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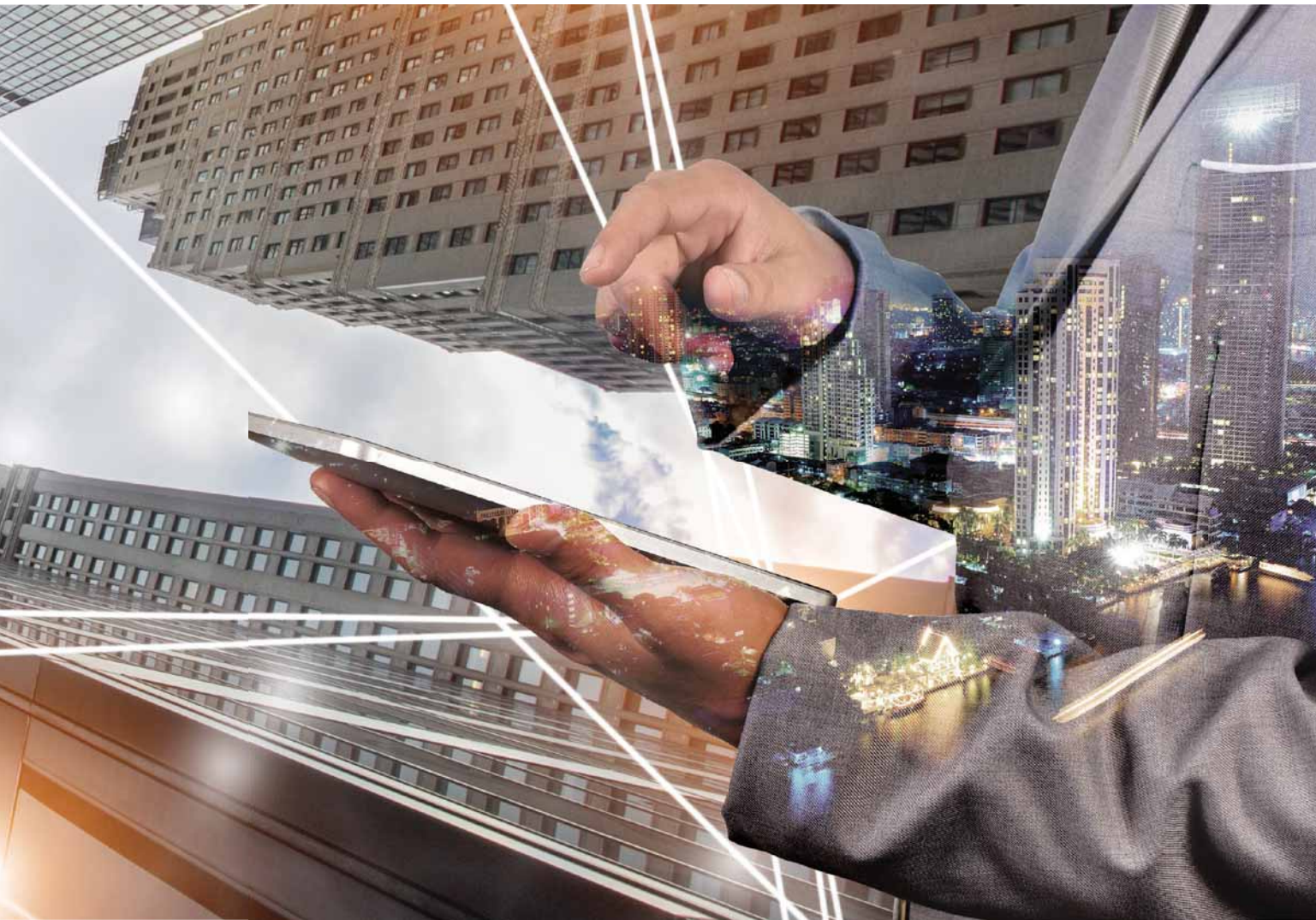
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Renewable energy sources, particularly solar technologies, are rapidly gaining momentum in Australia. But the transition to a renewables-powered grid is far from straightforward.



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While Australia enjoys high rates of solar energy production, much of the power generated is still not harnessed, stored or distributed. Community battery storage could offer a solution.

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Electrical accessory manufacturers have entered the home automation market. How can electrical contractors adopt them to better service their clients?






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PV, OR NOT PV?

There's no doubt that the solar industry is here to stay. Despite falling feed-in tariffs and some scare-mongering from some special interest groups, the solar industry in Australia continues to grow, driven by the collective desire for cheaper power and a lessened impact on the environment.

For electricians looking to expand their offerings, solar has proven itself somewhat of a godsend. It has opened many doors and certainly aided in contractor cashflow around the nation.

But, here's the rub.

It's no secret that the electrical network in Australia is ageing and when it was first designed, nobody expected solar to become as popular as it is. The network simply isn't designed for the dramatic increase in feed-in and, should the popularity of solar continue to grow, then it won't be good news for network operators.

I realise that to many people, feeling sorry for electricity network operators is akin to feeling sorry for taxi drivers in the wake of the launch of Uber, but the issues extend beyond operators with reports already emerging of networks being overwhelmed by the amount of solar-generated power being pushed back into the grid.

So, what's the solution? Surely, it's not slowing or stopping the roll-out of solar panels. At this point, that seems as unlikely of Australia ever winning Eurovision.

Of course, we could call on network operators to fix their aged network, but who will pay for that? The cost of electricity is already ridiculous, do you really want to pay more?

No, the reported solution appears to come in two stages: stopping feed-in and an effective rebate system for the adoption of solar storage systems.

When I say 'stop feed-in', I don't simply mean cancel tariffs, I mean stop feed-in altogether (thought I'm

not sure if or how this is possible). Until that occurs, contractors need to stop selling solar based on feed-in tariffs and focus more on the affordable power and environmental arguments (laughable, I know).

In reality, this is no easy or identifiably realistic solution to this challenge.

In this edition of *Electrical Connection*, we have found ourselves with an abundance of solar-centric articles, which will hopefully give contractors new insight into the technologies in play and the reasoning behind them.

Our cover story (on page XX) looks at the issue that I've written about in this column - how do we address the challenge?

Freelancer John Power (has there ever been a more appropriate name gracing these pages?) deep dives into the challenges and talks to some insiders who believe they know the way forward.

On page XX, Phil Kreveld looks at developments in remote access technologies for inverters in the commercial sector.

Then, on page XX, he looks at how to best protect solar installations from the dangers of lightning strikes.

On page XX, Ross McGravie looks at the new and 'fringe' technologies that are being trialled in battery storage technologies, including hydrogen, compressed air and supercapacitors.

Finally, on page XX, I speak to a social entrepreneur (whatever that is) and a bunch of final year uni students about a solar-powered tuk tuk that is making the rounds around the world.

I hope you enjoy this edition and find some new ideas for your business moving into 2019.

Until next time,



Paul Skelton

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CONTRIBUTORS



JOHN POWER

Solar

John Power is a freelance journalist based in Cherokee, Victoria, and a former editor of *Building Connection* and *Plumbing Connection*.

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BRIAN SEYMOUR

Estimating

Brian Seymour MBE is an industry consultant and author of four books, including *Electrical Estimator's Labour Unit Manual*; *Starting Out*; *Electrical Contracting in Australia*; and, *100 Years Electrical Contracting in Australia*. He conducts regular industry training programs throughout Australia on behalf of the electrical and air conditioning industries, focusing on estimating.

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MURRAY TEALE

Technically Speaking

Murray Teale is the technical director of VTI Services with responsibility for the establishment of conformance requirements for mandatory and technical communication cabling standards. He has worked within the electrotechnology field since 1979 in Australia and the UK and has been heavily involved with the standardisation process since 1998.

See page 44



PHIL KREVELD

Let's Get Technical

Phil Kreveld is an energetic energy writer and electrical engineer. He has worked in electrical, electronic and scientific instrumentation, including relay testing power and power quality analysis, in Australia and the US. Phil is also quite an adept artist, regularly showing his paintings in galleries around Victoria.

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ROSS MCGRAVIE

Battery Tech

Ross McGravie is an award-winning journalist/subeditor who never wants to stop learning or enjoying life.

See page 32



JAMES TINSLAY

Apprentices

James Tinslay is a consultant and engineer with some 40 years of experience dealing with the electrical contracting industry. He is an ex-CEO of NECA - an organisation he has worked with since 1988 - and is a current director of NECA Electrical Apprenticeships and Standards Australia. He also runs his own consultancy firm, JCT Advisory.

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NECA WELCOMES CANCELLATION OF VET FEE-HELP DEBTS

Young Australians who were ripped off by unscrupulous training providers under the failed VET FEE-HELP scheme have received some welcome news.

The Federal Government has announced a plan to introduce legislation that seeks to cancel inappropriately incurred debts. Under the scheme, a number of unethical training providers and their agents targeted vulnerable or unsuitable people and lured them into signing up for a course.

These young people ended up with insurmountable debts and often a worthless qualification. The National Electrical and Communications Association (NECA) believes the waiving of debts, in particular for those students who were saddled with course expenses for a worthless qualification, is encouraging. This decision clearly draws a line in the sand and helps to rebuild confidence in the future of VET.

"The failed VET FEE-HELP program enabled a situation where

a small number of unethical training providers targeted vulnerable and often unsuitable students, which led to a drop in standards and a loss of confidence in the VET sector," NECA chief executive Suresh Manickam says.

"The appalling behaviour of these unethical providers created an inequitable situation for the countless students caught up in the scheme, as well as tarnishing the reputation of quality Registered Training Organisations."

Suresh says VET education is just as important as a university degree and the parents of young Australians should know that learning and training standards are rigorous and of high quality.

This is especially important as we seek to address future skills shortages in the electrical trades.



BETTER MENTAL HEALTH IN TRADE INDUSTRIES NEEDED

The rate of suicide among men in the trades industry, especially lower skilled employees, is approximately double that of the general male working population.

It's this trend that motivated Australian not-for-profit AccessEAP to launch *Toolbox Talks*. These sessions focus on increasing awareness of mental health issues and helping men to understand that at some point most people need help and that help is available.

AccessEAP relationship management director Eleni van Delft has already provided tailored *Toolbox Talks* to organisations in the manufacturing, mining and construction industries and is amazed by the immediate effect it has had on participants.

"Often in male-dominated industries, the macho mentality still

exists where men are afraid to show weakness, sadness or vulnerability," says Eleni.

"If men don't feel like they can open up, it can have a detrimental effect on their mental wellbeing."

With a recent focus on promoting a healthy body and healthy mind, *Toolbox Talks* helps build awareness in some of the more male orientated workplaces where mental health issues are prominent.

"Talking about problems and taking action are proven ways for male tradies to stay mentally healthy, but it's still difficult to get them to take that all important first step," explains AccessEAP clinical services director Marcela Slepica.

Managers and employees need to be educated on the behaviours that may indicate a colleague is going through a tough time and learn ways to encourage them to seek help if there is concern for their welfare.

VICTORIAN REGULATORS JOIN FORCES TO SUPPORT STATE-WIDE SOLAR ROLLOUT

Worksafe, Energy Safe Victoria [ESV] and the Victorian Building Authority [VBA] have joined forces to maximise safety for workers and householders during the rollout of 30,000 new solar power and hot water systems across Victoria.

"Agencies across government want to make it very clear that safety breaches will not be tolerated," Solar Victoria chief operating officer Jonathan Leake says.

"The primary responsibility for safety lies with installers and the people or company employing them.

"Compliance with Victoria's long-standing workplace health and safety and electrical safety laws has to be the paramount consideration.

"Solar retailers, installation companies, their contractors and workers have very real commercial and personal reasons to getting safety right the first time because there often aren't second chances."

The Victorian Government's *Solar Homes* program requires installers to be suitably trained, qualified and have the right equipment to safely do their work. That includes fall protection when working at height, electrical safety and meeting a range of other installation requirements.

"Failing the safety test may lead to you being removed from the Clean Energy Council's Accredited Installers lists and referral for investigation and prosecution by the appropriate agency," Jonathan says.

"We know most people and companies in the solar installation industry are working hard to do the right thing, but experience shows that people who are under time pressures can ask someone else to do something dangerous, or believe that because they have experience that means they're safe.

"It actually means it's a shortcut to disaster."

NECA WELCOMES \$60M INVESTMENT IN RURAL VET EDUCATION

The National Electrical and Communications Association (NECA) has welcomed the Government's investment of \$60 million in a trial wage subsidy aimed at encouraging regional and rural employers to engage apprentices across selected trades.

"This is welcome news for the electrotechnology sector and will help address the current and future shortage of quality electrical apprentices Australia is facing, particularly in rural and regional areas," says NECA chief executive Suresh Manickam.

NECA has strongly argued that VET education is just as important as a university degree and calls on all levels of government to promote trades career pathways as both viable and rewarding.

MIDDY'S SCHOLARSHIP FUNDS TOP ONE MILLION DOLLARS

Middy's Data & Electrical's annual Australia-wide scholarship program fund has handed out a total of \$1m to 120 recipients.

Just over 10-years ago, joint directors Nicholas and Anton Middendorp were looking for an additional way to give back to the industry.

They decided to create a scholarship program to encourage electrical contractors to undertake more training to improve their business processes and skills.

The Middy's Scholarship Program is open to include all A-grade electricians, fourth year electrical apprentices and data installers (with ACMA Open Registration accreditation) right across Australia.

Winners either receive a \$5,000 (Silver) or \$10,000 (Gold) scholarship to be used on any aspect of training that they or their business is in need of.

Scholarship recipients can select from a wide range of courses that are relevant to them from any Registered Training Organisation (RTO) in Australia.



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LEGRAND EXPANDS ITS COMMERCIAL PORTFOLIO WITH CP ELECTRONICS

Legrand has announced that it's adding CP Electronics – a global specialist in lighting, heating and ventilation solutions – to its commercial portfolio.

UK-based CP Electronics is a significant player in the lighting control field. The company's main driver is to help businesses reduce their carbon footprint through cost-effective lighting, heating and ventilation control systems.

With a track record of providing prestigious products, CP Electronics has a strong reputation for providing reliable and innovative solutions that suit a wide range of commercial and industrial applications.

CLEAN ENERGY COUNCIL LAUNCHES HOME BATTERY PROGRAM

A new quality assurance program developed by the Clean Energy Council will provide consumers with independent information on the safety of home battery products.

Clean Energy Council chief executive Kane Thornton says the new program confirms which home battery products have been tested against the industry's best practice guidelines.

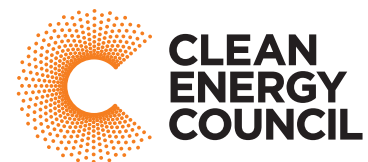
"Simply put, products that qualify for the Clean Energy Council's Battery Assurance Program meet the standard we should all expect for a major appliance we are installing in our homes," he says.

"The products have been independently tested to confirm they

are up to the necessary electrical safety and quality standards.

"Energy storage technology has the potential to completely revolutionise the way we use and think about energy. This program is part of a huge suite of initiatives, by the industry for the industry, to ensure the continued confidence of consumers long into the future."

A list of the products that have qualified for the Clean Energy Council Battery Assurance Program will be available on the Solar Accreditation website.



NECA AND MEA NEGOTIATIONS HAVE NOW CEASED

Negotiations between the National Electrical and Communications Association (NECA) and the Master Electricians Association (MEA) exploring better ways to represent the electrotechnology industry as a single entity have now ceased.

"This is a missed opportunity for electrical contractors, our industry stakeholders and our long-term sponsors," NECA president Alan Brown says.

NECA has said it will continue to focus on delivering improvements to its members and its long-term sponsors across Australia.

AUSTRALIA INVESTS IN ULTRA-RAPID CHARGING STATIONS

Electric vehicles will soon have access to an ultra-rapid charging network along the major driving routes from Brisbane to Adelaide, including around Sydney and Melbourne, and separately in Western Australia.

The Australian Government, through the Australian Renewable Energy Agency (ARENA), will provide \$6 million to Chargefox to develop 21 ultra-rapid charging stations powered by renewable energy.

The \$15 million network is expected to have no more than 200km between stations, which are within the range of current electric vehicles.

The ultra-rapid charge will provide a range of up to 400km in just 15 minutes, compared to a current charging time of several hours.

The stations will be open to the public and all electric vehicle models currently sold in Australia.

Euroa in Victoria and Barnawartha North, outside Albury-Wodonga on the New South Wales-Victorian border will be the first sites for the charging stations.

A WARNING TO SOLAR PANEL RETAILERS ON MARKETING TACTICS

Solar Victoria and Consumer Affairs Victoria have joined forces to establish a taskforce that will maximise consumer protection as a state government solar rebate program is rolled out.

The two agencies are working together to combat high-pressure tactics, inaccurate marketing and poor service.

Solar Victoria chief operating officer Jonathan Leake has urged consumers to use retailers who have signed the Clean Energy Council's *Solar Retailer Code of Conduct*, which aims to lift standards in the solar industry.

"This is a growing industry, and while most people in it will always do the right thing, others are undermining

the good operators and community confidence," Jonathan says.

The Victorian Government's \$60m *Solar Homes* rebate program requires installers to be accredited with the Clean Energy Council (CEC) and for them to install products approved by the CEC.

"Companies signed-on to the *Solar Retailer Code of Conduct* are better positioned to influence the industry's future direction," Jonathan adds.

"This program is helping Victorians to significantly reduce their energy costs, but we won't tolerate those who are fraudulently taking advantage of vulnerable people."

"Compared with the number of installations, we are receiving relatively few complaints, but there could be more."

AUSTRALIAN SUBCONTRACTORS IN CRISIS UNLESS GOVERNMENTS ACT NOW

An industry association for subcontractors has called for urgent intervention from the Federal Government to address the regular forced insolvency thousands of Australian subbies experience when building and construction companies fail to pay.

The Australian Subcontractors Association [ASA] ramped up demands for government action in response to the recent collapse of one of Australia’s oldest engineering firms, which will have a major impact on thousands of subbies.

“When it comes to the collapse of companies that rely on subcontractors to undertake the work, the domino effect can be devastating. Unfortunately, the subbies are often

left to fend for themselves,” says Australian Subcontractor Association [ASA] spokesperson Louise Stewart.

“When companies fail to pay subcontractors for work done, the subbies still have to pay employee entitlements and taxes.”

A 2015 Senate inquiry into insolvency found that the industry is burdened every year by an estimated \$3bn in unpaid debts, including subcontractor payments. In 2018 alone there have been 1,642 construction businesses that have become insolvent. A high percentage of these insolvencies have been attributed to misconduct.

“Sadly, non-payment issues have long plagued the industry – as evidenced by one subcontractor that has lost \$9 million due to a company not paying for work done,” Louise says.

The ASA stated that one family-owned subcontracting business has already lost millions because of the same company delaying payments for over a year. As a result, the two couples who own the business will have to lay off hundreds of employees and stand to lose their family homes.

The ASA believes national legislation is needed and either cascading statutory trusts or cascading project bank accounts must be mandated.

“The Queensland government is certainly taking the lead on this and has made project bank accounts a legal requirement. However, greater responsibility needs to be taken at all levels. Governments need to act to legally impose these solutions and ensure contractors pay subcontractors rather than spending their money.”

GOLD COAST TAFE NAMES APPRENTICE OF THE YEAR 2018

TAFE Queensland Gold Coast has recognised the next generation of exceptional trades men and women at the seventh annual Apprentice Celebration and Awards Evening held at The Star Gold Coast.

The highlight of the evening was the announcement of the Outstanding Apprentice of the Year 2018 winner. This year’s winner is fourth year electrotechnology student, Charlie Elizabeth Nightingale, who was nominated by her teacher for her quality workmanship and commitment to the electrical industry.

“I’m so honoured to have received

this award. I did not expect it and it came as a huge surprise,” says Charlie.

“Initially, I kicked off my studies with a business degree and changed after two years as I realised it wasn’t for me. I wanted something more practical and physical that got me moving instead of being stuck at a desk all day.”

TAFE Queensland Gold Coast general manager Karen Dickinson says: “Charlie has impressed all of her teachers, and work colleagues, who have nothing but praise for her quality work and commitment. She is enthusiastic, organised and professional about all aspects of her course.”

Charlie is employed at Tri State Electrical & Communications.

SONNEN TO MANUFACTURE BATTERIES IN AUSTRALIA

Germany’s sonnen Group is commencing the manufacturing of sonnenBatteries in Australia with the first product to be assembled at its manufacturing facility in Elizabeth, South Australia.

sonnen has recruited 50 new full-time employees in Adelaide to manage its production, call centre and technical support operations. It has also expanded its warehousing in Australia with an additional 1,000m² of warehousing space leased at LIONSGATE Business Park to store sonnenBatteries.

“sonnen has established a presence in Elizabeth at a time when South Australia’s manufacturing industry is undergoing a period of transition,” says chairman of Pelligra and owner of the LIONSGATE Business Park Ross Pelligra.

sonnen aims to produce 10,000 batteries each year to meet demand from Australian households and for export to Asia Pacific.

It plans to create up to 430 new jobs in South Australia as it ramps up production as a home battery supplier for the \$100m South Australia Home Battery Scheme.

EVOLT: “MORE CAN BE DONE”

Evolt has been a long-term advocate for environmentally friendly batteries; but, Evolt general manager MMR Eduardo Yudowski feels more noise is needed in the market place to grow awareness of the critical need for all manufacturers to use only environmentally friendly batteries, such as LiFePO4 in emergency and exit lighting products.

“Most reputable brands have migrated to LiFePO4; however, there is still a presence of lead acid or nickel cadmium batteries in the market place, which critically compromises the environment,” says Eduardo.

“Evolt is calling for a national approach. We believe making collection points more accessible means it’s easier for contractors to do the right thing.”



LEGRAND FLUSH-MOUNT SMOKE DETECTOR

Legrand has launched its new flush-mounted smoke alarm. Like its surface-mount partner, the new flush-mount alarm uses photoelectric technology that aims to provide optimum protection against smouldering fires.

The new smoke alarm is inter-connectable; it can be connected to a maximum of 20 units. Further, gone are the days of battery charging, the lithium battery eliminates the need to ever change the battery. Simply replace the entire unit after 10 years of use. The flush-mount uses the same cut-out as a 90mm downlight. This means any downlight with these measurements can be easily replaced to house this unit.

Legrand Australia
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EATON AFDD+

Eaton has announced the arrival of the new Eaton AFDD+, an arc fault detection device that provides critical all-in-one protection against electrical fires in homes and buildings.



With built-in arc fault detection, earth leakage current protection (RCD), short circuit and overcurrent protection (MCB) technology in one compact device, the AFDD+ can be easily installed on switchboards for new-builds or retrofitted in residential applications.

Standard switchboards with RCD and MCB circuit protection are unable to detect electrical arc faults that are the root cause of most fires – so by adding an extra layer of protection with Eaton AFDD+, arc faults can be detected early, immediately isolating the damaged cable and effectively eliminating the ignition point.

Eaton
www.eatoncorp.com.au

SCHNEIDER ELECTRIC POWERLOGIC ION9000



Schneider Electric has released its most advanced power quality and energy meter, the PowerLogic ION9000 series.

Through advancements in IoT, analytics and accuracy, this newest addition to the PowerLogic portfolio of power and energy meters provides the most complete power analysis solution for critical power applications.

The ION9000 is a key element in the EcoStruxure Power platform, part of Schneider Electric's EcoStruxure architecture, the open and interoperable system architecture for building, grid, industry and data centre customers.

Schneider Electric
www.schneider-electric.com.au

NHP N-LINE ENCLOSURES

NHP has strengthened its range of N-Line thermoplastic terminal indoor enclosures by releasing four additional sizes.

Available now in 13 sizes, this range provides flexibility dependent upon installation requirements. Providing IP65 ingress protection and IK07 impact resistance protection, these enclosures ensure the ultimate defence against water and dust ingress.

Complementing the grey base (RAL 7035) there are options of grey or transparent covers, both of which are halogen free and RoHS compliant, offering smooth covers for printing and signage for customised solutions.

This range allows for mounting plates and pre-cut DIN rail to suit, as well as having wire seal compatible cover screws to ensure anti-tampering.



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WEIDMULLER MAXGUARD

Fail-safe and maintenance-friendly control voltage distribution that can be installed in a time- and space-saving manner are a must for efficient machine and facility operation. With the new maxGUARD system, the terminal blocks [previously installed separately] for distributing potential to the outputs of the electronic load monitors become an integral part of a 24V DC control voltage distribution solution. The new combination of load monitoring and potential distribution saves time during installation, increases safety against failure and reduces the amount of space required on the terminal rail by 50%.

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NHP NEMO 96EA

The newly released NEMO 96EA from NHP provides high accuracy monitoring of energy and power measurements, ensuring you have all the important information required to identify consumption trends and any power quality issues.

The NEMO 96EA captures critical events such as voltage dips, interruptions, sags and swells, flicker, rapid voltage change, and THD analysis [individual harmonic analysis up to the 40th harmonic] providing valuable insights into the power quality onsite.

Featuring 8MB of built-in memory that allows the storage of up to 3,000 events, as well as energy consumption and real-time variables, the NEMO 96EA includes Modbus RTU communication as standard for remote monitoring. This modular power analyser integrates with digital and analogue I/O modules for the complete energy management solution.



NHP Electrical Engineering Products
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B&R POLYNOVA PU



B&R has introduced Polynova PU, a new range of general purpose enclosures.

Polynova PU enclosures are designed for outdoor use with IP66 and are suitable for low voltage double insulated applications. The enclosures feature 3-point locking with a swing handle, one-quarter turn locking on 300x250x40mm enclosures and insulated mounting pans.

Solid or window door options are available, with a range of optional accessories also available for purchase.

B&R Enclosures
www.brenclosures.com.au

MIXO GIGABIT

Treotham Automation has announced its latest modular connector unit, the MIXO Gigabit.

The robust and compact modular connector unit is a solution for challenging the need of shielded connectors in sectors like railway, wind, energy, factory automation application and other harsh industrial environments.

The 8-pole module, with its zinc alloy shield, features high signal integrity. It is suitable for different industrial Ethernet standards, or even just where shielded signals have to be connected. The MIXO Gigabit unit can be combined with other modular units of the Ilme MIXO series with a wide range of metal or plastic enclosures.



Treotham Automation
www.treotham.com.au



IPD EXT56 SWITCHBOARD ENCLOSURE

The IPD EXT56 is a switchboard enclosure system designed, tested and certified for outdoor applications. Made from marine-grade aluminium to withstand Australia's harsh climate the EXT56 system is an off-the-shelf modular structure, UV resistant, non-toxic and fire-retardant.

Unlike custom welded enclosures, EXT56 is adapted to suit techno modular framework and can be designed to provide access from all angles, decreasing assembly times and reducing labour costs.

The EXT 56 is available in a sanded finish or powder coated to suit specific application requirements.

IPD
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ADEPT DIRECT FOLDING CABLE STAND

Adept Direct has released a new lightweight folding cable stand that fits in under its range of heavy duty cable dispensers.

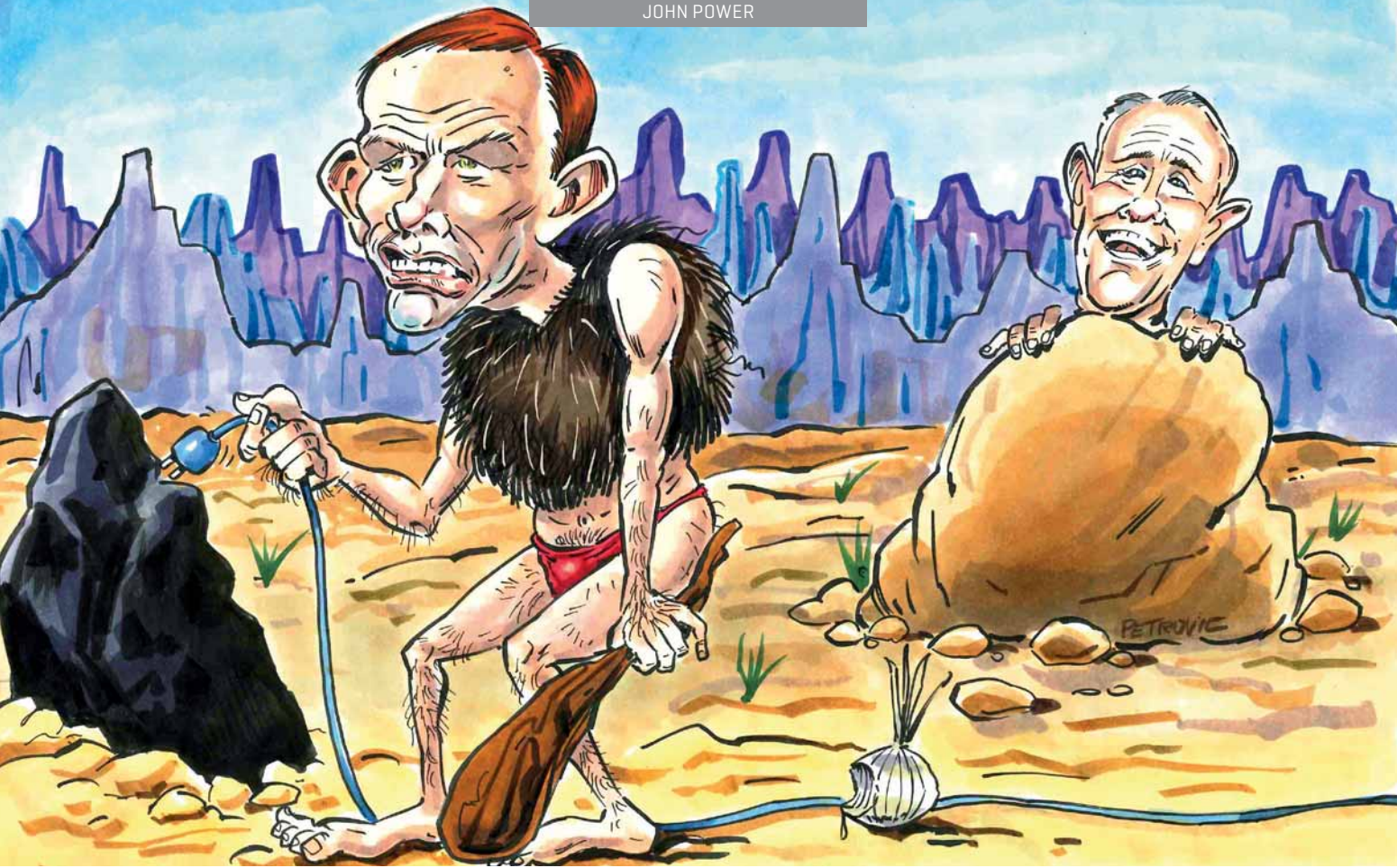
The new compact cable dispenser is specifically designed for smaller reels of telecommunications cable and wires. Incorporating a folding mechanism that also locks the axle into position, the new cable stand can be used to carry and unroll a number of cables at the same time.

When folded into itself the new cable dispenser is extremely compact for storage and transport.

Adept Direct's folding cable stands are available online in a bright yellow or galvanised steel finish and can be shipped anywhere in Australia.



Adept Direct
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CONTRACTORS: HERE'S THE 'GOOD OIL' ON RENEWABLES

Renewable energy sources, particularly solar technologies, are rapidly gaining momentum in Australia, writes **John Power**. But the transition to a renewables-powered grid is far from straightforward.

When discussing renewable sources of energy, it is important to make one point clear from the outset: renewable energy systems – primarily (but not limited to) solar- and wind-powered technologies – will inevitably replace coal-powered energy production just as assuredly as the car replaced the horse and cart.

How can we say this with certainty? Photovoltaic- (PV-) and wind-based energy sources are already cleaner, cheaper and more environmentally responsible than fossil fuel-burning systems, including gas. And consumers have made up their mind: a quarter of Australia's households (2 million) have already installed solar power systems... and the uptake is quickening. This trend

demonstrates a surging consumer preference for renewables over antiquated, costly and polluting dinosaur technologies like coal combustion. Given the scientific and market forces working in favour of renewables, a gambler would be a fool to back T-Rex over Tesla.

However, like any technological transition, the switch to a predominantly renewables-based future will require both political and technical prowess, no doubt beset by teething problems along the way. The hurdles are significant: for instance, the replacement of a 'centralised' fossil fuel production methodology with a cornucopia of 'decentralised', mixed-media renewable energy sources will require great ingenuity;

and managing the mix will need both civic and domestic behavioural change and cooperation in order to maximise efficiency and reliability.

Nevertheless, the transition is in motion... and hypothetically fully achievable within our lifetime, says Glen Morris from SolarQuip, which specialises in renewable energy training, design and installations. Glen has more than a decade's experience as a TAFE instructor in Victoria and has expertise in the practicalities of solar energy implementation for domestic and commercial applications.

When examining renewable energy topics, Glen says, it is important to realise that the creation of a renewables-based grid involves more

than simply ‘unplugging’ coal and ‘plugging in’ solar and wind or similar renewable energy sources. On the contrary, any meaningful discussion must involve an acknowledgement that the structure and useage of a future renewables-based grid will be very different from today’s models.

The grid of the future will be characterised by:

(a) GREATER DIVERSITY – there will be more diversified types of energy production from different renewable energy sources, all fed into more heavily interconnected grids at myriad locations.

(b) LOWER DEMAND – there will be reduced overall demand for electricity through more energy-efficient home appliances and industrial practices.

(c) DIFFERENT USEAGE – a greater emphasis on daytime energy consumption habits and storage methods, including ‘smart’ home automation-assisted operations, to maximise the effectiveness of solar energy production.

(d) MORE AUTONOMY – while most homes and businesses of the future will remain connected to the grid, there will be greater domestic self-sufficiency, as well as more autonomy at local levels through micro-grids and embedded networks, which will help streamline and minimise pressure on the grid.

Glen says all these elements, considered in tandem and applied within sensible regulatory frameworks, should provide more than ample renewable energy to fulfil Australia’s total electricity needs.

BACK TO BASICS

Let’s examine current renewable energy capture and storage systems, particularly in relation to solar energy, at a local level, and then expand our horizons to see how civic and national models might function.

Traditional electricity supply models in Australia have been based around centralised production facilities sending

energy into massive grids, but energy can flow in both directions.

“The ability for energy to flow in reverse direction, and to flow from the customer’s premises back to the grid, has allowed the customer to get some impact from the low voltage [LV] network,” Glen says, noting that consumer interest in grid-connected solar power generation in Australia really took off in 2007.

It works like this: homes generate direct current [DC] solar energy via rooftop panels, which is converted into alternating current [AC] by an inverter. If the solar energy being produced by the household is greater than the energy being consumed, then the surplus AC

energy is fed back into the local grid, resulting [hopefully!] in a healthy rebate back to the customer.

Initially, thanks to generous government incentives to install solar energy systems, rebates [or Feed In Tariffs: FITs] of up to 60 cents per kilowatt

hour [kWh] were being paid to customers in states like New South Wales and Victoria. Today, most FITs sit around eight cents per kWh or less; meantime, the cost of purchasing power direct from the network can cost from 15–30 cents per kWh.

What is stopping large property owners from going into business as mini power stations? The answer is that household energy flows being exported back into the grid are capped, regardless of the size or output of the particular user’s solar capacity. Again, levels vary across different networks, but feed-in thresholds of 3–5 kWh are common.

“Since 2015 inverter systems connected to the grid have had to comply with updated Standards AS/NZS 4777 Part 2 *Grid Connection of Energy Systems via Inverters*, which mandates that inverters cannot disturb the network beyond its safe parameters,” Glen explains.

“So, if inverters detect that the grid voltage is approaching its limits, they must ramp down their power output. We’ve actually got built-in safety or power reduction systems built into the inverters themselves, which you can’t override.”

More on feed-in thresholds later... but first let’s quickly consider how tactics to reduce demand might improve the effectiveness of renewable energy systems from the outset.

USER HABITS & EFFICIENCIES

Before considering how renewable energy supplies function, it pays to make sure demand is as low as possible.

Lower demand relieves pressure on overall renewables infrastructure, which in turn improves the feasibility of uptake at both private and civic levels. There are many ways of reducing energy consumption at a local level.

Solar-powered LED street lighting, for instance, is a fine model of energy reduction in the public domain. Likewise, batteries linked to garage or home solar arrays could be used to recharge electric cars overnight.

Glen says energy-efficient home appliances have also helped improve energy efficiency. Star rating schemes like the Water Efficiency Labelling Scheme (WELS) on appliances have had a really big impact – “In fact, energy-efficient appliances have done much more than solar in reducing demand!”

Importantly, he says home automation is playing a leading role in the management of household energy consumption. Smart programmable appliances like washing machines can be operated in the early afternoon during optimal sunny conditions even if the home owner is away. Similarly, hot water systems and pool pumps/heaters can be programmed to operate at times of greatest efficiency instead of during the night... the whole practice of heating water at night in ‘off peak’ times arose purely to accommodate coal-fired plants, Glen says, as a means of soaking up baseloads being fed into the grid; the opposite practice should apply to solar-based renewables, i.e. heat water when the sun is shining in the middle of the day.

At an industrial level, factories

Given the scientific and market forces working in favour of renewables, a gambler would be a fool to back T-Rex over Tesla.



Glen Morris, SolarQuip.



Joshua Jordan, ITP Renewables.

or industrial estates could be encouraged to slow down production or perform maintenance when unfavorable conditions (poor sunlight and no wind, known as a 'correlation period') are likely.

On a somewhat grander scale, micro-grids and embedded networks have also helped to ease pressure from grids and streamline daily consumption levels.

Micro-grids, Glen says, refer to clusters of houses (from a few dwellings to several thousand homes), which aggregate and distribute privately generated renewable energy such as solar power. For instance, Glen says his own property is a member of a seven-

home cooperative micro-grid.

"Often one home will have a greater demand for solar, while another one is producing more than it's using," he observes.

"So often the energy is not even being 'stored', we're just directly supplying it; you start to average generation and production rather than micro-supplying exactly the right amount to every single home."

Micro-grids usually retain connection to the wider grid, he explains, but only to supplement private energy reserves. Popular with greenfield developers, micro-grids allow for the cost-effective electrification of new or remote neighborhoods in a way that will appeal to home owners, allow developers to gain a better return on their investment, and reduce hassles for networks.

Embedded networks also help streamline energy consumption at a civic level. Used mostly in defined areas like retirement villages, customers remain connected to the wider grid with their own separate meters, but the network provider's relationship is with the overall village rather than with each resident. The advantage to the network is a simplified and aggregated connection.

Grid control at a local level is not new, Glen says.

"Once upon a time it was the norm for councils to generate and sell electricity," he says.

"In my area Warburton [Victoria], for instance, they had a hydro plant that generated electricity for the Yarra Valley. Interestingly, they have just put that back online and are now supplying electricity back into the market, so that's an example of a community initiative to regain control on clean energy production."

RAISE THE CAP

Given the success of these kinds of initiatives, should households be making a bigger contribution to the grid? We've already seen how energy export levels of 3-5 kW are commonplace, but should these caps be raised?

Yes, says Matthew Wright, executive director of the companies Beyond the Grid and Pure Electric, and executive director of Zero Emissions Australia.

According to Matthew, an award-winning, postgraduate-qualified engineer, export thresholds from homes back into the grid should be raised immediately and consistently across the board.

"I'd mandate a 10kW feed-in on all single-phase connections, which covers more than 90% of the population in built-up areas," he says.

At present, Matthew explains, many electricians are finding that 5kW energy export systems are tripping out due to apparently high levels of voltage already servicing the grid.

However, he says this occurrence is mostly due to poorly calibrated transformers, which only permit a certain percentage of fluctuation above or below preset voltage levels. Two years ago, he says, the International Electrotechnical Commission (IEC) Harmonised Standard in Australia was lowered from 240V to 230V... but not all transformers were adjusted in line with this new level. Hence, a grid operating at, say, 241V two years ago might have been measured at just 1V above the prevailing guideline level of 240V [a fraction of a percentage over the threshold], whereas that same system today - suddenly benchmarked against the lower ceiling of 230V - would be a massive 11V above the new mark [a much greater percentage difference].

"Most transformers operating at 240V would happily be accepting solar exports from these domestic customers."

Recalibrating transformers, Matthew suggests, could be done cheaply and swiftly.

"I'd be putting distribution companies on notice that they need to pick up the main transformers at their zone substations so that residential feed-in runs are auto tapping separately through commercial feed-in models, that way we can fix the voltage issues that are showing up on the grid.

"Auto tap changing means they put in more coils in the transformer [at the zone substation] so the voltage get's changed; they wouldn't need to retrofit the street transformer, which is where most of the cost is."

Another reason for low export limits of 3-5 kW, he suggests, is more political.

“Most of the electricity distributors are owners of gas as well, and they know that once people get solar they go all-electric and turn off the gas.”

OBJECTIONS

One of the main objections to renewable energy is that it lacks the grunt needed to power a dynamic metropolitan environment. Sure, solar energy [from wind farms and domestic sources] met 11% of all NSW’s need in January this year, but what about the other 89%? What happens in winter when energy output levels may drop? More specifically, how can renewables overcome unfavorable conditions and correlation periods?

Glen says these kinds of questions are infuriating, declaring that Australia is a ‘superpower’ as far as renewables are concerned. Countries like Germany, he says, which has the solar resources of southern Tasmania or South Georgia due to its geography and location, frequently hits 100% renewable energy supply via both wind and solar supplies – “The Germans are phasing out their coal-fired power stations and their nuclear plants, and this is a country with nowhere near the resources that Australia has.”

[And, as Matthew adds, a solar panel or wind turbine in Germany produces approximately half the annual energy of an equivalent panel in Australia!]

Glen says some Australian localities and states are leading the way by example. In South Australia, which recently installed a giant Tesla battery facility, the state is able to satisfy 100% of its energy requirements “on a good day” from renewable sources; similarly, towns like Yackandandah in Victoria and Tarago in NSW have cut themselves off the grid completely.

Another strong objection to a renewables-based grid is its complexity, involving both immediate energy delivery systems as well as storage reserves to keep power flows reliable and consistent all day, every day.

Solar panels, obviously, generate peak energy in times of strong sunlight, so it makes sense to use as much solar energy as possible during those times of peak production.



Coal-fired power stations, in particular, are highly inflexible, which means their output is difficult to ramp up or down.

Nevertheless, Glen says, energy storage is equally necessary to cater for nighttime demand and to provide 24/7 energy security. Storage can be achieved in two principal ways, i.e. [1] battery or chemical storage, as well as [2] pumped hydro, whereby solar energy is used to pump water from a low-lying dam to a higher-level dam; the higher-level water can be released at any time to produce gravity-assisted hydroelectric power]. Stored energy can also be supplemented by other 24-hour renewable sources such as wind, geothermal, wave, biomass, etc, to deliver reliable energy at all times of the day. When averaged out over large areas, these diverse forms of energy become increasingly reliable and predictable.

Battery storage systems like the Tesla array in SA are best regarded as fast-response capacity solutions, meaning they ‘kick in’ extremely quickly [140 milliseconds] when required. Such facilities are extremely powerful assets: Matthew Wright notes that the Tesla battery array in SA can provide one-seventh of the state’s overall energy requirements, “which is pretty amazing”.

POLITICAL

When it comes to renewable energy adoption on a grander scale, there

are some fundamental engineering and political principles that must be understood.

Coal-fired power stations, in particular, are highly inflexible, which means their output is difficult to ramp up or down. This matters because electrical energy supply must be precisely and continuously matched with electrical energy demand to keep system frequency stable. For instance, if there were a surge in renewable energy in a specific locality, perhaps due to an increase in wind strength or solar generation, then one might expect that the coal-derived energy could be lowered [or even switched off] rapidly in order to prioritise the higher levels of renewable energy. Not so.

Josh Jordan, senior engineer at ITP Renewables in Canberra, says pricing is the main instrument that determines the composition of eastern Australia’s a grid’s energy at any point in time.

“The Australian Energy Market Operator [AEMO] is responsible for continuously and exactly balancing electricity supply and demand,” Josh explains.

“One of the difficulties of applying markets to electricity is that there is no room for error!”

The primary balancing act occurs at five-minute intervals. Energy generators bid for the right to provide power to the grid at any given interval,



A quarter of Australia's households (2 million) have already installed solar power systems... and the uptake is quickening.]

and AEMO instructs winning and losing bidders to adjust their output accordingly. There are severe penalties for operators who ignore or contradict AEMO instructions.

AEMA dispatches energy according to bid price, which is related to marginal generation cost. Renewables like solar and wind have a marginal generation cost which is close to zero, compared to slightly higher marginal costs for coal and much higher marginal costs for gas. Therefore, renewables with a near-zero marginal cost – which have the potential to add additional revenue through green energy certificates – are very price-competitive in this system, placing immense pressure on costlier energy generators like coal-fired plants. As Josh says, there are even times when a coal-fired plant (and even wind farms, depending on conditions) will make a negative bid to provide energy to the grid, i.e. the generator will pay for the right to provide energy – i.e., they prefer to stay online because they believe they will be able to earn higher prices in due course. There is an additional layer of supply adjustment known as the Frequency Control Ancillary Services (FCAS) markets. These act to correct sudden imbalances such as the loss of a large generator, and also help to “correct any slight supply-demand imbalances that might have arisen.”

Things become more complicated, however, with solar energy, because

no single operator is responsible for this form of supply as a differentiated load. There are no government regulations, for example, requiring providers to accommodate rising tides of renewable energy.

Nor are there any regulations requiring a distribution network service provider (the owner of the poles and wires) to provide necessary infrastructure for new entrants to the renewables market, such as a wind farm. Indeed, as Josh observes, distribution networks are free to set their own prices and conditions regarding network connections with aspiring renewable energy players.

Regulatory uncertainty, as well as the absence of plans for more publicly owned renewable energy utilities, one might argue, has dissuaded the private sector from investing more heavily in Australia's renewables industry, particularly in relation to technologies like pumped hydro. And in turn, this nervousness has fed into the hands of naysayers who continue to allege coal's superiority as a primary energy source.

As Glen has already stated above, Australia has all the necessary resources to become a renewables 'superpower'.

Josh agrees: “You don't need coal in an electricity network – most electricity networks don't have coal in them – so it's completely false to say that coal is absolutely necessary. Coal is the low-hanging fruit from an environmental standpoint – the reason it's been there

historically is because it's cheap source of energy, but there are cheaper sources now. It's horrifying hearing politicians reduce the complexity to slogans like, 'We need baseload power', which is both untrue and does not cover the complexity of the issue at all.”

NEXT STEPS

Matthew has the last word regarding next steps, which he summarises as follows:

1. Fund the creation of a number of off-river pumped hydro facilities to gauge their true costs – up to 100 might be needed nationally to provide reliable 24/7 base power to the grid.
2. Adopt a carbon price, say \$25 per tonne, to encourage the uptake of renewables.
3. Push for the cap on domestic export levels to be raised to 10 kW.
4. Keep rolling out more solar systems to households.

If such initiatives were undertaken with full governmental support, he believes, then Australia could be equipped with 100% renewable energy within 5–10 years.

As far as contractors are concerned, the public acceptance of solar energy is now well entrenched, and falling prices for infrastructure will only serve to enhance future rollouts even if FIT rates decline over time. The big uncertainties, however, are mostly political: will governments provide greater levels of regulatory support for builders of civic-scale renewables? Will policies be developed to quicken the uptake of renewables or will energy generation pricing remain the dominant force affecting the appeal of future investment? These are matters for crystal ball gazers.

One thing is for sure: coal is going the way of the dodo, and renewables have a sunny future. ■

John Power is a freelance journalist based in Cherokee and Carlton, Victoria, and a former editor of *Building Connection* and *Plumbing Connection*.



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THE PANEL GAME

Medium-voltage and low-voltage grids will have to be redesigned, with remote access to inverters being a step towards smart networks. **Phil Kreveld** explains.

A few million solar panels have been installed on Australian roofs. Most are grid-tie, single-phase, H-bridge inverters (Figure 1a) technically described as voltage sourced.

They are dispersed on the basis of individual solar system purchase decisions rather than for balance among the phases of three-phase low-voltage networks.

They save money for residents and cause headaches for the networks. These headaches are summarised as:

- phase unbalance;
- voltage regulation;
- protection relay problems at substations; and,
- harmonics.

Networks are living with these problems and there is no solution in sight.

However, as inverters increase in output, the networks are imposing tough grid codes basically limiting the power allowed for feed-in.

For ratings of 30kW and over, three-phase inverters are usually required (Figure 1b). The common version is the single-stage inverter (basically the H-bridge with an extra 'leg'). The two-stage inverter (Figure 2) is suitable for high DC input, typically more than 600V.

Doubling the switching transistors makes for a more expensive product, and two-stage inverters are used in commercial and industrial installations. Three-phase inverters are more likely to provide phase balance, and that is of some advantage.

Maximum power point trackers (MPPT) are part of solar inverters with 'hill climb' or similar protocols for extracting maximum solar power from photovoltaic (PV) panels.

Figure 3a illustrates the concept of maximum power point, and 3b a basic maximum power point circuit (the DC link is connected to the inverter. Note that MPPTs are not used, or disabled, for inverters required to provide lagging or leading reactive power.

Alternating current (AC) power output can be maximised by using a sine wave modulated by a third harmonic, yielding a more flat-topped pulse width modulated (PWM) output with a higher root mean-square (RMS) AC power output.

Figure 4 illustrates a typical, bi-polar PWM switching waveform for a three-phase inverter. Our focus in this article is on three-phase inverters.

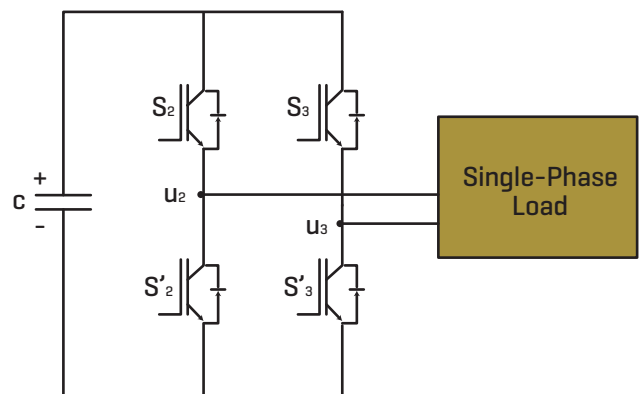


Figure 1a: A single-stage, single-phase inverter.

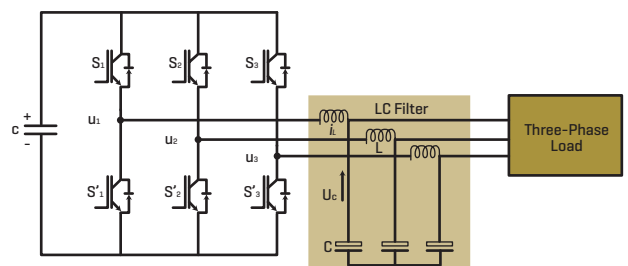


Figure 1b: A single-stage, three-phase inverter.

BASIC INVERTER TYPES

Four types are discussed, and they are illustrated in Figure 5.

They are basically voltage-sourced, controlled-current inverters, except for the grid tie 'prosumer' [producer-consumer] inverter.

It operates at unity power factor in terms of power export, but it can 'sink/source' quadrature lagging load current [leading load current is also possible but rarely occurs in practice] by virtue of the free-wheel diodes mounted across the switching transistors [Figure 1b].

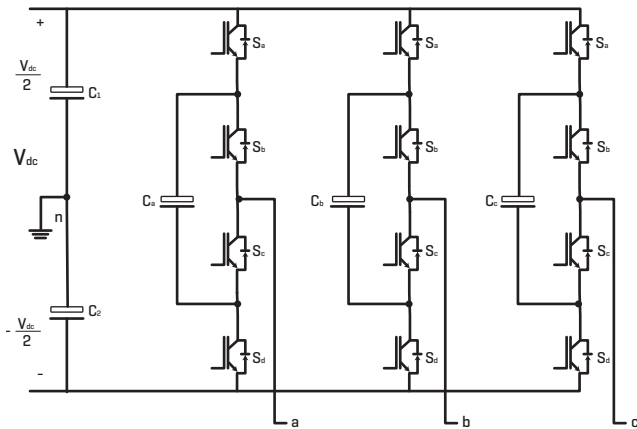


Figure 2: A two-stage, three-phase inverter.

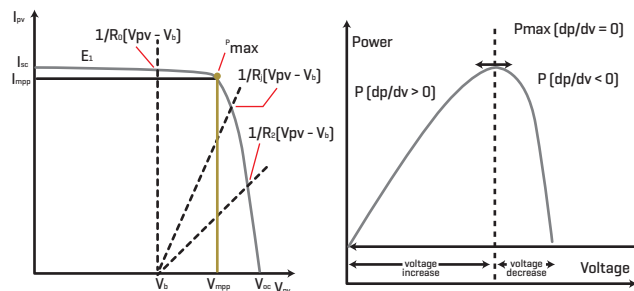


Figure 3a: The typical voltage current curve for a solar panel is shown on the left, and the power as a function of voltage on the right. The hill-climb procedure basically provides for small voltage steps starting at the lower voltage end of the power-voltage curve, until a further increment reduces power slightly.

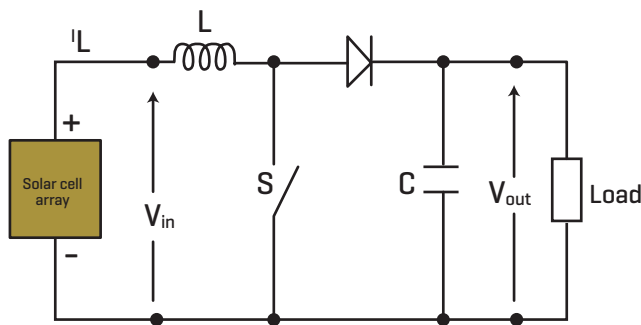


Figure 3b: Basic chopper circuit to provide the required voltage for the DC link of an inverter.

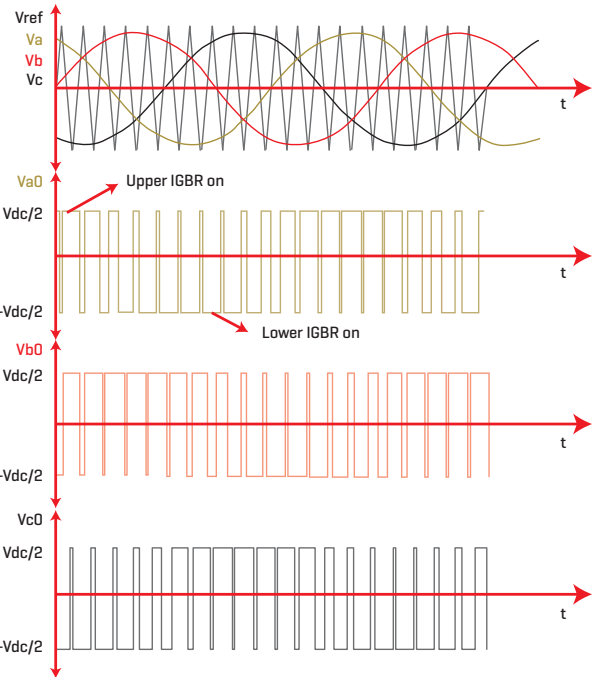


Figure 4: Basic operation of pulse width modulation [PWM]. Note the triangular carrier signal, which provides the switching frequency as well as pulse width when intersected by the sine wave.

The free-wheel diodes, in addition to allowing safe switch-off of transistors, also can conduct reactive power flow into the DC link of an inverter.

The other three types are grid forming [5a], grid feeding [5b] and grid supporting [5c/d].

Grid-forming inverters are suitable for use in micro-grids because they establish network voltage and frequency.

Grid-feeding inverters require voltage and frequency to be established, but they supply power and reactive power to take the pressure off from synchronous generators, for example.

The grid-supporting inverter can also help stabilise voltage and frequency. Grid-forming inverters are connected via low output impedance to the grid.

As mentioned in this issue's article on micro-grids, a voltage-forming inverter, probably fed by a battery energy management system would be needed to set voltage and frequency for the grid. Grid support, on the other hand, has become a reality.

GRID SUPPORT

As mentioned, grid support is becoming an essential task of PV inverters.

Essentially this requires three-phase inverters with the capability to supply quadrature power as well as usable power.

Single-phase inverters can supply quadrature power, but they are not commercially available. In any event – given the random nature of phase distribution for domestic PV – they would be of no practical use for quadrature power by adding to the imbalance of three-phase circuits.

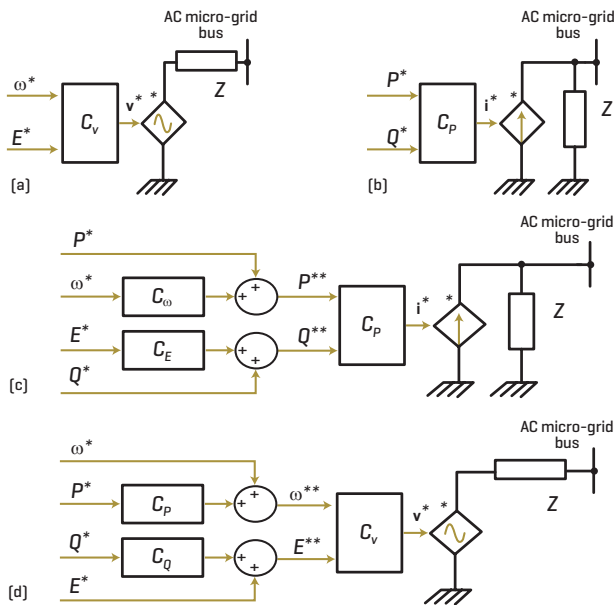


Figure 5: Various forms of grid-forming and grid-supporting inverters. Note that 5c is an example of current support [active and reactive current], and 5d provides voltage support [active and reactive voltage]

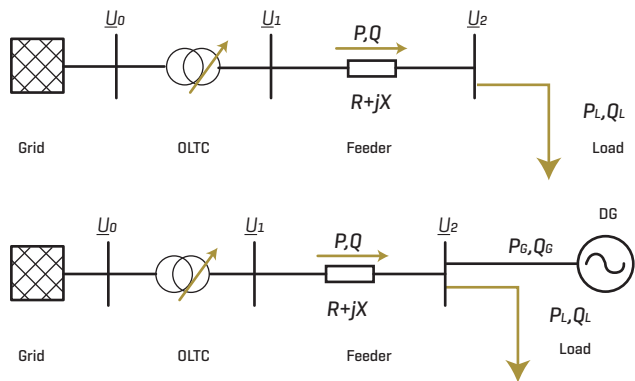


Figure 6: A schematic representation of a feeder in a distribution network with and without distributed generation.

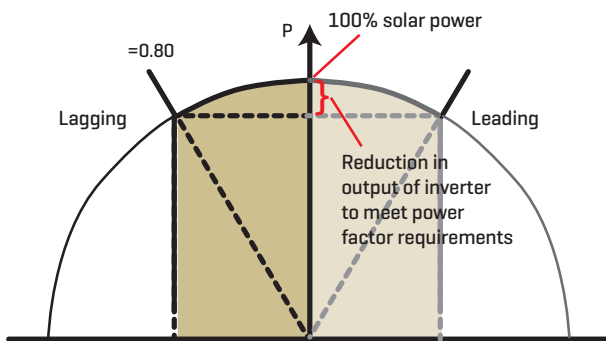


Figure 7: Solar panel DC power is indicated by the circle quadrant, and providing reactive power decreases the useful power available.

Although loads [air-conditioners, refrigerators, pool pumps] rarely have leading power factor, the ability to provide leading quadrature power is important for voltage support.

Furthermore, lagging power for voltage regulation downwards may be necessary at times. With high levels of feed-in from PV causing net reverse power flow [towards the substation], voltage can rise beyond the upper limit.

At present, that eventuality is taken care of by shutting down the inverter, generally at 264V, single phase. This is hardly a satisfactory solution given that 'behind the meter' energy generation is growing in importance for future electrical energy generation planning.

High-voltage [HV] transmission, medium-voltage [MV] and low-voltage [LV] networks have different impedance characteristics, going from mainly inductive for HV to mainly resistive for LV.

Voltage support by means of quadrature power in HV is supplied by synchronous condensers [over-excited synchronous motors, on no load].

In MV distribution, capacitor banks provide leading power factor – or a combination of thyristor-switched inductor/capacitors [STATCOM] provides leading and lagging power factor.

In LV distribution there is often no control provided, save for no-load tap changing transformers. Voltage control is mostly at substations and is provided by on-load tap changing transformers.

In Figure 6, a section of an LV distribution line is shown. Generally, LV distribution is by radial 'topology', radiating out from the substation, essentially without 'meshing' – the latter providing some additional security against partial network failure.

The voltage difference between points 1 and 2 is given by the formula below [applicable to mainly resistive power lines].

$$\Delta V = V_1 - V_2 \approx \frac{R P_L + X Q_L}{V_2}$$

R is the resistance of the line. X [although lesser in ohms than R] is the generally inductive impedance. PL and QL are respectively the power and quadrature power drawn by the load. When distributed generation is part of the network, voltage drop can be counteracted by local distributed generation, eg: a PV system, as shown by the relationship below.

$$\Delta V = V_1 - V_2 \approx \frac{R [P_L - P_G] + X [Q_L \pm Q_G]}{V_2}$$

The above formula shows clearly that as generated power PG increases, the voltage drop ΔV decreases.

The reactive power available has an effect as well. If the PV inverter can be made to supply reactive power QG, then ΔV can be made to reduce by means of leading reactive power [-QG] or to increase by providing lagging reactive power [+QG].

MORE THAN FEEDING IN

The importance of providing lagging and leading current as well as real power [in-phase current] has been established.

Three-phase inverters sold in Australia must be able to supply lagging and leading reactive power. Notwithstanding

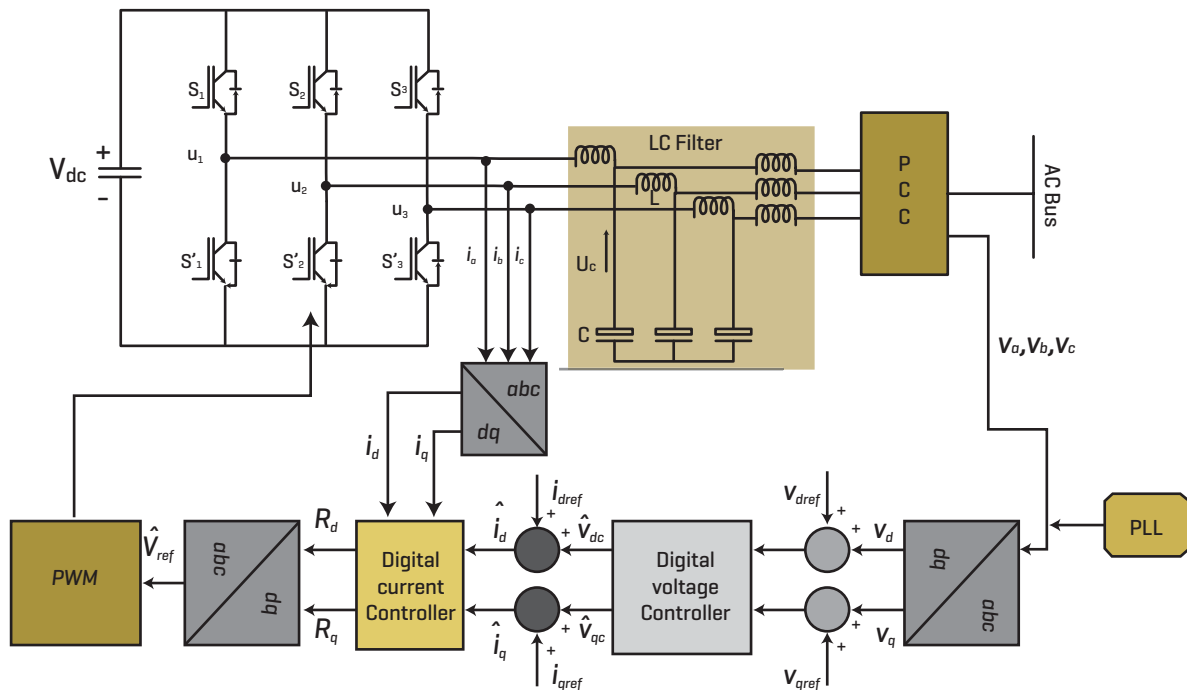


Figure 8: Voltage-sourced, current-controlled inverter with active and reactive power adjustment.

this requirement, the network control systems for managing inverters remotely has not been established.

Reactive control, whether lagging or leading, basically limits usable power as illustrated in Figure 7.

The circuitry required is obviously more complex than is the case for unity power factor inverters. The block diagram for a grid-supporting inverter is shown in Figure 8.

Rather than explaining the complete system, the essential control features are mentioned here.

The reference to 'abc' in various parts of the block diagram indicates three-phase voltage or current parameters (ie: the a-phase, the b-phase at 120°, and the c-phase at 240°). A set of three-phase parameters ['phasors'] rotates at line frequency of 50Hz.

The essence of power factor control is to 'retard' or 'advance' the current waveform in each phase with respect to the voltage. To make this possible, the current and voltage 'abc' phasors are converted to d-q parameters [also called space vectors]; 'd' representing the 'real part' and 'q' the 'quadrature' part.

The grid voltage is measured at the point of common coupling, and the voltage phasors are converted from three parameters to two, 'd' and 'q'.

Current output of the inverter is measured by a current transformer [next to the inductor connected to the inverter output]. The control circuitry can control the angle between the two [current, and voltage] d-q space vectors thus providing real as well as quadrature, or reactive power.

WHEN THE SUN DOESN'T SHINE

In essence, the circuit of a three-phase inverter is no different from an active harmonic filter.

Apart from harmonic correction, active filters are also used for power factor correction.

However, the circuit of three-phase power switches can also be used for supplying reactive current to a network.

As the circle diagram in Figure 7 shows, in theory, no power is required to provide reactive current. In practice, the switching losses of the three stacks of switching transistors must come from somewhere.

The capacitor, which is part of the DC link, furnishes this energy and the grid, by way of the free-wheel diodes [the diodes mounted across the switching

transistors], replenishes the energy lost by the capacitor during reactive current injection.

THE FUTURE

Given the doubt surrounding electrical energy policy, forecasting is a difficult.

However, there is some certainty that MV and LV distribution grids will require a redesign. Voltage variation is a problem that is likely to become more of a 'feature' in distribution networks.

Deployment of more on-load tap changing transformers is likely, but remote control of inverters is on the cards to limit the extra capital expenditure.

At the moment, grid codes restrict the ratings of inverters, but eventually these restrictions will have to be renegotiated in return for remote access. This will be an early step towards smart networks. ■

Phil Kreveld is an energy writer. He is an electrical engineer. He has worked in electrical, electronic and scientific instrumentation in Australia and the US.



WHAT ARE YOU REALLY WORTH?

As any seasoned small business owner will tell you, there's a mountain of stuff to get your head around in order to be successful. One small, but incredibly important detail, is knowing what to charge. *Electrical Connection* has taken the guesswork out of the equation with its charge out rate calculator.

As the backbone of Australia's economic success, small business owners must be recognised for their passion and purpose. As any one of these individuals will attest though, it isn't all rainbows and butterflies.

Cash flow, staff acquisition and retention, growth and compliance are all key things to consider. Then there are those other important things like family and work/life balance.

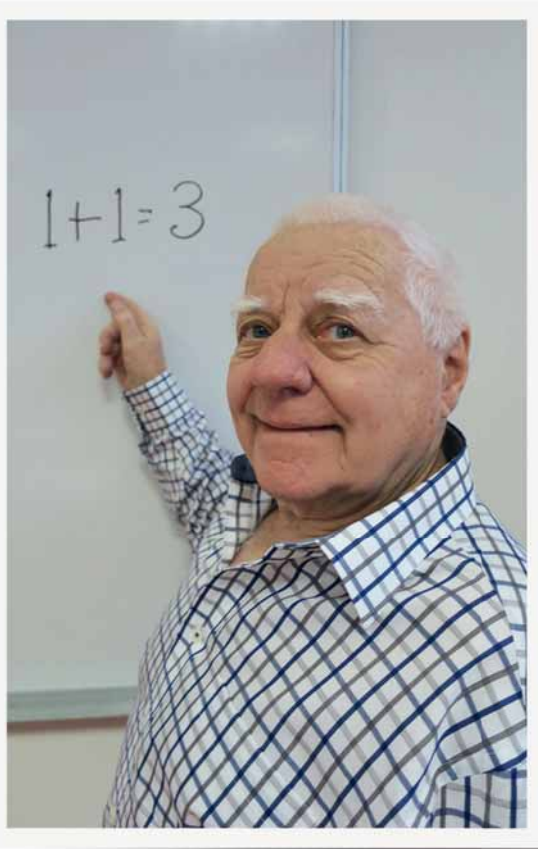
Plumbing, electrical, carpentry and various other trade services are often undervalued by the public, who fail to appreciate the real cost of doing business these days.

They don't differentiate between a skilled tradesperson who has gone through four-years of training or, for example, a company-employed washing machine repairer who has done a two-week training course that relies on multiple choice service answers from a manufacturer's app.

But part of the blame also lies with the trade sectors themselves, when they fail to deliver good value to the consumer [written quotes, on-time, good work, good communication], who doesn't have the same problems when dealing with many other business sectors.

If you are charging market rates to the consumer, they should rightfully expect good service and value.

The media loves to beat-up the trade industry. Publicity-seeking online job-referral companies like HiPages, One Flare, Service Seeking, etc. don't help either, especially when they get themselves on TV to announce what



Resident estimating expert Brian Seymour says you need to cover your bases or you'll end up working for discounted wages.

plumbers are charging per hour, without any clarification.

Inexperienced or start-up contractors coming into the market also cloud the situation by offering ridiculously low quotes, either through ignorance or deliberately.

Published in November 2018, the *Westpac Small Business Report* in collaboration with Deloitte revealed some statistics that highlight some of the issues business owners face when it

comes to paperwork, compliance and cash flow.

Some of these include:

- Small businesses spend up to eight hours on average each week chasing invoices for payment.
- More than 16% of small and 10% of medium businesses say they need to improve cash flow to achieve their financial goals.
- Small businesses spend 12 hours on average each week completing paperwork to comply with government regulation.

It becomes apparent fairly quickly then, that charging the right amount in the first place is vital to the success of any small business.

As there is little in the way of compulsory business training to guide new industry start-ups on how to run a fledging enterprise, we thought we'd help ease the burden by creating a charge-out rate calculator for a sole trader, which is often the starting point.

It's important to understand that there's a difference between estimating a job and a charge-out rate.

To estimate a project, businesses need to consider labour and material costs, as well as the price of plant/excavation works. These elements are used to create a library of standard rates, which are the catalyst for estimating.

As a sole proprietor things are a little different. You need to factor in the likes of hours, your required salary and all of the overheads you need to pay in order to keep your business ticking along.

While this calculator makes no account of hiring support staff or charging extra for night/weekend call outs, we hope it can improve the

likelihood of new businesses surviving the first year and minimising damage to the overall sector.

SETTING THE SCENE

The aim of this exercise is to demonstrate how to logically arrive at a charge-out rate calculation, for a typical first year contractor starting out.

In this example, Gary has served his apprenticeship with a local trade contractor. He reckons he's a good tradesman and gets on well with clients. Three years after finishing his time, Gary completes the exams and gains a contractor's licence.

At the age of 27, Gary is ready to take on the world and be his own boss, just like the guy he worked for over the past seven years.

He doesn't have a sophisticated marketing plan but believes there are enough potential customers for the work he's accustomed to doing.

Domestically, Gary has one child to his partner Sarah, who works part-time but much of what she earns goes into baby-sitting. Gary spends the first \$30,000 of their after tax income on rent and has family living costs much the same as most others.

He hasn't saved a lot, in spite of having a company van and completing a fair bit of overtime with his previous employer. He'll need some funds for cash flow, as he knows a lot of people don't pay on time and he needs to buy materials ahead of client invoicing.

Over time he hopes to earn a credit account with his main wholesaler.

To create the right impression with customers and be reliable, Gary's decided to finance a new van but he doesn't believe he needs an office and can work on quotes/accounts from home and claim a home-office tax deduction.

He's accumulated a reasonable tool kit including computer and software over the years and will opt to hire/rent any specialised equipment and charge it back on jobs. The world wishes Gary good luck with his new venture, in the knowledge that some 50% of small businesses fail in their first year.

To give Gary's business every chance of survival, let's see what his real costs are and then consider what he should charge his time out at. ■

To get an experienced view, Electrical Connection invited expert estimating trainer Brian Seymour to make some comments on the way through the exercise.

It's important to understand that there's a difference between estimating a job and a charge out rate.



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CHARGE-OUT RATE CALCULATOR

A. HOURS		EXAMPLE	YOUR RATE
Estimate the number of ordinary hours you work per year		<i>Fill out your rate here</i>	
Weeks in the year		52 weeks	
Less:	Annual Leave	20 days	
	Public Holidays	10 days	
	Sick Leave	2 days	
	Inclement weather	2 days	
	Lost time/Training courses	2 days	
Effective working weeks		45 weeks	
Ordinary working hours per week		38 hours	
Total available working hours per year		1,710 hours	
Less lost hours (1.5 effective hours lost a day*)		338 hours	
Total Available Hours [Available hours are different to chargeable hours. You probably won't reach 1,372 in your first year]		1,372	

*You lose time travelling, buying materials, providing quotes, chasing up debts, finding new clients]

B. SALARY	\$ PER YEAR	\$ PER YEAR
Decide how much pre-tax income you need to earn annually?		
<i>For this exercise we've used \$83,900, that's the average salary of all male workers throughout Australia. Just remember you are taking a significant risk working for yourself, as the majority of those earning the average salary work a 9-5 job for Government or a private enterprise.</i>		
Weekly pay rate \$1,613 x 52	83,900	
Superannuation @ 9.5%	7,970	
Total salary cost for you	\$91,870	

Brian says - Students often tell me these figures are bull\$#!t, until I point out to them that their existing wage is only 73% of what it costs the boss to employ them (they forget to consider holidays, super, etc...). They need to include them in their charge-out or they will be working for discounted wages.

C. OVERHEADS	\$ PER YEAR	\$ PER YEAR
Other costs involved in running your business		
Personal sickness and accident insurance	800	
Public liability insurance (compulsory)	650	
Contractor licence fee	650	
Electricity/gas (working from home)	500	
Van lease (3 years/30%/\$38,000 vehicle)	9,500	
Van servicing (Year 1 of ownership)	650	
Van registration/3rd party insurance	600	
Van comprehensive insurance	1350	
Petrol [-\$60 per week]	3,000	
Phone/internet plan plus business apps	960	
Bank fees	300	
Accounting fee	1000	
PPE/clothing	400	
Standards/Codes for reference	500	
Postage/stationery etc...	400	
Replacement of tools (per annum)	1000	
Contractor association membership	850	
Material waste	500	
Contingency [5%]	1000	
TOTAL OVERHEADS	24,610	

Brian says - In my training courses, I use the average figure of \$25,000 as a sole trader's overhead, but I also suggest including some 'direct costs' for the first year (i.e. stock, etc...). If Gary is working from home, he needs to ask the question - 'if my boss asked me to use my spare room as an office and my garage as a store, would I charge him?' If the answer is YES, then he should include this cost in his overheads or he is making an unappreciated donation to his customers.

$$(B+C) \div A = \text{Your charge-out rate}$$

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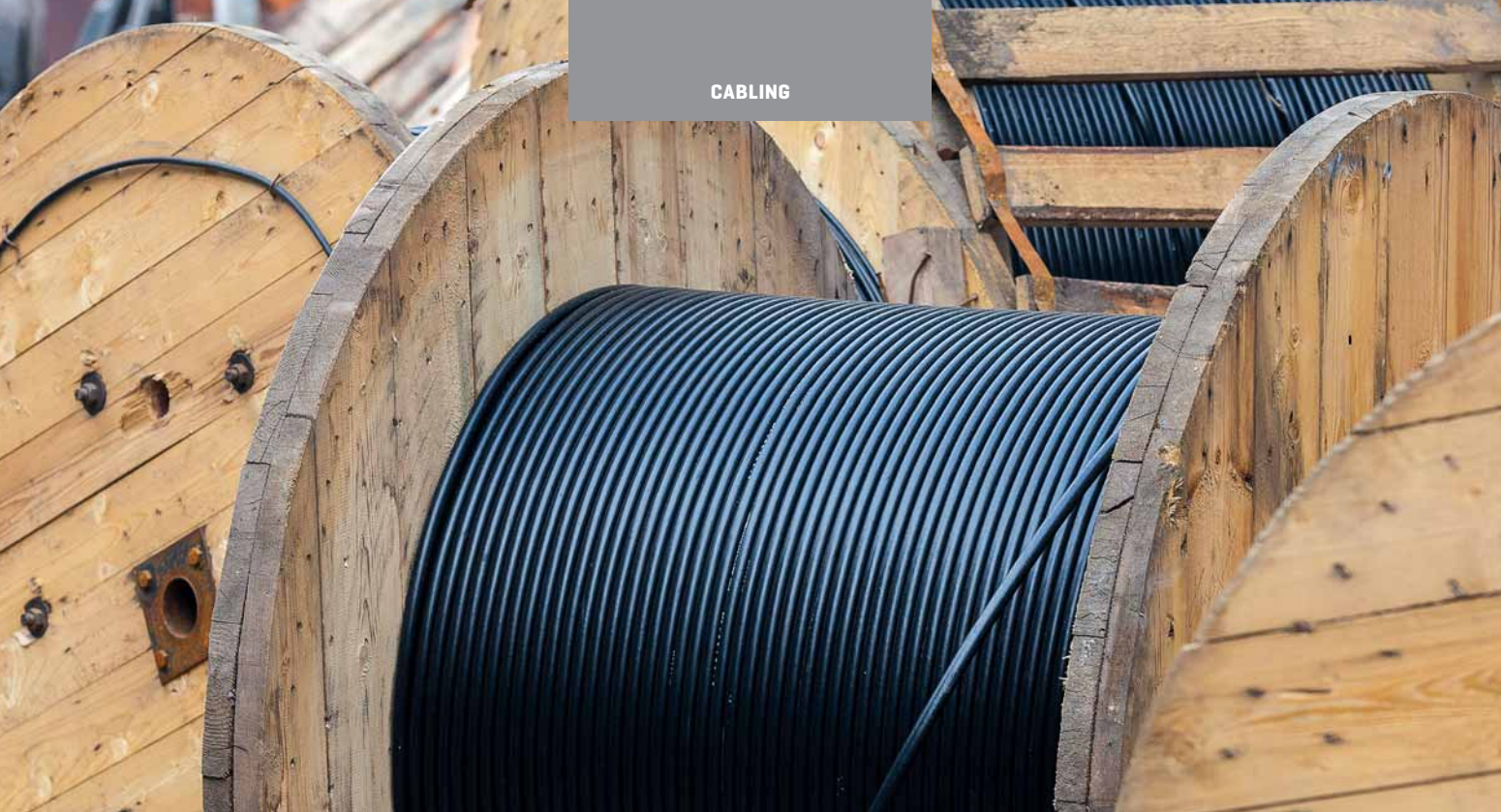
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SETTING THE STANDARD

The revision of Australia's mandatory cabling Standards AS/CA S008 and AS/CA S009 are about to be released. **Brihony Tulloch** breaks down the most important updates for cablers.

The Communications Alliance, through its working group WC80, is currently revising Australia's primary cabling regulations – AS/CA S008:2010 *Requirements for customer cabling product* and AS/CA S009:2013 *Installation requirements for customer cabling*. Both regulations are expected to be released in early 2019.

BICSI chief executive Paul Stathis, who is a member of WC80, says in addition to the amendments, several cabling and related ICT standards are being either released now or poised for release in the near future.

All the updates and amendments have significant application to the cabling industry, and their impact must be fully understood by ICT and cabling professionals.

CHANGES IN S008 ARE SET TO INCLUDE:

- Telecommunications Network Voltages [TNV] SELV, TNV-1, TNV-2, TNV-3 will be redefined as ES1, ES2, ES3, coinciding with the ACMA's migration of its telecommunications customer equipment safety Standard AS/NZS 60950-1 to AS/NZS

62368-1 *Audio/video, information and communication technology equipment – Safety requirements;*

- Introduction of one-pair cable and connectors;
- Revised labelling requirements for fibre optic enclosures;
- A new 'fitness-for-purpose' requirement to ensure what's provided will actually do what it's supposed to do;
- Defining 6-position plug compatibility with 8-position jacks;
- Revised underground conduit markings and pit criteria; and,
- Introduction of remote power feed requirements.

CHANGES IN S009 ARE SET TO INCLUDE:

- Redefining the network boundary to address new versions of the NBN introduced since S009:2013;
- Defining the maximum length of outdoor cabling that can come into a building before it must be transitioned to indoor-rated cabling;
- Permitting certain modular plugs to be terminated in the field and what is and isn't acceptable;

- Further clarification on 'fixed and concealed cabling' criteria;
 - Defining Earth Potential Rise [EPR] zone hazard distances;
 - Post-installation fibre labelling requirements;
 - Requirements for penetrations through fire-rated barriers; and,
 - Requirements for fitting jacks on moveable fixings [eg. pendants].
- According to a press release circulated by BICSI, the most significant changes to both Standards relates to the introduction of new energy source classifications.

According to the latest amendments:

- ES1 is deemed to be safe;
- ES2 is deemed to be safe with basic safeguards; but,
- ES3 has no current limit and no voltage limit and requires basic and supplemental safeguards to protect ordinary persons.

The introduction of these new energy source classifications is likely a response to the rise of IoT-, PoE-related products and their associated dangers.

Overheating can occur when

running PoE over existing cabling that may not be able to support constant current. Therefore it was important that the latest amendments implement regulations to reduce safety risks.

“Activation of multiple ES2 services within cable bundles and/or high pair-count cables potentially causes heat-rise to exceed the operational temperature of the cabling. To address this issue, the standards are looking at minimum conductor sizing as part of a risk-mitigation strategy.

“This is significant because LV telecommunication cabling would fall under the ‘ES3 Cabling’ classification, and introduces safety issues for a range of cabling situations that many cablers would encounter,” says the statement.

According to Paul, another big regulatory change is the replacement of AS/NZS 60950-1 – the ACMA’s mandated telecommunications customer equipment safety Standard

with AS/NZS 62368-1:2018.

“AS/NZS 62368-1:2018 is an adaptation of the ISO/IEC 62368-1 Standard and introduces some serious remote power issues,” he says.

The replacement of the AS/NZS 60950-1 Standard will be introduced over a four year transition period during which suppliers can choose to comply with either standard.

Paul also notes that the cornerstone ICT infrastructure Standard in Australia and New Zealand – the AS/NZS 3080:2013 is receiving a complete overhaul.

In previous years, it’s been a local adaptation of the international ISO/IEC 11801 Standard, but in 2018 the name will change to AS/NZS ISO/IEC 11801.

Instead of just one volume, it will be split into six separate ‘environment-based’ volumes:

- **AS/NZS 11801-1** General requirements
- **AS 11801-2** Office premises
- **AS 11801-3** Industrial premises
- **AS 11801-4** Homes

- **AS 11801-5** Data centres
- **AS 11801-6** Distributed building services

“Each of these environments will have different performance criteria,” says Paul.

“For example, Class E will be the minimum twisted-pair cabling requirements in office premises; Class E_A will be the minimum for data centres and distributed building services; while Class D will be the minimum for homes and industrial premises.”

The new separate volumes will make it easier for people in the industry to find the information they need specific to their trade.

“Some are mandated as regulations, while others are Australian and international standards that are voluntarily applied to industry,” says Paul.

According to the BICSI press release, the draft standards have been finalised by the Communications Alliance project team and have been moved on to the public comment phase. It’s on track to be available for download early this year. ■



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A WORLD OF POSSIBILITIES

While lithium-ion remains the most common battery technology for solar storage applications, a number of alternatives are making themselves known. **Ross McGravie** reports.

As hydrogen captures the attention of Australia's chief scientist Alan Finkel, an array of emerging battery storage technologies continue to turn heads.

These include the continued evolution of lithium-ion batteries, lead crystal batteries, supercapacitors, advanced compressed air energy storage, lithium ferro phosphate battery modules and various hydrogen options from one of the world's pioneering firms.

But amid the innovation, Energy & Power Supply Systems director Peter Cockburn says a three-pronged approach to training, safety and recycling is necessary to maintain trust and longevity of battery storage in households and businesses.

He says the lack of a national product standard for battery storage was worrying as it currently does not deal with the assumption of planning for 'a bad day' in the potentially volatile environment, when extreme temperatures, thermal warming and other external factors can affect day-to-day operations. Most importantly, this would incorporate a battery management system (BMS) failure mode to stop the battery from exploding or releasing toxic gas.

As part of the checks and balances, training would incorporate accreditation, installation and inspections, while a safety data sheet (SDS) and access to subject matter experts would delve deeper into the capabilities of each technology.

Last but not least, Peter says a recycling scheme to "take care of the cradle-to-the-grave lifecycle" – including the safe disposal of hazardous materials – was imperative for a cleaner, more environmentally friendly future.

ADVANCED COMPRESSED AIR ENERGY STORAGE (A-CAES) BY HYDROSTOR

Big things are expected of A-CAES,



Demonstration prototype of Hydrostor's A-CAES compressed air storage system in Toronto, Canada.

which will be used next year [2019] at the Terramin project at Strathalbyn, SA, for load levelling, frequency response and inertia as part of the National Energy Market. Developed in partnership with AECOM, A-CAES from Hydrostor serves as a wire-free alternative to network infrastructure development. The fuel-free storage solution "can be sited where needed to deliver hundreds of megawatts and for four hours to more than 12 hours of storage". It provides more flexible siting options than pumped hydro or conventional CAES, and its variable capacity provides dispatchable load and generation services.

The adiabatic process of A-CAES provides emission-free energy storage that also delivers synchronous generation and inertia. Its lower lifecycle costs include an ability to repurpose existing site infrastructure, 30-plus years unlimited cycling, low-pressure, bankable surface equipment and a small surface footprint, making

it ideal for urban applications. Total installed turnkey cost estimates range from \$US1,500 to \$2,500 per kW, depending on site location and system design.

ARVIO SUPERCAPACITORS

Compatible with existing inverters and DC electronics infrastructure, Sirius Energy Storage is a plug-and-play replacement for lead acid or lithium-ion batteries. Claimed to be the world's first supercapacitor-based energy storage system, the 3,550Wh-capacity Sirius operates within a 44V to 54V voltage range, highlighted by a -30°C to 85°C temperature range and a 99% DC round-trip efficiency. A single solution for short, medium and long duration discharging, it enables fast charging (30 minutes) in EV, solar, backup and applications. With no risk of thermal runaway or heat generation, it has a 100% depth-of-discharge in almost any location and eliminates the need for auxiliary cooling systems. The 0.75kg aluminium-cased

unit has a 1,500V galvanic isolation BMS and an audible alarm in the event of over-charge, over discharge, over-temperature and over-current.

In short, its high cycle life and high efficiency and low auxiliary operating expenses create the lowest cost of ownership and shortest payback period.

Peter says Sirius is only in its early stages but it promises one million life cycles and a 10-year warranty, delivering 70Wh per kilogram at supercap cell level. It can connect a maximum number of 18 modules in series, with no limit to those connected in parallel.

LEAD CRYSTAL BATTERIES

Cleaner, faster and environmentally safer, lead crystal batteries can be used in any application where lead acid, lead gel or AGM batteries are used. Up to 99% recyclable, they feature less acid, no cadmium and no antimony, and are classified as non-hazardous goods for air, sea and land transport.

Using the positive and negative lead plates as the core electrochemical reaction area, Betta Batteries says it has developed 2V,

6V, 8V and 12V lead crystal batteries to "overcome the fundamental flaws" of batteries, such as plate sulfation, active material loss, high water loss rate, serious acid pollution, poor low-temperature performance, short life cycle and poor transport safety.

The tech combines a microporous high-absorbent mat (AGM), pure lead plates and a silicon dioxide electrolyte solution that solidifies into a white crystalline powder when charged and discharged. The light-traction batteries can be discharged deeper, cycled more often (even in extreme temperatures of -40°C to 65°C) and have a longer service life for use in forklift trucks, railway systems, wind power, home solar systems, telecommunications, golf carts, wheelchairs, floor cleaners

and other cleaning equipment.

Each battery has a three-year factory warranty, with potential to store for two years. The design life is 18 years, with up to 6,000 charge/discharge cycles [20% DOD]. Charging up to two times faster than conventional alternatives, they can be fully discharged and then restored to full-rated capacity daily.

LIFE SERIES

A cost-effective alternative for solar and industrial applications, lithium ferro phosphate (LFP) battery modules provide durable, lightweight (39kg) and reliable energy storage with high energy density.

Operating in the same voltage window as lead acid batteries and managed with constant current/constant voltage charging, the Australian-designed-and-engineered battery module includes a BMS for increased protection and cell balancing to extend the battery life beyond its 10-year warranty.

Powerplus Energy has developed a smart BMS for control of circuit protection devices, a data interface for web monitoring, a Canbus interface to third-party products, and the ability to connect multiple batteries in series to create higher voltage batteries up to 1,000V.

Parallel additional batteries can be used as required.

The LiFe Series includes a 120V model for direct connection to the Selectronics Inverters. Operating in a temperature range from -20°C to 60°C with an IP40 rating, the battery modules have a 60A maximum current that is limited by a circuit breaker. They have 96% to 98% charge efficiency (full recharge in less than two hours) and 10,000 cycles in off-grid solar.

NEL HYDROGEN TECHNOLOGY

No project is too big or small for Norway's Nel, which has specialised in hydrogen projects across the transport, food, petrochemical, renewable energy, polysilicon and thermal processing sectors since 1927.

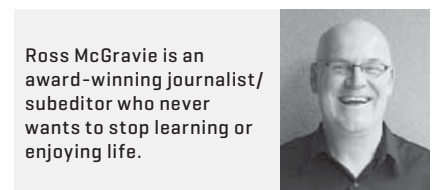


Hydrogen is yet another 'non-traditional material that could unlock widespread adoption of solar battery storage.'

Encompassing production, intermediate energy storage and manufacturing of hydrogen fuelling systems, Nel provides fuel cell electric vehicles (FCEVs) with fast fuelling and long-range capabilities to rival conventional vehicles. As the world's first UL listed and CE marked hydrogen fuelling station module, its H2 Station is part of an ASKO zero-emission transport project to operate three Scania distribution trucks and 10 forklifts from a solar-powered production facility and fuelling station at Trondheim. The facility produces up to 1,500kg of hydrogen energy for the AC150 containerised electrolyser, which has a daily production capacity of more than 300kg of hydrogen.

Nel's A Series electrolyser uses an atmospheric alkaline method for splitting water, while the M, C, H and S Series electrolysers use Proton PEM technology to produce ultra-high purity hydrogen on site. The units come in a variety of sizes and configurations and can be containerised for easy setup or grouped together for larger applications to save capital and operating expenses. ■

“The lack of a national product standard for battery storage is worrying...”



Ross McGravie is an award-winning journalist/subeditor who never wants to stop learning or enjoying life.

POWER... WITH A LITTLE HELP FROM YOUR FRIENDS

While Australia enjoys high rates of solar energy production, much of the power generated is still not harnessed, stored or distributed as effectively as it could be. Community battery storage could offer a solution. Jacob Harris investigates.

When it comes to our ability to generate power from the sun, Australia truly can be considered the 'lucky country' – we're one of the highest solar-producing countries in the world. Unfortunately, peak generation periods don't align with peak demand periods and while we've seen significant technological improvement in stand-alone residential solar storage batteries, they still only provide a partial solution.

Feed-in tariffs also leave much to be desired. This makes the proposition of feeding excess energy back to the grid less than compelling, which in-turn leads to much of Australia's solar power being lost.

One potential solution to the problem is community storage. A recent Dutch study conducted by DNV GL has suggested that community batteries do have a viable business case, with all stakeholders potentially standing to benefit.

The study concluded that considering current Li-Ion battery tech prices and the average cost of upgrading the grid, in some cases a community battery will work out cheaper than a traditional upgrade – making the model appealing to consumers and grid operators alike.

According to DNV GL's definition, a community battery is a battery that:

- Provides several services, including one or more system services to the regional grid operator, such as: congestion management and management of the voltage quality.
- Is the property of a private company.
- Is installed 'in front of the meter' and may be placed in a residential, commercial or industrial area.
- Serves more than one user; the owner and potentially an operating

company are not the system's only users. A location with a lot of consumers who, as far as the grid operator is concerned, make up one customer, is also a community battery. One example is a shopping centre, flat or micro grid.

- Would preferably be located in or near a low-voltage grid.
- Is used commercially and is therefore not operated by a grid operator.

The first Australian community storage trial was undertaken by Synergy and funded by the Australian Renewable Energy Agency (ARENA), and began in 2016 in Alkimos Beach, Western Australia. This used a community energy scale device (CESD): a system of hundreds of smaller (Li-Ion) batteries connected together in battery banks and cost \$6.7 million.

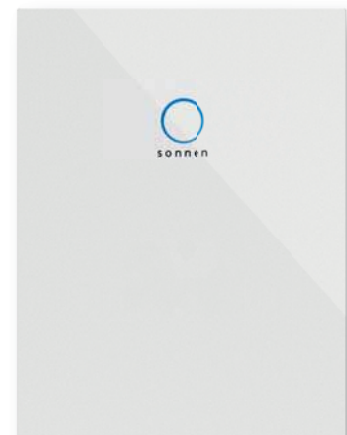
"We are very excited about this particular project, because 'the costs are coming down'. We expect that the cost of batteries will halve over the next couple of years and will keep going beyond that," said ARENA chief executive Ivor Frischknecht at an Alkimos Beach press conference.

"We have a number of other trials underway that are looking at different aspects of this. For example, people are buying batteries for their homes. There is not good data yet to say which model is better or which circumstances which model works in. You could have the same sort of impact on both the network and people's home energy costs by having lots of little batteries spread around all of these houses."

This is the model the sonnenCommunity (a program initiated by German battery manufacturer,



sonnen recently opened an Australian manufacturing facility in the Adelaide suburb of Elizabeth.



While classed as community batteries, sonnen's solutions are owned by the power consumer as opposed to a private company.

sonnen) uses, creating a virtual energy pool that enables supply and demand to be monitored and regulated throughout the community.

“The sonnenCommunity was established in Germany [where there are now 30,000 members nationally] at the end of 2015. This was followed by launches in Austria and Italy in 2016, and in 2018 we launched the program in Australia,” says sonnen eServices managing director Jean-Baptiste Cornefert.

“For the sonnenBatterie we are using lithium-ion phosphate batteries [LiFePO4] because they have a greater longevity and higher safety than most other lithium-ion batteries that are commonly used in the market.”

The linked batteries in a sonnenCommunity meet the DNV GL definition of a community battery in all ways but one: the batteries are owned by the power consumer as opposed to a private company.

Jean-Baptiste believes we will continue to see growth in community storage, and other decentralised models, as we move further towards renewable energy production.

“The future of our energy supply is decentralised. Renewable energy is getting cheaper and cheaper, especially compared to fossil fuel production.

“Virtual power plants like the sonnenCommunity, consisting of thousands of interconnected households with a PV system and a sonnenBatterie, are already supporting the energy transition today.”

With renewable energy now representing 16% of Australian energy production [according to the Climate Council’s *Fully Charged: Renewables and Storage Powering Australia* report] and Victoria, Queensland and the Northern Territory all investing in grid-scale battery storage technology, it would

Community batteries do have a viable business case, with all stakeholders potentially standing to benefit.

seem that Jean-Baptiste isn’t alone in this opinion. Indeed, the Climate Council’s report also highlights that energy storage is critical for building a reliable Australian electricity grid for the 21st century:

“The Australian electricity grid and old fossil fuelled power stations are increasingly vulnerable to worsening extreme weather events, particularly as these power stations age. Over half

of Australia’s coal fleet will be over 40 years old by 2030. Having a variety of storage technologies will improve the flexibility and resilience of the power system.”

This sentiment is echoed in the DNV GL report which explains that decentralised energy

sources are an important part of the transition to a more sustainable energy future. However, the report also highlights the fact that these resources can put pressure on local electricity distribution infrastructures and these must be bolstered to meet peaks in generation output.

Indeed, it would seem interconnected batteries are ever-increasingly becoming an accepted part of our energy future, with traditional energy suppliers either developing their own storage networks, or working with providers

like sonnen to offer hybrid solutions.

“In Germany most of our competitors in the storage market and some of the German energy suppliers created similar concepts. But most of them are simply electricity tariffs without a real added value for our energy system, so we are staying ahead of the competition,” says Jean-Baptiste.

sonnen works together with transmission system operators [TSO], distribution system operators [DSO] and energy markets to create additional flexible revenues. For the TSO, DSO and the energy markets, the sonnenCommunity as a virtual power plant is a flexible solution to balance the variability of the power grid.

“Whenever the market is not unbundled, for example in some parts of the US, we also work together with utilities. The sonnenCommunity is a very flexible system that we can adjust to different markets and conditions,” says Jean-Baptiste.

The DNV GL Report can be downloaded at <https://www.dnvgl.com/publications/feasibility-and-scalability-of-community-battery-storage-115668>. ■

ACCORDING TO ENERGY MATTERS, THE AVERAGE FEED-IN TARIFFS FOR EACH STATE ARE AS FOLLOWS:	
STATE	CURRENT RATE PAID
VIC	9.9 to 29c/kWh [depending on retailer]
SA	11 to 16.3c/kWh [depending on retailer]
ACT	6 to 12c/kWh [depending on retailer]
TAS	8.9c/kWh
NT	Same as consumption rate / grid purchase rate
WA	Varies - e.g. 7.1c/kWh [Synergy]
QLD	6 to 12c/kWh [depending on retailer]
NSW	11.9 to 15.0 c/kWh [depending on retailer]

*Source: <https://www.energymatters.com.au/rebates-incentives/feedintariff/>



Jacob Harris is a freelance reporter and is the former editor of *Electrical Connection's* sister publication, *Building Connection*.



MOVING TOWARD THE FUTURE

Several electrical accessory manufacturers have begun entering the home automation market. **Cameron Grimes** takes a look at some of the solutions on offer and how electrical contractors could adopt them to better service their clients while expanding their own business.

Since it began, the home automation channel has largely been isolated from the rest of the electrical industry. The electrical accessory market is a multi-billion dollar industry, with the home automation channel making up a small percentage of its total business.

The demand for home automation from end users has seen a significant increase in recent years, though, so it is no surprise that a number of large electrical accessory manufacturers have begun to enter this market with their own home automation solutions.

Companies like Legrand, ABB, Hager and Clipsal by Schneider Electric have all recently introduced product lines into the smart home automation space that aim to offer simple to install, simple to use solutions for homes and offices.

However, unlike traditional solutions adopted by integrators, these products are marketed towards electricians who are capable of installing and programming the controllers

themselves [and without the need of a specialist].

Legrand national systems and solutions manager Luca Frigerio says it was only a matter of time that companies like Legrand looked for ways to expand the potential of their electrical products.

“Technology is rapidly evolving and connected devices are now the standard for everyday living. These changes have transformed the industry’s landscape, which impacts how our products are designed,” Luca says.

Legrand’s MyHome and Intuity home automation solutions enable control over a household’s lighting, air conditioning, audio entertainment and video intercoms.

“Our main goal is combining simplicity with technology. We want our systems to be streamlined for those who use them. We want our systems to be user-friendly for the end user, giving them complete control over what they’re using,” Luca adds.

“We also want a streamlined installation process for the integrator, and finally, we need our products to be simple and versatile for the contractor.”

Hager national training and technical services manager Wayne Mosch agrees, and says that simplicity in the installation of the company’s newly introduced KNX Easy, and other offerings such as its Coviva system, is an important aspect for the future of these types of technology.

“If you give contractors full-blown polytechnic systems at the beginning, they’ll get scared. We’re trying to ease people into these types of systems so that they become comfortable with them, and in turn, experts,” he says.

“Maybe at some stage, they’ll go to the larger systems. That’s how we’re going down the path of automation in our business. We’ve got an ambitious goal that we think is very achievable.

“The thing that we’re finding is that they’re typically younger contractors or contracting companies that have seen

the opportunity to expand their business and developing their younger employees because this is what they see as the future of their businesses.”

Smart Voice managing director Paul Detering echoed this view, arguing that the nature of the modern electrician is changing.

“Previously they’re doing the wiring for homes. The ‘electrician of today’ is embracing the smart home and becoming a networking expert. There are a lot of young people out there building good businesses and expanding them,” he says.

“Electricians are critical. There are plenty of young electricians that are out there, but it is a trade that is in desperate need of growth.”

A concern that dedicated home automation integrators have is that these electrician-friendly solutions might result in their line of work being made redundant, but there is plenty of involvement and collaboration from the custom channel required, according to Clipsal by Schneider Electric smart space director Ben Green.

“Electricians are great at putting cables in walls and keeping it regulated and compliant. Where the system integrator comes into play is where you want to make all the technology work together.

“In a modern residential environment, you’ve got a lot of different things that are connected now and we want to avoid too many remotes on the table, too many apps on your phone,

The demand for custom control and home automation from end users has seen a significant increase in recent years, though, so it is no surprise that a number of large electrical accessory manufacturers have begun to enter this market with their own home automation solutions .

and so on. The integrator is in charge of making them all work together.

“They are still, as a service in a highly connected environment, really important.”

ABB Australia training and technical specialist Ian Richardson says that the company’s Free@Home solution is heavily targeted towards electrical contractors, but when it comes more complex systems, dedicated integrators are still very much at the forefront.

“Often integrators are using a higher level product than Free@Home, such as a KNX system,” he says.

“I think there’s always going to be a place for the electrician, likewise, a place for the system integrator. It comes into the level of complexity of the installation that they are working on.



ABB’s Free@Home solution is heavily targeted towards electrical contractors; however, it does have solutions for integrators too.



The Clipsal Iconic range places the requisite ‘smarts’ into an interface that everybody is familiar with - a standard switch.



Legrand’s MyHome system enables control over a household’s lighting, air-conditioning, audio and video intercoms.

The two will always go hand in hand.”

The time commitment required to become familiar with these systems is significantly shorter than traditional control systems. Free@Home and KNX Easy, for example, have training courses that can be completed within a few hours.

“Those that have taken up this technology are contractors that are working on second or third homes, where there’s a requirement to have some sort of automation but not at a highly complex level,” Wayne says.

“They’re people who have said that they don’t really want to do any complex training, which is the market our solution is catered for.”

The training required and offered varies from company to company. Legrand, for example, provides education that includes in-depth training in technologies, sales advice and market trends. This aims to give contractors using Legrand systems theoretical and practical experience for its solutions.

“Our training provides support through every step of the contractor’s journey. This involves pre, during and post installation and also throughout the commissioning process,” Luca says.

“Communication is key. Our smart home solutions are catered towards the trade and end-user markets. As such, our messages must be tailored to suit each market’s needs.”

Post-installation support for these systems also varies, but the simplicity of these solutions aims to provide basic troubleshooting options for both end users and contractors.

“With Free@Home, once the installation is complete, the electrician

still has a role to play, which is quite important. Not only are they in charge of the programming and the installation, they will provide the ongoing support as well,” Ian says.

“Though ABB can provide technical support on products, as a rule, we don’t get involved with programming. That is the realm of the electrician and we don’t want to tread on their toes and take away any potential business or income.

“Through this process, the electrician can look like quite the expert to their clients.”

Luca argues that the need for systems that are simple to install is a reflection on the market, and with the attention that home automation has received, the more options available to end users and consumers, the better.

“Within approximately three to five years, smart technology will be integrated into every single device within Legrand’s portfolio,” he says.

“Smart technology is embedded into contemporary culture. In a volatile, yet exciting time like this, we need to make sure we’re keeping up with

these trends.”

Ian agrees, saying that the international market for smart technology is expanding rapidly, and will eventually become more widespread in Australia.

“Unfortunately for us, Australia always lags behind the rest of the world when it comes to home automation, he says.

“However, we also get to see what is working, which allows us to work out what direction we can go, and what end users are interested in having in their homes.”

The ‘electrician of today’ is embracing the smart home and becoming a networking expert.

The regional development consultant for the Custom Electronic Design and Installation Association [CEDIA], Lauren Tuckwell, says the organisation acknowledges the increase of electricians entering the custom channel as a positive step for the industry, but ensuring that comprehensive training and appropriate certification is completed is essential in delivering the best possible service to clients.

“Technology is increasingly infiltrating the home. As a result, many require comprehensive wiring infrastructures and data network systems that are suitable for the modern smart home. In order to prevent opportunists from ‘doing it themselves’, it’s crucial for electricians to offer a service that home owners can benefit from,” Lauren says.

“The rise of ‘smart’ wiring presents a great opportunity for electricians to offer a service that home owners can benefit from. By offering a more complete service for the home, including specialist services, electricians can guarantee their businesses will be more resilient to the tough times and pick up more work from new and existing customers.

“To make sure electricians are equipped with the correct skills and knowledge, CEDIA is on hand with the best available training when it comes to wiring for smart homes. For electricians to gain credibility within this market, it is important for them to achieve certification.

“CEDIA Certification establishes clear, objective standards for knowledge within the home technology industry.” ■

Legrand

www.legrand.com.au

Hager

www.hagerelectro.com.au

ABB

www.new.abb.com/au

Schneider Electric

www.schneider-electric.com.au

Smart Voice

www.smartvoice.com.au

CEDIA

www.cedia.org

**FOR THE LATEST DATES IN HOME AUTOMATION TRAINING
TURN TO PAGE 98**

ELECTRICAL CONNECTION  *training diary*

ELECTRICAL

SAFETY RECALL

Eaton Industries Pty Ltd - Quicklag ELQ Earth Leakage Circuit Breaker (RCBO)



THE SAFETY RECALL IS STILL CURRENT FOR THESE AFFECTED RCBO MODELS

Current Rating	30mA 1 Pole	10mA 1 Pole	100mA 1 Pole	30mA 2 Pole
10A	ELQ110C3TW	ELQ110C1TW	ELQ110C10TW	ELQ210C3TW
16A	ELQ116C3TW	ELQ116C1TW	ELQ116C10TW	ELQ216C3TW
20A	ELQ120C3TW	ELQ120C1TW	ELQ120C10TW	ELQ220C3TW
25A	ELQ125C3TW	ELQ125C1TW	ELQ125C10TW	ELQ225C3TW
32A	ELQ132C3TW	ELQ132C1TW	ELQ132C10TW	ELQ232C3TW

Affected models were sold nationally from April 2004.

HAZARD: A non-compliant material has been used in the manufacture of a component, and when operating under short circuit conditions the product may express ionised gases through the exhaust port which may result in conditions creating a fire risk.

WHAT TO DO: Building owners, managers and electrical contractors should check switchboards or loadcentres for potentially affected RCBOs. The affected models can be identified by the presence of a green test button, as shown in the above image. Products without a test button or with a white or an orange test button are not impacted by this recall. Further guidance on how to identify an affected model are available at www.eatoncorp.com.au/elqtw-r

If your RCBO is an affected model, contact Eaton at the contact details below to arrange for a replacement RCBO to be installed onsite at no charge.

CONTACT DETAILS: Please direct all inquiries regarding this recall to:

Phone: 1800 870 851

Website: www.eatoncorp.com.au/elqtw-r

See www.productsafety.gov.au for Australian product recall information



TUK TALK: CROSSING AUSTRALIA THE NEW OLD FASHIONED WAY



A group of young engineering students and a 'social entrepreneur' are travelling the world using nothing but the power of sunlight. **Paul Skelton** reports.

A team of young Australians have embarked on a solar-powered journey across Australia – and the rest of the world – in an unlikely vehicle, a tuk tuk.

Helmed by social entrepreneur Julian O'Shea, the SolarTuk Expedition is a three-wheeled outreach and sustainability project that has seen the team drive the length of Australia powered by the sun.

In March, the group will head to Asia to cross the world's largest continent in a similar fashion.

"On 24 November we kicked things off and started our trip up the east coast of Australia at 55km/h," he says.

The SolarTuk was unveiled at RMIT University's EnGenius event on 17

October at the Melbourne Convention and Exhibition Centre, where it was showcased alongside projects from 1,000 final year engineering students.

A team of final year students from RMIT University's School of Engineering were responsible for converting the tuk tuk to solar power and preparing it for the expedition.

"The focus of this project is to promote sustainable transport and sustainable engineering," says final year electrical engineering student Andrew Klink.

"The tuk tuk's battery has a range of 250-300km. In an earlier version of the tuk tuk, we installed approximately 330kg of lead acid batteries, which led to a capacity of 15-16kWh. We have

since replaced that with six Tesla Model S battery modules, each of which offers about 5.3kWh, so we've now got a total pack capacity of more than 30kWh."

In addition to the solar panels, the tuk tuk is fitted with a charger that plugs directly into a power outlet as a redundancy.

"Unfortunately, there isn't enough surface area on the tuk tuk to be able to make it completely solar powered just yet, so we have included a 2,500W charger.

"From a normal wall outlet, to fully charge the tuk tuk's battery would take about 14 hours, from 0-100%."

Final year environmental and sustainable engineering student Jake Collier is responsible for planning the route the tuk tuk will take on its journey.

“Our aim with this project isn’t to advocate for people to have solar panels on their cars; rather, we’re trying to educate people about the benefits of electric vehicles and about renewable energy as a whole,” Jake says.

Julian says an important side effect of the trip is to dispel a few of the myths surrounding electric cars.

“We want to show that electric vehicles don’t need to be expensive. When you say ‘electric vehicle’ people think ‘Tesla’ and they think ‘\$100,000,’” he says.

“We have shown that you can drive across the country with zero carbon emissions in the cheapest vehicle humanity drives - the tuk tuk.”

Now that the team has conquered Australia, their attention is turning to Asia.

The journey will commence in March 2019, and throughout the trip the team will conduct educational and outreach workshops with rural schools and community groups.

The project is run by global educational social enterprise Unbound. Julian, who studied engineering, wants to encourage Australians to find more sustainable ways to live, work and travel, and transportation is an important part of the equation.

“We think that electric vehicles have a role to play and would love to see a faster transition to greener forms of mobility,” he says.

“We think that if we can make it across the world in a slow-moving tuk tuk then people needn’t be too worried about the range of their own, more appropriate, electric vehicles.

“Our goal is to use 100% solar power and make our way across these countries - meeting and running workshops with schools, politicians, innovators, educators, media and the wider community to share how transport can be more sustainable.”

The SolarTuk Expedition also aims to encourage young people to consider careers in science, technology,

engineering and mathematics [STEM], and to be involved in designing and inventing sustainable solutions.

The SolarTuk Expedition will travel across South East Asia with the support of the Australia-ASEAN Council, as a sustainability and outreach initiative to strengthen ties between Australia and the region - including a stop in Bangkok, the historical home of the tuk tuk.

This expedition is supported by the Australian Geographic Society and, if the expedition across Asia is a success, then the team hopes to complete a full global circumnavigation.

“The SolarTuk project is an ambitious, and slightly crazy, project, but one that we hope will reach thousands of people, and encourage a more sustainable future,” Julian says.

If you’d like to track Julian and his team’s journey across Asia, you can follow their progress at www.solartuk.org. ■



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MERCURY IN RETROSPECT

The voluntary FluoroCycle lamp waste recycling program is now entering its eighth year. **Cameron Grimes** takes a look at how the market has developed in the intervening years.

When dumped into landfill, mercury, which is an extremely dangerous chemical found in several lighting products, has been known to poison the water supplies of communities. When lamp waste is crushed in landfill waste sites it can potentially end up in water tables, and as such lead to mercury poisoning.

While a voluntary recycling scheme exists, FluoroCycle, ultimately it is expected that the collection and recycling of commercial lamp waste will become mandatory. But this will rely on the Australian Government ratifying the Minamata Convention, which it signed in November 2013.

The Convention (a global agreement between governments) includes provisions regarding the management of waste containing mercury, including the disposal of lamps containing mercury in landfill. These provisions are aligned with work that has been undertaken by the Basel Convention, which addresses

the treatment and movement of hazardous wastes.

Though not yet mandatory, responsible corporations, smart electrical contractors and government at all levels have chosen to sign up to the FluoroCycle scheme.

FluoroCycle is administered by Lighting Council Australia on behalf of the Federal Government. Its aim is to increase the national recycling rate of waste mercury-containing lamps. But the introduction of the scheme has also led to the development of several businesses that specialise in the proper disposal of mercury-laden luminaires.

Among the original collector/processor signatories to the scheme were CMA Ecocycle, Lamp Recyclers and Toxfree. These, and other, companies have been making steady in-roads into the installed base of hundreds of millions of luminaires. (*Electrical Connection* magazine was also the original media partner signatory to the scheme and has since promoted the program extensively.)

The recycling of fluorescent tube and lamp waste is a complex process that involves the separation of aluminium, glass, phosphor powder and plastics, which is achieved after the primary crushing of said tubes and lamps.

Once separated, the phosphor powder is heated in a distiller, turning the mercury into a vapour that is then condensed into pure metal.

The uptake of these recycling services largely started at the big end of town but over time, they have been embraced by smaller facilities.

Today, electrical contractors large and small are marketing the responsible advantages of recycling to their clients and that environmental message is getting through.

State government environmental schemes such as NSW's Independent Pricing and Regulatory Tribunal (IPART) Energy Saving Scheme and the Victorian Energy Efficiency Target (VEET), have contributed significantly to the levels of recycling, according to

CMA Ecocycle business development manager Daryl Moyle.

"I think there's more awareness of programs like FluoroCycle as well as a genuine desire by customers to recycle, as opposed to the irresponsible landfill option. Last year, we recycled 1,100t of lighting waste," Daryl says.

According to CMA Ecocycle, that equates to approximately 10-12% of recyclable lighting that exists in the market. Daryl adds that this number is destined to increase in states like Victoria, when a state-wide ban on e-waste in landfill comes into effect in July 2019.

With this increase and awareness in lamp recycling, Lamp Recyclers managing director John Field says a lot of electrical contractors are now jumping on board, but many have little knowledge of the recycling process so they don't always appreciate the sensitive logistics required.

"What we're finding with electrical contractors is a lack of planning in their recycling. We'll get phone calls from contractors on particular days with the

expectation that we can visit their site on the same day," John says.

"As soon as contractors are on site and ready to change over lamps, they should contact us as soon as possible, so we can plan ahead and have an orderly removal of the waste.

"Recycling glass and mercury isn't free and it's a complex process."

Lamp Recyclers has pioneered a number of logistic options over the years as not every site requires a cumbersome metal stillage that holds a thousand tubes.

"We can efficiently bring back sizeable quantities from even remote places like the north-west of Western Australia with our approved Ezy-Return boxes. These are returned to us via Australia Post's logistics system," he says.

"In recent times, we have also launched a new solution called the Ezy-Pal, which is a pallet-sized container that folds down for easy despatch to clients, as no-one likes shipping air...

"However, what's most exciting for us is our recent investment in a new

crushing/mercury processing facility we brought into Australia. That's been a big move for a company our size, but it demonstrates our confidence in a market that is growing strongly year-on-year."

While Lighting Council Australia is charged with moving the market forward, it is the personal responsibility of everyone across the supply chain in the electrical sector to play their part in this product stewardship initiative. We need to remove the danger of this insidious chemical element from our environment.

Lighting Council Australia declined to make comment for this article. ■

CMA Ecocycle

www.cmaecocycle.net

Lamp Recyclers

www.lamprecyclers.com.au

Fluorocycle

www.fluorocycle.org.au

Lighting Council Australia

www.lightingcouncil.com.au

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EMONA



PLAYING IT SAFE

Murray Teale explains how changes to the long-standing information and communication equipment safety standard will see the emergence of new energy classifications.

While the industry awaits the ratification of 100W Power over Ethernet on generic cabling, changes to AS/NZS 60950.1:2015 *Information technology equipment – Safety general requirements*, which deals with the delivery of DC power for telecommunications equipment, sees the emergence of new energy classifications.

These new energy classifications will see power exceeding 100W being delivered over telecommunications cabling with commercially available products that are now available, delivering digital power of 1,000W at 2,000m over a single pair.

The delivery of remote powering at this level creates a number of changes to industry, standards and regulations as changes create new challenges to both safety and performance.

NEW ENERGY SOURCE CLASSIFICATION

The new published AS/NZS 62368.1:2018 *Audio/video, information and communication technology equipment* in broad terms addresses three energy classes, - ES1, ES2 and ES3.

These energy sources may be used on telecommunications cabling for remote powering.

Along with the energy source classification, the Standard also defined different types of people - put simply

- **Ordinary person** - Not skilled or instructed.
- **Instructed person** - Instructed or supervised by a skilled person who can responsibly use safety equipment and procedures for the associated energy source.
- **Skilled person** - Relevant education, qualification and/or experience to identify hazards and take appropriate actions to reduce the risks to them and others.

Along with Energy Source (ES) and 'type of people' classifications, the Standards also address safeguards including but not limited to, basic safeguards, equipment safeguards, installation safeguards, skilled safeguards and supplemental safeguards.

The basic concept is to ensure that adequate safeguards are put in place. The safeguards will be specific safeguards to protect specific types of people from specific energy sources.

For the different energy sources, the following would appear to hold true:

ES1 CLASSIFICATION

- ES1 classification is when either the touch current limit or the touch voltage limit is considered safe for an ordinary person to touch.

ES2 CLASSIFICATION

- ES2 classification is applicable when ES1 conditions have not been met, but is still either touch current limited or touch voltage limited but is a higher level than ES1.
- ES2 is considered to be safe with basic safeguards.
- 100W Power over Ethernet (PoE) and HDBaseT would be considered to fall under ES2 classification.

ES3 CLASSIFICATION

- ES3 classification is applicable when ES2 conditions have not been met.
- ES3 circuits have no voltage and no circuit current limit.
- ES3 is classified as hazardous and requires basic and supplemental safeguards to protect ordinary persons.

WHAT ARE THE IMPLICATIONS OF REMOTE POWERING?

Remote powering on telecommunications cabling has two primary areas of concern that need to be addressed by standards.

Potential contact with a hazardous energy source and heat rise within cabling causing fire or cable failure.

ELECTRICAL SAFETY

While LV telecommunications (ES3) cabling has been within AS/CA S009:2013 *Installation for customer cabling [Wiring rules]* for some time, its application has been typically limited to special applications like EWIS and public address systems; the new energy classification may well see ES3 run over generic or structured cable like systems.

The use of ES3 circuits on generic and structured cabling systems will have to adequately address safety issues and ensure that adequate safeguards are in place to help ensure the safety of the person working on or using telecommunications cabling. This requirement may well require cable providers to have the ability to identify ES3 cable and equipment, and ensure appropriate safeguards are in place.

HEAT RISE

The heat rise in telecommunications will be affected by ES2 and ES3 circuits as a result of higher current flow. Generic and structured cabling has the challenge that what is put on the cabling system is not controlled by the cable provider. With the ongoing deployment of Internet of Things (IoT) technologies using remote powering and the introduction of ES2 and potentially ES3 running over generic cabling, a number of challenges present themselves related to heat rise.

AS ISO/IEC TS 29125 *Information technology – Telecommunications cabling requirements for remote powering of terminal equipment* looks at the issue of heat rise in cable bundles with 500mA per conductor 1,000mA per pair (ES2).

AS/NZS 62368.1 has no limit on current and ISO/IEC 11801:2017 *Information technology – Generic cabling for customer premises* has channel requirements to



Heat rise in cabling could cause fire or cable failure

750mA per conductor, which exceeds the work undertaken by ISO/IEC TS 29125. As such ISO/IEC TS 29125 can only really be used as a guide to the effect of powering telecommunications cabling.

ISO/IEC TS 29125 indicates a number of factors effecting heat rise in a cable bundle including the following

- Conductor size.
- How many pairs are energised.
- Current in each pair.
- Cable construction.
- Ambient temperature.
- Installation conditions such as open air, on tray in ducts, sealed conduit within insulation.
- DC resistance unbalance.

THE CHALLENGES FOR STANDARDS IN AUSTRALIA ARE:

- The suitability of a telecommunications cabling system is dependent on the installation, cable selection and how much power is carried within the cable/cable bundle.
- An IoT device requires both communication and power and twisted pair cabling provides both.
- The adoption of 100W PoE is likely to see higher levels of power used more often.
- That the regulatory model does not address who connects services on a generic/structured cabling system.
- It is possible that enough power can be injected into a cable bundle meeting AS/CA S009, AS/NZS 3080 and ISO/IEC 11801 by the connection of approved active equipment to render the cabling non-operational.

- The revised AS/CA S009 currently under development will need to address heat rise, however this standard does not address what services are activated over structured or generic cabling by the end users.

THE CHALLENGES FOR INDUSTRY INCLUDE:

- The concept of service activation by end users may well affect the installed cabling operation, which will have an associated impact on systems supporting safety, security and operational reliability that use twisted pair cabling.
- Cable providers will need to understand the new energy sources classification and how they will be applied within the regulatory framework.
- The rapid ongoing development and deployment of IoT may well see standards lagging technology and the convergence of technologies may see emerging technologies fall outside traditional standards and regulatory framework. As such, the Duty of Care obligations for individuals and organisations may need to be more carefully considered than in the past. ■

Murray Teale is the technical director of VTI Services. He has worked in the electrotechnology field since 1979 and has been heavily involved with standards since 1998.





STRIKE A BLOW TO SOLAR

PV systems in susceptible regions should be made safe from nature's power. **Phil Kreveld** explains.

Lightning strikes are dangerous, involving currents of up to several hundred thousand amps with rise and decay times of a few microseconds.

Direct strikes causing large, ground step potential differences are hazardous to life and limb, and to equipment.

Apart from direct strikes, induction effects are also hazardous to equipment. However, multiple earth neutral reticulation provides a safeguard but is not enough for a secure ground equipotential for equipment connected over some distance.

Lightning occurs in:

- Darwin and the top end generally (more than 80 days a year);
- Cape York Peninsula, Kununurra and Broome (more than 60 days a year);
- South Eastern Queensland (25 days a year);
- South Eastern New South Wales (25 to 40 days a year); and
- Victoria and South Australia (fewer than 10 days a year).

These figures indicate the importance of lightning protection for photovoltaic (PV) plant protection in designated areas.

INDUCTION EFFECTS

The aim here is to provide some numbers applicable to circuits in the vicinity of lightning strikes.

Assume a bolt with a peak current of 30kA (30×10^3 amps), a rise time of 5.5 microseconds (5.5×10^{-6} seconds) and a fall time of 75 microseconds.

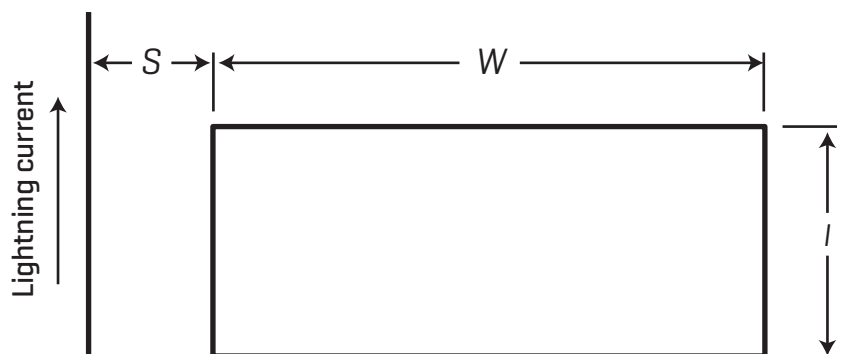
The induced voltage in the loop shown in Figure 1 is of the order of 33,000 volts! Of course, it depends on the orientation of the wire loop, with maximum induction occurring at right angles to magnetic field caused by the lightning bolt.

LIGHTNING ARRESTORS

The basic task is to provide a high electric field by virtue of a pointed, upward facing part, clear of parts to be protected, to provide a landing place for a lightning bolt.

The very short rise and fall time implies a very high frequency spectrum. Therefore, very low inductance flat ribbons with sufficient cross-sectional area to keep current density to safe limits must provide the path to earth.

Economic considerations may push aside the danger of a direct lightning strike. In commercial installations –



In this diagram assume S to be 30m and the loop to be 30m x 3m high.

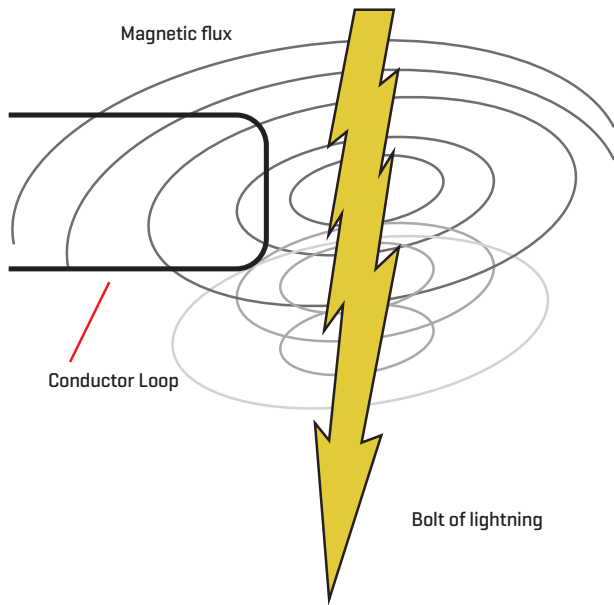


Figure 1: The lightning bolt has a concentric magnetic field which, when linking a nearby wire loop, will cause high voltages to be induced.

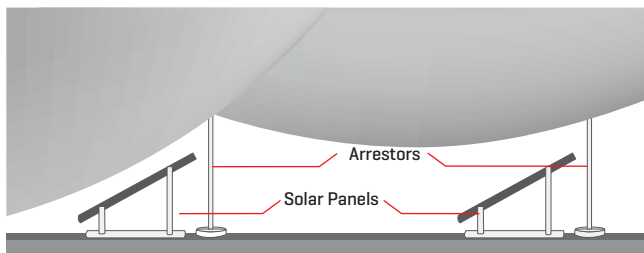


Figure 2: In the rolling sphere method the sphere can make contact with the lightning arrestor, but not with the solar panel.

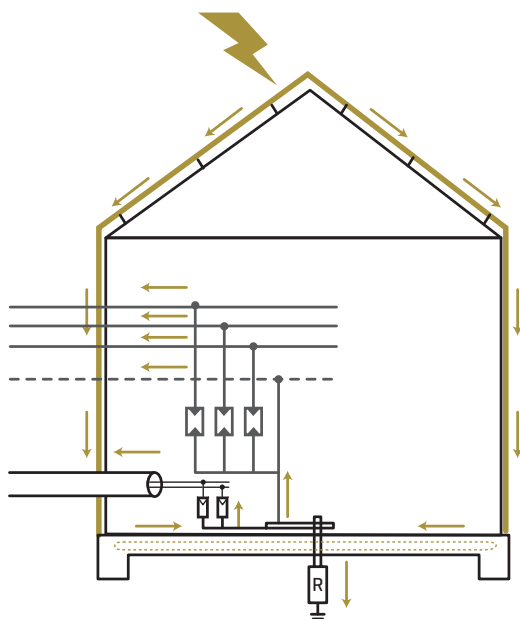


Figure 3: Surge protection for phase conductors and communication cables.

particularly those with large roof areas – reliance may be placed on a single arrestor.

Intuitively it seems that the taller a lightning arrestor is, the greater is the ‘shadowed’ or protected area surrounding it.

The challenge in designing protection arises from the inexact nature of protection models. The ‘rolling sphere’ method was developed for substations and is also useful for PV installations.

The principle is illustrated in Figure 2. The sphere rolling over an installation should not come into contact with any plant, except those portions where a lightning arrestor is placed or where a strike is not considered dangerous.

The rolling sphere method does not guarantee protection. For one thing, its diameter is crucial when considering the shadow area of an arrestor.

In the case of substations, a complicated formula gives the size. For PV an arbitrary size is picked, with typical diameters of 20m, 30m and 40m.

A critical aspect in determining the diameter is the ‘withstand voltage’ of insulated plant, that is, the higher the withstand voltage, the larger the diameter of the rolling sphere can be.

Earth resistance is probably too high to avoid dangerous step potential and neutral surges, so for connected buildings an earth mat must be constructed to provide a close to common ground voltage.

Even from several hundred metres away, lightning currents can cause dangerous surge voltages in conductor loops through capacitive, inductive or galvanic coupling.

Large surge voltages can be coupled over a radius of several kilometres. The international lightning protection standard IEC 62305 describes how direct lightning strikes of up to 200kA are safely arrested.

The current is coupled into the earthing system. Due to the voltage drop at the resistor, half of the lightning current is coupled into the internal installation.

The partial lightning current then divides among power lines entering the building (number of cores of power line entering building), and about 5% enters data cables, as shown in Figure 3.

LAYOUT OF PANEL WIRING

To minimise induction effects, cable lengths must be minimal. On the DC side of a PV system the cable length of the positive and negative terminals can be reduced by twisting the leads together to minimise the cable loop surface.

On the AC side, the cable length of the protective earth, phase and neutral conductors can be reduced by twisting them together to avoid large loops.

To have an effective routing precaution, the loop area [DC side connection and AC side power line] must not exceed 0.5m², in accordance with the Standard IEC 62305-2 [4].

Unfortunately, it is not easy to achieve this value, mainly because the junction box of each photovoltaic module has connection cables [positive and negative terminals] of about 1m spaced 10cm apart.

The formulas for evaluating induced voltage are provided in

annex A of Standard IEC 62305-4 [6]. It is possible to calculate the number of modules connected in series/parallel forming a loop area sufficient for an induced voltage greater than 1.5kV due to a nearby flash [250m away with a maximum current of 30kA].

A photovoltaic array field with fewer than 200 modules – and total power less than 40kW peak obtained by assuming 200W peak per module – should not have any problems.

SURGE SUPPRESSORS

As shown in Figure 4, these must be installed on the DC link side of the inverter and at the point of coupling [the AC side of the switchboard].

The metal oxide varistor [MOV] is probably the most popular clamping device used for transient suppression.

MOVs consist of millions of tiny semiconductor junctions [PN junctions] that act as diodes with larger forward voltages. A common material for MOVs is a granular form of

zinc oxide sandwiched between several parallel electrodes.

The MOV is inherently suitable for AC voltages, as the diodes are disposed in all directions. As the voltage across the MOV rises, more and more diodes turn on. The result is, in effect, a non-linear resistance that reduces incrementally with increased voltage.

This is precisely the effect needed for clamping excessive voltages on the device being protected.

A clamping function requires effective voltage division. At line voltage the MOV is essentially an open circuit, but as the voltage rises the differential resistance ΔR – which is equal to $\Delta V/\Delta I$ – decreases.

Provided the impedance of the upstream circuit to which the MOV is connected is higher than ΔR , voltage division will lower the transient voltage. However, MOVs have a high let-through voltage. That is to say, the voltage across the device continues to rise with input voltage, albeit at a much reduced

rate because of the low ΔR .

On the other hand, silicon avalanche diodes [SADs] have a sharply defined clamping voltage [being the point where the reverse biased diode junction breaks into avalanche mode with reverse leakage current suddenly increasing by orders of magnitude].

The ΔR of the device is then a virtual dead short, and the voltage is clamped at the avalanche point [no let-through voltage effects].

Compared with MOVs, SADs have a much reduced energy dissipation capacity and are therefore not usually employed on power circuits.

So far, voltage transients have been considered as time-dependent phenomena. They can also be thought of in terms of frequency spectra. The faster the rise time of an impulse, the broader is its frequency spectrum.

Filters constructed from inductors, capacitors and resistors can be very effective transient suppressors, as mentioned earlier. The low-pass filter, which can take several forms, represents the standard method of reducing the slew rate of fast transients.

The feed-through capacitor, combined with the self-inductance of the leads connected to it, forms a low-impedance path to earth for the high-frequency components [those associated with the fast rise time of the transient].

THE NEED FOR SPECIALISTS

Lightning protection is specialised branch of electrical engineering. For commercial and industrial installations in areas of high lightning incidence, specialists should be consulted and preferably engaged to design and implement protection systems. ■

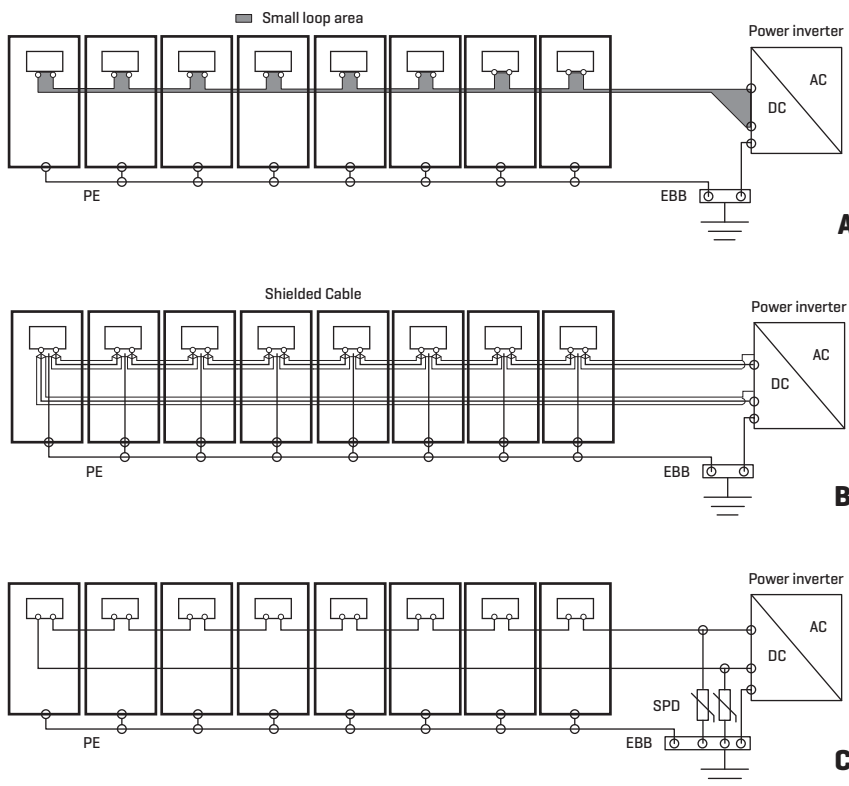



Figure 4a: The loop area of panel wiring must be minimised to avoid excessive induction voltages. Figure 4b illustrates the use of coaxial cable to avoid inductive loops. Figure 4c indicates the correct method for installing surge protection devices.

Phil Kreveld is an energy writer. He is an electrical engineer. He has worked in electrical, electronic and scientific instrumentation in Australia and the US.





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BUILDING THE FUTURE

The rollout of the IoT is accelerating, but are telecommunications cabling standards keeping pace? **Ross McGravie** looks at proposed enhancements to PoE standards and the birth of PoE++.

Planning for the future is problematic at the best of times, but the increasing adoption of Internet of Things [IoT] technologies for everyday working and living has literally created a power struggle.

One only has to think of the prevalence of wireless access points [WAPs], networked security cameras, building automation and control systems, and voice-over-IP [VoIP] phones to understand how commonplace it is becoming.

In fact, more than a million devices are already estimated to be connected via Power over Ethernet [PoE] - the system that safely transmits electrical power and data over standard Category 3 and higher-category cabling.

But with the Australian Communications and Media Authority [ACMA] in the process of remaking technical standards relating to customer equipment

and cabling, the Australian Digital and Telecommunications Industry Association [ADTIA] has called for upgraded training and greater awareness of the issues from regulators and standards bodies.

More specifically, ACMA is proposing to adopt the 2015 AS/NZS 60950 *Information technology equipment - Safety General requirements* and the 2018 AS/NZS 62368 *Audio/video, information and communication technology equipment - Safety requirements* industry Standards. The draft *Telecommunications [Customer Equipment Safety] Technical Standard 2018* is expected to have a four-year transition window for compliance.

On a practical level, ADTIA secretary Dominic Schipano says some of the older network cabling in Australian workplaces and homes was not rated for the data and power requirements of IoT and PoE, while technicians with older

qualifications may require retraining to be fully aware of the safety and performance issues.

HOW IT WORKS

PoE is designed so that Ethernet data and power signals do not interfere with each other. It works by converting the mains power supply into a low-voltage supply (with inevitable power dissipation), then transmitting the power over structured cabling to PoE-enabled devices.

The power sourcing equipment [PSE] is typically designed as end-span [built into an Ethernet switch port] or mid-span power supplies to the powered device [PD].

The simple nature of PoE has allowed network managers, installers and integrators to use structured cabling to provide power and data to many of their network devices. But as the demand grows, so does the need for more power from the cabling.

The original PoE Standard from 2003 limited the technology to devices requiring less than 12.9W of power. By 2009, the revised standard increased the power supply to 25.5W. And the third incarnation by the Institute of Electrical and Electronics Engineers (IEEE) currently in the pipeline, IEEE P802.3bt, intends to deliver at least 71.3W to PoE-enabled devices, assuming a 100m channel.

CommScope's 2017 white paper, *Laying the groundwork for a new level of Power over Ethernet*, says the infrastructure for the IEEE 802.3bt Standard – commonly referred to as PoE++ or 4-Pair PoE (4PPoE) – must deliver more power, increase efficiency and provide support for 2.5Gbps, 5Gbps and 10Gbps connections.

And with some devices, such as IEEE 802.11ac WAPs, expected to exceed gigabit Ethernet capabilities, the Standards will also need to adapt for PoE on higher bandwidth links, such as 2.5GBase-T, 5GBase-T and 10GBase-T.

Parameters set, the IEEE 802.3bt Task Force was charged with creating a four-pair PoE standard that will include a pair-to-pair resistance unbalance specification of about 7%, which allows the use of most of the installed base of Cat5e and better cabling. But considerations include the overall network and channel requirements, effects on thermal and capacity limitations, and cabling and deployment strategies.

TURNING OLD INTO NEW

The changes all sound fantastic on paper but the issue remains that legacy telecommunications building cabling usually has not been rated for the proposed power changes to PoE standards.

The result is that older cables, when installed in bundles, heat up more with greater wattage and suffer performance degradation.

"As the heat goes up, performance goes down," Dominic says.

"But cables with higher categories, such as Cat6A, have larger conductors [and can carry more current] and will

heat less than Cat6 and Cat5e. We are not really talking about potential fires, but slower throughput of data. There are other issues like sparking [arcing] that are also an issue at 90W, resulting in a pitting of contacts on the RJ-45 outlets."

In theory, Cat5 is no longer fit for purpose due to the potential

of future overload. But the commercial reality is somewhat different.

The increasing adoption of IoT technologies for everyday working and living has literally created a power struggle.

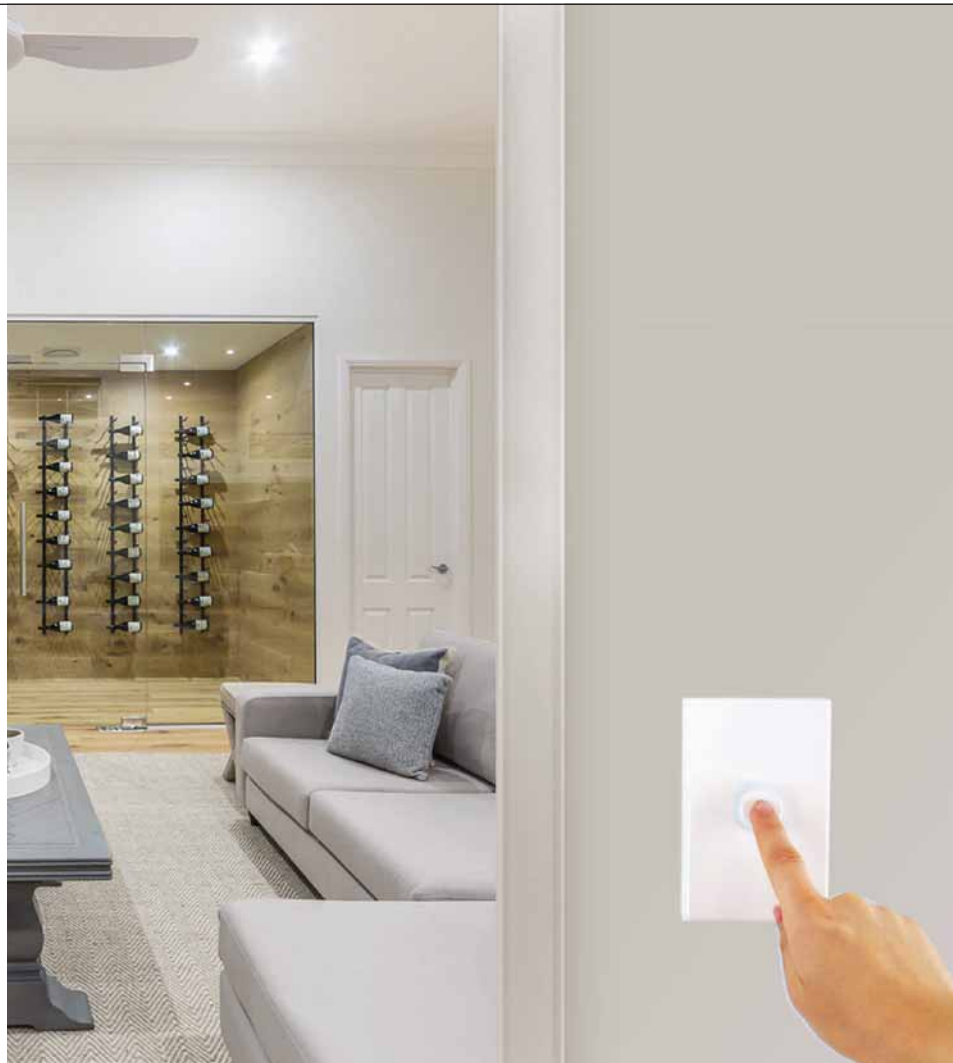
DISCOVER.

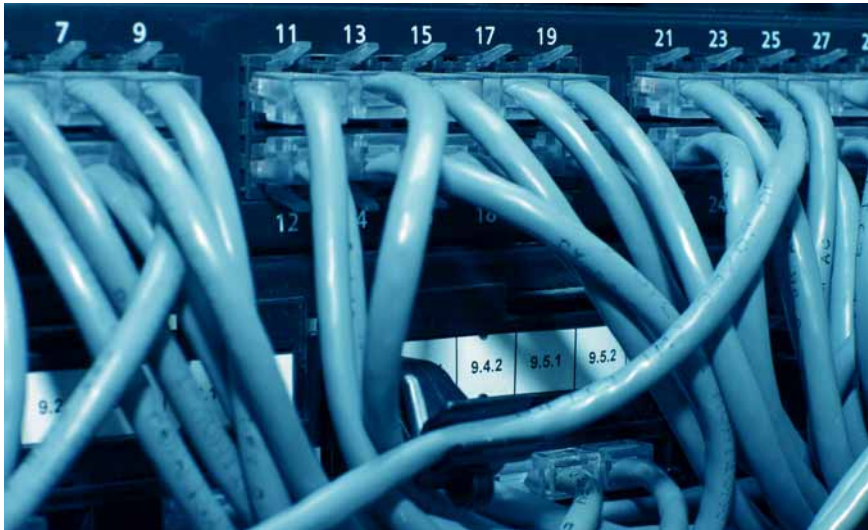
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In theory, Cat5 is no longer fit for purpose due to the potential of future overload.

“Business clients are usually more interested in cost factors – and that it works – rather than technical details. So they will often be unaware of the risks involved, particularly when using older [existing] cable never intended for the higher power transfer with PoE,” Dominic says.

To ensure businesses do not have to replace their entire network of cabling, Panduit outlined a series of recommendations in its 2016 paper, *Effect of Next Generation 100W Power over Ethernet on RJ-45 Connectivity*.

They included: ensuring ambient temperature plus cable bundle temperature rise does not exceed cable operating temperature; ensuring connectivity can meet applicable standards to prevent arcing damage to critical mating area; limiting bundle sizes to ensure temperature rise is 15°C or lower; and using Cat6A cabling for new installations for future proofing.

Likewise, CommScope recommends Cat6A cabling be used to improve thermal performance and energy efficiency while minimising the cost of moves and upgrades – preferably using a zone cabling architecture. To accommodate future capacity upgrades, it is also suggested that network managers plan for at least two runs of Cat6A cabling per powered device to each zone distributor.

STEADY PROGRESS

International Copper Association Australia technical consultant Ian Millner says the redesign of modular plug jacks has largely overcome sparking [arcing] issues. But educating cablers about the safe supply of power through telecommunications cabling under the new safety standards remains a major hurdle.

“We have three energy sources to find: ES1, ES2 and now ES3, which is classified as any energy source that can potentially cause damage to property and people. ES1 and 2 are intrinsically safe. ES3 is where there are no limits to the current or the voltage being put on telecommunications cabling, so therefore it is up to the manufacturer/installer to ensure that the barriers are in place to ensure the safe deployment of ES3 systems,” Ian says.

“One of the cable manufacturers, Prysmian, actually has VoltServe, which is a technology for digital power. It can deliver a high wattage on telecommunications cabling to provide power to remote wireless access points – and do so even though it’s high power and potentially high voltage. It built it such that if anyone goes across it, they’ll never get any more [of a shock] than touching an electric fence. You’ll know you touched it, but you didn’t die.”

The issue is not new, he says, with Telecom [now Telstra] using technologies in the 1970s and 1980s

that were remotely power fed from one end with 300V or higher to power systems in the carrier’s network. The key was that only carrier-trained personnel could access that cabling.

YEARN TO LEARN

Fast forward to the 21st century and the emphasis must shift to educating cablers of the risks they face.

Ian says the ACMA remaking of telco standards and changes to the labelling notice [in relation to safety] was one way in which regulations catch up with the fast-changing technical developments.

“Over the ensuing decade you’ll probably have a growing number of wireless access points to overcome the fact that we’ve got more devices on wireless networks, and wireless networks are moving to higher and higher frequencies, which means they may struggling to penetrate even gyprock walls in the future,” he says.

“Whatever you do, I always tell people nowadays, run Cat6 cable. If you have legacy Cat5, it’ll be fine and serve you for a significant period of time. But if you’re ever in doubt, put the Cat6 cabling in because you can always then connect a WAP where you need it.”

Dominic recommends it become common practice that customers are advised of the wattage capability of whatever cable is installed so that any additional items connected over time consider their power load.

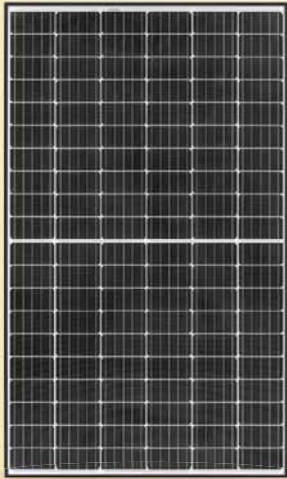
“We also need to jointly develop and update skills options for existing cablers and conduct short appreciation and information sessions for sales and marketers,” he says. ■

Ross McGravie is an award-winning journalist/subeditor who never wants to stop learning or enjoying life.



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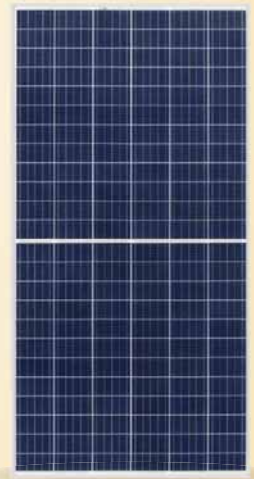
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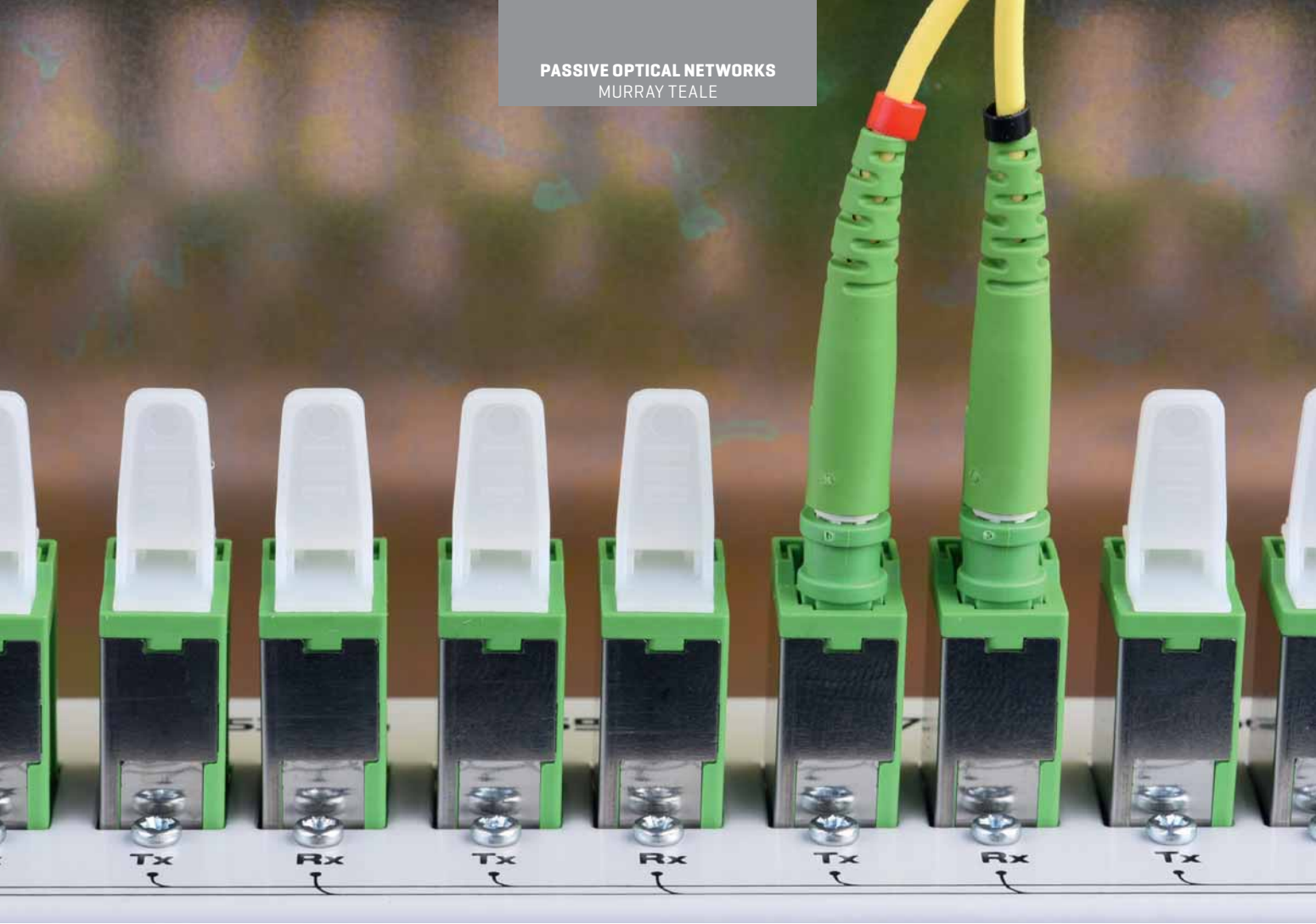






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NEED FOR COHERENCE

The rise of passive optical networks (PONs) - thanks largely to the rollout of the NBN - makes a common specification for testing rather urgent. **Murray Teale** reports.

The passive optical network (PON) introduced by NBN has made the long-established carriage network virtually irrelevant.

The organisation's PON provides a wholesale carriage service that offers an open-access network.

PON and other new technologies worldwide have fundamentally changed how premises are connected and substantially increased the availability of high-speed data. It's true to say that PON is a disruptive technology.

Do PONs have a place in the enterprise space? The answer is yes, but they won't have the same disruptive effect on local area networks.

PONs have been successfully deployed in Australia and New Zealand in mining camps, hotels and retail spaces, to name just a few.

One issue is the lack of an Australian generic specification for deployment - and associated test methodology to support the physical layer.

Internationally, ISO/IEC JTC1 SC25 (on which the AS/NZS 11801 series is based) is responsible for information equipment Standards, and there are no plans to encompass PON infrastructure.

The Standards Australia Committee CT001 agreed on 7 November 2018 to start investigating the development of an Australian Standard or technical specification for PON testing.

The groundwork for such development will be carried out by the CT001-002 optical fibre working group under the chairmanship of Ashley Martin of Commscope.

WHAT IS A PON?

Put simply, a PON allows one core of fibre fed from the distributor (CD-BD-FD) to be split multiple times close to the point of delivery.

This allows it to support up to 32 optical fibre cores, with each core servicing an individual optical network termination (ONT). The ONT may present Ethernet via RJ45 ports and/or wireless

The feeder cable is typically single mode, with each optical core connected to a passive splitter.

The latter splits a single core into 2, 4, 8, 16 or 32 cores with an insertion loss from about 4dB to 19dB. Each split core is connected to a single core distributor cable.

PON testing is envisaged to use a light source power meter (LSPM) and optical time domain reflectometer

[OTDR]. The amount and type of testing will be dependent on the service availability requirements of the system.

Testing of PON infrastructure in the enterprise will need to address the feeder cable, distribution cabling and the completed installation.

Feeder cable and distribution cabling testing can use LSPM and OTDR testing in accordance with the link requirements of AS/NZS 14763-3.

Feeder cable testing seems to present few challenges, as the cables are similar to links specified in AS/NZS 11801-1.

Distribution cables are typically single core, similar to links in AS/NZS 11801-1.

However, there is an anomaly associated with testing using an LSPM. Two cores must be tested at the same time to determine cable length.

This anomaly is associated more with the tester not being able to provide length information, rather than with its ability to provide accurate optical attenuation readings.

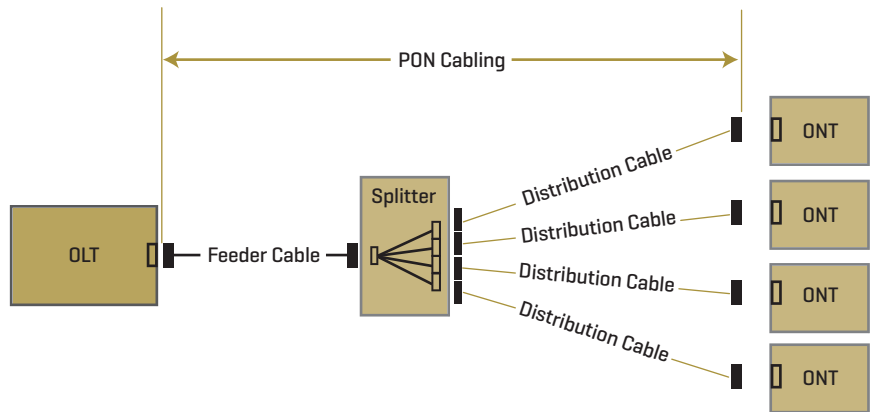
Optical attenuation of the PON cable will include the splitter, feeder cable and distribution cable. The splitter optical attenuation will depend on the number of splits it supports.

The PON cable ideally would be tested with an LSPM in both directions against the requirements for link testing in AS/NZS 11801-1.

The challenge for OTDR testing of PON cabling is caused by the splitter.

When testing from the OLT end, the OTDR will pick up all ONT distribution cables connected to the feeder cable under test.

When testing from the ONT end, the OTDR will identify the distribution cable under test, the splitter and the feeder cable.



A schematic of the physical layer from the optical line terminal (OLT) to the ONTs.

However, without OTDR testing in both directions, averaging cannot be used assessing the link.

One of the considerations for CT001-03 will be the value of PON testing with an OTDR when bi-directional averaging is not available.

Typically, in enterprise testing with an OTDR the results are averaged to determine the component value of any specific component in that link. The value of those specific components [mated] is specified in AS/NZS 11801-1.

As such, any optical attenuation of a specific component determined by an OTDR test in one direction will have high measurement uncertainty, limiting the value of PON cabling component testing.

But if the launch and tail cable have the same refractive index, the testing of the link [not embedded component] might be valid.

This concept is not currently used for enterprise testing, and CT001-03 will need to determine whether it is valid for inclusion in any Standard or technical specification that is developed.

THE ISSUE

In the absence of an Australian Standard for testing PONs in enterprises, specifiers and installers need to have a common understanding of what testing and sampling is to be adopted.

There should be an unambiguous explanation regarding:

- Feeder cabling, distribution cabling and PON cabling.
- The agreed optical attenuation allowance for each cable type, mated connector, interface connector, splice and splitter.
- The agreed maximum or minimum attenuation requirement for PON cabling and/or any other cabling if it varies from the optical attenuation requirements determined by the component allowances.
- The agreed optical return loss requirement [if required] for any interface or embedded mated connector.
- The agreed test method to be used [LSPM, OTDR].
- The applicable requirement for each measurement and the treatment of non-compliant results. This would include the agreed optical attenuation of any splitter. ■

PON and other new technologies worldwide have fundamentally changed how premises are connected and substantially increased the availability of high-speed data.

Murray Teale is the technical director of VTI Services. He has worked in the electrotechnology field since 1979 and has been heavily involved with standards since 1998.





AS QUICK AS A FLASH

Arc flash is a serious issue that every electrician faces. Eaton Power Distribution marketing manager **Simon Rigling** looks at electrical safety in low voltage installations.

Last year was certainly a big one for the electrical industry, with several key updates including the publishing of the new AS/NZS 3000 *Electrical Installations* (Wiring Rules) Standard. While this has cast a spotlight on certain aspects of electrical safety in low voltage installations such as arc faults, a number of recent incidents involving arc flashes have put worker safety top of mind.

In the coming year, we expect the industry to continue educating customers and workers about protection measures to reduce risk and ensure the number of serious electrical incidents in Australia declines.

While short circuit, overcurrent and earth faults are widely understood and protected against in low voltage residential installations, less is known about arc faults and arc flashes.

HIDDEN DANGERS IN ARC FAULTS

Statistics show electrical issues are still a leading cause of residential fires in Australia. In New South Wales, 40% of

residential fires are caused by electrical appliances and faults, while in Victoria, almost one quarter of house fires in 2017 were as a result of electrical appliances or faults.

Electrical safety risks range from overloaded power points and damaged outlets, right through to inadequately maintained installations; however, when it comes to electrical fires, experience shows that arc faults are a leading cause.

Arc faults occur at nominal currents or just below, making them difficult to detect using traditional technology such as miniature circuit breakers (MCBs). Some common causes include carelessly pulling cables out of a power point repeatedly, crushing the cable between objects like a door and door jamb, or cables being damaged by rodents or pets. In some cases, an arc fault can also be caused when wiring becomes loose at the terminal connection.

Over time, broken or damaged wires can lead to small arc currents continually or intermittently burning

and degrading insulation. They are mostly identified by high frequency (HF) electrical noise and the breakdown of the fault current close to the zero-crossing of the driving voltage.

Serial arc faults are most common and can go undetected for a long time, originating from a fault within the phase or neutral conductor. Parallel arc faults originate from a fault between live conductors, with the total current in the circuit increasing depending on load impedance and fault impedance.

ALL-IN-ONE PROTECTION AGAINST ARC FAULTS

While safety switches and circuit breakers for overcurrent protection can be effective in reducing the risk of electrically ignited fires, in most cases they cannot identify arc faults – therefore the addition of arc fault detection devices (AFDDs) is needed to ensure protection against all faults.

AFDDs divide the measured current of each final sub-circuit into a low-frequency and a high-frequency share.

These two signals are used as the basis for the electric arc identification; they are analysed by a micro-controller to determine whether they display the characteristic HF signals of an arc fault, and, if identified, automatic disconnection of the affected sub-circuit will be triggered.

They are not designed as an alternative to residual current devices (RCDs), or circuit breakers for overcurrent protection. Instead they work in partnership with RCDs and MCBs to provide a comprehensive switch board safety solution. However, some arc fault detection devices also incorporate RCD and MCB functionality in a single compact unit.

Included in the new AS/NZS 3000 Standard are guidelines on the use of AFDDs in final sub-circuits for locations storing flammable materials, fire propagating structures, premises with sleeping accommodation or buildings where valuable assets need to be protected. In Australia, there is not a mandated requirement; however, in New Zealand, AFDDs are required in certain types of application.

EXPOSURE TO ARC FLASH

Last year, an electrician and his assistant received burn injuries and temporary blindness after an arc flash event occurred while they were working on a low voltage switchboard in Western Australia. The impact on these individuals could have been significantly different if a risk assessment had been carried out and the correct personal protective equipment (PPE) worn. It has served as a timely reminder for employers to check compliance with relevant legislation.

In the simplest terms, an arc flash is an energy release that occurs during an electrical fault when current flows through the air between two live conductors, or live conductor(s) and earth, causing a short circuit. In a residential setting, an arc flash usually produces little more than a brief flash of light before extinguishing itself harmlessly due to the typically low prospective short circuit current in such installations, and the impedance of the arc itself.

In a commercial or industrial setting, however, available short circuit currents are significantly higher, so electrical faults typically release more energy. These arc flash events release a large amount of energy in the form of explosions which generate heat, toxic fumes, pressure waves, blinding light, and sound waves that can result in serious injury including critical burns, blindness, deafness or even death.

MITIGATING RISK OF ARC FLASH

There are a number of strategies that employers can implement to mitigate the risk of arc flash to employees including ongoing training and conducting thorough risk assessments. Electricians should always wear appropriate PPE such as flame-resistant clothing, eye protection and gloves. While there is currently no Australian standard regarding arc flash hazard assessment, the US NFPA 70e is typically used by workplaces taking a proactive approach.

Another option for mitigating risk is equipping low voltage circuit breakers with arc flash reduction maintenance systems to improve safety. This provides a simple and reliable method to reduce fault clearing time and lower the available arc flash energy at the connected downstream devices.

Systems can be activated at the breaker or from a remote location. The result is a reduction of the incident energy, allowing for improved personnel safety while eliminating the need for higher levels of costly PPE.

Additionally, technologies to mitigate the damage of an arc flash event in a switchboard extend to an arc quenching device. This device is triggered by a combination of overcurrent and UV light sensing, to introduce a bolted short circuit at the load side of the incoming protective device. The short circuit shunts the energy away from the arc, and at the same time causes the incoming protection to trip and disconnect supply. Implementation of this technology requires engineering input at the design stage of the low voltage switchboard. Retrofitting may be

possible depending on factors such as access, and acceptance of potential nuisance operation from the normal operation of protective devices.

LOOKING AT 2019 AND BEYOND

While electrical companies will continue to familiarise themselves with the new AS/NZS 3000 Standard this year, the industry should be keeping a close eye on a number of other regulatory changes related to electrical equipment and safety in 2019 and beyond.

This includes the implementation of the IEC 61439 Standard for low voltage switchgear and controlgear assemblies which is already adopted across Europe. The AS/NZS 61439 series was published in May 2016 and runs in parallel for five years with the old AS/NZS 3439 series. From May 2021 onwards, the new standard takes over. This year will see electrical companies continue to invest in their products to ensure they are compatible with the new standard when it takes over and the old standard disappears.

Other regulations related to working on or near energised electrical installations also play a role in protecting workers. Western Australia has made it illegal (in May 2018) to work on or near energised electrical installations (live work) under Regulation 55 of the *Western Australian Electricity [Licensing] Regulations 1991*. Assessing risk and commencing work is only permissible after specific criteria have been met and rigorous safety measures implemented. ■

Eaton Power Distribution

www.eatoncorp.com.au

Simon Rigling is Marketing Manager for Eaton's ANZ Power Distribution business, which covers low & medium voltage assemblies and circuit protection.



GENERATION EX

The argument that large baseload generators are here to stay is weakening, writes **Phil Kreveld**.

It's often said that we cannot live without thermal power, we will always need synchronous power and there can be no stability without baseload.

They are statements of fact only insofar as we are not prepared to accept substantial re-engineering of electrical power generation and delivery systems.

Such re-engineering is required for microgrids, but the technology is well established.

In the following material we go into some detail regarding synchronous generators because of their advantages, which can be summarised as follows:

- an ability to provide lagging and leading current as demanded by loads;
- synchronicity through power-speed governors regulating steam, water or gas to turbines; and
- the power is dispatchable, whenever needed.
- For wind and solar photovoltaic [PV] generators those benefits have to be 'engineered', and this means somewhat complex solutions.
- They lack the natural ability to provide lagging and leading current – and synchronicity in a system with many generators requires considerable engineering effort.
- The power is not dispatchable unless combined with energy storage.
- However, the advantages include:
- rapid response to power changes demanded by loads; and
- smaller unit power sizes allow economic deployment close to power consuming loads.

Rapid response to load changes thus requires energy storage, for example, a battery, to be part of the generators.

In large power systems such as the national electricity market [NEM], electronic power converters for wind and solar often act as slaves, reducing the load needing to be generated synchronously.

In microgrids, electronic power converters can provide voltage and frequency 'forming' tasks.

SYNCHRONOUS SYSTEMS

The speed of the generators – whether driven by steam, water or gas – is controlled by governors.

In principle, frequency and power have a direct relationship readily explained by the mechanical analogue of driving a car in hilly terrain. As the vehicle travels uphill, it slows unless the accelerator pedal is pressed. The opposite takes place going downhill.

A synchronous power system has a number of synchronous generators sharing the load, with their rotors running at the same speed. Apart from those separated by long transmission lines, they are in phase with each other.

In Figure 1, the phase [orientation of the rotor] concept is illustrated for two generators connected to a power station bus.

By virtue of the very low impedance offered by the bus compared with the network to more distant loads, the phase ['voltage angle' or 'power angle'] of the generators is identical.

Let us assume that the Unit 1 generator in Figure 1a speeds up, therefore assuming more load and relieving Unit 2 of some load.

Unit 1 draws more current, thus causing increased armature reaction and, as would happen in motors, more torque is provided by its turbine.

The Unit 1 rotor was speeded up ahead of Unit 2 and consequently the Unit 1 rotor is ahead by a small angle, δ , thus causing a phase shift in voltage. The voltage of Unit 1 leads slightly.

As shown in Figure 1b, an additional current will flow, adding to the Unit 1 load and reducing the Unit 2 load [it sees the current as a negative contribution], causing Unit 2 to speed up.

However, because we have a synchronous system, the speed governors must maintain speed for the entire system, so Unit 1 is now supplying more power than Unit 2 with total power output matching the load

The means of maintaining frequency while changing power sharing between

generators is a unique feature of synchronous generator systems [assuming that the combined load equals the combined generated power].

With respect to 'quadrature' [lagging or leading] current as required by the load, a somewhat similar reasoning can be adopted. However, rather than turbine power, excitation current of the rotors is involved.

Leading current causes field strengthening, requiring voltage reduction, and the opposite takes place with lagging current.

In the above example of two generators on a common bus, the voltage regulators balance out the quadrature current required by the load.

The high level of rotational inertia makes sharp changes in frequency impossible. A sudden increase in load causes the armature of a synchronous generator to be pulled back, experiencing a braking torque, against the direction of rotation.

But, because of inertia, the frequency barely changes for as long as six or more cycles. In this interval the speed governor allows more steam, gas or water to provide the power to restore speed at the synchronous level [50Hz].

LEGACY AND NEW SYSTEMS

Photovoltaic [PV] panels generate DC and this is inverted to AC for connection to the grid.

Wind turbines are asynchronous machines requiring conversion to DC and from there to AC in order to be connected to the grid. Power conversion is achieved electronically by means of fast switching transistors, decoupling the primary source of energy from the grid. In other words, there is no natural inertia.

In contrast to the grid-tied solar inverters on roofs, in isolated networks without a native synchronous machine source, at least some of the inverters must maintain voltage and frequency stability.

The mechanisms for this are based on some form of droop control as shown in Figure 2.

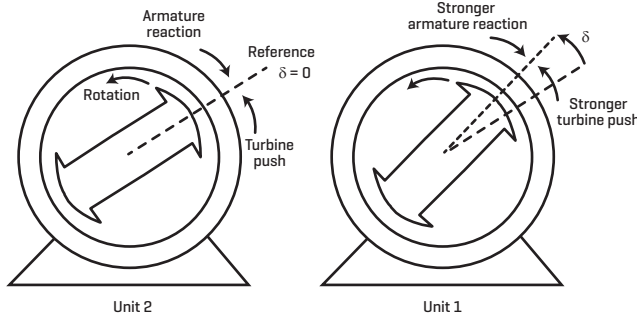


Figure 1a: Unit 1 receives more power from its turbine and its rotor pulls ahead of the Unit 2 rotor.

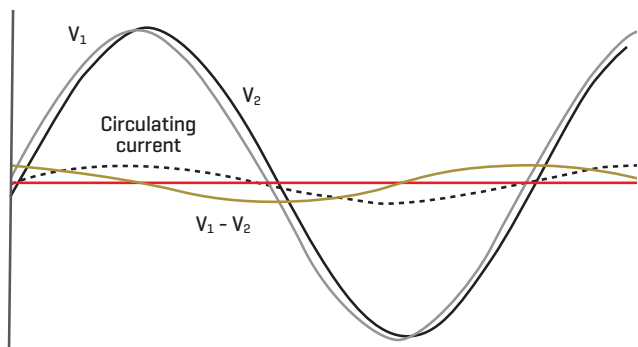


Figure 1b: The Unit 1 rotor is slightly ahead, as is its voltage V_1 with respect to V_2 of Unit 2. Subtracting V_2 from V_1 provides a sine wave of the same frequency. Because of the short distance between the generators, the link impedance is purely inductive, so that the circulating current between the two generators is lagging by 90° .

In a conventional network with only synchronous generators participating, individual generators provide the appropriate power and reactive power at the network frequency and voltage as determined by their droop characteristics.

If this seems a little confusing, imagine a power network being established from a 'black start'.

The frequency support generator starts up and – once it is running at a stable synchronous speed – a larger power generator is connected to the generator bus. Then the next one is connected, so that in due course the complete power supply to the network is established.

Every generator coming on line is first synchronised (voltage, frequency and phase being adjusted to that of the bus), and in that manner supplies power in accordance with its droop characteristics.

Powering up a large network cannot be done quickly, as the synchronisation process is a sequential one. The load is also being switched on to generator buses in steps small enough that generators already connected do not become unstable [dropping out of synchronism].

The grid-tied inverters receive their frequency instruction from the grid. The voltage is 'what it is' at the point of coupling to the grid, and the only controlled variable is the current supplied by the inverters to the coupling points.

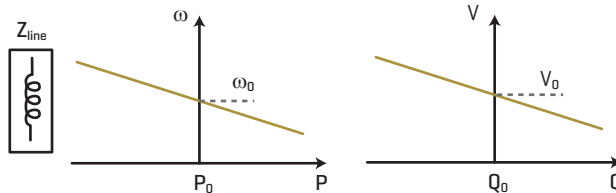


Figure 2: Droop control for synchronous generators supplying a lagging load [the usual case]. The left graph shows the relationship between power, P , and generator speed, ω . The more power required from the generator, the lower the speed. P_0 is the power providing synchronous speed, ω_0 . The right graph shows the relationship between reactive power, Q , and voltage, V . The bigger the lagging reactive load, the lower the voltage. At the system voltage, V_0 , the reactive load the generator can support is Q_0 .

The frequency of operation of the inverters is controlled by means of a phase locked loop (PLL), which ensures that the inverter's inbuilt oscillator marches in synch with the grid frequency. The PLL principle is explained in Figure 3.

Note that a change in phase is a change in frequency because a sine wave has the formula of $A \sin \theta$, where θ is the instantaneous phase equal to $2\pi ft$, f is frequency and t is time.

A sudden change in θ [meaning that t has not changed] implies that f , the frequency, changed. Changes in phase can cause instability in distribution networks with no synchronous generators.

MOVING ON

The grid-tied inverters of millions of solar PV systems can be part of a microgrid but only as 'prosumers', and not as independent generators.

There are 'voltage forming' inverters that can establish voltage and frequency for microgrids. Grid-tied inverters only push out current at whatever the grid voltage is, relieving power required from voltage-forming inverters and supplying power needs at their local installation sites.

Microgrids by their very nature are likely to be low voltage, or perhaps medium voltage. Unlike the high-voltage transmission system, which has largely inductive impedance, microgrids are usually far more resistive than inductive. This has important implications for connected generators, whether synchronous or asynchronous.

On the high-voltage side of power distribution, conventional synchronous generators adjust their excitation current of the rotor DC field current windings to provide the required reactive power of the network.

As is evident from the article on inverters in this issue, the natural ability of synchronous generators to supply reactive power is a big advantage. In the case of inverters, relatively complicated circuitry can be required to provide this capability.

Microgrids, in principle, can operate without a 'primus inter pares' [a first among equals]. However, a collection of voltage-forming inverters of equal power can suffer from voltage and

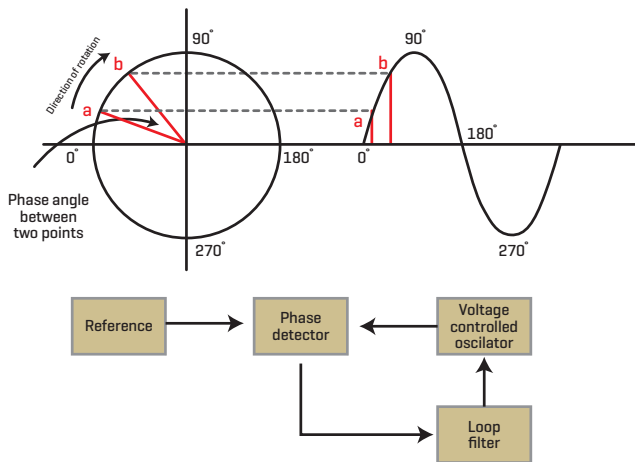


Figure 3: Phase locked loops are essential in keeping inverters supplying power to the grid at grid frequency. Points a and b can refer to two sine waves. Provided the angle θ [between a and b] remains the same, both sine waves have the same frequency.

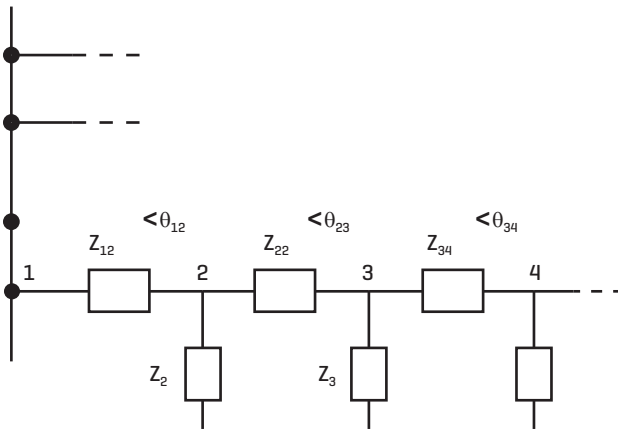


Figure 4: A line diagram of a distribution system with voltage-forming inverters at the nodes. Each generator has its own voltage angle, although in a stable situation there is little difference between individual angles. A sudden load change at a node can bring about a change in voltage angle and cause other generators to try adapting via their phase-locked loop circuits.

frequency swings that may not be tolerable for connected loads such as induction motors, etc.

Technical literature cites examples of basic support by diesel generators which, although not capable of servicing the power requirements, are large enough to form voltage.

Note that there is no absolute need for a synchronous generator. A large battery-supported inverter source can be used, and can even be used for 'black start' conditions.

In Figure 4, an important point is made about networks and the relationship with generators.

Generators placed at the 'nodes' have a voltage angle as indicated. Changes in load cause changes in the voltage angle, and a change in angle is a change in frequency while the angle is increasing or decreasing.

The rate of change of frequency has to be contained within tight limits for stability purposes. Without a dominant voltage former, a process of 'hunting' between the inverter PLL circuits can occur, leading to instability.

GRID RECONNECTION

Microgrids that can drop out and reconnect to the grid offer great security advantages, but this is not a simple exercise.

In the foregoing text the tacit assumption was that generators between them 'sort out' the stability of the network.

As we saw for a synchronous generator network, the 'black start' example operates on a strictly sequential basis whereby generators are added to the system, each in turn being synchronised to the growing generated power base.

As such, no communication between the generators is necessary. In practice, power stations work with forecasts and receive despatch commands from some central authority (eg: the Australian Energy market Operator), and this happens via a communication network.

A microgrid reconnecting to the grid cannot be 'brought up to speed' as would be done with a synchronous generator. In practice, a communication/control network is necessary.

The control protocol would disconnect non-essential loads then select a large generator or several voltage-forming generators. The frequency, phase angle and voltage conditions of these would be judged to be within an acceptable tolerance with the grid before the reconnection circuit breaker was closed.

CONCLUSION

In 50 years or so, no more than two investment cycles in baseload generation, will we still see high-voltage transmission grids and large baseload plant?

Or will there be growth in smaller nuclei of power generation in or close to population and industry centres? We call these microgrids today, but that term might have disappeared by then.

What about our fixation with alternating current or constant frequency? Appliances of the future capable of operating within larger frequency tolerances might be a natural consequence of the drift to decentralised power generation.

Direct current for stepper motors, rather than today's workhorse – the squirrel cage induction motor – may allow an almost direct use of solar PV power.

Hydrogen fuel cells, rather than electrochemical batteries, may be a main form of energy storage, and the NEM might well have disappeared. ■

Phil Kreveld is an energy writer. He is an electrical engineer. He has worked in electrical, electronic and scientific instrumentation in Australia and the US.





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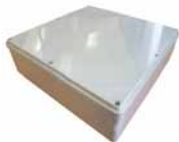
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NEW YEAR'S REPRIEVE

It is now 2019, so what are you doing to ensure you are more successful this year than last? **Brian Seymour** outlines the process every estimator needs to undertake today to ensure your company is around tomorrow.



It is at this time of the year that your estimating department (whether it is one person or a large team) really should be reviewing your company's past year's projects to determine the direction you should take into the future.

A decision also needs to be made as to which projects your company will bid for or decline as well as which projects are achievable, based on the tendering period, the resources required or the potential risks involved.

This review should carefully analyse your previous year of estimating and the following questions should be considered:

- How many jobs did you estimate? Did you pick up everything you could lay your hands on or were you selective in picking only the jobs that would suit your company and expertise?
- What type of jobs did you estimate? Were you selective in the type of jobs for which you have the people, the expertise and the plant and equipment to successfully complete it on time?
- What size were the successful jobs? What are your limitations on the size regarding your financial circumstances, number of employees, plant and equipment, and location?
- Did you do a risk assessment? Have you evaluated potential problems ahead of time to develop strategies to limit them (see more below) and set weighting criteria?
- How many successes did you have? Are you winning an exceptionally high number of tenders because you are pricing below the industry average or are you one of the few experts in this type of work and have limited opposition?
- How many were lost? Is there an industry downturn and all your competitors are lodging cutthroat tenders or are you are you competing in a sector in which you do not have the resources or the knowhow?
- Is your estimating system up-to-date? Do you need to make changes or update your estimating system whether it is a manual or computer-based system? Is it coping with your current estimating requirements?
- What changes will you make for the next year? Based on the above questions, what will you do to improve your prospects of achieving a more profitable outcome?



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Stable sales and increased profit outweigh being 'the biggest contractor in town' if the higher turnover is producing minimum profit and higher risk.

You must recognise that sales growth is not directly related to overhead levels. Overheads will at some point grow out of proportion to sales and investment in overheads becomes very expensive — additional non-productive staff, additional vehicles or a new computer system. Once overheads grow it's hard to reduce, and revenue levels are not guaranteed.

You should analyse your customer relationships on a regular basis otherwise it will be a case of 'no customer – no revenue'. It costs less to provide the service to retain customers than it does to recruit new ones. You also need to analyse all new business opportunities before you spend resources to tender for the work. Do you have the cash reserves to be the 'banker' on a new project? Many large projects have a longer period between progress payments than the cash expenditure required to maintain the work schedule.

A most important step in your review is giving thought about the trends of profitable projects versus the losers. What are the commonalities? Is there a specific type or size of project that makes you money and are there others that have never been profitable? Your review should include a risk assessment to be applied to future estimates.

RISK ASSESSMENT

Even after you have completed your estimated count and measure, priced

the materials, included the subbies' costs and your company's overheads and profit, the job is still not complete. The question needs to be asked: "What do we need to consider to reduce the possibility of a financial loss?"

Prior to starting the take-off, it is important to study the plans and specification of the project, to determine whether this job fits your company's requirements and having a risk assessment plan will considerably reduce the possibility of a loss.

This assessment should be done to verify that the cost

estimate follows standard estimating guidelines for the department. This would include a review to verify that the company's standard estimating procedures were followed regarding estimate format, costing, presentation and documentation. This would include items such as the following.

- Verify that the estimating methods used match the plans and specification.
- Using the correct techniques to overcome possible variances in the engineering documents.
- Ensuring the values on the summary sheet matches the detail pages.
- Confirming that all information on the estimate detail pages be tracked to the source documents.
- Making sure that all allowances, fees and factors are appropriate and consistent with comparable past projects.
- Confirming all nominated sums (e.g. prime cost, provisional and contingency) are included.

Determining the suitability and practicality of submitting a tender for a new project needs several issues to be addressed. Will this project fit within your current scheduling? Do you have the manpower and resources to complete within the time frame? Do you have staff trained in this type of work? Is there a substantial portion of

You should be reviewing your company's past year's projects to determine the direction you should take into the future.

the job that must be sub-contracted out? Is it in an acceptable location? Will weather have a delaying effect? Are there any unacceptable conditions either in the documents or on site?

Prioritise each of these issues. Some companies have 'tolerance levels' for these risks. Risk tolerance tells you how sensitive your company or people are to risks. High tolerance means you are willing to take a high risk, and low tolerance means you are not willing to take many risks. A company's risk tolerance varies according to its financial stability and project diversification. The generally accepted definition of risk in project management is time, cost, performance and other project factors that impact on these. The above issues influence the evaluation of the risk factor and is important to quantify matters.

There are quite a few construction risk probability software programs available on the market that offer suggested percentages as to the chances a particular event that may occur under certain circumstances. These programs offer a chart of the probability a risk will occur and the impact on the job.

However, whether you are using a computer-based program or a manually determined assessment, the cost of the risk needs to be calculated. Whether it is lost time, lost money, lost quality or a combination of all, it will have an impact on the final selling price.

Once the review has been completed and all parties signed off, it should not be tossed into the cupboard to look at 'when we get around to it'. It needs action and those matters that need improvement should be instigated now, or the same results will occur again next year... if you are still in business. ■

Brian Seymour, MBE, is the author of *Electrical Estimator's Labour Unit Manual, Starting Out, Electrical Contracting in Australia and 100 Years – Electrical Contracting in Australia*.





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A word from the CEO

Major infrastructure projects, new technologies, the rising demand for home automation and renewable energy sources, are all changing the profile of the electrotechnology sector in Australia.

NECA's bi-annual Market Monitor survey provides valuable information which helps us identify current and future trends. This information also supports the industry – from sole traders and family businesses through to wholesalers and distributors – helping them to make informed business decisions.

From our perspective at NECA, it helps us understand how we can better represent and support NECA members.

The 2019 Market Monitor survey is taking place in February and we'd really like to hear from as many people across the industry as possible.

I know it's a long survey which can be a bit off-putting, but you don't need to do it all at once. It's broken it down into four short sections which you can do any time, and the survey is open for a few weeks. We'll even send you a reminder when it's time to complete the next section.

Please, have your say and help us build a really good picture of what's happening across our industry. As a bit of an incentive, we've got some great prizes on offer and everyone who completes the survey will receive a

report detailing findings across charge out rates and specialisation trends.

Remember too that the survey is completely confidential, it's conducted by Bedrock Insight, an independent research company, and no-one sees any individual answers.

NECA on the road

Our NECA State Roadshows are always well received by members and our State Chapters are already planning their 2019 events. Make sure you get along to your local event, it's a great way to keep your skills current.

Who will be our 2019 National Excellence Award winners

Even though the excitement of the 2018 National Excellence Awards hasn't worn off yet, it's already time to start thinking about the 2019 State Excellence Awards. Entries for the State Awards open in February so, if you've got a project or apprentice that you'd like to showcase, get your entries in. We'll be sending out information on how to enter in your state soon.

Electrical Industry Conference – Hamilton Island

This year, the ultimate Electrical Industry conference is back on Aussie soil at the breathtaking Hamilton Island. As



Suresh Manickam
CEO, National Electrical
and Communications Association

usual, we'll have a range of innovative and valuable business speakers and fantastic networking events. The partners and kids programmes will offer something for everyone and make sure that it's a great time for the whole family.

Come and enjoy some winter sunshine in Queensland and take some time out to invest in yourself and your business.

2019 will be a great year for NECA as we continue to develop the services and benefits we offer our members – if you're not a member, think about signing up so you don't miss out.

Suresh Manickam
CEO





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NECA Market Monitor 2019



NECA's Market Monitor is the only Australia-wide survey of the electrical and communications contracting industry.

The survey, conducted every two years, is an opportunity for you to share your views on business issues, consumer trends and broad product analysis.

Market Monitor will be open throughout February 2019.

Visit the NECA website www.neca.asn.au to take part and be in the running to win some great prizes.

Participate to win!

- ★ Registration for 1 x delegate and 1 x partner for the 2019 NECA Electrical Industry Conference on Hamilton Island
- ★ iPhone XR 64GB
- ★ 2 x \$750 vouchers for NECA Trade Services
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NECA Market Monitor is conducted by Bedrock Insight an independent company and all information provided during the survey is treated in strict confidence.

* Terms & Conditions will be available on the NECA website.



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Celebrating 2018's best of the best in the electrotechnology sector.

Congratulations to all the companies who took home a 2018 NECA National Excellence Award or a Commendation. The awards were presented at a fantastic event in Melbourne at the end of last year.

We also took the opportunity to celebrate some of the brightest and best electrical apprentices and an outstanding Trade Teacher.

It was an incredibly competitive field this year and all entrants should be extremely proud of the quality and innovation they displayed.

WINNERS: NECA NATIONAL EXCELLENCE AWARDS 2018

AWARD CATEGORY	COMPANY	PROJECT
COMMERCIAL LARGE	Nilsen WA	Perth Stadium
COMMERCIAL MEDIUM	Kerfoot NSW	Green Square Community Facility
COMMERCIAL SMALL	Insight Electrical Technology WA	Perth Concert Hall
INDUSTRIAL LARGE	Wilken Service NSW	Huntingwood 132kv Substation
INDUSTRIAL MEDIUM	Kerfoot NSW	Parklea Correctional Centre
INDUSTRIAL SMALL	Fibre Optics Design & Construct NSW	M5 motorway
VOICE/DATA COMMUNICATIONS & AUDIO	Intravision ACT	Tuggeranong Office Park
LIGHTING	Next Generation Electrical VIC	Melbourne Market Authority
ENERGY EFFICIENCY & ENVIRONMENT	Greenstar Building Automation NSW	ALDI
WH&S MANAGEMENT SYSTEM (COMPANY)	Nilsen SA	Nilsen SA HSE Management
WH&S MANAGEMENT SYSTEM (PROJECT)	Downer WA	Wheatstone Project LNG Plant
SMALL CONTRACTING BUSINESS	Automated Innovation NSW	Belle Apartments
DOMESTIC RESIDENCE	Argus Technologies VIC	Private Residence

COMMENDATIONS: NECA NATIONAL EXCELLENCE AWARDS 2018

AWARD CATEGORY	COMPANY	PROJECT
COMMERCIAL LARGE	Stowe Australia NSW Shepherd Electrical NSW	Gosford Hospital Tuggeranong Office Park
COMMERCIAL MEDIUM	Fredon QLD Martin Donnelly ACT	The Wesley Hospital ANU Building 145
COMMERCIAL SMALL	Shepherd Electrical ACT	Essential Energy Tenancy
INDUSTRIAL LARGE	Downer WA	Wheatstone Project LNG Plant
INDUSTRIAL MEDIUM	Nilsen QLD RBD Electrical TAS	Lakeland Solar & Storage Tasports Inspection Head
ENERGY EFFICIENCY & ENVIRONMENT	Suntrix Commercial SA Next Generation Electrical VIC	Floating Solar System Melbourne Market Authority
WH&S MANAGEMENT)	RBD Electrical TAS	HSE Management System

WINNERS: NECA NATIONAL APPRENTICE AWARDS 2018

AWARD CATEGORY	WINNER	EMPLOYER & HOST EMPLOYER
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APPRENTICE INDUSTRIAL	Andrew Binetti – VIC	NECA Education and Careers & NHP Electrical Engineering
APPRENTICE COMMERCIAL/DOMESTIC	Sam Morrow VIC	Malady Electrical
APPRENTICE COMMUNICATIONS	Luke Hentschke SA	PEER & Apex Communications Technologies



2018 NECA NATIONAL EXCELLENCE AWARDS



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THEY WANT TO BREAK FREE

Many apprentices, upon completing their course, are going to leave their employer. But that's not necessarily a bad thing, writes **James Tinslay**.

Decades ago, it was not uncommon for apprentices upon completion of their apprenticeship to finish employment with their employer. There was no surprise in this; the apprentice expected this to occur and would head off to find other employment. This mainly occurred in the government sector, which at the time provided training significant services to both the public and private sector with an ongoing supply of qualified tradespeople.

That does not occur today and in fact, the public sector does little training with the responsibility clearly on the private sector. The only parallel to those earlier days are group training companies that exist purely to train – so the job actually finishes on the completion of the apprenticeship.

I know many small employers, electrical contractors and others, who sadly will not take on an apprentice because of the financial impact and poor past experiences. To some extent group training schemes have filled some, but not all, of that void. For employers with a strong culture of training it is usually the last thing that they want after four years of training, for young electricians to up stumps and go elsewhere. Those employers think that they have trained a young person in their business and the culture of their business and want them to stay on to 'repay' the business for that commitment.

Many young tradespeople decide to strike out on their own and many have

made plans during the time with the employer who trained them. And of course, to the bane of many electrical contractors some of these young tradespeople have a business on the side and we have all heard stories about equipment disappearing to other locales unknown.

There is a conundrum in that while all electrical contracting businesses originated from a person who left an employer to set up a business, where would the industry be if nobody wanted to do that? The entrepreneurial spirit is important and in the electrical and communication contracting industry we have it in spades. So, should an employer close their eyes to this possibility, or try to educate the young person about the business facts of starting out on a business? If you are a small or medium business do you really want opposition opening with no sound concept of overheads, adequate charge out rates and the like?

I often hear comments about apprentices and young tradesmen from some of the major contracting companies that have spent much of their life on construction sites becoming experts at cable trays, temporary wiring and similar activities that are part and parcel of large construction sites. The comments are not complimentary, and, in some cases, they will be accurate. However, there are many young tradesmen who understand that the traditional role of the electrical contractor that most people associate

with the profession, is vastly different than they were even 10 years ago.

Digitalisation, smart homes and the internet have revolutionised the sector. Now to make the light turn on in your home, an electrical contractor often goes beyond simply sticking two cables together and automates this system by programming computers and connecting lighting systems to other systems through the Internet of Things (IoT). If we add an electrical vehicle charger, smart meter and a rooftop solar panel into the mix, turning on a light becomes a highly complex and sophisticated process. As the electricity system embraces digitalisation more and more, the job of an electrical contractor evolves to fit the needs of the digital era.

We need our young tradesmen and aspiring young tradesmen to be prepared to have a go on their own and follow their dream, just as today's successful electrical contractors did in another generation. Enlightened business owners will recognise and make a choice about wishing them well or sizing up the opportunity that may exist for the employee to become part of the ownership equation with their own business. ■

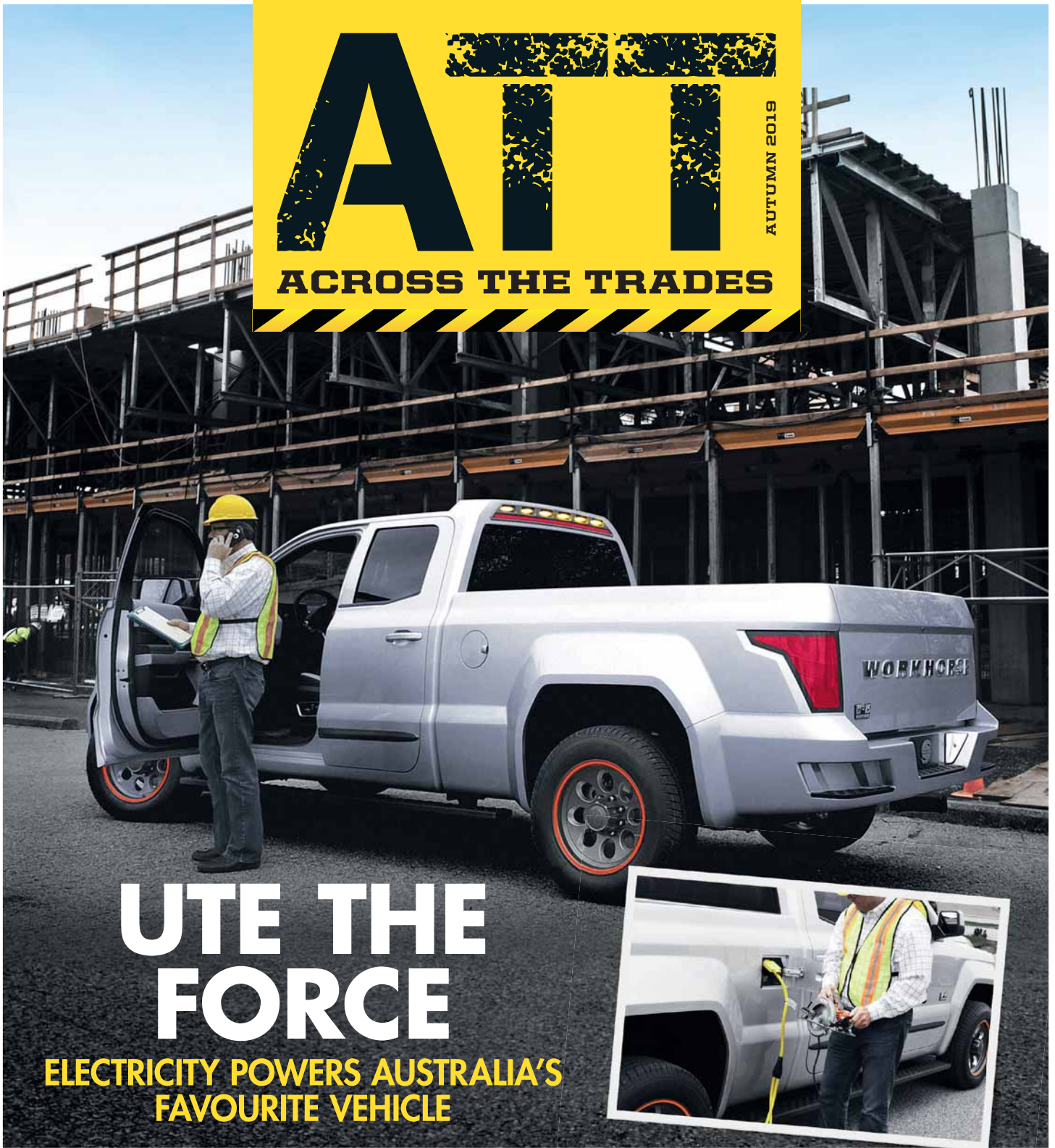
James Tinslay is a consultant and engineer with some 40 years of industry experience. He is an ex-CEO of NECA and a director of NECA Electrical Apprenticeships.



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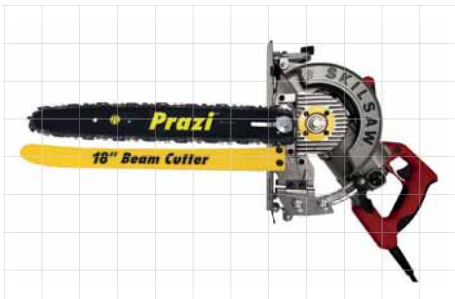
AUTUMN 2019

ACROSS THE TRADES



UTE THE FORCE

ELECTRICITY POWERS AUSTRALIA'S FAVOURITE VEHICLE



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PICK UP WHERE PETROL LEFT OFF

GIVEN THE RISE IN POPULARITY OF ELECTRIC CARS, IT'S ONLY A MATTER OF TIME UNTIL WE HAVE ELECTRIC UTES. **TERRY MARTIN** REPORTS.



It's simply wrong to think of Australia as a large and isolated continent far removed from what's happening in the rest of the world, where electric vehicle sales are taking off and auto companies are committing massive funds to building battery-powered cars, vans, trucks and, yes, even utes.

True, there's a lot of scepticism around these parts, plenty of doubt and, perhaps not surprisingly, hardly any meaningful demand from consumers right now for electric vehicles of any description, let alone the ute which is ingrained in our culture as a big, bold, brawny member of the working class - albeit one that in recent years has moved up into more polite society.

But just as solar panels are fast becoming standard fixtures on the average Aussie home, due in no small part to pain inflicted by higher energy bills, vehicle electrification has a relevance about it and has reached the point where the trends are undeniable and action is well and truly underway.

North America is leading the charge with electric pickup trucks but major programs are occurring in Australia, which gives us reason to investigate who's doing what, and why.

TESLA TWITTER FEED

Tech billionaire Elon Musk has already built the world's biggest lithium-ion battery in South Australia and as head of Tesla Motors in California he is driving the development of an all-electric pickup that could reach production as early as this year.

Hard facts are thin on the ground, with Musk revealing the plan late in

2017 using a comical design sketch that showed an oversized pickup with a more conventional model (such as Ford's F-150) in its load bed.

He has since followed the lead of US president Donald Trump in taking to Twitter to discuss the program and divulge a few details, such as its use of a dual motor layout, "crazy torque" levels, dynamically adjustable suspension (in accordance to the load) and the biggest battery that Tesla has built for its vehicles to date, enabling a driving range of around 500 miles (805km) before recharging is needed - enough to eliminate any sense of 'range anxiety' for most owners.

Expect the still-secret Tesla pickup to therefore offer excellent acceleration - overseas reports point to 0-60mph (0-97km/h) achieved in around five seconds flat - as well as strong pulling power and a high towing capacity, the latter tipped to be 4,500kg and could extend much further than that, if the tweets from Musk are credible.



In-wheel batteries should allow for a deep load bed, while an optional auxiliary battery on top of the load floor is expected to push the range out further. There should be plenty of supply here for tradies to use with their power tools, too, while the cabin is being touted as a six-seater and is guaranteed to come with a high level of advanced technology including, as Musk has indicated, 360° cameras and radars for high-level autonomous safety systems and handy features such as automatic parallel parking.

Whichever way you look at it, Tesla is one of the biggest names in the EV business and its pickup will be a game-changer for the automotive world.

We asked Tesla Australia about the impact the ute was expected to have here, but, perhaps not surprisingly, we were simply directed to Musk's Twitter feed...

BRIDGING THE GAP

All the major motor vehicle manufacturers are moving towards hybrids, combining their traditional internal combustion engines (ICEs) with various forms of electrification.

These include 'mild' hybrid systems that integrate a compact electric motor/generator with the ICE for extra power and efficiency, 'parallel' hybrid which uses a bigger electric motor that can power the vehicle by itself for short periods, and 'plug-in' hybrid electric vehicles (PHEVs) that typically have a longer electric-only range and can be recharged via mains electricity or fast-charging outlets.

With plug-in hybrids, the ICE kicks in only as required, and in the case of 'range extender' versions, the conventional engine is simply used to charge the battery rather than drive the wheels.

Mild hybrid systems are already available in America on pickups such as the Chevrolet Silverado and Fiat Chrysler's Ram 1500, and will eventually become widespread, attached to virtually every ICE from the mass-market brands during next decade.

PHEV pickups are also in the works. Ford, for example, has committed to a plug-in version of its best-selling F-150



Workhorse W-15



Havelaar Bison

that is scheduled to launch in 2020 - the Blue Oval pitching to tradies that it will not only get you to the jobsite but will power the site as well - while Jeep is preparing to launch not only an all-new Wrangler-based ute, known as the Scrambler, in 2020, but a plug-in hybrid powertrain designed for the same platform.

General Motors has also made it clear that its latest platform underpinning the new Silverado and GMC Sierra will be capable of running any powertrain configuration, including PHEV and full-electric, which is important seeing that Holden Special Vehicles (HSV) is now remanufacturing the Chevy pickup in Australia.

ELECTRIC LINE HONOURS

Beating just about everyone to the punch is the Ohio-based Workhorse

Group, which at the time of writing was preparing to launch its series production W-15 mid-size pickup in the US - a 'range extender' plug-in hybrid capable of up to 130km on electric power alone with its 60kWh Panasonic lithium-ion battery, or 500km in total with the three-cylinder petrol engine in action.

Priced from \$US52,500 (\$A73,500), the W-15 uses two 172kW electric motors, one at each end to allow four-wheel drive, with a total system output of 343kW. It can reach 60mph (97km/h) from standstill in 5.5 seconds, has a 1t payload, 2.5t towing capacity and, for running power tools, a 7.2kW power outlet providing up to 30A directly from battery pack. The ute also has high-level safety gear such as automatic braking and lane departure warning.

While the W-15 is not slated for right-hand drive markets, PHEV

powertrains are expected to turn up on global mid-size utes such as the Australian-developed Ford Ranger in the years ahead, in line with development plans announced by their respective parent companies.

Korea's SsangYong and China's LDV are also reportedly developing electrified versions based on their one-tonne utes - the Musso and T60 respectively - but for all the positive noises from various brands with global reach, it's whisper-quiet when it comes to making concrete commitments on full-electric models.

OTHERS STARTING UP

With full-blown battery electric utes, the big players are clearly waiting to see how the market reacts to the Tesla pickup and other new models from smaller manufacturers who are taking a leap of faith - and hoping tradies, as their core audience, come along for the ride.

Among those with positive energy is Havelaar Canada with the Bison, Bollinger Motors with its B2, and other fledgling North American brands such as Via Motors and Rivian Automotive - all of which are working to have full-electric pickups in production by next decade.

There are a lot of similarities in

the basic architecture, typically with truckloads of power and torque, 4x4 drivelines via electric motors stationed at each axle and promises of thorough engineering and heavy-duty components to cope with the demands of travelling off-road.

Preliminary specifications for the Bison point to a driving range of 300km on a single charge, a rugged carbon-fibre reinforced steel space-frame chassis and a body with 1.3m³ of space in the load area as well as 0.51m³ of lockable storage space. Like the W-15, the Bison also has a high-current power socket to run tools.

Bollinger, meanwhile, is taking orders for the B2 pickup ahead of production due to get underway in 2020. This is an all-electric, all-wheel drive, all-aluminium body combination, with dual motors producing a combined 388kW/697Nm that can shift the 2,300kg vehicle from 0-60mph in 6.5s. A 120kWh battery pack can deliver a 320km driving range, with recharging

available via 110/220V ports (taking up to 10 hours on 220) and fast-charge outlets (which need just 75 minutes).

The B2 has a healthy 3,400kg towing capacity and a 2,268kg payload, with a useful load area (measuring 1,752mm long x 1,245mm wide) and - in something you simply cannot get with a normal engine crammed in under the bonnet - a full load-through facility from front to rear that allows long pieces of timber to be carried. This includes 24 lengths of 2x4

through the 'patented passthrough' or 72 sheets of 4'x8.5' plywood with the rear seats removed, according to Bollinger.

The B2 has a healthy 3,400kg towing capacity and a 2,268kg payload, with a useful load area (measuring 1,752mm long x 1,245mm wide)

THE AUSTRALIAN WAY

If this all sounds a bit like 'only in America', let us show you how BHP - aka The Big Australian - is currently trialling all-electric versions of Toyota's tough-as-nails LandCruiser 79 Series ute that have been specially modified by Adelaide firm Voltra.

Voltra has replaced the LandCruiser's stonking 4.8L turbo-diesel V8 with



Bollinger B2

a full-electric powertrain - including 104kW/256Nm electric motor, custom gearbox and 42.24kWh lithium-ion battery pack - and since about mid-2018 BHP has been running two examples of the vehicle (dubbed eCruiser) at its Olympic Dam mine site in a 12-month trial.

It still operates as a fully-fledged 4x4 ute, but the eCruiser is expected to bring a number of important benefits.

These include: zero tailpipe emissions, which is especially important working in an underground environment where diesel particulate matter is a major health hazard; less maintenance due to fewer moving/wearing powertrain parts and less stress on the driveline; lower servicing costs, with no oil changes, air/oil/fuel filter replacement, etc; obvious savings on diesel consumption (and storage); and user-friendly operation, with less heat generation and a quieter, smoother and arguably more comfortable drive.



Bollinger B2

Recharging only takes around 40 minutes when using a 50kW DC fast-charger, and there's also the bigger-picture benefit of lowering the company's carbon footprint and reducing its impact on the environment.

BHP is currently collecting data on the vehicles' performance, power supply, maintenance requirements, charging times and corrosion resistance. Depending on the results, a decision on wider deployment will be made - and ▶

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Voltra eCruiser



Ace Yewt

could really build momentum for the conversion market in Australia while the vehicle importers take a 'let's wait and see' approach.

Voltra's eCruiser project manager Andrew Draffin told us that the company was primarily targeting the mining sector with the electric ute - which has been built to full Australian Design Rule compliance - and that it was really not viable at this stage for light-commercial applications.

But he agreed that "anything is really possible" in terms of potential longer-term opportunities with other sectors such as building and construction, or even exploring partnerships with factory-backed converters such as HSV and its Silverado program.

"The feedback that we've already got has been astounding with the amount of people who want to do a trial and take

this to underground mines," he said.

"If there's a market there for it, most definitely, but at the moment we're not targeting any other market than mining so there's really untapped potential there."

MORE LOCAL PROJECTS

There are other operations getting in on the act in Australia, such as Melbourne-based SEA Electric which has developed fully electric light trucks/cab chassis and vans. The company has backing from the Victorian Government, a pilot fleet contract in place with Kings Transport and a local development project underway with Isuzu Australia Limited.

The Isuzu program at this stage only goes as low as the 8,000-9,000kg GVM class with the NQR series - in this case using a 130kW/1,500Nm electric

motor and a 132kWh lithium-ion battery enabling a driving range of up to 250km - but there is obviously lots of potential for broader applications suitable for trade operators, including those driving with a regular car licence.

The beauty of this is the conversions are relatively simple and chassis rails enable battery packs to be packaged securely between them, which is good in terms of design, safety and dynamics.

Queensland-based ACE Electric Vehicles has also committed to assembling electric vehicles for sale in Australia, including a light-duty 'Yewt' small pickup and a 'Cargo' compact van with payloads of around 500kg, fully independent suspension and a 45kW/174Nm electric motor and 23.2kWh battery. Driving range is 150-200km with a partial load.

A POSITIVE CHARGE

Utes are big business in Australia, with more than 200,000 new ones sold every year, and the two top-selling vehicles in the nation are from the tray-backed class - Toyota's HiLux and the Ford Ranger.

As a result, we've seen rapid changes in recent years in areas such as infotainment and safety technology - driven by customer demand rather than government regulation - and we think powertrain technology, with electrification at its heart, will be the next frontier to be crossed.

The Aussie Voltra eCruiser is a great example. It's not a mass-market production model by any stretch, but a sign of times that was built out of real need, with clear benefits and, let's face it, plenty of question marks in terms of reliability, longevity and so on - all of which are being thoroughly tested and will provide important answers, not just for BHP but for us all.

This is clearly what is also happening in the engineering centres of the major auto-makers. Few want to show their hand just yet - and all of them are waiting, or working, on new battery breakthroughs that will ensure electric utes can cope with Australia's long distances and tough terrain.

But all understand that positive charge is in the air, and is bound to hit the road before too long. ▲



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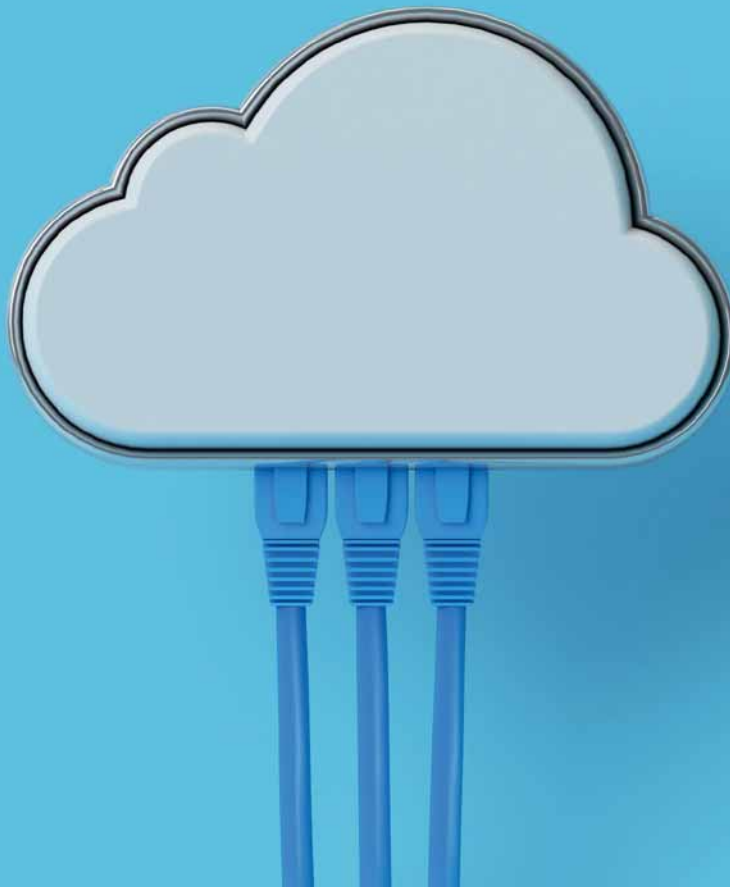
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REACH FOR THE CLOUDS

A NEW REPORT SUGGESTS A STRONG CORRELATION BETWEEN THE NBN, CLOUD-BASED APPS AND SMALL-BUSINESS SUCCESS. **PAUL SKELTON** REPORTS.

Tired of contracting, Clint Ruby decided a few years ago that it was time to become a sole trader, installing solar panels for a couple of major suppliers.

But, as is the case for many entrepreneurs, he didn't have an easy go of things from the outset. When the market dried up suddenly in 2014, Clint had to make a quick transition into general electrical work in construction to stay afloat.

"It was a long, hard road," Clint says.

The switch to construction changed the business model of Ruby Electrical in Currumbin, Queensland, to one with a high volume of jobs and clients. For one thing, it meant employing three or four staff.

This increase in staff, clients and jobs became unmanageable as Clint tried to co-ordinate everything with a diary and a whiteboard. He was working until 10.30pm most nights to catch up on quoting and invoicing.

Apart from two weeks at Christmas, Clint and his family didn't take a holiday in six years, because the paper-based business had to be shut down if he was absent.

Thinking there must be a better way, Clint began searching online for a digital solution and came across ServiceM8. The app was life changing, although making the switch wasn't simple, as he admits to having been computer illiterate.

But he pushed ahead and taught

himself to use ServiceM8, supported by the supplier's online training videos and chat rooms. Now, the app is a core part of his business operations.

Clint estimates that he and his staff save four hours a day by not doing the paperwork required by their compliance-heavy roles. This has freed up staff to do more jobs, as well as reducing the cost of duplicate record books.

Also, the professionalism of his business has increased, which has been the key to serving more than 1,500 clients. In particular, this has been crucial in serving insurance companies, which demand a high standard of care and compliance.

Many small business operators could relate to Clint's story. Going out on your

own isn't easy, but people could be making life harder than it needs to be. Are there readily available solutions that would be easy to integrate into your business?

Trent Innes is managing director of Xero, a cloud-based accounting software platform for small and medium-size businesses.

Recently, through its Small Business Insights division, Xero examined how changes in digital connectivity affect small operations - in particular the role of cloud-based applications and high-speed internet.

"For example, there's a belief in the market that digitisation, or digitalisation, has had a negative effect on employment, but that didn't feel right to me," Trent says.

To test his view, the teams at Xero and data analyst AlphaBeta looked at rollout data for the NBN as a basis for digital connectivity. They compared the figures to Xero customers' data to see what was happening to employment and revenue growth.

The resultant report - *From little things big things grow: How digital connectivity is helping Australia small businesses thrive* - found that the rise of cloud-based applications has enabled small businesses to improve their performance.

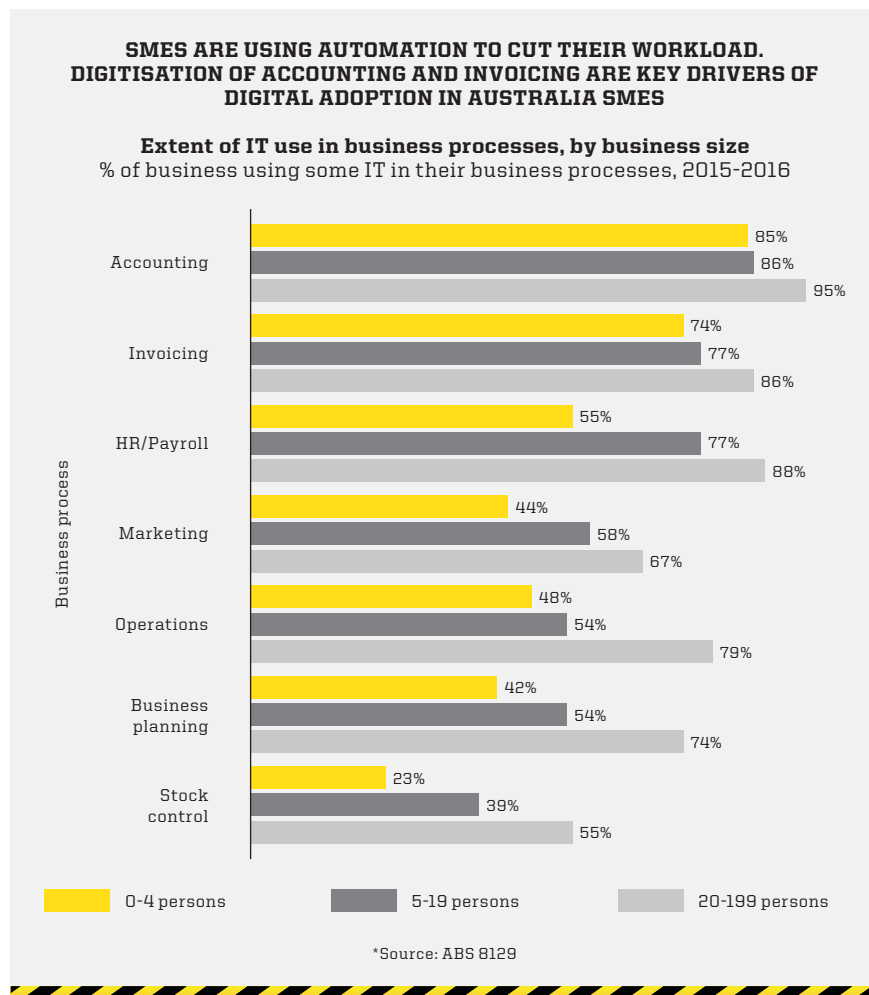
Cloud-based apps store software and customer data on secure, enterprise-grade remote servers instead of on the premises. This allows business operators to access information, updated in real time, regardless of whether they log on from home, at work or via their phones.

"There is a real revolution occurring in the way small businesses access new business process applications, and I believe it is very important," AlphaBeta director Andrew Charlton says.

"Digital connectivity and cloud-based applications are enabling small business to access the tools and efficiencies that were once the exclusive province of big business.

"Small business operators can now do all their accounting in a much simpler way, with a lot less paperwork and in a lot less time.

"They can also do HR functions, marketing and some recruiting. The



list goes on, but these businesses are saving real time and real money thanks to the way they conduct their activities."

Australia is home to 2.23 million small businesses, which make up 99.8% of all businesses in the country. They employ 10.9 million people, so their success is paramount to a healthy economy.

However, many small businesses are not fully participating in the digital revolution. Although the NBN covers half the country, two-thirds of small businesses were not connected to high-speed internet according to the Australian Bureau of Statistics in 2015-16.

"This speaks of opportunity," Andrew says.

"There is a lot to be gained by small business if the power of these technologies is properly harnessed."

He says the biggest challenges for the adoption of digital technologies are

awareness and transition costs. These are exacerbated by a lack of time to investigate options, and fear of change (according to the Australian Taxation Office, 30% of businesses still complete business activity statements on paper).


"Most small business operators are busy - they have limited resources and lots to do.

"Further, if there is a substantial transition cost involved in adopting a new technology, it won't be well received. The message of this report is that the payback period for small business is very short because of the amount of time it will save them."

The rollout of the NBN began in 2009. This sparked a major shift in the type of digital connectivity Australian small businesses can access. In 2009-10, only 8.7% of small businesses and 10.6% of medium-size businesses had a high-speed broadband connection. ➤

Apps connected to Xero are helping industries address longstanding inefficiencies or pain points

Trade & Construction

Business pain points / business needs	<ul style="list-style-type: none"> • Mobile workforce that needs a remote coordination and supervision • High volume of client jobs to schedule, perform and invoice • Essential to assure quality, safety and compliance of work
What do they use apps to do	<ol style="list-style-type: none"> 1. Clerical work 2. Job scheduling, quoting, invoicing and compliance 3. Business performance analysis (eg, cash flow monitoring) 4. Processing orders
Example apps	

quotations, appointment setting and reminders.

- Increased revenue by reducing unpaid bills through digital invoicing, which results in a higher proportion of prompt payment online.
- Increased revenue by reducing invoicing errors, or even failing to invoice.

“When you look at the number and type of small businesses in Australia, they’re so fragmented and they do so many different diverse things,” Trent says.

“From a technology perspective, they were largely ignored until the cloud came along. Now they have better access to the technology that big business enjoys, and at a fraction of the cost.”

Removing barriers for digital connectivity now is important, because the digital transformation of small businesses is likely to be a slower process than some other digital transitions, such as social media.

Further, small businesses are often time-poor and can absorb only a certain degree of change at any one time. Adopting digital innovations is likely to be staged.

“Small business is such an important sector, employing 66.8% of the workforce, so digitisation is going to have a huge effect on the efficiency

and competitiveness of the economy,” Andrew says.

He believes that growth in adoption of cloud-based apps will largely be organic, but it could be accelerated by more awareness and understanding among small-business operators.

“Gone are the days of people collecting receipts in shoeboxes for a few months then laboriously sorting them, manually entering and submitting them.

“The clerical activities that have consumed so much time in the past are now being automated in ways that are going to save many, many hours a week.” ▲

In the 2017-18 financial year, businesses on Xero using apps increased their revenue by 5.5% overall. That compares with 3.6% for those on Xero with no connected apps.

In the past decade, Australian businesses have increased their expenditure on information and communications technology hardware and software by 67%, and have shifted much of their spending from hardware to the cloud.

And it appears to be paying off.

“At a macro level, small businesses that are digitally connected are increasing their employment one-third faster than those not on the NBN,” Trent says.

“Their revenue is growing almost two-thirds faster.

“To get an idea of what is happening on a micro level, we decided to look at the number of apps our customers were using, integrated into their Xero system.”

The Xero system comprises more than 800 third-party apps that small businesses can use for a range of purposes, including rostering, time sheets or expense management.

With more than 50,000 registered third-party programmers on its database, the Xero app system is quickly becoming a powerful resource for tradies.

In the 2017-18 financial year, businesses on Xero using apps increased their revenue by 5.5% overall. That compares with 3.6% for those on Xero with no connected apps.

“Most of the apps our customers use are very much ‘clerical’ – accounting, invoicing and payroll, for example,” Trent says.

“But we’re also seeing a rise in the area of marketing, and for other purposes.

“If you look at construction specifically, the adoption rate is 40% for clerical apps and 20% for business intelligence. Further, 39% of tradespeople use apps for job scheduling and invoicing.”

Apps such as ServiceM8 and Tradify allow tradespeople to automate a range of micro-processes, including scheduling jobs with staff and customers, communicating with staff and clients about jobs, recording compliance information, preparing quotes and invoicing customers.

This benefits trades businesses in four main ways:

- Time saved on invoicing and reporting by field staff and managers.
- Increased revenue from better customer service and optimisation of employee time, for example, using time saved on compliance work to allow an extra job to be completed. Customer conversion and retention can be improved by automating



TOOLS



Leatherman Tread LT

Style meets functionality with the Tread LT from Leatherman.

Launching in 2018, the Tread LT is a slimmer and lighter version of the original Tread multi-tool. Consisting of 26 tools, it's travel-friendly, comfortable and will help you solve any problem you encounter. It's also adjustable to accommodate any wrist size and fully customisable with the links you need most.

Each stainless steel bracelet link is a usable tool, like Allen wrenches, screwdrivers and box wrenches. It's quite handy if you don't have your toolbox with you.

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Oliver WB 34 workboots

Oliver Footwear has released its WB 34 series, merging comfort, performance and durability across every style.

Specially formulated technologies make up the WB 34 collection including COMFORTcushion to absorb impact, Odorban Control Technology to minimise odour for optimum freshness and hygiene, NATUREform toe caps with a wide profile and cushion liner to ensure toes are comfortable and a GRIPthane dual density polyurethane sole for superior durability.

As well as offering a six-month manufacturer's warranty on all footwear, Oliver's WB 34 range also come with HYDROstop protection, offering a 3-year guarantee against the effects of hydrolysis and microbial attack on the sole.

Oliver Footwear

www.oliver.com.au



Macaron smart tape measure

With the combination of a flexible ribbon and a small pop-out extension piece, the Macaron smart measuring tape allows you to measure with increased accuracy and fluency. Curved or straight.

Further, it was designed to assist people suffering visual impairment. The Macaron was designed and created by four QUT students, one of whom is blind.

The Macaron is able to take measurements without needing to read the markings, and also connects via Bluetooth to a mobile device. The app can be used to pre-set the object and distances to be measured. Voice input is also available for the setup and all can be saved to the phone app with the press of a button.

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MANAGING FINANCES IS NEVER FUN; BUT, IT CAN BE EASY. FROLLO FOUNDER **GARETH GUMBLEY** HIGHLIGHTS A SERIES OF THIRD-PARTY APPS FOR YOUR PHONE THAT MAKE CONTROLLING YOUR SPENDING SIMPLE.

These days, it seems like money sprints out of a savings accounts faster than a toupee in a hurricane. It doesn't help that transactions happen so easily now with tap and pay.

Before you know it, you're down to double digits in your bank account and wondering how you're going to limp along to the end of your pay period. Two-minute noodles and instant coffee, anyone?

The apps provided by major Australian banks and lenders work well for checking your current balance, transferring money and paying bills, but they don't actually encourage you to save or budget your money.

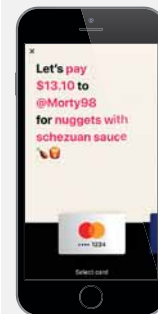
Thankfully, there are a handful of apps out there that fill the gaps and enable you to make the most of your hard-won earnings.



Finch www.finch.me

If you're somewhat of a social butterfly, Finch is a must-have for ensuring your hard-earned money doesn't end up paying for other people's expenses. Whether

it's splitting the bill for a group dinner, divvying up the cost of a shared holiday house or simply asking your mate to put in for a six-pack, Finch makes it as painless as possible with its intuitive interface. You can proactively pay someone money, request that someone else pay you, and also create groups to track shared expenses across multiple people. No more awkward conversations necessary.



Beem It www.beemit.com.au

The beauty of Beem It is that it doesn't overcomplicate payments. So long as the person you want to transact with is an existing Beem It user, the actual

payments process has been designed to look more like a Twitter feed than a stodgy bank transfer. The app is jointly owned by CommBank, NAB and Westpac, and given payments happen instantaneously, it's actually better than transferring money to someone's bank account via online banking – a process that typically takes 1-2 days. New users also get a \$5 credited to their linked debit account.



easyshare www.geteasyshare.com

easyshare is another payments app that focuses specifically on splitting payments and bills in a shared household.

This could be for rent, groceries, electricity, internet and any other shared expenses that need to be divvied up among roommates. Taking the awkwardness out of chasing household members for money – and negating the need for any passive aggressive post-it notes on the fridge – easyshare is clever enough to collect the cash from relevant parties and then pool it all together to pay rent or bills on your behalf on a one-off or recurring basis.



Stocard www.stocardapp.com/en/au

Rewards programs are a great way to save money with vendors that you frequent on a regular basis, but who wants to lug all of those loyalty cards around?

Stocard is an app designed to liberate you from loyalty card fatigue, with support for all of the major vendors and programs, including Woolworths, Flybuys, Myer, Priceline, Qantas and Coles. The app stores digital versions of each card on your phone, and also shows your current rewards points balance, nearby store locations, as well as any relevant offers, coupons and catalogues.



Frollo www.frollo.us

Designed to help improve your financial fitness, Frollo is a free app that gives you all the tools you need to manage your money effectively. It connects all of

your bank accounts, credit cards, loans and superannuation together into a single dashboard to give you a complete picture of your finances, and based off your transactions, it provides you with personalised insights that help you save money. Budgeting and keeping track of bills is all done automatically, and the inclusion of personal goals and community-based challenges help you stay motivated to continue your positive savings habits.



TOOLS



Comtruk Sports Utility Bed

Designed and manufactured in Australia, the Comtruk Sports Utility Bed (SUB) aims to re-imagine the classic ute tray with more performance features and improved safety features.

The SUB's integrated strapping system aims to make loading, load securing and unloading easier, regardless of cargo size or shape. It features multiple channels of attachment for securing of loads and installing equipment carrier accessories.

When not securing a load, the SUB's channels hold rubber friction strips to help reduce sliding and create grip to the bed floor.

Comtruk
www.comtruk.com

Prazi beam cutters

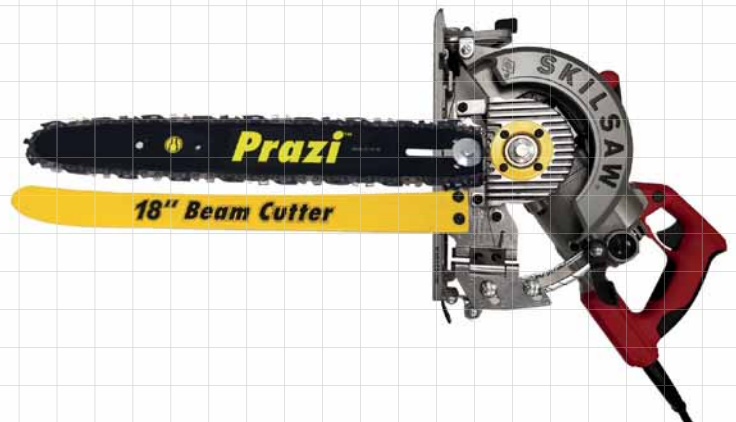
With more and thicker glue-laminated timber (GLT) being used in general construction, there comes a time when a standard circular saw is not up to the task.

Beam cutter attachments have been available in the US for more than 20-years but have had limited compatibility with some of the circular saw brands on the Australian market. Such attachments virtually turn a circular saw into a refined chain saw.

Recently, market-leader Prazi has released an 18" beam cutter that fits virtually all standard circular saws where the blade is on the right hand side. The product has also been tested and works well with a growing number of 36V cordless saws.

You can buy the tool direct from the manufacturer.

Prazi
www.praziusa.com



Bosch GOP12V-28 12V Multi-tool

The Bosch GOP12V-28 12V Max Starlock oscillating multi-tool features the next-generation Starlock 3-D interface; the accessory connection is cupped and shaped like a bottle cap to provide more contact surface area for rock-solid blade grip and maximum torque transfer.

The tool's EC brushless motor delivers more power versus the previous tool's 12V motor. This tool produces a top speed of up to 20,000 oscillations per minute and it has a 2.8° oscillating arc. The variable-speed dial allows users to match the oscillating speed to the material and task with a range of 5,000 to 20,000 opm (oscillations per minute). Bosch's Constant Response circuitry allows the tool to maintain the desired speed even as load increases.

Bosch Power Tools
www.bosch-pt.com.au

WHAT'S IN A NAME?

MUCH LIKE YOUR OWN NAME, YOUR BRAND NAME MEANS EVERYTHING, WRITES **BLAIR BEVEN**. ARE YOU PROTECTING IT?

They say that a person's own name is the sweetest sound in any language. We strongly identify with our names. It's often the first thing you learn about someone; your first chance to form judgements about who they are.

The same goes for brand names. We see over 4,000 ads every single day. Companies spend a lot of time competing for our attention and this is often through the promotion of brand.

As a seasoned tradie, you probably know all about the art of attracting new business and the value of having a good brand. Whether you've opted for a media-friendly brand (e.g. Dr Sparky for electricians) or you're simply trading under your own personal name, that name is an integral part of who you are and how customers

perceive you. So, what rights do you have in law to protect that brand?

This area falls under the broad umbrella of intellectual property (IP) law and it's frequently undervalued or overlooked by business.

It's also complicated: there are several situations where a company might seek to register a name and each requires a different method.

If you're operating as a company, you will have registered the name of your firm with ASIC. Companies must have Pty or Ltd in their name. If you're not operating as a company, you still need to register your business name. Companies can also register a business name, if they wish to operate under a different name from the name they are incorporated under.

But does registering a company or business name protect you from

imposters who want to steal your name and your goodwill? The answer is no. The only way to do this is to register the name as a trademark with the Intellectual Property Office of Australia and secure your ownership over the name. Once granted, the registration lasts 10 years, and if you continue to use it, can be renewed for another 10 years or in perpetuity.



Another misconception is that internet domain names afford you the legal right to that name. Like company names, domain names are merely for administrative use and do not give the company any monopoly in the name. A domain name is only associated with the company's website and points consumers to your business. It does not protect the name itself. It is possible, as most people know, to merely change the company name or domain name by the smallest margin to secure similar names.

For a trademark to be registrable, it must be distinct. The inherent distinctiveness associated with a trademark appears on a sliding scale. The most inherently registrable terms are those names

that are invented (Kodak, Google). Some are illusory (Facebook) and then more common/known names can be trademarked if they do not relate to the goods or services (Tesla, Nike). You would not be able to secure a trademark registration for a word that directly describes the goods or service; for example 'plumber' or 'electrician'. This defeats the purpose of the trademark

registration system where the government allows you to 'own' and have a monopoly in the name for a period of time. Trademark rights are national rights. Owning a trademark registration in Australia for example would not afford you any protection in the United States of America.

There are numerous benefits to obtaining a registered trademark including gaining a complete monopoly over the name, which acts as a deterrent for a third party

using or registering the same name. The investment business usually makes in the creation and promotion of their brands means that the name should be legally protected as a trademark. Most businesses have taken a considerable effort to create the brand and this investment can be consolidated through your IP protection.

Process

The drafting of a trademark application should be conducted by a qualified trademark attorney or specialised IP lawyer. When a trademark is being considered, the goods and services for which the



Blair Beven is a partner at national law firm Mills Oakley.

trademark will be used are classified with IP Australia according to a global classification system (called a specification of goods and services). There are 45 potential classes covering all possible goods or services in the world. IP Australia and most trademark professionals charge per class. The drafting of the specification requires some skill and expertise. There is no point in spending money to trademark a valuable name if it does not secure what you do or intend to do.

In Australia, once the application is lodged it can take anywhere up to four months for the application to be examined by IP Australia. However the filing date of the application acts as your priority date to the name. This priority date is highly important in IP and starts a six month clock to secure protection overseas and still claim the Australian filing date.

IP Australia will either issue an examination report raising any issues

with the application or issue a notice of acceptance. The application, if accepted, is then advertised in an official trademarks journal, which opens a two month window of opposition - if some other person or company was aggrieved by your trademark application. If no-one opposes the application it is then registered.

If IP Australia raises issues with the application then IP Australia allows 15 months to secure acceptance. A trademark lawyer should be engaged if you have issues with the application as it could identify an infringement risk or other inherent defect in the application. ▲

Blair Beven is a partner at national law firm Mills Oakley and specialises in trademark law and practice. He protects a significant number of trademarks in Australia and globally. He can be contacted at bbeven@millsoakley.com.au or +61 2 82895809.

Benefits of trademark registration

- You are deemed the absolute owner of the name/brand in Australia;
- The registration acts as a deterrence to others to file a similar or identical trademark application;
- The trademark registration lasts for 10 years;
- You can license others to use the trademark for a fee or royalty;
- You can use the Australian applications as a base to protect the trademark in other countries using the same filing date as Australia. This gives you some priority in the trademark.
- A registration can be used to stop others using the trademark or a similar trademark for your goods or services.
- You can sell the trademark to a third party;
- A trademark acts as an asset of the business which can be valued and included in your statement of assets for the company.

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PITCH PERFECT

WINNING JOBS CAN BE HIT AND MISS, BUT WHEN YOU DO LOSE A JOB IT'S IMPORTANT TO ANALYSE THE SITUATION TO FIGURE OUT WHY. **CECELIA HADDAD** LOOKS AT MASTERING THE PITCH.

Win some, lose some. That's the way life goes. But wouldn't it be nice to win more often?

Winning new business doesn't have to be daunting or time consuming but it does require an investment of a little bit of time to ensure you will reap the rewards.

There are definitely some jobs that will be small and straight forward that can be won by a quote over the phone. However, winning the bigger and more valuable projects require thought and preparation and some tailoring to meet the individual needs of your next customer.

So, what makes someone 'buy' from you? Is it the lowest quote, the fastest turnaround or the promise of quality? It is probably all of those things, but there is one thing that if you have it, you will always win and that's trust.

It doesn't matter if you have the cheapest price, the fastest turnaround or promise the best quality products money can buy, a customer will never give a job to someone they don't trust.

Trust isn't a word you can just slip into a sentence to make it happen. It starts building from the first impression the customer gets - this could be your website, vehicle signage or your first conversation. There are ways to build and gain the trust of your customer. A bit like a puzzle, you need this and all the other elements to complete the picture, and your pitch! Here are the three stages of pitching to win.

Stage 1 - Prepare

You must do your homework before you work on any quote or new business proposal. What is the customer's situation? What do they want? What do

they need? What is their budget? If you don't know or address this, your pitch will be way off and you won't get the job.

In the words of Stephen Covey: "Begin with the end in mind". Think about what you want your customer to think, feel and do. Sign here? Provide feedback? Make sure you have a clear take out, don't assume the customer will initiate closing the deal.

You should always go beyond expectations. Once you know what the customer needs, don't just supply one idea or one quote especially if you have additional or even better idea. It shows you have thought about their needs and gone above and beyond their expectations.

Time is money; how much time does the customer have? If they say half an hour then you should not be talking or presenting for more than 20 minutes



to allow them time for questions. You want to make sure they have all the information they need to decide there and then.

A picture tells a thousand words and photos of what you have done in the past or ideas for their project will be much more visually exciting than just a verbal presentation. It also allows you to demonstrate your experience. Before and after photos are very impactful and examples backed by facts or testimonials will go further than empty words.

Do you know what your unique selling proposition/point of difference is? Be ready to answer the question "why should we choose you for our project?". They may not ask it, but you need to make sure you cover it because the customer will be thinking it anyway.

Always be ready to address the competition. Do you know your competitors and what they might offer? You can address your competitors without mentioning them. Point out your positive differences (not their weaknesses). This will be far better received than criticising the competition.

Stage 2 - Present Your Pitch

It's all about the customer of course, so start by talking about them and what you understand their needs to be. If you find your pre-prepared presentation isn't going to meet their needs, then at least you will have an opportunity to address that and correct it during your pitch.

It is you they are buying not what's in your presentation. This is directly related to the trust factor. Find common ground - teenagers, pets, proximity - anything that connects them to you will help establish rapport and build a relationship from common ground. At the end of the day, they will hire you if they like you, but not if they don't, even if you have the best presentation in the world.

There is a fine balance between giving away too much information or not enough. You need to avoid underwhelming and overwhelming your client by ensuring you have enough information for a decision to be made but not so much that you have caused confusion and information overload.



A customer will never give a job to someone they don't trust.

Look at their body language, not just their words to understand what they really think about your presentation. Looking at their watch, physically turning away, losing eye contact, checking their phone - these are all indications that they are not on board with what you are presenting. Stop and ask questions before you just continue to ramble down the same path.

Stage 3 - Closing the deal

To close a deal, you will be advised to always talk to the decision maker; however, sometimes the influencer is just a crucial. Make sure one or both are present when you give your pitch.

Overcome any fears or objections. If you don't know what they are then ask if there is anything your potential client is unsure of doesn't like. Can you clarify anything further?

Don't pressure the customer to close the sale, but you can create a sense of urgency by offering an incentive for them to decide sooner than later. This could mean their project could be completed sooner due to a window of

opportunity or there is an add on you can offer them if they advise by a certain time.

Ask questions to ensure they have enough information to decide. If they are undecided and you really want the job then be bold and ask: "What do you need me to do to win your business?" You might be pleasantly surprised by the answer and something you are willing to do to get the job.

Once the customer has decided, the pitch process doesn't stop there. Evaluating their response will be a great investment of your time for future pitches. Understand why they selected you for the job - or why they didn't - and use that information for your next pitch. Good luck! ▲

Cecelia Haddad

Cecelia Haddad is the director of Marketing Elements, a PR company that specialises in the building and environmental sectors.



TRANSPORT

with Terry Martin

MERCEDES-BENZ VISION URBANETIC CONCEPT

Mercedes-Benz has developed a thought-provoking new high-tech light-commercial van concept that combines trade and family transport in the one package.

Dubbed the Vision Urbanetic, the concept is designed to answer “the questions of future urban mobility”.

We might have expected it to be fully autonomous, freeing up the owner from driving duties, and that it would have an all-electric powertrain, reducing air and noise pollution.

But what we did not anticipate was just how deeply the German auto giant’s designers, engineers and product planners were prepared to delve into the idea of a highly flexible trade van that can be easily transformed into an eminently suitable out-of-hours multi-purpose vehicle.

While utes and pickups are increasingly used for both work and recreational purposes, the trade-specific fit-outs in commercial vans are not in the same ballpark. With this concept, however, the vehicle comes equipped with different interchangeable bodies, depending on

the purpose of use.

In presenting the concept, Mercedes has configured a classic delivery van and a 12-seater people mover, but the bodies are really only limited by our imagination - there could be one set up for any particular trade, for example, and another that serves as a luxury lounge-style limo or a mobile man cave...

With the trade body, there is a variable load floor that can be split into two levels and offers 10m³ of cargo volume. The load space measures 3.7m long, within a total vehicle length of 5.14m.

Switching between bodies can be done either automatically or manually, Mercedes says, with the automated process taking just a few minutes.

All driving functions and running gear are built into the autonomous vehicle platform, onto which the bodies are simply fixed. So the chassis will operate independently - even moving from one location to the next if required, without the body attached.

The absence of a driver’s cab - with no need for a steering wheel, pedals,

dashboard, etc - also frees up space for new ideas on interior design, bringing obvious benefits with the ability to carry more tools, materials, occupants, and so on.

The concept also incorporates an IT infrastructure that can perform high-level functions in real time such as monitoring stock levels of materials used and planning optimum routes between jobs to avoid traffic jams and so on.

A lot of advanced safety technology is likewise fitted to the van. With the people mover body, the vehicle uses multiple cameras and sensor systems to communicate not just with the occupants but with those on the outside.

For example, there’s a large-format display on the front of the vehicle to inform pedestrians crossing the street in front of it that the vehicle has noticed them. There is also ‘digital shadowing’ around the side door where several hundred light units display the contours of people approaching along the flanks of the vehicle, signalling to them that they have been noticed. ▲





RENAULT ALASKAN AND OROCH

Renault Australia is continuing to work on the business case to bring the Alaskan one-tonne pickup and the smaller Oroch ute to this market.

Built on the same platform as alliance partner Nissan's Navara, the Alaskan is all but locked in for launch here but minor changes required for local homologation have pushed out its timing to late 2019 or early 2020.

There are also some sticking points in relation to the costs involved in sourcing the Alaskan from Nissan's plant in Barcelona, Spain; however, Renault Australia managing director Andrew Moore has told us that significant progress has been made and that the Alaskan will be sold here as a dual cab only with a limited model range.

He also pointed to the premium-looking design of the Alaskan compared to other pick-ups in the segment, adding that Renault was not out to compete in volume terms with the Thai-built heavy hitters in the segment.

This means the Alaskan will be pitched against the likes of Ranger Wildtrak, HiLux Rugged X, Volkswagen's Amarok and Mercedes-Benz's X-Class - the latter built as part of the same program that has delivered Renault its first mid-size one-tonner.

The Alaskan will be offered with the 2.3L four-cylinder turbo-diesel engine used in Navara, and its underpinnings will include the sophisticated five-link coil spring rear suspension seen on high-end versions of the Nissan ute.

The X-Class relies on many of the same components - including the basic architecture, four-cylinder diesel engine and rear suspension hardware - but has incorporated its own engineering modifications, and various other changes, including a V6 diesel engine option.

Renault Australia is also working closely with the factory in Spain to develop a range of high-spec body

parts and accessories for the Alaskan such as sports bars, wheel arch fenders and bullbars.

The Oroch, meanwhile, looks to be a slightly longer-term proposition for Australia but Andrew is pushing the case for it to be built in right-hand drive as it would hand the company a highly specified small/medium dual cab ute at a much lower entry point - around \$30,000.

Launched overseas in 2015, the Oroch is based on the same platform that underpins a variety of Renault and Nissan compact SUVs and passenger cars and borrows much from the budget-oriented Dacia Duster small SUV.

It was primarily developed for the South and Latin American markets and is designed to sit between the half-tonne pickups that are popular overseas and the one-tonners that are big business in Australia.

As such, Oroch's payload tops out at around 650kg and it is not designed for heavy duty workloads, relying at the moment on 1.6 and 2.0L four-cylinder petrol and dual fuel (petrol/ethanol) engines and using only a 4x2 (front-wheel drive) driveline.

It has a car-like monocoque chassis, fully independent suspension, circa 1,300kg kerb weight and measures around 4,700mm long, 1,820mm wide and 1,695mm high, resting on a 2,829mm wheelbase. This makes it bigger than, say, a Subaru Brumby but a fair bit smaller than Alaskan and Co. The cargo bed can hold up to 683L.

A significant update is due around 2020, so an Australian release would likely be based on this 'Phase II' overhaul, taking on more budget-oriented 4x2 dual cab utes from the Asian brands and hoping to pick up buyers who would otherwise have bought an Australian-made Falcon- or Commodore-based ute before Ford and Holden closed their local manufacturing operations. ▲



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HOW IT WORKS

The Metal Pecker's bolt-cutter sized handles provide far greater cutting leverage than other metal cutting hand tools.

Its precision cutter blade shears the metal between the anvils and pushes out a 1.7" (43mm) x 0.24" (6mm) slug with each cutting stroke. There is no blade face to blunt.

To cut, you simply punch a pilot opening in the metal sheet, poke the beak of the Metal Pecker's cutting jaw into the opening and commence cutting.

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The Metal Pecker compliments other tools that do their best work on single thickness profile cutting at ground level, or on flat sheet.

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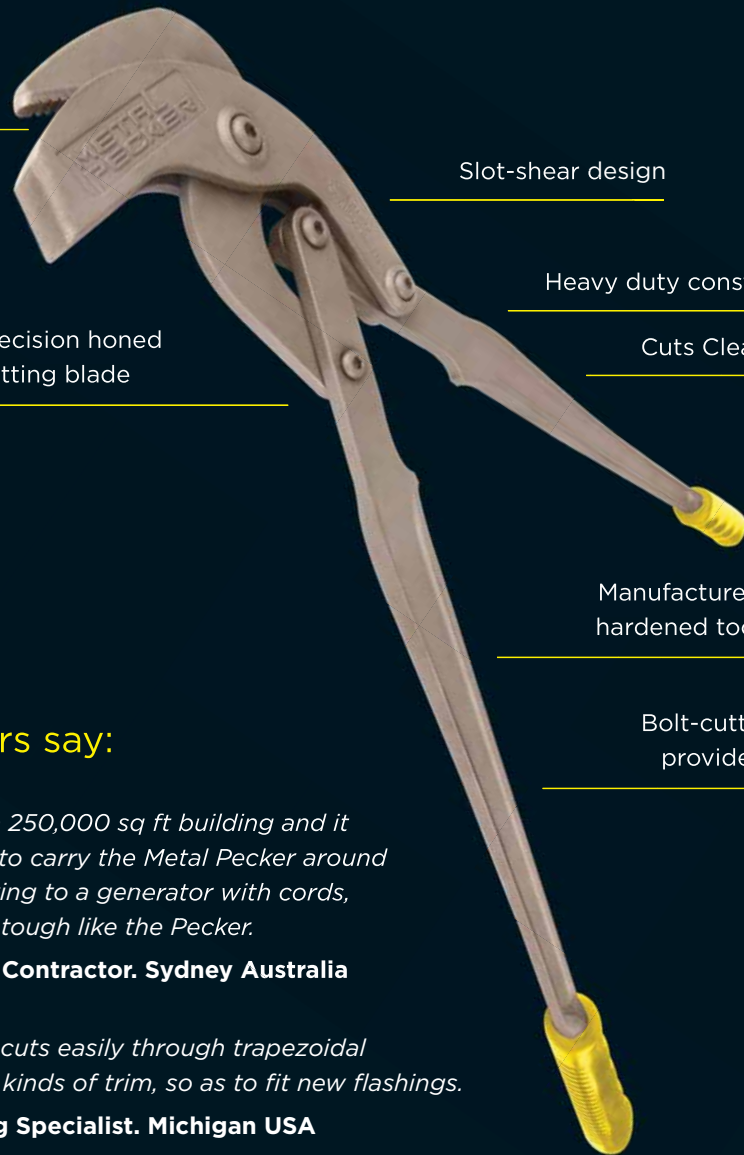
Its extended handles keep you away from the sheet's sharp edges and provide greater reach and leverage in hard to access places - reducing your work time.

Cutter blade shears the metal between the anvils





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Barney Smethers **Roofing Contractor. Sydney Australia**

I like the fact that the tool cuts easily through trapezoidal standing seam ribs and all kinds of trim, so as to fit new flashings.

James Gunnerson **Building Specialist. Michigan USA**

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VOLKSWAGEN AMAROK V6 TDI580 ULTIMATE

Volkswagen has set a new benchmark among the one-tonne mid-size ute brigade, launching a more powerful version of its Amarok V6 diesel engine that sees the German brand maintain bragging rights over newcomers such as the Mercedes-Benz X-Class X350d.

Available only in top-spec Ultimate guise for the time being, the new TDI580 4x4 twin cab has emerged with a revised version of VW's 3.0L 24-valve turbo-diesel engine that produces 190kW of power from 3,250-4,500rpm and 580Nm of torque from 1,400-3,000rpm - up 25kW/30Nm over the continuing TDI550.

What's more, Volkswagen says maximum power of 200kW is available from 3,500-4,000rpm via the temporary overboost function, which is a 10kW improvement over the TDI550 and kicks in for up to 10 seconds between 50km/h and 120km/h.

For this to occur, the standard-fit ZF-sourced eight-speed automatic transmission must be in either third or fourth gear, and the driver needs to have depressed the accelerator by at least 70%.

From a standing start, the TDI580 Ultimate can sprint from 0-100km/h in a claimed 7.3 seconds - 0.6s quicker than the 550 and enough to keep its

nose in front of the Mercedes X350d, its chief rival which can complete the task in 7.5s with its own 190kW/550Nm 3.0L V6 diesel.

This is a fair effort for the big VW ute, which drives all four wheels on a permanent basis, tips the scales at 2,244kg and maintains a good fuel economy figure on the official combined test cycle (city/country), returning 8.9L per 100km from its 80L fuel tank. The engine is rated to the Euro 6 emissions standard while the TDI550 is compliant with Euro 5 and returns 9.0L/100km.

The Ultimate brings with it 20" 'Talca' alloy wheels, a unique front bumper design, durable cargo area lining, stainless-steel side steps (with LED lighting) and a 'long-design' sports bar, while other exterior features of note include bi-Xenon headlights, LED daytime running lights, front fog lights with a cornering function and, assisting the driver, a rear-view camera, front/rear parking sensors and tyre pressure monitoring system.

As with all Amarok V6 variants, four-wheel disc brakes are fitted, along with ABS brakes (with off-road programming, electronic brake-force distribution and brake assist), a mechanical rear differential lock, electronic stability and traction control, hill holder system, hill descent

control, an active rollover prevention system, trailer sway stability control (when the towbar wiring kit is installed) and front and side airbag protection for the driver and front passenger.

Interior highlights on the Ultimate include Nappa leather seat upholstery, 'ergoComfort' heated front seats (with 14-way electric adjustment for the driver), a premium multi-function colour display in the instrument binnacle, high-grade 6.5" touch screen infotainment system with satellite navigation and Apple CarPlay and Android Auto compatibility, leather-clad multi-function steering wheel, transmission paddle shifters, alloy sports pedals, black headlining and pillar trim, tailored carpet mats and dual-zone climate-control air conditioning.

Maximum braked towing capacity remains at 3,500kg, while payload is not quite at the 1t mark - 836kg. Gross combination mass is 6,000kg and GVM 3,080kg.

The Amarok sits on a ladder-frame chassis and uses double wishbones with anti-roll bar at the front suspension and a 'multi-layered' solid axle with heavy duty springs at the rear.

The tray measures 1,555mm long, 1,620mm wide (1,222mm between the wheel arches) and 508mm from tub floor to sill. ▲

NISSAN NAVARA BLACK EDITION, SILVERLINE

Nissan has placed fresh emphasis on its Navara one-tonne ute range with two new special edition dual cabs: the ST-based 'Black Edition' and SL-based 'Silverline'.

Nissan has had a strong response to its value-laden mid-spec editions in the past - such as the 2017 ST-X N-Sport - and has now added a host of accessories and other detail items to create the 'black and silver' duo.

Black really is the central element in the ST-based special edition, with the colour appearing on the 18" alloy wheels (with General Grabber all-terrain tyres), front grille, nudge bar, fog lamp surrounds, smoked bonnet protector, wing mirror caps, wheel arch flares and sports bar.

The Black Edition also features an LED light bar, soft tonneau cover and protective tub liner.

The Silverline, meanwhile, has 16" alloy wheels in place of the standard steel rims, a polished alloy sports bar, unique tailgate badging and a mobile phone holder in the cabin.

There are no mechanical changes to the Navara, which at this level runs with the twin-turbo version of the 2.3L four-cylinder diesel engine producing 140kW of power and 450Nm of torque. It combines with a six-speed manual or seven-speed automatic gearbox, driving through a part-time 4WD system with low range.

The new editions join the Series III range in the current D23/NP300 generation, upgraded early in 2018 with a raft of mechanical and detail specification changes to make Navara better suited to Australian conditions and customer preferences.

For the SL, ST and ST-X dual cabs, which have a five-link coil spring rear suspension, the overhaul was headlined by a fresh round of modifications - including a dual-rate rear spring system and faster steering gear ratio - aimed at further improving ride and handling characteristics, especially with a load on board or with a trailer behind. ▲



ISUZU N SERIES

Isuzu Australia has launched its updated N Series light truck, bringing a broader availability of its automated manual transmission (AMT) as well as a host of detail mechanical, cabin technology and specification changes across the huge range that is now available in almost 70 different configurations.

Among the headline acts is the introduction of the NPS 75/45-155 4x4 AMT model, which is billed as the first-ever two-pedal 4x4 light truck on the Australian market - a direct response, Isuzu says, to customer demand for a reliable, rugged and easy-to-operate vehicle that can access difficult job sites and is available in both 7.5t and de-rated 4.5t (car licence) GVM ratings.

The NPS 4x4 AMT comes in single and crew cab body styles and combines the five-speed AMT with a part-time 4WD system and Isuzu's familiar 5.2L 16-valve '4HK1-TCN' four-cylinder diesel, which produces 114kW of power at 2,600rpm and 419Nm of torque from 1,600-2,600rpm.

When low range is selected, the AMT reverts to clutchless manual control mode, which keeps the selected gear engaged. Local engineering work has also seen the transmission specifically calibrated for Australian off-road conditions and usage patterns. A five-speed manual gearbox remains available, too.

Cruise control is now standard across the N Series range, along with a new dash-mounted infotainment system featuring a 6.2" touch screen, updated Android Auto operating system, USB 3.0 connectivity, Bluetooth V4 and DAB+ digital radio.

Local engineering work has also seen Isuzu revise tyre specifications on some model lines, such as the NPS 4x4 swapping to Bridgestone L330 225/80 R17.5 rubber (from Michelin XZT 8.5R17.5s) - a change that the company says improves its off-road performance and gives the truck a higher load capacity, maximising the use of the steer axle's 3,100kg limit (+200kg). NPR and NNR models also now have a new Michelin tyre that is said to bring improvements in braking, mileage and durability. ▲



VOLKSWAGEN AMAROK V6 TDI550 CORE

Volkswagen is pitching its most affordable V6-powered Amarok dual cab ute ever straight at the trades, lowering the entry price for the TDI550 engine to \$50,990 drive-away with the introduction of the new Core 4x4 model grade.

VW Australia has been slowly adding lower-priced variants to the Amarok V6 range, which initially arrived with highly specified Ultimate and Highline variants before a Sportline version was added to bring the baseline price down to around \$55K.

Now, the German prestige brand has stripped it back further with the Core 4x4, which misses out on a few creature comforts but has the main attractions front and centre: VW's highly regarded 165kW/550Nm 3.0L V6 turbo-diesel engine, combined with the eight-speed automatic transmission.

The price point could even fall below \$50K before too long, with Volkswagen Group Australia planning to introduce a long-awaited (six-speed) manual version now that the Core 4x4 is here.

With V6 versions accounting for around 70% of total Amarok sales in Australia - and rising - VW is hungry for more new buyers.

There's a useful amount of safety gear on board including four airbags for front occupants and four-wheel disc brakes with a supporting cast of electronic systems assisting the driver including ABS, EBD, brake assist, traction and stability control, a diff lock, hill holder and, when travelling off-road, hill descent control.

Items left off the Core's standard equipment list include front parking sensors, dusk-sensing headlights, rain-sensing windscreen wipers, a lockable tailgate (with 'comfort' closing), tinted windows, four 12V power sockets (leaving one in the cabin), under-seat storage, rear cup holders and chrome cabin trim highlights.

In terms of outright acceleration, the ute can reach 100km/h from standstill in a claimed 7.9 seconds. ▲

FORD TRANSIT PHEV, MILD HYBRID

Ford has unveiled new fuel-saving electrified versions of its Transit van - a plug-in hybrid electric vehicle (PHEV) version of the mid-size Transit Custom and a 'mild hybrid' version of both the Custom and the full-size Transit with a 48V starter/generator system.

The first series production PHEV in its class, the plug-in Transit Custom will enter production in the second half of 2019.

It uses Ford's 1.0L three-cylinder EcoBoost petrol engine but, rather than doing the main job of powering the vehicle, it serves as a 'range extender' which generates electricity that is then fed into a 14kWh lithium-ion battery pack located under the load floor.

Full technical details were not provided at the vehicle's unveiling in Germany, but the electric drive motor on board takes full responsibility for driving the front wheels and enables a 50km driving range on battery power alone - covering many inner-city trips - while the total driving range, with a full tank of petrol, is claimed to be more than 500km.

Meanwhile, Ford also has first-in-class bragging rights with the so-called mHEV (mild hybrid electric vehicle) powertrain developed for Transit, which uses a belt-driven starter/generator instead of a conventional alternator in combination with the latest 2.0L EcoBlue diesel engine across all power ratings.

The system is designed to capture energy when the vehicle brakes or decelerates, storing this as charge in the 48V air-cooled lithium-ion battery pack and using it to power the van's electrical ancillaries and provide improved torque under acceleration and during normal driving.

This reduces load on the diesel engine and, in combination with an updated automatic engine idle-stop feature, delivers fuel savings of up to 3% on average - or as much as 8% in start/stop urban conditions, based on the latest WLTP test procedure. ▲





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CHECKING AND TESTING AN ELECTRICAL INSTALLATION

This non-endorsed course provides licenced electricians, final year apprentice electrical mechanics and electrical fitters with the training, skills and knowledge to visually inspect and test a low voltage electrical installation in compliance with the requirements of AS/NZS 3000.

START DATE	LOCATION
23/01/2019	Joondalup
31/01/2019	Jandakot
8/03/2019	Jandakot

ELECTRICAL CORDS & PLUGS COURSE (NON-ENDORSED)

This non-endorsed course provides participants with the training, skills and knowledge required to fit plug tops to low voltage electrical cord connected equipment and to assemble low voltage cord extension sets up to 1,000V AC.

START DATE	LOCATION
6/03/2019	Jandakot
11/04/2019	Joondalup

10145NAT COURSE IN ELECTRICIAN - MINIMUM AUSTRALIAN CONTEXT GAP TRAINING

This course provides the minimum Australian context gap training to holders of an Offshore Technical Skills Record (OTSR) for the UEE30811 Certificate III in Electrotechnology Electrician qualification.

START DATE	LOCATION
18/02/2019	Joondalup
11/03/2019	Joondalup
1/04/2019	Joondalup
1/04/2019	Jandakot

UEENEFF105A INSTALL AND MODIFY OPTICAL FIBRE PERFORMANCE DATA COMMUNICATION (OPTICAL FIBRE CABLING COURSE)

This nationally-endorsed course is an extension of the ACMA Open Cabler Registration Training Requirements course and provides applicants with the training, skills and knowledge to correctly install and terminate optical fibre cabling.

START DATE	LOCATION
12/04/2019	Joondalup
12/04/2019	Jandakot

BATTERY STORAGE FOR GRID-CONNECTED PV SYSTEMS

This course delivers the requisite training in the design and installation of battery storage for grid-connected PV systems. It provides detailed knowledge and practical skills for the design, installation, fault-finding and repair of battery storage systems for grid-connected photovoltaic systems. Completion of this course meets the requirements for Clean Energy Council Battery Storage endorsement that will be applied to existing CEC Design and Installation of Grid-Connected PV Systems Accreditation.

START DATE	LOCATION
29/01/2019	Jandakot
25/02/2019	Jandakot
5/03/2019	Jandakot
15/04/2019	Jandakot

HIGH VOLTAGE SWITCHING SYSTEMS OPERATIONS COURSE

This industry endorsed course, derived from the UEP12 Electricity Supply Industry-Generator Sector training package and the UET12 Transmission, Distribution and Rail Sector training package, is intended for electrical workers and electrical engineers working with HV switchgear in industrial facilities and networks.

START DATE	LOCATION
11/02/2019	Jandakot
25/02/2019	Jandakot
11/03/2019	Jandakot
25/03/2019	Jandakot
8/04/2019	Jandakot

UEENEFF104A INSTALL AND MODIFY PERFORMANCE DATA COMMUNICATION COPPER CABLING (CATEGORY 5/6/7 STRUCTURED AND COAXIAL CABLING)

This nationally-endorsed course is an extension of the ACMA Open Cabler Registration Training Requirements course and provides open cablers with the training, skills and knowledge required to correctly install terminate Category 5/6/7 structured and coaxial cabling.

START DATE	LOCATION
15/02/2019	Joondalup

STAND-ALONE POWER SYSTEMS - DESIGN AND INSTALLATION CLEAN ENERGY COUNCIL ACCREDITATION

This course delivers the requisite training in the design and installation of stand-alone power systems required for Clean Energy Council Accreditation. It encompasses knowledge of renewable energy sources, primarily focusing on photovoltaic systems. The course provides knowledge and practical skills in design, installation, fault-finding and repair of stand-alone power systems.

START DATE	LOCATION
14/01/2019	Jandakot
18/02/2019	Jandakot

UEENEPP026A CONDUCT IN-SERVICE SAFETY TESTING OF ELECTRICAL CORD CONNECTED EQUIPMENT AND CORD ASSEMBLIES (PORTABLE APPLIANCE TESTING)

This course provides information regarding the safe and accurate operation of the Portable Appliance Tester (PAT) and testing of RCDs for persons required to operate this type of equipment. Essentially, the course is aimed at persons who have little or no understanding of electrical theory and are required to endorse equipment as safe to use.

START DATE	LOCATION
7/03/2019	Jandakot
12/04/2019	Joondalup

UEENEEL150A UEENEEL151A PROGRAMMABLE LOGIC CONTROLLERS

The course provides training in development, installation and testing of programs for programmable logic controllers and industrial systems requiring advanced control functions.

START DATE	LOCATION
11/02/2019	Jandakot
25/03/2019	Jandakot

UEENEFF102A INSTALL AND MAINTAIN CABLING FOR MULTIPLE ACCESS TO TELECOMMUNICATION SERVICES (OPEN CABLER REGISTRATION)

This nationally-endorsed course provides applicants with the training, skills and knowledge required to meet the Australian Communications Media Authority (ACMA) Open Cabler Registration.

START DATE	LOCATION
9/02/2019	Joondalup
23/03/2019	Jandakot
6/04/2019	Joondalup

UEE20111 CERTIFICATE II IN SPLIT AIR-CONDITIONING AND HEAT PUMP SYSTEMS

This nationally-endorsed qualification provides participants with the training and knowledge to install, commission and de-commission single head split air conditioning and heat pump systems to a prescribed routine, where the maximum plant capacity for each system does not exceed 18kW. It includes wall hung, floor, and ceiling suspended, cassette and ducted fan coil split and water heating heat pump systems.

START DATE	LOCATION
4/02/2019	Jandakot
18/03/2019	Jandakot

52830WA COURSE IN ELECTRICAL TRADE LICENSING

This course was designed for those who have been advised by the West Australian Electrical Licensing Board to undergo a competency assessment or for electrical fitters transitioning to 'mechanic'.

START DATE	LOCATION
4/02/2019	Joondalup

DESIGN AND INSTALL GRID CONNECTED PHOTOVOLTAIC SYSTEMS

This course delivers the requisite training to licensed electricians for the design and installation of grid connected photovoltaic systems and associated equipment required for Clean Energy Council Accreditation.

START DATE	LOCATION
11/02/2019	Jandakot
1/04/2019	Jandakot

RESTRICTED ELECTRICAL LICENCE (REL) COURSE (DISCONNECT & RECONNECT TO 1000 VOLTS)

The Restricted Electrical Licence course provides eligible persons with the training, skills and knowledge required to apply for a restricted electrical licence. The full time course is structured to include both theoretical and practical training.

START DATE	LOCATION
11/03/2019	Joondalup

ELECTRICAL CONTRACTOR TRAINING PROGRAM (ECTP), ELECTRICAL CONTRACTORS NOMINEES/IN-HOUSE LICENCE, ELECTRICAL CONTRACTORS BUSINESS LICENCE

This EnergySafety WA approved course satisfies the Electrical Contractor Training Program (ECTP) and provides licensed electricians with the training, skills and knowledge required to identify, investigate and apply statutory and legislative requirements, manager jobs and operate a business and inspect and test electrical installation work according to regulatory requirements.

START DATE	LOCATION
4/02/2019	Jandakot
11/02/2019	Joondalup
11/02/2019	Jandakot
4/03/2019	Joondalup
11/03/2019	Joondalup
25/03/2019	Jandakot
1/04/2019	Joondalup
1/04/2019	Jandakot

SATELLITE DIGITAL RECEPTION SYSTEMS (TRAIN-SDRS)

Offering competencies of the Certificate II and III, this one-day program will arm you with knowledge of the design, installation and commissioning of new systems; ranging from domestic premises to 5-wire trunk SMATV systems. Exercises will ensure your understanding of radio frequencies, locating satellites, setting up mounts and measuring signals using the latest test equipment. Walk away with the knowledge of Pay TV installation standards and you will be in the box seat to profit from market demand.

START DATE	LOCATION
21/02/2019	Melbourne
21/03/2019	Sydney

DIGITAL TERRESTRIAL RECEPTION SYSTEMS (TRAIN-DTRI)

Embark on your learning path in television reception systems with this two day course. The program offers competencies of the Certificate II and III, including selection and installation of terrestrial antennas, managing and installing coaxial cable and designing simple domestic distribution systems. It covers installation of digital television receiving equipment such as decoders and PVRs, and involves practical exercises to ensure you learn the skills required to progress through a full domestic installation.

START DATE	LOCATION
19/02/2019	Melbourne
19/03/2019	Sydney

STATEMENT OF ATTAINMENT FOR DIGITAL RECEPTION TECHNOLOGIES (TRAIN-DRT-SOA)

This program is designed to provide participants with the necessary competencies to install digital reception equipment for homes and businesses. It provides participants with fault finding skills on a range of digital reception equipment for subscription TV and free-to-air TV reception. This course consists of four days of face-to-face training, correspondence using print-based learning materials as well as assessments.

START DATE	LOCATION
19/02/2019	Melbourne
19/03/2019	Sydney

COMPLEX DIGITAL RECEPTION SYSTEMS (TRAIN-CDRS)

This one-day course dives into complex digital systems, encompassing competencies of the Certificate II and III in television reception systems. You learn not only how to select antennas for large systems, but you will also gain an understanding of how to locate and rectify digital reception faults. To keep pace with the demands of consumers and business today, emphasis in the new digital era is on the convergence of the Internet, Pay TV, Terrestrial TV and inhouse video systems, especially for applications in hotels, apartments and commercial premises.

START DATE	LOCATION
19/02/2019	Melbourne
19/03/2019	Sydney

BATTERY STORAGE

With the growing interest in battery storage systems and the forecasts show that demand will grow rapidly as the cost of such systems comes down, driven by competition and technology.

START DATE	LOCATION
15/03/2019	Carlton North

CPR+LVR

This course allows you to gain the skills and knowledge that will keep you safe, should you need to perform a low voltage rescue and CPR on a mate or colleague until the professionals arrive.

START DATE	LOCATION
18/02/2019	Carlton North
12/03/2019	Carlton North
9/04/2019	Carlton North

GRID CONNECT

This course provides licensed electricians with the skills to design, install, set-up, test, fault find, repair and maintain grid connected photovoltaic systems and the associated equipment

START DATE	LOCATION
1/02/2019	Carlton North
1/04/2019	Carlton North

OHS MANAGEMENT FOR MANAGERS & SUPERVISORS

This course is specifically designed to provide contractors and their management with a clear understanding of the role of Occupational Health and Safety in today's work environment and specifically in the electrotechnology industry.

START DATE	LOCATION
18/03/2019	Carlton North

REGISTERED ELECTRICAL CONTRACTOR (BUSINESS)

If you want to start your own electrical contractor business then this course is for you. The course sets out the knowledge and skills required to ensure regulatory, technical, occupational and workplace relation requirements are met in conducting a contracting business.

START DATE	LOCATION
4/02/2019	Carlton North
16/02/2019	Carlton North
4/03/2019	Carlton North
16/03/2019	Carlton North
1/04/2019	Carlton North
6/04/2019	Carlton North

CONSTRUCTION WIRING

Construction wiring is a specialised area providing regulatory, industrial relations and cost challenges for contractors. Successfully managing these challenges requires comprehensive skills and knowledge of the relevant Australian and industry standards to ensure compliance and eliminate risks.

START DATE	LOCATION
27/02/2019	Carlton North

ELECTRICAL INSTALLATION TESTING

Electricians and RECs have a legal obligation to test and certify that their electrical work complies with relevant standards. It is essential that you or your employees have the essential testing skills so that you can test and sign off on COES with confidence.

START DATE	LOCATION
1/03/2019	Carlton North
21/03/2019	Carlton North
1/04/2019	Carlton North

LICENSED ELECTRICIAN THEORY (LET)

Brush up on your knowledge before you go for your electrical licence. This component prepares you for the LET component PLUS you can book your assessment at the same time.

START DATE	LOCATION
18/02/2019	Carlton North
16/03/2019	Carlton North
15/04/2019	Carlton North
20/05/2019	Carlton North

OPTICAL FIBRE

Optical Fibre training using state-of-the-art equipment that you will be using on site to pace, secure, test and terminate optical fibre cable in new installations and upgrades existing networks in domestic, commercial and industrial installations.

START DATE	LOCATION
30/03/2019	Carlton North

STRUCTURED AND COAXIAL CABLING

This course builds on the knowledge gained during your Open Registration course to give you greater insight and detail in structuring telecommunications infrastructure and installing, terminating and testing coaxial cabling.

START DATE	LOCATION
16/02/2019	Carlton North
6/04/2019	Carlton North

CONSTRUCTION WIRING REFRESHER

This two-day refresher course will update your knowledge and understanding of changes to standards and legislation impacting on installation practices.

START DATE	LOCATION
20/03/2019	Carlton North

ESTIMATING ELECTROTECHNOLOGY PROJECTS

This course will provide you with accurate and profitable estimating skills as well as undertaking practical construction of an estimate from the receipt of the tender documents, through the practical take off and pricing to final submission of the tender.

START DATE	LOCATION
18/02/2019	Carlton North
8/04/2019	Carlton North

LICENSED ELECTRICIAN PRACTICE (LEP)

Brush up on your knowledge before you go for your electrical licence. This component prepares you for the LEP component PLUS you can book your assessment at the same time

START DATE	LOCATION
29/01/2019	Carlton North
11/02/2019	Carlton North
4/03/2019	Carlton North
23/03/2019	Carlton North
8/04/2019	Carlton North

OPEN REGISTRATION

Don't be stuck in the dark ages, Open Registration has become a necessity for all things internet. It doesn't matter what project your working on; networking, data and voice cabling will be part of the scope of works.

START DATE	LOCATION
16/03/2019	Carlton North

SAFE WORK PRACTICE (SWP)

Brush up on your knowledge before you go for your electrical licence. This component prepares you for the SWP component, plus you can book your assessment at the same time.

START DATE	LOCATION
8/02/2019	Carlton North
25/02/2019	Carlton North
14/03/2019	Carlton North
28/03/2019	Carlton North
12/04/2019	Carlton North

NECA EDUCATION & CAREERS
www.necaeducation.com.au



IVORY EGG AUSTRALIA
www.ivoryegg.com.au



FIRST AID

This course provides the skills and knowledge required to provide first aid response, life support, management of casualty(s), the incident and other first aiders, until the arrival of medical or other assistance. The course includes performing CPR and providing basic emergency life support.

START DATE	LOCATION
15/02/2019	Laverton North
20/03/2019	Laverton North
8/04/2019	Laverton North

LICENSED ELECTRICAL INSPECTOR

This course covers the various safety and testing requirements that are required in an installation inspection, including the application and use of Certificates of Electrical Safety (COES) and logging the defects under the Wiring Rules, the ESV Defect list and relevant Standards.

START DATE	LOCATION
1/04/2019	Melton

PROJECT STAKEHOLDER & COMMUNICATION MANAGEMENT

This course provides an advanced understanding of the critical need for stakeholder management and how to deal with potentially troublesome issues. This course equips project managers with a set of tools to help them identify key stakeholders (internal and external) and their role in the project, and then to manage stakeholder engagement throughout the project lifecycle with a model for communications plans and strategies.

START DATE	LOCATION
10/04/2019	Carlton North

INTRODUCTION TO PROJECT MANAGEMENT

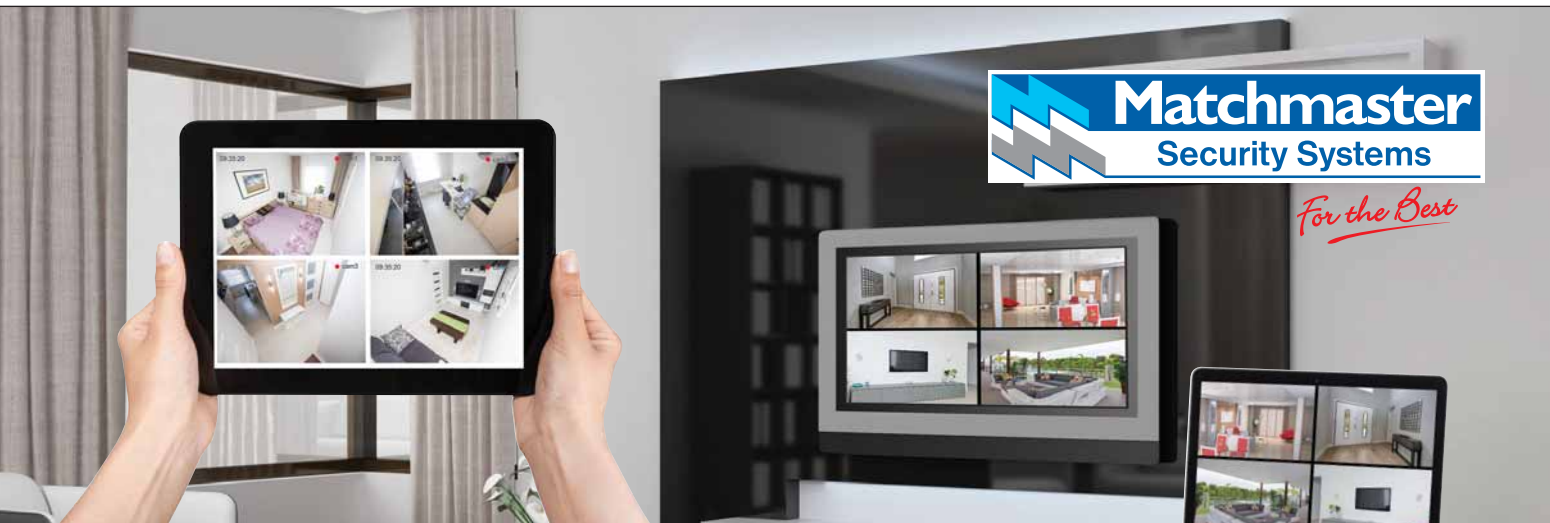
This course provides you with the knowledge and skills to leverage the key elements of project management best practices for your projects - from establishing scope through to managing risks and reporting project status.

START DATE	LOCATION
4/03/2019	Carlton North

KNX BASIC ACCREDITATION TRAINING

KNX is an international building control standard that is used to put the intelligence into intelligent buildings. It enables the integration and programming of a range of products from a range of manufacturers using a single software tool. KNX products are all thoroughly tested for compliance ensuring they operate seamlessly together on a single, simple network. Who supports KNX? There are over 450 manufacturers, 80,000 partners, 126 scientific partners as well as user clubs, national groups and test labs over some 160 countries, that is why KNX is becoming the automation technology of choice.

START DATE	LOCATION
5/02/2019	Sydney
12/02/2019	Brisbane
19/02/2019	Adelaide
5/03/2019	Melbourne
19/03/2019	Perth
2/04/2019	Sydney
9/04/2019	Melbourne



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DESIGN AND INSTALL GRID CONNECT PV SYSTEMS

This course consists of two main components: online theory completed at students' own pace and the face-to-face (3 days) component held at our GSES Training Facility in Botany, Sydney. The required work includes the online and written assessments, the 3-day Practical Course and a written open book exam.

START DATE	LOCATION
23/01/2019	Sydney
6/02/2019	Brisbane
27/02/2019	Sydney
27/03/2019	Brisbane
3/04/2019	Sydney

INSTALL ONLY GRID CONNECT PV SYSTEMS

This course has been designed to address the PV grid-connect market in Australia and is ideal for electricians who wish to expand their knowledge and skills. The delivery mode of this course is designed for busy tradespeople who do not have the time to attend face-to-face courses to gain relevant qualifications.

START DATE	LOCATION
23/01/2019	Sydney
6/02/2019	Brisbane
27/02/2019	Sydney
27/03/2019	Brisbane
3/04/2019	Sydney

DESIGN AND INSTALL GRID CONNECT PV SYSTEMS WITH BATTERIES

This course comprises online material including theory, quizzes, written answers and a System Design Task; and a 3-day practical component including theory revision and the hands-on installation of a battery system, testing, commissioning and programming selected multi-mode inverters.

START DATE	LOCATION
30/01/2019	Sydney
13/02/2019	Brisbane
6/03/2019	Sydney
10/04/2019	Brisbane
10/04/2019	Brisbane

CRESTRON DIGITALMEDIA NETWORKING CERTIFICATION (DM-NVX-N)

This is an optional follow up course to DM-NVX. It provides deeper understanding of networking for NVX and upon completion, you will earn Crestron DM-NVX-N Networking Certification. This 1-day course will cover topics such as networking components, designing a network, network topology, unicast and multicast, network applications and troubleshooting the network.

START DATE	LOCATION
31/01/2019	Chatswood
14/02/2019	Chatswood
28/03/2019	Chatswood

CTI-P301 ADVANCED PROGRAMMING SKILLS

This three day course will teach advanced level programming concepts, including SIMPL+.

START DATE	LOCATION
12/03/2019	Chatswood

CRESTRON FUSION PROGRAMMER (CTI-FUSION-P)

This course dives into Crestron Fusion, its functions and capabilities along with the different types of deployments available. The focus of the course is to create a firm understanding of the Fusion SSI modules, where to find them, what they are for, and a step by step procedure of how to implement them in programming.

START DATE	LOCATION
4/04/2019	Chatswood

CTI-P201 CORE SYSTEM PROGRAMMING

This three-day course will teach more advanced SIMPL Windows programming skills needed for more complex systems. It is intended for individuals that are looking to continue their Crestron programming and are looking to be able to program more complex systems.

START DATE	LOCATION
6/03/2019	Chatswood

CTI-P101 FOUNDATIONS OF CRESTRON PROGRAMMING

This is an Introductory level programming course for individuals entering the Crestron programming environment seeking the ability to implement, make changes, and maintain programming for basic single room systems.

START DATE	LOCATION
22/01/2019	Chatswood
22/01/2019	Chatswood
20/02/2019	Chatswood
19/03/2019	Chatswood

DM CERTIFIED ENGINEER – 4K (DMC-E-4K)

This is an Intermediate level course designed for those who will fully execute and support a DigitalMedia project, including system setup, diagnostics, testing and reporting. Only Crestron dealers with a DMC-E-4K person on staff can bid on projects.

START DATE	LOCATION
5/02/2019	Chatswood
9/04/2019	Chatswood

NVX DESIGN AND APPLICATION (DM-NVX)

DM NVX is the latest addition to the DigitalMedia™ family. Together with XiO Director, NVX creates a secure, reliable and versatile solution that can be monitored, managed and controlled on the same network.

START DATE	LOCATION
29/01/2019	Chatswood
12/02/2019	Chatswood
26/03/2019	Chatswood

SMART GRAPHICS TRAINING (CTI-SG)

This course will increase your ability to design a flexible user interface that is intuitive to use. It will challenge you to use smart objects in new and creative ways. And it will hone your SIMPL Windows programming skills, a skillset necessary to make these new smart objects work.

START DATE	LOCATION
4/03/2019	Chatswood

For more training dates visit

www.trainingdiary.com.au





“It’s good to give something back to the industry that was so good to me.”

Neil has over 50 years electrical experience since starting his apprenticeship at 15. Neil enjoys seeing students pass their classes and get where they want to go, especially when they have overcome a subject they found difficult.

Get up to speed on the new wiring rules with expert instructors like Neil

NECA Education & Careers run LEA tutorials so you can brush up on what you need to know to sit the LEA exams. Plus you can book your assessment at the same time! Visit our website for dates and fees.



national electrical and communications association

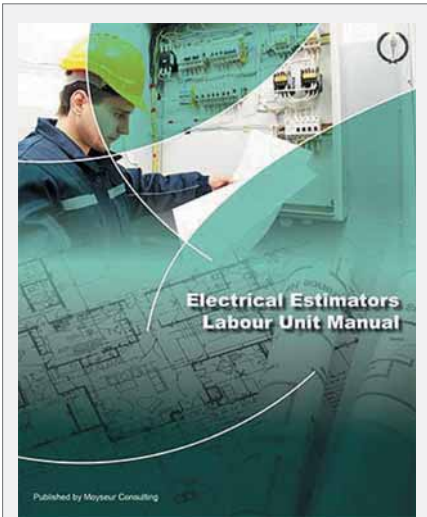
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ELECTRICAL ESTIMATOR'S LABOUR UNIT MANUAL 14TH EDITION

This labour unit manual has been produced to assist contractors to allow a realistic labour allocation to their jobs. These units have been developed over a number of years using actual time studies. This publication also includes a CD estimating spreadsheet and templates for calculating hourly charge out rates and minor installation quotations.

Written by Brian Seymour, Electrical Connection contributor.

\$120.00 CODE 583

ELECTRICAL WIRING PRACTICE VOLUME 1 & 2

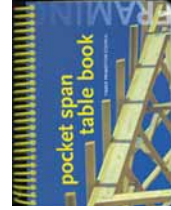
Volume 1 and 2 of Electrical Wiring Practice has been updated to provide guidance in the use of the Australian and New Zealand Wiring Rules, AS/NZS 3000:2007, including the 2009 Amendments. Taking a practical approach, this book employs clear visual tools to illustrate the knowledge and practices required by specified products and the Standards.



\$186.95 CODE 086

POCKET SPAN TABLE BOOK

Updated and expanded, the 2007 edition of this popular publication is a must-have for students. The 330-page Pocket Span Table Book continues to be presented in an easy to carry pocket sized durable and spiral bound format. Included are new span tables for MGP10 and Treated F7 seasoned softwood, and LVL and I-beam floor joists, as well as new bracing installation details and nominal fixing requirements.



\$35.95 CODE 635

SOLAR HOT WATER

This booklet gives you an understanding of solar hot water heaters and the most common models and their features. It also covers retrofits, size and site locations, including mains pressure versus low pressure, collectors, tanks, boosting and freeze protection, warranties, rebates and Standards.

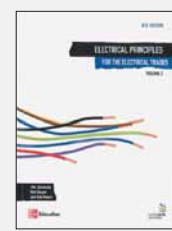
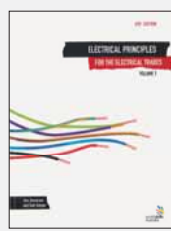


\$16.95 CODE 589

ELECTRICAL PRINCIPLES FOR THE ELECTRICAL TRADES: VOLUME 1 & 2

VOLUME 1: Ideal for electrical apprentices, the 6th edition of Electrical Principles for the Electrical Trades is the first volume of a two-volume set. Written by two TAFE/VET teachers, the book looks at the fundamental knowledge required to become a successful electrician. A portion of the proceeds from this book will go to WorldSkills Australia.

VOLUME 2: Volume 2 of Electrical Principles for the Electrical Trades explores the electrical applications of the principles learned in Volume 1. This is an excellent learning resource for electrical apprentices and teachers, as well as being a suitable long-term reference for tradespeople. A portion of the proceeds from this book will go to WorldSkills Australia.



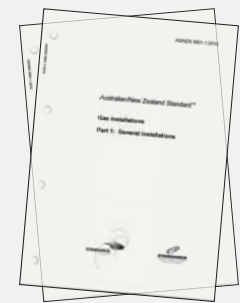
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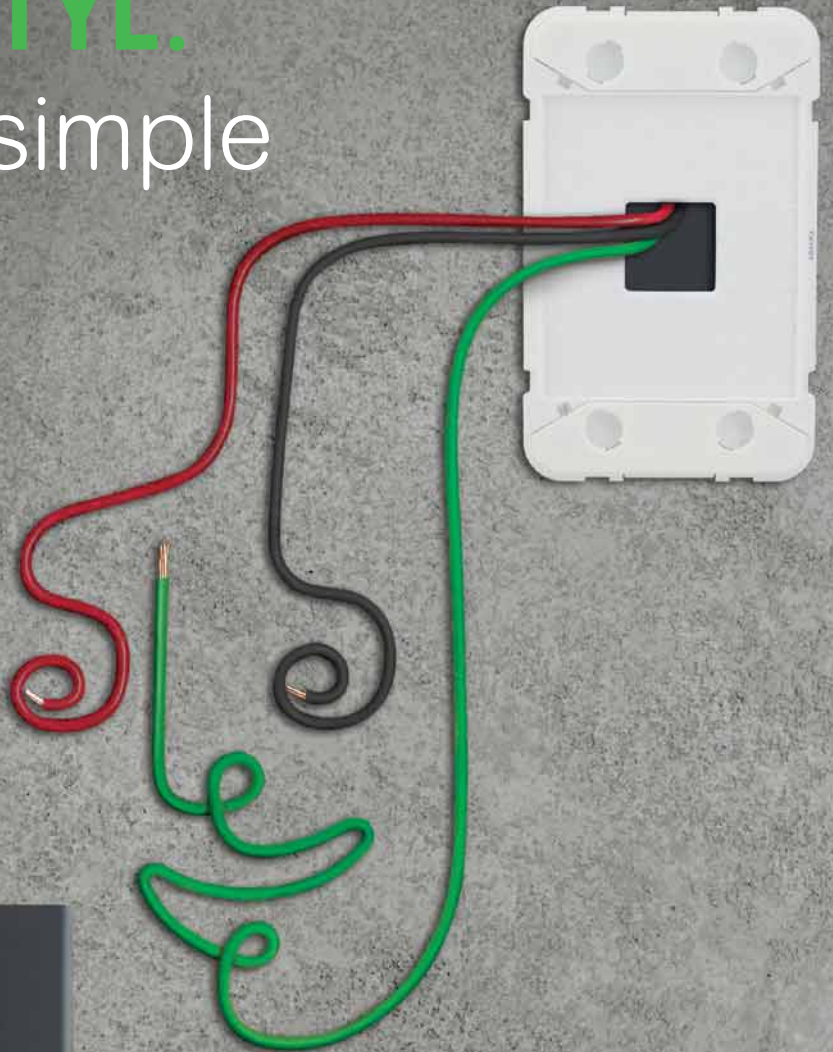
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