

Smart Energy

AN OFFICIAL SMART ENERGY COUNCIL PUBLICATION

POSITIVE SOLUTIONS TO CLIMATE CHANGE

VOLUME 39, ISSUE 154, WINTER 2019

Counting the cost of climate change
High hopes for hydrogen
Renewables vs coal
Optimising solar resources
Smart Energy Show key messages





BOS saving



Warranty



Half-cell

Hi-MO 4

BIFACIAL, STARTING FROM 420W

Hi-MO 4

- ✦ BOS saving
- ✦ 30-years power warranty
- ✦ Half-cut cell technology
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Front cover: Climate emergency solutions, image Leanne Tattersall



SMART ENERGY is published by the **SMART ENERGY COUNCIL**
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Smart Energy ISSN 2206-1673

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Smart Energy was first published in 1980 as *Solar Progress*. The magazine aims to provide readers with an in-depth review of technologies, policies and progress towards a society which sources energy from the sun rather than fossil fuels.

Except where specifically stated, the opinions and material published in this magazine are not necessarily those of the Smart Energy Council. Although every effort is made to check the authenticity and accuracy of articles, neither the Smart Energy Council nor the editors are responsible for any inaccuracy.

Smart Energy is published quarterly.
www.smartenergy.org.au



John Grimes, Chief Executive, Smart Energy Council

FOLLOWING THE ELECTION it is clear that there remains one true leader on climate and renewables in Australia – business.

That is because business is driven by economics.

And economics is driving the massive transition underway towards a zero carbon future.

The greatest success story so far has been the steep incremental price reductions in solar PV.

Price reductions that are not stopping, as scale increases and research pushes efficiency boundaries further back.

By the mid 2030s solar PV is set to become so cheap it will essentially be free, so cheap it may not even be worth metering.

At that point the competitors are dead economically.

So sure, we can stand still. Put the collective ‘casino chips of the nation’ all on ‘black’. But we already know black becomes the losing hand.

When the music stops, when the market moves, Australia will be left without a seat.

By then other countries will have grasped the mantle of exporting energy. Clean renewable energy. Really, really cheap energy.

Our collective challenge now is to back the businesses driving the transition.

To use our spending power to ‘vote’ for businesses that are climate leaders.

Pull your superannuation funds out of ‘black’ industries. Put your own chips on green.

And all pull together to amplify the good news of the jobs, investment and greater economic productivity these leading businesses are delivering for the national economy.

In my view ...

AN UNEXPECTED FEDERAL ELECTION VICTORY for the conservative Liberal/National Coalition led by Scott Morrison signals a new environment where state, territory, corporate and community action can be expected to bolster momentum for renewable energy development in Australia. With an inadequate program of policy and programs at a federal level the significant level of support for climate action and renewable energy development seen across the Australian electorate will stimulate new policy approaches and projects. Activity will also continue to be maintained by key market fundamentals around the cost competitiveness of new build wind, solar, and increasingly battery storage.

Much of the heavy lifting to continue to support higher levels of renewable energy development, and grid augmentation can now be expected to occur at the subnational government level, with states such as Victoria (40 per cent by 2025), Queensland (50 per cent by 2030) and potentially others, coming under increased pressure to set higher state based Renewable Energy Targets, announce further rounds of reverse auctions and implement additional measures to support grid expansion, electric vehicles and battery storage. A renewed focus on renewable energy growth in NSW may not see an explicit state based target but the pace of its Transmission Infrastructure Strategy can be expected to accelerate.



Simon Corbell is Chief Adviser at Energy Estate

Ongoing development of corporate Power Purchase Agreement’s (PPA) will also be a key market driver. The maturing of initiatives such as the Business Renewables Centre as a clearing house for aggregating off takers and connecting buyers with generators and other service providers will continue. As corporate Australia continues to see the moral and financial imperative of responding to climate change, and the ongoing impact of volatile energy prices, we will continue to see a significant strengthening of the corporate PPA market.

Given the strong election result for the Coalition in Queensland and the Hunter Valley in NSW, a clear focus must now be put on the jobs and economic security outcomes which can be achieved from broad scale renewable energy development and the creation of new zero carbon fuel exports such as hydrogen. Significant

potential exists for the renewable energy industry to make economic development outcomes and community benefit sharing the standard approach for all renewable energy projects.

Renewable energy developers and investors who can identify innovative and leading ways to help achieve a more ‘just transition’ in rural and regional Australia, with projects which tap strong resources and achieve excellent technical performance will be best placed to secure offtake and respond to the challenges in this new political and policy environment.



CLEAN POWER FOR ALL



SG8K-D

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At Sungrow we're working relentlessly to make solar energy accessible to all by delivering uncompromising quality at an affordable price, and as the global leading inverter supplier for renewables, this affords us the ability to deliver our customers maximum value. With a workforce of more than 3000, we're proud to employ the world's largest PV inverter R&D team. Having 79 GW+ deployed in more than 60 countries, our products speak for themselves through their performance and reliability. our 22+ year track record of growth and success and more than 15% global market share means we must be doing something right.

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- 5kW hybrid inverter
- 4.8-14.4kWh, residential 48V batteries
- With Samsung SDI Li-ion cells



Commercial

- 15-110kW solar inverters
- Covering almost all application fields
- 50-250kW storage inverters
- With battery banks turnkey solution



Utility

- 250kW world biggest HV string inverter
- 3.4/6.8MW solar inverter with MV solution
- 2.5/5MW storage inverter with MV solution





PERILOUS PLANET EARTH'S CO₂ LEVELS recently reached their highest of the past 800,000 years. Climate change impact is fast and furious: around one million animal and plant species are now threatened with extinction, many within decades. "We are eroding the very foundations of our economies, livelihoods, food security, health and quality of life worldwide," warns the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.



CLIMATE CHANGE 100% increase since 1980 in greenhouse gas emissions, raising average global temperature by at least 0.7 degree 1 degree Celsius: average global temperature difference in 2017 compared to pre-industrial levels, and rising +/-0.2 (+/-0.1) degrees Celsius per decade

Even for global warming of 1.5 to 2 degrees, the majority of terrestrial species ranges are projected to shrink profoundly.

Each year over the past two decades global sea levels have risen more than 3 mm, totaling a rise of 16-21 cm since 1900.

DESPERATE TIMES, DESPERATE MEASURES to repair the Earth's climate: Cambridge scientists are investigating radical approaches such as removing CO₂ from the atmosphere and refreezing the Earth's poles by 'brightening' the clouds above by pumping seawater up to tall masts on uncrewed ships through very fine nozzles.

The geoengineering initiative is co-ordinated by Prof Sir David King who said "What we do over the next 10 years will determine the future of humanity for the next 10,000 years." According to his colleague Prof Wadhams "If we reduce our emissions all we are doing is making the global climate warmer a bit more slowly. That is no good because it's already too warm and we have already got too much CO₂ in the atmosphere."

More on geoengineering on pages 18 -19



Bravo Britain which recently clocked up **122 HOURS STRAIGHT WITHOUT USING COAL-FIRED POWER** to generate electricity. The milestone marks the longest ever renewable powered stretch since 1882 on the opening of the world's first coal-fired power station in London.

Experts believe that Great Britain's electricity system can operate with zero carbon as early as 2025. Meanwhile Bank of England Governor Mark Carney who says further progress in the transition to a low-carbon economy will be driven by the "coherence and credibility of government policies on climate change" notes markets are beginning to understand the costs of climate risk, with insured losses rising five-fold over three decades.

Australia's Climate Council recently declared that unless greenhouse gas emissions are rapidly reduced, by 2030 about one in every 19 properties would have unaffordable insurance premiums.

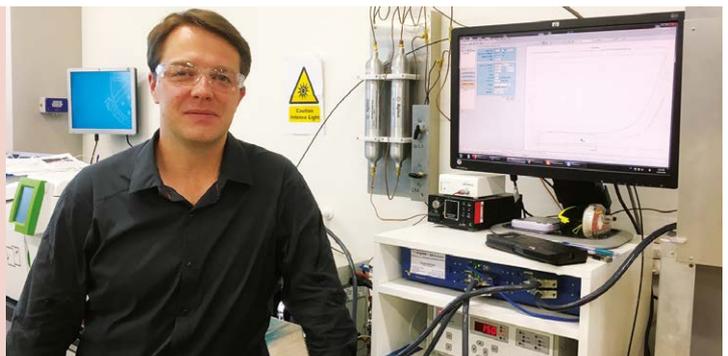
RIP BOB HAWKE, a man who in 2008 condemned the Coalition's lack of concern for the heating planet and intransigence toward climate action saying "The conservatives: they never change, they never learn. [They say] you can't do this, it will cost jobs. It will cost economic growth. You can't do it, you mustn't do it."



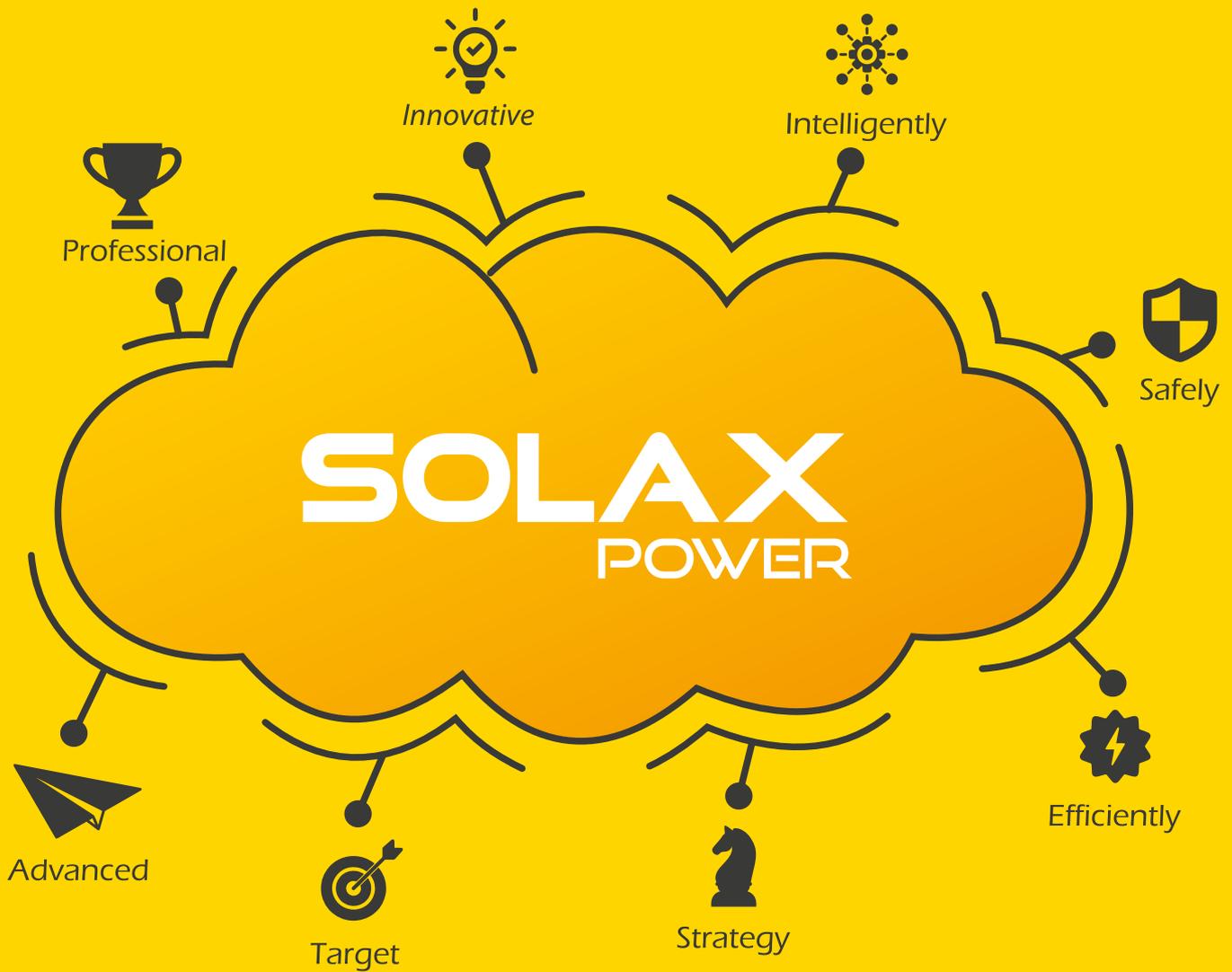
Monash School of Chemistry has reported a **BREAKTHROUGH IN ELECTROLYTIC WATER SPLITTING** that will bring inexpensive generation of green hydrogen from renewables much closer to reality and further establish Australia's role as a global powerhouse in the generation and export of renewables.

Dr Alexandr Simonov (pictured) said "The outstanding stability in the operation and the low cost of the developed catalytic system identifies it as a potentially suitable option for use in the industrial production of green hydrogen fuel by water electrolysis."

More on hydrogen on pages 22-28.



We Take Care of
Your Energy





LOCAL and GLOBAL NEWS

CATCHING THE BUS Conventional car sales are now in decline and more electric vehicles (EVs) will be sold than internal combustion engines by 2037 according to Bloomberg New Energy Finance. However the final one billion internal combustion engines will still be seen on roads up till 2050, until they wear out.

The transition to electric buses is moving faster, with the BNEF electric vehicle outlook estimating that almost 70 per cent of the world's buses will be electric by 2040, compared to just under 40 per cent for all other types of vehicles.

With just 25 electric buses, Australia is lagging well behind China's 400,000.

The price crossover date for EVs and combustion-engine equivalents is now forecast for 2024 based on dramatic price reductions in EV batteries. According to BNEF in 2015 the battery made up more than 57 per cent of the total cost, by 2019 it was 33 per cent and in 2025 will fall to just 20 per cent of total vehicle cost.

WESTERN AUSTRALIA'S BATTERY MATERIALS

SALES have soared more than 30 per cent in one year on the back of strong global battery demand. WA has seven producing lithium mines and accounts for more than half the global supply. Spodumene – the ore turned into lithium – recorded sales of \$1.6 billion, 34 per cent higher than the year before. WA is also home to the world's biggest mine Greenbushes and will soon start producing lithium hydroxide from a Tianqi Lithium processing plant in Perth.

Pilbara Minerals' Pilgangoora lithium mine



Sweden's Northvolt plans to raise \$US1.68 billion to build **EUROPE'S BIGGEST BATTERY CELL PLANT** and is discussing fundraising with IKEA.

Should plans materialise, the factory project would rival the Tesla Gigafactory in Nevada. There's another connection too: Northvolt was founded by former Tesla executive Peter Carlsson.

FAIR DINKUM POWER software company Atlassian is the third Australian company to make the pledge as part of the RE100 global initiative to commit to 100 per cent renewable electricity. Billionaire co-founder Mike Cannon-Brookes, who famously labeled renewable energy 'fair dinkum' said "I think Australian corporations could be doing more to set great examples ... so we hope to start a bit of a trend there." Atlassian plans to become 100 per cent renewable by 2025.



A new \$130 million **100 MW SOLAR FARM IN WEST WYALONG** will generate up to 150 jobs during construction, and create clean, renewable energy to power about 37,500 homes. The project has the potential to save up to 212,000 tonnes of greenhouse gas emissions and will help NSW meet its target of net-zero emissions by 2050.

"We have a booming solar industry in NSW, which will become a vital part of our energy mix as we transition to a cleaner, more sustainable energy future." NSW Energy and the Environment Minister Matt Kean said.

Since 2017, the NSW Government has approved 26 solar projects across the State, providing about 4,500 construction jobs and supporting about \$5 billion investment in regional and rural NSW.

NSW HOMEOWNERS WITH ROOFTOP PV are set to receive the higher feed-in tariff of 8.5-10.4c/kWh, up from 6.9-8.4c/kWh. The lift reflects rises in the wholesale electricity price.



Image: Nearmap

Brisbane Airport's new **5.725 MW SOLAR INSTALLATION**, Australia's largest commercial and industrial solar system, is now fully operational. The 20,937 solar panels used in the project are spread across six sites, the equivalent area of two Melbourne Cricket Grounds.

Trina Solar and Epho Commercial Solar Power were behind the project.

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Change Your Energy Charge Your Life

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RESU

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- Diverse Product Options



Grid-scale



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2016 RESU Series with New Li-ion Battery
2017 Stand-alone Battery Module (SBM)

Polls apart

“There is still good reason to feel positive, due to the rising support for renewables among the community, business, local councils and state governments.

Big businesses are standing up, going to 100 per cent renewables. And financiers are backing renewable energy projects rather than plants that pollute.

We know that renewable energy delivers the cheapest electricity into the market and that renewable storage technologies like pumped hydro energy storage can provide market firming and be delivered at a significant discount to the market spot price for coal.

What this tells us is that economics wins.

Business, financing and the grass roots community is driving the change.”

John Grimes

The economic rationality for renewables remains the same. They are cheaper.

AN ORDERLY TRANSITION to renewable energy may sometimes seem unlikely, but there is good reason to feel positive based on rising support for renewables among the community, business, local councils and state governments.

As usual business is way ahead of government and getting on with the job of transitioning the economy to a clean energy future, Smart Energy Council Chief Executive John Grimes says.

In recent months big players including the Commonwealth Bank, Westpac, Bank of Australia and Atlassian have joined the global RE100 commitment to 100 per cent renewable energy by 2030.

“Big businesses are standing up, going to 100 per cent renewables. And financiers are backing renewable energy projects rather than plants that pollute.”

He also pointed out the economic rationality of the move to renewables given the rapidly declining cost of solar, storage and electric vehicles.

“We know that renewable energy delivers the cheapest electricity into the market and that renewable storage technologies like pumped hydro energy storage can provide market firming and be delivered at a significant discount to the market spot price for coal.

“What this tells us is that economics wins. It is business, financing and the grass roots community that is driving the change,” John Grimes said.

Oliver Yates who ran a strong campaign as an Independent candidate on a climate change and integrity ticket in the federal seat of Kooyong concurs with John Grimes, telling *Smart Energy* “The economic rationality for renewables remains the same. They are cheaper.

“The need to accelerate the renewable energy industry has not gone away – every day it gets more urgent and there are more opportunities.

“People can clearly see the evidence of the impact of climate change on the environment which is becoming more extreme. The declining state of the Barrier Reef and the Menindee Lakes drought are among the casualties.

“These will continue to worsen, it won’t get any better. The trajectory is for more extreme climatic and environmental events.

“If people want to ignore the situation they can, but it won’t go away ... people at the grass roots are recognising that climate change is significant,” he says.

Manly beach (pictured left) – voters in the Warringah electorate have thrown their support behind action on climate change

Moving forward

Following the election ANU Professor Frank Jotzo issued a reminder about the business community’s aversion to an economy that’s stuck in the past, and in concert with the Smart Energy Council Jotzo highlighted the pressure from progressive states that are critical of the climate and energy policy void.

The world will not “carve out a niche for Australia to continue prospering as a 20th-century style high carbon economy”, he says. Global demand for coal will fall. The future for our energy industries is in cheap renewable energy.

“With effective policy, things could be very different. We could build up an industry that produces green hydrogen, ammonia, aluminium and steel for export to countries less fortunate than Australia in their endowment with renewable energy opportunities.

“Those industries could grow larger than the coal and gas industry now is. They could last indefinitely and help the world decarbonise.

“The opportunities in the global shift to clean energy are compelling, and coal is not the future.”

The Australia Institute’s Ben Oquist says the Senate is where government policies can live or die, and it was the Senate that prevented Tony Abbott from gutting the RET and abolishing the CEFC and ARENA, protecting \$23.4 billion worth of renewable energy investment.

Independent MP Zali Steggall who ran a strong campaign for action on climate and won the hearts, minds and votes of a more progressive electorate has vowed to emphasise that the cost of climate inaction is greater than the cost of action.

As a friend and ally of the Smart Energy Council, she has pledged to be a strong voice in Parliament on climate and renewable energy.

Prudent paths

Meanwhile the Australia Institute (www.tai.org.au) is ramping up its research capabilities to demonstrate that renewable energy is key to Australia’s economic growth and coal mining is not a jobs panacea.

With a change in the energy market rules the ceiling on renewable energy could be lifted and drive down power costs, TAI declared.

After the election the Australian Conservation Foundation issued a heartfelt statement reminding those in the community who care about climate action that progress is being made even if sometimes it doesn’t seem like it.

ACF messages mirror those of the Smart Energy Council.

“Investors are largely shunning new thermal coal projects.

Renewable energy costs are falling rapidly.

“At some point Australia must reconcile the action needed to halt the climate crisis and crash of nature with our deficient national plans and policies.”

Turning up the heat

The hopes, fears and tears ... and some rational thinking to address the climate emergency

“Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems.”

Intergovernmental Panel on Climate Change

THERE'S NO WAY of sugarcoating things. The earth's temperature is rising and so are sea levels, delivering more extreme weather events and catastrophic consequences.

By 2017 the average global temperature had risen 1°C compared to pre-industrial levels, having risen about 0.2°C per decade.

The 10 warmest years in 139-year record have all occurred since 2005 with the five warmest being the five most recent years. And there's no cooling or stabilisation in sight. Planet earth is on a warming trajectory of between 1.5°C and 2°C, bringing more severe and frequent extreme heat, increasing heat-related deaths and more forest fires according to the latest Intergovernmental Panel on Climate Change report.

Sea levels continue to rise. With the melting of the ice cap and expansion of seawater as it warms, sea levels over the past two decades have risen more than 3 mm each year, amounting to a 16-21 cm rise in global average sea level since 1900. They are projected to rise by 30 to 122 cm by 2100.

Under that scenario 10 million more people by 2100 would be affected and hundreds of millions of people would suffer from climate-related poverty.

The Arctic Ocean is expected to be ice free in summer before mid-century, triggering more powerful and destructive tropical storms.

More than a third of the ice in the Himalayas and surrounds will thaw by 2100, disrupting river flows vital for growing crops from China to India where farmers rely on glacier melt water in the dry season. About 250 million people live in the mountains and 1.65 billion people in river valleys below.

A 2°C temperature rise would flood 40 per cent of the Mekong Delta and destroy 30 million livelihoods.

Flora and fauna hapless victims

According to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, even for global warming of 1.5 to 2°C, the majority of terrestrial species ranges are projected to shrink profoundly.

Since 1970, humans have wiped out 60 per cent of mammals, birds, fish and reptiles and

species are dying at unprecedented rates. Now up to one million species are threatened with extinction, many within decades.

Almost 33 per cent of reef-forming corals, sharks and shark relatives, and more than a third of marine mammals are threatened with extinction. One third of all marine fish stocks were in 2015 being harvested at unsustainable levels; 60 per cent are maximally sustainably fished.

The list continues: more than 40 per cent of amphibian species are threatened with extinction, around 560 of domesticated breeds of mammals were extinct by 2016, with at least 1,000 more threatened. As many as 3.5 per cent of domesticated breeds of birds were extinct by 2016.

Five per cent of species are at risk of extinction from 2°C warming alone, rising to 16 per cent at 4.3°C warming.

There has been a 5 per cent decrease in net rate of forest loss since the 1990s, with today's global forest area two-thirds that of pre-industrial levels.

Existential threat

Naturalist David Attenborough foresees the unfolding collapse of our civilizations and the extinction of much of the natural world and cautions “What happens now and in these next few years will profoundly affect the next few thousand years”.

Indian Prime Minister Modi likewise describes climate change as the “greatest threat to the survival of human civilization as we know it” and failure to address it shows an “alarming glimpse of our own selfishness.”

US Democratic presidential candidate Bernie Sanders warns climate change is directly related to the growth of terrorism resulting from conflicts caused by displaced communities and refugees.

Rise of carbon emissions

Despite the clanging of alarm bells and the pledges by nations at the 2015 Paris Accord we are barreling toward runaway climate change by pumping ever more greenhouse gas emissions into the atmosphere. This on top of the 100 per cent increase in greenhouse gas emissions since 1980 that have already pushed up average global temperature by at least 0.7°C.

RENEWABLE ENERGY SOLUTIONS



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Last year, carbon emissions in the global energy sector rose by 1.7 per cent and hit a high of 33.1 Gt CO₂. Coal-fired power plants were the single largest contributor to the growth in emissions with an increase of 2.9 per cent, or 280 Mt, compared with 2017 levels. Coal-fired electricity generation accounted for 30 per cent of global CO₂ emissions.

CO₂ emitted from coal combustion is responsible for more than 0.3°C of the 1°C increase in global average annual surface temperatures above pre-industrial levels.

Incremental damage

In 2018 the global average annual

concentration of CO₂ in the atmosphere averaged 407.4 parts per million, up 2.4 ppm since 2017. As a guide, pre-industrial levels ranged between 180 and 280 ppm.

They now measure 412 ppm and should carbon emissions keep rising at the current rate, by the end of the century we will reach 1,000 ppm and trigger temperature rises of 3°C to 4°C in the next few centuries, according to the International Energy Agency.

And here's an inconvenient truth: Global subsidies for fossil fuels have amounted to US\$5 trillion in overall costs. Had fossil fuel prices been 'fully efficient' or subsidy-free in 2015, global CO₂ emissions would have been 28 per cent

lower and fossil fuel air pollution deaths 46 per cent lower today.

Australia's shifting landscape

Within Australia, the scale of the impact of the rise in temperatures is widespread and excessive, with bushfires starting earlier and raging for longer and defying nature by affecting rainforests. We have – and continue to – suffer widespread drought as well as flood with massive loss of livestock, and we have also seen the distressing images of a depleted Murray Darling river system and millions of dead fish.

The Climate Council report *The Angry Summer of 2018/19* noted the breaking of more than 206 records around Australia in just 90 days and the hottest summer on record for the Australian continent.

During 2018 insurers paid out more than \$1.2 billion due to extreme weather events and GDP will be slashed up to \$12.5 billion. On current trends the forecast is for an escalation of wild weather.

Australia would be particularly hard hit by an extra 0.5°C of warming, with significantly



increased risk of drought and virtually certain loss of the Barrier Reef due to bleaching.

The reality is the window to effectively tackle climate change is rapidly closing.

Rising emissions

Despite increasing impacts of climate change on the horizon Australia continues to pump more emissions into the environment by the day and comes in as the 15th-largest emitter of greenhouse gases in the world.

Analysis by ClimateWorks reveals Australia needs to double its emissions reduction progress to achieve the current 2030 target and triple its progress to reach a pathway to net zero emissions by 2050.

Given the abundance of natural resources it's eminently achievable. ANU Climate Change Institute Director Mark Howden speaks for many when he says "We could be among the world's climate change winners", with responses to climate change providing economic opportunities for Australia.

What will it take?

Political statements

The Welsh, Scottish and British governments have all declared a climate change emergency,

partly in response to environmental activist group Extinction Rebellion. Dozens of towns and cities across the UK have already declared a climate emergency and commitments to varying degrees of action that mitigates the scale of disaster.

It is part of a global movement, as of late May, 548 councils with 64 million constituents in 12 countries had "adopted the climate emergency language". Populations covered by governments that have declared a climate emergency now exceed 43 million citizens.

Here in Australia the ACT has formally declared a climate change emergency, and more than 17 local governments in Australia have declared a climate emergency, representing 1.5 million of the nation's population of 25 million.

Australian Greens MP Adam Bandt plans to move a state of climate emergency motion when parliament resumes, saying "It's time to act as if our house is on fire, because it is."

Adding voices to the chorus

With "a duty to care for human health and to alleviate suffering" Australian Medical doctors recently declare a climate emergency saying "We cannot be silent and watch governments continue to dismiss the threat posed by climate change and unhealthy environments to the health of their people."

Fire and emergency leaders have also joined forces to call for stronger action on climate change, warning that worsening extreme weather is threatening Australian lives.

Students across Australia are staging peaceful protests under the #FridaysForFuture, the global school strike movement started by 16-year-old Swedish climate activist Greta Thunberg. Now more are joining forces as part of the global Extinction Rebellion movement with a rise in civil

disobedience to put the spotlight on the heating planet. The youth of today are calling into account the decisions made by leaders of today on tomorrow's world – their world.

Leadership on climate change is emerging in some key influential sectors.

Business momentum

RE100 – the global corporate leadership initiative of influential businesses committed to 100 per cent renewable energy in a bid to accelerate change towards zero carbon grids – is spreading word on the compelling business case for renewables to companies, utilities, market operators, policymakers and other key influencers.

The initiative increases to attract a string of high profile companies including eBay Google and Apple. It's catching on in Australia with the Commonwealth Bank, Westpac, Bank of Australia and Atlassian committing to renewable energy by 2030 or before.

Will it make a difference? Slowly but surely, as more sign up and encourage their supply chains to follow suit says Jon Dee who is instrumental in the growth of the movement.

Financiers, banks, investors and superannuation providers and global corporations are also responding in greater numbers to address their risks and responsibilities, and not before time.

Finance based action

Monash sustainable development institute recently released *Climate Risk And The Financial System, Lessons For Australia from International Experience*.

Authored by Chris Barrett and Anna Skarbek, the report states financial policy and regulatory reform to address climate change has its

"Nature makes human development possible but our relentless demand for the earth's resources is accelerating extinction rates and devastating the world's ecosystems."

IPBES

Extinction Rebellion is using non-violent civil disobedience to avert a climate breakdown





“Climate change is the greatest challenge humanity has collectively faced ... an existential challenge to humanity.”

US Democrat Bernie Sanders

roots in the last financial crisis and a growing determination by international policymakers to avoid climate being the cause of any future crisis.

Policy makers have shifted financial regulation of climate risk through the “creation of a new agenda” for banks, investment funds, insurance companies and financial regulators.

The new approach stems from two critical events: a landmark speech by Bank of England Governor Mark Carney in September 2015, showing how the worst impacts of climate change will be felt beyond the typical planning horizons of the finance sector and create a “tragedy of the horizon”. Later that year saw the Paris Climate Accord.

Significant initiatives since that date include the Taskforce on Climate-Related Financial Disclosures launched by Mark Carney, and the Network for Greening the Financial System.

The latter brings together central banks and financial supervisors around the world to “contribute to the development of environment and climate risk management in the financial sector, and to mobilise mainstream finance to support the transition toward a sustainable economy” with measures to assist in scaling up green finance.

Today there are 35 members – including the Reserve Bank of Australia – whose combined commitments signal the prospect of a fundamental shift by financial authorities and forms part of the growing movement facilitating low carbon transition, potentially including penalties for high-carbon activities.

In mid march RBA Deputy Governor Dr Guy Debelle sounded the alarm bell about the impacts of climate change on the economy, declaring climate change is likely to cause more economic shocks to the economy and that Australia’s economic stability is under threat unless businesses and government act, and quickly.

Dr Debelle called for solutions in an orderly transition to renewable energy; investment in energy transmission and storage; and energy policy that is steady and orderly.

Returning to the *Climate Risk* report, which highlights the significance of China’s green finance policy push along that provides positive incentives for commercial banks to increase green credit and green deposits, and the demands of China’s Paris agreement commitment to peak emissions by 2030.

The moves are buoyed along by China’s regional emissions trading schemes, and this year marks the start of its national carbon trading market.

Hooyah.

What about Australia?

The land of stranded assets.

With a highly carbon-intensive economy that is contributing to a rise in national emissions, Australia at the same time “stands disproportionately to benefit from a successful low carbon transition” courtesy of solar and wind energy resources and minerals vital to battery production.

At the ready is “a large and sophisticated funds management industry ... to provide financial services products to realise these opportunities,” *Climate Risk* reports.

Example one: the launch of the Australian Sustainable Finance Initiative, an industry-driven grouping to devise policy recommendations and chart a course for the development of sustainable finance in Australia.

Two: Responsible interventions from the Australian Prudential Regulation Authority, the Australian Securities and Investments Commission and the Reserve Bank of Australia.

We would like to add to that list the work of the Clean Energy Finance Corporation that has invested \$6.4 billion in clean energy commitments since inception in 2012. By 2023 carbon abatement from the total investment

portfolio is estimated to come in at 22.6 million tonnes per annum.

In some quarters political response to the climate emergency may be lacking but, as the saying goes, business is getting on with it.

If the Green New Deal ever sees the light of day in the United States the tide will turn in that superpower. With the reelection of Prime Minister Narendra Modi India should remain on track to reduce its greenhouse gas emissions by up to 35 per cent by 2030 under the Paris Climate Agreement. Maybe he could have a quiet word with Gautam Adani.

Early signs

Research on the effect of CO₂ dates back to 1824 when Joseph Fourier inferred the existence of the atmospheric ‘greenhouse effect’. Svante Arrhenius in 1896 showed that coal burning could cause global warming. Research advanced rapidly after 1940; from 1957, Roger Revelle alerted the public to risks that fossil fuel burning was “a grandiose scientific experiment” on climate.

In 1988 NASA scientist James Hansen said fossil fuel emissions are responsible for most of the increase in atmospheric CO₂, and alerted the world to the dangers of climate change due to increased CO₂ with severe warming likely within the next 50 years, bringing storms and floods. In the three decades since, nearly half of the Arctic ice cap has melted and the oceans have acidified. More extreme weather has become the new norm.

Time for some geoengineering to cool the planet? See article on pages 18-19.

Despite the science of global warming decades ago the rate of pollution has continued and accelerated and the finger is pointed at the failure of politicians and energy companies. Fossil fuel conglomerates have turned a blind eye to science and the impact of human-caused climate change and effectively lobbied for the right to damage the environment and continue to do so, staging a campaign based on denial and misinformation. Their actions over several decades are comparable to those of the tobacco industry underpinned by self preservation at the expense of human health.



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Perth Racing Club
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Adelaide Pavilion
Cnr South Tce & Peacock Rd, Adelaide

GOLD COAST, QLD | Thu 18 July 2019
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SYDNEY, NSW | Thu 25 July 2019
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COMPOUND COSTS: How Climate Change is damaging Australia's Economy

Photo: Alison Taylor

LEADING AUSTRALIAN EXPERTS in the field of economics, science and risk assessment have identified climate change as a major threat to Australia's financial stability and poses systemic economic risks across the country and the region.

The recent report compiled by the Climate Council contains the largest analysis of property risk from climate change ever undertaken in Australia and finds that the value of Australian property is predicted to fall dramatically unless urgent steps are taken to address climate change. The key findings are as follows:

1 Climate change is a major threat to Australia's financial stability, and poses substantial systemic economic risks.

- Direct macroeconomic shocks from climate change, including reduced agricultural yields, damage to property and infrastructure and commodity price hikes, are likely to lead to painful market corrections and could trigger serious financial instability in Australia and the region.
- Australia's financial regulators acknowledge that climate change is now a central concern for the economy and financial stability.

2 Detailed new modelling, based on the Federal Government's current approach to climate change, finds that the economic damage to Australia's property and agricultural sectors will be very significant.

- Australia's greenhouse gas emissions have been rising for four years and we are not on track to meet our weak 2030 emissions reduction target. If the world followed Australia's approach we would be on track for at least 3-4°C of global warming, which would have catastrophic economic consequences.

“
Australia's financial regulators have acknowledged that climate change poses significant and systemic risks to our economy.
”

3 The property market is expected to lose \$571 billion in value by 2030 due to climate change and extreme weather, and will continue to lose value in the coming decades if emissions remain high.

- One in every 19 property owners face the prospect of insurance premiums that will be effectively unaffordable by 2030 (costing 1% or more of the property value per year).
- Some Australians will be acutely and catastrophically affected. Low-lying properties near rivers and coastlines are particularly at risk, with flood risks increasing progressively and coastal inundation risks emerging as a major threat around 2050.
- Certain events which are likely to become more common because of climate change are not covered by commercial insurance, including coastal inundation and erosion.
- More than \$226 billion in commercial, industrial, road, rail, and residential assets will be at risk from sea level rise alone by 2100, if greenhouse gas emissions continue at high levels.

“
If climate change continues unabated, extreme weather and climate events will increasingly cause economic shocks that will cascade through the economy.
”



4

Extreme events like droughts, heatwaves, cyclones and floods have an impact on agriculture and food production; this is already affecting Australia's economy and will cost us much more in the future.

- Climate change is increasing the severity and intensity of extreme weather events in Australia.
- On current trends, the accumulated loss of wealth due to reduced agricultural productivity and labour productivity as a result of climate change is projected to exceed \$19 billion by 2030, \$211 billion by 2050 and \$4 trillion by 2100.
- By 2050, climate change is projected to halve the irrigated agricultural output of the Murray-Darling Basin region, which currently accounts for 50% of Australia's irrigated agricultural output by value (about \$7.2 billion per year).
- By 2090, wheat yields on the 4,200 family farms in WA that produce half of Australia's wheat are projected to fall by 41-49% if greenhouse gas emissions remain high.
- Previous severe droughts have reduced Australia's Gross Domestic Product by around 1%; estimates suggest that increasing drought frequency and impacts in the future may reduce GDP by 1% every year.

5

The severe costs of climate change outlined in this report are not inevitable. To avoid the costs of climate change increasing exponentially, greenhouse gas emissions must decline to net zero emissions before 2050. Investments in resilience and adaptation will be essential to reduce or prevent losses in the coming decades.

- Increasing resilience to extreme weather and climate change should become a key component of urban planning, infrastructure design and building standards.
- Buildings and infrastructure must be built to withstand future climate hazards and to facilitate the transition to a net zero emissions economy.
- A credible national climate policy is needed to safeguard our economy by reducing the direct costs of climate change, and avoiding economic risks associated with a sudden, disruptive or disorderly transition to net zero emissions.

Compound Costs: How climate change is damaging Australia's economy, authors: Will Steffen, Karl Mallon, Tom Kompas, Annika Dean and Martin Rice. Visit www.climatecouncil.org.au for more details



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Why you need to get involved in the geoengineering debate – now

Rob Bellamy says the key to defining a responsible way to govern geoengineering experiments is accounting for public interests and concerns.

THE PROSPECT OF ENGINEERING the world's climate system to tackle global warming is becoming more and more likely. This may seem like a crazy idea but I, and over 250 other scientists, policy makers and stakeholders from around the globe descended on Berlin [in 2017] to debate the promises and perils of geoengineering.

There are many touted methods of engineering the climate. Early, outlandish ideas included installing a 'space sunshade': a massive mirror orbiting the Earth to reflect sunlight.

The ideas most in discussion now may not seem much more realistic – spraying particles into the stratosphere to reflect sunlight, or fertilising the oceans with iron to encourage algal growth and carbon dioxide sequestration through photosynthesis. But the prospect of geoengineering has become a lot more real since

the Paris Agreement. The 2015 Paris Agreement set out near universal, legally binding commitments to keep the increase in global temperature to well below 2°C above pre-industrial levels and even to aim for limiting the rise to 1.5°C.

The Intergovernmental Panel on Climate Change (IPCC) has concluded that meeting these targets is possible – but nearly all of their scenarios rely on the extensive deployment of some form of geoengineering by the end of the century.

How to engineer the climate

Geoengineering comes in two distinct flavours. The first is greenhouse gas removal: those ideas that would seek to remove and store carbon dioxide and other greenhouse gases from the atmosphere. The second is



Some geoengineers take their inspiration from supervolcanic eruptions, which can lower global temperatures.



Geoengineering comes in two distinct flavours. The first is greenhouse gas removal: those ideas that would seek to remove and store carbon dioxide and other greenhouse gases from the atmosphere. The second is solar radiation management.

solar radiation management: the ideas that would seek to reflect a level of sunlight away from the Earth.

Solar radiation management is the more controversial of the two, doing nothing to address the root cause of climate change – greenhouse gas emissions – and raising a whole load of concerns about undesirable side effects, such as changes to regional weather patterns.

And then there is the so-called ‘termination problem’. If we ever stopped engineering the climate in this way then global temperature would abruptly bounce back to where it would have been without it. And if we had not been reducing or removing emissions at the same time, this could be a very sharp and sudden rise indeed.

Most climate models that see the ambitions of the Paris Agreement achieved assume the use of greenhouse gas removal, particularly bio-energy coupled with carbon capture and storage technology. But, as the Berlin conference revealed, although research in the field is steadily gaining ground, there is also a dangerous gap between its current state of the art and the achievability of the Paris Agreement on climate change.

The Paris Agreement – and its implicit dependence on greenhouse gas removal – has undoubtedly been one of the most significant developments to impact on the field of geoengineering since the last conference of its kind back in 2014.

This shifted the emphasis of the conference away from the more controversial and attention-grabbing solar radiation management and towards the more mundane but policy relevant greenhouse gas removal.

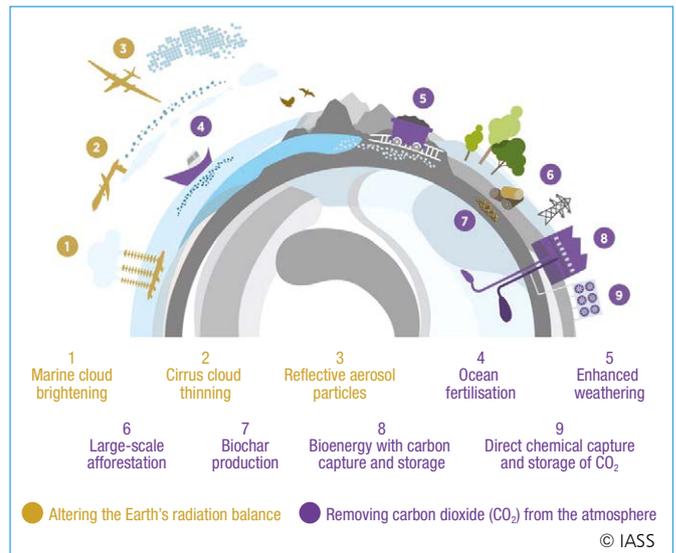
Controversial experiments

But there were moments when sunlight reflecting methods still stole the show. A centrepiece of the conference was the solar radiation management experiments campfire, where David Keith and his colleagues from the Harvard University Solar Geoengineering Research Programme laid out their experimental plans. They aim to lift an instrument package to a height of 20km using a high-altitude balloon and release a small amount of reflective particles into the atmosphere.

This would not be the first geoengineering experiment. Scientists, engineers and entrepreneurs have already begun experimenting with various ideas, several of which have attracted a great degree of public interest and controversy. A particularly notable case was one UK project, in which plans to release a small amount of water into the atmosphere at a height of 1km using a pipe tethered to a balloon were cancelled in 2013 owing to concerns over intellectual property.

Such experiments will be essential if geoengineering ideas are to ever become technically viable contributors to achieving the goals of the Paris Agreement. But it is the governance of experiments, not their technical credentials, that has always been and still remains the most contentious area of the geoengineering debate.

Critics warned that the Harvard experiment could be the first step on a ‘slippery slope’ towards an undesirable deployment and therefore must be restrained. But advocates argued that the technology needs to be developed before we can know what it is that we are trying to govern. The



Geoengineering measures under discussion

challenge for governance is not to back either one of these extremes, but rather to navigate a responsible path between them.

How to govern?

The key to defining a responsible way to govern geoengineering experiments is accounting for public interests and concerns. Would-be geoengineering experimenters, including those at Harvard, routinely try to account for these concerns by appealing to their experiments being of a small scale and a limited extent. But, as I argued in the conference, in public discussions on the scale and extent of geoengineering experiments their meaning has been subjective and always qualified by other concerns.

My colleagues and I have found that the public have at least four principal concerns about geoengineering experiments: their level of containment; uncertainty around what the outcomes would be; the reversibility of any impacts; and the intent behind them.

A small-scale experiment unfolding indoors might therefore be deemed unacceptable if it raised concerns about private interests, for example. On the other hand, a large-scale experiment conducted outdoors could be deemed acceptable if it did not release materials into the open environment.

Under certain conditions the four dimensions could be aligned. The challenge for governance is to account for these – and likely other – dimensions of perceived controllability. This means that public involvement in the design of governance itself needs to be front and centre in the development of geoengineering experiments.

A whole range of two-way dialogue methods are available – focus groups, citizens juries, deliberative workshops and many others. And to those outside of formal involvement in such processes – read about geoengineering, talk about geoengineering. We need to start a society-wide conversation on how to govern such controversial technologies.

Public interests and concerns need to be drawn out well in advance of an experiment and the results used to meaningfully shape how we govern it. This will not only make the experiment more legitimate, but also make it substantively better.

Make no mistake, experiments will be needed if we are to learn the worth of geoengineering ideas. But they must be done with public values at their core.

Author Rob Bellamy was James Martin Research Fellow in the Institute for Science, Innovation and Society, University of Oxford when he wrote this piece. He is now Presidential Fellow in Environment, University of Manchester. This article first appeared in The Conversation in late 2017.

Reflections on energy economics and climate change

"While climate sceptics like to call the renewable energy target (RET) a subsidy, it is not. It's a pollution control measure."

Richard Denniss,
Prominent Australian economist



"I have no doubt that the era of fossil fuels is drawing to a close. But questions remain as to the speed of the coming transition and, in direct consequence of that speed, the nature of what will be left in its wake. Human decision-making and action are now in control of our planet's thermostat ... if rapid emissions reductions

are delayed until 2030, then the global temperature will remain more than 1°C higher than preindustrial levels for about 400 years."

Former NASA scientist and 'father' of climate science Dr James Hansen



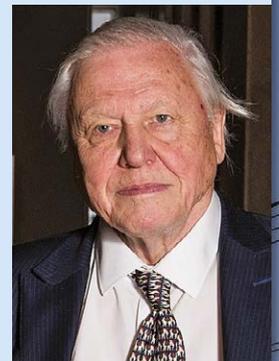
"The price of climate change action is nothing compared to the price of inaction."

Zali Steggall,
Independent MP for Warringah



"If we have not taken dramatic action within the next decade we could face irreversible damage to the natural world and the collapse of our societies. What happens now and in these next few years will profoundly affect the next few thousand years".

Naturalist Sir David Attenborough



"The proposed mine in the Galilee Basin has the potential to be a carbon bomb. It poses serious risks to the environment, public health and North

Queensland tourism. If all the coal in the Galilee Basin was burned, it is estimated that 705 million tonnes of carbon dioxide would be released each year ... more than 1.3 times Australia's current annual emissions."

Professor Tim Flannery,
Climate Council



"As a 16-year-old, I am very aware that the effects of climate change will be most harshly felt by my generation and future generations to come ... I am getting fed up with you and your [Coalition] party's inability to take meaningful action."

Youthful ABC Q&A participant during the solo appearance by Treasurer Josh Frydenberg



"The ridiculous climate wars in Australia have led to a very damaging climate and energy policy vacuum for more than a decade ... this inaction is putting us at war with a climate that has no more room for atmospheric pollution."

Christiana Figueres helped instigate the 2015 Paris climate change agreement and is now a World Bank climate leader



"The Coalition government assumes there's a 'do nothing' option [on climate change]."

Mark Butler, shadow Climate Change Minister on the Coalition's attitude to climate change



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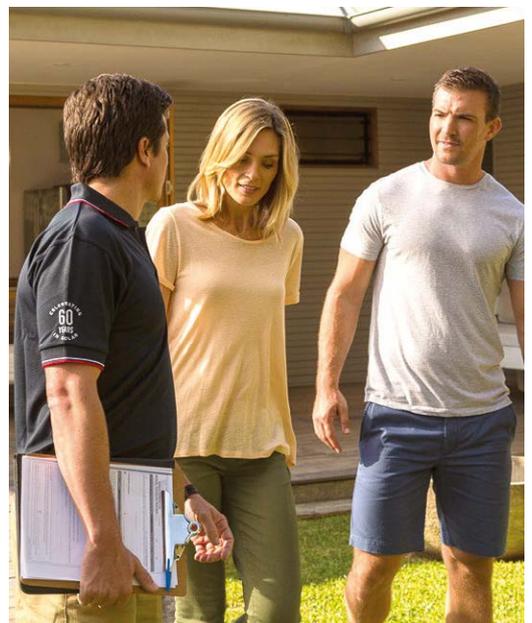


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The rise of Hydrogen

It is light and colourless but can hydrogen – which forms a liquid at very low temperatures – derived from renewable energy develop into a commercially viable ‘green’ energy market for domestic and export markets?

IN RECENT MONTHS Chief Scientist Alan Finkel has been presenting the compelling case for a hydrogen industry based on renewable resources in a carbon constrained economy.

Today natural gas accounts for virtually all – 96 per cent – of global hydrogen production. However cost reductions in renewable energy edge it to an increasingly feasible power source for splitting water molecules into hydrogen and oxygen.

Taking the concept one step closer to fruition is a high level team of researchers within the Scientist’s department who are developing a National Hydrogen Roadmap.

The document plots the path to clean hydrogen for use as an alternative to fossil fuels to power transport including cars, trucks, trains and ships; also for heating in commercial buildings and houses.

Hydrogen driven future

And looking to a future in which electric vehicles are powered by hydrogen fuel cells rather than batteries, Alan Finkel says state and territory governments could start scoping the

potential for hydrogen refueling station infrastructure. The focus, he says, needs to be on heavy vehicles to help meet increasing demand for zero-emissions transport.

“The technical challenges for a hydrogen powered future are not insurmountable,” says John Grimes of the Smart Energy Council. “Hydrogen holds the potential to unlock enormous opportunities not just in transport but also right across the industrial manufacturing sector.”

Costs involved in hydrogen gas processes and storage are currently high, however the pendulum will shift once mass production and economies of scale kick in, he says, emphasising the benefits of hydrogen as well as being the most abundant element in the universe, the only by-product when used as a fuel is water vapour.

“By using renewables in the electrolysis process you can have a completely clean cycle,” he says.

“Australia has some of the best renewable energy resources in the world which is why the CWP Renewables project in Western Australia’s Pilbara region that plans to ship hydrogen overseas is so important.”



Australia has the potential to build a hydrogen export industry worth \$1.7b billion and provide employment for 2,800 people by 2030, predominantly in regional areas at sites of hydrogen production, storage and loading for export.

**Chief Scientist
Alan Finkel**



The Saratoga, California, True Zero hydrogen fueling station, filling a Toyota Mirai while the station is being refilled by an Air Products SmartFuel Hydrogen delivery truck. Image by Dicklyon



CWP Renewables' Asian Renewable Energy Hub to be developed in the Pilbara region of WA will generate 33 TWh of energy annually. Image by Ben Carless on Unsplash

Indeed. No project is more ambitious – or daunting – than CWP Renewables' Asian Renewable Energy Hub that will generate 33 TWh of energy annually.

CWP's grand plans

The 9 GW wind and solar project comes in two independent project phases which includes 3 GW of generation for the production of hydrogen for domestic and export markets and to power mines and downstream mineral processing as well as towns in the region.

The export phase will dedicate 6 GW of generation for export to Jakarta and Singapore via 2000 kilometres of subsea high voltage DC cables.

"Instead of exporting coal for financial gain, ships could depart Pilbara filled with hydrogen. We have the potential. Japan doesn't, it doesn't have the land or the solar resource. We can do it more cost effectively than they can.

"We have many overseas trading partners, there is a sound economic future for hydrogen and saving the planet at the same time."

A window of opportunity for export

Alan Finkel has also identified Australia's competitive advantages of renewable energy and infrastructure and ability to generate clean hydrogen along with thousands of jobs.

He says if Australia moved assertively into the hydrogen market it could target Japan, South Korea and China as the main export markets, but warned "the window of opportunity to capture emerging markets in Asia is a small one".

Modeling by ACIL Allen Consulting suggests green hydrogen exports to the highly populated Asia-Pacific region could generate \$3.6 billion annually to the economy and 6000 new jobs by 2030.

"Public consultation on the national strategy for the development of a new clean hydrogen industry opened in early March and a draft strategy will be publicly released in September 2019. More information can be found at: <http://wcoagenergycouncil.gov.au/publications/establishment-hydrogen-working-group-coag-energy-council> and <https://consult.industry.gov.au/national-hydrogen-strategy-taskforce/national-hydrogen-strategy-request-for-input>



Image courtesy of ARENA

OUR NEXT GREAT EXPORT?

As a nation, we've long shipped coal to the world. But could renewable energy be our next great export industry? ARENA has set exporting renewable energy as one of its four priorities. Here's how it might work.

1
Water is purified

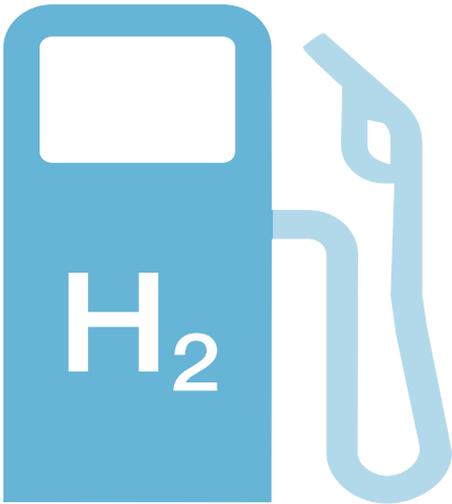
2
Water is split into hydrogen and oxygen using an electrolyser and electric current

3
Electrolyser is powered by solar, wind or tidal energy

4
Hydrogen used as fuel locally or converted into ammonia or synthetic natural gas for transport

5
Ammonia or SNG is shipped to places like Japan or Korea, then reconverted to hydrogen and used as fuel.

Image courtesy of ARENA



How hydrogen power can help us cut emissions, boost exports, and even drive further between refills

By Sam Bruce, Manager, CSIRO Futures

HYDROGEN COULD BECOME a significant part of Australia’s energy landscape within the coming decade, competing with both natural gas and batteries, according to a new CSIRO roadmap for the industry.

Hydrogen gas is a versatile energy carrier with a wide range of potential uses. However, hydrogen is not freely available in the atmosphere as a gas. It therefore requires an energy input and a series of technologies to produce, store and then use it.

Why would we bother? Because hydrogen has several advantages over other energy carriers, such as batteries. It is a single product that can service multiple markets and, if produced using low- or zero-emissions energy sources, it can help us significantly cut greenhouse emissions.

Compared with batteries, hydrogen can release more energy per unit of mass. This means that in contrast to electric battery-powered cars, it can allow passenger vehicles to cover longer distances without refuelling. Refuelling is quicker too, and is likely to stay that way.

The benefits are potentially even greater for heavy vehicles such as buses and trucks which already carry heavy payloads, and where lengthy battery recharge times can affect business models.

Hydrogen can also play an important role in energy storage, which will be increasingly necessary both in remote operations such as mine sites, and as part of the electricity grid to help smooth out the contribution of renewables such as wind and solar. This could work by using the excess renewable energy (when generation is high and/or demand is low) to drive hydrogen production via electrolysis of water. The hydrogen can then be stored as compressed gas and put into a fuel cell to generate electricity when needed.



One of the first hydrogen demo cars. Photo courtesy CSIRO

Australia is heavily reliant on imported liquid fuels and does not currently have enough liquid fuel held in reserve. Moving towards hydrogen fuel could potentially alleviate this problem. Hydrogen can also be used to produce industrial chemicals such as ammonia and methanol, and is an important ingredient in petroleum refining.

Further, as hydrogen burns without greenhouse emissions, it is one of the few viable green alternatives to natural gas for generating heat.

Our roadmap predicts that the global market for hydrogen will grow in the coming decades. Among the prospective buyers of Australian hydrogen would be Japan, which is comparatively constrained in its ability to generate energy locally. Australia’s extensive natural resources, namely solar, wind, fossil fuels and available land lend favourably to the establishment of hydrogen export supply chains.

Why embrace hydrogen now?

Given its widespread use and benefit, interest in the “hydrogen economy” has peaked and troughed for the past few decades. Why might it be different this time around? While the main motivation is hydrogen’s ability to deliver low-carbon energy, there are a couple of other factors that distinguish today’s situation from previous years.

Our analysis shows that the hydrogen value chain is now underpinned by a series of mature technologies that are technically ready but not yet commercially viable. This means that the narrative around hydrogen has now shifted from one of technology development to “market activation”.

The solar panel industry provides a recent precedent for this kind of burgeoning energy industry. Large-scale solar farms are now generating attractive returns on investment, without any assistance from government. One of the main factors that enabled solar power to reach this tipping point was the increase in production economies of scale, particularly in China. Notably, China has recently emerged as a proponent for hydrogen, earmarking its use in both transport and distributed electricity generation.

But whereas solar power could feed into a market with ready-made infrastructure (the electricity grid), the case is less straightforward for hydrogen. The technologies to help produce and distribute hydrogen will need to develop in concert with the applications themselves.

A roadmap for hydrogen

In light of this, the primary objective of CSIRO’s National Hydrogen Roadmap is to provide a blueprint for the development of a hydrogen industry in Australia. With several activities already underway, it is

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The benefits of hydrogen as a fuel are potentially even greater for heavy vehicles such as buses and trucks which already carry heavy payloads, and where lengthy battery recharge times can affect business models.

designed to help industry, government and researchers decide where exactly to focus their attention and investment.

Our first step was to calculate the price points at which hydrogen can compete commercially with other technologies.

We then worked backwards along the value chain to understand the key areas of investment needed for hydrogen to achieve competitiveness in each of the identified potential markets.

Following this, we modelled the cumulative impact of the investment priorities that would be feasible in or around 2025.

What became evident from the report was that the opportunity for clean hydrogen to compete favourably on a cost basis with existing industrial feedstocks and energy carriers in local applications such as transport and remote area power systems is within reach.

On the upstream side, some of the most material drivers of reductions in cost include the availability of cheap low emissions electricity, utilisation and size of the asset.

The development of an export industry, meanwhile, is a potential game-changer for hydrogen and the broader energy sector.

While this industry is not expected to scale up until closer to 2030, this will enable the localisation of supply chains, industrialisation and even automation of technology manufacture that will contribute to significant reductions in asset capital costs.

It will also enable the development of fossil-fuel-derived hydrogen with carbon capture and storage, and place downward pressure on renewable energy costs dedicated to large scale hydrogen production via electrolysis.

In light of global trends in industry, energy and transport, development of a hydrogen industry in Australia represents a real opportunity to create new growth areas in our economy.

Blessed with unparalleled resources, a skilled workforce and established manufacturing base, Australia is extremely well placed to capitalise on this opportunity. But it won't eventuate on its own.

This article first appeared in The Conversation. More recommended reading: Hydrogen fuels rockets, but what about power for daily life? We're getting closer by Zhenguo Huang, Senior lecturer, University of Technology Sydney, <http://coagenergycouncil.gov.au/publications/establishment-hydrogen-working-group-coag-energy-council>



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- Proven in photovoltaic, biomass and battery storage applications



33 kV cast coil „dry type“ transformer used in indoor & outdoor battery storage and solar farm aux transformer application



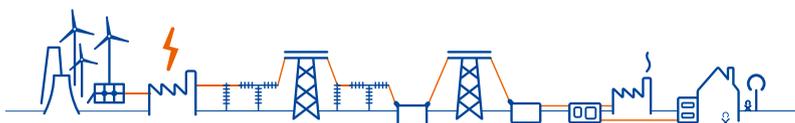
Windfarm tower compact substation with 4 MVA oil immersed forced cooled transformer, 5 sections of MV switchgear and LV switchgear



120 MVA power transformer for collector substation application in wind or solar



33 kV / 4 MVA regulating transformer for smallest of wind tower applications width 780 mm



From vehicles to renewables: Hydrogen to breathe new life into Toyota's Altona plant

TOYOTA'S SHUTTERED PLANT in Melbourne's west is set for a new lease on life, with plans to develop a green hydrogen transport hub.

Under the new plan, the multinational car manufacturer has pledged to develop the \$7.4 million Toyota Australia Hydrogen Centre to demonstrate an end-to-end process for the production, storage and use of renewable hydrogen.

The Hydrogen Centre will include solar PV and battery storage to contribute towards the energy requirements for the production of renewable hydrogen via electrolysis.

ARENA will provide \$3.1 million towards the pilot project.

The project aims to demonstrate the end-to-end process from production using an electrolyser, through to compression and storage of hydrogen for use in hydrogen fuel cell vehicles.

The Hydrogen Centre is the first step towards Toyota's broader transformation of the decommissioned car manufacturing plant into an EcoPark and centre of excellence.

With a target of reaching zero emissions from its sites and vehicles by 2050, Toyota will install solar panels and battery storage to produce more than 60 kilograms of renewable hydrogen through electrolysis every day.

Toyota Australia's Vice President of Sales and Marketing Sean Hanley said ARENA's funding, together with \$4.3 million from Toyota, will establish a state of the art hydrogen centre that will make a contribution back to the community that they have operated in for more than 50 years.

"It's no surprise that hydrogen has the potential to play a pivotal role in the future of energy, both here in Australia, but also globally," Hanley said.

He identified hydrogen as the next step in a journey Toyota has been on for more than 18 years, since they launched the Prius hybrid vehicle.



ARENA's Darren Miller outside Toyota's Altona Centre of Excellence

"It can be used to store and transport energy from renewable sources, including wind and solar, to power many things. For example, Toyota is using hydrogen in fuel cell forklifts in the warehouse, right here in Altona now," he said.

The facility will include an education centre and Victoria's first commercial scale hydrogen vehicle refuelling station infrastructure to allow refuelling of hydrogen fuel cell vehicles.

"We want to play a leading role in the transition to a decarbonised future, and we've already started on that journey with the Toyota Mirai fuel cell vehicle trials with Hobsons Bay City Council, Ausnet Services, Mondo and Hydrogen Mobility Australia."

Toyota believes that the new centre will demonstrate that hydrogen is a viable fuel source for transport and storing renewable energy.

ARENA chief executive Darren Miller said Toyota is paving the way for more renewably powered vehicles in Australia, where electric vehicle uptake has lagged behind other countries.

"The demonstration of low cost hydrogen production and distribution is key to the uptake of hydrogen-powered electric vehicles," he said.

"Australia holds a competitive advantage to play a global role in the emerging hydrogen export market due to our existing expertise and infrastructure.

"The development of a renewable hydrogen export industry could help to maintain our place as an energy export powerhouse as the world looks to decarbonise."

With a target of reaching zero emissions from its sites and vehicles by 2050, Toyota will install solar panels and battery storage to produce more than 60 kilograms of renewable hydrogen through electrolysis every day.



This year's Smart Energy Show was all things to all people: from investors to designers to installers, academics, consultants, advisers and all beyond. The dynamic nature of the conference program was reflected in the exhibition halls where leading companies in all facets of smart energy met with current and future customers and clients.

Simon Corbell says our biggest challenge is facing a deteriorating climate which is having an impact on our urban cities, regional communities and agricultural sector. This demands that we act with greater haste to tackle underlying causes.



ANY RATIONAL PERSON with kids, grandkids, nieces, nephews might pose a question similar to that delivered by **Alan Kohler**: "What I want to know is how difficult will life be for my one year old grandson who was born last year. Should I be worried?"

The words were posed in the context of Australia's dismal history of climate related policies which financial analyst Alan Kohler, who wears many hats and was co-founder of *Climate Spectator*, traces back many years.

He's more worried than ever – more sceptical, too – about the political landscape, and told delegates at the Smart Energy Show: "The debate about emissions reduction is getting old, we need a policy that provides a credible path to meeting international commitments.

"We see climate change all around us – what will stop it? We need a permanent commission made up of scientific, financial and social experts to advise government and the community what will happen, what can be done, and what it will cost.

"It is time for more difficult matters to be addressed. Rational leaders should have advanced this, it is time to plan and save up for the cost of climate action."

Oliver Yates who is former head of the Clean Energy Finance Corporation echoed the messages of Alan Kohler saying "Policy and regulatory leadership has been a failure of unmitigated proportion.

"Over the past five years the government pathway has been totally irresponsible, now major policy intervention will be required in all sectors of economy."

He reinforced the case for a clean energy pathway, saying "Renewables have won, they are cheaper and they will provide the future jobs and exports for the nation."

How to get there?

Simon Corbell has a vision for the pathway. He presented three key recommendations that will enable the next government to accelerate the pace of renewables.

Keynote presenters John Hewson and Alan Kohler



"A massive and unstoppable transformation is currently underway in the energy sector. The nature and pace of that transformation was on show at the Smart Energy Conference and Exhibition."

John Grimes



From left: Nicky Ison, Gabrielle Kuiper, Nigel Morris, Andrew Blakers and Andrea Gaffney

First is a policy for a Reverse Auction program, which has proven highly successful in the ACT and Victoria. This could be used to award off-take for large-scale developments and to align with existing state programs; and to augment finance for programs for reverse auctions to support and increase the pool of funding for developments of megawatt proportions.

Further, the CEFC could sign off and focus on additional, new generation and economic developments and benefit sharing for successful proponents with more regional communities benefitting, he said. Just 10 per cent, that is \$1 billion of the CEFC's additional \$10 billion funding, could unlock a further 10 GW of projects in a practical move with a focus on additional economic developments to take us beyond 50 per cent renewables.

"This would accelerate renewable energy developments immediately," Simon Corbell said.

Next, we could move toward a more sustainable transport sector by reducing emissions and sourcing 100 per cent renewable energy to power rail, with a mandate for Power Purchase Agreements for major infrastructure programs such as the series of metropolitan rail projects underway across the country.

"These are the three additional steps a future government could and should take to help Australia realise the potential of renewable energy as we transition to a decarbonised society," said the architect of the ACT's 100 per cent renewables project that reaches fruition next year. We just need greater haste and urgency."

Indeed.

Speed and action

Global greens ambassador **Christine Milne** emphasised the destruction wrought by a one-degree rise in temperature since pre-industrial days, with half a degree more to cause catastrophic consequences.

Two thirds of fossil fuels need to stay in the ground – no debate.

"Being carbon neutral means 50 per cent fossil fuels ... we need to aim for **zero carbon**," she said – forcibly. "The time has come for 100 per cent renewable energy.

"Australia is a pariah, extracting then shipping vast quantities of carbon based products overseas.

"You cannot offset fossil fuels with tree planting – you have to stop putting them in the atmosphere, full stop."

Alex Hewitt of CWP Renewables, which is the name behind the Asian Renewable Energy Hub, agreed.

"We all know the maths, the predictions, the projections on the climate," he said. "We need to double down our efforts in communication and in action."

Queue Smart Energy Transition Plan, as explained by John Grimes

- An accelerated transition plan to zero carbon emissions by 2030
- An orderly planned and lowest cost transition of the energy sector
- Certainty and ensures a just transition.

"This plan is a simple outline of a mechanism to alter the trajectory of the world which is heading toward a cataclysmic disaster. We need to pull out all stops to prevent a worsening climate, and renewable energy is key to the transition," John Grimes said.

Australia is well placed to take a leading role.

Mind boggling dimensions

Professor Andrew Blakers of ANU explained Australia is already installing 250 watts per person (of variable wind and PV) each year which is five times per capita that of Europe, the US and China and ten times the global average.

"We are runaway winners, Australia is a pathfinder and globally important, what we are doing really matters, and it is remarkable," he said before delivering a reality check: 85 per cent of our greenhouse gas emissions stem from oil gas and coal.

"We can drive the whole lot out by installing a large amount of renewable energy. We need about 300 GW of wind and PV to drive all gas and coal out."

Referring to the Global pumped hydro storage Atlas he outlined how there is unlimited opportunity in virtually every country of the world to support 100 per cent renewables.

Remarkable.

What could have been

John Hewson declared he was "Embarrassed by the hundreds of thousands of jobs and tens of billions of dollars in investment we did not capitalise on as a nation in the 30 years recognising our natural assets in solar and wind and storage and other aspects in the essential transition to a low carbon society."

Zali Steggall (now Independent MP for the federal seat of Warringah) concurred with John Hewson, commenting that her nemesis Tony Abbott has acted as a handbrake on clean





Smart Energy Show 2019 featured change makers and influencers. Pictured from L to R are Alex Hewitt of CWP Renewables, Global Greens Ambassador Christine Milne, John Dee of RE100 and Arup, Ken Baldwin of ANU, Independent MP for Warringah Zali Steggall, Simon Holmes à Court of Melbourne University and Tim Buckley of IEEFA

energy investment and the cost of inaction – the failure to act over the past ten years – has resulted in lost opportunities.

“Scientists have known for decades that climate change is an issue but around the world there has been inaction and failure.

“We have the capacity skills knowledge and passion but governments need to head in right direction. We cannot feel the task is too big – every tiny fraction makes a difference.

She recommends politics be removed from the equation and instead be led by specialists. “Reinstate the Climate Change authority to steer science based, effective and trustworthy climate actions,” she said.

“Strong emission controls and a strong economy go together. I don’t understand why as a nation we punch above our weight in so many things but in this we fail to lead the way.”

She added a new RET or NEG could work and we have to provide certainty for investment, and that government should aim for 50 per cent fleet to be electric. Renewable energy can provide 56,000 direct and indirect jobs by 2030.

“Australians want to see leadership, ambitious goals and make it happen.”

Her powerful words and declarations drew rapturous applause.

More powerful words and insights from Sydney University Law lecturer **Penelope**

Crossley who pointed out that other countries have identified in their laws 28 benefits of renewable energy.

“As a lawyer I find it distressing we are relying on individual states to pick up the burden that creates overlaps burdens and gaps and difficulties for people in industry dealing with cross border regulations,” she said. In some positive news, progressive corporations are getting a wriggle on.

RE100 – clocking up milestones

John Dee had some good news to impart about the increasing number of large corporations pledging commitment to renewable energy. To date 167 globally influential companies have committed to renewable energy, 76 of which operate in Australia. The Commonwealth Bank has joined the list, now Bank Australia is also transitioning to 100 per cent renewable energy and more large, significant Australian names are leading the way by joining RE100: Westpac and Atlassian led by Mike ‘Fair Dinkum power’ Cannon-Brookes.

(www.re100.eng.anu.edu.au)

“This sends a strong signal to the corporate sector ‘we are doing it’ and for their supply chains to get a move on too,” John Dee said

Not all the action was in the conference sessions. Coinciding with the Show was the launch of the two-seater ACE Urban cargo van, the first electric car to be manufactured in Australia.

Company director **Greg McGarvie** commented the electric van is “part of an exciting ecosystem” and that there is a future for manufacturing EVs industry in Australia.

“We now have a fantastic opportunity for small business to do their bit in curbing emissions by having clean transport,” he said with plans to produce 100 Cargo vans by year’s end.

Also on show was the much anticipated Hyundai Kona Electric, the first 100 per cent electric small SUV. And Sol Invictus the solar powered car built by students from the ANU.

Feedback

Smart Energy Council’s Senior Event Manager Sona Swindley who orchestrated the entire show is delighted watching its growth each year in terms of exhibitors, guest speakers and attendees.

“We had lots of positive feedback on the exhibition the conference, the venue – people seem to value the whole package,” she said.



PHOTOS: NICOLA CARD AND ANDREW BURN

Remarkable round up

Dynamic data presented at Smart Energy Show 2019

6.5 solar PV panels are installed per minute in **Australia**, placing it at the **top of global installation rates**.

Australia **leads the world** with **one in five households** (21%) sporting rooftop PV. Belgium's next with 8% and the USA 1%.

Current **solar PV** installation capacity in the National Energy Market stands at **7,400 MW**.

The **cost of PV has reduced 84 per cent** since 2010; payback now is around four years.

21 per cent of Australia's **energy** was produced from renewable sources during 2018; large scale solar tripled.

Rooftop PV will hit another **2.5 GW during 2019**. By contrast 2016 saw an additional 1 GW in large scale and residential PV.

Another **12 GW** is needed **to reach 50%** renewable energy by 2030; 1.1 GW new utility scale wind and solar projects a year.

Jobs in **coal: 35,000; renewables: 27,700**

Timelines and trends

In **2013** there were 22 active renewable energy projects totaling **1231 MW**

In **2018** 136 connection requests totaling **19,507 MW**

Growth of renewable energy **1987 – 2017:**
12 GW

70,000 household batteries in 2019 (spurred by state government schemes).

Source: AEMO

PHES

Six minutes: That's all it took for Professor Andrew Blakers to deliver news of the **530,000 pumped hydro electricity sites** identified across the globe and listed in the World Atlas just published.

A small fraction – the **top 1%** – of the 530,000 potential sites identified would **support 100% renewable electricity** system.

The **3000** good sites in Australia would generate **163 TWh**

“Australia is a globe forerunner in variable wind and PV ... what Australia is doing matters – and is **remarkable**, and could be **20 GW more** in two or three years.”

Andrew Blakers



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PHOTOS: NICOLA CARD AND ANDREW BURN



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Right at home with AlphaHOME

Established in 2012, AlphaESS specialises in advanced battery storage products and intelligent energy management solutions with independent intellectual property rights. Now it is taking ‘smart’ to a whole new level.

ALPHAESS DEBUTED ITS GROUNDBREAKING new energy storage concept, Smart Alpha Home at this year’s Smart Energy Conference and Exhibition in Sydney.

The crowd shot on this page illustrates the level of interest the new technology attracted among conference goers when Dr Ding Lin stepped forward to demonstrate the smart new function.

He explained that Alpha ESS had been testing and trialing the new system over several months in preparation for the big launch at the Show to a target audience.

The Big Reveal

Adaptable to various purposes, including monitor, interact and control of energy storage system – as well as other IoT devices that go beyond energy storage – Alpha Home enables users to feel the human-machine interaction in real time and introduces the Smart Home concept into everyday lifestyles.

Integrated with Amazon web services (AWS) IoT from Amazon, the Alpha Cloud makes it possible for the Alpha system to control the IoT devices via Amazon Echo.

Even without IoT devices, a home could also be upgraded to ‘go smart’; courtesy of the IoT contacts provided by Alpha home circuits can be leveled up to IoT capable while installing the energy storage system.

Smart modules are rapidly building momentum in the solar industry today and during the Show AlphaESS exhibited its Smart PV panel for the first time.

“The aim is to make life easier and save money at the same time.” said Dr Dong Lin, Vice President of AlphaESS.

“The new move has unfolded the ambition of AlphaESS, to shake the known experience and take life to the next level of technology.”



Four sessions were held to demonstrate the convenient, user-friendly technological advancement

Residential and industrial product lineup

The Alpha 10 kW household energy storage system T10, commercial system T30 and large industrial containers were also exhibited at this year’s Smart Energy Show.

Opportunities in 2019

Dong Lin commented on the success of South Australia’s home battery scheme that has really prompted energy storage solutions in the market.

“The home battery scheme has really prompted ESS in the market,” he said in his speech at the Show.

“The further price drop of both solar PV and energy storage and state government driven energy storage policies that provide subsidies for batteries are definitely going to boost the Australian market this year.”

Business expansion

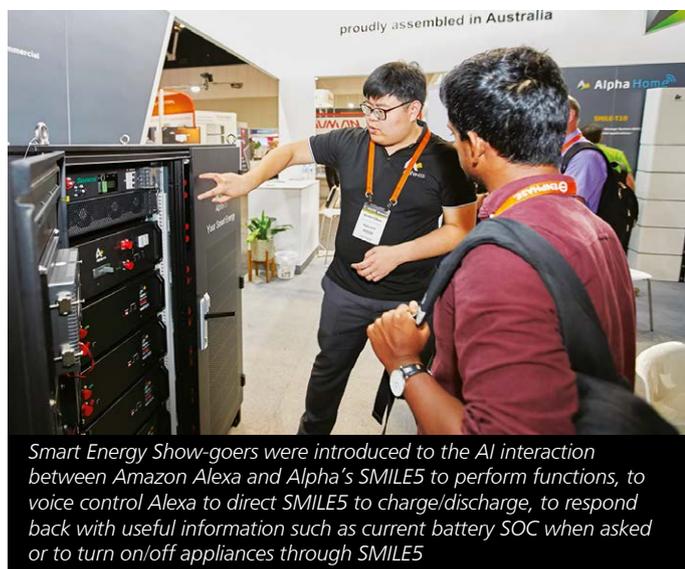
With the establishment of subsidiaries in Europe and Australia in 2015, AlphaESS has expanded to more than 30 countries and regions around the world. In 2019, AlphaESS established a new Korean subsidiary and signed strategic partnerships with Taeyang Enertec, a new energy Korean company, and Okaya Electromechanical in Japan, to further expand its global presences.

<https://www.alpha-ess.com/>

Since 2012, AlphaESS has continuously placed great importance on and increased its investment in R&D while developing a full power range of energy storage systems to meet the needs of different residential and commercial and industrial users.

In the process the innovative company has picked up a string of awards: AlphaESS has won iF Industrie Forum Design awards that attracts more than 5,500 entries from around 59 nations each year.

AlphaESS also won the prestigious Red Dot Design Award and was selected as a finalist in the global EES award in both 2018 and 2019.



Smart Energy Show-goers were introduced to the AI interaction between Amazon Alexa and Alpha’s SMILE5 to perform functions, to voice control Alexa to direct SMILE5 to charge/discharge, to respond back with useful information such as current battery SOC when asked or to turn on/off appliances through SMILE5



Forging ahead: LONGi and UNSW

THE SMART ENERGY SHOW presented an ideal opportunity for LONGi to stage an event at its Innovation & Technology booth with LONGi Solar president WenXue Li along with LONGi senior management Monsoon Wang and Boyal Mao.

The trio scoped the scale and ambitions of the company before UNSW Scientia Professor Martin Green joined the high profile line-up to elaborate on the success of their collaboration on project developments.

The multi award winning ‘father of PV’ professor presented the timelines of globally renowned PERC technology since its inception in 1983 and the decades of research devoted since to successfully improving cell efficiency.

The level of cell efficiency reached in 1986 was, he said considered ‘the four minute mile’ of PV.

By 1999 it stood at 25 per cent, a record that held for 15 years.

PERC efficiency which adds bifacial capacity has continuously broken world records is now the technology of choice.

“It’s very gratifying seeing the uptake of PERC in the industry and technology getting cheaper ... cell efficiency becomes more important in driving down costs,” Martin Green said at the Smart Energy Show.

“We are working hard to accelerate developments and could see 40 per cent efficient panels in 40 years.”

Each year LONGi devotes \$200m towards R&D to drive innovation. Representing 5 per cent of turnover, this is believed the highest in the industry. The company invested US\$183.58 million in R&D in 2018 and has a team of about 548 staff in R&D. Over the years, LONGi has registered 526 patents.

And it’s paying dividends.

Just three weeks after the Smart Energy Show LONGi publicly announced that the front side power of its 72-cell Bifacial half cut module exceeded 450 W, achieving the world’s highest power in this module type.



This new record was tested and verified by renowned certification agency TÜV-SÜD.

“This is another validation of LONGi’s strategy of enterprise growth through technological innovations,” the company’s media statement read.

Strong performance

In late April LONGi released its 2018 Annual Report and 2019 First Quarterly Report that revealed a strong performance for the company: operation revenue in 2018 was ¥21.988 billion, an increase of 34.38 per cent over the previous year.

The company’s monocrystalline silicon wafers and monocrystalline silicon modules production capacity reached 28 GW and 8.8 GW respectively.

In other highlights: shipment of cells and modules reached 7.072 GW.

Independent third-party research data showed LONGi accounted for 38 per cent of the industry’s monocrystalline silicon wafer capacity, reinforcing its position as the largest monocrystalline module manufacturer in the world.

By the end of 2019, the capacity of ingot/wafer will reach 36 GW, cell capacity 10 GW and module capacity 16 GW. By the end of 2020, the capacity of ingot/wafer will be 50 GW, while cell capacity will be 15 GW and the module capacity 25 GW.

LONGi also released the latest capacity planning: By the end of 2019, the capacity of ingot/wafer is 36 GW, cell capacity is 10 GW and module capacity is 16 GW. By the end of 2020, the capacity of ingot/wafer will be 50 GW, while cell capacity will be 15 GW and the module capacity 25 GW. By the end of 2021, the capacity of ingot/wafer will reach 65 GW, the capacity of cell 20 GW and the capacity of module 30 GW.

LONGi has been listed in ‘2018 Forbes Asia’s Top 50 Listed Companies’, ‘Fortune China Top 500’ and ‘Global Top 500 New Energy Companies in 2018’.



Solar roll-out

A large, eye-catching exhibit was on display at this year's Smart Energy Show, the 5B Maverick solar array.

THE PORTABLE, PREFABRICATED, MODULAR SYSTEM is the brainchild of UNSW cofounders Chris McGrath and Eden Tehan, who have established a state-of-the-art production facility in the Sydney suburb of Alexandria equipped with a team of technologists, inventors and innovators.

The company website provides insights into the origins of the innovative solar system.

The story goes back to mid 2013 when Chris, then development manager for Infigen Energy, was standing in empty paddock in remote NSW when struck by the idea of solar modules in an apex, replicated across the entire 100 ha paddock.

"I raced back to Sydney to start work, on the phone to Eden most of the way, and over the next 15-months, working from our backyard in North Bondi, we developed the prototype for a new kind of solar array," he wrote. "One that would smash on-site construction times and drastically simplify supply chains."

Starting from scratch, they redesigned the most expensive components of a solar farm, racking and installation, to develop their flagship technology: a world-first portable, prefabricated solar array.

As seen in the images on this page the non-penetrative, above ground solar mounting system sits on concrete beams on rubber levelling pads, rather than relying on pile-driven racking.

The prototype proved successful and took off; projects to date total more than 5 MW.

One of the earliest completed was the 26 kW system using two MAVs installed in November 2016. Deployment time for the turnkey solar farm in Mittagong was just 15 minutes, with a team of two carrying out the task.

A more recent project was the 120 kW array using 9 MAVs at Smithfield in NSW that took a team of three just one day to deploy.

With the majority of labour and logistics taking place in the factory, on-site time is cut by 50 to 90 per cent compared to traditional solar farms.

The website states that a 5B team of two can install a 12 kW MAV on a greenfield site in around half an hour. This equates to 200 kW in a day and one MW in a week with a team of just three people.

"Essentially we are building the pre-fab solar array, a solar farm in a factory," a company spokesperson told *Smart Energy*.



The 1.5 MW Maverick solar array in Albury, NSW. 5B has reimaged the solar array as a portable, prefabricated, modular system, a plug-and-play unit ready to connect to DC isolator or inverter



Two sites for a client: Borroloola and Timber Creek, NT at 843 kW. Borroloola recently survived Cyclone Trevor completely unscathed





What's on their minds

DURING THE SMART ENERGY CONFERENCE a panel of speakers was asked to share their excitement and concerns about the renewable energy industry.

Their responses pretty much sum up the views of the greater industry, as follows:

The excitement:

- The pace of renewables is getting ahead
- The substitution of coal by renewables – we are bypassing gas

- Consumer involvement, and people are learning more and taking control of their generation and energy efficiency, and also the onset of battery storage and what that might mean for homes
- Demand side engagement and demand response and VPPs
- "I'm loving the fact we proved all those doubters wrong"
- The growth of renewable energy which back in 2001 was dubbed a mickey mouse scheme



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The concerns:

- Delays or difficulty in connecting renewables to grid
- The policy and regulations keeping up with the consumer thirst for renewables
- Level of disruptions with bus models and the economics we need to sort through.
- The make up of the senate after the federal election
- Lack of investment in infrastructure connecting re power station with customer and that we are not using all the power stations
- And not using all the distribution and energy storage

Lunch Mixers

THE LUNCH MIXERS in the Energy Revolution Area were another drawcard that enabled several innovative companies and ‘creative geniuses’ to showcase their products and services to the assembly during the lunch breaks.

The sessions came with the comfiest seats in the house, along with tables to work at or enjoy lunch at. No wonder people made themselves right at home.

Let’s take a look at the companies who took advantage of the assembly to explain their good and services to a target audience in the hundreds.

Breath of fresh air

Zen Ecosystems sent along Product Vice-President Grant Hatamosa to explain how to “Take control of one of the most overlooked energy users in buildings - split system air-conditioning”

Here’s what he said: Up until now, the only way to control split system air-conditioning has been individually, with manual remote controls.

Zen Ecosystems devices and software empower businesses, facilities managers, schools and homeowners to gain visibility over their heating and cooling usage and take control of one of the most overlooked energy users in buildings - split system air-conditioning.

Zen Air devices and the Zen HQ cloud software allows multi-site and multi-zone facilities to remotely manage and control their HVAC as a single portfolio. By being able to set schedules which prevent unnecessary use and control the temperature, ZenHQ users can make energy savings without sacrificing comfort.

The system enables HVAC usage patterns to be adjusted to maximise the value of solar power and time of use rates and minimise demand charges.

Fronius Primo Gen24 Plus – the upcoming single-phase hybrid inverter from Fronius

Sebastien Ng, Application Engineer, Fronius covered the key technical features of the much-anticipated single-phase hybrid inverter from Fronius, the Fronius Primo GEN24 Plus, which is due for release in Australia this year.

Expanding on their very popular SnapInverter range, Fronius’ latest inverter offers a host of new features and is sure to impress. Integrated with both LG Chem and BYD, the Fronius Primo GEN24 Plus takes the innovation leader significantly closer to realising its vision of 24 hours of sun – a world powered 100 per cent by renewable energy sources.

Power to the people...

... was the title of sonnen Asia Pacific chief executive Nathan Dunn’s address.

He explained how people can share the energy generated in their own community, reduce reliance on grid electricity and save on energy bills at the same time.

“Let’s bring power back to the people,” Nathan said.

From Product Innovation to Recycling

Jinko Solar was ably represented by Dr Jin Hao, VP of R&D. He told the group that with the development of technology, Jinko Solar’s main module products have changed from multi-crystalline to mono-crystalline, from single side power generation to dual sides, and from fixed axis to intelligent tracking.

The module application has also changed from industrial application (power plant) to house usage. Meanwhile, standardisation of PV devices, application, and safety is critical.

He warned too that considering the lifetime cycle of modules, PV recycling will take a high priority to manage within next five years.

Energy Storage Solutions

The presentation by Ben Li who is Managing Director of INVT Australia focused on the energy storage solutions from INVT, from 3 KW residential energy storage systems, 30-100 KW commercial energy storage, to MW energy storage containers for large scale solar and wind project.

INVT is also introducing a new application titled ‘Solar-Storage-Charge’ for the electrical vehicle market.

Completing the wrap was Daniel Kogoy, Head of Project Sales for **Sungrow Australia** who addressed ‘Innovative Commercial Solutions’.



Energy users contemplate the market

A conversation with Energy Users Association of Australia chief executive Andrew Richards who says large energy users are employing significant innovations and lateral thinking to manage cost, reduce gas use where possible and find alternative solutions to the high cost challenges they face.

“While rooftop solar creates a great opportunity for homeowners, the huge expansion and lack of transparency of generation is putting a lot of pressure on networks and AEMO ... one person used an analogy of a car which can drive in reverse, but it is not primarily designed for this purpose and in reverse, it has limitations.”

IN THE ABSENCE of lasting national energy and climate policy, the challenges faced by large energy users have been amplified with costs rising dramatically in recent years, along with the threat of increased obligations and risks. To address these issues the Energy Users’ Association of Australia’s National Conference shone the spotlight on ‘Sorting Fact from Fiction’.

Speakers included Clare Savage from the Energy Security Board, Paula Conboy, outgoing chair of the AER, and Nicole Ross of the ACCC.

Discussions centred on the future of network pricing, a topic close to the hip pocket of large energy users whose bills now consist of a minimum of 40 per cent network costs. But who will end up paying for the fundamental changes shaping the market?

“A big challenge in the huge transition taking place in electricity markets is the impact of what is now fast becoming a two-way grid with increased Distributed Energy Resources. AEMO’s Integrated Services Report indicates huge expansion of the network to pick up new renewable zones which will mean increased costs,” Andrew Richards said. “Working out how this is prioritised so as not to increase costs unnecessarily on all energy users is critical. So too is looking at total system cost as we bring increasing volumes of renewable energy into the system.”

He said that with the enormous transition underway a better understanding of the total system cost of the transformation of the energy system is vital. “Only then will we really understand the implications and costs that will flow on to energy bills.”

In particular new ways of funding the transition need to be explored, especially the increased costs associated with the “rewiring” of the grid, and the EUAA wants to see a more equitable sharing of costs and risks amongst all market participants rather than the cost burden falling entirely on consumers.

Andrew Richards listed other matters under consideration, including the lack of energy policy that continues to create uncertainty and increasing costs. Part of the response from large energy users is to enter into corporate PPAs directly with new entrant generators as a price hedge.

“Large users are driving new large-scale projects through PPAs which underwrite their cost as it gives the ability of large business to create some certainty on energy prices for a set period. This situation is unlikely to change irrespective of RET finishing,” he said.

In gas, more supply is needed to create greater competition but this alone is not likely to bring prices down. Implications for gas users of no action to address issues in the gas market are dire.

According to EUAA large energy users are innovating in their businesses (with some presenters discussing drastic diversifications), the way they source energy and how they use energy to manage cost and improve sustainability outcomes; and finding least cost firming solutions is high on the agenda.

A role for more renewables?

We asked Andrew if there was much discussion over investment in renewables by large energy users to lower power costs in the long term.

While rooftop solar creates a great opportunity for homeowners, the huge expansion and lack of transparency of generation is putting a lot of pressure on networks and AEMO, he said.

“In relation to networks, one presenter at our National Conference used an analogy of a car which can drive in reverse, but it is not primarily designed for this purpose and in reverse, it has limitations.

“It is the same for our electricity network which was not designed to take huge amounts of energy off





homes so how do we adjust to this increasing scenario without creating huge cost impacts?

“There is no precedent for the space we find ourselves in in Australia and no one knows the speed of battery uptake. For large users seeking firming products at scale, batteries are not yet able to provide this service.”

One thing conference delegates were more certain about was the critical need for more data in helping business seeking to find solutions that improve energy efficiency and productivity.

“More broadly, working out how we can use data that is already collected and share this data with third parties, could improve user ability to participate in demand response or RERT and functionality in electricity networks (two way grids).”

The future

With the re-election of the LNP in mid May, EUAA will continue to press government to implement an energy and climate policy to create greater certainty in energy markets, and take further action in gas markets.

“The EUAA will be seeking greater certainty in electricity markets. We support a price on carbon and would like to see total system pricing take place so we can effectively manage the transition and understand the implications across the network. In gas, we need more action so that we can deliver reasonably price gas on the east coast,” Richards said.

“Not enough has been done to improve liquidity in markets and increase competition. Without action in gas, electricity prices will remain high, and many manufacturing businesses are likely to go to the wall.”

That does not bode well for Australian industry.

“Overall, what came through loud and clear from the breadth of presentations at the conference was the myriad of issues that are both present and emerging in our energy markets are likely only solvable only if we all work constructively together.”

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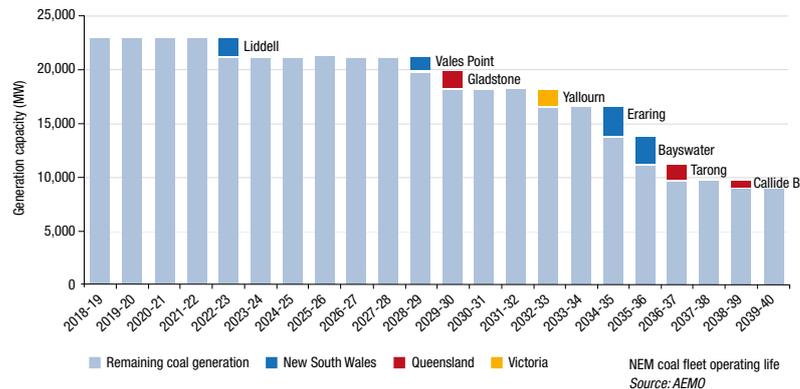
Energy market dynamics

April 2019 energy sources contribution to grid

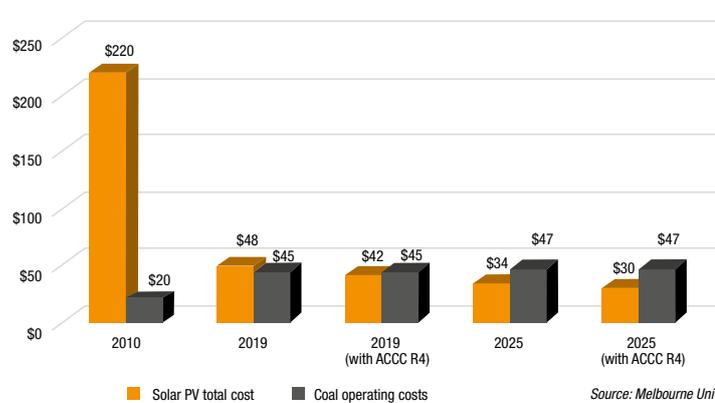
Sources	Power MW	Contribution to generation	Price \$/MWh
Sources	15,654.8		\$83.22
Solar (Rooftop)	716.1	4.6%	\$75.40
Solar (Utility)	329.7	2.1%	\$73.26
Wind	1,232.9	7.9%	\$82.12
Hydro	914.4	5.8%	\$105.75
Battery (Discharging)	4.7	0.03%	\$105.34
Gas (Reciprocating)	64.7	0.4%	\$68.50
Gas (OCGT)	176.2	1.1%	\$110.47
Gas (CCGT)	612.4	3.9%	\$89.05
Gas (Steam)	287.2	1.8%	\$111.94
Distillate	1.9	0.01%	\$124.35
Biomass	5.6	0.04%	\$68.87
Black Coal	8,713.5	55.7%	\$75.09
Brown Coal	2,595.6	16.6%	\$97.97
Loads			
Pumps	-40.0		\$57.08
Battery (Charging)	-4.6		\$86.99
Net	15,610.1		
Renewables		20.4%	

Source: AEMO, BoM

Looking ahead, the national electricity system will continue to transform



Solar PV total cost vs Coal operating cost (\$ per MWh)



TOP 20 SOLAR PROJECTS IN AUSTRALIA IDENTIFIED BY SOLARPLAZA

#	Name	Primary Owner	Stake [%]	Capacity (MW)	Operational from	Location
1	Bungala Solar Project	Enel Green Power	50	220.00	2018	South Australia
2	Coleambally Solar Farm	Neoen	100	150.00	2018	New South Wales
3	Daydream Solar Farm	Blackrock	90	150.00	2018	Queensland
4	Ross River Solar Farm	Palisade Investment Partners	100	135.00	2018	Queensland
5	Sun Metals Townsville Solar Farm	Sun Metals	100	125.00	2018	Queensland
6	Karadoc Sun Farm	BayWa r.e.	100	112.00	2018	Victoria
7	Bannerton	Foresight Solar Fund Limited	100	110.00	2018	Victoria
8	Nyngan Solar Plant	Powering Australian Renewables Fund	100	102.00	2015	New South Wales
9	Clare Solar Farm	Lighthouse Infrastructure	50	100.00	2018	Queensland
10	Susan River Solar Farm	Elliott Green Power	100	95.00	2019	Queensland
11	Barcaldine Remote Community Solar Farm	Foresight Group	100	75.00	Stage 1: 2016 Stage 2: 2018	Queensland
12	Hamilton Solar Farm	Wirsol	95	69.00	2018	Queensland
13	Emerald Solar Farm	Lighthouse Infrastructure	100	68.00	2018	Queensland
14	Gannawarra Solar Farm	Wirsol	95	60.00	2018	Victoria
15	Parkes Solar Farm	Neoen	100	55.00	2018	New South Wales
16	Broken Hill Solar plant	Powering Australian Renewables Fund	100	53.00	2018	New South Wales
17	Whitsunday Solar Farm	Wirsol	95	52.80	2018	Queensland
18	Kidston Solar Project 1	Genex Power	100	50.00	2018	Queensland
19	Hayman Solar Farm	Blackrock	90	50.00	2018	Queensland
20	Manildra Solar Farm	New Energy Solar	100	48.50	2018	New South Wales

Top six Solar Asset Optimisation tips to ensure maximum returns

Mina Mesbahi steps through key aspects of Solar Asset Management.

AS THE AUSTRALIAN SOLAR MARKET continues to scale, asset owners and managers will be faced with a number of complex issues unique to solar power generation. In an industry that is increasingly cost-conscious, equity returns have become far more dependent on the reliability of the system.

So, where to begin with asset optimisation? Although the operational phase is the focal point, the project needs to also be cemented with the right foundation at the early stages to weather the test of time.

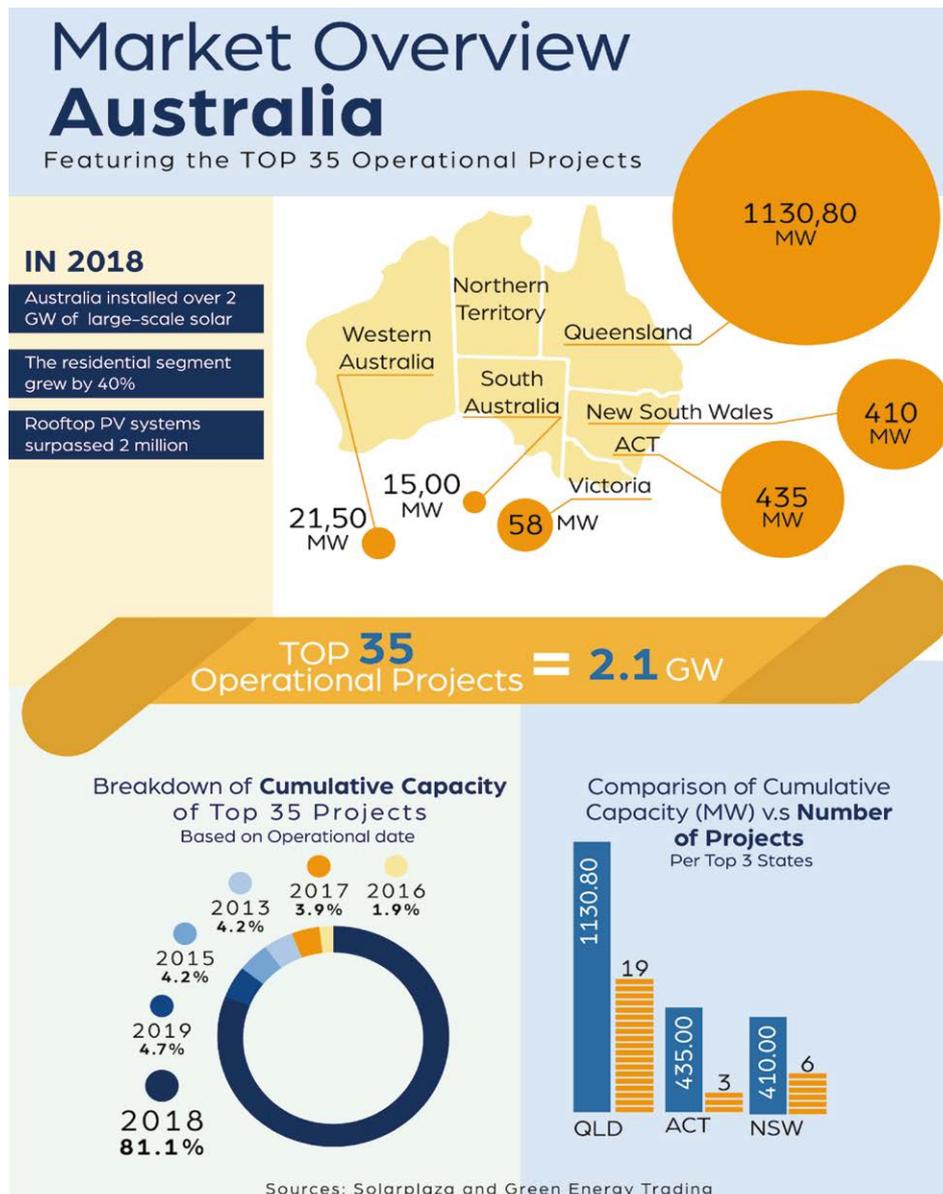
Solarplaza is present in the most advanced solar markets and we've seen many recurring scenarios playing out. Here's a curated overview of a few

fundamental tips to look out for in the early to mid-stage phases of an asset's lifetime:

1. Turn ordinary data into extraordinary actionable insights

Let's begin with maintenance management systems and the fact that, in the year 2019, Excel spreadsheets are no longer an acceptable tracking system. Digitalisation has had an immense impact on how solar assets are managed and maintained across the globe. Going digital is the name of the game and having proper computerized maintenance management system (CMMS) capabilities in place will make all the difference.

Continued over page



AUSTRALIAN CONFERENCE

Sydney, Wednesday June 26 to Thursday June 27

More best practices in technical & financial management of operational solar plants

The Australian solar PV market, being in its infancy, poses certain challenges. However, in every challenge lies an opportunity. Australia can capitalise on the learnings from other successful international markets.

It is never too early to start optimising your assets

To meet and learn from the best of the best, join the pre-eminent Solar Asset Management Australia, fully focused on the optimisation of solar plants and portfolios, taking place in Sydney on June 26-27.

Join sessions like 'Assessing PV Performance' during the Solar Asset Management Australia conference.

www.solarplaza.com

www.australia.solar-asset.management

Shell, sonnen, and storage

Last year sonnen developed its battery manufacturing facility in Adelaide to meet the growing demand by Australian households for home energy storage. Smart Energy chatted to sonnen APAC chief executive Nathan Dunn about company operations and expectations.

Smart Energy: To set the scene, what can you tell us about sonnen manufacturing operations in South Australia?

Nathan Dunn: To date, more than 50 sonnen staff work at Elizabeth in production, warehousing, shipping, the call centre and technical service. We've recently added dedicated sales and marketing staff to support partners and customers, and sonnen will continue to

invest in ways we can better support them. In April, we introduced the ninth generation of the sonnenBatterie hybrid that was manufactured in our facility at Elizabeth. The sonnenBatterie hybrid is a fully-integrated system that delivers high efficiency through an integrated solar inverter. It takes away the need for a separate solar inverter so it significantly reduces system and installation costs for customers.

While I can't provide specific numbers for manufacturing, sonnen will continue to invest in

sonnen APAC
chief executive
Nathan Dunn



Continued from page 43 – Solar Asset Optimisation

2. Get your supply chain ducks in a row

During the first two years of the project, which are also referred to as the mortality stage, things are bound to break and fall apart. Therefore, it is important to provide easy access to spare parts storage to minimise downtime, in particular for remote projects. Distances between some of the sites in Australia can run up to 400 kilometres.

3. Understand the specifics of your market

Not every market has the weight of all the existing technologies and services behind it, especially as far as remote project sites are concerned. The reality of the extent of the scope of the available services can turn out to be more sobering than anticipated and require thorough research when entering a new market.

One of the aspects to consider is the washing economics of the market, particularly in Australia's desert regions. Another challenge more specific to Australian is the wildlife and venomous snakes - the combiner box makes just the perfect home for these reptiles!

4. Involve your selected O&M team as early as possible

At the commissioning stages, the Engineering, Procurement and Construction (EPC) to Operations and Maintenance (O&M) handover period represents an inflection point while reflecting on early to mid-

stage O&M. Involving your selected O&M team as early as possible is recommended as they tend to observe and grasp certain elements often missed by everyone else.

5. Pay attention to the small components with big impact

When looking at asset optimisation, it is crucial to discern that at times the future performance of the project is already hampered before the operational phase due to the issues 'baked-in' to the system on a component-level.

Cabling and connectors may seem like small details, but the devil is in the detail. When not correctly deployed, these elements can hurt performance and overall bankability of the project.

6. Know the two sides of an optimum Levelised Cost of Energy (LCOE)

At its crux, LCOE optimisation is about capital expenditure (CAPEX) optimisation and operating expenditure (OPEX) minimisation. In other words, the project could very well experience more downtime, and hence a worse LCOE in the long term, when merely focusing on cost minimisation at the early stages.

.....
Mina Mesbahi is a Research Analyst with Solar Asset Management.

“ Mature customers and professional families see their investment in solar and storage as a way of reducing their carbon footprint and doing their part for climate change through energy generation. ”

our operations to support the demand for batteries in Australia, New Zealand and Asia.

SE: What are the main drivers for residential battery storage uptake in Australia?

ND: Subsidies and low-interest loans in Victoria, Queensland and South Australia have been a great stimulus for the industry.

But when we look deeper into the motivations behind residential battery storage uptake, we see energy independence as a significant driver for consumers who are installing home batteries. Many households have been frustrated by bill shock and they are willing to invest in a smart home energy solution that gives them greater certainty.

There is also a segment in the population, especially with mature customers and professional families, who see their investment in solar and storage as a way of reducing their carbon footprint and doing their part for climate change through energy generation.

SE: What are sonnen's expectations for sales volumes and growth?

ND: While I can't provide specific numbers locally and globally, I believe there are significant opportunities for sonnen to grow. We've recently shipped sonnenBatteries produced at our factory in Elizabeth to New Zealand and entered into an exclusive distribution agreement with Taspac Energy.

The energy storage industry may have a perception that New Zealand is a small market. However, it is a market that has grown organically from the consumers desire to be energy independent.

Unlike Australia where the growth of solar has been driven by subsidies, the opportunity in New Zealand is 'emotion' because homeowners want the ability to have back-up power and be independent from their energy retailer.

Subsidy schemes and grants that extend nationally so that every household in Australia has the chance to install rooftop solar and batteries and begin their energy independence is what our

overall goal is at sonnen. We hope whoever governs after the Federal election will consider this.

This would accelerate the development of virtual power plants and help Australia overcome some of the challenges we are seeing with grid infrastructure and energy prices. Australia already enjoys the advantage of being the sunniest country in the world and it would be impressive if we could be the country with the highest density of homes that are connected to virtual power plants.

SE: What will be the main impact of Shell's acquisition of sonnen?

ND: Shell's ownership of sonnen will allow us to offer more choice to customers seeking reliable, affordable and cleaner energy. Together, we can accelerate the building of a customer-focused energy system in support of Shell's strategy to offer more and cleaner energy solutions to customers.

We can help more households achieve energy independence and benefit from opportunities in the energy market.

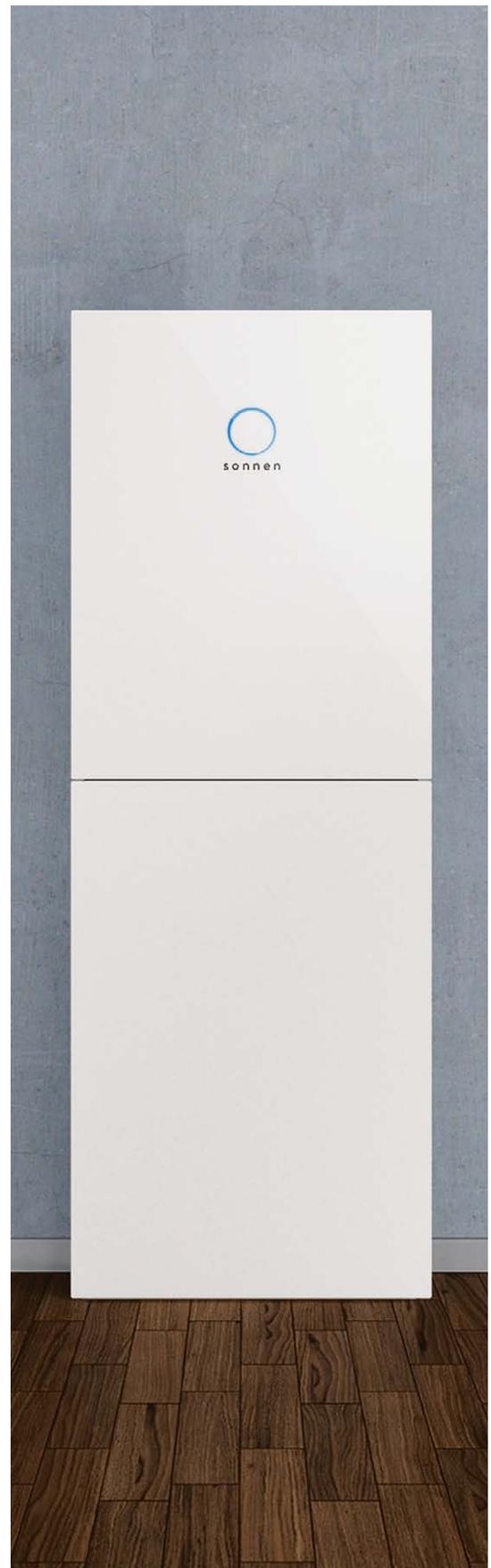
sonnen continues to operate as an independent company globally and there are no changes planned to our operations and manufacturing facility at Elizabeth, Adelaide.

The marketing and branding for sonnen remains the same and we will continue to leverage the sonnen brand, which is recognised by our customers and partners globally.

SE: Will your role take on any new dimensions?

ND: Being a subsidiary of Shell New Energies means my role as chief executive of Asia Pacific is to identify new opportunities where sonnen and Shell can work together in Australia and in the wider region.

Whether it is building on existing or new partnerships with utility companies to identifying ways where we can accelerate our battery storage and sonnenFlat, a fixed monthly energy plan that is available to sonnenBatterie owners in most states across Australia.



OUT and ABOUT

A THIRD-GENERATION PEAR AND STONE FRUIT FARM

in Shepparton, Victoria has cut energy use by a third after installing two 100 kW PV systems across its two energy intensive cold storage sheds. With "energy costs that were out of control, we knew we needed to be more efficient. If we weren't being efficient we were going backwards," farm manager Mr Peters said. Payback of just five years is anticipated, and over the lifetime the system will earn an additional \$1.07 million in benefits.



DNV-GL has developed 'one-stop shop' **RENEWABLES GEOPLATFORM** which offers solar and wind developers expedited access to geospatial data, data layers and reports to facilitate development and improve project success rates.

<https://renewablesgeoplatform.dnvgl.com>

LONGi recently announced that the front side power of its 72-cell Bifacial half-cut module exceeded 450W, achieving the world's highest power in this module type. Construction will effectively reduce package loss and increase average output by 5-10W. Early this year the positive conversion efficiency of LONGi monocrystalline PERC cells reached 24.06 per cent, breaking through the industry's previously theoretical PERC cell efficiency limit of 24 per cent.

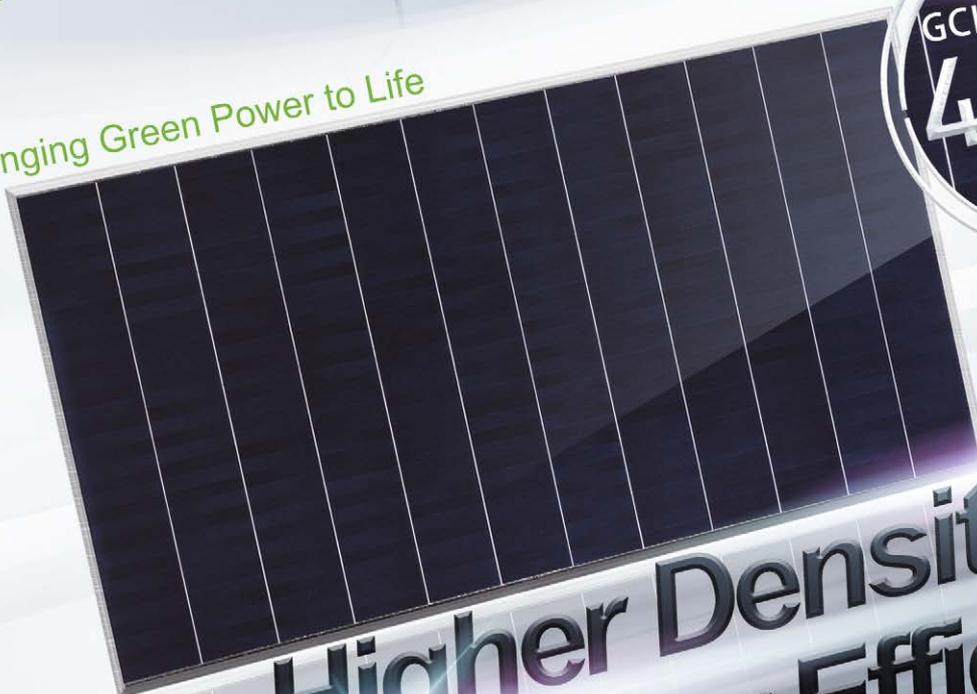


Image: sonnen



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Transforming the landscape

Global transformer manufacturer SGB-SMIT is setting its sights on expansion in Australia's burgeoning renewable energy sector. Here we talk to Claude Corso who is managing local operations.

WHEN YOU ARE BUILDING cutting-edge electrical transformers the size and shape of a small house, the options for manoeuvring them around the factory floor are somewhat limited. That usually means the use of one large, cumbersome crane. Not so for SGB-SMIT which deploys a futuristic-looking hovercraft air cushion.

Another smart device is the use of a world first patented robotic core-stacking machine. Devised by SGB-SMIT this is said to have revolutionised the manufacturing process, saving thousands of man-hours in production.

But the company has always prided itself on being a technological forerunner, reflecting the words of electrical engineering pioneer Thomas Alva Edison (1847-1931) who said, "If there's a way to do it better – find it."

The high level of precision and automation in the manufacture of large and medium power transformers, cast resin and oil distribution transformers, coupled with just-in-time manufacturing processes, a century of experience contribute to significant cost efficiencies, and that has helped SGB-SMIT win some of the largest tenders on offer.

Renewable energy projects to which SGB-SMIT Group has supplied power transformers and or shunt reactors/harmonic filters include some of the most prestigious, among them the 6 GB Hornsea Project One Offshore Wind Farm in the North Sea.

Other notable projects include the 659 MW Walney Bank Offshore Wind Farm in the UK and further south the 300 GWh Noor Ouarzazate solar Farm in Morocco touted "as big as Paris in the Sahara Desert". With construction cost of \$3.9 billion it is also believed to be in the top five world's largest solar farms. So large it is visible on Google earth.

SGB-SMIT technology can be found at the Middenmeer Onshore Windpark in the Netherlands, and at the 66 turbine 228 MW Stronelairg wind farm south-west of Loch Ness in the Scottish Highlands.

Downunder

Plant and equipment supplied to Australia's renewable energy sector include auxiliary compact substations for Swan Hill, Daydream, Hayman and Emerald solar farm projects, and an auxiliary transformer was recently supplied to the 100 MWp Wemen Solar Farm project in Victoria.

That is just the start as far as newly appointed SGB-SMIT Australia managing director Claude Corso is concerned. He's been charged with the task of expanding business in medium and large power transformers to Australia and New Zealand's large-scale wind and solar energy sector.

"Our aspirations are to grow business in these areas while sourcing product and services from group factories





and establishing local partnerships for installation and testing on specific projects," he told *Smart Energy*.

"We are now embarking on a renewed push and currently tendering for similar sized projects in Australia.

"Our plan is to build up to a double digit organisation and capitalise on the strength of Europe's customer base and project references."

He emphasises the company's existing presence, with the name already well established in Australian industry through third-party suppliers and agents.

"Operations dried up somewhat in recent years following the liquidation of one player, but the show goes on with newly established local offices and a team of business developers, sales and distribution staff poised for action," he said.

Experience

We asked Claude Corso about the main advantages of using SGB-SMIT

transformers for Australian based utility scale developers.

Naturally, longevity plays a key role. "Developers can be comfortable that they are dealing with a 106 year old company with a solid shareholder backing and balance sheet," he said.

"The SGB-SMIT Group has a supply record for delivering transformers to some 80 countries, over the years we have learned a lot, overcome many challenges and taken on projects requiring specific solutions and acquired an impressive database of knowledge and experience which is second to none.

"This translates directly into know-how, knowledge and reliability," he said.

"Having supplied transformers to some of the harshest climates our database of knowledge and experience, SGB-SMIT ranks among the top tier of global transformer manufacturers.

"With over 140 suppliers on our books SGB-SMIT group's buying power is very strong."

Range and power

European pure-play transformer specialist SGB-SMIT Group has been in business since 1914 - just 28 years following the 1885 invention of the first constant-potential transformer. Company headquarters are in Regensburg, Germany, with branch operations in the USA, Malaysia, the Netherlands, Romania, the Czech Republic, India, China, South Africa, France and Australia.

SGB-SMIT transformers and products include

- Large power transformers in the range of 100 to 1,200 MVA and voltages up to 765kV
- Medium sized power transformers in the range of 20-300MVA and voltages up to 275kV
- Auto transformers in the range of 120 – 400MVA at voltages up to 275kV
- Cast resin & resin impregnated transformers in the range of 3.3MVA to 25MVA and voltages up to 33kV
- Oil distribution transformers in the range of 50kVA to 16 MVA and voltages up to 33kV
- Compact substations in the range of 160kVA to 5MVA and voltages up to 33kV
- Reactors and shunt reactors
- Phase shifting transformers

SGB-SMIT spends around 1.6 per cent of its turnover in R&D programs and is affiliated with many universities and partners in Europe, China and US.

www.sgb-smit.com

Stepping aside

Trevor Berrill is an engineer, academic, trainer and alternative technologist who foresaw the renewable energy revolution well before its time.

WELL-KNOWN AND HIGHLY REGARDED sustainable energy systems consultant and educator Trevor Berrill recently announced he is stepping back a bit from his consultancy work.

The news follows a health scare that caused a rethink of his priorities. He's a man who tends to get his timing right.

Well ahead of his time – we are talking the early '70s – Trevor entered his essay about a decentralised power system run on renewables in a prestigious competition but was pipped at the post by an essay on coal fired power.

However the die was cast and by 1978 the visionary was monitoring and solar flat plate collector testing and a few years later went on to conduct the first ever wind energy survey of southern Queensland.

Fast forward four decades and the award winning, private consultant has worked in renewable energy and energy efficiency, focusing on sustainable energy system design and installation, research and development, technical training, public education and policy.

He was branch president of the Australian Solar Energy Society (predecessor of the Smart Energy Council) and a founding member in Queensland of the Alternative Technology Association and Wind Energy Association.

Trevor authored the 2011 publication *Solar Electricity Consumer Guide*. As a project leader for the Australian Cooperative Research Centre for Renewable Energy, he coordinated development of

and co-authored distance learning materials and text books for national technical training in renewable energy, now being used in training institutes and universities across Australia.

His lifestyle reflects his work, living in a home fully solar powered with a grid connected, PV system, solar water heating, passive solar design and rain water system.

Smart Energy Council chief executive John Grimes commended Trevor for his devotion to the industry, saying forty years in this sector was pretty amazing.

“Stalwarts such as you have created the foundation for so much improvement in the world, and Australia in particular,” he wrote in an email to Trevor.

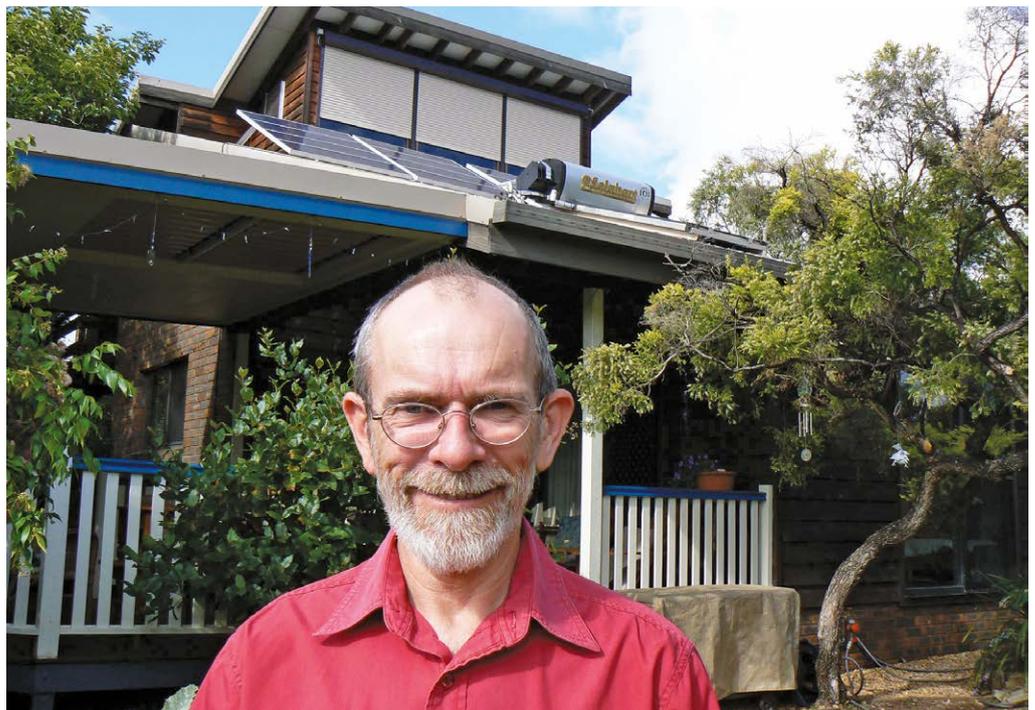
“I sense the tide is finally turning – something that would not have been possible without your effort.”

Trevor who is feeling better by the day may in future consider “one off” projects but in the short term is more likely be found catching the waves at the picturesque beaches south-east of Brisbane. Ever the engineer, wind surfing is, he says, “real testing of the cubic law for power in the wind”. How to get to the nearest beach? Driving his Mitsubishi iMeiv electric car charged from the sun, of course.

“I hope that my work over 40 years in policy, national training and public education, in system design and installation, energy auditing and feasibility studies, and R&D has contributed to a better world,” he says.

Heck, yes.

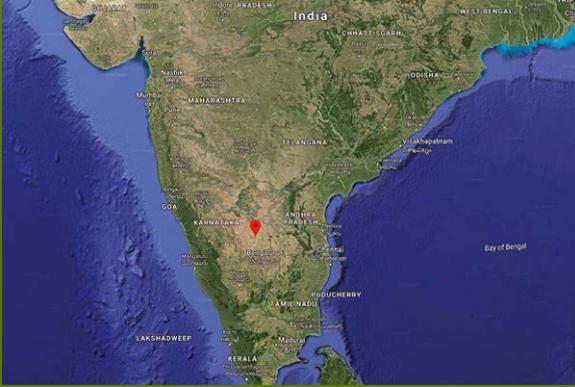
“
In the early 70s I worked as an assistant to the maintenance engineer in a coal fired power station – I saw and smelt the pollution and was not impressed.”



Five mega solar plants

1

The 2000 MW (2 GW) Shakti Sthala, Pavagada, Karnataka, India: Spread across almost 53 square kilometres and five villages, the 2,000 MW capacity Pavagada solar farm will produce enough electricity to power around 700,000 households.



2

The 1000 MW Kurnool Ultra Mega Solar Park, Andhra Pradesh, India: This solar park became operational in May 2017 and within five months had generated >800 million units of energy and saved over 700,000 tonnes of CO₂. The mega park is situated on land spanning 23 square kilometres.



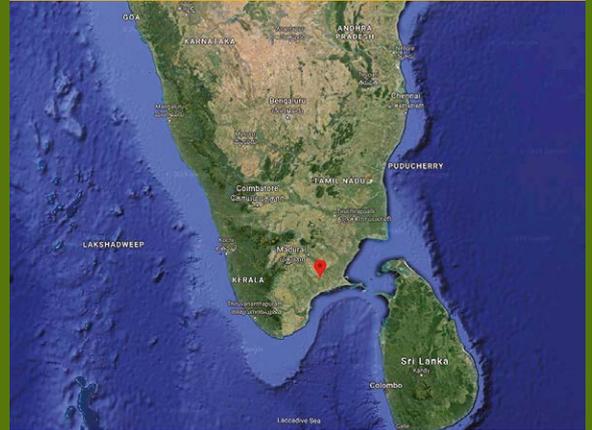
3

The 850 MW Longyangxia Dam Solar Park, Qinghai province of China: The 850 MW Longyangxia Dam Solar Park occupies more than 25 square kilometres, and boasts four million solar panels. The plant was the world's largest in February 2017. The park generates around 220 GWh of electricity per year, enough to power 200,000 households.



4

The 648 MW Kamuthi solar farm, Tamil Nadu, Southern India: This \$US679 million plant which is spread over 10 square kilometres was in 2016 declared the largest solar power plant at a single location. It comprises 2.5 million individual solar modules and produces enough electricity to power approximately 150,000 homes.



5

The 580 MW Noor Complex Solar Power Plant, Sahara Desert, Morocco: The 580 MW Noor Complex is the world's largest concentrated solar power (CSP) plant. Due for completion in 2020, it is expected to provide electricity for more than one million people. The first phase of the three-part project is the 160 MW Noor 1 which became operational in 2016 and has slashed Morocco's annual carbon emissions by hundreds of thousands of tonnes.



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For full listing of Smart Energy Council Members see www.smartenergy.org.au

Platinum



Gold



Silver



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| Auspac Energy Technologies | Crystal Solar Energy | global-roam | Origin Energy | Smart Renewables | Velocity Electrical |
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**“Member promotion,
networking and engagement
remain core to our functions.”**

John Grimes, Chief Executive

Smart Energy Council

The National Voice of Solar, Storage and Smart Energy

THE SMART ENERGY COUNCIL is the peak industry body for the solar industry in Australia.

We represent companies in solar hot water, large-scale solar thermal concentrating plants, solar PV (at all scales), solar passive design and energy-efficient materials.

We also represent solar customers and consumers and provide advice to the federal and state governments the public, and commentary to the media.

As a not for profit organisation we trace our history back to 1954 in Australia.

The Smart Energy Council is committed to high-quality long-term solar and storage solutions.

All profits are ploughed back into the industry for and on behalf of the industry.

Join the Smart Energy Council for brand placement and marketing, keeping up with competitors, alignment and credibility, market intelligence and networking, and professional and career development.

Want to know more or to sign up?

***Contact Luke Shavak, Membership Sales
luke@smartenergy.org.au, 0499 345 013 or for
marketing enquiries contact Brett Thompson,
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Our programs and services are extensive, they include:

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- Industry training through the Smart Energy Training Centre
- Networking events, roadshows and summits
- Leveraging market intelligence and consolidating data
- News and updates delivered by a quarterly *Smart Energy* magazine and fortnightly e-newsletter
- Helping deliver state and national smart energy policy
- Continuing to improve quality and safety of solar and battery storage systems
- The Positive Quality program, Master Installers program, Installer directory, Battery finder, and Product directory

The Smart Energy Council is committed to clean, efficient and affordable smart energy solutions





Solar, Storage and Smart Energy Events

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Sydney

26 to 27 June 2019

<https://australia.solar-asset.management>

The inaugural edition of Solar Asset Management Australia will mark the 21st installment of the global conference series organised by Solarplaza. Learn how to maximise return on investment and optimise performance during the operational phase of solar plants.

Intersolar North America 2019

San Francisco, California

9 to 11 July 2019

www.intersolar.us

Grand Renewable Energy International Conference and Exhibition 2019

Yokohama, Japan

10 to 12 July 2019

www.renewableenergy.jp

2020 theme: Smarter evolution
smartenergyexpo.org.au

SMART ENERGY
CONFERENCE & EXHIBITION

7 - 8 April 2020 | Sydney
INTERNATIONAL CONVENTION CENTRE

6th Solar Africa 2019

Nairobi, Kenya

25 to 27 July 2019

www.expogr.com/solarafrika

The 11th Guangzhou International Solar PV Exhibition 2019

Guangzhou, China

16 to 18 August 2019

www.pvguangzhou.com

Intersolar South America 2019

São Paulo, Brazil

27 to 29 August 2019

www.intersolar.net.br

Intersolar Mexico 2019

Mexico City, Mexico

3 to 5 September 2019

<https://www.intersolar.mx>

Solar & Storage Live 2019

Birmingham, UK

17 to 19 September 2019

www.terrapiinn.com/exhibition/solar

Renewable Energy India Expo 2019

Greater Noida, India

18 to 20 September 2019

www.renewableenergyindiaexpo.com

Want to reach thousands involved in smart energy?

Give Brett a call

DID YOU KNOW? *Smart Energy* magazine is read by more than 20,000 industry professionals. Our readers include: PV solar designers and installers, large-scale solar project contractors, manufacturers and wholesalers, energy retailers, government representatives of all levels, trainers, consultants and industry thought leaders.

If you would like to boost your presence among the smart energy community across Australia, contact Brett Thompson.

Brett can also help you to highlight your brand at the industry's leading show, the **Smart Energy Conference & Exhibition**, which takes place in Sydney on April 7 and 8, 2020.

Due to unprecedented demand at residential, commercial and industrial-scale levels, the smart energy industry is advancing at a rapid rate. Brett is here to help more companies right across the supply and manufacturing chain to capitalise on more opportunities.



SMART ENERGY
COUNCIL

**Contact Brett on
0402 181 250 or
brett@smartenergy.org.au**



Warm Welcome

The Smart Energy Council would like to welcome the following new members to the organisation:

PLATINUM MEMBERSHIP

Brighte	www.brighte.com.au
Capral Aluminium	www.capral.com.au
Captain Green	www.captaingreen.com.au
Delta	www.deltaww.com
Edge Electrons	www.edgeelectrons.com
Evergen	www.evergen.com.au
Fronius	www.fronius.com
Green Deal	www.greendeal.com.au
Schneider	www.se.com
Solar Edge	www.solaredge.com
Sunshine	www.sunshineenergy.com.au

GOLD MEMBERSHIP

Canadian Solar	www.canadiansolar.com
Polyglot	www.thepolyglotgroup.com
Sunman	www.sunman-energy.com

Psst ... keep a look out for our newest membership category 'Titanium' membership being launched soon ...

Membership queries:

Luke Shavak, Membership Sales Manager

Phone 0499 345 013

Linked-In: <https://www.linkedin.com/in/lukehavak>

E: luke@smartenergy.org.au

W: www.smartenergy.org.au



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applications*

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As one of the earliest pioneers in energy storage market with lithium iron technology and intelligent BMS & EMS, AlphaESS has a vision to pave the path for everyone in the world to enjoy clean energy one day.



Solar industry Positive Quality™ and performance

THE SMART ENERGY COUNCIL'S Positive Quality™ program sets rigorous standards that ensure manufacturers who achieve and maintain high standards are singled out and recognised.

Prominent panel maker **Jinko Solar** meets those high standards and proudly displays the Positive Quality™ logo, a symbol of manufacturing excellence, which sends a signal of confidence to consumers.

Participating manufacturers are fully recognised, consumers enjoy peace of mind and the industry's reputation is strengthened, delivering **Positive Quality™** for all.

Australian consumers and businesses can have confidence in the quality of the solar panels they are installing by looking out for the **Positive Quality™**.

The Smart Energy Council developed the program because the generic appearance of panels makes it difficult to determine good from bad, unless an identification mark denotes otherwise. A logo that signifies superior quality.

The **Positive Quality™** program admits and endorses manufacturers that are independently tested and verified through plant visits. The initial assessment consists of a company's entire manufacturing processes undergoing independent and intensive inspection and testing.

This is carried out by the Smart Energy Council's specially appointed **Positive Quality™** specialists in a three step process: Certification check and compliance with IEC and Australian standards; Factory inspection with



POSITIVE QUALITY™
Continuous Quality Assurance

By displaying the Positive Quality™ logo solar companies convey high standards in panel manufacturing to industry and consumers



a 60-point check; and a Product quality check: appearance, IV, EL, Hi-Pot, and leakage current.

Positive Quality™ participants' premises are then inspected at random every 12 weeks to ensure the continuity of those high standards. All solar PV manufacturers of high quality can participate.

Contact Positive Quality™ Manager Brett Thompson on 0402 181 250, email brett@smartenergy.org.au or visit www.smartenergy.org.au

Winter ADVERTISING CONTENT

ADVERTISER	PAGE	WEB ADDRESS
Alpha ESS	55	www.alpha-ess.com
Captain Green	33	www.captaingreen.com.au
Fronius	Outside back cover	www.fronius.com.au
GCL System Integration Technology	46	www.gclsi.com
Growatt	47	www.ginverter.com.au
Lendfin	26	www.lendfin.com.au
LG Chem	7	www.lgesspartner.com
LG Electronics	Inside back cover	www.lgenergy.com.au
LONGi Solar	Inside front cover	http://en.longi-solar.com
R&J Batteries	11	www.rjbatt.com.au
REC	17	www.recgroup.com
SGB-SMIT Australia	27	www.sgb-smit.com
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Solarwatt Australia	38	www.solarwatt.com.au
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the Fronius Eco string inverter is the perfect answer to the demands of large-scale systems.

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/ Unrestricted use indoors and in unsheltered outdoor locations owing to the IP 66 protection class.

/ Quick and easy installation thanks to the Fronius Power Package system solution.

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