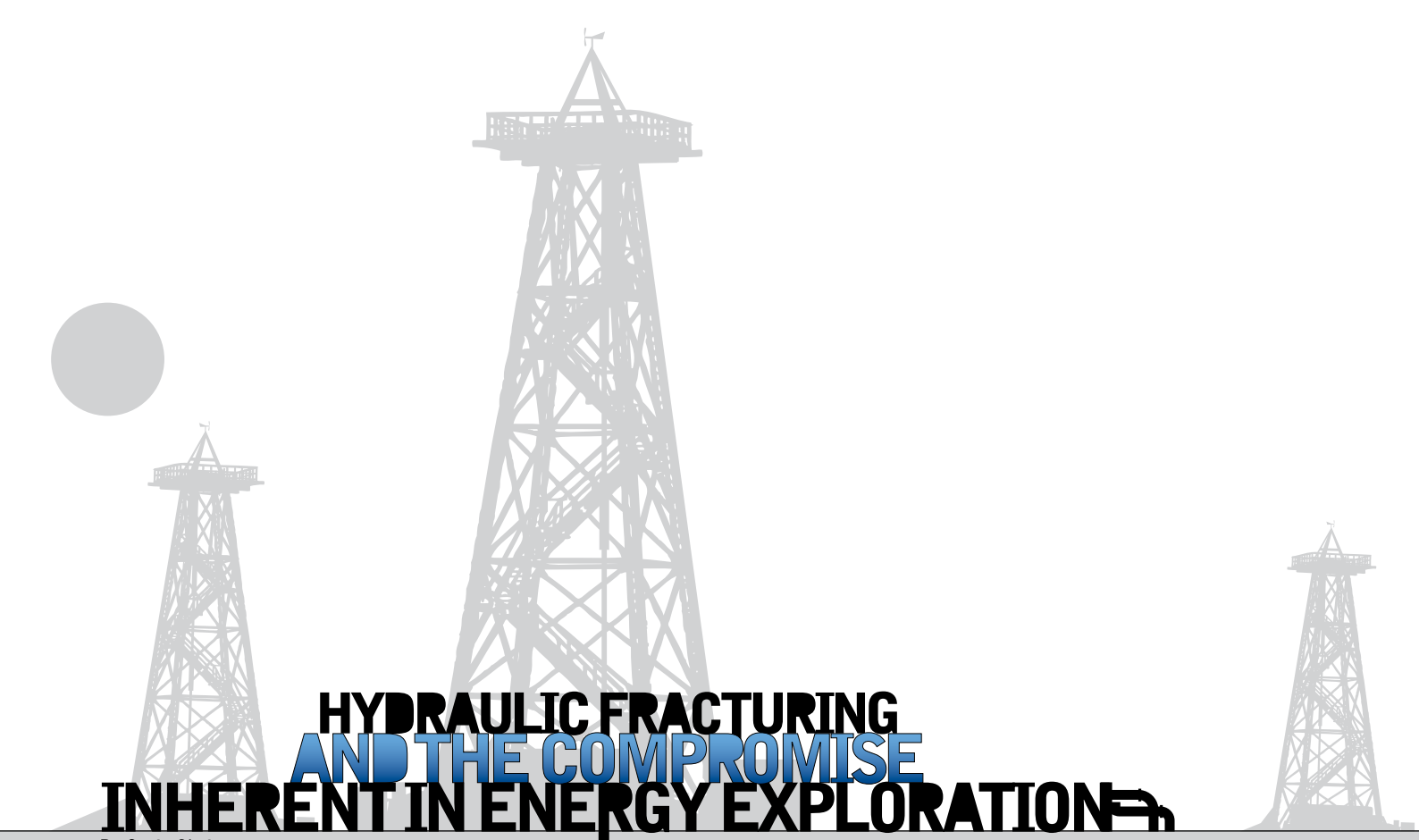

HYDRAULIC FRACTURING AND THE COMPROMISE INHERENT IN ENERGY EXPLORATION

By Gavin Chait

The earth beneath us is not solid rock. Millions of years have shifted and tortured it, twisting it into bizarre shapes and formations.

Oceans have been submerged. Water has worn caverns and channels through the rock. Minerals have leached out into these spaces. The combination of heat and pressure has created extraordinary new compounds that have become essential to our global economy.

Drilling and digging through the earth to reach these precious materials has been a part of all human history, from the 3 000-year-old system of qanats – a series of well-like vertical shafts connected together by gently sloping tunnels – still in use leading water to the Iranian city of Bam, to the North Sea oil rigs braving unspeakable weather conditions to bring that most global of commodities to shore.

These tremendous pressures are not necessarily stable. Many of our most valuable resources can be found in geologically delicate spots. Sometimes our most sophisticated efforts go terribly awry.

At 05h00 on 28 May 2006, second stage gas drilling operations lead by Lapindo Brantas in the Kujung formation carbonates in East Java, reached 2,834 metres through thick clay, sands, shales, volcanic debris and – finally – permeable carbonate rocks. The drilling was proceeding without the standard protective casing designed to shield the well head. Water, steam and a small amount of gas erupted 200 metres southwest of the well.

Aftershocks following an earlier earthquake then led to a complete loss of circulation of the mud being pumped down the shaft, implying that there was a fault somewhere in the shaft. The miners pumped a loss circulation material into the well in an attempt to stabilise it.

On 29 May, steam, water and mud at 60 degrees Celsius began erupting 200 metres from the well. What would become known as the Lusi mud volcano is still erupting.

UK geologists, led by Richard Davies, a professor of Earth Sciences at Durham University, have theorised that the drilling pipe punctured the over-pressured limestone, resulting in a high-pressure emulsion of mud and water. The influx of this fluid fractured the well bore and then penetrated the surrounding layers of earth. As this pressure built

up, fractures propagated two kilometres upwards. For want of a steel casing a well was lost. BP's 2010 travails in the Gulf of Mexico certainly made news, but the company has set up a $20 billion fund to rehabilitate the area and has spent $37 billion to date. BP's executives faced the full glare of public scrutiny, as well as an American political process determined to hold someone to account. The source of the 4.9 million barrels of crude oil leak has been stopped.

Not so fortunate the citizens of East Java. In the immediate aftermath of the Lusi eruption 12 villages were smothered, 42 000 people were evacuated from their homes and mud – to a depth of 15 metres – swamped the area.

"Our estimate is that it will take 26 years for the eruption to drop to a manageable level and for Lusi to turn into a slow bubbling volcano," says Davies.

Over that period the ground is slowing subsiding as the caldera beneath the volcano empties and the ground sags into the space. By 2037 the depression will be 95 to 475 metres deep.

The Indonesian government blames an earthquake eruption at Mount Merapi, 280 kilometres away, that occurred a few days before Lusi erupted. Foreign experts lay the blame on Lapindo Brantas, a company owned by Aburizal Bakrie, a minister in the Indonesian government.

The Indonesian government offered landowners about R700 per square metre of residential land but farmland at only R70. Since most people were subsistence farmers they have received little for the disaster. Corruption and ongoing political intrigue have denied many refugees even that.

Compensation for disaster, and the techniques used to prevent it in the first place, has as much to do with the political and legal dispensation governing mining as it does with who is doing the mining. If BP had caused Lusi the consequences would have been far different.

Consider, though, the technical achievements involved in drilling at these depths. The drill operates a drill-string which can be thousands of metres long. The drill bit can work in a variety of ways. Some cause the rock to disintegrate through compressive failure; others cut slices of rock as the bit turns.

Drilling fluid, a complex mixture of chemicals, fluids and solids, is pumped down the drill well. The purpose is to cool the bit, remove rock cuttings, stabilise the well-head and overcome the pressure of the fluids coming out of the rock as the well is bored.

As the well is deepened, steel pipe is pushed down the well, surrounded with concrete, and then set to stabilise and isolate the borehole. This also means that the diameter of the hole gets thinner the deeper it goes to ensure that steel pipe can be pushed down.

As drilling fluid circulates back to the surface, the cuttings are removed and monitored, and the fluid is returned to the wellhead. Pressure must be permanently monitored to prevent a 'kick' when the pressure at the wellhead overcomes the pressure from the drilling fluid resulting in an uncontrolled blowout. Blowout preventers keep this under control. It is these which failed on the Deepwater Horizon.

Once the well reaches its operational depth it must be completed. This involves preparing the bottom of the well to pump up oil or gas. The concrete and steel sleeve now runs all the way to the bottom, pressurising the well and isolating it from the surrounding rock. There are a variety of ways of preparing the production zone, from leaving it open – 'barefoot' – where the reservoir is particularly deep or naturally fractured and egress is straightforward, to open hole completion where sand-control or other flow-control means are incorporated, to cased hole completion.

The latter is most common, as it offers control of the fluid flow. Preparing the casing at the bottom requires that the liner be physically pierced to connect it to the production zone. Shaped explosive charges blast holes through the casing. The controversial bit is when that well connection is supplemented with

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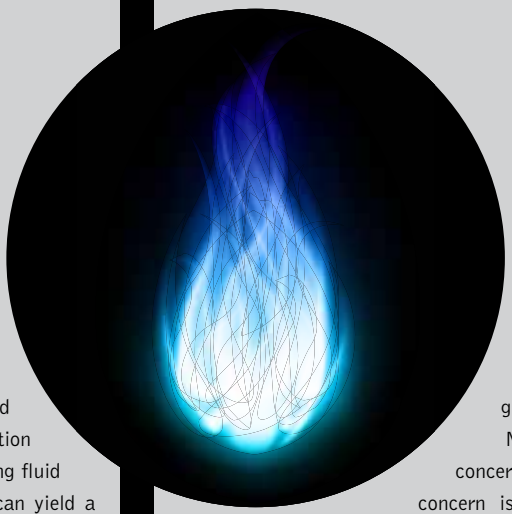


hydraulic fracturing.

Some form of hydraulic fracturing – or 'fracking' – is used in a significant proportion of wells. Neither is it limited just to the extraction of hydrocarbons; groundwater is extracted this way too.

Geology is complex. At greater depth the weight of the earth above the wellhead will provide sufficient pressure to force fluid up the borehole. Lower down, or in more impervious rock, extraction can require a little help. That can involve anything from pumping fluid into the rock formations to increase pressure. Such activity can yield a further 5-15 percent extra oil from 'depleted' wells.

One of the most effective ways to ensure productivity is to create cracks and pathways in the rock, which gas, oil or water can then flow through, into the well. The process sounds easy: blast open fractures in the rock with a fluid and then maintain the width of the cracks by propping them open. Proppant is any material – sand, ceramics, or other particulates – which prevent the fractures from closing once the fluid injection stops.

Some 90 percent of natural gas wells in the US use hydraulic fracturing to maintain production.

South Africans have been introduced to fracking through Shell's investigation of potential shale-gas extraction in the Karoo. There is a great deal of noise but little light in these discussions. Some of it is chronic nimbyasim ('Not In My Back Yard'), but there are genuine concerns.

Shale rock is not sufficiently permeable to allow gas to flow into the wellbore at economic rates, however, there is plenty of gas down there and the demand for energy is increasing. As more people escape poverty and plug in their new refrigerators their lives change immeasurably for the better.

The energy for all that improvement has to come from somewhere and, as we've covered elsewhere, alternative energy is still only a small – and expensive – component of overall energy production. For a while yet hydrocarbons of one form or another are necessary to keep our lifestyles afloat.

A well-designed and managed oil or gas operation will ensure stability of the surrounding rock as the well reaches the end of its productive life. Some subsidence may occur as the earth empties its contents. This may cause fracturing of the rock bed. Some minor tremors around Gauteng are blamed on mining operations kilometres beneath the ground.

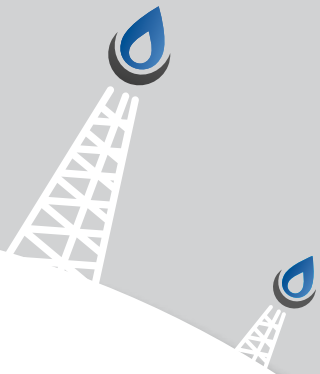
None of these need be of major concern to the general public. The real concern is the nature of the fluid used to force fractures into the wellhead. With groundwater extraction the fluid can simply be water and disinfectant but with oil and gas, the mixtures are more complex.

These are usually closely-guarded trade-secrets; mixtures of gels, foams, and toxins like benzene and propenoic acid. The proppant can be sand, resin-coated sand or manufactured ceramics. Not all such mixtures are toxic but the combinations are guarded as chefs guard their most popular recipes. Billions of dollars are invested in such operations and hundreds of thousands of litres of these fluids are required. They are injected by pumps at pressures of up to 15,000 psi at 265 litres per second.

If the well suffers blowback, or the liquid escapes into groundwater, then the implications will be difficult to measure – especially if no one knows what's in the mixture.

In Pennsylvania, in the US, nearly two-thirds of the state's 28 million acres lie on top of a thick seam called the Marcellus Shale. The volume of the basin contains sufficient gas to supply the entire energy needs of the US for two decades. Here it isn't the fracking itself that is of concern, it is the number of wells being drilled: 3 314 of them had been drilled by 2010 while 60 000 new wells are expected to be drilled by 2030, enough to require 90 000 acres of land, much of it pristine forest.

The number of wells, and the rate of drilling, has also resulted in lapses in oversight. In 2009 the Cabot Oil & Gas Corp allowed combustive gas to escape into the drinking water used by Dimock township. In June 2010, 70 000 litres of fracturing fluid exploded after an uncontrolled blowout into the air in Clearfield Country.



GAS EXTRACTION

Between 2005 and 2009, some 145 million litres of water were pumped into wells across 19 US states.

China, with less scrutiny and less interest in environmental hygiene, has now also caught the fracking bug. The Chinese Ministry of Land and Resources calculates its shale gas reserves as being 26 000 billion cubic metres. The China National Petroleum Corporation intends to produce 500 million cubic metres of shale gas by 2015. That is, if China can overcome its acute water shortage concerns.

Fracking requires a great deal of water to be pumped down the shaft and such water becomes useless for agriculture or drinking. Clearly the economic reasons for using it need to be good ones.

In a water scarce area like the Karoo, ensuring such water supplies can be tricky.

In the UK, Cuadrilla Resources, a US private equity firm, is developing a shale gas site near Calgary. The 3 000 metre shaft will require 1 200 cubic metres of water and chemicals to produce the fracking mixture. Complicating matters is that an aquifer lies some 200 to 400 metres beneath the surface, significantly above the gas bed.

The fracturing process can be precisely controlled. Starting at the wellhead and working up, charges are detonated at specific intervals, the fracturing liquid is pumped into the fractures to enlarge and extend them, then the area is plugged and a new charge detonated above it.

Despite this, accidents will happen. Chesapeake, one of Pennsylvania's largest shale gas producers, experienced a blowout in April 2011, resulting in thousands of litres of fluid entering a waterway. They still don't know what caused it.

The South African Petroleum Agency has asked for applications to explore 220 000 square kilometres in the Karoo, of which Shell has applied for 90 000 and could spend up to R1.4 billion in just the exploration phase.

The uproar has been immediate and intense and includes such charismatic environmental lobbyists as Lewis Pugh. That said, the Karoo is sparsely populated and such accidents – if they were to occur – would be unlikely to affect the local population. What is complicating matters for Shell is the location of the Square Kilometre Array.

The SKA is a radio telescope which will have a total collecting area of one square kilometre offering the ability to survey the sky more than ten thousand times faster than ever before. It will be hosted by either South Africa or Australia and – with a construction budget of R15 billion and annual operational costs of R1.5 billion – the competition for the prestige of being host is fierce.

A decision is due in 2012 and some of the criteria for inclusion are interference from nearby electrical devices, the physical characteristics of the site, infrastructure costs (including energy supply) and the long-term sustainability of the site as a radio quiet zone.

South Africa already struggles with many of these, especially energy availability. A large mining operation spread out over 220 000 square kilometres is unlikely to be well-received.

Whether it be nuclear, coal-fired, or gas-powered, environmentalists will object. Solar panels will cause reflection and reduce the Karoo's attraction for astronomical observations. Wind turbines cause electrical and auditory noise.

Yet South Africa is a poor country. Our energy needs have drastically outpaced production. Those who support the maintenance of the Karoo as it currently stands – for whatever reason – are fighting against massive and ongoing investment, the tax revenues from gas extraction, and the needs of the country's massed unemployed.

Minerals Minster Susan Shabangu may have halted further exploration until the government completes a study into fracking, but the likelihood is that the opportunity is too lucrative to ignore.

Fall-out from the tsunami

As news from the Tokyo Electric Power Company—that the storage pools and reactor cores are cooling and reactor control systems are coming back online—filters through, folk around the world are assessing the impact, directly or indirectly, of the tsunami catastrophe on their lives.

Less than a week after the tsunami, trace particles of radioactive iodine and caesium—emitted from the melting cores of reactors 1, 2, and 3 and the spent fuel pool in reactor 4 at the Fukushima Daiichi plant—were detected on the West Coast of America. News of the detection drove many North Americans to purchase (and consume) iodine tablets.

The most radioactive isotope of iodine, Iodine-131 (I-131), is highly carcinogenic when accumulated in small doses. The stable isotope of iodine is I-127 and this is naturally used by the thyroid gland to regulate metabolism. By saturating the thyroid with stable iodine, radioactive isotopes of iodine are excreted rather than accumulated. However, although the benefits of stable iodine generally outweigh the disadvantages, particularly in a radiation emergency, there are some side effects and the metabolism of those North Americans who saturated their thyroids with stable iodine has been affected.

Closer to the epicentre of the nuclear disaster, sixty-six children and infants were found with excessive exposure to iodine and in these cases additional I-131 was administered to kill off tissue where the radioactive isotope had accumulated.

Another radioactive isotope emitted by melting reactor cores is strontium. Due to the chemical similarity between strontium and calcium, strontium is absorbed as if it were calcium, and then deposited in the bones. The stable isotope of strontium is used to increase bone density and in fact strontium ranelate is used to treat osteoporosis. Luckily, strontium ranelate must be prescribed by a doctor and administered by a pharmacist or a reaction, similar to that of iodine, would have played out across the globe.

There has been debate as to whether the evacuation radii imposed by TEPCO, and subsequently by the Fukushima prefecture, were adequate and in time to prevent dangerous exposure to radioactive material. The initial evacuation zone had a radius of 3km from the stricken plant, with an advisory to those within a 10km radius to stay indoors. A week later the evacuation zone was increased to 10km with restrictions up to 30km away. On March 25, two weeks after the earthquake, the mandatory and policed evacuation zone was 30km, which displaced an estimated 149 000 people. But the UNs' nuclear watchdog, the International Atomic Energy Agency, reported radiation levels well in excess of regulatory limits at Iitate village, 40km to the northwest of the plants. US and UK authorities recommended an initial evacuation zone of 40km and a week later revised this to 80km. If this limit were to be imposed by the Japanese authorities it would displace an estimated 1.2 million people.

Unfortunately, those people living near the plant have been exposed to radiation, and the daunting task of identifying the levels of exposure in this already stressed population must begin. The International System of Units provides two symbols to describe radiation doses: the Gray for absorbed dose to describe physical effects and the Sievert to describe the biological effects of a dose of ionizing radiation.

The Roentgen equivalent man or 'rem' is a variant metric unit similar to the Sievert and is widely used in North America. For example, eating a banana (a portion of which is radioactive potassium) would give a dose equivalent to 0.1uSv or 0.01 milli rem; and sleeping next to your partner is equivalent to eating half a banana (0.05uSv).

Randall Munroe (of www.xkcd.com fame) created a radiation dose chart in an attempt to limit West Coast iodine consumption. Facts include: people within the latest Japanese exclusion zone have been exposed to between 1mSv and 40mSv; radiation workers may receive 50mSv (60t of bananas) annually; a 100mSv dose (120t of bananas) is the lower cancer causing dose limit; and two TEPCO employees each received doses of about 180mSv (216t of bananas). Regulatory limits for emergency workers are set to a dose of 100mSv for those protecting valuable property and 250mSv for those protecting life.

During the Fukushima Daiichi meltdown, the radiation dose limit for TEPCO employees was increased to 250mSv, but few reportedly received doses in excess of 100mSv during the disaster. Obviously these doses were in addition to the natural background radiation the workers had been exposed to previously.

Economically, Japan provides manufacturing capacity to many large multinational companies. A number of NAND memory manufacturing facilities are located within the 30km evacuation zone, affecting production of this critical storage component. The knock-on effect is that computer manufacturers are experiencing stock shortages as manufacturing capacity is increased in plants that have not been closed. There are similar stories for Toyota spares, Honda and Nissan assembly lines, Epson touch screens, and Canon ink production facilities (to name a few). Even the much publicised iPad 2 launch was delayed due to stock level shortages caused by relocating component assembly facilities outside of the evacuation zone.

While acknowledging that the reactors at the Fukushima Daiichi plant were second generation boiling water reactors and that modern reactors have additional safety components, Japan also has the shortest distance between nuclear reactors and epicentres of earthquakes with magnitudes greater than 7. Thus existing designs must be reviewed in light of the engineering hubris that allowed for the location of backup generators in the low lying areas behind the sea walls.

Project and Portfolio Management

In business, project managers are challenged to do more with less and, as a result, have to be judicious about where they spend their money and how they allocate resources.

This is one of the key drivers behind the steady growth of PPM (project and portfolio management) solutions. PPM products help project managers to collect and make sense of data so they are able to assess the status of service delivery projects.

According to James Avenant, Microsoft Project & Microsoft Visio Product Marketing Manager, South Africa, there is huge pressure on businesses across all industries to make sure their projects are delivering optimally. "To do this effectively,' he says, "they need to be able to prioritise projects and spending, manage their resources effectively and manage the performance of the people delivering the projects."

This sounds easy in theory. But as any project manager will tell you, keeping track of numerous projects in diverse locations, at different times, is a headache. It's hard to meet your deliverables when you don't know what resources you have at your disposal, and how your existing projects are being run.

"It's about getting the right information into a central place where all the stakeholders can see the state of a project instantly through a dashboard. PPM (project and portfolio management) products keep track of all the moving parts and reports are created, on the fly by the system," says Avenant.

The introduction of PPM in a business will ensure the availability of accurate data and reports on all projects, and create easy-to-use governance workflows, project delivery frameworks, processes and templates.

"PPM allows project and budget owners to collaborate with project teams and track resource utilisation. Project communication improves as does the ability to manage risk, issues and knowledge about projects in a centralised location," he explains. PPM identifies the resources needed on a project, allowing the project manager to shift or hire people as required.

It is estimated that between 30 and 50 percent of the energy that businesses expend on projects is wasted through inefficient processes and poor decisions. Technology can drive project delivery and performance management effectively for businesses in all sectors," says Avenant.

10 years of energy management training in SA efficiency

Launched in 2001, the Energy Training Foundation (ETF) programme has delivered almost 500 energy efficiency professionals, the majority of whom are actively involved in local industry. Of the 500, 345 are Certified Energy Managers (CEMs) while the others contribute as energy auditors and measurement and verification professionals. The ETF is affiliated to the Southern African Association for Energy Efficiency (SAEE) whose vision is to broaden South and Southern Africa's pool of knowledge in the energy efficiency sector.

The training is developed and promoted by the Association of Energy Engineers (AEE) in the United States. All certification programmes require that specific educational and/or experiential criteria be met. The qualifications obtained at the ETF are recognised internationally as leading standards of competence in energy management, as well as measurement and verification, and carbon management. Locally the courses are accredited for Continuing Professional Development (CPD) with the Engineering Council of South Africa (ECSA) for engineering practitioners.

Courses are hosted throughout the year and can be tailored to suit a specific niche industry or an organisation's individual requirements. ETF is the training division of Energy Cybernetics (Pty) Ltd, an AEE approved training provider for Southern Africa (south of the equator).

Visio 2010
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1. **Simplify large and complex diagrams.** Add clarity to diagrams using Subprocess and Containers to group related shapes visually and logically. As a diagram grows larger or becomes more complex, Subprocess and Containers help you keep information more organised and understandable.
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The world is more complex than ever, and people need an easy way to simplify information, communicate it to others and ultimately make better decisions. Diagramming has always been a way to help organise information into easy-to-see, digestible parts. Whether on napkins, white boards or paper, diagramming helps convey thoughts and ideas.

"Humans have always communicated visually, to make sense of the world and communicate quickly with others."
James Avenant

That's why the diagram is so powerful, and even more relevant in today's fast, global, news-intensive society. "What is lacking from today's diagrams are the operational data that contextualise the diagram at a point in time," said James Avenant, who heads the Microsoft Visio business at Microsoft South Africa.

Whether it's a network diagram, floor or plant layout or a business process, the latest tools in Visio 2010 help create visually-pleasing diagrams that simplify complexity and get everyone on the same page. With a large collection of pre-drawn shapes, pictures and templates, and the dramatically improved user experience, every step is easier and more intuitive.

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Since Visio 2007, users can connect external data to their Visio diagrams with Visio "data graphics". While this is an excellent way to visualise your data, it was limited to the desktop. In Visio 2010, this limitation is removed when the diagram is published to SharePoint.

This increases productivity by bringing together separate silos of information—such as a business process diagram and the operational data related to that process—into a single, up-to-date view, saving time and speeding up decisions. The icons, symbols, colours and bar graphs give a clear view of the information that matters to your business—and automatically links to popular data sources such as Excel and Access to help you display visuals that are always current.

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what's wrong with africa's agricultural sector?

By Paddy Hartdegen

As many people have said before – and many more will say in future – Africa should be the breadbasket of the modern world. This continent of abundance should be producing vast quantities of food and feeding millions of people in other, less fertile parts of Asia, India, Central America and Europe.

But Africa is not exporting food. In fact it is a poverty-stricken, basket case when it comes to food production, and the primary reasons for this are:

- Lack of engineering resources and infrastructure.
- The lack of investment in science and technology.
- Limited expenditure on research and development.

For instance, just to resolve the food crisis that was facing Africa in 2008 – and things have become worse since then – the African Development Bank (ADB) estimated that about $670-million would be needed immediately and, in the medium to long term, about $19-billion would need to be spent.

It was in 2008, during a meeting of Regional Member Countries of the African Development Bank, that the idea of formulating a Comprehensive African Agriculture Development Programme (CAADP) was first suggested. It was eventually adopted and endorsed by the New Partnership for Africa's Development (NEPAD).

In essence, the CAADP was admitting that Africa had failed in terms of its agricultural production and the primary reasons for this were:

- The collapse of water management and a lack of investment in the infrastructure to prevent the soil erosion and water wastage.
- The lack of investment in, or maintenance of, a once-efficient transport infrastructure.
- No investment in science and technology to prevent a loss of fertility within the soils of Africa.
- A complete lack of investment in the energy sector resulting in poor yields from all farmers because they are unable to water, harvest, store or distribute their produce without sources of energy and sustainable distribution mechanisms.

In addressing these problems the CAADP framework highlights the inherent fragility in Africa's soils, the continent's climatic variability and the uneven distribution of surface and sub-surface water resources.

However, it says that there is substantial untapped potential for the development of natural resources to increase agricultural production. It says – rather obviously, I thought – that an important element of agriculture is water but goes on to add that building up the soil fertility and its moisture-holding capacity is just as important.

The ADB says that land and natural resources in Africa are key assets for economic growth and development and it goes on to add that customary land management systems are under pressure while formal land tenure and management systems – that were introduced under colonial rule –

have generally had limited coverage in Africa.

In simple terms, it says that in practise land rights claimed and allocated by the African states are often in direct conflict with the land tenure practices of ordinary people. This makes land tenure uncertain and is one of the most important reasons for a lack of investment from major private companies that would ordinarily invest in any of the African countries if there were some certainty that their investment would be protected and their land tenure inviolate.

In addressing the problems facing a strategic land and water management policy the CAADP says that the problems can be broken down in three main categories:

- Knowledge and technology barriers (including the shortage of engineers, artisans, technicians and technologists).
- Policy, institutional and government barriers.
- Economic and financial barriers.

It is immediately clear that there are fundamental problems facing Africa's ability to produce food or feed its people and, when one examines the potential of the agricultural sector, the anomalies of famine, malnutrition and drought do make some sense.

The World Food Programme is now spending $12,5-billion on providing food to Africa while Africa itself spent $18,7-billion on food imports and received more than 2,8-million tons of food aid, about 25% of the total food aid provided to countries around the world.

At least 25 million people need emergency food and agricultural assistance and 28-million are facing food emergencies.

Hunger and malnutrition in Africa, coupled with the degradation of water resources have increased the susceptibility of people to life threatening diseases. In sub-Saharan Africa, 15% of the 183-million people will be under-nourished by 2030. Malnutrition is expected to increase by an average of 32% a year.

Land degradation has led to the forced migration of individuals, rural households and entire communities and conflicts between settled farmers, herders and forest dwellers over access to land have increased sharply.

Estimates by the United Nations indicate that unless immediate remedial action is taken to prevent further degradation of Africa's soils then roughly 70% of the existing croplands will be non-productive by 2025.

These facts give an indication of the scale of the problems facing technologists, engineers, scientists and farmers when it comes to getting Africa's agricultural sector back on track.

In terms of agricultural water, Africa currently receives an average rainfall of 678mm of water every year and that's equivalent to about nine percent of the world's fresh water resources. However, more than half of Africa receives less than 500mm of rainfall annually.

According to Population Action International, more than 1,4-billion people in Africa will face severe water stress or scarcity by 2025. The countries facing the most severe stress when it comes to water supply are: Algeria; Libya; Egypt; Ethiopia; Somalia; Kenya; Rwanda Burundi; Malawi and South Africa.

To complicate the water shortage there has also been less agricultural water development in sub-Saharan Africa than in any other region of the world. Over the past 40 years only four million hectares of new irrigation has been developed in Africa compared with 25-million hectares added by China during the same period.

In fact, just 4,9% of the total cultivated area of 183-million hectares has been developed and Sudan, South Africa and Madagascar account for two-thirds of that amount.

More than 33-million people in Africa derive their main income from areas where water is properly managed and about six million households representing about 33-million people rely directly on earnings from agriculture in areas where water and irrigation is managed.

According to the World Bank, most of the countries in Africa have low levels of water storage averaging 543m^3 per capita compared with 2 428m^3 in Latin America and well below the world average of 963m^3 per capita.

In Kenya, total storage capacity per capita is only 126m^3, which is less than four percent of the level in Brazil. The World Bank report reveals that:

- Surface water is overwhelmingly used for irrigation.
- Groundwater irrigation is used but only about 10% of the land is irrigated via groundwater resources.
- Governments are generally responsible for managing large-scale irrigation schemes.
- Development and management of smaller schemes involves farmers who effectively run the smaller schemes.
- Cereals are the dominant irrigated crop in Africa and account for about 50% of the harvested crops. Fodder production, mainly in South Africa, and fruit trees account for just 12% of the irrigated land.
- Yields are generally low by world standards with rice producing about 1,6t/ha in Africa compared with about 4,2t/ha in China.

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WHAT'S WRONG WITH AFRICA'S AGRICULTURAL SECTOR?

Food prices in Africa are high and rises in food prices in 2007 and 2008 eventually led to food riots in many African countries. In January this year the United Nations Food and Agriculture Organisation reported that its food price index for December was at an all time high indicating that, unless food prices fall, food riots might again be on the cards.

In parts of Africa, falling food production, food insecurity and repetitive cycles of droughts or floods have complicated matters. In Kenya, a drought that occurred in the northern parts of the country this year affected pastoralists. The last severe drought was just two years ago.

Yet in other parts of Kenya, farmers are producing surplus foods and seem outraged by media reports that people in the northern parts of the country are starving. They attribute this to 'media lies' because the southern regions of the country are producing record crops.

The Kenyan government has been forced to intervene so that it can better distribute crops to the northern parts of the country.

Roger Thurow, a senior global agricultural expert with the Chicago Council of Global Affairs, says food distribution is a common problem in Africa, particularly as the most destitute and most hungry people are those on the fringes of the economy. They are the people without buying power and they are the first to starve, he says.

He says that ironically in Africa, during times when prices are high, farmers often lose rather than gain because the smallholder farmers end up paying for things with food on a barter basis. So farmers pay school fees using seeds but have to buy their own seeds and fertilisers at prevailing market prices.

Many Kenyans sell their grains based on market needs rather than to meet financial demands. Then they have to go back to the market to buy food and seeds for themselves at the prevailing higher prices.

Joseph Karugia, co-ordinator of the East and Central Africa node known as the Regional Strategic Analysis and Knowledge Support System, says that low prices to farmers at higher price times lead to high prices during the hungry season when they have to buy food staples.

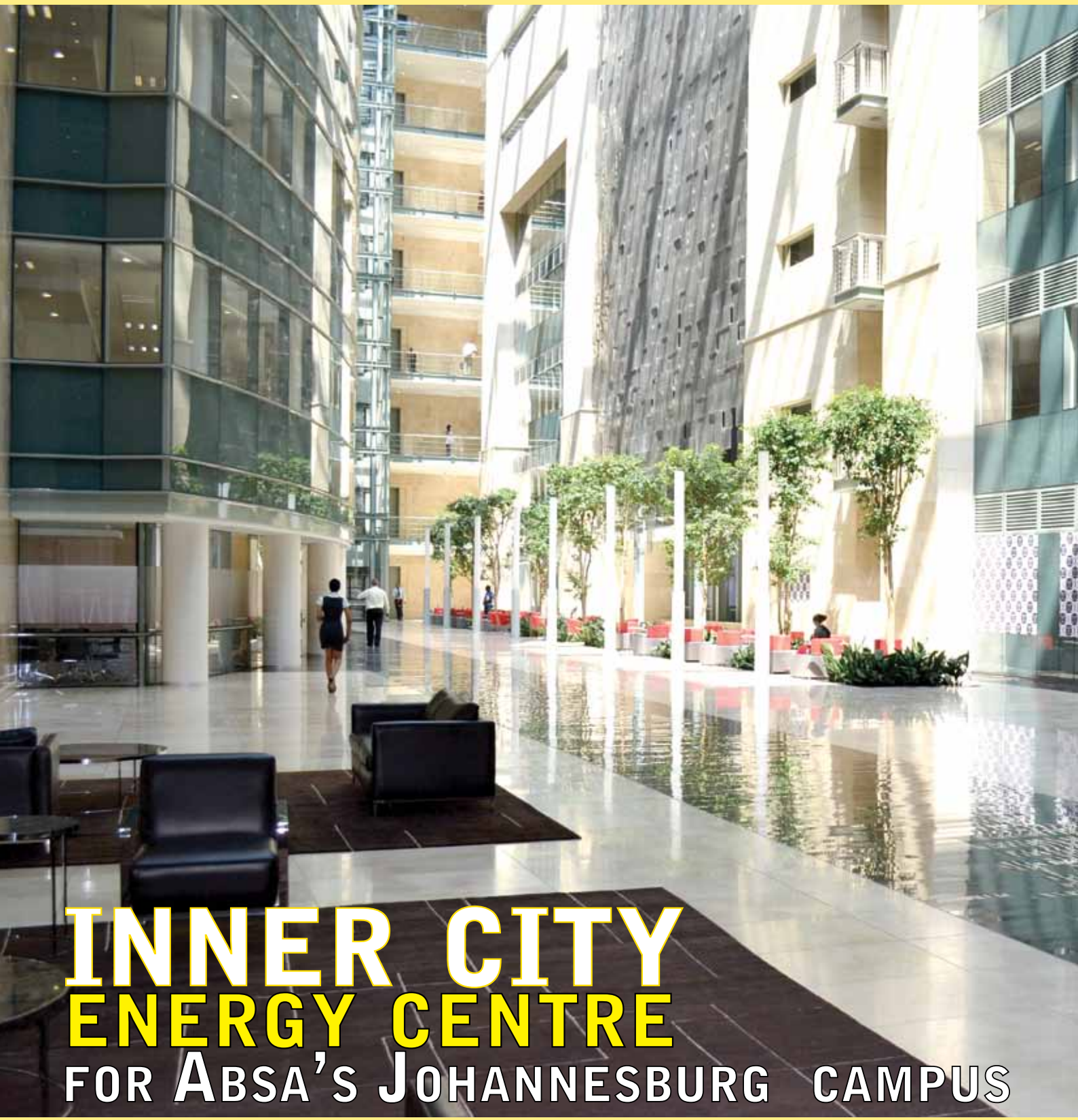
Moreover, he says, when prices are high farmers hold onto their crops hoping that prices will continue to rise and they end up losing much of their crop to spoilage because they waited too long. He refers to this as the cycle of greed, which predominates in some regions when prices are high.

With regard to essential ecosystems and the challenges these pose, the World Bank estimates that fundamental ecosystems services have been valued at about $33-trillion and include elements such as:

- Provisioning: providing products extracted from ecosystems for human consumption such as food, water, timber, fuel, fibre, medicines, ornamental plants and so forth.
- Supporting: the basic natural processes that sustain life on Earth and include biomass and oxygen production, soil formation, carbon cycling, maintenance of biodiversity and so forth.
- Regulating: elements that benefit humanity through the regulation of natural ecosystems processes such as maintaining climate and hydrological cycles, water purification, breaking down of waste products, erosion control, prevention and mitigation of natural disasters and so forth.
- Maintaining: relating to the non-material benefits that ecosystems provide for society such as recreation, aesthetic value, a healthy environment, spiritual benefits and places of worship; sense of community and belonging; social relations and prevention of land resource conflicts and so forth.

Having written this story – and the accompanying one on the challenges facing Africa, there was one question I had to ask: "You tell me which of the above cannot be fixed by proper engineering disciplines?"

And as Lewis Carroll once said: "No answer came the stern reply."



INNER CITY ENERGY CENTRE FOR ABSA'S JOHANNESBURG CAMPUS

The new Absa Towers West building has a four star rating from the Green Building Council of South Africa. The use of natural light is maximised and supplemented by an automatic system that measures the lux levels and maintains comfortable working light.

The recently occupied Absa Towers West building in Troye Street Johannesburg is the latest addition to the Absa Campus, which now comprises nine buildings spread across Commissioner and Anderson and Von Wielligh and Mooi Streets in central Johannesburg. Absa Towers West is not only built to be one of the most eco-friendly and energy efficient buildings in South Africa, but as a result of the power uncertainty created in 2007, the entire campus is also self-sufficient. An energy centre capable of generating the maximum demand for the entire campus – 11,2MW from gas powered engines and 6,0MW of emergency backup from diesel units – has been installed in the car park of the new building. Peter Middleton takes a tour of the facility.

Absa Towers West is a sparkling new building just east of central Johannesburg, in an area that only a few years ago was being cited as evidence of the 'Death of Johannesburg'. The city is clearly experiencing 'rejuvenating times' but it remains a surprising location for a first-of-a-kind South African commercial cogeneration project.

"Our philosophy as a bank is not only to say the right things, but to do them. In the energy context, we strive to be an advocate for clean, green, reliable and economical energy solutions," says Hope Mashele, Absa's manager for engineering and energy.

Being linked to Barclays Bank has led Absa to align itself voluntarily with its global parent's emission reduction commitments. "But South Africa also has good potential for energy efficiency improvements," Mashele adds. So, along with the new energy-efficient building, Absa has included an energy centre as an integral part of the development and installed all of the reticulation required to share the energy generated across the whole of Absa's Johannesburg campus.

The motives? "Our initial thinking was driven by the power outages and load shedding schedules of 2007 and 2008. But we could have gone in several different directions," Mashele explains. "Renewable solutions were always considered, but gas emerged as the most resilient and popular option. With emissions reductions of at least 40% on offer compared to diesel or coal, it was an obvious choice for power generation that was compatible with our green commitments," he says.

Also driving Absa's choice is the support of technology initiatives by local service providers with the aim of creating momentum towards energy efficiency and emissions reductions. "It is with this in mind that we chose GE Jenbacher gas engine business, through GE South Africa, for the gas engines and Diesel Electric Services, a truly South African company, for the installation and long term maintenance service contract," Mashele continues.

Robert Ladbury, manager for critical engineering at Absa gives a summary of the facility's key features and uses: "The Energy Centre is based in Absa Towers West, but we have installed reticulation to connect it across all nine buildings in the Johannesburg city campus," he says. "During normal operation, the key idea is to reduce our maximum demand from City Power." So during the day and throughout the peak demand period, Absa generates its own power at the energy centre, synchronises this power to a fixed power draw from the grid, and then supplies the total campus demand. "The total peak load of the campus is around 12,0MW during the day, so we are drawing a fixed 7,5MW from City Power and, between 6:00am and 10:00pm, we operate engines running on Egoli gas to generate the balance," he explains.

The core of the energy centre's generation capacity comes from four GE Jenbacher J 620 gas engines, each capable of producing a peak output of 3,0MW, but optimised into the Absa energy centre to peak at 2,8MW. "We manufacture gas engines in the power range 200kW to 4,4MW per unit," says Leon Jansen van Vuuren, GE's head for sales for Jenbacher gas engines in Africa, the Middle East and South Asia.

"Our engines can run on natural gas, landfill gas, biogas, coal mine methane, coalbed methane, steel gas from the smelter industry and a variety of other speciality gases. We are very proud of the Absa project, which is the first of its kind in the financial sector," adds Jansen van

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Vuuren. "Absa is the kind of local company that fits well with our philosophy, which is to manage energy use as cleanly, efficiently and reliably as possible. This project is particularly notable for demonstrating the emissions savings that are possible by switching to gas."

Summarising the gains already achieved by the energy centre, Ken Gafner of Single Destination Engineering (SDE) and the design engineer for the centre, points out that before the energy centre was installed, Absa was using 81-million kWh of electricity per year, all drawn from the utility. "As we stand at the moment, in Phase one of the project, we are drawing 54-million kWh and generating 26-million on our own. This reduces emissions from 97 000t to 78 000t per year, the equivalent of planting 1 900Ha of forest," he says.

But this is not where the project stops: "In future, by using waste energy from the engines of this plant more effectively, we will be able to drop the power required from the utility down to 28-million kWh, a massive reduction. And even though we will be generating the same amount of power from our engines, the total emissions will drop to 66 000t. i.e. the total emissions of the Absa Campus will be reduced by a third because of our energy centre," he points out.

Absa Towers West is the green building pioneer on the campus with several energy efficient features incorporated into its design. The use of natural light is maximised and supplemented by an automatic system that measures the lux levels and controls indirect lighting levels to a constant 400 lux where required. Sensors are used to automatically switch off electrical lighting 15 minutes after everyone has left an office.

"But air conditioning and heating are our biggest consumers," says Mashele. "At night during the summer months, we flush out the whole building with natural cold air. Cool air is drawn in from the bottom of the building and used to push out all of the hot air at the top. This significantly reduces the amount of mechanical power we need to keep the building cool during the day," he says.

As with any engines, there are substantial amounts of waste heat available from both the cooling systems of the engines and the higher temperature exhaust gases. "This heat is available for campus heating or for cooling via absorption chillers," Gafner explains.

At present, most of the campus buildings pre-date the energy centre and weren't designed to use low temperature hot water (LTHW) – but Absa Towers West was. "We use approximately 1-1,5MW of LTHW during summer and winter for Towers West alone," he says. "It is used for heating coils in the air handling units and for domestic hot water for the showers, etc – and this is as a direct saving that comes straight off the electrical load of the building."

But substantial amounts more waste heat are accessible. "As more buildings are upgraded, we expect to see increasing amounts of LTHW being used, which will again reduce electrical demand," says Gafner. "In addition, the centre is also designed to recover the higher temperature exhaust waste heat, which is better suited to absorption chillers. Chilled water can then be pumped to any of the campus buildings to reduce air conditioning demand from traditional compression/expansion cycle chillers."

In the energy centre, two of GE's Jenbacher J 620s are operating and two are idle. In the control room, the total load status of the campus shows 11,6MW; a flat blue line sitting at 7,5MW is the draw from City Power and a less flat red line at just over 4,0MW is being generated from the two working gas-engine generator sets. "With four engines installed," says Gafner, "we have the capacity to generate almost all of the peak demand, but currently, we are operating an economically optimum combination, i.e. two of the gas engines at 75% of full-load. Four additional bays are provided for future engines and absorption chillers."

In event of a major utility power failure, diesel generators, at the energy centre and those previously installed in the campus' other buildings, will automatically start. In the background, the diesels are being used

One of the four J 620s from GE installed at the Absa energy centre in Johannesburg. These 20 cylinder reciprocating gas engines have a peak generation capacity of 2,8MW each and emit 40% less greenhouse gases than coal-based generation, making them one of the cleanest combustion based technologies available.

to start up the gas engines ready to support the full campus load. After 15 minutes or so, once the gas engines are up to speed, the energy centre supplies all the power via the campus reticulation system. Local campus diesel generators see that power has been restored, and while not knowing whether the utility or the energy centre is supplying, they shut off. Then, when utility power is restored to the building, the gas engines will automatically and seamlessly synchronise and generation from the gas engines is reduced and/or shut down until the load requirements are optimally met.

"Looking at the whole picture, we may also be able to supply external companies with energy in the Johannesburg region," says Mashele. "We are legally prevented from doing so at the moment, but we are in consultation with the City and it might make sense in future."

Jansen van Vuuren explains how the J 620s work: "This is a 20 cylinder reciprocating engine with a volume of 6 000cc per cylinder. Natural gas comes in from the off-take and through pressure-

control valves, it is mixed with air and compressed via turbochargers, forced into an intake manifold, then into the cylinders when the valves open, and ignited by sparkplugs.

"Radiators on the roof are used to cool the oil and water circuits and slightly overpressure ventilation is provided on the air intake side. In the event of any gas leak, the engines stop and the fan accelerates to disperse the gas safely and quickly. Through a process called LeanOx®, the air/gas mix can be continuously optimised to give lowest emissions on one hand or highest power on the other. The power output is also continuously variable, but the machines are designed to run continuously.

Gafner points out the heat recovery systems: Heat exchangers are designed into the exhaust ducting of each engine for future use with absorption chillers, and plate heat exchangers are already being used to heat LTHW for Absa Towers West. "Any heat that we don't use is rejected via cooling towers on the roof," he says.

"The design philosophy is to use as much of the thermal waste energy as possible," adds Mashele. According to a GE Jenbacher gas engine business report, this 'tri-generation' approach – the use of gas engines to generate power, heating and cooling – can result in net efficiencies of above 80%. And the entire infrastructure is in place to take full advantage: around 100 sleeves of between 300 and 700mm in diameter are installed for the distribution of power, LTHW and chilled water. "Over 4,5km of 11kV cables link the buildings and hot and cold water piping is in place to enable Absa to make increasing use of the thermal energy as each building gets refurbished. "This will give us a massive reduction on the demand side," says Gafner.

Incoming gas is at very low pressure, which makes it an extremely safe transporting mechanism. "We don't hold reserves, either. We use a continuous piped supply from Egoli Gas," says Gafner. For safety, the main gas valve is held open against a spring and will shut automatically should any sensor detect a leak.

"This is a substantial gas supply, 240 000MJ/year. We have been running since May last year and have used just on 5-million cubic metres of gas, and each cubic metre is the approximate equivalent of one litre of diesel," Gafner explains. "We have generated 20-million kWh in 10 000h of operation. So far we have used nearly 80% of our gas allocation for the first year, so the plant is doing exactly what it was designed to do," he points out.

The costs? "Our direct running costs, including the maintenance contract with Diesel Electric Services, are currently sitting at R1,00/kWh," responds Gafner. This compares favourably to City Power's winter peak tariff, which is already at between R1,30-R1,40 per kWh. *And the comparison between gas and diesel engine costs?* "Diesel generation costs in the order of R2,40 per kWh, just because of the fuel price difference between diesel and natural gas. And when the waste heat savings are fully realised, the economics will make even more sense," he says.

"This is a very nice project on a commercially sensible scale," says Mashele. "It is not a pilot plant either; it's a real inner-city power generation facility. But we don't want to ring fence any one reason for building it. We are not motivated simply by costs. The combined equation is what makes business sense, the holistic approach. It's about being efficient, cost effective, community aware and environmentally sensitive all at the same time," he concludes. "And if at some point we are able to export energy to the grid, we already have capacity and the potential to expand."

Plate heat exchangers make use of rejected heat from the engines' cooling systems for low temperature domestic hot water. GE Jenbacher gas engine business believes that a 'tri-generation' approach can result in net efficiencies of above 80%.

Incoming gas is at very low pressure, which makes it an extremely safe transporting mechanism. The main gas valve is held open against a spring and will shut-off automatically as soon as any sensor detects a leak.

In April 2011, six wind turbines on Farr Farm, Scotland, were temporarily shut down – the owner paid approximately R9 million to do so – because the electricity grid couldn't handle the load produced from unusually wet and windy weather.

Energy production through environmentally sensitive means is only part of the overall problem. That energy needs to be stored and distributed as well. The nature of many renewables – particularly those depending on wind, wave or sunshine – is that generation may not take place in tandem with demand.

It is this asymmetry that holds up the adoption of some of the more speculative means of creating energy. For vehicle owners, fuelling their cars requires even more consideration.

Consider the distance you drive between refuelling stops and the time it takes to complete. You can usually travel hundreds of kilometres without thinking about visiting a filling station and then complete the task in mere minutes.

By comparison, battery-operated vehicles need to be recharged daily and each process can take hours. The time it takes to complete a full recharge can render the car unusable.

Alternative fuels aren't ubiquitous and you can end up incurring additional time and consumption costs just driving the extra distance to your nearest biodiesel or hydrogen filling station.

Batteries degrade with time and so vehicle makers over-supply their cars with them to ensure energy consistency over the 10-year lifespan of the vehicle. In order to release their energy quickly, batteries are made with many layers of thin electrodes. This increases the mass of the battery while reducing the amount of energy it can store.

Nickel metal hydride (NiMH) batteries can supply 40 to 100 Watt-hours per kilogram (Wh/kg) while lithium-ion batteries provide over 120Wh/kg. Normally these types of batteries are run at about 20-50 percent of their total capacity to preserve their lifespans and prevent overcharging. The chemical reactions within these batteries make recharging slow and degrade the electrodes after a few thousand recharge cycles.

Capacitors can smooth this cycle, allowing batteries to store more energy and release it more slowly. This would reduce the cost as well.

Chief among these is a class of device called ultra-capacitors or electric double-layer capacitors (EDLC). These are electrochemical capacitors which offer relatively high energy densities. The highest commercially-available EDLC offers an energy density of 30Wh/kg, which does not yet make them battery replacements, but development is proceeding rapidly with 85Wh/kg achieved in experimental conditions. At that energy, density ultra-capacitors become competitive with batteries.

Conventional capacitors' potential for charge stored per unit voltage is a function of the size, distance apart and material properties of two metal plates and the material properties of the dielectric that separates them.

In EDLCs the dielectric is a space, of the order of nanometres, between layers of the same substrate. The physical separation of the layers results in the 'electric double layer' in which a surface charge builds up between the two layers and creates the non-conductive layer necessary for capacitance. The larger the surface area then the more charge that can be stored and the faster

FUELLING THE CARS OF THE FUTURE

By Gavin Chait

it can be discharged. This means that capacitors have a higher power density than batteries but lower energy densities. Batteries discharge and recharge slowly. Capacitors do so quickly.

Better still, there is little degradation between charge-discharge cycles meaning that EDLCs can last for the entire lifespan of the devices they support as compared to batteries.

In the short term, ultra-capacitors can act to reduce battery weight and improve their lifespan by acting as a charge conditioner, storing energy for load balancing and using excess energy to charge batteries when suitable, ideally as infrequently as possible.

Improving the energy density of EDLCs would also make them good substitutes for batteries. That means increasing the surface area available to store charge. At present, the majority of ultra-capacitors use activated carbon as a nanoporous material.

The future material most studied is grapheme, which is highly conductive and has a specific energy density of 85.6Wh/kg at room temperature and 136Wh/kg at 80 degrees Celsius.

Nanotek Instruments in Ohio plans to introduce commercial EDLCs based on graphene sheets. Their approach is to crumple the graphene sheets to increase the surface area.

Other approaches include carbon aerogel. This rather bizarre material has the lowest bulk density of any porous solid. It is produced by extracting the liquid component of a gel through supercritical drying. It was first created by Samuel Kistler in 1931 and the first carbon aerogels were produced in the late 1980s. EDLC aerogels are a composite material usually made from non-woven paper, produced from carbon fibres coated with organic aerogel, then subjected to high temperatures (over 430 degrees Celsius) and pressure to stimulate thermochemical decomposition of the organic material.

The devices are still very sensitive and work only at low volts, but produce energy densities of 90Wh/kg.

Energy can also be stored using flywheels. Formula 1 experimented with using kinetic energy recovery systems (KERS) in the 2009 season and again in 2011 as part of regenerative braking systems. Using continuously variable transmissions, energy is recovered from the drive train during braking and then stored.

To be useful, flywheels need magnetic bearings and need to operate in a vacuum. Here they can maintain 97 percent efficiency. However, they are usually contained in a heavy vessel to protect against any shrapnel that may result from a flywheel explosion. They also act as gyroscopes since their angular momentum is of a similar magnitude to the forward motion of a vehicle. This changes the car's handling rather badly.

Solving this requires that the flywheel be mounted on a set of gimbals to allow the vehicle to turn and go up and down hills. All of this is heavy and, once more, adds mass.

Some combination of batteries, regenerative energy storage and ultra-capacitors will result in an efficient electrical vehicle and the breakthroughs are starting to pile up. A global fleet of battery-powered cars would also solve the potential problem of where to store the notoriously asymmetric supply of renewable energy.

Watt's Energy

You may find your daily commute a grind, but your car is stationary most of the time. Proposals for connecting cars to the electricity grid for Vehicle-to-Grid energy storage offer a place to store such peak production. This requires new types of infrastructure as well as software and telecommunications systems to ensure that the grid is able to balance itself.

Smart grids permit bi-directional metering; you can be both a consumer and producer of electricity. Such a system allows the coordination of a large number of small energy producers and from a wide range of energy sources. Grid modernisation will be expensive but a US Department of energy study estimated savings of between $46 and $117 billion over a twenty-year forecast.

When rush hour starts and everyone heads off to work, the system must continue to function. People who start their cars only to discover that Granny Smith down the road has drained their batteries in an epic tea-making party while watching the Royal Wedding will be very displeased.

The promise of using vehicles to store energy in the grid is positive. A car with a 20 to 50 kWh battery pack - equivalent to 60 to 450 kilometres of range – would be able to provide sufficient energy to power a household for two to five days.

But first the smart grid must exist. The first, and still largest, implementation is in Italy. Completed in 2005 at a cost of about $2.8 billion, the Telegestore project delivers savings of around $800 million a year. Other projects in Austin in Texas, Boulder in Colorado, Ontario in Canada and Mannheim in Germany have also been completed. However, this is still a small slither of what would be required to ensure comprehensive smart grid cover.

For all of this to come to fruition a large number of breakthroughs must take place in batteries, capacitors, energy storage and infrastructure development. All to replace fuels derived from fossil energy stores. What happens, though, if the fuels themselves are replaced with alternatives?

Petrol and diesel is a long-chain carbon molecule produced by organisms. The most promising are algae fuels which can theoretically yield 10 to 100 times more energy per unit area than other biofuels since the entire organism can photosynthesise. Such fuels are already being tested in combination with jet fuel by Boeing, Air New Zealand, Continental Airlines and Japan Airlines.

One of the leading companies in algae fuel production is Sapphire Energy whose backers include Bill Gates and the Wellcome Trust. They have recently formed a partnership with Monsanto, the biotech agricultural company.

Craig Venter, the bad-boy of biotech who revolutionised genetic sequencing, and his company, Synthetic Genomics, are looking to go further than merely producing energy-rich plant matter. He is developing synthetic bacteria and algae that would consume carbon from the air and convert that directly into fuels. In 2010 he produced the world's first entirely synthetic living organism. Exxon, a traditional oil company, has put $600 million into a partnership with Synthetic Genomics. The carbon would be sourced directly from the waste stream of coal-fired power stations.

The race is on between synthetic biology and micro-electronics. Along the way a whole host of new industries and technologies will revolutionise the way we work and live, along the way destroying old industries and creating whole new ones.

Greenhouse facility at SGI Headquarters depicting algae growing in open and closed bioreactors. Images courtesy of Synthetic Genomics.

Electric 'grand prix' for South Africa?

The Formulec World Series – a racing format based on Formula 3 but running electric cars only – is likely to include South Africa in the 10-race season that will be held on five continents around the world.

A local company is bidding to host the African leg of the series either at Kyalami in Gauteng or as a street-race in Durban.

Electric cars have the reputation of being slow, unreliable and of extremely limited range but this is untrue, claim the organisers, who point out that new racing versions of the electric cars can reach speeds of more than 250km/h and can accelerate from 0-100km/h in less than three seconds.

One of the racers due to compete in South Africa is the French-designed EF01, which has been tested on the Bugatti track in Le Mans. The car, driven by Alexandre Premat, is currently rated as the fastest electric single-seater racing car in the world today.

Durban is viewed as a potential venue for the electric car series because of the experience it gained while hosting the A1 street races that were run across a winding track along the northern beachfront and through some of the twisting main roads of the city.

It attracted thousands of visitors to the city for the week when the event took place but local residents complained about excessive noise and traffic problems while the A1 racing circus was in town. This 'green' event is expected to be much quieter though as electric-powered racers generate less noise and carbon fumes than conventional fossil-fuel vehicles.

Winstone Jordaan, a spokesman for Formulec SA and ECO Promotions, says that a final decision on hosting rights for South Africa will only be reached in August but he says that South Africa is expected to win as it is the only country on the continent to have put in a bid for the African leg of the series.

Jordaan says that the event will have a minimum of 15 electric racing cars competing in the first race with up to 36 vehicles taking part in subsequent events. The Formula 3 format comprises shorter races at slightly slower speeds than the premium Formula 1 series.

Tariff cuts for renewable energy get industry in a tizz

New tariffs for the renewable energy sector could hamper investments in wind, solar, and biomass projects according to representatives from these sectors who were addressing the public hearings of the National Energy Regulator of South Africa (Nersa).

The revised tariffs, which were released in March, surprised industry as most of the revisions meant that projects were no longer profitable and would be unlikely to attract the level of development finance needed to create them.

SolafricaTherma's energy representative Prabashen Govender claimed that the new tariffs would "render the industry stillborn", while David Chown, managing director of Mainstream said the lower tariffs would make it impossible for project developers to provide macroeconomic benefits to rural areas. He said the revised tariffs were not adequate to seed the industry and developers will now struggle to raise the finance needed for many of the projects.

According to Mark Tanton of Red Cap Investments, the review of tariffs had created uncertainty in the renewable energy market and he urged Nersa to leave the tariffs at the 2009 levels and then revise them from 2013, when many projects were already underway.

Tanton said the revised tariffs had created a lot of uncertainty for the renewable energy sector at a time when investments and some risk financing were needed.

South African Wind Energy Association's chief executive, Johannes van der Berg, said that revised tariffs could be applied from 2014 when the industry had gained local experience with construction, operation and maintenance of the different renewable energy technologies.

However, Concentrated Photovoltaic producer, Amonix, stated that the 2009 tariffs were "over generous" and that the revised lower tariffs were internationally competitive and should be welcomed. This comment surprised many other participants at the public hearings.

The new tariff structures are between 7,3% lower for some technologies and 41% lower on others. They were announced shortly after the Cabinet accepted the IRP2010 document, which outlines that as much as 42% of South Africa's generation capacity is expected to come from renewable energies over the next 20 years.

The initial Renewable Energy Feed-In Tariff (Refit) was approved in 2009 but was considered to be generously high by some observers so the cuts in the tariff are not really that surprising although, as industry participants predict, it will make it more difficult to raise the necessary capital.

Under the proposed Refit programme, tariffs for wind projects with a capacity that is greater than one megawatt, will drop to R0,938 per kWh in 2011 then rise to R0,945 in 2012 and to R0,952 in 2013. The figures are 24,9% lower than the 2009 tariff of R1,25/kWh.

The biggest cuts of 41,5% and 41,3% are reserved for concentrated solar power and for ground-mounted photovoltaic. The CSP trough tariffs will fall to R1,836/kWh in 2011 then rise to R1,845/kWh in 2012 and R1,854/kWh in 2013. This is down from the 2009 estimate of R3,14/kWh.

Solar photovoltaic tariffs were cut from R3,94/kWh to R2,311/kWh in 2011. For CSP Tower technology with six hours of storage, the tariffs fell from R2,31/kWh in 2009 to a proposed R1,399 in 2011, a drop of 39,4%.

The proposal cuts the tariff for gas from landfill projects from R0,65/kWh to R0,539/kWh in 2011 and reduces the tariff for small hydro plants from R0,94/kWh to R0,671/kWh. Tariffs for biogas and biomass projects fall by 12,9% and 10,1% respectively from R0,96/kWh to R0,837/kWh and from R1,18/kWh to R1,06/kWh.

The revised tariffs can be downloaded from www.sapvia.co.za

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spintelligent CLARION EVENTS

Chubu reactor closed,
damage assessed at Fukushima

Japan has suspended a second reactor at the Chubu Electric Power Company's Hamaoka facility in central Shizuoka prefecture.

Prime Minister Naoto Kan called for it to be shut down as a precaution following the devastating initial earthquake in March and the serious waves of aftershocks that have since struck the country. Kan says that Japan's Science Ministry is predicting that there is an 87% chance of a magnitude 8,0 earthquake striking the region again within the next 30 years.

Meanwhile, the Tokyo Electric Power Company (Tepco) has increased the flow of water into the damaged Number One reactor at the Fukushima Daiichi plant that was crippled in the earthquake and tsunami.

Tepco plans to completely submerge the reactor and activate an air-cooling system to reduce the level of airborne radioactive substances by June this year. It also plans to install a heat exchanger near the equipment hatch of the reactor building and air-cooling devices that are outside the building.

It will install similar devices on the Number Two and Number Three reactors as well.

In a separate development, Tepco released footage of explosions that took place in the Number Three reactor, which left the nuclear fuel rods covered in wreckage. Hydrogen explosions at four buildings at the six-reactor complex destroyed roofs and walls, and scattered radioactive debris across the site.

In the operation, filmed by an underwater robot, contaminated water was collected to carry out further analysis of the reactor. Experts believe that most of the fuel rods were undamaged despite the disaster. It is estimated that it will take another six to nine months to bring the plant to a cold shutdown.

Congo gets new power,
INGA III BACK ON THE TABLE

The oil-producing Congo Republic has started generating power from its Chinese-funded hydroelectric power station that is aimed at shoring up its electrical power. The 120MW power station is set on the Daugava River.

The $377-million Imboulou plant, 150km north of the country's capital of Brazzaville has been 85% funded through soft loans from China. It was built by China National Machinery and Import and Export Corporation (CMEC). No details on the terms of the funding have been released.

According to Energy Minister, Bruno Jean Richard Itoua, the plant will produce 876-million kilowatt-hours of energy a year, which will allow the country to wean itself off energy imports from its neighbour, the Democratic Republic of Congo (DRC).

The Congo Republic consumed around 470-million kWh of energy in 2007 but had a production capacity of about 400-milllion kWh in that year.

Meanwhile, the DRC has said that plans to go ahead with the enormous Inga III power project are back on track and South Africa's Energy Minister, Dipuo Peters, says the country's President, Jacob Zuma has "been aggressively engaging with the DRC" to make sure the project goes ahead.

The Inga Falls are a series of powerful rapids on the Congo River, situated in the north of the country's Matadi region. Until about 18 months ago, South Africa, Angola, Botswana and Namibia were working with the DRC to create a 5 000MW hydroelectricity project worth an estimated R65-billion Rands.

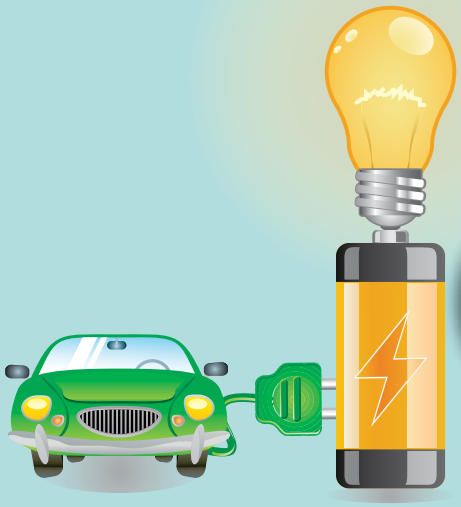
The DRC turned its back on its African partners and walked away from the development claiming that Eskom had failed to commit itself to the project. But Peters says that the South African government is now "very optimistic" that Inga will go ahead.

Apparently a team of officials from South Africa and the DRC is working on an inter-governmental Memorandum of Understanding to start the project going. It is not clear at this stage if Botswana, Namibia and Angola will join South Africa and the DRC in developing Inga III.

Angola and Namibia are currently working on another new hydroelectricity plant on the Kunene River in the Baynes area, 40km downstream from Epupa Falls. It will have an installed capacity of 465MW and an average daily production of 171MW.

CPD

New materials hold promise



New materials may be useful in converting waste heat, such as from auto-exhaust, into electricity; and Jeffrey Snyder and colleagues from the California Institute of Technology report that they have altered the chemical composition of materials to boost their thermoelectric efficiency.

Snyder says that most thermoelectric materials have a 'figure of merit' – which is a measure of overall performance – of less than one while values of 1,5 or higher are needed in many applications. These higher values can be achieved by nanostructuring, but Snyder's team achieved similar gains by carefully controlling the composition of bulk materials.

The team claims to have managed to engineer the desired combination of thermal and electrical properties into alloys of lead, tellurium and selenium, producing a substance with a thermoelectric figure of merit of 1,8.

The researchers say they boosted performance by modifying the electronic band structure. The improvements were made by carefully adjusting the relative abundance of tellurium and selenium in the lead alloy.

Durban researcher in **ground-breaking cancer chemistry**

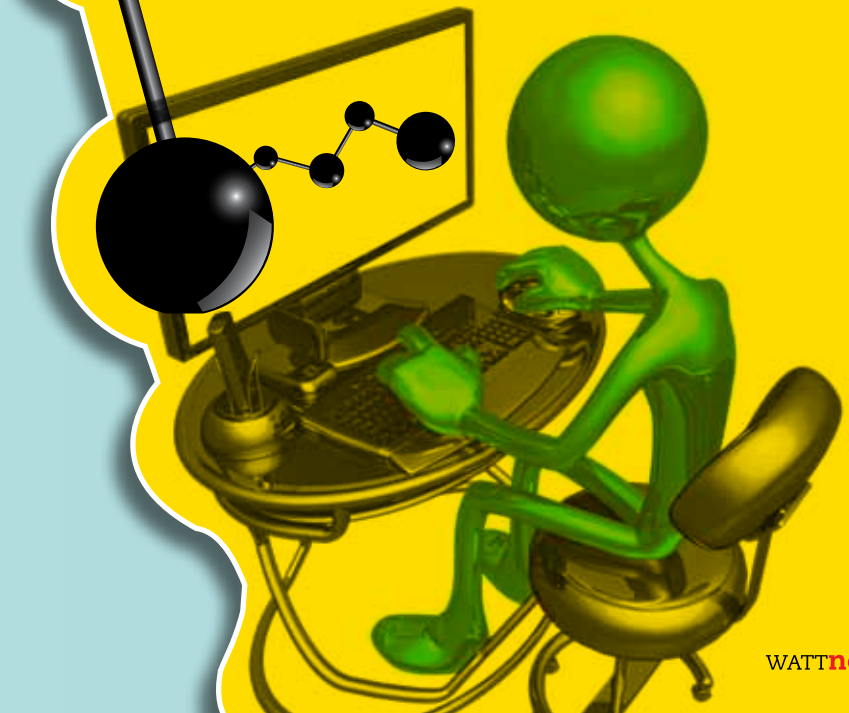
Using computer based models, Parul Sharma, a doctoral researcher at the Durban University of Technology, has completed ground-breaking chemistry research into the bioactive structures needed for the design of anti-cancer drugs.

Sharma – whose research involves the study of computational chemistry and protein engineering – is studying a series of neuropeptides, or small protein-like molecules, responsible for many cancers including prostate and lung.

Her study involved an assessment of all possible structures that neuropeptides can adopt with a view to determining which the preferred bioactive structure was. This work could assist in a better understanding of the mechanisms of action of cancer-causing peptides that could be helpful when designing new drugs.

The study has been funded by the Durban University of Technology in collaboration with the National Research Foundation: Spain-SA Bilateral Agreement, which allowed her to travel to Spain for more than two months in 2009 to complete her advanced data analysis.

She says that information obtained from her simulations might be helpful in combating diseases other than cancer and might even lead to the design of more potent anti-HIV drugs as well.



UCT to play a role in drug development

The University of Cape Town has established the Holistic Drug Discovery and Development Centre, H3-D for short, which aims to provide a research infrastructure that is comparable within anything found overseas. South Africa has an enviable reputation in basic sciences and clinical studies of various diseases and medicines but has struggled to translate this into being able to develop and bring to market new medicines.

According to Kelly Chibale, scientist at H3-D, with appropriate investment the centre can play a significant role in creating jobs and preventing the constant brain-drain that sees skilled and talented researchers leaving the country to work in advanced medical centres in Europe, India or the USA.

He says this drug discovery centre is likely to bridge the gap between basic and clinical studies and integrate a number of scientific disciplines including biology; pharmacology; medicinal, synthetic and computational chemistry; drug metabolism and pharmacokinetic studies into a single research facility.

"H3-D will create a value chain and a skilled base of expertise, coupled with modern technology platforms to assist researchers tackle the disease burden that faces Africa today," says Chibale.

"It will compete with similar initiatives in western and Asian countries and in many cases will be able to offer the same services and skills at a lower cost because of the exchange rate," he says.

According to Chibale the development of H3-D came about after the government adopted the National Biotechnology Strategy in 2001 and the National Research and Development Strategy in 2002. These identified the need for the creation of viable biopharmaceutical industries to help fight diseases that are prevalent in Africa.

"The South African Research Chairs Initiative (or SARChI) was created by the Department of Science and Technology and administered by the National Research Foundation. It was set up to make South Africa competitive in the international knowledge economy when it comes to medicines and pharmacological research," says Chibale.

He says that as the founder of H3-D he has the honour of holding the new SARChI chair in drug discovery that was established to concentrate on the discovery and pre-clinical development of novel potential treatments for major communicable diseases affecting Africa.

According to Chibale, the academic community, including Stellenbosch and Cambridge universities, has also contributed to the founding of H3-D and private companies such as Pfizer and Novartis have become involved in helping to develop the research centre.

Chibale points out that in 2009 the first SA Medical Research Council/UCT drug discovery and development unit was established to introduce technology platforms that would allow the exploration of potential African natural products, including those used in traditional medicines and by healers.

He says that funding for various initiatives was provided by the Cape Biotech Trust as well as by the European Union and the World Health Organisation's Tropical Diseases Research centre. African traditional medicines will remain a core part of the research areas that H3-D will undertake in the years ahead.

However, Chibale points out that it is dangerous and irresponsible to promote the use of traditional medicines unless these have been subjected to the kind of rigorous research that other drugs must undergo before being used by the medical fraternity.

He says, for instance, various scientific studies have shown that St John's Wort extracts, a herbal remedy used to treat depression, increase the metabolism and premature clearance of various other drugs including anti-retrovirals, oral contraceptives and cyclosporine.

Similarly, he says, ginseng is known to reduce the anti-coagulant effects of warfarin, thus complicating the effectiveness of the drug.

"Such interactions present an opportunity to bring modern drug discovery technologies to bear on African traditional medicines," says Chibale.

The research and development costs of developing drugs are extremely high and it can cost as much as $1-billion – and take between 12 and 14 years – to bring a new drug onto the market.

Chibale points out that typically a vast number of molecules must be studied before one successful drug is identified and, in the clinical phase of testing, just one in 5 000 products making it to market is not an uncommon event for drug development.

He says the challenge for researchers is to shorten the time it takes to identify a pre-clinical drug candidate so that its development can be speeded up and it can come to market more quickly.

Apart from his role as founder of H3-D, Chibale is a professor of organic chemistry at the University of Cape Town and the director of the SA Medical Research Council's drug discovery and development research unit. He is a full member of the UCT Institute of Infectious Disease and Molecular Medicine.

METHANE or COAL – which is worse?

According to a study by researchers at Cornell University, greenhouse gas emissions from natural gas-fired power stations are about half those of coal. The study says that methane leaking during shale gas production does more harm to the environment than the burning of coal.

A recent paper by Gregory Staple, chief executive of the American Clean Skies Foundation and Joel Swisher, director of technical services at Camco International and consulting professor at Stanford University, says that there are serious flaws in the Cornell study.

Staple says the Cornell study used a theoretical model to compare the estimated greenhouse gas footprint of shale to that of coal. The Staple-Swisher study, using data from the Department of Energy, found that fuel chain emissions from existing gas-fired power stations were about 52% less in terms of greenhouse gases than existing coal-fired generation.

The Cornell study says that natural gas emits about half the amount of carbon dioxide of coal. During extraction, however, methane is released and this methane is far more damaging to the environment than the carbon dioxide say Cornell's researchers.

The Staple-Swisher paper discounts this saying that overall, the greenhouse gases from natural gas are lower than coal-fired power stations even after leakages of methane have been taken into account.

The US Energy Information Agency points out that shale gas production will account for about 50% of natural gas production in the United States within the next 25 years and warns that this production method might add to the levels of greenhouse gas emissions in the US.

Why MATTER has MASS but LIGHT doesn't

The discovery of a new sub-atomic particle has set the scientific community abuzz and if it proves to be true then it could upset the rules of physics that were established more than 30 years ago.

The discovery follows what was called "an intriguing bump" in the data collected from high speed collisions at Fermilab's particle collider near Chicago, which smashes protons and anti-protons into each other at two million times a second.

Scientists thought they could detect energy emissions from a new sub-atomic particle, or what they called a "whole zoo of particles", that exist for just a fraction of a second before turning into something more familiar.

Researchers believe that the anomaly in their data indicates that the undiscovered sub-atomic particle has a mass of about 150 times that of a proton, the positively-charged entity within an atom's nucleus. If this proves to be the case it could spell the end of the idea that matter has a mass because of the existence of another kind of sub-atomic particle, the Higgs boson – sometimes referred to as the 'God particle' –predicted by theoretical physicists.

Professor Kenneth Lane, a theoretical physicist at Boston University says that if this signal is, "what we think it is," then "we could be on the verge of understanding why matter has mass whereas light doesn't".

He says the new nuclear interaction – called technicolour – could basically replace the Higgs boson. The standard model of physics explains how sub-atomic particles interact with four known forces of gravity, electromagnetism and the strong and weak nuclear forces and predicts that the Higgs boson, if it exists, could explain why things have weight.

Professor Brian Cox of Manchester University says that if the results hold up to further scientific analysis and are confirmed in a second experiment then it is "rest-in-peace for the standard model".

Physicists at the Tevatron particle collider say that they are 99,7% sure of the data. This does not yet qualify as a new discovery because for that they need the probability to be better than one-in-a-million.

FRANCE says its nuclear plants are safe

Opposition to the use of nuclear power is rapidly growing in France with environmental activists calling for the immediate closure of the Unit 1 reactor at the Fessenheim nuclear power plant. Two nearby Swiss cantons have also called on the French government to close the facility.

Fessenheim, situated about two kilometres from the German border, is one of the country's oldest nuclear power plants. The reactor – like the other 57 in France – is run by Electricite de France whose chief executive, Henri Proglio, maintains that Fessenheim and all other nuclear facilities are "in excellent condition". He says the Fessenheim plant has regularly been modernised since it was first built in 1977.

However, President Nicholas Sarkozy has instructed that stress tests be carried out on all of France's reactors, which are used to produce about 80% of the domestic power used in the country and allow France to export electricity to neighbouring states, including Germany and Switzerland.

German Chancellor Angela Merkel has also ordered that a comprehensive range of stress tests be carried out at all 17 of Germany's reactors. She has decided to shut down seven of the older nuclear plants built in the 1970s or early 1980s for at least three months so that safety tests can be conducted.

Merkel says that unless the safety facilities of these plants are guaranteed they will be taken off the grid entirely and forced to shut down. She says that the government will look into ways of replacing nuclear power generation with other sources of sustainable electricity in the future.

ORGANIC SOLAR PANELS face serious challenges

Solar power development is facing new challenges as efforts are being made to introduce more organic substances and components into the solar power generation technologies used around the world today.

Organic photovoltaic modules are widely viewed as an industry for future growth but so far these have proven inefficient and much more costly than conventional solar power generation units. Organic photovoltaic modules use carbon-containing polymers or molecules to covert light to electricity while conventional solar power production uses silicon or synthetic film.

A report from Lux Research says that growth in the use of organic photovoltaic modules will be slower than originally anticipated. The report says that organic photovoltaic modules have poorer conversion efficiencies and shorter lifespans than conventional solar technologies and unless these issues are addressed and resolved they will limit the application of this technology. However, experts believe that as organic materials improve, the use of organic photovoltaic modules will increase.

The announcement came at the same time as American company Emerson announced that it had done a deal with Sanmina SA of Ottawa to build innovative power inverters for Canada's growing renewable energy programme.

The inverters convert dc power from photovoltaic arrays into ac power that can be fed directly into the electricity grid. The Emerson grid-tie inverters are designed for utility and large scale commercial use.

CONSIDERING THE ALTERNATIVES TO INTERNAL COMBUSTION ENGINES

By Gavin Chait

The world's most successful hybrid vehicle was launched in 1997 and, by September 2010, had sold two million units around the world. Toyota's Prius is the beloved of movie stars and has become the thinking person's environmentally responsible choice.

Sadly, it isn't very green. A new Prius will set you back over R330 000 and offers fuel efficiency of 3.9 litres per hundred kilometres during combined urban and rural driving according to the UK's Vehicle Certification Agency. The closest 'regular' production car is the Ford Fiesta 1.6 diesel, also a mid-sized family hatchback. This costs R191 000 and its fuel efficiency is 3.8 litres per hundred kilometres.

Neither are these even the most economical. The Polo blue Motion achieves 3.4 litres per hundred kilometres and the best is the Smart for two, at 3.3. Forty one cars achieve greater fuel economy than the Prius on the VCA top 50 rankings.

Hybrid cars are a class of vehicles that combine an internal combustion engine and one or more electric motors. The motors act to recover energy lost during braking and store this on-board in large batteries. The batteries can even be charged overnight to add additional power for urban start-stop driving.

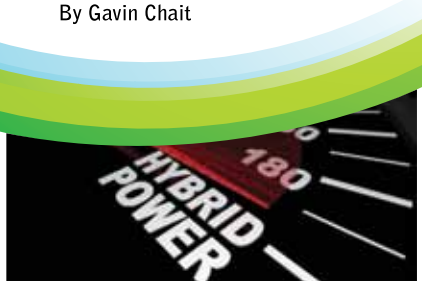
The problem is that batteries are heavy. Even the nickel-metal hydride cells and the more recent lithium-ion batteries used in the Prius weigh sufficient to reduce fuel economy. The weight of its 1.8 litre engine and a bathtub full of batteries bring the Prius to 1.3 tons, 200 kilograms more than the Fiesta. All the clever engineering in the world won't help a combustion engine if it adds that much extra weight.

Not to say that regenerative braking and other energy tweaks aren't clever ideas, but they add complexity, cost and bulk to existing vehicles. They have introduced the idea that there are alternatives to combustion engines. These alternatives will be limited by consumers' willingness to pay for them.

JD Power and Associates, a US-based market information service, has released its 2011 US Green Automotive Study. "Despite a rapid increase in the number of alternative powertrain vehicle models projected for the next several years, automakers will be fighting over the relatively few consumers who are willing to drive green," says the report.

Over 75 percent of consumers sampled were interested in cost and fuel savings while only 50 percent were interested in their next vehicle being "better for the environment".

"Alternative powertrains face an array of challenges as they attempt to gain widespread acceptance in the market," says JD Power's Mike van Nieuwkuyk. "It is the financial issues that most often resonate with consumers, whether it is the higher price of the vehicle itself, the cost to fuel or charge the vehicle, or the fear of higher maintenance costs. The bottom line is that most consumers want to be green, but not if there is a significant personal cost to



them." Despite these concerns, the 31 hybrid and electric vehicle models of 2009 will have grown to 159 by 2016.

The first motorised vehicles for personal transport were all electric. The 1867 World Exposition in Paris presented a two-wheel electric cycle created by Franz Kravogl, an Austrian inventor. Thomas Parker, who electrified the London Underground, claimed to have developed an electric car in 1884.

On 29 April 1899, Camille Jenatzy set a world record speed of 105.88 kilometres per hour in a Jamais Contente, a one-off improbably torpedo-shaped electric vehicle. Ferdinand Porsche even got in on the act with an all-wheel drive electric car powered by a motor on each hub.

The Americans were a little slower on the uptake but, in 1897, the Electric Carriage and Wagon Company of Philadelphia introduced a fleet of electric New York City taxis. Drivers preferred them as quieter, less smelly, and with fewer disaster-prone parts than the alternative steam and gasoline-powered vehicles. They also didn't require painful gear-changes or manual cranking to get them started.

By 1900, 40 percent of US vehicles were steam-powered, 38 percent electric and a mere 22 percent powered by fuel: 33,842 vehicles were registered in the US.

The short operating ranges of the vehicles, as well as the lack of home recharging, were a problem. The major roll-out of home electrification in the US didn't begin until 1912. In 1896, the Hartford Electric Light Company introduced an exchangeable battery service. In a clever partnership with the General Electric Company, owners bought their vehicles from GE without batteries and then paid Hartford a consumption fee. The service operated until 1924.

1912, though, would prove to be the high-point of the first electric cars. Take the points against electrics first: they were slow, offering speeds of only 24 to 32 km/h; they had low range, 50 to 65 kilometres.

Then innovations in combustion engines came thick and fast: Charles Kettering invented the electric starter in 1912, Hiram Percy Maxim's 1897 invention of the engine exhaust muffler was catching on, and Henry Ford turned up in 1915. His first vehicles were sold at $440. In 1916 he dropped the price to $360. The cheapest electric roadster cost $1,750. However, this wasn't the nail in the coffin. Interstate highways saw to that.

In 1916, the US Federal Aid Highway Act provided government subsidies to build sealed highways between major cities across the country. Americans began to travel and the long distances required vehicles that were faster and could travel further without refuelling. Electric vehicles just weren't up to the task.

While companies tried to revive electric vehicles over the next decades, they never proved economically viable. Even Chris Paine, whose 2006 documentary "Who killed the electric car?" attempted to demonise manufacturers for killing General Motor's EV1, couldn't answer the problem of a lack of consumer demand.

Mentorship

The SAIEE is offering mentorship and advice to young engineers.

The offer comes at a time when our country is suffering a shortage of skills, and we believe that mentoring is an essential requirement in the training and development of the next generation of engineers.

If, as a member of SAIEE, you believe that you need a mentor you can request a mentorship service from the Institute.

The service will be of particular benefit to those young engineers working under the leadership of busy and pressurized engineers, who may not have the time to spend with the young engineers discussing and planning their career paths.

This service is particularly relevant to young engineers who are working in an environment devoid of engineers or with non technical managers. The young engineer may feel frustrated because he or she cannot benefit from the wisdom of an experienced engineer.

It will give a young engineer, the mentee, a chance to talk to a mentor, who will be his or her advisor, teacher and role model, away from the work environment. His or her mentor, matched to a similar profile, will understand the mentee's work and personal situation, having been there him- or herself.

The mentee will be able to discuss problems and frustrations with his independent mentor, who would have no stake in the outcome, and who would be able to provide an unbiased opinion and advice. The mentee might not be able to do so with his superiors, particularly if he is unhappy, and is considering an alternative career.

The mentor and mentee could arrange to meet regularly, but not too often, say a few times a year, when both should have enough time to listen properly to what the other has to say.

The mentor could recommend to the mentee what course of action to take without being too prescriptive while the final decision and the consequences remain with the mentee.

Among its more than 5000 members the SAIEE has many experienced engineers who are willing to act as mentors. They are are spread across the country and include engineers who are experienced in steelworks, furnaces, rolling mills, mining, manufacturing, electrical generation, transmission and distribution, through to light industrial, process control, instrumentation, telecommunication, robotics, automation, software development and engineering management of these sectors.

So if you feel that you would benefit by talking to a mentor, please contact Ansie Smith on the number below. She has a database to match the profiles of mentors and mentees.

Prospective SAIEE Mentors
If you feel you have the time and interest to help mentees, please contact Craig Smith on craigs@saiee.org.za or 011 487 9042
In addition you gain CPD credits, for when you are required to re-register.

That was then. A combination of higher fuel prices, growing concern about environmental issues and a few sexy releases, like the Prius, have revived alternatives.

The most glamorous is the Tesla Roadster, produced by the Californian Tesla Motors, based on the Lotus Elise. The roadster has a range of 393 kilometres on a single charge, lithium-ion battery, and can accelerate from 0 to 97km/h in 3.9 seconds.

It costs $109,000 and, at 2.7 tons, weighs three times as much as the Elise and costs $40,000 more. Rather infamously, the BBC's Top Gear ran an unflattering review of the Tesla and is currently being sued for libel by the manufacturers.

Electric cars continue to be limited by the weight of the batteries, the time it takes to recharge them, and the range of the vehicles.

In order to compete with a combustion engine, any alternative vehicle has to offer similar costs and range, a wide network of refuelling stations where the vehicle can be reprimed in five minutes, and a similar network of service and repair stations. The infrastructure that supports combustion vehicles has taken a century to build and has cost more than any collection of companies can afford.

That hasn't stopped the contenders.

To much fanfare, Motor Development International debuted its MDI Air Car in South Africa in 2002 and predicted production by mid-2004. It even announced a partnership with Tata Motors. To date, this hasn't gone anywhere.

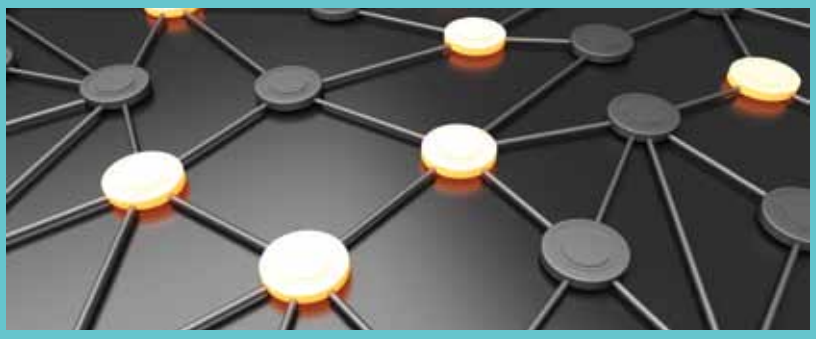
A compressed air engine does mechanical work through the expansion of compressed air. Linear motion can come from a diaphragm or piston actuator, while rotary motion is achieved via a piston air motor. As the air expands out of the storage tank it cools (Charles's Law, and familiar to any aqualung diver). This can cause icing up of the working components and reduces the energy available for work. So a heat exchanger is required. Mekarski system air engines used in locomotives heat the air via a small boiler prior to use. The advantage of compressed air is that compressors can easily be rolled out at existing filling stations and be powered by electricity. Refuelling is fast and straightforward. If you have a 1 000kW compressor, that is. The theoretical energy that can be extracted from compressed air is 11 to 28 Wh/kg, very little different from the earliest electric cars and so of limited range. The only car tested with a compressed air engine managed a distance of 7.22km.

Hydrogen is another challenger, but the production and distribution of hydrogen is a problem. David MacKay, a Professor in the Department of Physics at Cambridge University, examined the theoretical energy that could be extracted from different sources in his 'Sustainable Energy – without the hot air'. He concludes that shifting energy requirements from fuel to the electricity distribution system is not 'green'.

"I know of no form of land transport whose energy consumption is worse than this hydrogen car," he says of the BMW Hydrogen 7. The Hydrogen 7 achieves 254kWh per 100km; 220 percent more than the average European car. In addition, hydrogen is difficult to store, requires heavy containment vessels and is extremely expensive and energy-inefficient to manufacture: 95 percent of hydrogen is derived directly from natural gas, releasing carbon dioxide as a waste product.

Under today's technology, hydrogen doesn't seem to offer a solution. The pure battery-powered electric vehicle offers energy-consumption of 1kWh per 100km, about four times better than the average current internal combustion engine. That includes the Tesla battery-powered sports car. If the energy which charges these batteries can be sourced from renewables, then all is well. If those batteries could be more capacitive in nature, enabling rapid recharging, then it would be a viable replacement to the internal combustion engine.

Eskom's low reserves may lead to outages



Eskom's low reserve margin for the next few years will make it difficult for the utility to complete essential maintenance work while maintaining a stable power supply for the country, warns the power utility's chief executive Brian Dames.

He says the peak forecast for 2011 is about 37 500MW, a two percent increase on 2010 levels. However, he warns that even this modest increase will place strains on the power utility. He says the maintenance cycle starts in mid-May and continues throughout the winter.

The organisation needs at least 2 000MW of operating reserve. "However, with increasing demand, the reserve margins make it difficult or impossible to shutdown units for essential maintenance and this raises the risk that the units could fail," says Dames.

Every degree that the temperature drops during winter results in an increased demand of between 600MW and 700MW during the evening peak and the 2011 winter season is expected to be colder than last year.

Dames says that in January about 4 000MW of generation capacity underwent planned maintenance, followed by about 3 000MW in February and 3 200MW in March. Koeberg's Unit Two is undergoing planned refurbishments and refuelling but this is expected to be completed before the winter peak.

The Duvha Unit 4 generator failed earlier this year and it will take at least a year to complete the repairs needed for this unit. As a result it will remain out of commission for the winter season, placing more pressure on Eskom's reserves.

Dames has pleaded with consumers – residential and industrial – to work hard on reducing electricity consumption to relieve some of the pressure on the generation capacity. The utility has allocated about R1,8-billion for demand-side management that is aimed at reducing consumption and relieving pressure on the network.

In terms of buying additional power from independent providers, Eskom has confirmed that it has agreements with Sasol to buy 240MW, with Sappi for 35MW, with Ipsa for 13MW and with Tangent Mining for 85MW. Dames says that Eskom is supporting certain municipalities in an effort to get them to commission idle plants. So far Eskom has reached agreements to take a further 410MW from municipalities and, of this, 260MW of generation capacity was introduced last month.

New category of **Eskom Eta Awards**

Eskom has introduced a new category for it annual Eta Awards which recognise efficiency, innovation and achievement within the electricity sector. The new award is for energy savings in households.

Individuals who have implemented innovative energy efficiency solutions in their homes can be awarded the runner-up's prize of R5 000. The winning entry will receive R30 000.

Eskom's Steve Lennon says that there is a wealth of information available to households that wish to use electricity more efficiently and claims that a geyser alone can contribute at least 70% to the overall household electricity bill.

He says that, through the Eta Awards, Eskom wants to recognise those citizens who are already using electricity sparingly and are finding other ways to save even more power.

Last year, Geyserwise won the Eta Award for the development of its intelligent energy control system. This allows the geyser's energy consumption to be digitally monitored and controlled and results in savings of between 17% and 50% in terms of peak shifting charges and lower energy consumption. Already more than 80 000 of Geyserwise's units have been installed countrywide.

The Eskom Eta Awards, which have run for more than 20 years, are supported by the Department of Energy. The various categories – open to individuals and companies – include:

- Innovation in Industrial, Commercial and Residential sectors.
- Energy efficiency awareness.
- Energy champion in the industrial sector and communities.
- Young designers.
- Energy savings in households.

Entries for this year's Eta awards close on 10 August.

GREEN CLIMATE FUND

to be operational by December

Trevor Manuel, Minister in the Presidency responsible for the National Planning Commission, wants a $100-billion Green Climate Fund to be established before the end of this year. He is one of three co-chairman on the transitional committee that is responsible for designing the Green Climate Fund, which is a mechanism agreed to at the Cancun 2010 conference by the United Nations' Framework Convention on Climate Change. It seeks to mobilise funds from industrial countries that can be paid out to poorer developing nations for climate damage and mitigation or adaptation projects.

Many of the First World countries have accepted that they have a responsibility to contribute to this fund – mainly because of high levels of emission in the past that have contributed to climate change that affects poor countries. Manuel says that there is "still some reticence" about handing over the money.

The transitional committee is responsible for designing the governance arrangements of the fund, then for mobilising resources and establishing the modalities of spending these resources. The World Bank will be the trustee of the Green Climate Fund for the first three years.

The Green Climate Fund is supposed to be fully operational when the 17th Conference of Parties is held in Durban this December.

The fund is expected to generate $100-billion a year for climate financing by 2020 and it was supposed to have set aside $30-billion for use between 2010 and 2012. No money has yet been paid to the fund. Manuel also says that what will happen between 2013 and 2020 must still be resolved.

Christiana Figueres, chief of the United National Climate division, says that it is critical that the fund be operational by the time that delegates meet in Durban in December. She has urged the fund managers to produce a framework that will lead to a flood of additional financing for climate change initiatives throughout the world.

The fund will be governed by the Green Climate Board, comprising 24 members as well as alternate members, with an equal number of members from developing and developed countries.

BP sues all 'accountable'

It was bound to happen: BP has sued Transocean for $40-billion over the catastrophic oil spill that occurred in the Gulf of Mexico last year. Transocean owns the Deepwater Horizon Rig. It has also sued the Cameron International Corporation for negligence, saying the blowout preventer made by the company failed to avert the catastrophe.

Clearly BP thinks that someone else should be blamed for the mess that was made in the Gulf of Mexico last year. Both complaints have been filed with the courts in New Orleans.

When the Deepwater Horizon rig exploded last year, eleven people were killed and soon after, vast quantities of oil started leaking into the Gulf until, eventually, a total of 4,9-million barrels or 1-billion litres of oil had flowed from the subsurface well. BP incurred tens of billions of dollars in liabilities as a result of the failures.

BP has now accused Transocean of negligence saying that its rig was not seaworthy. BP says that it is "a simple fact" that every single safety system and device on the Deepwater Horizon failed, resulting in the casualties and deaths.

Transocean has responded to BP's lawsuit saying that it represents "a desperate bid" by the company to renege on the existing contract that makes BP assume full responsibility for the pollution and environmental costs.

In a separate action, BP has asked US District Court Judge, Carl Barbier, who oversees national litigation over the spill, to order Houston-based Cameron to reimburse BP for "all or part" of its damages because the blowout preventer it made failed to function in the way it was designed to and it also failed to perform.

This, says BP, is evidence that the "design was flawed" and that alternative designs did exist that did not have similar flaws.

BP has set aside $41-billion in charges that it expects to incur as a result of the spill and has so far spent $17,7-billion on its clean-up operations. BP says it wants to make sure that all parties involved in the Macondo well are "held appropriately accountable" for their roles in the Deepwater Horizon accident in April last year.

PneuDrive Challenge 2011
Roadshows in full swing

Roadshows to the Universities of Cape Town, Stellenbosch, Nelson Mandela Metropolitan and Johannesburg, and to the Cape Peninsula Technikon have been completed with great success.

Over 500 students attended the events and were introduced to the SEW Eurodrive and Festo product ranges and presented with the latest technology from the two companies; the Movigear from SEW Eurodrive and the CMAX from Festo. These products have been earmarked for bonus points in the competition.

The Movigear is the first mechatronic drive from SEW Eurodrive and incorporates a servo motor, gearbox and frequency inverter in one hygienic design. It is often used in the food and beverage industry and recently an installation of this product at a Coca-Cola plant in Vienna proved its worth when calculations showed a 75% reduction in energy costs after 40 of these units had been installed.

The CMAX from Festo is a servo pneumatic controller and extends the automation platform with intelligent drive technology. The drive provides more freedom in controlling positioning systems by communicating via fieldbus. Position and force control are possible with this unit. The competition is jointly sponsored by SEW Eurodrive and Festo, both well known for their innovative motion control solutions. The competition has been endorsed by SAIMechE and SAIEE.

More information on the competition can be found at www.pneudrive.co.za. The PneuDrive Challenge can also be followed on social networking websites, Facebook and Twitter.

Entries for the competition close on 15 October 2011. Universities that would like to participate are welcome to contact the PneuDrive team on info@pneudrive.co.za or vrrose@sew.co.za.

THE PAPER BOOK
– more bells toll for its demise

PricewaterhouseCoopers (PwC) says that publishers, content owners and retailers must act quickly to secure positions in the eBook and eReader markets or risk losing out on a major new industry.

In its report entitled Turning the Page: The Future of eBooks, PwC says that publishers, bookstores and companies that make eReaders have high expectations for the future of digital books, magazines and newspapers. The technology not only opens a number of new target markets but allows a whole new customer base to develop. Publishers of traditional books and magazines maintain that the industry would not be able to retain control over pricing and content – citing the music industry as an example.

Vicki Myburgh, South African entertainment and media industry leader for PwC says that the digital publishing industry appears to be reaching critical mass.

"Media coverage and extensive reports on eBooks and eReaders have given most consumers a basic understanding of the digital technologies being used. However, they don't understand the concepts behind digital publishing and the advantage of reading digital books over paper ones," Myburgh says.

She points out that the discussion around the viability and success of eBooks – and now eMagazines and eNewspapers – is not new but in recent times these discussions have focused on whether eBooks would overtake sales of printed books.

"The progress of the digital publishing industry is moving quite significantly as technical development and sophistication of reading devices produces an experience that it similar to that of reading a printed book," she says.

She has urged all publishers, bookstores and device managers to exploit the opportunities that exist and provide the market with innovative new products and warns that if these organisations fail to do so they will be forced out of the publishing market altogether.

Based on the PwC survey, eBooks and printed books will co-exist for some time. However, Myburgh points out that while consumers still prefer to hold a book and turn the pages, this appears to be an insignificant factor.

She says that tablet computers will ensure that newspapers, periodicals and magazines can be displayed in digital form and can be purchased as part of a subscription thanks to the integrated Internet access offered by these devices.

BANG, BANG, BLING - here's your DIAMOND

A Canadian company, EnviroDiamond Technologies (ETI) has succeeded in making a diamond from carbon dioxide – something that many scientists thought would be impossible to achieve. According to Daren Swanson, president of ETI, the company had been working on this project for the past three years.

It is achieved using what is called cold detonation physics or CDP and consists of mixing dry ice, or frozen carbon dioxide, with other ingredients to make it explosive. This chilly -78,5°C mixture is packed into a steel pipe and then detonated.

The explosion results in a diamond.

Five such tests have recently been conducted in Beijing and the by-product analysis done by Queen's University in the UK clearly shows that ETI's technology produces a nano-diamond.

Extremely fine-grained diamond materials are widely used in various industries ranging from coating tools and drill bits to polishing methods. Creating nano-diamonds from carbon dioxide may prove the least expensive way to make synthetic diamonds and is seen as being considerably more environmentally friendly.

Moreover, carbon dioxide is now being used to make a diamond explosive that detonates at extremely low temperatures, reducing the risks of methane or coal dust explosions underground.

ETI says that its next step is to develop a strategic partnership with a company that can assist it in commercialising the diamonds.

Land Rover's all electric Defender

An electric version of the renowned Land Rover is being developed and will provide an alternative game viewing vehicle for safari parks and national parks around the world. The electrically powered Defender is a concept vehicle that combines Land Rover off-road capabilities with an electrical power train.

The concept vehicle has been developed by Land Rover South Africa. It has already been demonstrated to tour operators who were at the Indaba 2011 show, held in Durban in May. The electric version was built by Barker Performance Products with technical support from Land Rover's product specialists.

The vehicle has zero emissions and is virtually silent, allowing the driver to sneak-up on animals and get really close to them without startling them. According to Kevin Flynn, managing director of the company's sub-Saharan operation, the vehicle was developed in response to a request from Londolozi, one of South Africa's premier game parks.

Flynn says that Londolozi wanted to use ecologically-sensitive vehicles in its operations. Land Rover researched the concept and then appointed Axeon, one of Europe's leading battery systems specialists to design the lithium-ion system used in the Electric Defender. The electrical system incorporates an air-cooled ac induction motor linked to the 300V 27/kWh lithium ion battery pack. The entire system fits into the vehicle's existing engine bay to maintain the vehicle's high ground clearance.

The electric motor produces 59kW of power with regenerative capacity of 10kW. It has 330Nm of torque, which enhances its already impressive off-road ability from its permanent four-wheel-drive system. Differential locks on the front wheels are included. On a single charge the Defender claims to have a range of 80km with 20km in reserve, sufficient for a game drive lasting up to about eight hours or roughly three times the length of an average tour in the Londolozi park. Recharging is done using the single-phase charger connected to a standard electrical outlet. The Defender offers a solar charging unit as well.

CPD

CPD Overview

WATTnow, in conjunction with the SAIEE, launched this programme for engineers who need to meet their professional development commitment by acquiring Continuing Professional Development (CPD) credits in Category One (10). In terms of the renewal of registration requirements, all registered professional electrical engineers, technologists and technicians must earn CPD credits so that after five years they have acquired at least a total 25 CPD credits in all categories and at least five credits in Category One (1). The **WATTnow** CPD Programme provides a convenient and cost-effective way for engineers to acquire the Category One (1) CPD Credits. Failure to certify CPD credits could jeopardise renewal of their registration (CPD credits in the other Categories Two (2) and Three (3) must be acquired by other means – see the ECSA Rules on this aspect).

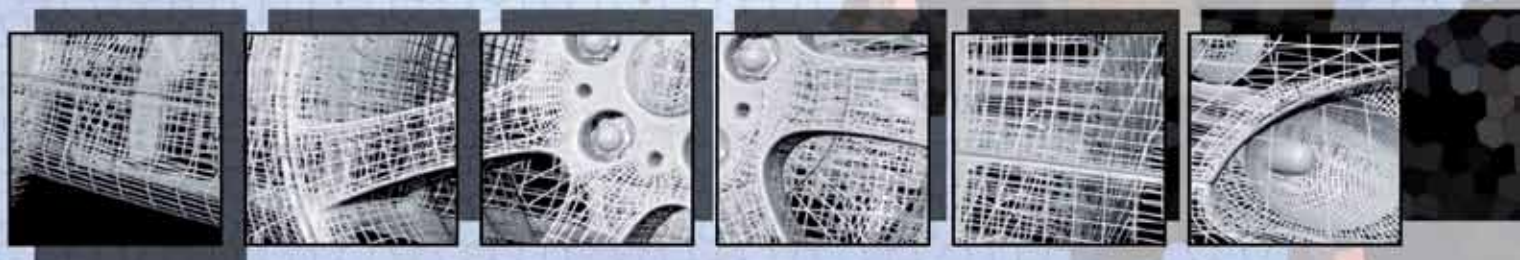
WATTnow publishes CPD articles in each issue that entitle subscribers to the scheme to claim for Category One (1) CPD credits. The programme requires engineers to respond to set questions posed on articles that are specially designed and validated to provide CPD credits. Engineers using the programme can accumulate 0.1 CPD credits per month if all the questions are answered correctly. **WATTnow** is published monthly so a total of 1.0 CPD credits can be acquired annually by this method. The articles and questions set are independently validated and reviewed by the SAIEE to which Validation numbers are allocated and should be recorded by subscribers.

Each year, **WATTnow** will supply a series of DVDs of lectures/conferences on topics that have been validated for CPD by the SAIEE. These DVDs can be ordered via the **WATTnow** website by subscribers to the CPD Programme.

Questions relating to the DVDs will be available on the **WATTnow** website and members of the programme can submit their answers online. Correctly answering the questions on the presentations in the DVD will entitle the subscriber to claim credits in Category One (1). These credits are in addition to the credits acquired by answering the questions to the CPD articles.

The SAIEE will provide subscribers with a certificate that records the exact number of credits gained for his or her records.

The **WATTnow** CPD Programme is based on a subscription service that will cost non-members of the SAIEE R2 400 a year while members of the Institute will pay an annual subscription fee of R1 000. The programme offers all members of the **WATTnow** CPD Programme a one-stop-shop to participate in and comply with the professional development criteria laid down by ECSA and ensure that all professional engineers can maintain their status without having to search around and pay significantly more to attend CPD courses or conferences in order to acquire sufficient credits for Category One (1) to meet the ECSA requirements.



For further information visit www.wattnow.co.za

Australia embarks on its battlespace system

Australia is to go ahead with plans to build a battlespace communications system and modernise its military's personnel system according to the Minister of Defence, Stephen Smith. The projects are expected to cost at least $1-billion by the time they are completed.

The first project is the Joint Project 2072 Phase 2B for a battlespace communications system on land. It is aimed at providing the military with a new next-generation telecommunications network that allows for the transmission of information over a range of wired and wireless networking systems that include radios, satellites and computer servers and terminals. The Joint Project 2072 Phase 2B's costs are capped at between $100-million and $500-million and a final decision to complete the project will be made in the 2012-13 financial year. It will enable army and air force elements to replace aging mobile communications infrastructure and provide commanders with increased levels of command and control.

It will also improve situational awareness and information sharing capabilities for the army and air force. The Department of Defence has been given the go-ahead to complete an assessment of the costs and risks of this project. The Defence Personnel Systems Modernisation project is aimed at providing a single, unified human resources and payroll system and to improve all aspects of administration, career management, education and training, and workforce planning. This project has its costs capped at $500-million

Skills shortage hurts **BRICS** and **SADC**

The shortage of skilled workers is a significant constraint for business growth in Brazil, Russia, India, China and South Africa, all member states of the Brics group of emerging market economies. About 42% of businesses in those countries complain that a shortage of skills prevents them from expanding, according to Grant Thornton's 2011 International Business Report.

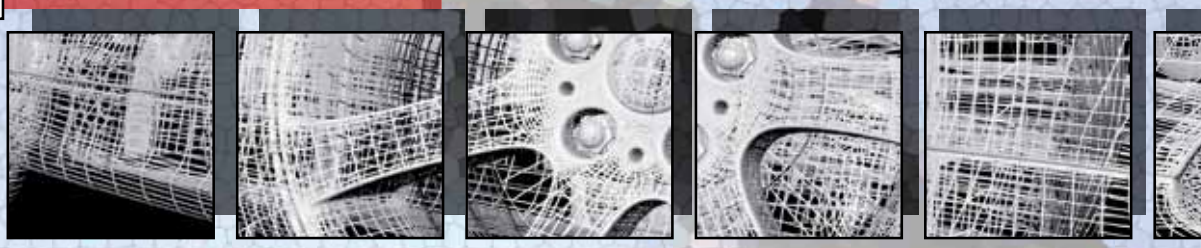
The research shows that business owners in the Brics region had all reported difficulties in sourcing sufficiently skilled and experienced individuals for their rapidly growing economies and India is the most affected by the shortage, particularly in technology.

Meanwhile the Industrial Development Corporation in South Africa has said that it has put aside R100-billion in total investment over the next five years so that more jobs can be created in South Africa. It says that emphasis is on the agro-processing industry that will stimulate job creation. IDC chief executive, Geoffrey Qhena said that between 15% and 25% of its industrial spend will be directed to other parts of Africa although the main thrust of the IDC's investment will remain in the countries that are members of the Southern Africa Development Community.

He says that the SADC members will be the first beneficiaries of any investments made by the IDC and that the job creation measures were not restricted to South Africa but focused on the region as a whole. He said that it was important to realise that there must be an alignment of policy in the different countries so that the investments made were not undermined by other circumstances. He emphasised that partnerships between government and private companies were urgently needed to stimulate growth and investment in the SADC regions.

Referring to the Industrial Policy Action Plan implemented two years ago, Qhena said that South Africa had made substantial progress since then and has now embarked on the New Growth Plan of Economic Development that provides greater clarity on those areas that would produce the fastest job-creating growth for the country and the region. He said that the IDC was involved not only in providing funding to projects in the SADC region but also in planning these projects and ensuring that once completed, they will be fully functional and sustainable. He referred to the fact that several countries in the SADC had access to minerals but had no way of beneficiating these minerals because of technology shortages and a lack of knowledge and skills. He said the IDC would partner with these countries to provide the skills and technology necessary to overcome these hurdles.

Enrol for the WATTnow CPD programme



1. Monthly articles, published in **WATTnow** and validated by the SAIEE CPD provide credits for Category One (1) by answering appropriate questions.

2. A series of DVD recordings of lectures/conferences held throughout South Africa also provide CPD credits by answering appropriate questions.

4. A simple, quick and efficient online answering system via the **WATTnow** website for subscribers to submit answers to CPD questions makes this method of acquiring credits easy and convenient.

5. A complete administrative system to ensure that credits acquired are correctly recorded and available to all subscribers.

6. Subscribers to the **WATTnow** CPD Programme receive an annual certificate from the SAIEE detailing credits obtained in a calendar year.

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Note: Voluntary associations registered with ECSA can apply to the SAIEE to allow their members to gain credits at the reduced rate.

Research shines light on magnetic effects

The unexpected magnetic effects of light could be used to make solar power cells that do not use semiconductors. The findings could effectively lead to the manufacture of an 'optical battery' according to Michigan University researcher, Stephen Rand.

He says the findings fly in the face of long-held beliefs about physics and the properties of light. Rand says that light has electric and magnetic components but, until now, scientists believed that the effects of its magnetic field were so weak they could be ignored.

The team discovered that at the right intensity, when light is travelling through a material that does not conduct electricity, it can generate magnetic effects that are 100-million times stronger than previously thought.

He says that scientists have repeatedly been taught that light does not have any significant magnetic effects and this is why, he says, it has been overlooked for more than 100 years.

Rand says that the findings could lead to the development of a new kind of solar cell without semiconductors and without absorption to produce charge separation. He says in solar cells the light goes into a material, gets absorbed and creates heat.

He says that instead of light being absorbed, energy is stored in the 'magnetic moment' and then intense magnetisation can be induced using intense light and this means that light is capable of providing a capacitive power source.

According to William Fisher, a doctoral student in applied physics at the university, a previously undetected brand of optical rectification is what makes this possible. In traditional optical rectification, light's electrical field causes a pulling apart of the positive and negative charges in the material, which sets up a voltage similar to that found in a battery.

This electric effect, says Fisher, was previously detected only in crystalline materials that possessed a certain symmetry, but he found that light's own magnetic field can create optical rectification in other types of materials and under the right circumstances.

Fisher says the light must be focused through non-conductive material at an intensity of 10-million W/cm^2, which is much higher than the sun's intensity of 0,136 W/cm^2. He says that the team is now looking for new materials that will work at lower intensities.

Jo'burg to be wired

From the end of next year Jo'burg is promising that its residents will have faster and better Internet access than anyone else in South Africa. Moreover, it says that these services will be offered at reduced costs to ensure affordability.

The project is a joint venture between the city and Ericsson. The BWired venture has already laid more than 300km of fibre-optic cable around Johannesburg at a cost of R250-million. BWired is building, managing and operating the network under a 15-year licence agreement. At the end of 15 years it will revert to the municipality.

According to BWired's chief executive, Musa Nkosi, a further R600-million will be invested to put in a total of 640km of fibre-optic cable. He says this city-wide broadband network will increase the availability and accessibility of telecommunications, cutting the council's communications costs.

The network will have a capacity of 1,2 Terabits-per-second (Tbps). This will mean that BWired will be able to offer cheaper telephone calls and Internet access to local businesses. Nkosi says that he believes this will stimulate the number of Internet cafes and Wi-Fi access points being offered by businesses within the city's boundaries.

The fibre-optic network will enable transportation of any kind of data, voice or video material and will even allow for the future implementation of Internet television services. Fibre to the home is also in the offing but details are sketchy at this stage.

Nkosi says that the nine core rings around the city have been completed to link Soweto in the south to Midrand in the north. The first 100 buildings to have access to fibre-optic cables will be completed by the end of May.

BWired will not be making services available to the general public or directly to businesses. Instead it will sell its network access to businesses and they will then sell the service to consumers. BWired has network operation centres in Woodmead and in Jo'burg's city centre.

Watt Says

Good day Paddy.

Thank you once again for a most interesting mix of engineering topics in the March 2011 magazine.

I don't believe I have seen any unjustified criticism of policy makers in your editorials that I can remember.

I agree with Mr Munnings regarding PV Energy but would include Solar water heating as being a good source of energy in Africa too, if the prices of both dropped by about 70%. Wood burning is to be discouraged as nine tenths of Africa's deforestation is because everyone thinks the problem belongs to someone else and rehabilitation never takes place without strict legislation.

On another tack it is interesting to note that I am not the only person wondering why the CPD programme is so expensive as to exclude many prospective candidates, especially individuals responsible for their own costs.

Once again thanks for your good work.

Yours Sincerely
Godfrey Kerr
Engineering Technician
SAIEE Snr Member

Dear Paddy,

Sincere congratulations on your splendid selection of articles each month. Your magazine reads like an exciting adventure novel! Where on earth do you get such up-to-date scientific and engineering developments?

Also, thank you for the very positive Editorial in the March 2011 issue: Praise for the weather lads and scientists, and the R200 million development on Marion Island. Have you any more fascinating positive 'goings on' up your sleeve? If so, please let's 'ave 'em!

Ciao
HOWARD DAVIES Pr.Eng.

PS: I think that Free Energy from the Vacuum will soon burst forth from Grass Roots Level (in spite of the Oil and Electricity Institutions). Just type in 'The Latest on Free Energy from the Vacuum' on Google and you will see what I mean (there are about 4,760,000 results at last count ... and pages of fascinating links).

Hi Paddy

I would like to take this opportunity to discuss two points of interest:

Minimum Wage Legislation

I consider Walter E Williams' article, 'The minimum wage and minority employment opportunities: the real impact of government-mandated programs' (originally published in the National Federation of Independent Business, Washington, DC) to be the best article I have ever read on the dangers of minimum wage legislation.

What is significant is that no matter at what level such wages be set, some people will always be unemployable because their productivity does not contribute to making any profit and the higher the minimum wage, the more unemployment will be created.

An article such as this should be made compulsory study for any Cabinet Minister or Trade Union leader.

Workers, however, can hardly be blamed for striking for higher wages when they see the obscenely huge salaries and bonuses paid to certain bankers and political leaders.

Apprenticeships

I noted with interest your two articles in recent months referring to the need for proper apprenticeship training. What concerns me is that I did not notice any reaction to your articles; it is as if apprenticeship has become a dirty word.

Having started an Indentured Apprenticeship in December 1942 (middle of WW1), I had not been to Tech. and had to sign for five years.

However, I had the privilege of observing the vital contribution of artisans of all trades in maintaining and developing the steelworks and other industries. This contribution was considered so vital that General Smuts appointed a controller of manpower to manage the movement of artisans, to prevent vital industries losing key personnel.

During those years, we had to attend night school after work and had some excellent part time lecturers drawn from practising engineers and technicians. A pass mark of 50% was required in all subjects. This led to further studies and eventually to professional registration.

Most of the artisans trained in those days have retired and most of the properly trained artisans who followed are on the verge of retirement, after which there will only be semi-skilled artisans to train newcomers to the workforce.

I strongly endorse your plea for the return of proper apprenticeship training.

Regards,
Llewellyn Hunt

To contact our Editor at WATTnow Magazine with your comments, please email Paddy on paddyh@crown.co.za

SAIEE AGM

Andries Tshabalala congratulated Mike Cary (above) and Paul van Niekerk on their election as Deputy President and Vice President respectively.

The South African Institute of Electrical Engineers recently held its Annual General Meeting at the SA Museum of Military History in Saxonwold, Johannesburg. The meeting was attended by Presidents of various sister Institutions, members and guests totalling 90 people. At the AGM, the new SAIEE President was inducted and he delivered his Presidential Address titled 'Engineering the Future Relevance of the SAIEE in our Contemporary Times'.

A vote of thanks was given by du Toit Grobler, Past President of the SAIEE, to the outgoing President Dr Angus Hay. He presented Dr Hay with a Past President's badge and certificate.

Dr Angus Hay retiring President presented Andries Tshabalala with the President's Badge as he was inducted as the 2011/2012 President.

Council Members

Thomas (Tom) Eichbaum

Chairperson KwaZulu-Natal Centre

Tom graduated with a B.Sc. Eng (Electrical) degree from the University of Natal (Durban) and is the General Manager Projects in the Industrial Solutions division of Siemens Limited.

During his tenure with Siemens Tom has spent 30 years in the electrical industry in various positions of Project Management, during which time he has completed numerous projects including *inter alia* Richards Bay Coal Terminal Phase 3, Alusaf Hillside Smelter High Voltage switch yard, Saldanha Steel Project, Orapa Diamond Mine, Moma Sands Project, etc.

Tom has served as a co-opted member of council of the SAIEE for three years and was elected to council in 2011. He has also served on the Electrical and Allied Industries Association for almost ten years including holding the positions of vice-chairman and chairman.

Over the years he has served on numerous committees of the SABS.

Tom is one of the industry representatives on the University of the Witwatersrand School of Electrical and Information Engineering Industrial Advisory Board of which he is currently the chairman.

In 2003, Tom completed his MBA co-branded by the Association of Professional Engineers, Scientists and Managers, Australia (APESMA) and La Trobe University Melbourne.

He is registered as a Professional Construction Project Manager in terms of Act 48 2000.

Viv Cohen

Council Member
Fellow

After more than 50 years in the Electrical industry, Viv Cohen in 'retirement' still consults as a Low Voltage Protection specialist. Moreover, he has also become involved in the training and conferencing circuit in South Africa, Southern Africa and Australia.

Viv Cohen was an active participating member of several IEC (International Electrotechnical Commission) Working Groups and Sub Committees. His involvement in Standards work, covering several decades, is the source of his wide experience and understanding of the operation and structure of these committees. He has represented South African interests internationally in his fields of expertise at the IEC. He also sits on numerous committees of the South African Bureau of Standards (SABS) and other professional organisations. His extensive international travels have brought him into close contact with experts in low voltage circuit protection from countries across the globe.

Viv is a Graduate of the University of the Witwatersrand. He is a Fellow of the South African Institute of Electrical Engineers (SAIEE), a Past Chairman of the Power Section of the SAIEE and is a member of the Council of the SAIEE.

He is the author of numerous technical papers as well as a book published by CBI and titled "Application guide for the protection of LV distribution systems". Viv Cohen was the designer and programmer of the original version of a computerised circuit breaker application software package known as (CBI)2. He holds several local and international patents and was the recipient of the 1980 Shell Design Award, the 1981 Telemecanique Design Award, the 2002 SABS Standards Development Award and more recently the SAIEE 2009 'Engineer of the year' award as well as the Electrical Contractor's Board 'Testimonial of Service' award. He is widely acknowledged as the foremost authority on Low Voltage Circuit Protection in Southern Africa.

Roland Hill

Council Member
Fellow

Roland manages a dynamic team of engineers creating Landis and Gyr's next generation of advanced and innovative multi-part prepayment metering products.

Prior to this, he developed the ECOLEC range of electricity meters at CBI-Electric.

He has worked for Marconi in the UK and lectured at Clemson University in the USA. He developed a head-up-display camera for a supersonic aircraft during his time with IST in Pretoria.

Roland participates in many voluntary associations and standardisation bodies. He is:

- The Southern African representative on the AFSEC management committee.
- An Exco member of the South African National Committee of the IEC.
- A Fellow and a Council member of the SAIEE.
- A member of the SAIEE's Technology & Knowledge Leadership committee.
- Chairman of the national IEC TC13 electricity metering, tariff and load control committee and TC13 liaison member on the national IEC TC57 committee.
- He represents the SAIEE on the SABS TC62 electricity metering committee and the SABS TC242 energy efficiency committee.

Roland has a Master's Degree in Electronics from the University of Natal.

Mike Carey

Deputy President

Mike Cary is an independent consultant having retired from Rotek Engineering in September last year after 15 years of service, nine of which were as Managing Director. Prior to Rotek, he was a Director and/or General Manager of ABB Powertech Transformers and of Alstom Transformers (now Actom), amongst other positions. He is also the Chairman of HiTech Transformers.

He has held various positions in industry such as being the Hon. Treasurer of the AMEU Affiliates, and Chairman of the Electrical Engineering and Associated Industries.

He became a member of the SAIEE in 1970 and a Fellow in 1996. He is currently the Deputy President and Hon. Treasurer of the Institute.

Forthcoming Events

The Technical Document Writing for Engineers course takes place in Johannesburg on the 8th and 9th of June and in Bloemfontein on the 14th and 15th of June, 2011.

This course is worth 2 CPD credits.

For further information contact :
Sue Moseley on 011 487 9047 (suem@saiee.org.za)
or Craig Smith on 011 487 9042 (craigs@saiee.org.za).

Calitzdorp power station

The small town of Calitzdorp lies on the main road between Oudtshoorn and Ladismith in the Little Karoo, and is famous for its award-winning local wines and port.

The old power station is equipped with one Lister-Blackstone ER3 3-cylinder diesel engine, producing 168HP at 750rpm, coupled to a 150kVA 400V alternator from Garbe-Lahmeyr, Aachen.

This engine is a later development of the type EV of the 1950s and it is interesting to compare it with the earlier model EPV3 at Ladismith, which is rated at only 120HP at 600rpm.

The plant is in good mechanical condition, but is no longer maintained and is not capable of being operated without restoration of supporting equipment, such as coolant and fuel supplies, and compressed air for the starting cycle.

The equipment is housed in the municipal electricity department's workshop building in central Calitzdorp, and includes the engine, alternator and associated switchboard. A more modern switch panel for the local distribution of Eskom power is accommodated in the same room.

This article forms part of a series, 'Early power stations in the Southern Cape' with text and pictures by Les Stuart.

CALL FOR NOMINATIONS

The SAIEE is calling for nominations for its three prestigious awards to be presented at the Annual Banquet on 14 October 2011. The Awards and their criteria are indicated below:

Criteria for the SAIEE President's Award:

The SAIEE President's Award is the SAIEE's premier annual award and recognises current major contributions in any sector of electrical, electronic, telecommunications and computer engineering. It is open to all living individual persons (members and non-members of the SAIEE). The award is not intended to recognise long or distinguished service, but current major engineering contributions.

Criteria for the Keith Plowden Young Achiever's Award:

The SAIEE has an annual award for the most outstanding young achiever of the year in the field of Electrical/electronic engineering.

Whether this person works in a large progressive company or organisation, or in a smaller dynamic one, is of no consequence – it is the spirits of achievement, creativity and leadership that count. These rare qualities must be recognised and nurtured wherever they are found. Innovative, entrepreneurial action plus an infectious enthusiasm to succeed are the qualities exhibited by young achievers.

Age: Up to and including 35 years of age during the stated calendar year of the award.

Eligibility: Open to all persons living in South Africa (Members and Non-Members) for current major contributions in the electrical electronic engineering field.

Criteria for the SAIEE Engineer of the Year Award:

A member of the SAIEE who has energetically and voluntarily worked towards promoting electrical science and its applications for the benefit of SAIEE members and the Southern African community through his or her involvement in Institute affairs is recognised and honoured through the above award.

Nomination forms are available from Gerda Geyer at geyerg@saiee.org.za

The closing date for nominations is 16 September 2011.

TELECOMMUNICATIONS RESEARCH GROUP

POWER LINE COMMUNICATIONS:
University of Johannesburg

Our Research Interests

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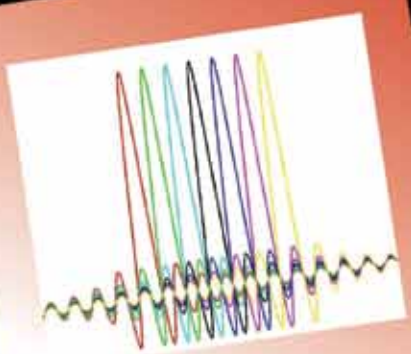
Coding Techniques
Information Theory
Video Communications
Networks



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Telecommunications Research Group
Electrical and Electronic Engineering Sciences
Faculty of Engineering and the Built Environment
University of Johannesburg
P.O. Box 524
Auckland Park
2006

Phone: +27 (0)11 559 2147
Fax: +27 (0)11 559 2357
E-mail: hcferreira@uj.ac.za
pvanren@wsu.ac.za
tgswart@postgrad.uj.ac.za
ktouahada@postgrad.uj.ac.za

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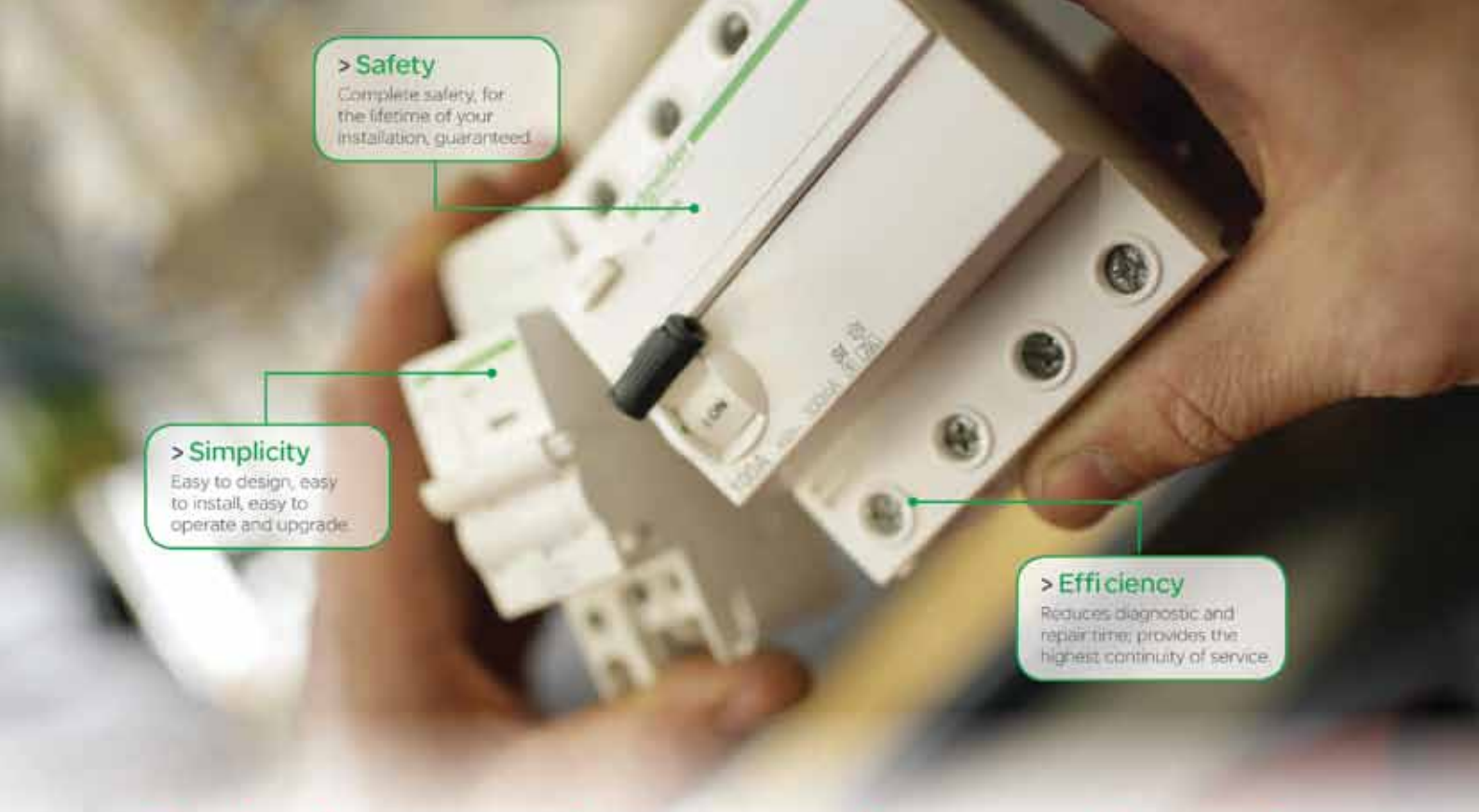

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