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OF THE AUSTRALIAN
INSTITUTE OF ENERGY



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Project Spotlight: Macarthur Wind Farm

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Cover courtesy GL Garrad Hassan

Resilience a priority



Tony Vassallo FAIE, President Australian Institute of Energy

The past few months have seen disastrous floods, fires and storms across much of Australia. Many of our members have been impacted, from Queensland to Victoria and Western Australia, and our thoughts go to those and others who have suffered.

Disasters of this magnitude almost always result in the loss of power, and it is during times such as these that we are reminded how dependent we have become on remotely generated power.

Resilience in our energy supplies must be a high priority for planners and regulators. Only a few decades ago, widespread loss of power was inconvenient but manageable with a few candles and a kerosene stove. In a modern economy loss of continuous supply of quality electricity now causes a much greater problem, as almost every aspect of our livelihood is dependent on continuous energy supply. From communications, to health care, education, industry and commerce, our dependence on a continuous supply of energy is almost complete. We have become reliant on large-scale, centralised production and distribution of electricity, which has served us extremely well and has been a major factor in Australia's economic

growth and standard of living. But the question needs to be asked – will this model continue to provide for our electricity needs in the decades to come? Aside from natural disasters, we are faced with a need to decarbonise our energy supply, replace ageing infrastructure and meet the energy needs of future generations.

In Australia, and many other countries, if you pick up a newspaper or read an online news service, the issue of escalating electricity prices is frequently seen. After many years of falling or stable prices, Australian electricity prices are rising rapidly. This has been uncritically (and often unfairly) blamed on everything from government policy, privatisation, carbon taxes and support for renewable energy. The cost increases largely result from the need to replace and augment transmission and distribution infrastructure (nearing the end of its serviceable life) coupled with rising fuel costs (especially gas) and 'peakier' demand. The latter is especially troublesome as it requires expensive generation, transmission and distribution infrastructure to be built to cater for only a small number of hours each year – typically very hot summer afternoons and cold winter evenings. The cost to generate and deliver this energy for perhaps only 20–40 hours per year can be astronomical. Yet as consumers we are still oblivious to the underlying economics and we complain bitterly when prices rise.

The current boom in resource exports might be welcomed by economists and investors in the sector, but it will also add to upward pressure on energy costs. Australia is now well connected to global energy markets and our domestic fuel costs will be influenced by global prices. Higher prices for coal, iron ore and other metals will flow through to higher capital costs for energy infrastructure, which will feed back into higher electricity prices

in the future.

While rising unit costs for electricity might seem inevitable, we can do more than just wring our hands and complain. We have become profligate in our use of energy, and there is much to be gained in using it more thoughtfully. Without much effort we could easily reduce our consumption while still growing our standard of living. Improved building design, more efficient appliances, greater use of digital technology and a host of other changes would allow us to achieve more with less energy in the next few years. Beyond that, however, real breakthroughs in energy science, engineering and technology are required. Are our political leaders in Australia thinking about this challenge? Let me get back to you on that...

Tony Vassallo FAIE

As **ENERGYNEWS** goes to print, the people of Japan are facing the aftermath of the tragic earthquakes and tsunami. Apart from the unfathomable human tragedy, these events provide an even greater focus on centralised electricity supply and in particular the role of nuclear power. It remains to be seen if these events will precipitate a review of nuclear power in Japan. While many will be quick to point out the failings of these designs, it is clear that other large industrial facilities, including petrochemical plants, have failed, and will also result in major environmental damage and health impacts. A rational approach on risks and benefits needs to be applied to all major plant, and each country should assess the suitability of nuclear power according to its own needs, resources, costs and benefits. No doubt we will continue to have a robust debate in Australia. The AIE will foster this debate, sticking to the facts, and leaving politics to the politicians.

Australian Government energy announcements

- Draft guidelines for the **Carbon Farming Initiative** (CFI) are available for review and consultation. The CFI is a proposed carbon offsets scheme to provide new economic opportunities for farmers, forest growers and landholders. Potential participants are now able to gauge how they can get involved and help identify gaps or unintended impacts of the legislation. www.climatechange.gov.au
- The second paper on the **Smart Meter Customer Protection and Safety Review** has been released by the Ministerial Council of Energy Standing Committee of Officials. The paper responds to submissions received on a range of customer protection issues with reference to the National Energy Customer Framework. www.mce.gov.au
- The Department of Resources, Energy and Tourism is calling for submissions on the discussion paper for the review of the **Energy Efficiency Opportunities** program requirements. www.ret.gov.au
- The Australian Energy Regulator has released a discussion paper proposing **objectives and priorities for electricity distribution and transmission network service providers performance reporting**. www.aer.gov.au
- The **Green Start Program** was cancelled on 21 December 2010 due to an unsatisfactory level of risk. The program was to provide energy assessments to assist householders to become sustainable through information and advice. www.climatechange.gov.au
- **Santos** will build a US\$16 billion LNG project at Gladstone after striking an offtake deal with the world's biggest LNG buyer, Korea Gas. www.glng.com.au
- The Australian Energy Regulator has released its **State of the Energy Market 2010** report, which provides an overview of Australia's electricity and natural gas markets over the past 12 months. www.accc.gov.au
- The Government has amended regulations to implement changes to the **Solar Credits** support. The regulations establish an inspection regime for solar panels and enables the division of the **Renewable Energy Target** scheme into large-scale and small-scale components. www.comlaw.gov.au
- As part of the United Nations Climate Change negotiations at Cancun, Australia has committed A\$10 million towards the **Partnership for Carbon Market Readiness** – one of the supporting frameworks that makes clean technologies more viable by providing incentives for investment. www.dfat.gov.au
- Australia allocated A\$80 million in **new funding for adaptation to climate change to the Pacific region**. Funds will be used to build capacity of partner countries to plan for and respond to the impacts of climate change such as climate-proofing infrastructure, strengthening food security and improving water catchment and storage. www.climatechange.gov.au
- Australia is supporting Indonesia's efforts to address climate change with an allocation of \$45 million. Funds will be used to accelerate demonstration work with **Indonesia's National Carbon Accounting System**. www.dfat.gov.au
- Six projects have shared in \$2.87 million of funding through the **Climate Adaptation Research Grants Program**. The fund provides seed funding for priority research identified through National Adaptation Research Plans. www.climatechange.gov.au
- A final report for the Ministerial Council on Energy's Smart Meter Working Group on **Costs and Benefits of Smart Metering in Off-Grid and Remote Areas** was released. It includes responses to submissions received on the draft. www.mce.gov.au
- Applications to the **Green Car Innovation Fund** have been closed as a result of spending cuts to support flood recovery. www.innovation.gov.au
- Australia and China have agreed to cooperate on a feasibility study towards a commercial-scale **carbon capture and storage project in China**. There is a commitment of A\$12 million from the National Low Emissions Coal Initiative towards the project. www.ret.gov.au
- The **Multi-Party Climate Change Committee**, chaired by the Prime Minister, has agreed on 11 policy principals to support deliberations on a carbon price mechanism. They include environmental effectiveness, economic efficiency, budget neutrality, competitiveness of Australian industries, energy security, investment certainty, fairness, flexibility, administrative simplicity, clear accountabilities and international objectives and obligations. www.climatechange.gov.au
- Professor **Ross Garnaut** has prepared an update to his original review, covering **Part 1 – Weighing the Costs and Benefits of Climate Change Action** and **Part 2 – Progress Towards Effective Global Action on Climate Change**. A final report is due 31 May 2011. www.garnautreview.org.au
- Seven applications are vying for two funding opportunities under Round 1 of the A\$1.5 billion **Solar Flagships Program**. The two opportunities are for photovoltaic and solar thermal projects that will demonstrate the commercial operation of large-scale solar power in Australia's competitive electricity markets. However, on 27 January 2011, the Prime Minister released a

continued on page 20

Project Spotlight

Macarthur Wind Farm

Wind power scales up in Victoria

Macarthur Wind Farm will be the largest wind farm in the Southern Hemisphere. Construction started on the billion dollar project in December 2010 and the first of the 140 turbines will arrive on site in July 2011. When the project is completed (anticipated in 2013), Macarthur Wind Farm will generate up to 420 MW of electricity – sufficient to power the equivalent of 220,000 average Victorian households. This represents approximately 3% of Victoria's electricity needs. Macarthur Wind Farm will mitigate approximately 1.7 million tonnes of greenhouse gases per year, and will contribute to the Australian Government's expanded Renewable Energy Target. The power from Macarthur will be semi-scheduled with AEMO (Australian Energy Market Operator) and therefore is expected to displace some conventional fossil fuel-fired base load generation (assuming steady growth in demand).

Construction has commenced, but only after wide-ranging and comprehensive studies of the potential impact on ecology, landscape, cultural heritage, visual amenity and other environmental factors such as noise. The planning process also included panel hearings with stakeholders.

SPECIFICATIONS

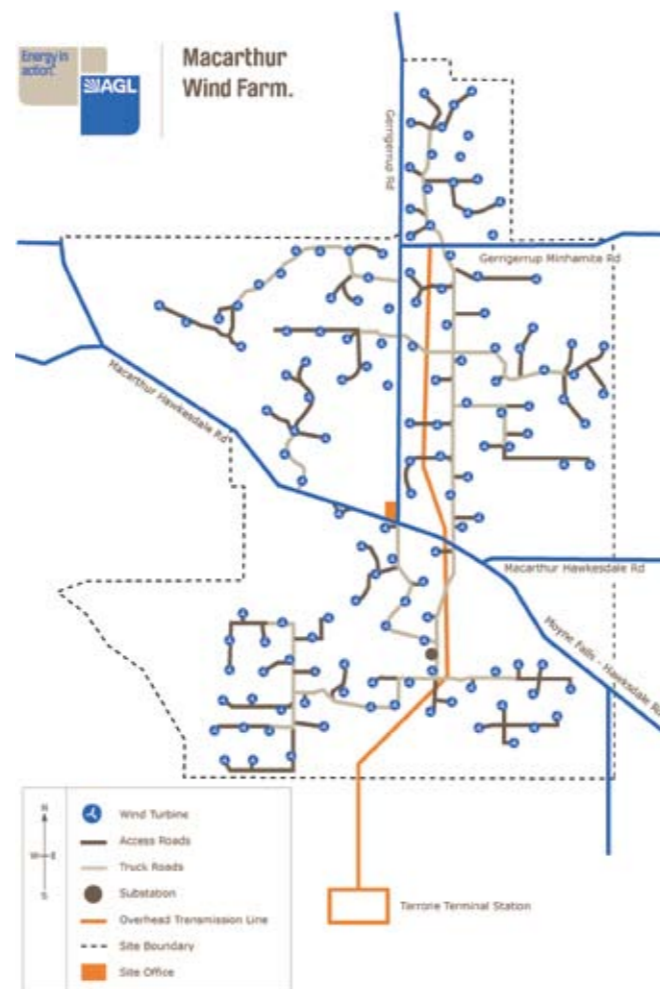
Project location:	SW Victoria
Total output capacity:	420 MW
Individual turbine capacity:	3 MW
Turbine type:	Vestas V112
Turbine height:	84 metres
Maximum blade tip height:	140 metres
Capacity factor:	35%
HV transmission lines:	21 kilometres

The Vestas V112-3.0 MW turbines are designed for low and medium wind sites, and deliver high productivity due to their large swept area, higher rotor efficiency and better serviceability and reliability. With a rotor diameter of 112 metres, swept area of 9852 square metres, cut-in wind speed of 3 metres per second and cut-out wind speed of 25 metres per second, they are well suited to the Macarthur site, which has an average wind speed of 7.6 metres per second.

Macarthur Wind Farm is a joint venture between AGL Energy Limited (www.agl.com.au) and Meridian Energy Limited (www.meridianenergy.com.au). AGL Energy was formed in 2006 from the original Australian Gas Light Company, which has been operating in Australia for more than 170 years. It supplied gas for the first public lighting of a street lamp in Sydney in 1841 and was the second company to list on the Australian Stock Exchange. AGL Energy is Australia's largest private owner, operator and developer

of renewable generation assets. Meridian Energy is the largest state-owned electricity generator in New Zealand, and all of Meridian's electricity is generated from renewable resources, mostly hydro. With a strategy to expand into a global reference company in renewable energy, Meridian Energy has ventured outside New Zealand to participate in renewable energy projects in Australia and the United States. AGL Energy and Meridian Energy are each funding 50% of the capital construction costs, and AGL Energy will acquire all of the wind farm's energy output and renewable energy certificates.

The 30-month construction phase represents one of the biggest construction projects in Australia over the next two years, and will make a considerable contribution to the economic wellbeing of the local community in and around the town of Macarthur, which is located 230 kilometres from Melbourne between the regional centres of Hamilton and Warnambool.



Schematic of Macarthur Wind Farm
Source: AGL Energy

ENERGYNEWS asked Mark Stephens, Head of Construction, Power Development, AGL Energy, about the construction aspects of the project.

Q. Who will build Macarthur Wind Farm?

A. An EPC (engineer procure and construct) contract has been placed with Vestas Leighton Contractors Consortium. Leighton is a leading national construction company, and Vestas – the world's largest manufacturer of wind turbines – brings state-of-the-art technology, quality and reliability.

Q. What is the scale of the construction project?

A. Macarthur Wind Farm has all the usual construction elements associated with a development of this nature, only more of them:

- 140 foundations each requiring ~400 cubic metres of reinforced concrete to counteract the anticipated forces and loads associated with a fully operational wind turbine.
- By the end of the civil works phase, more than 55 000 cubic metres of concrete will have been transported and placed at planned locations along 120 kilometres of onsite roads.
- Each of the 140 turbines comprises three steel tower sections each about 28 metres long and weighing around 50 tonnes.
- Each blade is 56 metres long and there are 420 in total to be supplied and erected. The combined weight of the nacelles and drive trains is around 120 tonnes, and they need to be lifted 84 metres vertically into place. This will require the mobilisation of one of the largest capacity cranes in Australia.

Therefore, the principal construction challenges are in the planning logistics, procurement and movement, and erection of oversized components.



Construction of Macarthur Wind Farm is underway
Source: AGL Energy

Q. What are the key issues for the community and how are these being addressed?

A. Communities are generally supportive of developments in their area if they can understand the drivers behind them and share the benefits. The Moyne Shire Community is no different and has contributed fully during all project phases to date to optimise the opportunities the development presents and minimise any adverse impacts it may introduce. Besides the obvious advantages of supporting a new source of clean energy, the project will create up to 900 annual construction

and manufacturing jobs in the region. In addition to the 300 onsite jobs during the peak construction period, there will be a multiplier effect of around three times for additional full-time jobs that will be created as an indirect consequence of the project. This includes opportunities in transportation, catering, accommodation, retail sales and tourism. There will be around 30 full-time ongoing operations and maintenance positions to service the wind farm during its 25-year design life.

Our Community Engagement Plan identifies all parties and our public website (www.agl.com.au/macarthur) is specifically designed to give factual information, encourage feedback and seek interaction. It is acknowledged that the finished asset will continue to operate for many years, and AGL has set up a community fund to sponsor local events and support worthy initiatives over the life of the wind farm.

Q. As the largest wind farm to be connected to the national electricity grid, what are the challenges in getting connected?

A. The turbines generate at 690 V and are transformed to 33 kV within the nacelles for onsite reticulation. Underground 33 kV cable transports the generation load to an onsite substation, which ramps the voltage up further to 132 kV for transportation to the main grid (500 kV) terminal station via 15 kilometres of overhead transmission line. To be commercially viable, a new wind farm needs close proximity to a part of the electricity grid with the capacity to accept the wind farm's maximum generation level. The double circuit 500 kV line running from Geelong to the Portland Aluminium Smelter and connecting to South Australia is the part of the grid most able to accept connection of large generators.

Victoria is unique in that there are two separate transmission entities to deal with when negotiating a connection – SP Ausnet (owner of the Victorian transmission network) and AEMO (Australian Energy Market Operator), which absorbed the functions of VenCorp in the role of planning growth and connections to the transmission network. The three-party agreements between a new generator SP Ausnet and AEMO take significantly longer to negotiate than most bilateral agreements. All generators planning to connect to the network have been encouraged to cooperate to share the cost of a common connection station. However, it is very difficult for a proponent to lock into dependency on another party's construction program, and all proponents for connection to the Western Victorian 500 kV lines have chosen to continue with their own autonomous connection. To discourage outages that could impact system security, onerous charges apply on critical lines, such as the 500 kV connection to South Australia. Also, generator performance standards are a little more challenging for wind farms than gas-fired power stations.



NSW Gas Future 2020: Big changes ahead?

Report on AIE Sydney Branch half-day symposium held on 18 October 2010 and sponsored by Lucas and the New South Wales Department of Industry & Investment

Lucas specialises in engineering infrastructure, building construction and drilling services to the property, utilities, water, coal and oil and gas sectors in Australia and the Asia-Pacific. Its interest in the gas future for New South Wales lies with its coal seam drilling technology and engineering infrastructure. The New South Wales Government Department of Industry and Investment has a role in attracting new players to the industry and supporting them technically through industry partnerships. The symposium featured seven speakers.

1. Mark Duffy
Deputy Director General
– Mineral and Energy Division
Department of Industry and Investment

State government regulation is one of the most important influencing factors in the evolution of the gas industry, and will set the framework for the future. Gas has a role alongside renewable energy in reducing the greenhouse intensity of electricity supply. Compared to coal, which is a major source of electricity supply in New South Wales, gas generates 50% lower CO₂ emissions for the same energy output. Its main application is as a transition fuel, for peak load, and as back-up for renewable sources, such as wind energy. Gas-fired cogeneration is a largely neglected opportunity which has the potential to reduce greenhouse emissions and lower the cost of generation delivery. Some lessons can be learnt from Victoria's longer history of using gas; however, New South Wales faces a different set of issues.

2. Sandra McCullagh
Research Analyst
Credit Suisse

New South Wales has very little indigenous gas resources, with annual production of 6 PJ (compared to 200 PJ in Queensland), much lower than its market size of 150 PJ. According to the Australian Energy Market Operator (AEMO), gas-fired generation will be a driver but not until 2016 onwards when the allocated installed capacity no longer exceeds the required capacity for reliability. Drivers for gas peaking generation include summer peak demand growth and wind generation. Analysis by Santos shows that the total scope for gas penetration as a percentage of power generation in New South Wales is limited to 5%, compared to 50% in South Australia. Santos argues the case for natural gas underwriting a 20% reduction in carbon emissions by 2050 while doubling the level of power generation (estimate 166% of current emissions if old coal is replaced with new coal). Stark contrasts may be seen between

Queensland and New South Wales. Drivers in Queensland include the Queensland Gas Scheme, which now requires electricity retailers and other liable parties to source 15% of their electricity from gas-fired generation; the relative ease of consents; and huge industrial demand growth, coupled with well-located coal seam gas reserves, vast reserves to attract big players and sweet spots with easy low-cost access. Queensland coal seam gas-to-LNG projects will have some impact on the New South Wales market through gas swaps.

3. Graham Dowers
Generation Development Manager
TRUenergy

A 2015 technology ranking of the levelised cost of technology and CO₂ emissions for various generation options shows closed cycle gas turbine (CCGT) generation outperforming wind on both counts, but this technology struggles to attract investment under current national policy settings, which are driving the market towards wind and less efficient peaking gas rather than base load gas. A carbon price would greatly support growth in CCGT. As a result of the failure of the Australian Government to establish a price on carbon, the Australian electricity sector is now entering in a period of unprecedented uncertainty, with investment in generation drying up. This will result in supply shortfalls in several states within the next few years (see Figure 1). Investment in gas base load generation will not take off until policy is aligned nationally and a carbon price introduced.

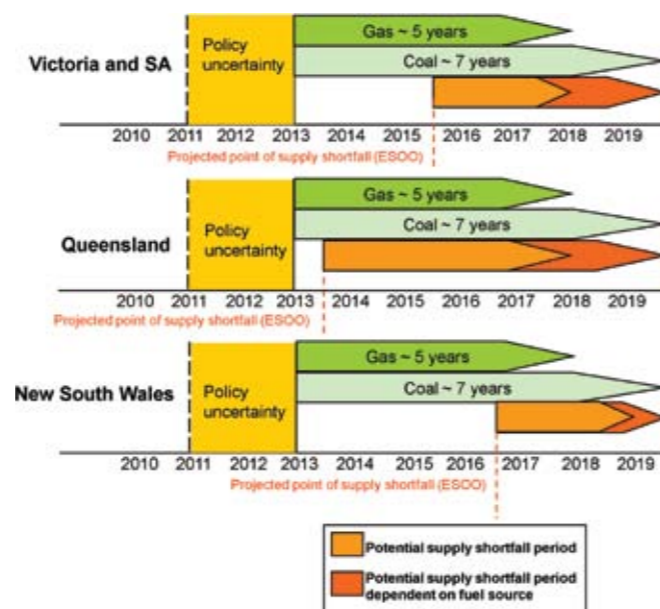


Figure 1: Investment lead times under current policy settings
Source: AEMO; Deloitte Economics; TRUenergy

4. Graeme Dennis
Partner, Clayton Utz

The major regulatory issues shaping the market are 'carbon, carbon, carbon' – along with renewables, the short-term trading market (STTM) and the national retail regulation framework. The National Energy Customer Framework, driven by the Ministerial Council on Energy, will harmonise retailing rules across gas and electric energy and will be implemented between 2011 and 2013. The STTM, operated by AEMO, is the recently introduced compulsory market for the wholesale trading of natural gas. The market uses bids, offers and forecasts to determine schedules for deliveries. The market sets daily market prices and settles each hub based on the schedules and deviations from schedules. The intermittency of renewables presents opportunities for gas (wind 30% capacity factor; solar PV 25% at best, 15% on average). Renewables also present challenges to gas, such as a low entry price due to subsidies (eg RETs) and crowding out new entrant 'peakers'. While the challenges to gas from renewables will remain after the introduction of a carbon price, new gas plant will become much more viable than coal, with the carbon price lifting coal-fired generation costs higher towards the cost of gas (Figure 2).

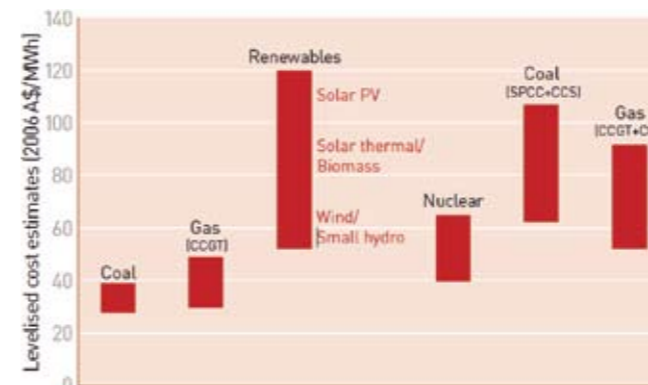


Figure 2: Lifecycle economic costs of electricity generation
Source: Australian Energy Regulator, 2009

5. Kevin Lester
Director Technical Services
AJ Lucas Group Limited

There are many opportunities in gas in both New South Wales and Queensland; but, advanced drilling technology is needed to release the methane. Issues the industry is facing include NIMBY (not in my back yard) campaigns; the need to protect aquifers; and use and disposal of water produced in the mining process. While little conventional gas has been found to date in New South Wales, the state is 'awash' with gas in unconventional sources including coal seam gas, gasification of coal and shale gas in the west. New drilling technologies (vertical drilling, horizontal drilling, fracturing) provide access to some of these resources. Underground gasification (burning coal in a controlled environment) can produce 30 times more energy per cubic metre of coal compared with a cubic metre of coal seam gas.

6. Phil Randall
Managing Director, EnergyAdvice

One of the key issues for gas users over the past decade has been security of supply. While the market has generally responded

effectively to supply crises, there have been notable exceptions (eg June 2007 winter gas curtailment). Variable levels of retail/supplier competition and lack of market price transparency have also been features. The Gas Market Bulletin Board, which commenced in July 2008, provides capacity information but no commercial or trading mechanism. The STTM provides some pricing visibility, but there is a lack of market depth at this stage. New pipelines have brought gas into New South Wales from the Gippsland Basin (Eastern Gas Pipeline) and from Queensland (QSN Pipeline). There remains a lack of available capacity, encouraging new pipelines and supply sources. Potential future developments include a pipeline link between northern New South Wales and Sydney/Newcastle and a Queensland–Hunter pipeline. A market snapshot for 2020 would show a more mature and effective market for gas trading and physical swaps; base load gas-fired power generation; and increased supplier options, with questions remaining around upstream consolidation; LNG markets; electricity generation; pipeline capacity and market depth.

7. Anthony Szatow
Project leader–Intelligent Grid
CSIRO

Distributed electricity generation from gas in New South Wales is an idea whose time has come. Projections by CSIRO of net energy costs to 2050 with and without distributed generation, based on the Garnaut 450 ppm scenario, put the value of distributed generation at \$130 billion by 2050. In the distributed generation outlook, energy and built environment systems will increasingly converge, including governance structure. CSIRO is looking at how this could best work. Scenario analysis indicates that distributed generation can do much 'heavier lifting' (Figure 3).

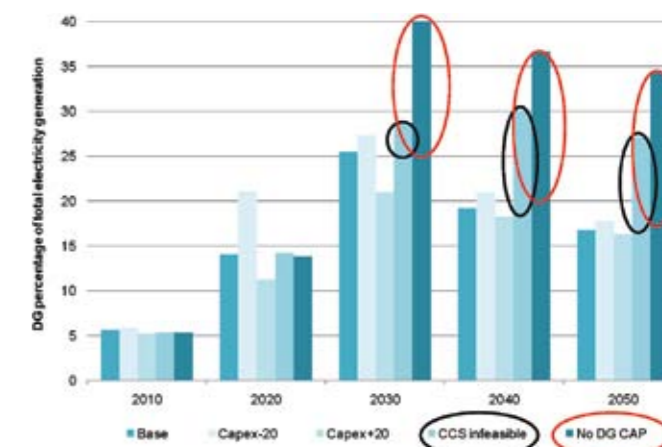


Figure 3: Uptake of distributed generation – sensitivity analysis
Source: CSIRO

Uptake of distributed generation will be influenced by many factors, including gas price, carbon price, technology evolution, water availability (for centralised generators), the grid connection process, future operating models and system governance. Building regulations can be a useful anchor point, as can minimum CO₂-e benchmarks. Distributed energy is an opportunity for emerging business models, but will challenge existing business models and governance regimes.

Site Visit: Newport Power Station

AIE Melbourne Branch started the year with a site visit to Newport Power Station on 4 February 2011

Commissioned in 1980 to supply peak power to Victoria, Newport Power Station is a familiar outline on the Melbourne skyline. Situated just 13 kilometres from the CBD on the road to Williamstown, the power station had a controversial beginning. Now, it is an integral part of the electricity supply network in eastern Australia.

Process Technician and tour guide, Russell Brown, was an amiable and informative host. Tour participants enjoyed a close-up view of the boilers, turbines and cooling system, and panoramic view of the city and Port Phillip Bay from the roof.

Originally designed as a 1000-MW facility, only one unit was built and the current capacity is 510 MW (gas-fired, on cooler days). This is reduced to around 500 MW on hot / humid days. In emergencies the boilers can be fuelled with diesel but it uses a tanker of fuel every two hours at its maximum capacity (on oil) of 480 MW.

The plant was operating on the day of the tours in response to relatively high wholesale electricity prices caused by hot weather in New South Wales. Newport usually comes on to the grid at about \$40 per MWh. It can shut down and start up quickly – three hours cold start / one hour hot start.



Turbine housing, Newport Power Station

Old-style gas boilers produce steam to drive turbines. The steam is superheated to 540°C and passed through the high-pressure turbine, which has been replaced once in its 30 years of operation. Steam is returned to the boiler for reheating, then passed through the intermediate-pressure

and low-pressure turbines – both original units. Cooled by seawater, the steam condenses back to water to be reused. Russell recalled the day that a large group of jellyfish brought the power station to a stop for a short time when they blocked the screen in front of the seawater inlet pipe!

The plant's control systems are being upgraded from panel board to computer screen. The control room also remotely operates the gas-fired Jeeralong Power Station, near Morwell in the Latrobe Valley.

The morning tour included two engineers involved in the original construction – Keith Sutherland FAIE and John Gregory MAIE – who recalled that the SEC (State Electricity Commission) built power plants to last. From the outside it is impossible to tell whether the plant is operating or not. There is no noise from the operations or smell / smoke from the 183-metre chimney. The former maintenance workshop still houses the original models created by the SEC's (then) dedicated modelling workshop and used by draughtsmen to make sure the pipes were all in the correct location.



John Gregory and Keith Sutherland in the control room

Given there is still room to add another 500 MW of capacity, the Newport Power Station may be expanded, but this will depend on incentives such as a carbon tax. A combined-cycle plant would increase efficiency from around 36% to 55% and could be used for base load power.

The AIE Melbourne Branch site visit proved so popular that a second tour was organised, and both tour groups enjoyed a delicious lunch together at the nearby Pekish restaurant.

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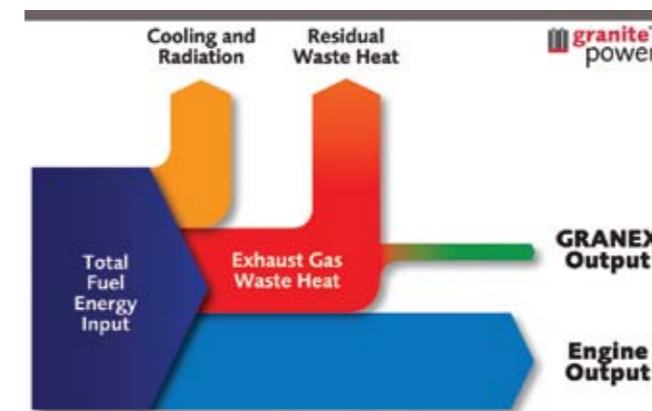
Geothermal Energy: Current state of play and developments

Annual Meeting of the Four Societies (Nuclear Engineering Panel of the Sydney Branch of Engineers Australia; Australian Nuclear Association; Royal Society of New South Wales; and AIE Sydney Branch) held on 24 February 2011

This year's Four Societies event featuring Dr Stuart McDonnell, Chief Operating Officer, Geodynamics, and Stephen de Belle, Managing Director and CEO, Granite Power, attracted more than 100 attendees. The event was supported by Industry and Investment NSW, which provided the venue and catering.

The current product offerings and innovations of Granite Power include GRANEX™, a Regenerative Supercritical Rankine Cycle for improved conversion of low-to-medium temperature heat into power, and delivering a significant reduction in unit cost of power relative to traditional technologies. A 1 kW proof-of-concept plant and a 100 kW prototype plant demonstrating the GRANEX technology have been built and tested.

In Australia, most geothermal opportunities are engineered geothermal systems (EGS), and this application was the genesis for GRANEX. The recovered waste heat market is also a great opportunity for low-to-medium temperature energy technology systems, but a major challenge has been the accurate measurement of the available resource, which includes waste heat from stacks, smelters, furnaces, and many other sources of industrial waste heat.



Indicative GRANEX engine energy balance Source: Granite Power

Key challenges for the roll out of the GRANEX technology include the difficulty in deploying the technology at initial reference sites, negotiating initial sales, and enhancing cycle efficiency at low temperatures. The Latrobe Valley in Victoria and the Hunter in New South Wales have great potential as a geothermal resource due to their heat resources, their proximity to existing high-capacity grid connections, their current 'brownfield' land status and the potential for the incumbent fossil-fuel labour sector to transition to new growth sectors such as geothermal energy.

Geodynamics has conducted a number of investigations in the Cooper Basin, located in the centre of Australia, and

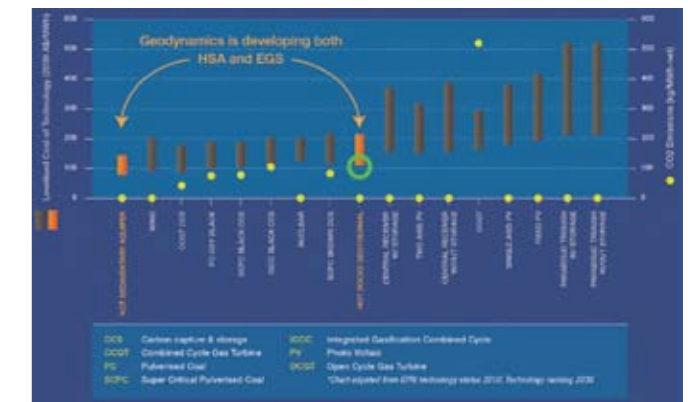
has assessed that there is 6500 MW of geothermal resource available. Key technical issues have included predicting and controlling the chemistry of the rising water; controlling rock fractures, which are required to allow the water to sweep the available heat field; and maintaining component integrity under operating pressures exceeding 34 MPa.

Scaling should not be an issue with geothermal systems once plants in the 25–40 MW range have been deployed and validated. The critical areas of interest to Geodynamics in terms of plant operations are subsurface fracturing and drilling, and surface-level heat exchangers. Much has been learnt about the chemistry of the recovered hot water, such as the discovery that antimony or other metals can be present and this presents a challenge in the operation and maintenance of surface-level plant.

Although geothermal heat fields may be exhausted, it is expected that plants comprising wells laid out in a one square kilometre grid pattern will produce reliable heat for the duration of the plant's working life.

Globally, geothermal systems have achieved success rates exceeding 90% with respect to the heat recovered from plants deployed. Yet despite this, and the abundance of quality resource in Australia, the Australian private investment community has consistently failed to show interest in geothermal and waste heat recovery technologies.

This is partly explained by the estimated A\$43/MWh subsidy that is available to conventional coal-fired power generators, due to the neglect of capital recovery and the continuation of very low cost coal contracts, thereby artificially lowering the levelised cost of electricity (LCOE) available from such plants. Given the maturity of long distance HVDC transmission, geothermal energy is expected to be a competitive energy source in the future, with an LCOE as low as A\$89/MWh.



Cost comparison of future technologies Source: Geodynamics

The rising pressure to deploy renewable technologies, partly driven by the imminent expiry of current coal supply contracts, is expected to improve the future outlook of the geothermal technology industry.

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From left, Stephen de Belle (Granite Power), Dr Stuart McDonnell (Geodymanics) and Denis Cooke (AIE Sydney Branch)



Energy Efficiency in the UK

Presentation by Graeme Cuthbert, Head of Energy Security, UK Department of Energy and Climate Change, to Sydney Branch on 1 November 2010

The United Kingdom has made a legally binding commitment to reduce its greenhouse gas (GHG) emissions by 80% by 2050, and aims to work towards this goal by setting 5-year carbon budgets, which simultaneously address decarbonisation, energy security and energy efficiency. The UK Department of Energy and Climate Change (DECC) recently released a report analysing how to deliver deep GHG emissions reductions in the United Kingdom. One of the key issues that arose was that GHG policy and investment decisions made over the next ten years will have an effect on emissions and investments all the way out to 2050. The process highlighted that this is a very challenging and complex issue for all stakeholders. DECC therefore decided to help stakeholders better understand the various GHG reduction actions available and their implications. This involved the development of a GHG actions model, available on DECC's website (www.decc.gov.uk), which contains a whole range of GHG reduction options available, their various characteristics, and how their selection would affect the United Kingdom's future GHG emissions. The aim is to allow stakeholders to play with various options and see the consequences of the choices made, in order to help them to understand the various challenges faced in developing policy solutions.

DECC has developed a number of scenarios for the United Kingdom's energy and GHG emissions future out to 2050 consisting of various low-carbon energy sources and energy uses. These were used to illustrate a variety of issues and challenges in achieving the 80% GHG reduction target. Some key takeouts were:

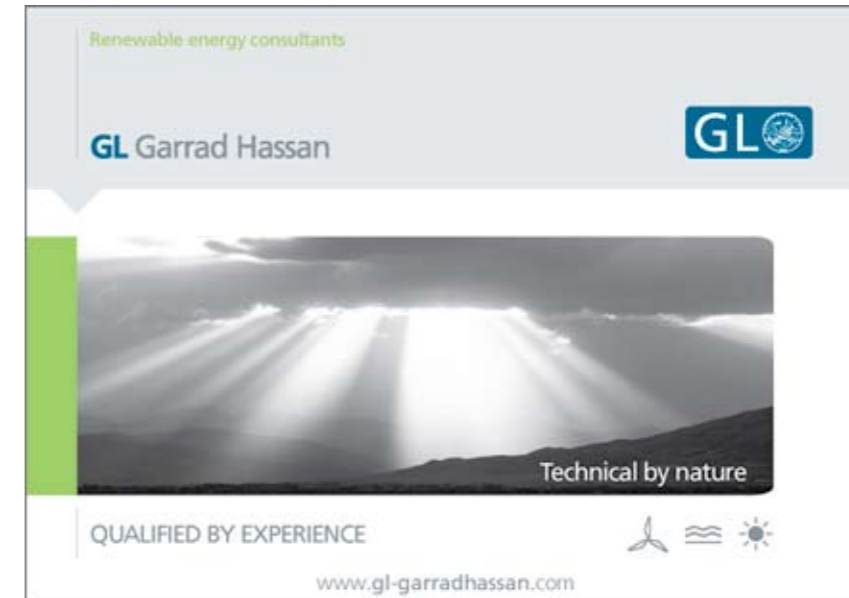
- Overall energy demand would need to stay roughly constant over this period, meaning there would need to be very significant improvements in energy efficiency to offset business-as-usual growth in energy demand.
- A significant switch away from fossil-based fuels to electricity (eg for industry, heating, electric vehicles) would result in a significant increase in demand for electricity.
- To achieve the 80% GHG reduction across all GHG sources by 2050 effectively means a 100% GHG reduction in the energy sector by 2050. This is a massive challenge.
- In addition to large-scale low-carbon electricity, the United Kingdom will also need to use substantial amounts of sustainable bioenergy to meet this target.
- Issues relating to feasibility, construction times and intermittency for some of the energy supply technologies included in the scenario (eg CCS, nuclear, wind) are

indicative of the many challenges to be faced.

The costs of various GHG emissions reduction options available are often presented in marginal abatement cost curves. While cost is one factor, there are many other issues that need to be addressed, including the need for behavioural change and the political sensitivity of specific options. This may mean that just choosing the 'cheapest' option is not always practical. DECC's general policy aim is to progressively implement options with a negative or low abatement cost where feasible, while pursuing a range of technology options (some of which may have a relatively high cost per tonne of GHG emissions abated). Shifting from conventional fuels to renewables as well as nuclear as a basis for electricity production entails shifting from a predominantly operational expenditure cost structure to a more heavily capital expenditure cost structure. The government is considering a range of reforms to the electricity market to bring forward this investment.

There are other key issues driving energy policy in the United Kingdom beyond decarbonisation, including energy security and energy costs. Specific examples include the United Kingdom's dwindling indigenous fossil fuel reserves and the risk of increasing fossil fuel prices over time. With regard to the latter, a comparative analysis has been completed of a low-carbon future pathway versus a business-as-usual situation for varying future oil price scenarios. The conclusion from this analysis was that for oil prices above US\$110–120/bbl, the low carbon pathway becomes the cheaper alternative, emphasising the risks to the United Kingdom of increasing fossil fuel prices.

Two significant energy policy proposals are about to be released in the United Kingdom – the Green Deal and Energy Market Reform. The Green Deal will involve the government setting up a major energy efficiency program. The costs of these measures will be paid for over time through energy bills so that costs and savings are essentially tied to a site's energy meter/account as opposed to the customer. This means that if a person leaves a property, repayments stay attached to the property. Details on the Energy Market Reform are not yet available as a consultation paper is soon to be released. However, significant market reform is needed to enable the market to function effectively in the face of the major changes to both the supply and demand of energy envisaged in working towards the 80% GHG emissions reduction target. EN



An Engineering Sabbatical in the Pacific Islands

By William Thorp, Senior Engineer, GL Garrad Hassan

In 2009, I offered to work for six months in a voluntary capacity as renewable energy engineer with the electricity utility, EPC based in Apia, Samoa. Like most Pacific island countries, Samoa is very keen to reduce its reliance on diesel for electricity generation. Some work was already underway to measure the wind resource and I moved this work forward with the installation of new wind monitoring equipment and I modelled the results with the assistance of GL Garrad Hassan in Melbourne. Potential wind farm sites were identified and assessed by determining their modelled and measured wind resource, topography, land ownership, accessibility and grid access. A monitoring and development plan was proposed for EPC for Samoa's wind energy development and negotiations with landowners were commenced.

After the six-month secondment to EPC, I completed a six-month contract as Renewable Energy Officer with the South Pacific Regional Environment Programme (SPREP), also based in Apia, Samoa. There I worked on the Pacific Islands Greenhouse Gas Abatement through Renewable Energy Project (PIGGAREP).

I assisted PIGGAREP activities in Samoa, Nauru, Tuvalu, Fiji, Cook Islands and Vanuatu by installing monitoring masts, selecting wind monitoring locations, selecting potential wind farm locations, preparing feasibility reports and strengthening capacity in each of the countries. I was able to fill the knowledge gap between the consultants employed and the PIGGAREP administration and review reports and recommendations, by performing activities that would otherwise have required external consultants at greater expense.

The inaccessibility and lack of development of some of the locations visited is a barrier to their development. For example, Niulakita Island in Tuvalu was accessed by a sixteen-hour boat



Unelco Wind Farm, Efaté, Vanuatu, comprising 11 Vergnet 275 kW turbines

trip, and landfall cannot be made in high seas, and Tongoa Island in Vanuatu has a grass airstrip that is unusable after heavy rain.

There are few suitable models of wind turbines on offer for Pacific sites and grids. Modern, internationally certified, reliable turbines are required in the 50–300 kW size range and they need to be capable of surviving extreme winds and a corrosive marine environment.

The economies of the Pacific island countries are being crippled by the cost of importing fuel. Significant opportunities exist for independent power producers and energy project developers in the region. The regional organisations and the utilities in each country are open to proposals for projects. Wind, solar PV, biomass and hydro are all options that, when implemented carefully, can compete favourably with the often unreliable diesel generation.

Funding and regional organisations involved in energy in the Pacific include SPREP, SPC/SOPAC, IUCN, UNDP, the World Bank and GEF.



Electricity Losses: Do they matter?

By Martin Thomas AM FTSE HonFIEAust FAIE

Mankind is naturally wasteful. Faced with plenty, we choose low-hanging fruit with little thought of replacement, often spoiling its original value. Does this matter? Not really, provided the fruit continues to grow in season with little effort and minimal competition. There is plenty for all. Nature provides.

To some extent Australia, the 'lucky country,' epitomises this mindset. We Australians enjoy sun, water, minerals and energy in abundance. So why should it matter that we waste much of these resources through inefficiencies? Losses get more serious when populations increase, competition arises and resources, previously free – eg water – command real prices in competitive markets. Capital is invested in the means for creation and distribution of developed end products in forms called for by that market. Losses matter much more as systems – water, energy, food, transport – become more sophisticated and more capital and job intensive. So it is with electricity. The product is certainly sophisticated: precisely controlled voltage, fixed frequency, absolute stability, unquestioned reliability and other desired attributes now command serious market value. Of course losses matter! They translate to money and are inevitably painful to the customer.

Some claim that losses of electricity generated from 'free' renewable resources – sun, wind and waves – are costless. Nothing could be further from the truth. 'Free' renewable energy sources require massive costly infrastructure investments to bring electricity to customers. Needed capital can only be paid for through sales. It clearly follows that electricity lost is income foregone to the supplier and thus is an invisible extra cost to customers. That the cost of electricity is growing fast, and forecast to continue growing, is abundantly evident to those who pay the bills.

So electrical losses must be minimised, but how? Who pays? Why? At what point along the pathway from source to end use? And with what resources? Classical economic theory claims that the stick of intelligent regulation plus the carrot of unconstrained markets provides for the best directed and most efficient allocation of resources. It makes no sense at all, for example, to allocate substantial land, labour and capital to generate electricity from free abundant energy services such as the sun, wind and tides if the notion of free energy translates to needless losses along the customer pathway.

However the measurement of and accounting for such losses and the provision of market signals to help minimise them, as technology can, is quite a different matter. This is ably demonstrated by Harry Colebourn in his recently

cited EESA 2010 Conference 'best paper' entitled The cost of losses for future network investment in the new network regime. Colebourn's scholarly work guides us through the varied nature of electricity losses from energy source through generation, transmission and distribution to the customer, for today and into the foreseeable future. Colebourn shows us first how losses are categorised as no-load or 'shunt' and load or 'series'; in other words losses that occur continuously in a live system, whether loaded or not, and losses which depend directly on the load and its magnitude – the I2R losses some will recall from university lectures. He then identifies these losses following the electricity pathway from generation through transmission, distribution and end use, calculating the long run marginal cost (LRMC) of losses for each step. Although constrained in his analysis to New South Wales, the results are illuminating.

Nationally, according to published data, some 7% of electricity generated is consumed in internal losses and auxiliaries consumption at the power station, with the balance being net 'electricity sent out'. Losses following in the national transmission system are also substantial, typically another 7% through the step-up transformers, switching stations and the nearly 40 000 kilometres of high-voltage overhead and underground transmission lines and cables (220 kV up to 500 kV) that interconnect and span Australia's states. A further 7–9% or more, depending on numerous local factors, is lost in lower voltage, more scattered customer distribution systems, typically from 132 kV down to 240 V single-phase at the average domestic customer's meter. Conventionally the power from large coal, gas-fired or hydro generators is supplied at around 25 kV and immediately stepped up to a higher voltage through the adjacent power station transformers for direct feed into the transmission system. This minimises losses at the first step of the customer pathway, although at this stage values are still low, especially for base load power. This is not the case for many renewables which, through low source intensity, are generally distributed widely and remotely in much smaller generation units. Wind farms typify this paradigm, introducing a further loss factor, which my colleague John Sligar in a recent submission to the Prime Minister's Task Group on Energy Efficiency described as an 'assembly network'. His submission pointed out that with low wind generator terminal voltages of say 600 V, and lower from solar panels, the assembly network is far more widespread, comprising inverters, long medium voltage feeders and numerous relatively small transformers before grid voltage is attained. Average losses in the assembly network, depending on topography and line lengths, can be significant with estimates of 5–10% or more being

quoted. But, given the squared loss multiplier for current flow, it follows that losses at system peaks are firstly much higher than the average and, by definition, occur when electricity value is at its highest. The world of losses and quantification of their value in terms of revenue foregone is indeed complex.

To get the value of losses into a broader context, Australian power stations of all types generated just over 250 TWh of electricity in 2008–09. We may assume, very approximately, that average end-to-end system losses, excluding the power station and the assembly network at this time, are around 15%. If the sale value is taken as a modest \$120/MWh (Colebourn uses generally higher LRMC figures), then Australia-wide losses cost at least A\$4.5 billion each year and probably more. We must bear in mind that so called subsidised feed-in tariffs of 60c/kWh (A\$600/MWh), designed to stimulate renewables investment, suggest that yet higher electricity values could be considered.

Losses, regardless of energy source, are thus far from insignificant and certainly not free. Indeed, depending on the carbon intensity of the source (negligible for hydro, wind, solar, geothermal and nuclear), system losses contribute around 30 million tonnes of CO₂ each year. Such emissions will, very soon, command their own price through tax, trade or hybrid. In short, electricity losses are a substantial economic burden.

So much for the problem – but what is the solution? How do we reduce such losses to the economic minimum? Regulatory instruments are still blunt but effective, so improvements are desirable. Market forces are generally a more refined and intelligent answer, although both stick and carrot must play their part. With national losses so costly it behoves us to consider how we should invest most effectively to reduce them. What, for example, is the economic case for larger diameter low-loss copper power cables, low-loss transformers and other supply equipment and even, for example, superconducting cables in the future? What is the role for system minimum energy performance standards (MEPs), commonplace for appliances, and a host of other efficiency improvement measures? What can we achieve with intelligent grids and dramatically better load control systems in our businesses and homes? This market space is still on the threshold, and sorely in need of national standards and an appropriate regulatory environment that properly recognises and reflects the cost burden of system losses.

The classic means of engaging market forces is to ensure that price signals impact the person or organisation that benefits from loss minimisation investment. But does not this happen already? No, explains Colebourn, it does not! He notes, for example, that there is currently no direct regulatory incentive scheme for distribution businesses to minimise their system losses.

For transmission and distribution, what price signal incentives drive loss reduction investments? Colebourn takes us through the complexities of bulk measurement, LRMC calculations and settlement arrangements in the

generation, transmission and distribution systems. As noted above he exposes limitations in recording and directing the correct loss prevention price signals to those who could take action, especially network owners. If properly captured, directed and analysed these signals could, where economically warranted, encourage corrective investment in, say, efficient low-loss transformers, higher capacity cabling and overhead conductors, increased HV transmission voltages and more.

For consumers in the home, apartment, office, business and factory, the potential for energy efficiency and loss reduction is immense. In my active energy management practice days, both in Australia and overseas, I would confidently predict 25% potential energy reductions (at least as compared to unconstrained business-as-usual growth) with economically rational investments showing a 2–3 year payback or less. I would make that same prediction today; not because little has been done since the 1980s, but because advanced technologies such as low-loss variable speed drives, computer-based measurement and control devices, smarter sensors and faster online analytical tools have all raised the potential for yet further efficiency gains by automatically managing consumption to programmed criteria. Energy efficiency 'beyond the meter' must inevitably reduce the ratio of overall system losses to useful load.

I conclude with just four observations on the future of electricity supply systems and their likely impact on losses.

1. The fast rising price of electricity and its likely future trajectory must harden the case for enhanced energy efficiency and the collection and focussing of loss-related price signals on system investors, owners, managers and operators. Some commentators forecast electricity price rises up to 300% by 2020, far above predicted economic growth rates of 2–3%. The critical need is to focus those signals more effectively.
2. Without substantial debottlenecking investment in transmission and distribution systems, the squared losses attributable to system peaks, arising from home air-conditioners, for example, can only increase.
3. A price on carbon and an increasing shortage of base load generation capacity will drive investors firstly towards gas – as is now the case – then to advanced clean technologies, such as subsidised renewables with storage, coal with carbon capture and sequestration, and eventually nuclear and geothermal. Significant supply system investment will be needed to cater for changing load flow patterns.
4. Electric vehicles will soon be ubiquitous. They will impact systems significantly, increasing load flows (and hence losses) but also contributing to system stability and security through their online storage capacity. New supply system investment will be needed as load flow patterns adjust to the shift from oil to electricity for domestic transport.

In summary, the substantial economic burden of electricity losses, exacerbated by growing costs, warrants more

exhaustive, better informed and far sighted long-term investment analysis in transmission and distribution systems. Planning horizons, often short and expediency driven, must extend to take account of the true economic impact of losses in developing core national assets. National standards

(deriving from international models), far sighted policies and regulations that give due weight to the real cost of losses are all part of the solution. Colebourn and Sligar have made a sound start in articulating the problem; much more lies ahead to deliver effective solutions. **EN**

Waves of Change: A review of marine energy developments

By **Jeremy Cavanagh MAIE***

After some 30 years of development, marine energy could be on the brink of commercialisation. Just two years ago wave and tidal technology developers talked about testing single prototype devices at sea. Fast-forward to 2011 and this nascent industry has a challenge of Apollo-project proportions to develop and deliver by 2020 a pipeline of international projects of over 1.6 GW.

A plethora of wave and tidal energy converter designs exists, with the United States Department of Energy listing more than 140 different international wave designs. Some are still on paper, some are being tested in tanks, while others such as Australia's Oceanlinx Oscillating Water Column and Scotland's Pelamis line absorber have been extensively tested in the ocean with connection to the grid. So far only two shore-based wave devices – Portugal's Pico and Voith Hydro's Wavegen Limpet in Scotland – totaling just one megawatt, have been tested generating energy into the grid for sustained periods over the past 10 years. Since 2008, the Seagen 1.2 MW tidal flow generator has been successfully operating at Strangford Narrows in Northern Ireland. Reporting overall efficiencies of 40–45%, it is the first offshore generator to achieve certification by OFCOM, the United Kingdom's electricity industry regulator, selling into the grid and earning Renewable Obligation Certificates (the United Kingdom equivalent of RECs). Despite this tiny capacity, it is clear why ongoing effort goes into this sector. The World Energy Council estimates economically accessible wave energy at around 800 GW or approximately 2000 TWh per year, with the deep ocean resource estimated at between 8000 and 80 000 TWh. Renewables UK estimated in 2007 the global accessible tidal current resource as 90 GW.

Wave technology developers work with five basic energy capturing configurations.

1. Overtopping (similar to a barrage pond floating at sea) – Denmark's Wavedragon
2. Oscillating Water Column (OSC) – Oceanlinx
3. Point Absorber (buoys) – Carnegie's CETO
4. Line Absorber – Pelamis
5. Terminator – Aquamarine Power's Oyster.



*Aquamarine Power's Oyster in operation off the UK
Source: The Crown Estate*

The variety of designs arises from tradeoffs in both exploiting the wave resource (a spectrum of both kinetic and potential energy) and trying to survive it. For example, Oceanlinx's OSC sits on the surface where energy is the greatest while Biopower's wave and tidal devices sit on the seabed experiencing exponentially less energy but costing less to survive. A sign of the scope for commercialisation is the emergence of 2nd generation designs such as that by 40SouthEnergy, where point absorbers are attached to a submerged truss, constructed from off-the-shelf components that automatically adjusts depth for resource. Its inventor, Dr Michele Grassi, said that this results in near constant output without needing to build for storms.

Then there are some novel approaches such as Checkmate Seenergy's Anaconda, a 200-metre long submerged rubber tube. Designed by physicists Dr Francis Farley (who started with radar in the Second World War) and Rod Rainey, Anaconda works by passing waves generating water bulges in the rubber tube that travel along its length ahead of the passing waves to drive a turbine fixed at the end and generating up to 1 MW. Tidal flow designs are already converging in design, such as Atlantis and MCT with bladed designs, and OpenHydro with its bladed turbine.

Until now funding for developers has been a mixture of subsidy that is either program specific (United Kingdom Carbon Trust's Marine Energy Development Fund or New

Zealand's Marine Energy Deployment Fund) or mixed with private investment. On commercial readiness the majority consensus of funding bodies, trade associations and developers is "not right now", with the expectation of three to five years before the emergence of commercial wave projects but with tidal maturing faster. Dr Tom Denniss of Oceanlinx said that they expect to start projects on a positive ROI basis within two years.

Dr Steve Wyatt, head of the Carbon Trust's Marine Energy Accelerator Program in the United Kingdom, likens wave energy to the position of wind energy in the 1980s – a fragmented market with a variety of systems and technologies. Dr Wyatt said that he believes wave and tidal will catch up fast because we have a better understanding of how technology is developed with less barriers than 20 or 30 years ago, and wave energy will benefit from the political and public push for lower emissions from renewable and secure energy.

The harsh marine environment requires a different development effort to wind; being on land made many different iterations relatively easy while the ocean is difficult to access and monitor, requiring specialist expertise and expensive facilities. Biopower's Dr Tim Finnigan estimates that it costs up to A\$30 million to get one design to the commercial stage.



*Open Hydro's Turbine test rig near Orkney off the coast of Scotland
Source: The Crown Estate*

Projected costs (in 2006) for marine electricity were in the range A\$0.63–0.71/kWh for the first MW; reducing to A\$0.19/kWh for 1 GW before any government support. In 2007, Ernst & Young gave an estimated cost in 2020 equivalent dollars of A\$0.24/kWh for wave and under A\$0.22/kWh for tidal. The industry view is that arrays will be the only economical way to operate, and, according to Dr Wyatt, marine energy should aim to become cost-comparable with other renewables, not coal. However, already 2nd generation developers are claiming to be able to beat the costs above. 40SouthEnergy claims its F series wave energy converter will achieve 80% capacity for a levelised cost of electricity of US\$0.16/kWh (IRR 10%), while Checkmate claims Anaconda, due in 2014, will cost under A\$0.14/kWh.

It is the ambitious single plan of 1.6 GW by 2020 that is the leap for marine energy. Initiated by the Crown Estate for the Pentland Firth in Scotland, highly energetic ocean sites have been leased to a number of wave and tidal ventures for up to 25 years. The Crown Estate owns the seabed out to the United Kingdom's territorial limit and John Callaghan, Program Manager for Wave and Tidal, said that the reasons for undertaking what many in Australia would consider a very risky and large leap with a not yet commercialised technology was to turn underutilised ocean assets into long-term revenue prospects, while creating a visible market for wave and tidal.

A number of factors mitigate the risk for the Crown Estate based around its experience in pioneering offshore wind leasing. Starting more than 10 years ago, it is now on the third leasing round of 35 GW by 2020. Mr Callaghan sees offshore wind sharing a number of aspects with wave and tidal including: construction in the same environment, similar consenting and permit processes, sharing stakeholders such as the fishing and shipping sectors, environmental constraints and connection into the grid. For the Crown Estate the biggest difference is the immaturity of wave and tidal technologies compared with offshore wind 10 years ago. The construction profile is for different leaseholders to commence installation in 2014–15, close to industry expectations on commercialisation. From an Australian perspective, it is interesting to note that Atlantis Resources has a 10% share in the 400 MW MeyGen consortium lease.

Industry participants say that there are wider pointers to marine energy taking off than just the Pentland Firth, including:

- Pedigree manufacturers such as Voith, Rolls Royce, Siemens, BAE Systems and Alstom either partnering with technology developers or taking stakes.
- Joint generating ventures such as the Atlantis Resources/Gurajit Power Corporation 50 MW tidal project in India.
- International utilities getting involved, such as EDF testing Pelamis' P2 wave energy converter at the European Marine Energy Centre (EMEC) in Scotland.



Pelamis 2-1 wave energy converter
Source: The Crown Estate

- Development of a supply chain; for example, the renewable energy firm RES concentrating on project development services and not technology.
- Strategic infrastructure such as the EMEC in Orkney.

“The effort in the next 10 years is to get where we can push the button on wave and tidal commercial deployment,” said Dr Wyatt.

Developments in Australia

Australia has access to the world’s largest amount of wave energy with long uninterrupted swells from the Southern Ocean hitting our southern coastline. The energy in these shoreline waves, according to a joint Geoscience/ABARE report, ranges from just under 35 kW per metre for Victoria and Tasmania to 26 kW per metre for South Australia and 25 kW per metre for Western Australia. A detailed analysis of this southern coastline wave resource by CSIRO’s Mark Hemer and David Griffin puts the accessible resource at around 146 GW. They estimate that, if 10% could be converted to electricity, it would meet approximately one-half of Australia’s present electricity needs. Australia also has good tidal ranges for barrages but mostly these are located away from major population centres – the exception being near Darwin with a range of around 5.5 metres. Tidal flow is different, with the Geoscience/ABARE report listing it as 6.1 kW per square metre along Western Australia’s coastline at a depth of 50 metres. Dr Tim Finnigan, CEO of Australian wave and tidal energy technology developer Biopower, said, “You

could liken it to a country discovering an easily accessible major oil field and ignoring it.”

Five wave and tidal technology developers have started operating in Australia with three of them – Carnegie (Perth), Oceanlinx (Sydney) and Atlantis Resources (based in Singapore and London) – leading the international pack in technology development. Biopower (Sydney) is a 2nd generation design and WaveRider (South Australia) originally a Chinese design, is to be constructed entirely by firms local to South Australia and entirely privately financed.

Australia has a number of projects mooted or under active development. Carnegie is aiming to build an initial 4–5 MW grid connected plant sited 1.5 kilometres off Garden Island in Perth by 2012, with the Australian Department of Defence and Western Power as customers. Biopower is planning a seabed site off Port Fairy in Victoria with Diamond Energy as the market access partner for the power. Construction is expected to commence in 2011, depending on funding, and it will initially supply 250 kW with the idea of growing to 2–4 MW. These Australian projects are just the start, with Carnegie mapping possible sites around Australia and Diamond assessing the Port Fairy site for its potential of up to 100 MW.

Leighton Holdings and United States developer, Ocean Power Technologies (OPT), are planning a staged 19 MW wave farm off Portland in Victoria. OPT’s Australian manager, Gilbert George, advised that, while not specifying a start date, infrastructure and electrical design have commenced. Once construction commences, it is expected to take three years to complete. The first stage is for 1.5 MW using 10 of OPT’s PB150 wave energy converters. Later stages will be constructed using OPT’s larger PB500 converters. From trials OPT carried out some years before off Portland, it is expecting that the regularity of the wave resource will make it easier to integrate the wave farm into the grid than an equivalent wind farm.

Australia has been relatively slow to address the licensing and regulation requirements at government level to ensure that this industry develops smoothly. That could be changing. The Victorian government has set up a cross-agency and department working group to develop marine energy policy with the draft being available for comment later in 2011.

* *Jeremy Cavanagh is an engineer undertaking research into marine energy at postgraduate level.*

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Turning Coal into Gold: What can the coal industry gain from the patent system?

By Mike Lloyd and Byron Bowman, Griffith Hack Coal & CO₂ Technologies Group

Coal is Australia’s major export industry and the dominant source of its electrical energy. Given this importance, it is not surprising that the Australian coal industry and Australian researchers invest significantly in coal-related research and development. A lot of this investment is related to reducing CO₂ emissions in response to community pressure. Australia is not the only country with an interest in reducing CO₂ emissions from the burning of coal; there is much research around the globe in this area, with the potential for such research to be picked up by the Australian coal industry. One of the more accessible sources of information regarding new innovation, including in coal technology, is the patent literature.

More than 1.9 million new patents are published every year by a variety of companies, researchers and individuals, added to the more than 60 million existing patent publications. Patents can be searched by keywords, companies, inventors, and by using a sophisticated patent classification. The vast majority of patents published are not filed in Australia, meaning that Australians should be free to apply many of these inventions in Australia. Filing patents brings a range of benefits to patent applicants. Besides the potential for a commercial monopoly, patent applicants may be able to license their technology to other parties, prevent other people from claiming their invention, and improve their chances of raising cash from equity and government sources.

Despite these benefits, the Australian coal industry is not a major user of the patent system. For example, a 2009 Griffith Hack report on clean coal patents filed in Australia since 2003 found that just over 100 clean coal patents had been filed by the A\$43 billion coal industry between 2003 and 2008, with only 17 of these filed by Australian applicants. This can be contrasted to the more than 18 000 patents filed in Australia between 2003 and 2009 in the A\$6 billion medical technology market, with 1200 of these patents filed by Australian applicants. There may be a number of reasons for these differences. The coal market is a commodity market, and much of the technology for mining coal is imported. In contrast, many medical advances are technology focused, so patents are employed to protect the high level of investment in such technology. Also, Australia has a significant local dependence on brown coal, which is not commonly mined outside Australia.

While filing patents is a business decision made by different businesses for different reasons, even non-filers of patents need to be aware of two key consequences of the patent system:

- Companies can inadvertently infringe on patents filed by other companies. Innocence is a weak defence for patent infringement. Patent owners can obtain a court order

for damages or the profits made by patent infringers, and can also injunct such infringement. While the low number of patents filed in Australia in the coal industry may give the coal industry some comfort regarding the risk of infringement, just one successful patent assertion can lead to significant consequences for a company (eg plant shutdown).

- The patent literature is a significant source of new ideas. Coal companies with an interest in innovation should be aware of the potential to systematically search and make use of such literature.

Recently there have been two significant developments in the patent world that may assist the coal industry:

- The World Intellectual Property Organisation (WIPO) and the European Patent Office (EPO) have taken a strong interest in how the patent literature can help the development of sustainable energy technologies. This includes alternative coal combustion techniques such as IGCC, and CCS. This interest has resulted in it becoming much easier to search for patents filed in these areas.
- The Australian Government is considering an experimental use exemption for infringement. This may give those coal companies wanting to test any ideas they find in the patent literature the freedom to run experiments on these ideas without being concerned about patent infringement.

Improved searching for clean coal patents

Both WIPO (www.wipo.int) and EPO (www.epo.org) provide internet patent databases that are easy to use. Due to the growing global trend towards reducing CO₂ emissions, both organisations have provided on their websites support in searching for patents in various area of sustainable energy production, but via two different mechanisms. WIPO has provided a list of patent codes, which should be searched when looking for specific subject matter areas. These subject matter areas include IGCC, CCS and carbon trading. One issue when searching the list of patent codes provided by WIPO is that patents not specifically related to these subject matter areas will also be found. The European Patent Office has gone further, developing a special set of specific patent codes for a range of sustainable energy technologies, and then assigned existing patents in their database to these patent codes. In practice, this means that these patents are very easy to search and locate; a simple search will produce a targeted list of patents of interest. As an example of this, the numbers of patents in subject areas of possible interest to coal technologists are shown in Table 1.

From this table we can determine information of likely value to coal technologies:

www.aie.org.au

Table 1: Summary of patent data of interest to coal technologies*

Subject of patent search	EPO patent code	Number of published patents worldwide in patent code	Patents published since 2005 (% of total patents)	Patents filed in Australia	Australian sourced patents
<i>Combustion specific topics</i>					
Oxyfuel combustion	Y02E20/34D	4570	1290 (28%)	231	4
IGCC	Y02E20/18	2740	1150 (42%)	229	5
IGCC combined with CCS	Y02E20/18B	53	28 (53%)	7	2
Controls of combustion specifically inferring on CO ₂ emissions	Y02E20/32H	270	23 (9%)	11	1
Use of reactants before or during combustion	Y02E20/32D	67	10 (15%)	4	0
<i>CCS specific topics</i>					
CO ₂ capture by absorption	Y02C10/06	3620	1320 (36%)	266	24
CO ₂ capture by adsorption	Y02C10/08	3030	1170 (39%)	210	10
CO ₂ capture by chemical separation	Y02C10/04	3230	1700 (53%)	210	64
CO ₂ capture by rectification and condensation	Y02C10/12	1460	440 (30%)	102	19
CO ₂ capture by membranes or diffusion	Y02C10/10	1190	560 (47%)	72	2
Subterranean or submarine CO ₂ storage	Y02C10/14	1070	620 (58%)	95	11
CO ₂ capture by biological separation	Y02C10/02	150	115 (78%)	15	4

* taken from Espacenet in late October 2010

- A significant proportion of all identified clean coal patents have publication dates later than 2004, suggesting increasing activity in this area.
- Oxyfuel combustion is the leading area of research for improving coal combustion, ahead of IGCC developments.
- Research on CO₂ separation is far ahead of research on CO₂ storage.
- Research on photovoltaic cells is much more prolific than research in clean coal.
- Comparatively few of the clean coal patents are filed in Australia. Note that this list includes patents filed in all countries around the world, so we would only expect a small proportion of these patents to be filed in Australia.
- Even fewer of the identified clean coal patents originate in Australia. Australia is comparatively overweight in

patents related to CO₂ capture by chemical separation, is underweight in patents related to CO₂ capture by membranes or diffusion, and is very underweight in patents related to improved coal combustion. Again, the figures for clean coal patents originating in Australia can be contrasted to the 1200 patents in the medical technology area filed in Australia by Australian applicants between 2003 and 2009.

Infringement exemption for experimental use

There are many reasons for and against patents. One reason against patents is that a field of research can be blocked for the life of a patent, which can prevent the development of technology that could greatly benefit humanity. A contrasting argument in favour of patents is that patents are a necessary tool for researchers to recoup the cost of research, raise equity for future research, and make a profit. Moreover, patents can be an incentive to conduct research in areas that may otherwise be unviable if the market was flooded

with copycats. On any analysis the patent system is here to stay, if for no other reason than to comply with Australia's obligations under international treaties and to compete in a global market for research dollars and investment into Australia.

At present, patent owners have exclusive rights to exploit an invention covered by a patent. In the coal industry (and other industries) this allows a patent owner to prevent others from reverse engineering, testing, and further improving patented technology during the life of the patent, because such activities usually infringe on the exclusive rights of patent owner. This is soon expected to change. In 2011, the federal parliament is expected to finalise a long anticipated amendment to Australian patent law, which will introduce an exemption to patent infringement for 'experimental use' of patented technology. The exemption to patent infringement is meant to bring Australian patent law up to date with statutory infringement exemptions presently available in Europe and other countries such as Japan. Experimental use is also possible in the United States. Like the infringement exemption in other countries, the Australian infringement exemption will not interfere with the normal 'commercial monopoly' rights of a patent owner. However, the infringement exemption is expected to allow a person to do anything covered by a patent that has the purpose of:

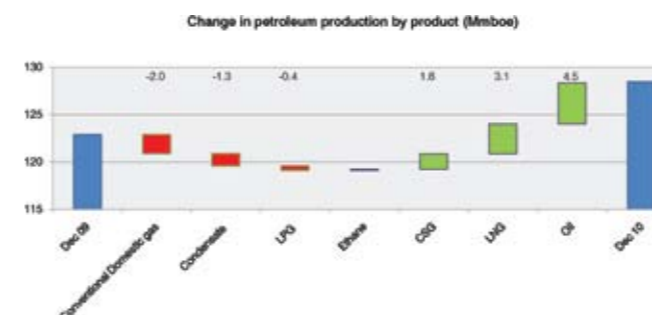
- determining how a patented invention works
- attempting to improve the patented invention
- testing the validity of the patent
- determining the scope of coverage of the patent
- determining whether the act or product infringes the patent.

The infringement exemption for experimental use will allow research into coal, and other technologies to be undertaken without fear of infringing a patent. If it allows a researcher to 'work around a patent' so be it! However, the infringement exemption is by no means an undoing of the patent law. What is clear is that the exemption will not allow the commercialisation of technology resulting from research which is covered by a patent. In this situation, a licence is typically required from the patent owner and, when the research has resulted in an improvement to the original patent owner's technology, the researcher will be in a strong position to obtain their own patent and prevent the original patent owner from using the improved technology. Needless to say, both the original patent owner and the researcher will have incentives to negotiate a cross-licensing arrangement, whereby each party authorises the other to use their particular patented technology. **EN**

Australasian Oil and Gas

Highlights from EnergyQuest's Energy Quarterly, February 2010*

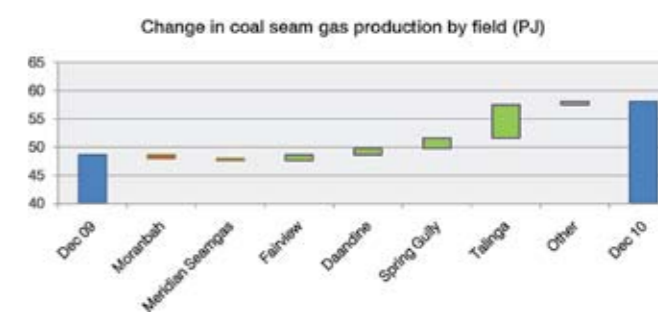
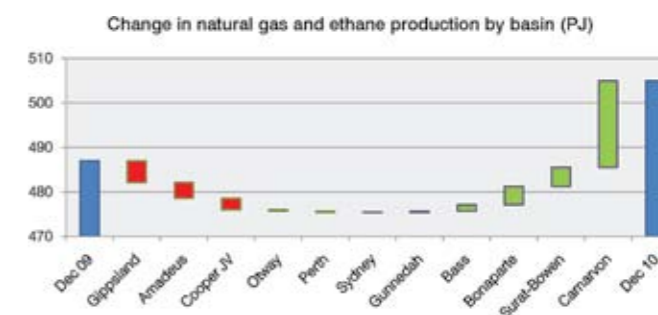
"One of the welcome developments last year was the turnaround in Australian oil production," said Dr Graeme Bethune MAIE, CEO, EnergyQuest. "After slumping to a 40-year low of 99 million barrels in 2009, production grew to 116 million barrels in 2010 due to production from Pyrenees, Van Gogh and Vincent. Reflecting the contribution made by these fields, Apache and Inpex moved up to third and fifth place respectively in the league table of Australian oil producers.



Source: EnergyQuest

"Last year was a record one for Australian LNG and the momentum has continued into 2011 with GLNG reaching sanction and APLNG reaching major milestones. Further projects are likely to be sanctioned in 2011 but how many? By our reckoning there are seven Australasian LNG projects

aiming for final investment decisions in 2011, with combined capacity of around 40 million tonnes per annum. The perennial questions are whether there is the market appetite and available resources for all these projects and, if not, which projects will make it to the starting line.



Source: EnergyQuest (for both figures)

“Last year was also a record one for Australian domestic gas production, which reached 1060 PJ, driven by gas-fired power generation. However, in contrast to LNG, there is no line-up of gas-fired generation projects rushing towards sanction. There are many plans and approved sites but not much action, partly due to uncertainty about carbon pricing. The Government has now announced that it is pressing ahead with a carbon pricing scheme from 2012 but with many qualifications and not many details. The issues here are whether there will be sufficient progress with climate policy this year to provide the certainty investors need to go ahead and, if not, what the consequences might be of continuing stalled development.”

Highlights

- Oil prices have spiked to around US\$100/bbl, based on stronger demand and unrest in the Middle East.
- There was strong growth in global gas demand in 2010 and record imports of LNG into North Asia. Natural gas prices remain low in the United States (around A\$4/GJ) but have increased in the United Kingdom (around A\$8/GJ). Asian import prices continue to be around A\$10/GJ.
- Australian petroleum production increased by 6.3% in 2010 to a record 520 MMboe. Oil production grew by 16.2% and gas production by 5.1% to a record 1999 PJ.
- Oil and natural gas liquids reserves (2P) were essentially flat, as were conventional gas reserves (although conventional gas reserves grew strongly in 2009 with the sanctioning of Gorgon). However 2P coal seam gas reserves grew by just over 9000 PJ to reach 35 246 PJ as LNG proponents built up their 2P reserves.
- LNG production increased by 6.2% in 2010 to a record 19.8 Mt. The value of LNG exports was a record \$9462

million, up by 24%.

- The GLNG project has been sanctioned and is now under construction. APLNG has Federal environmental approval and has secured its first offtake agreement, with Sinopec.
- Total Australian domestic gas production increased by 2.7% in 2010 to a record 1060 PJ.
- West coast production was steady. The new domestic gas projects underway (Gorgon domestic gas, Reindeer, Macedon and Halyard/Spar) are reported to be on schedule.
- Total east coast production grew 4.4% due to record CSG production of 222 PJ.
- The costs of development offshore Victoria are increasing significantly.
- East coast gas consumption reached a record 713 PJ in 2010, an increase of 8.8%. Gas consumption in Queensland is now nearly the same as in Victoria.
- East coast consumption growth was driven by higher gas-fired generation, which increased by 29 PJ, driven by growth in Queensland and NSW.
- On the east coast short-term gas prices continue to be very low but buyers continue to report difficulties in getting long-term contracts. On the west coast long-term contracts are available but at two to three times prices on the east coast.

* Copies of *Energy Quarterly* (up-to-date, independent and comprehensive 130-page report on Australian oil and gas production, reserves, prices and development projects) can be purchased from EnergyQuest at www.energyquest.com.au **EN**

media statement indicating a reduction and deferral of funding from the Solar Flagships Program, as part of the government's response to rebuilding flood-affected regions across Australia. www.ret.gov.au

- The *National Transmission Network Development Plan* and the *2010 Gas Statement of Opportunities* were released by the **Australian Energy Market Operator**. Both reports model a range of scenarios that show potential development opportunities. www.aemo.gov.au
- The **National Carbon Capture and Storage (CCS) Council** was established. The National CCS Council will have a key role to play in the development of the Cleaner Future for Power Stations. www.ret.gov.au
- A number of 'green' programs are proposed to be cut to fund the flood levy. They include the 'cash for clunkers' scheme, green car innovation fund and green start fund. Savings have also been proposed in the solar hot water program, solar home and communities program and funding for the Global Carbon Capture

and Storage Institute. www.climatechange.gov.au

- The *Developing a National Coastal Adaptation Agenda* report was released. The priorities in the report include the need for a coordinated nation approach to provide greater consistency in planning, clearly defined roles and responsibilities as well as clear and early community engagement. www.climatechange.gov.au
- The Australian Government has funded a **shower head swap** program for residents of Perth to reduce water use and improve energy efficiency. www.environment.gov.au
- The Prime Minister announced a new climate change framework, comprising a two-stage plan for a **carbon price mechanism** that will start with a fixed price period for three to five years before transitioning to an emissions trading scheme. www.climatechange.gov.au

From our Canberra correspondent, Anntonette Joseph MAIE, Environmental Resources Management

Membership Matters

The members' section of ENERGYNEWS

ENERGYNEWS welcomes contributions to Membership Matters, including member profiles, corporate member profiles, anecdotes, and advertising. Send ideas and contributions to editor@aie.org.au



New Members

New Members

Name	Grade	Branch	Name	Grade	Branch
Paul Carey	Member	South Australia	Leonard McKeluey	Associate	Brisbane
Nick Carter	Member	Melbourne	Luke Menzel	Student	Melbourne
Prof. Prince Efere	Fellow	Overseas	Auppatham Nakaruk	Student	Sydney
Tracy Goh	Member	South Australia	Charles Paul	Student	Brisbane
Keryn Hassall	Associate	Sydney	Justin Robinson	Graduate	Tasmania
Roger Kilby	Fellow	Melbourne	Jim Rogers	Fellow	Perth
Glenn Lydard	Member	South Australia	Paul Carey	Member	Perth
Sandra McCullagh	Fellow	Sydney	Timothy Tritton	Graduate	Tasmania

New Corporate Members

Company Name	Representatives	Branch	Company Name	Representatives	Branch
IPART	Eric Groom	Sydney	AGA Consultants	Anthony Gaskell	Sydney
	Margaret Sniffin	Sydney		Robert Mallindine	Sydney

Study Scholarship Report

Managing Energy with Smart Meters

Mark Kealy*, winner of the 2010 AIE Energy Scholarship, travelled to the United States to attend conferences and meet with industry representatives working in the emerging area of smart meters. This is his report.

The benefits that smart meters can bring to the electricity distribution system are well established. What is less clear is how consumers can begin to access their smart meter data and use it to manage their electricity use in the home. Many of the smart meters that are being rolled out across the globe are establishing what is known as a Home Area Network (HAN) which allows consumers to have their energy consumption displayed to them in a meaningful way. But how far away is this from realisation?

Thanks to the Australian Institute of Energy's Study Scholarship I was able to explore this issue during a two-week trip to California and Texas in January and February of this year. I was able to attend two conferences and met with a range of utilities and technology companies. Largely, I found that the

home energy management space is still developing but at a rapid pace. Like all new industries there are a few speed humps, but we are beginning to see some exciting developments. Here are a few of the trends that I identified.

Focus on the consumer

Consumer backlash is something that has been synonymous with smart meter rollouts around the world. Some of the frustration has stemmed from the consumer not being able to see any real difference once they have had the new meter installed. This issue is now being given a lot of attention and finding ways to engage the consumer and demonstrate value is key. This was most evident when reading through the list of the press releases coming out of the *Distributech* conference, one of

the leading electricity industry trade shows in North America. All the significant smart meter announcements were consumer focused, whether it was the results of the latest trials or new consumer products and services that were being launched.

Big players jostling for position

Being able to display smart meter data to consumers in a meaningful way is big business at the moment. According to Green Wave Reality, around 212 million smart meters are expected to be installed by 2015 around the world. For technology companies this represents a very large new market and as a result the race is on to produce convenient, cost-effective products and services to manage and control home energy. The list of heavy hitters working in the home energy management space is impressive, including Cisco, GE, Google, Intel and Microsoft.

Changing roll of in-home display

Previously, there had been quite a bit of attention given to the in-home display (IHD), which is effectively a bench top or wall mounted display that communicates to the smart meter and portrays electricity data. There seems to be a growing realisation by technology companies that people generally want to access their home energy data from where they already go for information – their computer, tablet device (eg iPad) or their smart phone. As a result, we have seen a few companies pull back from the development of high-end IHDs with greater emphasis given to web portals and home energy ‘apps’ for smart phones. With the enormous growth in smart phones and tablet devices over the past 12 months, it makes good sense to be utilising the existing ‘screens’ people are already engaged with and, of course, prevent more clutter on the kitchen bench.

Standards evolving

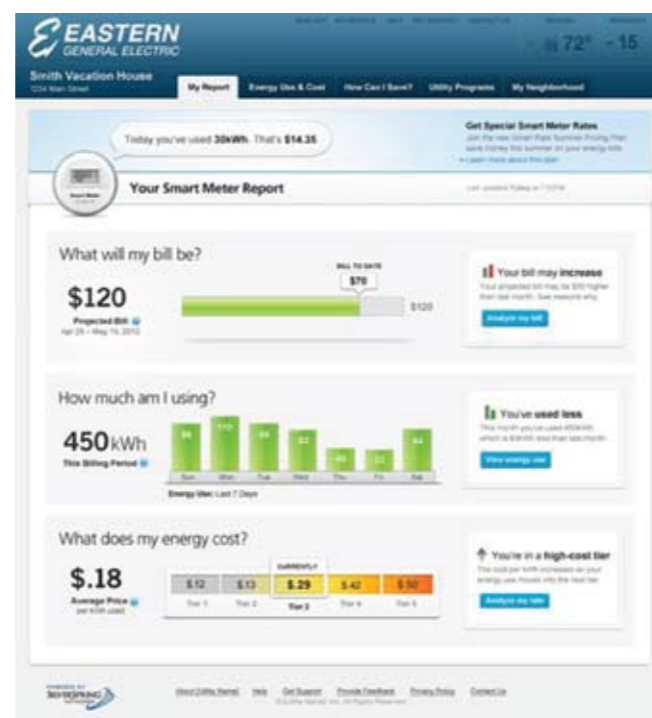
One problem confronting this emerging industry is that there are various protocols used for communication between the smart meter and devices in the home. Some are wireless (WiFi, Zigbee) and others are based on using electricity wires in the home to send the communication signal (HomePlug). So, the industry is coming together to develop a common, open and interoperable protocol for use in home energy management – Zigbee Smart Energy Profile v2.0. Having a single protocol makes it a lot easier for the appliance manufacturers and also makes it a lot easier for consumers as they will not have to worry if their new WiFi device is capable of communicating to their Zigbee enabled meter and so on. Developing open, interoperable standards has been a key priority for the industry and this process is well advanced. Industry players are hopeful of having the process completed by the end of 2011, but developing standards to be agreed upon across an entire industry can be a protracted process.

Products available now

Although standards are still being developed for in-home devices, there is a range of product offerings available to utilities that can provide a meaningful analysis of smart meter data and do not rely on the standards being finalised.

CustomerIQ is a web portal that has been developed by Silver Spring Networks. It presents smart meter data in an easy to understand fashion so that customers can better comprehend their energy use. Bill forecasts, anonymous neighbourhood comparisons, carbon footprint calculations and historical data can all be accessed using the portal. Customers can set a budget

and track progress throughout the period as well as opting to receive email reports and have access to a smart phone interface to manage their energy.



CustomerIQ web portal displaying bill forecast, total energy use and current tariff rate

Nucleus is a product from GE that enables real-time energy information to be displayed on a web portal as well as on a smart phone. *Nucleus* plugs into an ordinary power socket, much like a home air deodoriser, and coordinates communication between the smart meter and an online energy portal. *Nucleus* comes with a CD which is installed on a computer to activate the web portal, which in turn provides insight into current and historical energy use for the entire home. It is also capable of displaying energy information of individual appliances. All data is securely stored in the *Nucleus* and is protected using industry standard encryption. GE is looking to partner with utilities in the first instance, with plans to make the product available directly to consumers in the future.

In January 2011, Tendril released *Energize*, which is a consumer focused software platform available to utilities. It enables the utility to display smart meter data through a wide range of



Nucleus' fully customisable web portal to access energy information

different methods depending upon customer preferences. The customer can choose how to receive smart meter information, and options range from a paper insert in the bill to accessing a web portal or full activation of smart appliances with access to smart phone applications. *Energize* can cater for the elderly without an internet connection through to ‘tech-savvy’ young families that want to use home energy management for educational purposes.

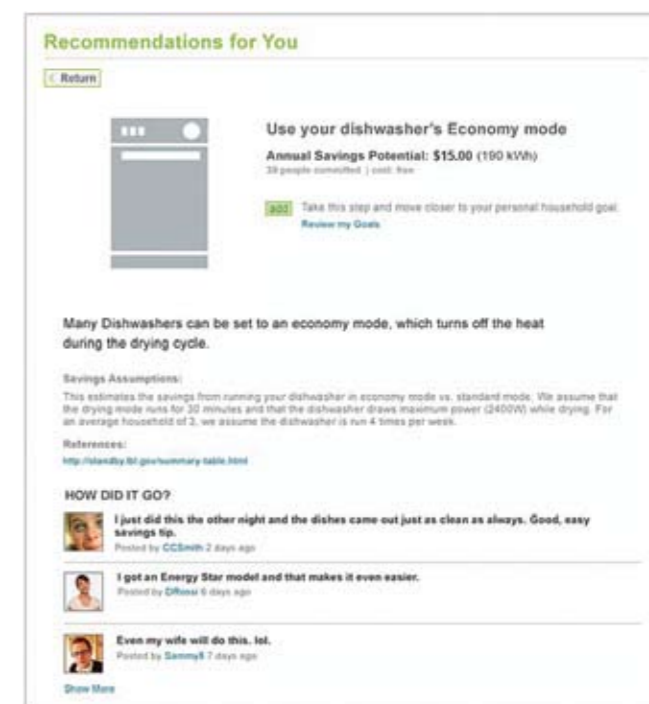
The application seeks to get the consumer actively involved by setting energy goals and then monitoring them over time. It will advise the household on how it is tracking and offer tips on how to meet or better the goals. The web portal is unique in its use of social networking and the option to ‘ask an expert’. For a given energy saving measure that is recommended, users can share their experiences online or even ask an expert from the energy retailer if they are having difficulties.

Access to the technology

There is no prescribed way in which these products and services will become available to consumers, but the most feasible avenue in the early stages will be through electricity retailers. Most of the technology vendors want to test new products in partnership with a utility before they launch into the mass market. In competitive deregulated electricity markets we are also seeing that these technologies are being used by the electricity retailers as a means of differentiation to assist them to retain and attract customers. We are already starting to see some interesting developments in the retail market with Australian start up Greenbox positioning itself as an energy retailer that will save people money using smart meters and home energy management technology.

Concluding thought

An unfortunate reality over the coming decade is that the price of electricity will increase significantly. The investment in our



Energize uses social networking to provide feedback on energy saving measures

aging electricity grid and the subsidisation of renewable energy and energy efficiency programs will all have an impact on the cost of electricity. Inducing further increases in prices will be carbon pricing. As the price of electricity increases, convenient technology and services that help consumers monitor and control their energy use will have increased appeal.

* Mark Kealy works for the Victorian Government Department of Business and Innovation. This article reflects his own views and not necessarily those of his employer.

On reflection

Dr David Allardice FAIE was awarded the AIE Medal in November 2010 for his contribution to the energy industry and to the Australian Institute of Energy. ENERGYNEWS asked David to reflect on his more than 30 years of involvement with the AIE.

“I joined the AIE’s predecessor, the Institute of Fuel, in the 1970s, and was Melbourne Branch Secretary of that organisation when the AIE was formed in 1978 out of the Australian membership of the Institute of Fuel,” David recalled. “Even though it made sense to create an Australian organisation, it’s a pity that we have not maintained stronger links with the UK group, which is now the Energy Institute.

“The early years of the AIE were very exciting, even more so when I joined the national council (now the AIE Board) as Melbourne Branch representative in 1982. I was a young scientist working my way up through the State Electricity Commission of Victoria, and there I was on the same council as chief executives of major corporations and senior government representatives.

“Even though the AIE has never been a political organisation, our meetings and conferences were a source of useful information and ideas for policy makers. The 1983 conference, held in Canberra jointly with the Institution of Engineers, discussed a series of task force reports, from which we delivered a technical White Paper to the Australian Government. The emphasis was on the responsible use of energy. At that time, energy was so cheap it was difficult to get a financial return on energy-saving devices, but we were committed to this goal from the beginning.

“We held more technical meetings in those days, such as half-day seminars on fluid bed combustion or steam traps for commercial boilers. These seminars would attract a large crowd to learn about the latest technical developments, and equipment suppliers would pay for stands to show off their latest systems. Perhaps the pendulum has shifted too far from practical energy issues and the balance could be reviewed.

“What has not changed is the great networking opportunities that the AIE offers, particular for committee and board members. You get to meet people outside your own organisation and are exposed to different views on all aspects of energy. Events

remain a very important part of the organisation's activities, particularly for the branches. Melbourne Branch has always had an exciting branch program, with a cross-section of technical, policy and educational meetings. This reflects the wide range of interests among members.

"I have really enjoyed my time in the AIE, and I have made lots of friends. I am particularly proud of my involvement in the postgraduate student awards, which have been held in some form since 1983. (Ed. – see *Where are they now?* on page xx). I am so pleased that many of the prize winners have continued to contribute to the AIE through participation on branch committees and the national board.

Around the Branches

Brisbane

- Dr John Burgess FTSE, presented "Low-Carbon Energy: Evaluation of New Energy Technology Choices for Electric Power Generation in Australia" on 23 February 2011.

Melbourne

- AIE Melbourne Branch hosted a site tour of Newport Power Station Site Tour on 4 February 2011.
- AIE Melbourne Branch hosted a 'Speed Networking Event' on 10 March 2011. Supported by specialist recruitment company Hays Energy and HRL Technology, the novel format included experienced energy professionals sharing their wisdom with AIE Melbourne YEPs and an opportunity for YEPs to network with recruiters and potential employers.
- Dr Victoria Haritos, Stream Leader–Biofuels, CSIRO Ecosystem Sciences; Mat Nelson, Partner–Climate Change Team, Ernst & Young; and Richard Marshall, Director Energy and Environment, GM Holden, presented "Biofuels: Future Energy Source?" on 30 March 2011.

Perth

- Dr Paul Stevens, Senior Research Fellow, Energy, Environment and Development Programme, Chatham House International Affairs Group, London, presented "Oil Prices: Where to from here?" on 15 March 2011.
- Perth YEPs hosted "Talkin' About Your Generation" – proudly supported by Verve Energy – on 30 March 2011.

The AIE is a great organisation and will continue to have relevance. The growing number of younger professionals getting involved in the AIE is an exciting development. I am keen to encourage younger people to make the Institute what it needs to be for the next generation.

It is a privilege to have been awarded the AIE Medal, and I thank the Institute for the honour. Perhaps we should revert to the original concept of awarding the medal more frequently to those making a contribution to energy in Australia. The award is not necessarily limited to AIE Members."

South Australia

- John Pierce, Chairman, Australian Energy Market Commission, presented "Rule Making in Liberalised Electricity Markets" on 9 December 2010.
- Dr. William (Bill) Lyons, General Manager, Boeing Research and Technology Australia, presented "Development of a sustainable biofuel for aviation" on 10 Feb 2011.

Sydney

- The Annual Meeting of the Four Societies (Nuclear Engineering Panel of the Sydney Branch of Engineers Australia; Australian Nuclear Association; Royal Society of New South Wales; and Australian Institute of Energy) featured Dr Stuart McDonnell, Chief Operating Officer, Geodynamics, and Stephen de Belle, Granite Power, who presented on "Geothermal Energy: Current state of play and developments" on 24 February 2011.
- Prof. Barry W Brook PhD, Director of Climate Science, The Environment Institute, University of Adelaide, presented "Advanced Nuclear Power Systems for Long-term Energy and Climate Security" on 10 March 2011, in a combined technical event arranged by the Australian Institute of Energy Sydney Branch, Engineers Australia Sydney Division, the Academy of Technological Sciences and Engineering, Australian Nuclear Association, Nuclear Engineering Panel of Engineers Australia, and the Australian Young Generation in Nuclear.

Vale Ken Basden and Wilbur Harvey

The AIE lost two longstanding members in the fourth quarter of 2010.

Ken Basden FAIE, Sydney Branch member since the Institute's founding in 1978, passed away in December, aged 85, and Dr Wilbur Harvey MAIE, of Melbourne Branch, passed away in September, aged 77. Both gentlemen were active supporters of the AIE, as well as other organisations.

Mr Basden was an expert on air pollution and a member of the committee that established CASANZ (Clean Air Society of Australia and New Zealand).

In his retirement after a long career with Geelong Cement, Dr Harvey, completed a mature age PhD in regional economic development and was active in Geelong development programs.

Our condolences to their families.

Finlaysons

Finlaysons is a full-service commercial law firm with local, national and international clients. Finlaysons' involvement in the energy sector in recent times includes acting in the 'privatisation' of the electricity industry in South Australia. Since then, Finlaysons has advised regulators, industry participants and network providers on a wide range of matters in the power and gas sectors. The energy team works for clients in electricity generation, transmission and retail sectors, advising on matters ranging from acquisition and mergers to key project agreements, divestment contracts and regulatory frameworks. Since acting in relation to the first private wind farm in South Australia at Lake Bonney in the early part of this new century, Finlaysons has specialised in wind energy projects and, more recently, solar projects, throughout Australia.

The energy team is headed by Jeremy Schultz, who has been a board member of the Clean Energy Council (and a predecessor, AusWind) for seven years. Jeremy is also Finlayson's primary contact for the corporate membership of the AIE. **ENERGYNEWS** asked Jeremy, "What is the key issue in energy?"

"Our view is that the major issue in the energy space is a growing awareness of the impact of carbon emissions and the consequent uptake of low-carbon technologies," he said. "We think this is an appropriate but challenging change for both industry and regulators.

"Unlike many of our colleagues in the legal industry, we have taken a position on this issue. We believe that clean energy and lower emissions are the future. We accept that the climate is changing, even though we think it is for scientists and society to determine the cause or causes. That being said, I am convinced that carbon emissions need to be reduced, for environmental and health reasons as well as for proper resource management. Our clients tend to be either in the gas or renewables sectors of the industry in some shape or form.

"Since the introduction of renewable energy targets in 2000, what to do about carbon has been the 'big ticket' item politically. It has been one of the factors in changing the governing party at federal level, and the leaders of both major parties, and is crucial for the current government's future. It was very disappointing when funds for clean energy technology development were redirected to fund the flood levy instituted due to the Queensland floods. It was the principle that was of concern – that clean energy was the first to be disaffected by an adverse event requiring public funding. The shelving of green energy programs due to funding constraints arising from other causes is a worrying demonstration of a lack of commitment to clean energy.

"For our clients – whether in traditional forms of electricity generation or wind farm operation – uncertainty is the reverberating constant. Despite the recent announcement

of a carbon tax, each participant in the energy industry will be affected in a different way according to the nature of their business and their future business. Even when you look at business operations in isolation it is complex. Finlaysons can assist; our areas of expertise include: project agreements; connection agreements; EPC contracts; power purchase agreements; joint venturing; landowner agreements; native title; environment issues; national electricity law; regulatory frameworks; planning approvals; licensing approvals; FIRB approvals; mergers and acquisitions; due diligence; MRET and green energy credits advice; greenhouse gas emissions and abatement schemes; corporate governance; and workplace issues."



Jeremy Schultz

Finlaysons joined the Australian Institute of Energy in 2007 and chose to be a corporate member because the firm is squarely committed to participating in business communities. "It is a fundamentally good thing to do," said Jeremy. "Our corporate membership of the AIE arms our practice and our lawyers with the ability to provide a better service by understanding industry issues. The AIE is a very good vehicle for gaining additional information, knowledge and understanding, and allows us to differentiate our practice from our competition.

"We sponsored last year's national conference, where I made a presentation. I have also delivered a couple of papers for the Institute's South Australian Branch lunch series. Although the benefits of these activities are difficult to quantify, the feedback from delegates at the conference was very positive. These events enable us to bring greater focus to the energy issues of the day.

Energy is just one of the specialisations at Finlaysons, which has twice been awarded ALB's Adelaide Law Firm of the Year in recent years. For more information, see www.finlaysons.com.au

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Where are they now?

Do you recognise yourself (or a colleague) in this selection of winners at the 1983 student awards? If you are in one of the photos, send an email to editor@aie.org.au and let us

know if you are still in the energy industry and where your career has taken you.



A SELECTION OF WINNERS AND MEMBERS AT THE STUDENT FORUM

Don Gibson presenting 1983 Student Awards



Corporate Member Directory



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Forthcoming AIE Events

For all forthcoming AIE events, see <http://www.aie.org.au>

If your branch has organised an event in 2011 or 2012, send details to editor@aie.org.au to promote the event in **ENERGYNEWS**.

Other Events 2011: Australasia

2–7 May in Melbourne	Clean Energy Week, CEC national conference and ATRAA http://www.cleanenergycouncil.org.au
9–10 May in Townsville	Nth Qld Mining, Processing & Energy Conference http://www.nq-mpec.com
9–10 May in Broome	4th Annual Kimberley Energy & Resources Dev. http://www.iir.com.au/kimberley
11–12 May in Brisbane	4th Surat Basin Coal & Energy Conference http://www.informa.com.au
17–19 May in 3 locations	EUAA Training Workshop Electricity Market Fundamentals for Energy Users http://www.euaa.com.au
19–20 May in Melbourne	Sustainable Building http://www.absa.net.au/
22–25 May in Broken Hill	Australian Resources and Energy Conference http://www.symposium.net.au
30 May–1 June in Brisbane	9th Annual National CSG Summit 2011 http://www.csghsummit.com.au
31 May–1 June in Brisbane	Shale Gas Symposium 2011 http://www.iir.com.au/shale
7–8 June in Sydney	Demand Management & Energy Conservation http://www.demandmanagement.com.au
8–9 June in Sydney	Financial Review National Infrastructure Conference http://www.afr.com/events
9–10 June in New Plymouth, NZ	ENEX – New Zealand's Oil & Gas Event http://www.conferenz.co.nz
21 June in Melbourne	Electric Vehicles Infrastructure World 2011 http://www.terrapinn.com/2011/electric-vehicles-world
21–23 June in Melbourne	Smart Electricity World Australia 2011 http://www.terrapinn.com/2011/smart/
23–25 August in Perth	Offshore Convention: Australasia 2011 http://www.neoventurecorp.com/oc/aus/
4–7 September in Brisbane	Ecogen 2011 http://www.ecogen2011.com/
18–21 September in Sydney	Chemeca 2011 http://www.chemeca2011.com/
19–21 September in Perth	Global Gas 2011 http://www.globalgas.info/
26–27 September in Perth	Smart Transport http://newurbanism-smarttransport.com/home
12–13 October in Melbourne	All-Energy Australia 2011 http://www.all-energy.com.au
8–10 November in Sydney	Smart Utilities Australia and New Zealand 2011 http://www.smartutilities-ausnz.com
8–11 November in Gold Coast	International Conference Energy & Meteorology http://www.icem2011.org

Please note that the events listed here are based on information provided by event organisers. The AIE does not necessarily endorse the views of the speakers. The events are brought to the attention of members as potentially contributing to discussion on relevant energy issues. If you know of any conferences or other major events in our region that would be of interest to AIE members and will be held in 2011 or 2012, please email date, location, title and web link to editor@aie.org.au

Other Events 2011: International

For global energy events, see the following websites:

<http://www.conferencealerts.com/energy.htm>

<http://www.energyiq.co.uk/Energy.aspx>

<http://www.eia.doe.gov/calendar/meetings.htm>

<http://www.econference.com.au>

<http://www.ieee.org>

<http://www.pmaconference.com/>

<http://www.bvents.com>

<http://www.expopromoter.com>