WATT now

Be Enlightened

Innovative glass

magnetricity, electricity's little sister

a practical approach to photovoltaic technology

vulnerable telecommunications

Official Magazine of SAIEE

February 2011


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How can I help
today's talents become
tomorrow's leaders?

Responsibilities of the modern engineer

For a number of unfathomable reasons, I find myself writing a comment for this edition of WattNow. Let it be said that the prospect is one that excites me – and one that will take me away (I suspect this is a good thing) from my current activity of quaking in my boots as I consider the number of youngsters entering first year to study in engineering and related programmes.

In preparation for writing this, I paged through some of the articles in this edition, and my mind drifted.

Why?

It is because I realise so thoroughly, as I read WattNow, just how broad the interests and responsibilities of the modern engineer are; and how broad the engineering team has become – in a manner of speaking.

I even found the word metamorphosis on the SAIEE page.

This got me to thinking about the SAIEE and electrical engineering *per se*, and I thought I would just throw out a point for debate.

A long time ago, in the days when we could still weigh current, we used to speak of Heavy and Light Current Engineers (oddly, a surprising number of HR professionals still use those scales ...). In our modern world we encounter Information Engineers, Electronics Engineers, Energy Engineers, Biomedical Engineers, Software Engineers – and numerous other species to boot.

All may be members of the SAIEE.

The SAIEE is the institute of Electrical Engineers. Heavy and Light Current engineers were still electrical engineers – and no one really argued much about it. I mean, we should not offend anyone, and should make all feel welcome, shouldn't we?

Yet, some famous and large institutes, and some not so famous and not so large, have decided to broaden their names to ensure that the weight of current is indeed accommodated ... and some to accommodate what may be perceived as ranks within the profession.

Others, of course, have done the opposite, and become very specific indeed: imagine the Institute of Electronic Engineers (strictly 5 V dc and lower, current limited to 100 mA), more commonly known as IEES5VDCCL100MA ...?

So the question is: has electrical engineering broadened to encompass a far wider range of sub-disciplines and specialities that should by necessity find themselves at home within a broader institute; or is the concept of electrical engineering pretty much redundant and focused specialisation has become the way to go?

Should there, indeed MUST there, be room for both?

As you think about this – and I do appreciate that the topic is not as straightforward as it may seem – recognise that there are many folk who strongly associate with very specific components of the profession and equally many others who will argue that application alone (of the same fundamental principles and theory) defines where you find yourself in the family of electrical engineering. And while you are at it, bear in mind that many folk can engage with you on this topic for many hours!

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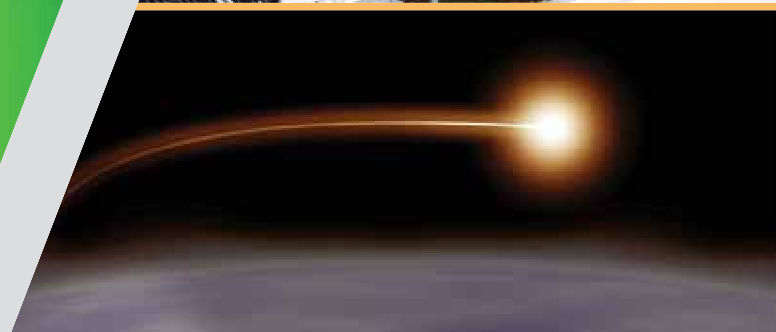

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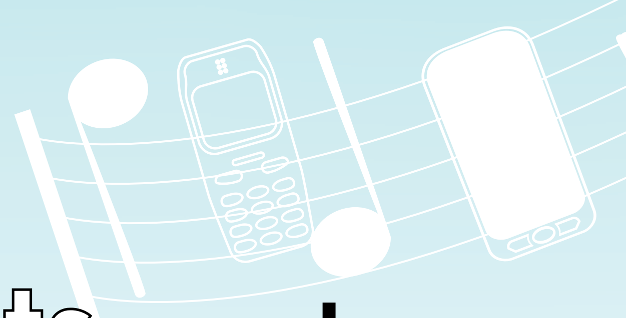


Even glass elephants can dance

By Gavin Chait

The annual Consumer Electronics Show (CES) in Las Vegas is known for its high-tech electronics and youthful start-ups shaking the world.

CES has been the launch-pad for the original video cassette recorder in 1970, the camcorder CD player in 1981, the Nintendo game system in 1985, Tetris in 1988 and DVDs in 1996. It's quite an illustrious place.

This year one of the most popular stands belonged to Corning. You know, Corning, the 150-year-old company famous for making Pyrex cookware? Except, while you weren't paying attention, glass has become one of the most sophisticated and innovative products in the tech industry.

Forget fibre-optics. Think booming smartphone sales. Corning's Gorilla Glass is becoming the standard for both capacitive and resistive touch screens and is behind the beautiful finish on Apple's iPhone.

Gorilla Glass is used in 150 different products on the market today - phones, tablets and laptop screens. Over 200 million devices with Gorilla Glass have sold and after just three years it has 20 percent of the phone market. In 2010, it sold $400 million of product and expects to double that in 2011.

Gorilla Glass' success will see it used in new flat-screen televisions and in cars. The glass' strength allows it to be thinner and lighter, making it optimal for super-sized televisions and low-weight, battery-powered electric cars.

Corning isn't even amongst the giants of the global glass-making fraternity. Asahi, the Japanese behemoth, has decided to enter the fray with its new Dragontrail glass and is hoping to have sales of $350 million by the end of 2012.

Traditional blown glass in a bazaar.

Glass-making, though, is old.

"The tradition is that a merchant ship laden with nitrum being moored at this place, the merchants were preparing their meal on the beach, and not having stones to prop up their pots, they used lumps of nitrum from the ship, which fused and mixed with the sands of the shore, and there flowed streams of a new translucent liquid, and thus was the origin of glass."

So wrote Pliny the Elder, in around 50 AD of glass-making, then already an industrial process more than 1 500 years old. Glass was the plastic of the Roman era, used in stately homes for windows and in making bottles and jars.

In around 100 AD, Jewish glass blowers in Alexandria discovered a process for creating clear glass by adding manganese oxide to the mix. Soon the most luxurious villas in Herculaneum and Pompeii were not considered complete unless they had the new clear glass windows. This glass still had poor optical qualities, being thick and cloudy due to the lower heat used in the processing.

In China, owing to the success of their porcelain-making industries, glass was comparatively undeveloped. This even had an impact on China as a seat of learning.

Euclid, who lived from 325 BC to 265 BC, developed some of the first mathematical theories of optics. "Things seen under a greater angle appear greater, and those under a lesser angle less, while those under equal angles appear equal," he wrote. Ibn al-Haytham, who lived near present-day Basra, Iraq in the 9th century, produced his Book of Optics, which was influential in much European optical development. Francis Bacon used glass spheres as magnifying lenses to help people to read. Salvino D'Armate, an Italian, developed the first wearable eye glasses in 1284.

From that moment the productive life-span of a scholar dramatically improved. Since this innovation relied on supreme glass-making skills it favoured European intellectual and cultural development.

The first windows were made from crown glass, a process in which glass was blown, then opened up and flattened onto a metal plate before being spun. You can still see such windows in old European houses where the panes look no different from the bottom of bottles. It was invented by the French in the 1320s. The process was improved by swinging the blown glass to create cylinders which were then cut open and rolled flat.

During this process of swinging, the glass at the distal end would become slightly thicker. Glaziers would place the panes into window-frames thicker-side down for stability and to prevent water pooling at the base. This has led to the misconception that glass is a liquid and 'flows' downwards over time. Glass is an amorphous solid, not a liquid.

As you can imagine, this glass had little in common with the glass now found in even the most modest of homes. That required a revolution in production.

Watt's Going On?

Between 1953 and 1957, Sir Alastair Pilkington and Kenneth Bickerstaff of the UK's Pilkington Brothers developed the first successful commercial application for forming a continuous ribbon of glass. The hot end includes a furnace for melting the batch-mixed sand, soda ash, dolomite, limestone, salt cake and cullet (waste glass), and also a bath of molten tin, the key to it all. The tin's density enables molten glass to 'float' on top of the molten metal. Once molten, the temperature of the glass is stabilised at approximately 1 200°C to ensure a homogeneous specific gravity. The heat is maintained by electrical elements from a carefully shielded control room. Constant supervision, and electricity availability is essential for, if the glass cools inside the furnace, it becomes extremely costly to restart operations.

As the glass spreads over the bath, it achieves an even thickness and flatness both top and bottom. The glass is drawn over the bath's surface in a continuous ribbon and along the way the temperature drops to a point where the glass can be lifted onto rollers. Next it progresses through a 'lehr,' an area in which it's 'annealed' to make it robust enough to survive further cooling.

In a modern float-glass plant, the cutting and processing of glass at the cold end is entirely automated. 'Cold' is relative here, the glass temperature is still at approximately 600°C.

The lehr exits the cold end onto a passage of rollers stretching for 100 metres to the point where cutters shear the glass into prescribed shapes. Meanwhile automatic scanners watch for distortion and unacceptable glass faults. These areas are eliminated and, at the same time, edges are trimmed. The best glass is reserved for applications where perfect optics are essential; such as automotive, architectural laminates and mirrors.

South Africa's most modern float glass plant is operated by PFG, owned by the Lubner family, and opened in 2007. It operates under the name SP4. Their first float glass operation, SP3, was launched in 1977, the first such line in Africa and, like all the others, encompassing a hot end and a cold end.

Elsewhere in the world, float lines are routinely limited to a narrow range of products and may run for months with minimal interruption. SP3 has been a jack of all trades. Though the bulk of its output has been earmarked for the construction industry, significant quantities have been reserved for value-adding applications like mirrors, vehicle glass and 'performance' products.

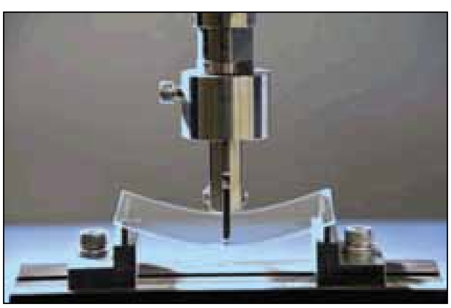
The launch of SP4 has reduced the pressure on SP3, and it's expected that SP4 will focus on producing glass with superior optics. That includes the glass used to make PG mirrors – a tradition stemming from the group's earliest days. To comply with international environmental standards, the plant has stopped using copper chemicals to sensitise the glass and instead applies a micro-coating of palladium chloride.

At the beginning of 2007, PG's 110th anniversary, the second float line was approaching completion. Roughly 55% of the money budgeted for the new project was being spent

Corning® Gorilla® Glass is a damage resistant cover glass which protects today's most sophisticated electronic devices from scratches, drops and bumps of every day use.

overseas, and equipment was being shipped to Springs in close to 880 containers. The first to arrive contained metal ingots, and nobody could figure out what they were for. Then it emerged that they were intended for a company in India, which instead received a container of Springs' refractories.

SP4 was designed with a length similar to SP3s but with greater width – four metres rather than 3.2. By March 2007 nearly everything was in place and the furnace was lit. A month later the line produced its first glass, marking the start of a new era.



Dragontrail glass under pressure. A 1 mm thick piece can withstand up to 60 kg of weight.

The new plant produces 24 kilometres of glass per day and the two lines together produce 250 000 tons of glass per year.

Before the launch of SP4 there were only two float lines in the whole of Africa. One was PG's main float line, SP3, and the other a Guardian line in Egypt. In the whole world there were just over 200, with nearly 100 of them in China. SP4 is only the eighth float line in the southern hemisphere.

Corning, though, has led the glass industry in innovation. Float glass is not sufficiently pure for the hi-tech applications required in electronic devices. As big screen televisions become larger, glass thickness, purity and distortion become more of an impediment, affecting weight and clarity. The same is true of ultra-light, super-slim mobile phones.

During experimentation, Corning scientists Stuart Dockerty and Clint Shay developed the fusion overflow process that is now used to produce their flat glass. In their method, molten glass flows down both sides of a tapered trough and rejoins, or fuses, at the bottom to form a single sheet of flawless glass.

In the 1980s, research labs working on active matrix liquid crystal displays (LCDs) found that ordinary glass was not precise, stable or durable enough to meet their requirements. Corning's 'fusion' glass fitted the bill perfectly. Bill Dumbaugh led an aggressive R&D effort to improve glass composition and refine the fusion process to supply the emerging LCD market with high-quality flat glass. The result was a lightweight, durable panel that aided the industry in making large, high-quality flat displays possible for televisions, computer monitors and other new applications.

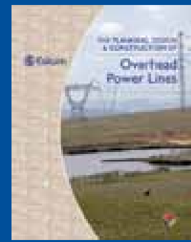
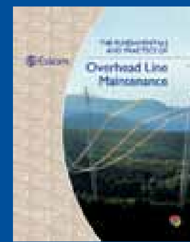
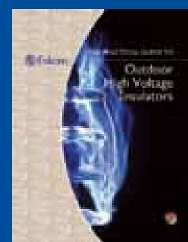
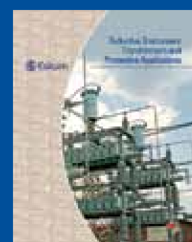
Float glass ranges in thickness from 0.55 mm to 19 mm. The nature of the process makes the thickness highly variable and line laser scanners are used to detect this variation and cut glass accordingly. Corning's fusion glass ranges from 0.5 mm to 2mm.

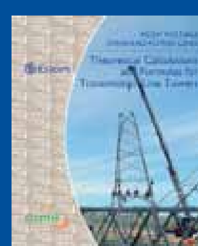
The glass is then chemically tempered. Standard soda glass is slightly porous. It is these imperfections that permit sufficient friction for glass to scratch and, more attractively, bubbles to form on the sides of your champagne or beer glass.

Tempered glass is immersed in a molten salt bath to induce ion exchange between sodium ions and larger potassium ions. This creates a thin layer, often only 0.1 mm thick, of the less porous surface. Corning has ensured that their layer is even thicker, this

To be launched at Africa Utility Week

14 March 2011 at Cape Town International Convention Centre

Volume 7

Eskom Power Series

This is a comprehensive reference book on the corona design and performance considerations of high voltage ac, dc and hybrid ac/dc transmission lines. While corona losses may have an impact on the economic choice of conductors, radio interference and audible noise are the principal environmental consequences of corona on ac and dc line conductors. In some cases the radio interference, because of its influence on power line carrier performance, can be an additional factor. The corona-generated space charge environment is also an important design consideration in the case of dc and hybrid ac/dc transmission lines.

Treatment of the physical, analytical and experimental aspects of corona performance of ac and dc transmission lines is presented in this book. Example calculations are included throughout in order to provide a better understanding of the analytical techniques presented and of the orders of magnitudes involved. Explanatory photographs, diagrams, tables and graphs complement the text. Development of criteria and methodologies for the corona design of ac and dc transmission lines and their application to typical cases are also described.

This book is a valuable resource for transmission line design engineers and for those involved in carrying out corona research studies as well as for developing university undergraduate and graduate courses.

For further information contact: Lauren Baird: +27 11 629 5452 or Sanjeev Bisnath: +27 11 629 5702

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creating the properties of Gorilla Glass. The annealing and tempering process allows the glass to be six times stronger than soda glass, which permits it to bend further under strain before shattering as well as to resist scratches. Asahi claims that a 1 mm thick piece of Dragontrail can withstand a 60 kg weight.

The pace of this development is accelerating other consumer production innovation. Sony's Bravia ZX1 LCD television is only 9.9 mm thick. These days that is considered terribly hefty. LG was also at CES 2011 with a 31 inch OLED television only 2.99 mm thick.

Also at CES was Toshiba who launched their 56 inch, glasses-free 3D television. This is another revolution in visual displays that will drive glass sales.

The pure technology companies, like Microsoft, Apple, Sony or LG take most of the public attention for technological innovation but it is important to remember that every component that goes into their devices is also subject to similar competitive forces.

If Apple wants to make a thinner, lighter device with higher graphics resolution then they put pressure on their memory, processor, plastics, screen and glass makers.

Entering the world of consumer electronics doesn't always mean designing a better iPad. Google and Motorola have teamed up to produce the Xoom which they hope will give Apple a bit of competition. However, neither of these giants could take on Apple without innovations in batteries, chargers and other more mundane components.

Good to know then that glass is as innovative and competitive as it has been in more than 3 000 years.

The ultra-thin LG OLED screen is only 2.99 mm thick.

World's computing capacity goes **MAD**

According to Rachel Ehrenberg of ScienceNews, a new assessment of the world's technological capacity from 1986 to 2007 confirms that the data deluge has long since washed over us—and presents some astounding data of its own.

Drawing on more than 1 000 sources including United Nations statistics, historical inventories and information from research firms, scientists from the University of Southern California in Los Angeles and Chilean researchers affiliated with the Open University of Catalonia, an online institution headquartered in Barcelona, assessed humankind's ability to communicate, store and transmit information.

Some of the numbers, reported online February 10 in Science, make perfect sense. The fraction of data that is stored digitally, for example, has risen from about 0.8 percent in 1986 to 94 percent in 2007.

What is also surprising is the types of devices doing the computing.

In 1986 computing was still largely the domain of the calculator, which crunched 41 percent of all computed instructions per second. By the year 2000, personal computers were doing 86 percent of such work. But by 2007 video game consoles were doing 25 percent of the world's computing. And cell phones are catching up, doing six percent of all computing in 2007.

Here are some figures that may floor anyone who remembers the floppy disk:

- In 2007 about 3.4 billion cell phones were in use globally versus 1.2 billion landline phones and 0.6 billion Internet subscriptions.
- In 2007, humankind sent 1.9 zettabytes (10^{21}) of information through broadcast technology such as televisions and GPS. That's equivalent to every person in the world reading 174 newspapers every day.
- General purpose computing capacity, which includes devices such as laptops (but not the dozens of microprocessors in the typical new car, for example) grew at an annual rate of 58 percent.
- The capacity for storing information grew from less than one CD-ROM per person in 1986 to almost 61 per person in 2007. The 2007 number equates to a stack 404 billion CDs, which would stretch beyond the moon.
- As recently as in 2000, digital storage made up a mere 25 percent of information memory. In 2002, digital surpassed analogue storage. By 2007, 52 percent of stored information was on digital media.

Of course, just because there's more information out there doesn't mean we are consuming it, says technology-management expert Roger Bohn of the University of California, San Diego.

"It's harder and harder to get more bits into the same brains and eyeballs that we've always had," Bohn says.

And Mother Nature still dwarfs computing power, notes economist Martin Hilbert, co-author of the work. "We still have many more stars in the universe than we have bits."

200 years to find a printed battery

By Gavin Chait

In 1936 an archaeological dig in the village of Khuyut Rabbou'a near Baghdad in Iraq uncovered a set of small terracotta pots. Each contained a copper cylinder and a single iron rod. They are thought to be from the Sassanid period, 224 – 640 AD.

In 1940, Wilhelm Konig, the then German director of the National Museum of Iraq, published a paper speculating that they may be galvanic cells. If true that would mean that the Baghdad Batteries, as they have come to be known, predate Alessandro Volta's 1800 invention of the electrochemical cell by more than a millennium.

Most archaeologists have discounted the theory but it is at least within the realms of possibility. In 2005, Discovery Channel's eponymous MythBusters set up a similar device and filled the pots with lemon juice. By connecting them in series they were able to produce a 4V potential drop. The MythBusters went on to show that the cells could perform a small amount of electroplating, produce a random pulse that could be used for acupuncture, or even – after wiring up an electric fence generator to a replica of the Ark of the Covenant – that a small electric shock would be administered to the faithful to cause real shock and awe amongst believers.

So, it was at least possible that electric devices were known almost 2 000 years ago. For the rest of us Volta's was the first electric battery. His original voltaic pile consisted of zinc and silver plates immersed in wine goblets filled with brine. Later he replaced the goblets with cardboard soaked in brine.

The word 'battery' dates even earlier to Benjamin Franklin, the US polymath, who in 1748 described multiple Leyden jars by analogy to a battery of cannons. These were capacitive batteries, storing static electricity between two electrodes on the inside and outside of a jar.

The science is complex but the practical implementation is so straightforward that toy shops around the world now sell DIY potato- or lemon-powered clocks and radios for kids to build. However, lemons aren't a very efficient electricity producer, requiring frequent lemon changes. When you factor in the costs of production and distribution, lemons are nowhere near the environmentally friendly or renewable energy source you may be looking for.

They also don't produce much power.

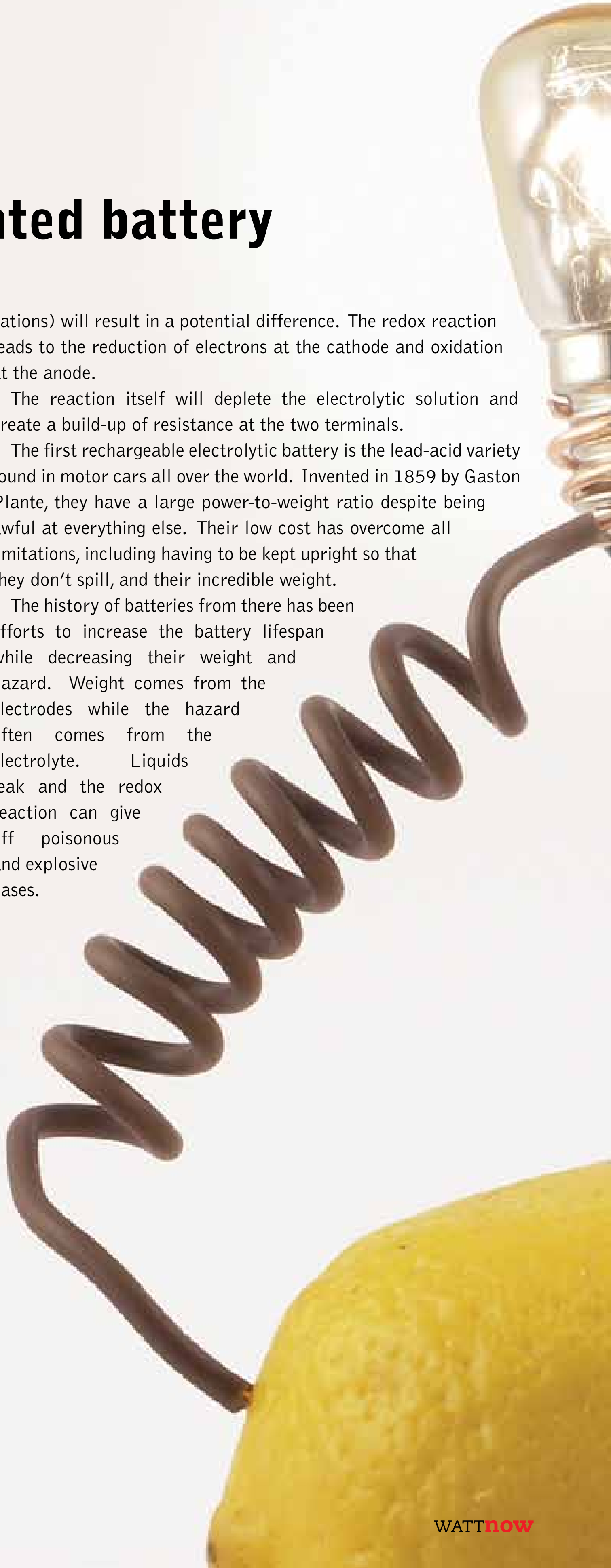
Batteries are useful for a number of reasons. They make energy portable and they permit the storage of energy for later use.

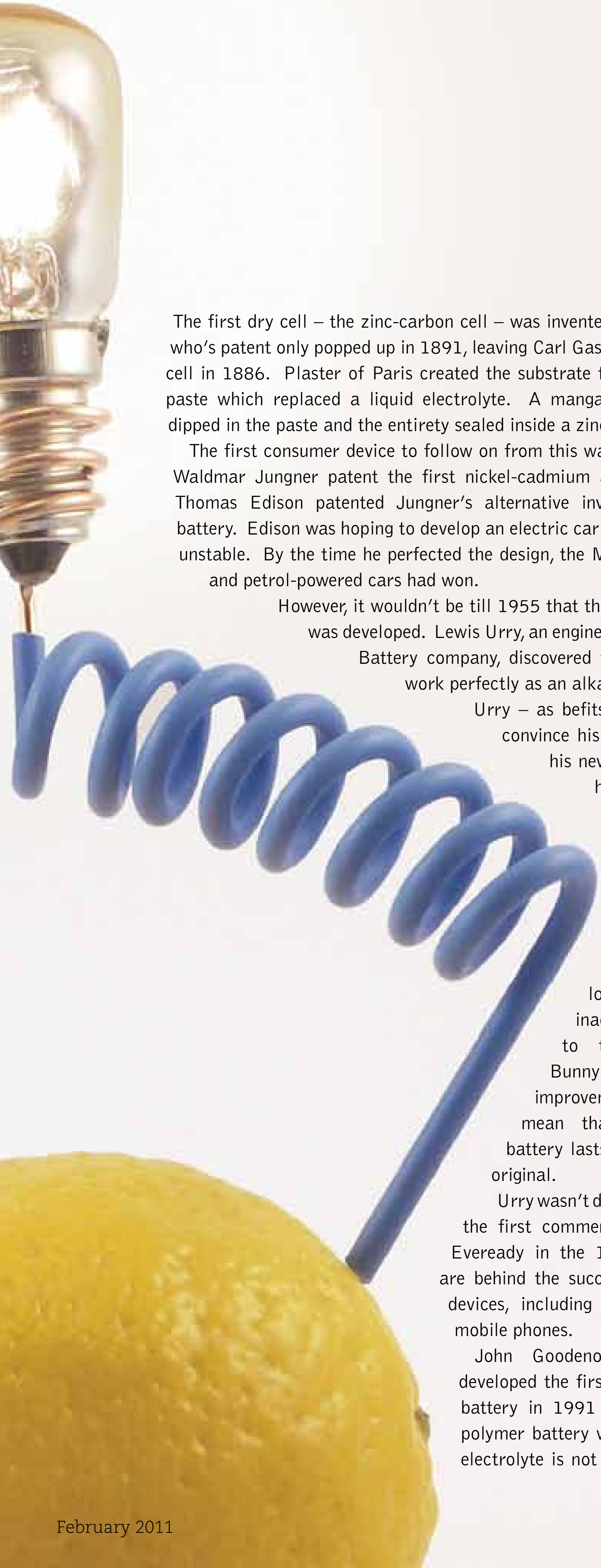
The principle behind battery operation was first articulated by Michael Faraday back in 1834: cations (positively charged ions) are attracted to a cathode, and anions (negatively charged ions) are attracted to an anode; two electrodes consisting of a cathode and an anode separated by an electrolytic medium (containing anions and cations) will result in a potential difference. The redox reaction leads to the reduction of electrons at the cathode and oxidation at the anode.

The reaction itself will deplete the electrolytic solution and create a build-up of resistance at the two terminals.

The first rechargeable electrolytic battery is the lead-acid variety found in motor cars all over the world. Invented in 1859 by Gaston Plante, they have a large power-to-weight ratio despite being awful at everything else. Their low cost has overcome all limitations, including having to be kept upright so that they don't spill, and their incredible weight.

The history of batteries from there has been efforts to increase the battery lifespan while decreasing their weight and hazard. Weight comes from the electrodes while the hazard often comes from the electrolyte. Liquids leak and the redox reaction can give off poisonous and explosive gases.





The first dry cell – the zinc-carbon cell – was invented by Sakizou Yai of Japan who's patent only popped up in 1891, leaving Carl Gassner clear to patent his dry cell in 1886. Plaster of Paris created the substrate for an ammonium chloride paste which replaced a liquid electrolyte. A manganese dioxide cathode was dipped in the paste and the entirety sealed inside a zinc shell to act as the anode.

The first consumer device to follow on from this was the flashlight. 1899 saw Waldmar Jungner patent the first nickel-cadmium alkaline battery. In 1903, Thomas Edison patented Jungner's alternative invention of the nickel-iron battery. Edison was hoping to develop an electric car but his initial designs were unstable. By the time he perfected the design, the Model T was on the market and petrol-powered cars had won.

However, it wouldn't be till 1955 that the common alkaline battery was developed. Lewis Urry, an engineer working at the Eveready Battery company, discovered that powdered zinc would work perfectly as an alkaline electrolyte.

Urry – as befits many tinkerers – had to convince his managers of the value of his new development. He placed his invention in a toy car and raced it around the company canteen against a similar vehicle fitted with the company's standard batteries. His prototype lasted significantly longer and he may also inadvertently have given life to the appalling Energizer Bunny adverts. Incremental improvements to Urry's design mean that the modern alkaline battery lasts 40 times longer than his original.

Urry wasn't done yet, going on to produce the first commercial lithium batteries for Eveready in the 1970s. Lithium batteries are behind the success of portable electronic devices, including notebook computers and mobile phones.

John Goodenough, working at Sony, developed the first lithium ion rechargeable battery in 1991 and the first lithium ion polymer battery was produced in 1996.The electrolyte is not held in an organic solvent but in a solid polymer composite such as polyethylene oxide or polyacrylonitrile. Lithium batteries have become the world's most popular since they produce more power for their weight than any other material. Gel-based batteries can also be shaped to fit a device, making their use more flexible.

Yet the process for manufacture is expensive. Almost half of a typical lithium-ion battery is derived from components which play little part in the battery's chemistry. This includes its casing and the permeable polymer separator, designed to keep the electrodes from touching each other and short-circuiting. Cut down on the materials, reduce the complexity of the manufacturing process, and batteries can be lighter and cheaper.

If the electrolyte can be solid then it can act as the necessary shielding and casing. Vacuum deposition allows atomic layers of electrolyte to be built up. Such batteries are small and expensive and so only suit specialist sensors. Yet such thin-film printing technology may be the future of battery technology.

Thin film electronic printing utilises all forms of industrial printing, from ink-jet, to screen printing, to nano-imprint lithography.

Gravure printing has been used to produce solar cells, reaching up to 10 000 square metres per hour. Such printing can also be used to produce organic semiconductors and semiconductor/dielectric interfaces in transistors.

There is already significant experience and development in mass-production of solid-state electronics using printing techniques. Producing batteries in this way is more about experimenting with the necessary 'inks' than in inventing a new industrial process. Developing these inks is complex. For printing, viscosity, surface tension and solid content must be tightly controlled. Cross-layer interactions such as wetting, adhesion and solubility as well as post-deposition drying procedures affect the outcome. Additives used in conventional printing inks are unavailable, because they often defeat electronic functionality.

Introducing Planar Energy, a spin-off of the National Renewable Energy Laboratories (NRAL) in Orlando, in the USA: Planar has developed a ceramic electrolyte which, it says, works as well as a gel. It prints this electrolyte, along with the electrodes, using a roll-to-roll process.

The firm has received $4 million from the Advanced Research Projects Agency and claims this will allow them to produce solid batteries that offer three times more storage than liquid lithium-ion batteries of the same size. "These batteries have many of the same attributes as thin-film batteries, but can be packaged in large formats," says Roland Pitts, a senior scientist at NREL.

Planar Energy is developing three different battery chemistries. One of them combines lithium manganese oxide with other ions, and operates at about three to five volts with a charge capacity of 200 milliamp hours per gram. Pitts says this compares favourably with lithium cobalt oxide, a high-energy, high-power battery chemistry currently on the market.

"The crucial trick is that although both the electrodes and the electrolyte appear solid, they are finely structured at the nanometre scale (a nanometre is a billionth of a metre). This is to allow the lithium ions free passage," says a profile on Planar in The Economist. "The 'inks' they use to print their battery cells are waterborne precursor chemicals that, when mixed and sprayed onto the substrate in appropriate (and proprietary) concentrations and conditions, react to form suitably nanostructured films. Once that has happened, the water simply evaporates and the desired electronic sandwich is left behind in a thousandth of the time that it would take to make it, using vacuum deposition."

The immediate opportunities for printed batteries lie in smartcards and RFID tags, which are already produced using printing techniques. At the moment they are passive devices and would benefit from having access to a small power supply.

As contactless payments and systems develop, such innovation is limited by the requirement for small, thin and flexible batteries.

A report by Nanomarkets even mentions an opportunity for 'smart bandages' to serve the needs of the US military.

Printed batteries, therefore, aren't only about creating the 1mm thick mobile phone. The creation of thin, cheap, long-lasting and light batteries will trigger a wave of innovation and product development.

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 that you have the time and interest to help mentees, please contact Ansie Smith on smitha@saiee.org.za or 011 487 9050,
In addition you gain CPD credits, for when you are required to re-register.

SDO Sundog mystery

NASA's Solar Dynamics Observatory (SDO), best known for cutting-edge images of the sun, has made a discovery on Earth.

"It's a new form of ice halo," says atmospheric optics expert Les Cowley of England. "We saw it for the first time at the launch of SDO—and it is teaching us new things about how shock waves interact with clouds."

Ice halos are rings and arcs of light that appear in the sky when sunlight shines through ice crystals in the air. A familiar example is the sundog—a rainbow-coloured splash often seen to the left or right of the morning sun. Sundogs are formed by plate-shaped ice crystals drifting down from the sky like leaves fluttering from trees.

Last year, SDO destroyed a sundog—and that's how the new halo was discovered. SDO lifted off from Cape Canaveral on February 11, 2010—just over a year ago. It was a beautiful morning with only a handful of wispy cirrus clouds criss-crossing the wintry-blue sky. As the countdown timer ticked to zero, a sundog formed over the launch pad.

"When the rocket penetrated the cirrus, shock waves rippled through the cloud and destroyed the alignment of the ice crystals," explains Cowley. "This extinguished the sundog."

The sundog's destruction was understood. The events that followed, however, were not. "A luminous column of white light appeared next to the Atlas V and followed the rocket up into the sky," says Cowley. "We'd never seen anything like it." Cowley and colleague Robert Greenler set to work figuring out what the mystery column was. Somehow, shock waves from the rocket must have scrambled the ice crystals to produce the 'rocket halo.' But how? Computer models of sunlight shining through ice crystals tilted in every possible direction failed to explain the SDO event.

Then came the epiphany: The crystals weren't randomly scrambled, Cowley and Greenler realised. On the contrary, the plate-shaped hexagons were organised by the shock waves as a dancing army of microscopic spinning tops.

Cowley explains their successful model: "The crystals are tilted between 8 and 12 degrees. Then they gyrate so that the main crystal axis describes a conical motion. Toy tops and gyroscopes do it. The earth does it once every 26 000 years. The motion is ordered and precise."

Bottom line:

Blasting a rocket through a cirrus cloud can produce a surprising degree of order. "This could be the start of a new research field—halo dynamics," he adds. The simulations show that the white column beside SDO was only a fraction of a larger oval that would have appeared if the crystals and shock waves had been more wide-ranging. "We'd love to see it again and more completely," says Cowley.

"If you get a once-in-a-lifetime opportunity to be at a rocket launch," he advises, "forget about the rocket - look out for halos."

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Photovoltaic (PV) technology, as a substitute for centrally generated electricity, is nearly as contentious as the global warming debate itself. Low power output, high costs per kWh and an unfavourable energy balance are well used arguments by detractors, but the use of PV cells is growing exponentially with an associated upsurge in the number of 'low-cost' products available at DIY stores. Peter Middleton takes a practical approach to unpacking the technology's usefulness.

PV - A DIY perspective

By Peter Middleton

I am generally driven to DIY projects (eventually) by a combination of 'domestic demand' and an inherent reluctance to spend money. My PV experience was no exception. It began with an 'order' for a string of coloured lights to illuminate our braai. I bought a length of cable, 10 screw-on bayonet sockets and 10 incandescent 60 W coloured light bulbs (coloured CFLs were rare at the time). I broke one fitting and was reduced to a string of nine lights, which I suspended outside and powered via an extension lead passed through the kitchen window. The job was signed off. This same string of lights has since been dismantled for use during camping trips and was a key feature of the Hogwarts atmosphere – with candle bulbs, obviously – for a Harry Potter party.

Now when you put nine 60 W bulbs onto a single string, you tend to become more aware of the power draw. A single light bulb can easily be dismissed as insignificant, but nine on a string add up, steering one towards the likes of compact fluorescents (CFLs). Secondly, though, it is a pain having to thread an extension through a window every time you want the lights switched on, so your mind moves towards expanding your distribution infrastructure – and the last time I had an electrician adding wiring to my distribution board, it cost me R1 800 for the equivalent of 3,0 m of extension lead without plugs or sockets. Hence the decision to boldly look into an autonomous PV solution. PV, I have long believed, is ideal for lighting and particularly well matched to CFLs.

A house with 20 CFLs, for example, would probably not need more than 10 switched on at any one time, for say 5-6 hours a night. At 12 W each, you only need consume 600-720 Wh per night to illuminate a home. Based on the very optimistic assumption of ten hours of sunshine per day, you might only need 72 W of PV panels.

But that aside, I love the idea of stealing some of the sun's energy to compensate for its absence at night. Google quickly led me to a Canadian website – not to my mind the sunniest place on Earth – and I downloaded a guide called 'An introduction to photovoltaic systems'. It describes three types of system, autonomous, hybrid and grid-connected. Skipping directly to autonomous, a simple systems diagram told me that such a system includes four interconnected elements, a PV array, a power conditioner, (an inverter?), a battery and household loads (my string of lights).

Also included, was a worksheet to help one size a PV system, presumably to suit Canadian sunshine. Step 1: calculate the total daily load by adding up the individual loads (10×11 W), dividing by an inverter efficiency factor (0,9) and multiplying by your intended daily use in hours (four?). So my total daily load came out at 484 Wh/d. Next, you calculate the battery capacity. Now I thought this would be a simple conversion from Wh/d to Ah, ie, 484/12, which comes to a nicely inexpensive 40 Ah. The recommended equation, however, multiplies the Wh/d by three (to give you a number of days storage) and then divides by a factor (0,42, derived from an assumed battery efficiency of 85% and a maximum depth of discharge of 50%). Using their equation, my battery capacity calculation evaluates to a very expensive 288 Ah.

The final sizing task on the worksheet is to estimate the capacity of the PV array: total daily load divided by peak sunlight hours and another efficiency factor (0,77). I went for nine hours of sunshine and came up with a 63,84 W requirement.

I then had a go at some approximate costing, which is not easy as it involves a whole lot of decisions about equipment that is not quite what you had in mind. One 60 W panel or two 30 W panels came to around R1 200. 'Solar' batteries come in all sizes, 12, 36, 85 and 105 Ah, but even for 36 Ah, it was going to cost over R1 000. The inverters, too, are priced across a very broad range, from R400 to R1 700 for units of between 150 and 600 W. A relatively random selection of 'lowest-cost' components took me to R2 800, which at 0,5 kWh/d of use and at the soon to be R1,00 electricity cost per kWh, gives a payback period of 4 800 days (of use), or 15,34 years of daily use – certainly not in cost effective territory, but not quite as bad as I imagined.

Then, while on the hunt for toys at a cash-and-carry, I stumbled on a PV section, offering matching solar panels, batteries and inverters, a 36 Ah TV battery at R263 and 10 W solar panels at R149 each. I decided to take the plunge and bought a battery and three panels. Inverters were also available at around R400, but I had already identified my redundant 600 W computer UPS for use as the inverter. I spent (including VAT) R509 on panels, R300 on the battery and R307 on nine coloured CFLs, each rated at 9,0 W.

It was relatively easy to mount the panels on the roof. I connected them up in parallel using connecting blocks and ran a cable off the roof to connect directly to the battery, as indicated on the brief set of instructions on the PV panel. I removed the small battery from the UPS and connected the TV-battery instead. I converted the UPS's computer power lead to a three pin extension socket and plugged in my string of lights. I had a working system up and running that same weekend.

The UPS has an automatic shut-off that initially triggered after about two and a half hours of use. The battery also had a charge indicator that turned white when discharged and green when charged. The solar panels seemed to be able to change the white to green in about three days. But a few weeks later, while boasting about this system over dinner one evening, I couldn't get the lights to stay on for longer than 10 minutes, even though the battery charge indicator was a healthy translucent green. I was straight back to threading the plug through the window.

The failure brought to mind two pieces of information that I

Six 10 W amorphous panels connected in parallel to give a theoretical 480 Wh from eight hours of sunshine. Actual power output of around 270 Wh was achieved, calculated based on recharging the battery after three hours of use.

A string of nine coloured lights illuminating an outside area, mostly 9,0 W CFLs but with some 12 W replacements. The actual total power draw is 87 W.

had selectively ignored: the advice about always using a deep cycle battery; and the existence of a piece of equipment called a solar charge controller to protect the battery from being overcharged by the PV panels. It seemed counter-intuitive to me that you have to limit the output of a 30 W system to prevent damage, but on the other hand, I felt irrationally proud of my three little panels for having the power to destroy the battery they were charging.

I first spent some time investigating the deep cycle battery, and was fortunate to stumble on the work of First National Battery and Louis Denner, who helped me to unravel the variety of deep-cycle battery options available. Amazingly, all efforts to make batteries last for more deep discharge cycles revolve around preventing a process called shedding, where, on discharge, the active material on the positive plates of lead acid batteries falls off, becoming inactive and therefore reducing the total battery capacity. Denner was able to explain how the different types of battery are built and their relative shedding resistance. My Silver Calcium TV battery uses plate-separator technology that makes it one step up on the 'deep-cycle' ladder, offering perhaps twice as many charge and discharge cycles as a normal car battery, ie, 60 cycles instead of 30. Denner recommended that I use a Raylite SMF100 for my system, a 102 Ah battery described as a 'solar storage battery' with a 'high cycling design'. The deep-cycling life is extended because of its 'high density active material formulation' and 'glass matt backed separators for active material retention'. Denner was also kind enough to arrange a test battery for me, immediately ending my search.

Then I turned my attention to the solar charge controller or intelligent charger. Do I need one? "Not always, but usually. A rough rule is that if the panel puts out about 2 watts or less for each 50 battery amp-hours, then you don't need one." OK, so I need one. I discovered that there were three types: simple shut off types that disconnect the solar panel when a certain voltage is reached; pulse width modulation (PWM) types, that control the charging voltage into the battery by pulsing the current flow on an off; and maximum power point tracking (MPPT) technology, the only technology that allows you to get full power out of a set of PV panels.

Based on minimum price, I found a local supplier of a Steca 6,0 A PWM charge controller for R258,00 plus VAT. Then, feeling bullish, I went out and bought another three solar panels to push the PV charging capacity up to 60 W.

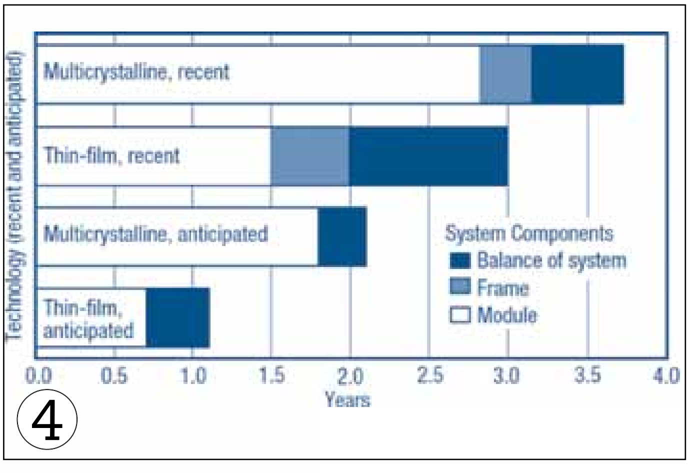
But before claiming a restoration of boasting rights, I decided I would do a few basic tests on the system. Firstly, I ran the lights for a timed three hours. At the end of that time, I switched off and measured the battery voltage at 24,5 V. Over the following days, I measured the battery voltage every night, but they were very wet days. My Steca charge controller showed a flashing fully charged light four days later, and I measured the battery voltage at 13,8 V.

That weekend, I ran the lights for a second three-hour period and again measured the battery voltage at 25,0 V just afterwards. The following Saturday was relatively (although not completely) sunny and I measured the battery voltage at 13,4 V that night. It was fully charged on the evening of the following day. My rough expectation was that three hours of lighting at 90-odd watts should be consuming 270 Wh of energy, which should be replaceable in 4h30 by a panel delivering 60 W. The real charging rate, albeit under not such sunny skies, is down at half of that or less.

Now I understand that the Steca charge controller is responsible for some of the losses, but I am still not at all sure of the true output of the solar panels themselves. What does the 10 W actually mean? Should I be getting 10 W all the time or does the output vary as the sun's intensity varies through the day?

My (very brief) panel specifications tell me that I am using amorphous silicon solar panels, and that thin film technology allows them to absorb a wider spectrum of natural light so they can therefore

The Steca PWM 6,0 A charge controller sits between the solar panels and the 102 Ah Raylite SMF100 battery. The battery is in turn connected directly to the inverter, which is actually a 600 VA computer UPS.



A comparison of the energy balance between modern multichrystaline and TFPV technologies.

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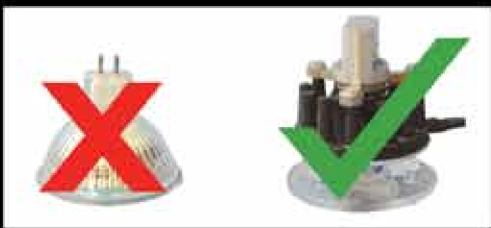

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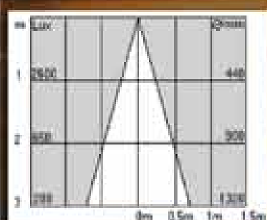

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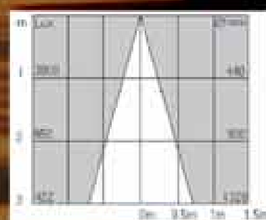
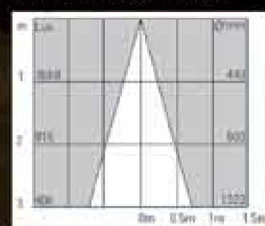
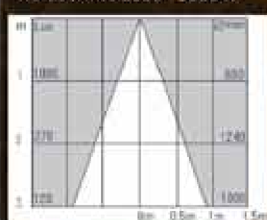


ARIII LED retrofit - source 3 x Cree or Osram LEDS - 700mA driving current
15 degree beam spread warm white 2800 - 3000 K



MR16 LED retrofit - source 3 x Cree or Osram LEDS - 350mA driving current
30 degree beam spread warm white 2800 - 3000 K



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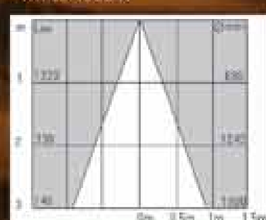

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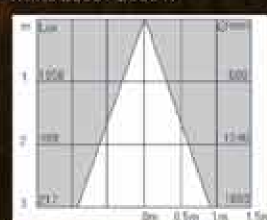
30 degree beam spread warm white 2800 - 3000 K



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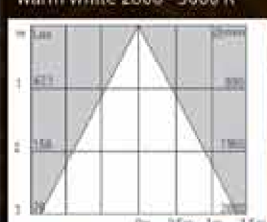
50 degree beam spread warm white 2800 - 3000 K



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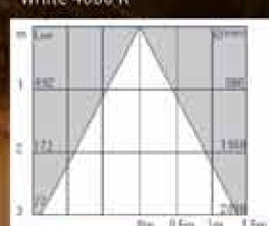
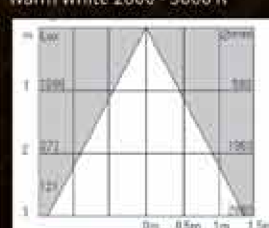
50 degree beam spread soft white 4000 K



ARIII LED retrofit - source 3 x Cree or Osram LEDS - 700mA driving current
50 degree beam spread warm white 2800 - 3000 K



For soft white 4 000 K, add 10% light levels.

work in cloudy conditions. So I should get 10 W all day? 'This technology also enables the solar panel to handle the intense heat of the summer sun. Its power loss due to high temperature is less than that of other types of solar panel', it reads in translated Chinese. But I am none the wiser about the output I should expect.

In my travels I was once warned against using any type of PV panel other than the original monocrystalline cells, also known as single-crystal PV (c-PV) cells. These are made by crystallising melted silicon into an ingot. The ingot is then cut into slices to make individual cells. While these are the most efficient (up to 18% for panels) they are also the most expensive to produce. The key argument in the warning was that the efficiency of thin-film panels decreases with time, while c-PV panels 'last forever'.

Between thin-film PV (TFPV) and c-PV options are two further technologies, polycrystalline, also known as multicrystalline (m-CV), and a variant, the ribbon-type PV cell. Polycrystalline cells are cut directly from a large piece of silicon rather than one large crystal. This block of silicon consists of several different crystals grown together in an ingot. They are slightly less efficient and less expensive than c-CV equivalents but the silicon used has a significantly lower cost. Ribbon type cells are made by growing a ribbon from the molten silicon rather than an ingot, and cutting it into individual cells. They are again slightly less expensive and slightly less efficient.

TFPV sits at the bottom of the efficiency ladder with panel (as opposed to cell) efficiencies usually quoted between 5 and 8%. These are made from various semiconductor materials including cadmium telluride (CdTe), copper indium gallium diselenide (CIGS), and amorphous silicon (a-Si). CIGS TFPV cell efficiencies are reported to be reaching almost 20% with actual module efficiencies between 10 and 13,5%.

The energy balance is the other often used argument against PV technology. The 'myth' put about by its most fervent detractors is that the energy balance is negative, ie, the total amount of energy consumed during manufacture exceeds the total amount of electrical energy a panel can generate in its lifetime. Most refute this and several comprehensive studies are available. All agree that PV panels use significant amounts of energy during manufacture but the energy pay-pack periods are pegged at between 1 and 4 years, depending on the technology. TFPV cells have the most favourable energy balance for two reasons, firstly because they use so much less purified silicon, up to 100 times less, and secondly, because they do not require the rigid (usually aluminium) frames required to prevent crystalline silicon wafers from bending and breaking.

So my TFPV panels, of semiconductor material unknown, may well be inefficient, but the technology is fast becoming the dominant one.

I am also deeply sceptical of the efficiency debate. I am not really sure you can talk about the inefficient use of the sunlight. After all, you are not really wasting the sunlight that you aren't using. I also don't mind using a bigger panel to get the output necessary, as long as the bigger panel isn't more expensive than the smaller one. The only measure that makes sense to me is the actual specific cost per (real) watt of output – and it seems that TFPV will emerge with the upper hand in that regard.

The total value of my system, ignoring the R300 ruined battery but adding in the R1 200 approximate cost of the test battery that I didn't have to buy, was R3 062, only R200 off my original thumbsuck. The estimated 15 year payback period, though, seemed to have doubled to 30-odd years, but if the average price of electricity over the next 15 years reaches R2,00/kWh, which is not unlikely, then that too will be restored.

But I am now defending my toy as if it were a real investment. The real advantage is that I no longer have to put a plug through my kitchen window to light up my braai – and during the next power cut, I shall gladly bring a lead from the outside in to power my TV.

Sibling for electricity

"Electricity has a new little sister: magnetricity," says Devin Powell in ScienceNews.

A team of physicists in England has created magnetic charges—isolated north and south magnetic poles—and induced them to flow in crystals no bigger than a centimetre across. These moving magnetic charges, which behave almost exactly like electrical charges flowing through batteries and biological systems, could one day be useful in developing 'magnetronic' devices — though what such devices would do is anybody's guess.

In magnets, poles always come in pairs. No matter how many times you cut a magnet in half, down to the atoms themselves, each piece will always have a north and a south—a dipole.

But the magnetic molecules that make up a crystalline material called spin ice are arranged in triangular pyramids that prevent them from lining up comfortably with all of their poles pointing in the same direction. In an awkward compromise, each pyramid tends to have two magnets pointing inward and two pointing outward.

In 2009 Steven Bramwell of the University College of London found that sometimes a molecule squirms and flips. Two poles, a north and a south, are born. The molecule itself stays put, but these ghostly poles, which aren't actually attached to a physical object, can move around independently of each other as chain reactions of flipping molecules carry them from pyramid to pyramid.

"Eventually they get so far apart that they lose all memory of each other," says Bramwell. "The dipole splits in half and becomes two monopoles."

Some scientists have questioned the use of the term monopole for a phenomenon that exists only inside spin ice. This term traditionally refers to cosmic monopoles thought to be created during the Big Bang and first theorised by Paul Dirac in 1931.

"A real monopole would be a magnetic charge that would exist in a vacuum," says Michael Bonitz, a physicist at the Institute for Theoretical Physics and Astrophysics in Kiel, Germany. "What they have is a complicated condensed matter system."

Within the confines of the spin ice, though, these wandering poles do behave much like monopoles. The poles have magnetic charge that closely agrees with theoretical predictions and interact with each other according to the same law that governs the interaction of electric charges, Coulomb's Law.

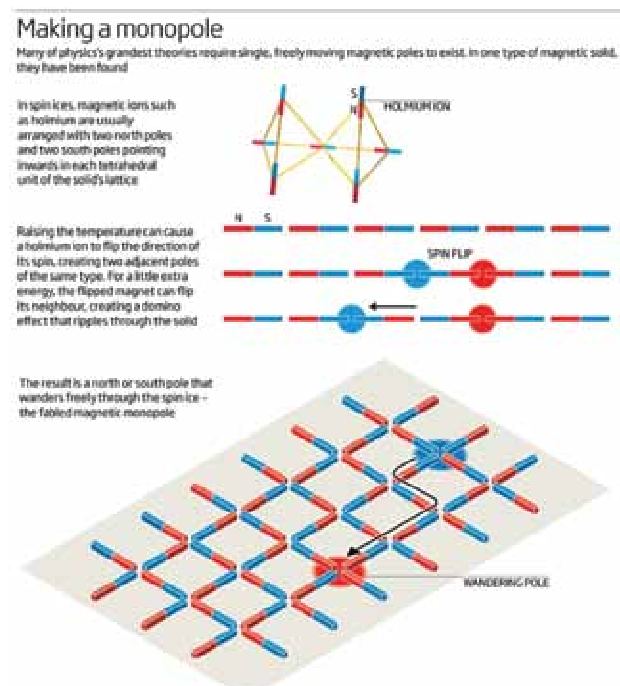
Using brief magnetic pulses, Bramwell and his team have now developed a way to trigger currents of these magnetic charges—'magnetricity' —that last for minutes.

"We apply a magnetic field to create magnetic charges and get them all going the same direction," says Sean Giblin, a physicist at the Rutherford Appleton Laboratory in Oxfordshire and a co-author of a paper published online February 13 in Nature Physics.

These currents have revealed new similarities between magnetic and electric charges. The creation and slow dissipation of new magnetic charges follows the exact same principles that govern charged particles in solutions—such as ions in battery electrolytes.

The way that the spin ice stores magnetic charge is also similar to the way existing devices called capacitors store electric charge. Bramwell's pie-in-the-sky dream is for magnetricity to someday spawn a new technology called 'magnetronics'. But he admits it may take a while to get there, especially because these currents appear only in crystals kept close to absolute zero.

The EMU Muon spectrometer at ISIS - www.newscientist.com



Making a monopole diagramn - www.newscientist.com

The world's EXPOSED telecommunications nervous system

By Gavin Chait

During the height of the civil unrest in Egypt in January/February, the country became an information dead zone. The four largest ISPs responsible for most of the country's connectivity – Vodafone/Raya, Telecom Egypt, Link Egypt and EtisalatMisr – all vanished.

James Cowie, writing for Renesys on 27 January, "At 22:34 UTC (00:34am local time), Renesys observed the virtually simultaneous withdrawal of all routes to Egyptian networks in the Internet's global routing table. Approximately 3 500 individual BGP routes were withdrawn, leaving no valid paths by which the rest of the world could continue to exchange Internet traffic with Egypt's service providers. Virtually all of Egypt's Internet addresses are now unreachable, worldwide."

While information transiting Egypt was unaffected, Cowie notes that, "the majority of Internet connectivity between Europe and Asia actually passes through Egypt. The Gulf states, in particular, depend critically on the Egyptian fibre-optic corridor for their connectivity to world markets. Commodity traders are already nervous about the potential impacts on oil prices of any closure of the Suez Canal, but the potential risks to global Internet connectivity through Egypt are equally significant, and far less widely understood. "

The Internet – for all the wonders of wireless – still depends on crucial and physical telecommunications cables that traverse the globe. And those cables are frightfully vulnerable.

The first cable, laid across the English Channel in August 1850, was a copper wire coated with gutta-percha, a natural latex from the Palaguiumgutta tree. In 1852, the Submarine Telegraph Company linked London to Paris.

The first successful transatlantic cable was laid by the ship Great Eastern which started out from Foilhommerum Bay, Valentia Island off Ireland on 15 July 1865. A mere two weeks later, with 1 968 kilometres of cable laid out, it snapped and the end shot over the stern of the ship. Undeterred, Cyrus West Field, the visionary financier behind the venture, formed a new company – the Anglo-American Telegraph Company – and tried again. The Great Eastern put to sea on 13 July 1866. While unrolling the cable it was noted that nails had been forced into it as some early attempt at sabotage. Captain Sir James Anderson threatened to throw overboard whoever was responsible. On 27 July, the cable reached America.

A few months later, on 9 August, the expedition set out to find the broken end of the 1865 cable. It took almost a month, but they did it, successfully splicing the cable and completing the transatlantic cable on 7 September.

Almost at once they became a political tool. At the outset of wars nations would promptly cut the cables of their enemies. During World War I, German and British forces systematically destroyed most of the world's telecommunications cables in an effort to deprive each other of information.

Even today, less than 1% of telecommunications is sent via satellite signals. Fibre-optic cables, developed only in the 1980s, now account for virtually all communications. The first transatlantic fibre-optic cable – TAT-8 – was laid 23 years ago, in 1988.

Interestingly, the electrical interference shielding for its high-voltage supply lines was removed which caused feeding frenzies amongst sharks swimming nearby. They would attack the cable until the voltage lines killed them. Numerous and prolonged outages resulted until shark shielding was developed. The power cables are there to power the solid-state optical amplifiers needed to repeat the signal across vast distances.

Each repeater comprises signal reforming, error measurement and controls. A solid-state laser dispatches the signal into the next length of fibre. The solid-state laser excites a short length of doped fibre that itself acts as a laser amplifier. As the light passes through the

fibre, it is amplified. This system also permits wavelength-division multiplexing, which dramatically increases the capacity of the fibre.

The purity of the glass fibre allows repeaters to be spaced 100 kilometres apart, reducing the power-requirements of the system.

As Asia has become more financially important, so more cable has been laid across the Pacific. Between 1998 and 2003, about 70% of undersea cables were laid there. In July 2009, the race to plug Africa into the rest of the world began when SEACOM connected a cable down the coast of East Africa.

The proliferation of cable has also increased the danger. Between 1959 and 1996 less than 9% of cable breaks were as a result of natural events with more than 50 repairs a year required in the Atlantic alone.

The Cold War saw Soviet and American forces battling for supremacy. In February 1959, a series of 12 breaks were discovered on five American transatlantic cables. The USS Roy O Hale was dispatched to investigate and boarded the Soviet fishing trawler Novorosiysk. Subsequent investigation showed that the Soviets had dragged their fishing net along the ocean floor, pulled up the cables and then cut them.

In 2005, a portion of Pakistan's major SEA-ME-WE 3 cable south of Karachi failed, disabling communications for 10 million people. In 2006, the Hengchun earthquake destroyed cables near Taiwan. Pirates stole 11 kilometres of the T-V-H cable connecting Thailand, Vietnam and Hong Kong in March 2007 in order to sell it for scrap.

Similar disruptions have taken place in 2008, when two of three Suez Canal cables, two in the Persian Gulf and one in Malaysia were all broken.

But it isn't only about destruction. In the early 1970s the US government discovered that a Soviet Pacific Fleet base in Petropavlovsk on the Kamchatka Peninsula was linked to the Fleet's headquarters in Vladivostok via a cable under the Sea of Okhotsk.

The Sea was well within Soviet territorial waters and defended by a network of sound detection devices along the seabed. There was also plenty of Soviet military shipping.

Despite this, the Americans felt the opportunity was too good to miss. In October 1971, the USS Halibut, a customised submarine, was sent deep into the Sea of Okhotsk. Divers working from the submarine in 120 metres of water wrapped a 6.1 metre-long device around the cable which would be able to record all communications made over it.

Once a month divers returned to the site, replaced the tapes and delivered the old ones to US intelligence services. Over time the US placed an ever greater number of listening devices on Soviet cables around the world.

In 1980, Ronald Pelton, dissatisfied with his pay and position at the NSA, walked into the Soviet embassy and told them about the operation for a payoff of $35,000. It wasn't till 1981, however, that the Soviets recovered the device and so ended the US operation.

The end of the Cold War coincided with the explosion of consumer telecommunications and the Internet. Some of the biggest growth markets are also dominated by the world's most tyrannical leaders.

In 1998, fearing the widespread availability of uncontrollable information over the Internet, the Golden Shield project was started. What would become known as the Great Firewall of China was officially launched in 2006. Estimates put the development costs at $800 million.

A number of services attempt to negate the effects of China's firewall. Psiphon is a software project designed by University of Toronto's Citizen Lab under the direction of Professor Ronald Deibert. Psiphon is a circumvention technology that works through

social networks of trust and is designed to help Internet users bypass content-filtering systems set up by governments.

"We're aiming at giving people access to sites like Wikipedia," says Michael Hull, Psiphon's lead engineer.

Despite these efforts, China's 30 000 Internet police continue to block thousands of international news websites, and search terms on everything from Tiananmen Square massacre to tank boy.

In January 2010, Google made the following announcement on their official blog:

"Like many other well-known organizations, we face cyber-attacks of varying degrees on a regular basis. In mid-December, we detected a highly sophisticated and targeted attack on our corporate infrastructure originating from China that resulted in the theft of intellectual property from Google. However, it soon became clear that what at first appeared to be solely a security incident - albeit a significant one - was something quite different."

The target was a host of technology companies, including Adobe Systems, Juniper Networks, Rackspace, Yahoo, Symantec and Google.

China, or its agents, appear to be deliberately targeting companies with sophisticated networking and social media software in order to steal intellectual property and know-how.

However, the news most alarming in Europe and the US, is that the attacks also targeted political dissidents in widespread attempts to hack into their email accounts.

Google concluded by saying: "These attacks and the surveillance they have uncovered – combined with the attempts over the past year to further limit free speech on the web – have led us to conclude that we should review the feasibility of our business operations in China. We have decided we are no longer willing to continue censoring our results on Google.cn, and so over the next few weeks we will be discussing with the Chinese government the basis on which we could operate an unfiltered search engine within the law, if at all. We recognize that this may well mean having to shut down Google.cn, and potentially our offices in China." Later, in 2010, they did just that.

It isn't just tyrants who wish to censor what their citizens may know or see. The US has a proposed Protecting Cyberspace as a National Asset Act before congress which would give the US President the power to apply a full block to the Internet for a period of 120 days at a time.

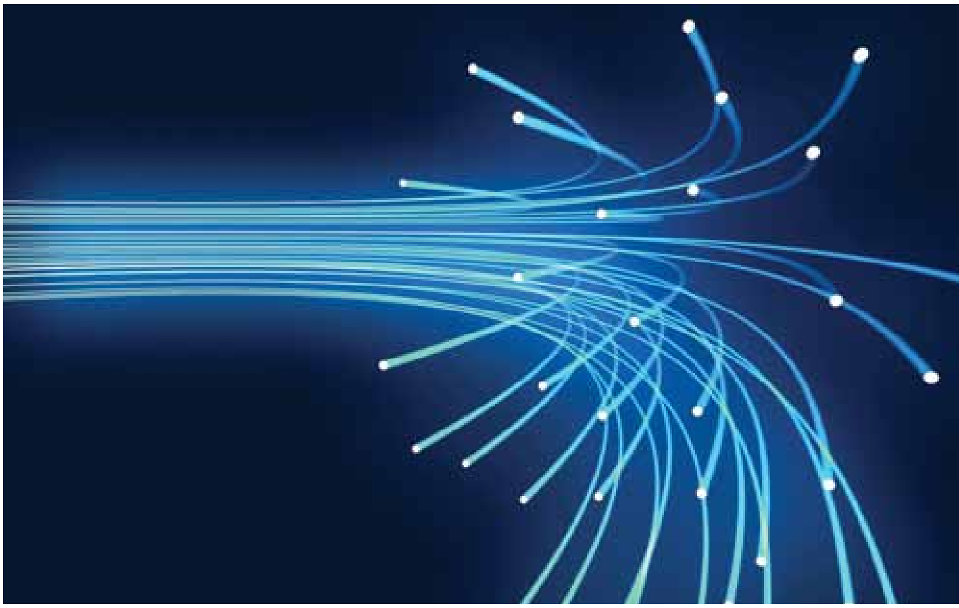
And, even without active measures, accidents will happen. In February 2008, Pakistan decided to ban YouTube by routing YouTube's address block into a "black hole". This should only have affected users in Pakistan but the information "escaped" to Pakistan Telecom's ISP in Hong Kong which propagated the route to the rest of the world.

The result was YouTube's banishment. China, however, continues to be the biggest worry for freedom lovers.

In late 2010, the US-China Economic and Security Review Commission released a 300 page report on what's happening inside China. They included an incident in April 2010 in which, for 18 minutes, 15 percent of world Internet traffic passed through China's servers:

"For about 18 minutes on April 8, 2010, China Telecom

advertised erroneous network traffic routes that instructed US and other foreign Internet traffic to travel through Chinese servers. Other servers around the world quickly adopted these paths, routing all traffic to about 15 percent of the Internet's destinations through servers located in China. This incident affected traffic to and from US government ('.gov') and military ('.mil') sites, including those for the Senate, the army, the navy, the marine corps, the air force, the office of secretary of Defense, the National Aeronautics and Space Administration, the Department of Commerce, the National Oceanic and Atmospheric Administration, and many others. Certain commercial websites were also affected, such as those for Dell, Yahoo!, Microsoft, and IBM."



This has fuelled concerns, particularly after leaked information from the Wikileaks deluge revealed that the original Chinese attack on Google was authorised by senior politburo members.

Government snooping on the Internet isn't only about international politics, most often it is about stifling local dissent. Venezuela is only the most recent government to prohibit online content attacking 'good customs'. Thailand regularly arrests people for transgressing their onerous lèsemajesté laws. Most recently, Chiranuch Premchaiporn, webmaster of the country's only independent news portal, Prachatai.com faces a 50-year prison sentence for anonymous comments left on his site. Iran blocks Facebook, Twitter and Wikipedia. Egypt, in other words, is in good company.

The potential for global repercussions on such a ubiquitous service is becoming a cause for concern. The EastWest Institute in New York is called for rules of engagement for cyber war akin to "rendering the Geneva and Hague conventions in cyberspace."

The Munich Security Conference will, for the first time, discuss cyber security. With those attending the conference including UK Prime Minister David Cameron, German Chancellor Angela Merkel, US Secretary of State Hillary Clinton and Russian Foreign Minister Sergei Lavrov there is potential that some agreement may be reached.

"Cyber weapons can deliver, in the blink of an eye, wild viral behaviour that is easily reproduced and transferred, while lacking target discrimination," says the report.

The UK is taking it seriously, allocating almost $1 billion towards cyber security and a new Cyber Security Operations Centre. With more critical infrastructure, like financial trading platforms, schools and hospitals operating online, such fears are not entirely over-hyped.

Energy production is still mostly a national affair, yet Russia hasn't been afraid to use control of its gas pipelines to Europe to exert influence over European policy as well as bringing its nearest neighbours – particularly Ukraine and Georgia – into line.

With so many unprotected telecommunications cables spanning the world, the stakes just got higher.

ENERGY SAVINGS

Are you on the road to nowhere?

What type of car do you drive? A high performance 4.2 L fuel guzzler? Of course not, you're reading an article on energy saving so you are probably driving a cute and efficient 1300 or a hybrid vehicle—a true mark of doing your bit for the environment? Or is it?

Recently, BBC channel screened an episode of Top Gear [1] featuring a test between Prius and BMW M3 to see which car was more efficient on the road. Who won? Believe it or not, the BMW M3 with its 4 litre V8 engine was proven to be more efficient than the hybrid Toyota Prius.

The test featured the two cars driving 10 laps on a race-track at a steady 100 mph. For the Prius that meant putting pedal to metal all the way as it's not designed to go that fast. For the BMW M3 it meant a steady and controlled speed. So what does this tell us? Jeremy Clarkson, host of Top Gear concluded: "It's not what you drive that matters it's how you drive it". The moral of the story: don't change your car, change your driving style!

This is a good comparison with the energy efficiency industry. Our buildings and facilities might have the potential to be efficient, we certainly have the technology available, but we are not efficient because our buildings are not 'driven' they way they should be.

Two things 'drive' energy efficiency: technology and management—management of people and the management of the processes within your building envelope. Technology alone won't bring you the energy savings it is designed to do.

Arguably, most people are by now well aware of the environmental issues that prevail and may already have spent millions to ensure that their companies do their bit for the environment.

But, do you know if you are winning or losing money with your energy efficiency investment? If someone in your building leaves the lights on 24/7, is your investment still bringing you the returns you were banking on? Most companies therefore cannot see the value of all the money spent on these investments. They are also internally challenged by their financial departments to justify their expenditures.

However, energy efficiency is easier said than done, especially in the commercial sector.

It's the landlord's problem

The largest opportunity for energy savings is in industry and commercial buildings. Commercial buildings use 40% of the total fossil fuel energy world-wide [2]. Percentage-wise, this sector has the largest potential savings to contribute to the country's future energy stability. However, one of the biggest problems in the energy efficiency industry, even from an Eskom Demand Side Management point of view, is making inroads into the commercial building sector.

There are a number of reasons for this, one of which is that most of the buildings are tenanted, not owner occupied like in an industrial plant. For instance, with a shopping centre, you have a landlord and tenants. Who is responsible for the energy use? The landlord gets the electricity bill—he simply passes the cost on to the tenant as part of the operational cost of the rented space. On the tenant's side the attitude is, well what can I do about it, it's not my property; it's the landlord's problem.

Where does that leave South Africa's huge window of opportunity to save energy in its commercial buildings? Each party is abdicating the responsibility. Is our country on the road to nowhere with its energy saving strategies?

This is where the Energy Barometer can make a difference, by putting pressure on the right people to take responsibility for becoming drivers of energy efficiency. You can start an energy efficiency initiative just by 'driving' your building better to deliver results. The Energy Barometer will tell you where your building stands with regard to your energy saving status, in comparison to others within your industry. Once you know where you are, you can take action to follow a more energy efficient route.

Get the taxman on your side

In the words of Laura Brown, author of Using Microsoft, "When applied successfully, technology is a wonderful thing". When applied successfully, together with measurement and verification of your energy savings, the Energy Barometer will be a wonderful thing for your company.

With the proposed regulations that will govern the energy efficiency tax rebates, you can claim a substantial tax rebate for every kWh of energy saved due to your energy efficiency initiatives—provided the savings can be backed up.

Tax rebates will quickly increase your return on your energy efficient investment and reduce your payback period significantly.

Comparing like with like

The Energy Barometer is based on US Energy Star building methodology. The US has what it calls a Commercial Building Energy Consumption Survey [3]—a survey involving thousands of buildings in the US and Europe. From this survey energy usage is compared. Though we cannot use these values in South Africa, we can apply the methodology and the models, and the scientific and mathematical logic behind them.

You might be sitting in your office in Johannesburg thinking that because it is colder in Johannesburg you will be running your air-conditioning system more than your rival in Durban.

How would it be fair to compare your energy use to that of a similar building in Durban?

The good news is that the Energy Barometer compares 'apples-to-apples'. Because buildings vary greatly in size, occupancy, floor space, location, climatic conditions, type of use, service delivery, etc., these

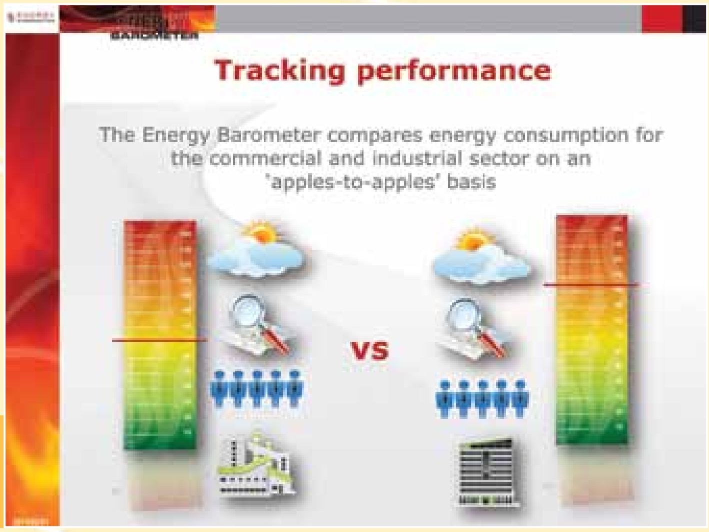


Figure 1: To track energy efficiency performance, statistics are normalised, allowing buildings to be compared on an 'apples-to-apples' basis.

Figure 2: Once utility bills are evaluated, an average is assigned and becomes the benchmark for that specific industry.

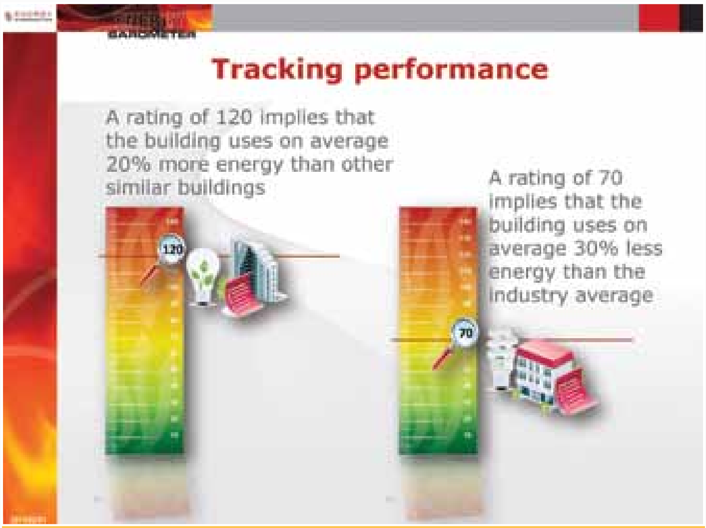


Figure 3: The benchmark for the industry indicates whether your building's consumption is below or above the industry average, thereby providing a practical starting point for energy efficiency planning.

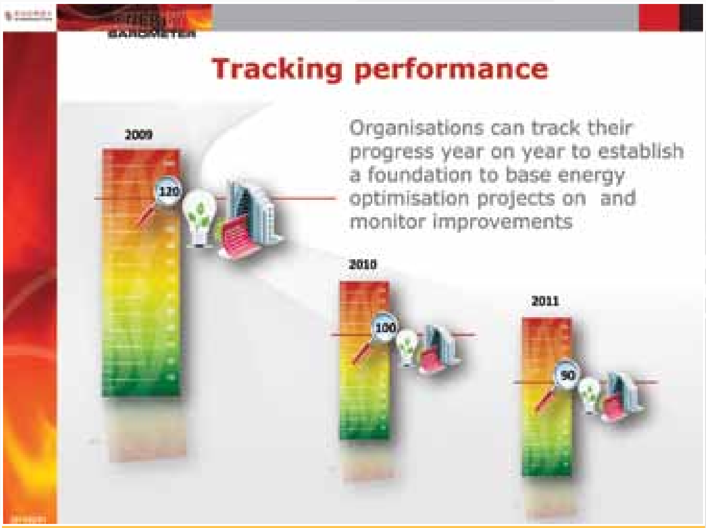


Figure 4: Energy efficiency improvements can be tracked yearly to ensure that investments are performing adequately.

factors are all evaluated and normalised for each industry in which the building is used. So, to make it fair, all the data from the participants in each industry are normalised for weather, time, occupation, etc. The values are fed into the Energy Barometer system to even out the playing field (Figure 1) and, for instance, a shopping centre in Cape Town can then be compared to one in Durban and Johannesburg. The same would apply to hospitals and so forth.

The Energy Barometer assesses the energy bills of all participants in each category—the average in industry then becomes the benchmark. For example, the shopping centre average is assigned to 100 as shown in Figure 2. Figure 3 shows that when your rating is 120 it implies that you used 20% more energy than the average in your relevant industry. A rating of 70 means you used 30% less energy than the industry average.

As seen in Figure 4, over time you can track your performance, either for your individual building, or your portfolio of buildings. It lets you monitor whether you are improving: after all, you should know whether you are winning or losing on your energy efficiency investment. Should you have a portfolio of buildings it assists you to decide which energy efficiency projects you should start with—obviously it would be your worst performer. Annually, you can control and plan energy efficiency road to follow.

Know your status

The Energy Barometer ranking is not a name and shame system. If you are doing a good job your ranking encourages others to strive for the same success. If you are not doing a good job, you find out so that you can start doing something about it.

The Energy Barometer provides a simple way for everybody to understand what is going on in a specific building and, how one building compares with another in a similar industry. Independence and confidentiality are assured: only you know your own status and can make it public if you wish to.

Participation attitudes have varied. Some companies have been reluctant to enter the system as they have felt that they have not done not enough to ensure a good result—oddly enough, some of these use less energy than the industry average and if they hadn't participated, would not have known this.

Some, having spent millions on renovations to achieve better than average results, have been confident the Energy Barometer would re-affirm this only to discover that they have not performed that well. Why, you may ask?

The buildings assessed, in both the upper and lower scales of the results, were a mix of older and brand new buildings – so the age of the building didn't affect the result. However, as mentioned before, technology alone does not deliver savings. Management, measurement and control of the operation of the system and the

Earth Wire Monitor – EWM550

Profit and production are the key to your success.

However, if these are to be achieved by compromising on safety, then best you reconsider your business model.

The EWM550 is a unique device offering you increased peace of mind in the most hostile of operating environments.

It works with the electrical supply system to monitor and alert you to a deterioration of the earthing system allowing you to react before your production is affected – but protecting your plant and personnel in the case of a dangerous condition developing.

Features

- Continuous monitoring of earth bond integrity.
- Connects to 400/525V 3-phase system.
- For safety the maximum energy available at the local earth is 380/525V limited to 0.3 Joule / pulse.
- Three different trip times and levels available for discrimination.
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JOJEN SUPPLIES

technology are what ultimately deliver a successful return on an energy efficiency investment. This is where the Energy Barometer keeps track of your efforts. To find out your status you can join the Energy Barometer survey for 2010. Participate by completing a simple, two page questionnaire which you can get by sending an email to barometer@energycybernetics.com or by logging on to www.energybarometer.com.

If you operate a building envelope in a shopping centre, corporate head quarters, general office building, a hotel or a hospital, join the survey before May 2011 to know your status.

Internationally, people are starting to ask questions about energy efficiency: "Is this office block energy efficient? Should I be shopping at a shopping centre that doesn't care about my environment? Does this hotel just charge its energy inefficient practices to my room rate?". Not only is going green the right thing to do; with tax rebates and soaring electricity prices it also makes good business sense.

Acknowledgement

This article was based on a paper presented by Dr LJ Grobler at the Southern African Energy Efficiency Convention 2010 (SAEEC2010)—SAEEC2011 will be held at Emperors Palace on the 16th and 17th of November 2011.

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Great Brak River
Hydro Power Station

The Searle family, who were among the early settlers in the Great Brak River Valley, were instrumental in establishing much of the commercial enterprise in the area. They were particularly well known for their leather tannery and shoe factory, for which they needed electrical power.

The family imported the required hydro turbine equipment and a DC generator and in 1924 built a power station in the river valley about a kilometre above the village.

A 25 km water channel diverts water from the river to supply the station. The turbine uses a 24 bucket Pelton wheel to drive the power generator. Runaway speed is 1080 rpm. The hydraulic head is 520 ft, and flow rate is a minimum of 3 and maximum of 7 cusec.

The original DC generator was replaced in 1936 with the present AEG three-phase 3300 V 50 Hz, 350 kVA alternator, running at 600 rpm.

The switchboard and all support, control and protection equipment is well maintained and the station is capable of operation if sufficient water is available. The building is neat and well maintained.

An interesting feature of the building is that fire protection is still provided by the original glass bulb type of system, suspended from the roof.

Tours of the power station can be pre-arranged through the local museum staff, with assistance from the Mossel Bay municipal electricity department.

Museum curator: Nisda McRobert
Museum: 044 620 3338
Heritage interest: Rene de Kock
044 620 5124

1. Valve console

2. Flow control

3. Plant

4. Switchboard

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Cranefield College specialises in project-, programme-, portfolio-, and value chain management education. It is accredited by the Council of Higher Education and registered with the Department of Education as a private higher education institution.

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For further details, access Cranefield College's website at www.cranefield.ac.za and click on the CPD button. The Engineering Council of South Africa (ECSA) validation code is SAIEE-0534-V.

NASA spacecraft closes in on Comet Tempel 1

For the first time, we'll see the same comet before and after its closest approach to the sun. The comet is Tempel 1, which NASA's Deep Impact probe visited in 2005. Now another NASA spacecraft, Stardust-NExT, closed in for a second look on February 14, 2011. The two visits bracket one complete orbit of the comet around the sun – and a blast of solar heat.

"Close encounters with the sun never go well for a comet," says Joe Veverka, principal investigator for NASA's Stardust-NExT mission. "Fierce solar heat vaporises the ices in the comet's core, causing it to spit dust and spout gas. The cyclic loss of material eventually leads to its demise."

Researchers suspect the flamboyant decay does not happen evenly all over a comet's surface, but until now they've lacked a way to document where, exactly, it does occur. Stardust NExT will image some of the same surface areas Deep Impact photographed six years ago, revealing how these areas have changed and where material has been lost.

"Deep Impact gave us tantalising glimpses of Temple 1," says Veverka. "And we saw strange and unusual things we'd like a closer look at." At a January 2011 press conference, Veverka and other Stardust-NExT team members listed the features they're most interested in seeing again.

For starters, parts of the comet's surface are layered like pancakes. "Earth has layers because water and wind move dirt and debris around here, but layering on a comet was a surprise–and a mystery," says Veverka.

"One idea is that two protocometary bodies collided at low speeds and smushed together to form something like a stack of flapjacks," says Pete Shultz, Stardust-NExT co-investigator.

Data obtained by Stardust-NExT will provide clues and possibly reveal what made the 'comet pancakes'.

Another area intrigues the research team even more. "There's a large plateau that looks like a flow," says Shultz. "If it really is a flow, it means there was recently gas and dust emanating from the [surface]."

Stardust-NExT will reveal how the plateau has changed (is it flowing?), helping the team determine its origin. Whatever their origins, the plateau and layering show that comets have a much more complicated geologic history than previously thought.

"Tempel 1 is not just a fuzzy ball," says Shultz. "It has history."

It's a history NASA has had a hand in. During its 2005 visit, Deep Impact dropped an 820-pound projectile into the comet's core. In a development that surprised mission scientists, the impact excavated so much material that the underlying crater was hidden from view. Deep Impact's cameras were unable to see through the enormous cloud of dust the impactor stirred up. Stardust NExT could provide a long anticipated look at the impact site.

"The dust has settled and if the right part of the comet is facing us, we could see the crater and learn its size," says Veverka. "That would answer some key questions. For instance, is a comet's surface hard or soft?"

In a future mission, a spacecraft may land on a comet and gather samples for analysis. To design a suitable lander, researchers need to know what kind of surface it would land on. They'll also need to know which tools to send – drills for hard surfaces or scoops for something softer.

Like Deep Impact, the Stardust spacecraft has already had a productive career. Launched in 1999, it approached Comet Wild 2 close enough in 2004 to image its feature-rich surface and even gather dust particles from the comet's atmosphere (a key finding in the sample was the amino acid glycene – a building block of life).

"We could have let this old spacecraft rest on those laurels, leaving it to orbit the sun forever," says Veverka. "But instead, we're doing first-class comet science with it – again." As for Tempel 1, a hungry sun awaits.

Bipedal gait earlier than previously thought

A tiny 3.2-million-year-old fossil found in East Africa gives Australopithecus afarensis an unprecedented toehold on humanlike walking.

Australopithecus afarensis, an ancient hominid species best known for a partial female skeleton called Lucy, had stiff foot arches like those of people today, say anthropologist Carol Ward of the University of Missouri in Columbia and her colleagues. A bone from the fourth toe — the first such A. afarensis fossil unearthed — provides crucial evidence that bends in this species' feet supported and cushioned a two-legged stride, the scientists report in the February 11 issue of Science.

"We now have the evidence we've been lacking that A. afarensis had fully developed, permanent arches in its feet," Ward says. "Survival for Lucy and her comrades must have hinged on abandoning trees for a ground-based lifestyle."

The new fossil confirms that members of Lucy's species could have made 3.6-million-year-old footprints previously found in hardened volcanic ash at Laetoli, Tanzania, says Ward. A. afarensis lived from about 4 million to 3 million years ago. Scientists have argued for more than 30 years about whether Lucy and her kin mainly strode across the landscape or split time between walking and tree climbing.

News of arched feet in these hominids comes on the heels of a report that a recently discovered A. afarensis skeleton, dubbed Big Man, displays long legs, a relatively narrow chest and an inwardly curving back, signs of a nearly humanlike gait.

"There were far too many highly detailed adaptations in every part of the A. afarensis skeleton for upright walking and exclusive ground travel not to have emerged," remarks anthropologist Owen Lovejoy of Kent State University in Ohio, who studied Big Man's remains.

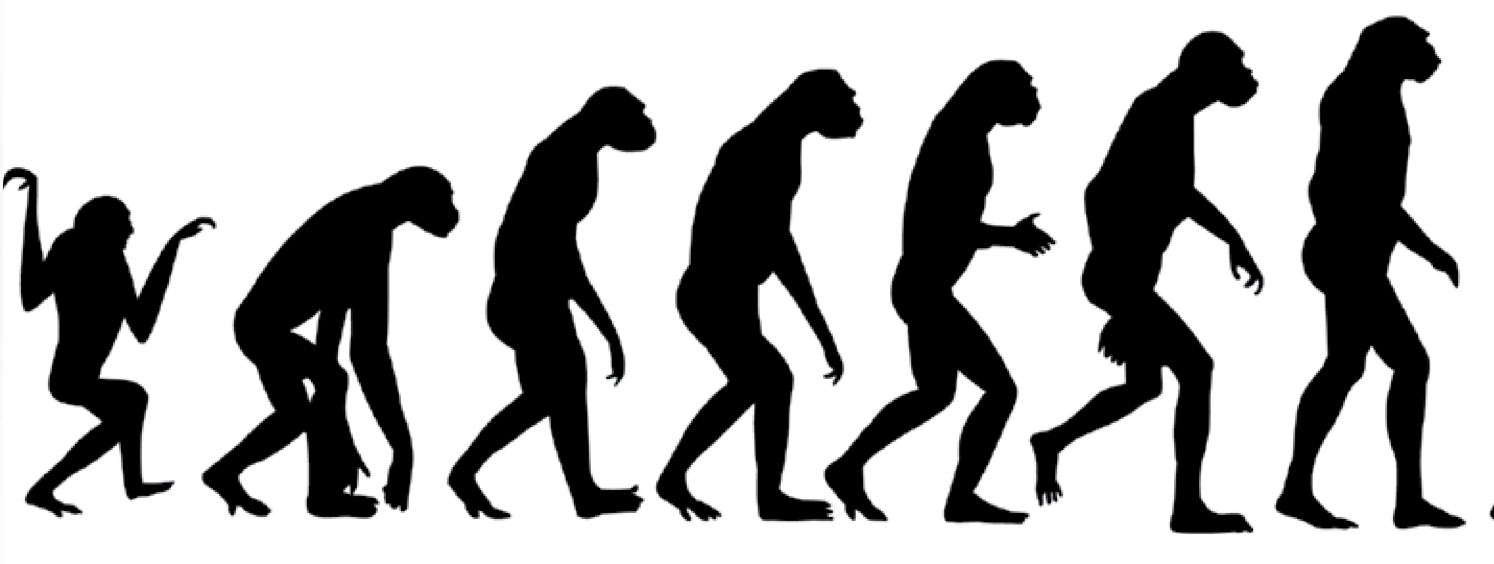
A foot much like that attributed to Lucy's kind by Ward's group had already evolved by 4.4 million years ago in the early hominid Ardipithecus Lovejoy says. Although Ardipithecus had an opposable big toe incapable of propelling a two-legged gait, this creature walked effectively using its other toes, in his view.

Based on the new find, A. afarensis does appear to have had arched feet, remarks anthropologist William Jungers of Stony Brook University School of Medicine in New York. But, he asserts, other foot features, including long, curved fifth toes, indicate that a skeletal system for upright walking had not fully evolved in Lucy's kind.

Considerable differences in foot anatomy may have existed among members of A. afarensis, Jungers says. An analysis of fossil ankle bones published in 2010 by other researchers concluded that Lucy had flat feet while many of her comrades had an arch at the back of the foot.

"Even if Lucy had lower arches than other individuals, she still would have had the stiff, humanlike foot structure that we see in people but not in apes," Ward says.

Excavations at one of several sites at Hadar, Ethiopia, yielded the ancient toe bone in 2000. Since 1975, this location has produced more than 250 fossils representing at least 17 A. afarensis individuals. Shape and design features of the fossil toe closely match those of corresponding toes on people but not chimpanzees or gorillas, Ward's team says.



Watt Says

Hi Paddy,

The article 'Sunshine and Sewage', in WATTnow, June, raises some very interesting points. There is nothing really new about the proposals, taken individually, but the attempt to combine them into one scheme seems to be novel. I have one reservation, however: Is it not getting a trifle too complex to be seen as a practical option?

While the project is under the control of the CSIR, all the necessary scientific and technical know-how is readily available 'in-house', but when installed at some remote location in its practical incarnation this may not be the case, since the availability of even basically-qualified Engineering staff at a municipal level is known to be one of the major crisis points in the current SA situation. Since this scheme brings into play a combination of operating chemical plant, electrical plant and some form of waste-heat distribution, it seems that a great number of different disciplines will need to cooperate for successful management of the system. Such staff are in extremely short supply today. Some municipalities are reported as currently being unable even to operate a conventional sewage-processing plant correctly.

The discussion of costs seems a little incomplete. The reference to this scheme costing around R24-million a year, compared to R2-billion for the pebble-bed reactor omits to mention a difference of scale. This scheme is targeted at the capacity of a 600 kW generator, whereas the PBMR was looking at some hundreds of Megawatts for a single system; on the other hand, the overall time-scales involved in the implementations are significantly different. The uptake of the waste heat output seems somewhat vague, and presupposes some form of industry that can be fed with this energy. In Northern Europe, where the density of housing is much greater than in suburban SA and local temperatures are often lower, schemes for community-level domestic heating are sometimes envisaged, but that option seems unusable here.

I am awaiting the final results with great interest.

Regards
Tony Fisher

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

Dear Paddy,

Hats off to Don Andrews and his letter on CPD, which I support.

Firstly, I believe that the whole idea was dreamt up by a committee consisting largely of academics, trying rightly to boost the status of professional engineers. However, like many committees sitting around a table, they got completely carried away with their ideas and have created a rather unwieldy monster. I fully support continuing education, and think that to legislate it is probably very important for professions like medical doctors, accountants and lawyers, most of whom do need a broad range of the latest knowledge in many subjects.

However, most engineers work in extremely specialised fields, and perforce have to keep up with developments in these areas, if they want to succeed in their jobs. Legislation to try and broaden their knowledge is to me rather silly, expensive, and wasteful. Forcing them to get CPD points is not going to stop bad engineers from making mistakes, and is not going to enhance engineering in general.

I have been giving extremely specialised five day courses on control loop optimisation for over 20 years, and have had thousands of engineers and technicians on them. The large industrial process companies send their people repeatedly. However, when I tried to get the courses certified for CPD, the requirements laid down by the SAIEE were unbelievably demanding, and incredibly costly. I could possibly understand this if the courses were for conferring qualifications, which they are not. The certification also would only last three years. Fortunately I managed to get the courses certified by a different institution which was happy to vet the course manuals, read the course comments, and charge less than half of what the SAIEE wanted.

Like Don, I too did not renew my professional status. I am completely specialised in my field and was not prepared to waste a lot of time, money and effort trying to raise the necessary points. I am still a member of the IET of Britain (previously the IEE), an august and revered body. They do not demand CPD, and I am still a registered Chartered Engineer of the UK.

A lot of the engineers who attend my courses have also told me that they are not renewing their professional status. I think the whole thing has gone completely overboard.

Kind regards,
Michael Brown
MIET, FSAIEE

Hi Paddy,

The letter from Howard Davies (WATTnow, December) calls for a little expansion.

While most electric vehicle (EV) manufacturers tend to claim something better than a 100 km driving range for a fully charged battery, few go beyond around 250 km. This estimate includes the effects of regenerative braking; otherwise the figures would be even more laughable. The problem has been summed up by various articles although the figures tend to vary.

It has also been estimated that to emulate the range provided by a small-car fuel tank of 55 litres a battery installation weighing in at around one and a half tons would be required.

It seems that all the propagandists for EV adoption ignore one basic fact: the ordinary 'Joe Soap' motorist buys a car with two major uses in mind. He needs something to commute to and from work on a daily basis – around 50 km a day or less (those enthusiasts who live in the Johannesburg area and work in Pretoria, or vice versa, clock up distances of 100 – 160 km a day – the less said about that, the better); plus an annual holiday trip of around 650 km each way (Gauteng to KZN coastal resorts, further for other destinations).

An overnight charging scenario can cope easily with the first requirement (even if the charge time is 11.33 hours); I won't comment on the Eskom-rate costs of the electrical energy consumed here, but the holiday trip becomes impractical, needing three or more recharging sessions during each one-way journey. To mitigate this, a scheme has been proposed of 'refuelling' by means of a battery exchange, with the batteries then being recharged off-line. However, the logistics involved here to cope with the common holiday-season traffic densities of over 1000 vehicles an hour on each route are somewhat mind-boggling.

It seems to me there are some very difficult problems to be overcome before EV usage becomes widespread.

Regards
Tony Fisher
Retired SAIEE member

SAIEE envisages restructuring

The Institute celebrated its centenary in 2009 and was registered as a company by the erstwhile Transvaal under the Transvaal Ordinance in 1909.

While the SAIEE operates as if it were a registered company and operates close to the company statutory requirements governing this great learned Institution, it has been served well for over 100 years by its Constitution and By-Laws. Granted, these have had to be amended from time to time but now it is time to overhaul the document if the SAIEE is to prosper going forward.

Members will be pleased to learn that Innes House boasts of taking on between 25 and 60 new members each month. The bad news is that the attrition rate has been such that previously the real growth in membership has been nullified by the attrition—members emigrating, resigning and dying. The good news is that for the last two years there has been a real growth of about 4%pa and the membership now stands at some 5,500 members—astounding growth for a voluntary association given the recession and job losses of late. This alone proves there is value in belonging to the SAIEE.

What with the new building and other significant objectives set last year by our President, Angus Hay, and that these objectives are all likely to be realised before long, plus the growing Council in the way of numbers (six member grade Council seats having been added in 2008), it is no surprise that a restructure has manifested itself as a major imperative.

The Institute staff and executive structures, as well as the delegation of authority, must be looked at if the SAIEE is to enhance its growth and success going forward. Currently all decisions, no matter how trivial, can only be made by Council and there is no delegated authority to Office Bearers or anyone else except the Honorary Treasurer.

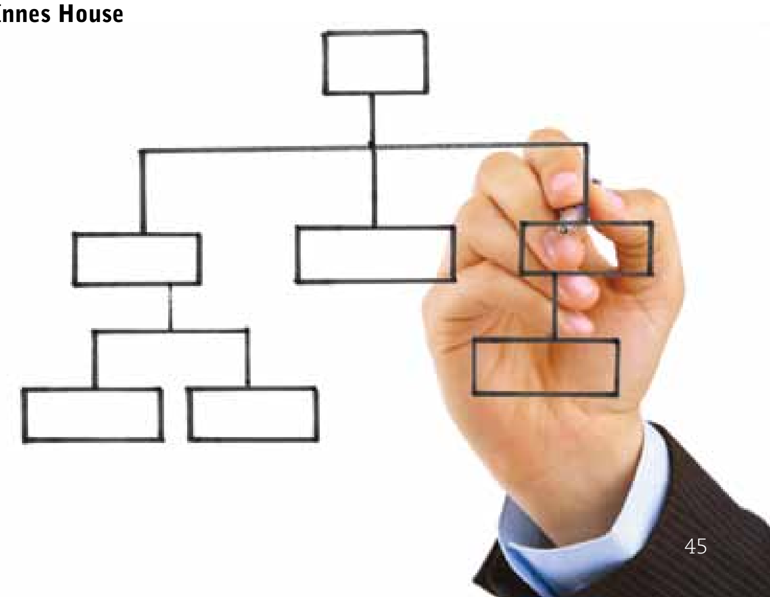
The other aspect addressed in the restructure is the ability to respond rapidly to the macro environment in Southern Africa as well as to Government and the electrical engineering fraternity at large. The concept of professional individual membership of the SAIEE is sovereign and must continue to be so, the outreach of the Institute, however, to industry, Government and entities engaged in leading edge research, must be urgently explored. Exciting proposals are being mooted in this regard. Watch this space!

Over the last few years the SAIEE has made tremendous progress in maintaining and enhancing relevance to the metamorphosis taking place in SA and while its core business is meeting the needs of its members – members must know that they belong to an Institute that is relevant and that it is a force to be reckoned with by the macro environment.

Consequently our Policy and Constitution Committee (Chairman Viv Crone) is hard at work reviewing the Constitution and By-Laws to facilitate all the changes envisaged.

Members can therefore expect to be asked to vote on the amendments to the Constitution and By-Laws in the near future. Again, watch this space!

Stan Bridgens Pr Eng
Innes House



DSM: A joint energy saving initiative between SAPPI and ESKOM

KZN Centre visit

Sappi SA, a division of Sappi Ltd, a global pulp and paper company, is actively involved in Eskom's Demand Side Management Programme, which is aimed at alleviating South Africa's shortage of electrical energy. On Thursday, 13 October last year Sappi SA Engineering, Braamfontein and Sappi Tugela Mill, KZN, in conjunction with the KZN Centre of the SAIEE hosted a DSM Seminar and site visit to the most successful Sappi Tugela River Pump Station Upgrade Project on the KZN North Coast. The upgrade of the river pump station was completed in May 2010 and allows for a shift of 1,85 MW away from the peak demand periods during the day and a 0,185 MW energy saving throughout the day.

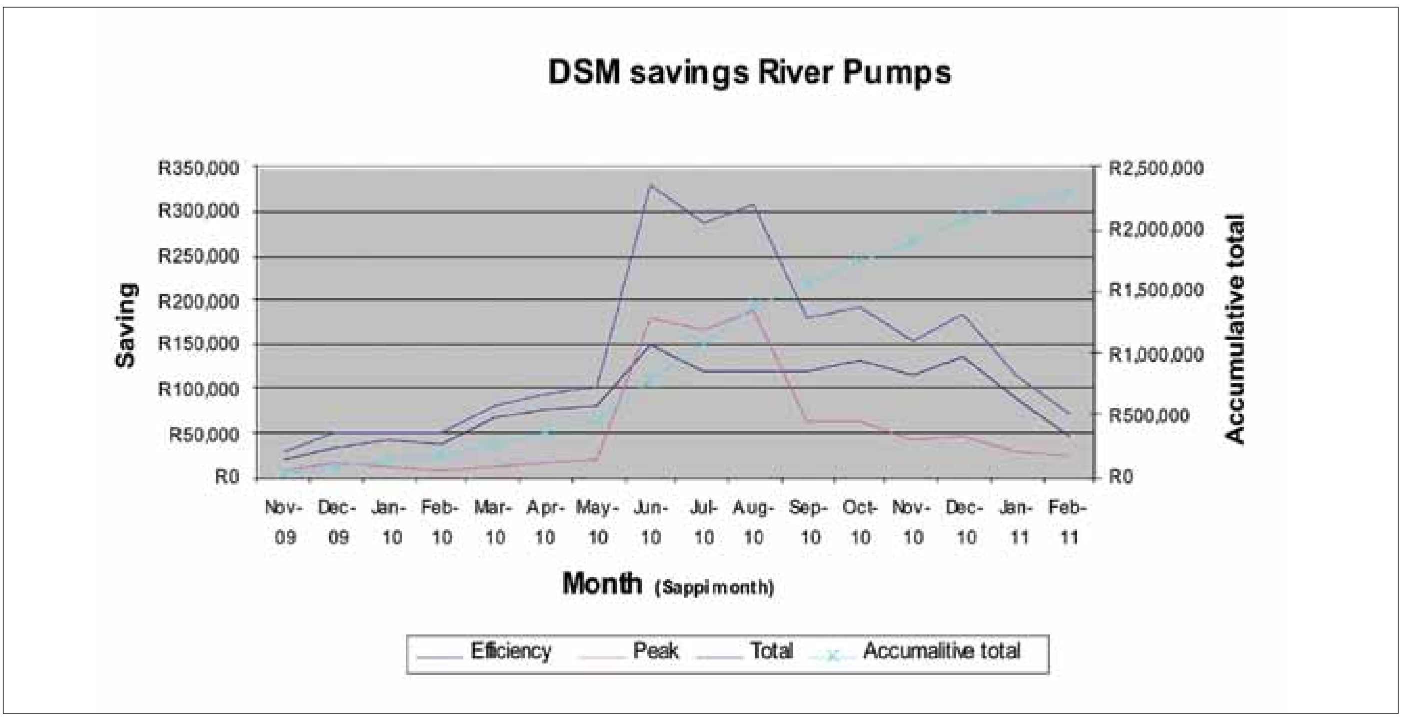
The event included presentations on the principles of DSM, the development of the Sappi-Eskom DSM Agreement over a period of three years, the scope and design criteria of the project and a visit to the river pump station where attendees could see the plant in operation, the new equipment which had been installed and the state-of-the-art PLC-based control and energy savings system.

Tugela Mill now has a substantially upgraded and improved river pump station with state-of-the-art process control that is capable of pumping the Mill's daily requirement of water in less than 20 hours therefore providing the opportunity to shift load from peak periods to off-peak periods, using existing water storage capacity and without impacting on the security of the supply of water to the plant operations.

Month	Efficiency	Peak	Total	Accumulative Savings
Nov-09	R 20,612	R 9,290	R 29,902	R 29,902
Dec-09	R 35,047	R 15,399	R 50,446	R 80,348
Jan-10	R 41,525	R 10,089	R 51,614	R 131,962
Feb-10	R 39,135	R 9,658	R 48,794	R 180,756
Mar-10	R 65,982	R 12,933	R 78,915	R 259,671
Apr-10	R 76,433	R 17,345	R 93,778	R 353,450
May-10	R 82,517	R 20,344	R 102,861	R 456,311
Jun-10	R148,531	R 181,206	R 329,738	R 786,049
Jul-10	R 119,178	R 166,626	R 285,804	R 1,071,852
Aug-10	R 120,598	R 188,245	R 308,843	R 1,380,696
Sep-10	R 119,954	R 61,404	R 181,358	R 1,562,053
Oct-10	R 130,171	R 61,245	R 191,416	R 1,753,470
Nov-10	R 112,923	R 40,858	R 153,781	R 1,908,049
Dec-10	R 137,422	R 46,386	R 183,808	R 2,091,858
Jan-11	R 88,320	R 28,224	R 116,545	R 2,208,402
Feb-11*	R 6,697	R 4,089	R 10,786	R 2,219,188

Table 1 (Left): Savings to date including incremental savings during construction and commissioning of the project works.

- Month to date only
- January 2011 was a bad month compared to the previous months. This is due to sanding up of equipment during high river levels and a low lift pump failure.



Performance of the upgraded pump station

In terms of the DSM Agreement the performance of the project is being monitored and verified by an independent Measurement and Verification Team from the University of Cape Town. A second verification on 07 September 2010 confirmed the following performance:

Parameter	Design	Actual	% of design
Load shifting	1,850MW	1,960MW	106
Energy savings	0,185MW	0,233MW	120

Table 2: Funding sources and savings

Total Project Cost	R9 553 368
DSM Contribution	R6 853 368
Mill Contribution	R2 700 000
Predicted Annual Savings	R1 752 000
Actual savings to 2010/10/31	R1 753 470

Table 3: Payback periods.

Without DSM Contribution	5.45 years
Projected with DSM Contribution	Less than 1 year

The project received the 21st Department of Energy / Eskom ETA (η) Award for Industrial Projects in 2010. The project was also nominated for the Sappi Technology Innovation Awards (TIA) in 2010.

The event was oversubscribed and the 40 attendees included members of the SAIEE and ICMEESA, representatives from Eskom and Magnet Electrical - the DSM ESCO, Sappi employees from various pulp and paper mills and Sappi Management and Engineers who were responsible for the project. Attendees registered as engineering professionals with the Engineering Council of SA earned 0,5 CPD credits for attendance of this outstanding technical event.

Attendees in front of the Sappi Tugela mill entrance. Front (ltr): visitor to the site, Gareth Jago, Sappi Enstra, du Toit Grobler Sappi SA, Braamfontein, Johan de Klerk, Sappi Tugela – DSM Project Engineer. Back (ltr): Pat Naidoo, Incoming Vice President 2011 , SAIEE, Vincent Pillay, Sappi Saiccor, Gill Nortier, Secretary: SAIEE KZN Centre, Andrew Coakley, Pöyry Southern Africa, Chris Ramble, Chairman: SAIEE KZN Centre.

SAIEE forthcoming events

Date : 4/3/2011
Event : *SAIEE Council Day*
Venue : SAASTA Meeting Rooms, 18A Gill Street, Observatory

Info : For further information please contact Gerda Geyer 011 487 9043 or geyerg@saiee.org.za

Date : 9-10/3/2010
Event : *LV VARIABLE FREQUENCY CONTROL COURSE* : Presenter Chris Conroy
CPD validated for 2 CPD credits
Venue : SA Museum of Military History, Eastwold Drive, Saxonwold, Johannesburg

Info : For further information please contact Sue Moseley 011 487 9047 suem@saiee.org.za

Date : 23/3/2011
Event : METERING FUNDAMENTALS COURSE : Presenter John Michel Smith
CPD validated for 1 CPD credit
Venue : SA Museum of Military History, Eastwold Drive, Saxonwold, Johannesburg

Info : For further information please contact Sue Moseley 011 487 9047 suem@saiee.org.za

Date : 31/3/2011
Event : *SAIEE ANNUAL GENERAL MEETING*
Venue : SA Museum of Military History, Eastwold Drive, Saxonwold, Johannesburg

Info : For further information please contact Gerda Geyer 011 487 9043 geyerg@saiee.org.za

Continuing Professional Development

SAIEE Courses

The SAIEE recently ran its very popular TECHNICAL DOCUMENT WRITING FOR ENGINEERS course. Demand was such that two courses had to be run and both were fully booked. This training is considered essential for progressive engineers who are renowned for not communicating their good work.

The course is part of the extensive SAIEE Continuing Professional Development (CPD) and Skills Enhancement Programme intending to serve its members and engineers in the electrical engineering fraternity.

The SAIEE is committed to hold at least 2 CPD courses per month, running February to November in 2011 and members should diarise the following are the upcoming CPD validated courses :

Date : 9-10/3/2011
Event : LV VARIABLE FREQUENCY CONTROLS
2 CPD credits

Date : 23/3/2011
Event : METERING FUNDAMENTALS
1 CPD credit

Date : 6/4/2011
Event : ELECTRIC POWER CABLES
1 CPD credit

Date : 13/4/2011
Event : PROTECTION FUNDAMENTALS
1 CPD credits

Date : 25-26/5/2011
Event : Finance Essentials for Engineers
2 CPD credits

Contact Sue Moseley on 011 487 9047 or suem@saiee.org.za should you need any further information about the SAIEE's CPD course programme.

The only good watt is a negawatt

Mining | Generation | Transmission | Point of use

Due to intrinsic inefficiencies, 33 units of energy consumed at the point of use require 100 units of primary energy

What's a negawatt? The one you didn't use.

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Yes, the smart grid is coming and we are actively implementing intelligence and innovations to help make it a reality. But we need a solution that will save energy and drive efficiency today as we are building the smarter grids of tomorrow.

Introducing EcoStruxure™: Active Energy Management Architecture from Power Plant to Plug™

Right now, EcoStruxure solutions from Schneider Electric™ can reduce your energy use by up to 30% while cutting capital and operational costs. End-use efficiency is where our focus needs to be! The percentage of revenue spent on energy by companies could reach 30% by 2020. And there is an urgent need to reduce CO_2 emissions, especially as energy demand escalates. Energy management is the key – the fastest and most effective solution to curb greenhouse gas emissions while improving business performance. In fact, by 2030, energy efficiency and behaviour change will offset more CO_2 than all the new wind, solar, and other alternative energy generation methods combined.*

EcoStruxure

EcoStruxure solutions cut energy costs today

As energy prices continue to climb, every unit of energy you save matters. One unit saved at the point of use means three units of primary energy not consumed. Today, only EcoStruxure Active Energy Management architecture can deliver up to 30% energy savings across your buildings, industrial plants, and data centres. You deserve an Efficient Enterprise™!

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