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Hastening slowly in the global renewables race

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Until a few years back, renewable energies – such as solar, wind, bioenergy, tidal and wave power – were widely regarded as incapable of delivering utility-scale power. Now renewables account for a quarter of the installed power capacity of California, one-third of Sweden's, half of Norway's and three-quarters of Iceland's, according to Charlie Hargroves from sustainability think-tank, The Natural Edge Project. Wind power alone accounts for 20 per cent of Denmark's electricity generation.

Credit: Horizon Power

Here in Australia, renewables accounted for a modest 5.8 per cent of our electricity generation in 2007/08 (16 per cent of installed capacity).[1] With its per capita greenhouse gas emissions being among the highest in the world – more than 80 per cent of our electricity is generated from coal – there is a strong argument for Australia to rapidly develop low-emissions energy sources. This would assist our transition to a decarbonised economy, where mechanisms such as an emissions trading scheme would put a cost on carbon emissions.

Hargroves believes the transition to a low-emissions future is within our grasp. 'Modelling by the Clean Energy Futures Group[2] in Australia suggests that a combination of demand management, investment in energy efficiency and renewable energy, and using gas as a transition fuel, can supply a significant percentage of baseload electricity demand by 2040.

'The study found that renewable energy could contribute 60 per cent of electricity by 2040, and that CO_2 emissions from Australia's electricity generation could be reduced by 78 per cent compared with the 2001 level.'

Hargroves adds that the study assumes minimal improvements to existing technologies such as solar – despite the fact that current developments indicate it would cost 40 per cent less by 2040 – and also does not factor in major new technologies such as geothermal.

Small-scale solar and the RECs factor

The Clean Energy Council's Mark Bretherton says the most significant recent development in the clean energy sector has been the expansion of the Federal Government's renewable energy target or RET, which now requires 20 per cent of Australia's energy supply be sourced from renewables by 2020.

The RET is designed to create a guaranteed market for renewable energy via tradeable Renewable Energy Certificates (RECs). The idea is that large-scale electricity companies must source a certain percentage of purchases from renewable energy sources to meet annual targets. This creates a demand for RECs, with 1 REC being generally equivalent to one megawatt-hour (MWh) of renewable energy.

However, in 2009, the price of RECs – the sale of which had underwritten much of the wind industry's expansion – fell (see *Ecos* 152, p.8). The drop in the value of RECs was, says Bretherton, largely the result of well-intentioned Federal Government initiatives.

'The Solar Homes and Communities Program stimulated spending on solar panels. The uptake was so widespread that the program was estimated to be $850 million over budget, and is single-handedly responsible for the rapid expansion of solar panels.

'The Federal Government also invested heavily on rebates for household solar hot water systems as part of its stimulus spending in 2009.' At the same time, some States introduced solar feed-in tariffs.[3]

'These [initiatives] have transformed the solar industry, providing new jobs and opportunities,' continues Bretherton.

'But the glut of RECs flooding the market depressed their price – down to less than $30 at one stage – and made it harder for larger scale technologies to get financing from banks.'

Earlier this year, the government responded by announcing changes to the design of the RET scheme. From 1 January 2011, the scheme will have two parts – a Small-scale Renewable Energy Scheme (SRES) and a Large-scale Renewable Energy Target (LRET).

The LRET will cover large-scale renewable energy projects involving wind farms, commercial solar and geothermal, while the SRES will cover technologies such as domestic solar panels and solar hot water systems, and will provide a fixed price of $40 per MWh of electricity produced. By splitting the scheme, the uptake of household technologies such as solar panels will not affect the market for construction of large renewable energy projects such as wind farms.

The Clean Energy Council has also been lobbying for national consistency in the implementation of feed-in tariffs. Currently only NSW, the ACT and Alice Springs have gross feed-in tariffs, while some other states have net tariffs. Effective feed-in tariff policies have been successful in driving the uptake and development of small-scale clean energy technologies such as photovoltaic cells in Germany, Spain and Italy.

Working on wind's acceptability

Hydroelectricity accounts for 77 per cent of the total renewables generation capacity in Australia. However, the output from hydro schemes has been limited by low rainfall in key dam catchments, a situation likely to continue under global warming.

Wind makes the second largest contribution to Australia's clean energy capacity (16 per cent) followed by bioenergy (mainly bagasse cogeneration 4.5 per cent) and landfill gas (1.5 per cent)).

Credit: Clean Energy Council

Currently, Australia has more than 50 operating wind farms with 1000 or so turbines. South Australia is the leader here, accounting for around 45 per cent of the nation's installed capacity.

'Wind power is technically mature,' says Dr Jim Smitham from CSIRO's Energy Transformed Flagship. 'Technical innovation will still occur to reduce costs, but more slowly than before. Commercial innovation will also reduce costs. Suppliers from China are emerging to compete with traditional European suppliers and that competition will help drive wind power prices down further.

'But there are issues with wind: the best sites may not be located in economically and socially viable locations.

'Whether we fully exploit wind's potential in Australia will depend on the limit of what's acceptable to local people, rather than what's technically possible.'

Many wind farms are located along the coastline where population densities tend to be higher. But suitable inland sites can now be located using a 'wind prospecting' tool called Windlab, based on technology originally developed by CSIRO. Indeed one such site has been identified at Collgar, 250 km east of Perth, where a 206 MW wind farm – WA's largest – is about to begin construction.

Power from the ocean

With an estimated 1 million GWh of wave energy hitting Australian shores each year, it's not surprising that a number of wave power projects are under way.

Oceanlinx Limited operates a 0.5 MW grid-connected wave energy plant off Port Kembla, NSW. On the other side of the continent, Carnegie Corporation is developing a 0.1 MW plant off Fremantle, WA. Victorian Wave Partners' planned 19 MW wave power station off Portland recently attracted funding under the REDP.

Oceanlinx grid-connected wave energy unit at Port Kembla, NSW. Oceanlinx

Overseas, energy has also been harnessed from tidal flows across dams or barrages, and engineers have proposed thermal energy conversion plants that exploit the thermal difference between the ocean's warm surface waters and deeper cold layers.

Funding boost for large-scale solar

In May 2009 the Federal Government announced a $1.5 billion Solar Flagships program to help fund the construction and deployment of up to four large-scale solar power stations. The program will support commercially proven solar technologies – for example, those that have been demonstrated to produce at least 30 MW for 12 months – that have been unable to find funding for full commercial deployment.

The program's first funding round aims to deliver an additional 400 Mw of combined solar generation capacity to the national grid across two projects, one based on solar thermal and the other on photovoltaic technology. There were 52 applications in the first round indicating strong interest in the marketplace. Successful projects are expected to begin operating by 2015.

The difficulties faced in commercial-ising large-scale solar were highlighted by the collapse in 2009 of a much-anticipated 154 MW concentrated solar PV project that had been planned for Mildura in Victoria. Before its collapse, the company behind the project, Solar Systems, led the world in concentrated solar PV and employed 150 people at its manufacturing facility in Melbourne. In March, when the company was sold to Silex Systems, Chris Breen, a spokesman from Save Solar Systems – an alliance of former employees and environmentalists – claimed there were no firm commitments from Silex that it would revive the 154 MW project.

Overseas, utility-scale solar power plants (ie larger than 200 kW) have been multiplying rapidly, with an estimated 1800 such plants existing worldwide at the end of 2008. The world's largest solar PV plant, the 60 MW Olmedilla de Alarcon plant, is located in Spain. Spain is also home to a ground-breaking solar thermal concentrator plant – the Andasol-1 – that uses thermal storage technology for operation after sunset. The Andasol-1 has more than seven hours of full-load thermal storage capability.

Dr Smitham believes that, as storage technologies further improve, fluctuations in supply from renewables will reduce and 'significantly improve the quality of renewable energy, and smooth out unreliability issues.'

In the US, the use of a high-voltage direct current (HVDC) grid is also proving effective in smoothing out intermittent supplies and reducing transmission losses over very long distances, compared with the more conventional AC grid.

Bioenergy cleans up overseas

Bioenergy is electricity or thermal energy derived from organic matter (biomass) – crop or plantation wood waste, urban green waste, sugar cane residue (bagasse), sewage, or animal waste.

Bioenergy has been around for 100 years in Australia, where the sugar industry has used it to meet its own electricity and heat requirements.

Credit: Clean Energy Council

But according to the Clean Energy Council, biomass could deliver at least 11 000 GWh of Australia's electricity annually by 2020. For example, the electricity generated from bagasse could be significantly increased if sugar mills and associated power plants were made more efficient, and if more cane trash were used in electricity generation – only 50 per cent of the cane biomass available for use is currently collected.

The bioenergy sector already generates around 60 000 GWh of electricity annually in the USA – more than the entire grid-connected electricity demands of WA, SA and Tasmania combined.

Bioenergy plants can generate electricity all year round, 24 hours a day. Existing landfill gas plants operating in all Australian capital cities often operate for over 90 per cent of the year, which is comparable to traditional energy power stations.

A rough guide to the Clean Energy Initiative

The Federal Government's $4.5 billion Clean Energy Initiative (CEI) comprises three key initiatives:

1. CCS Flagships program, supporting the demonstration of large-scale integrated carbon capture and storage projects;
2. Solar Flagships program, supporting the demonstration of large-scale solar power stations; and
3. Australian Centre for Renewable Energy, which will promote the development, commercialisation and deployment of renewable energy technologies.

The government designed these initiatives to support its 2020 Renewable Energy Target and its now postponed Carbon Pollution Reduction Scheme.

Other programs falling under the CEI include the Renewable Energy Demonstration program to assist commercial-scale deployment of proven renewable technologies, a Geothermal Drilling program to support proof-of-concept drilling, and a Second Generation Biofuels R&D program for developing new biofuel technologies and feedstocks.

Cost – or opportunity cost?

The big ticket item, in terms of a renewable energy source that can deliver baseload power, is geothermal.

Geoscience Australia estimates that hot rocks 2–5 km below the earth's surface contain enough energy to provide 2.6 million years worth of energy to Australia, based on current energy supply figures! At the moment, however, geothermal energy in Australia is still in its early stages and needs government funding for research and development.

Analysts from RBS Morgans recently concluded that geothermal has the capacity to deliver up to an estimated 6.8 per cent of Australia's baseload power needs by 2030.[4]

Around 50 companies have applied for hundreds of licences for geothermal exploration across Australia including SA, NSW, Victoria and Tasmania.

Late last year, the Federal Government elected to support two SA-based geothermal projects – Paralana (Petratherm/MNGI) and Innamincka-Moomba (Geodynamics) under its $235 million Renewable Energy Demonstration Program (REDP).

The two projects deploy different technologies in different geological settings. The 30 MW Paralana project is located adjacent to the Beverley uranium mine, while Geodynamics' 25 MW Cooper Basin project, located between Moomba and Innamincka, will demonstrate what the company claims to be the world's first multi-well hot fractured rock power facility.

'Geothermal energy may be more costly initially than other forms of energy generation, but this should not be a barrier to its adoption,' says Dr Smitham. 'Everything has a cost, whether it be capital expenditure or the costs of emissions on the environment. We just need to find the least cost solution.'

Once pilot plants have been proven and the technology moves towards deployment, however, the geothermal sector will be faced with another challenge – that of network connection. Here again, a HVDC grid appears to be the best prospect for linking remote geothermal power supplies to Australia's coastal population centres.

Fiona Wain, CEO of Environment Business Australia, believes renewable energy represents an opportunity for Australian companies to add value to the nation's resources and become a big player in the clean industrial economy. 'Using cheap, renewable energy, Australia has an opportunity to become a regional hub for minerals processing and heavy duty manufacturing as well as potentially becoming a base energy supplier to Asia,' she says. 'We have 40 per cent of the world's high-grade bauxite, for example, and we need to ask ourselves why we are exporting the raw material, rather than value-adding and commanding the lion's share of a speedily changing marketplace, such as supplying aluminium to lightweight vehicle manufacturers.'

Wain thinks that before this can happen, 'there needs to be a level playing field for renewable energy technologies to emerge at scale. Policy change needs to occur, removing or reallocating subsidies and preferential pricing contracts that have allowed free riders to dominate the market. These subsidies have a perverse outcome – they allow the status quo to dominate.'

Mark Bretherton agrees. 'Despite the great progress we've made, we still need to do more to support emerging technologies. The Solar Flagships and REDP programs are certainly a good step forward, but we also need to look at providing better tax breaks for cleantech companies, to stop them commercialising their technologies offshore.'

More information:

CSIRO, www.csiro.au/science/energy
Clean Energy Council, www.cleanenergycouncil.org.au
Australia's Renewable Energy Future, Australian Academy of Science, 2010
www.science.org.au/reports/documents/AusRenewableEnergyFuture.pdf
www.ret.gov.au/energy/clean_energy_technologies/Pages/CleanEnergyTechnologies.aspx

[1] Installed capacity is the total capacity or 'nameplate' capacity of a power plant, measured in megawatts (MW). It differs from the actual electricity generated by the power plant. For example hydro power plants may generate significantly less electricity than their installed capacity due to low rainfall in catchments.

[2] Saddler, H, Diesendorf, M and Denniss, R (2004) *A Clean Energy Future for Australia Energy Strategies*, Clean Energy Future Group, Canberra. Available at http://wwf.org.au/ourwork/climatechange/cleanenergyfuture/

[3] Feed-in tariffs offer small producers of renewable energy a premium rate for the electricity they generate. There are two main types: gross and net. Net feed-in tariffs pay households or other producers only for electricity fed into the grid (ie surplus to consumption). Gross feed-in tariffs pay the producer for all electricity generated, even if it is entirely consumed on-site.

[4] http://newworldenergy.com.au/wp-content/uploads/2010/02/RBS-Morgans-Research-Report.pdf