Focus

Energy superpower – or sustainable energy leader? 2

In this second instalment, **Michael Smith** and **Karlson Hargroves** look at two key planks to Australia becoming an 'energy superpower' through a sustainable energy approach – energy efficiency and the viability of renewables in delivering base-power loads.

Huge wind turbines are a familiar sight off the coast of Denmark, which generates 20 per cent of its electricity from wind. Vestas

Last issue (Part 1, *Ecos* 139) we explored the idea of Australia as a new type of 'energy superpower' capitalising, in today's carbon-constrained world, on technologically savvy, low- or no-carbon energy sources rather than our traditional reliance on non-renewable and greenhouse intensive energy sources, such as coal.

This time, we turn our attention to the role of demand management in supporting a renewable energy based future for Australia, as well as the renewables 'base load fallacy'. This is the argument – often invoked against the adoption of renewables – that renewable energy is intermittent and thus incapable of meeting the 24-hour-a-day, 7-day-a-week background demand for power that is currently largely met by massive, centralised coal-fired power stations.

As we will argue, our base load power requirements may be much higher than they need to be, and could be reduced by better demand management.

Australia's economy and its way of life depend, and will continue to depend, on access to low-cost energy. Added to this are concerns about rising greenhouse gas emissions – and whether the fuels and technologies Australians currently use will be appropriate for our future.

An expansion of nuclear power will take decades to make a significant difference and commercial geo-sequestration is still some years away. But a recent report[1] by Dr Mark Diesendorf shows how Australia could reduce its greenhouse pollution by 30 per cent by 2020. While some experts now say higher cuts will be required, this study was the first to show that 30 per cent could be achieved through a combination of energy efficiency, demand management, decarbonising our transport fleets and expanding renewable energy infrastructure.

In our online Sustainable Energy Solutions Portfolio,[2] the Natural Edge Project (TNEP) has come to a similar conclusion.

Energy efficiency opportunities

Energy efficiency savings are the quickest, easiest and most cost-effective way to

1 Diesendorf M (2007). Paths to a Low Carbon Future: Reducing Australia's Greenhouse Gas Emissions by 30 per cent by 2020. Sustainability Centre. http://www.greenpeace.org/raw/content/australia/resources/reports/climate-change/paths-to-a-low-carbon-future.pdf (Accessed 7 November 2007).

2 Smith M, Hargroves K, Stasinopoulos P, Stephens R, Desha C and Hargroves S (2007). Engineering Sustainable Solutions Program: Sustainable Energy Solutions Portfolio. The Natural Edge Project, Australia. www.naturaledgeproject.net/Sustainable_Energy_Solutions_Portfolio.aspx (Accessed 7 November 2007).

The ABC TV series *Carbon Cops* showed Australians how they could make big cuts to household energy consumption – and energy bills – in a matter of weeks. ABC TV

Energy efficient building design can dramatically reduce energy consumption – the Szencorp office building in Melbourne has a 6-star rating and includes its own photovoltaic energy supply on the roof. Szencorp

reduce greenhouse emissions – not only for industry and government sectors, but for individual Australians who will together determine our direction as a nation in energy consumption. The recent ABC TV series *Carbon Cops*[3] illustrates this point. Six family and student households all reduced their greenhouse gas emissions by over 60 per cent in a matter of weeks, while also halving their energy bills.

However, Australian businesses, government and consumers have had little economic incentive to invest in energy efficiency because of the low cost of Australia's electricity. The National Framework for Energy Efficiency's research shows that energy efficiency opportunities of 30–70 per cent exist for most industry, commercial and residential building sectors in Australia.[4]

These opportunities for energy savings abound. Geoff Andrews, Director of GenesisAuto, says that after 20 years as an energy efficiency consultant 'our experiences have led us to conclude that roughly 50 per cent of the base load electricity usage we find should not be there. For instance, street lighting at night can easily be made 50 per cent more energy efficient'.

'Hospitals run 24 hours, 7 days a week, so it might be reasonable to expect a flat load profile,'[5] says Andrews. 'But then you ask about the areas in a hospital which aren't 24 hours 7 days a week – consulting rooms, admin, laundry, kitchen, x-ray, central sterilising, maintenance, pathology – and more often than not there is still a flat load profile.'

'Also I am still amazed at the portion of base load contributed by storage-based electric water heaters both for commercial and residential buildings. A huge portion of the buildings we see have electric water heaters inconspicuously losing heat supplied with electricity from coal.'

Even higher energy efficiency savings can be achieved in the design of new buildings, factories or appliances. In the last 20 years, engineers using 'whole system design' techniques have found they can cost-effectively achieve energy efficiency improvements of 60 per cent or more in the design of buildings, cars, motor systems, heating and air conditioning systems and computer servers, to name a few.[6]

Economic modelling by the National Framework for Energy Efficiency has shown that if Australia as a whole implemented 50 per cent of available energy efficiency opportunities having a four-year or less payback, this would increase real GDP by AU$1.8 billion and create 9000 new jobs in addition to the environmental benefits.[7]

Improvements in end-use energy efficiency on a large enough scale could save tens of billions in infrastructure costs by delaying for decades the need to build new power stations and extend the electricity grid. Allen Consulting has shown the economic savings from energy efficiency opportunities to be large enough to cover the cost of building new renewable energy infrastructure. In short, a smart combination of energy efficiency and renewable energy would have negligible negative effects on Australia's economic growth.[8]

Solar, wind, biofuels, geothermal, tidal and hydropower now represent a global market of AU$74 billion, which is forecast

3 See ABC TV's *Carbon Cops* at http://www.abc.net.au/tv/carboncops/ (Accessed 7 November 2007).
4 National Framework for Energy Efficiency (NFEE) (2003). Towards a National Framework for Energy Efficiency – Issues and Challenges Discussion Paper. NFEE. http://www.nfee.gov.au/about_nfee.jsp?xcid=64 (Accessed 7 November 2007).
5 Energy demand profiles are graphs plotting peaks and troughs of energy consumption or load over a day or other unit of time. Thus a flat load profile represents a constant level of demand, without significant day or night peaks.
6 Stasinopoulos P, Smith M, Hargroves K and Desha C (2007). Engineering Sustainable Solutions Program: Technical Design Portfolio, Whole System Design Suite. The Natural Edge Project, Australia. www.naturaledgeproject.net/Whole_Systems_Design_Suite.aspx (Accessed 7 November 2007).
7 National Framework for Energy Efficiency (NFEE) (2003). Towards a National Framework for Energy Efficiency – Issues and Challenges Discussion Paper. NFEE. http://www.nfee.gov.au/about_nfee.jsp?xcid=64 (Accessed 7 November 2007).
8 Allen Consulting (2006). Deep Cuts in Greenhouse Gas Emissions: Economic, Social and Environmental Impacts for Australia. Report to Business Roundtable on Climate Change. www.allenconsult.com.au/publications/view.php?id=316

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The US has been forging ahead with solar thermal power. Acciona's Nevada Solar One™, an enormous solar thermal concentrator array, can generate 64 megawatts – enough to power 14,000 households. Acciona'

to grow fourfold by 2015. By 2003, the global annual output of co-generation and renewable energy surpassed that of nuclear power.

The base load myth

One of the biggest barriers to people accepting the need for greater investment in renewable energy is the perception that renewable energy sources cannot supply base load electricity. Few appear to be aware of the range of sources that have refuted this belief since the early 1980s.[9]

In fact, renewable distributed energy now accounts for one-quarter of California's installed capacity, one-third of Sweden's energy, half of Norway's and three-quarters of Iceland's. Since 2003, Denmark has also generated 20 per cent of its electricity from wind.

Many forms of renewable energy – such as hydro, biomass and geothermal – do not depend on day-to-day weather variations and hence can provide electricity all day, every day. Wind, wave and tidal power can also provide base load electricity when used on a large scale separated by several hundred kilometres and subject to different wind, wave or tidal regimes. The total output of such systems generally varies smoothly; only rarely would such a system be in a situation of no wind, waves or tidal change at any site.

Graham Sinden from Oxford University has investigated the potential contribution of wind, solar, tidal, wave power and other renewable energy sources for electricity in the UK.[10] He concluded that most of the UK's electricity could be generated from renewables, with wind from dispersed sites providing the greatest contribution.[11]

Solar energy can also be stored at low cost as heat in water, rocks or thermo-chemical systems such as ammonia, enabling it to provide electricity 24 hours a day.[12] Solar thermal electric power plants convert solar energy to heat that is used to drive thermal electricity generators. This electricity can supply base load and is just as reliable as base load coal.[13] In fact, solar thermal base load electric systems have been around for 20 years.

Australian scientists have made world-class contributions to solar thermal research over the last 50 years.[14] As was recently reported on ABC TV's *7.30 Report*, two of America's biggest power utilities have unveiled plans for a multi-billion dollar expansion of solar power supply based on technology developed by a former Sydney University professor, David Mills, now based in California. The utilities have confidently predicted that their solar power will soon be providing base load electricity at prices competitive with coal.

Indeed, according to a review by CSIRO scientists for the CRC for Coal in Sustainable Development, some experts now argue that the cost of concentrated solar thermal will become competitive to coal-fired generation when the former's installed capacity reaches 5000 MW worldwide by 2013.[15] As the study's lead author, Dr Louis Wibberley from CSIRO, said: 'What makes solar thermal particularly attractive is the fact that it integrates very well with existing technologies including coal, gas, biomass, photovoltaics and wind power.'

More information:

Smith M, Hargroves K, Stasinopoulos P, Stephens R, Desha C and Hargroves S (2007). Engineering Sustainable Solutions Program: Sustainable Energy Solutions Portfolio. The Natural Edge Project, Australia. www.naturaledgeproject.net/Sustainable_Energy_Solutions_Portfolio.aspx (Accessed 7 November 2007).

Stasinopoulos P, Smith M, Hargroves K and Desha C (2007). Engineering Sustainable Solutions Program: Technical Design Portfolio, Whole System Design Suite. The Natural Edge Project, Australia. www.naturaledgeproject.net/Whole_Systems_Design_Suite.aspx (Accessed 7 November 2007).

ANU Solar Thermal Group, http://engnet.anu.edu.au/DEresearch/solarthermal/pages/pubs.php

Sydney University solar research, www.physics.usyd.edu.au/app/research/solar/clfr.html

Correction: In the first part of 'Energy superpower – or sustainable energy leader' in *Ecos* **139**, p. 20, Barry Jones from the Australian Petroleum Production and Exploration Association was mistakenly identified as the former Labor Party politician with the same name. The error was made by *Ecos* during production.

9 Diesendorf M (2007). *Greenhouse Solutions with Sustainable Energy*. UNSW Press, Sydney.

10 Sinden G (2005). Variability of Wave and Tidal Stream Energy Resources. Oxford University Environmental Change Institute. A summary of the report and further information is available on the Carbon Trust's website at www.carbontrust.co.uk/NR/rdonlyres/EC293061-611D-4BC8-A75C-9F84138184D3/0/variability_uk_marine_energy_resources.pdf (Accessed 7 November 2007).

11 Tickell O (2005). Wave, wind, sun and tide is a powerful mix. *The Guardian*, 12 May 2005. http://www.guardian.co.uk/life/opinion/story/0,,1481539,00.html (Accessed 2 June 2007).

12 Lovegrove K *et al.* (2007). Closed loop thermochemical energy storage system using ammonia. ANU Solar Thermal Energy Research, Canberra. http://engnet.anu.edu.au/DEresearch/solarthermal/high_temp/thermochem/index.php (Accessed 2 June 2007).

13 Lovegrove K *et al.* (2007). Introduction to concentrated solar thermal. ANU Solar Thermal Energy Research, Canberra. http://engnet.anu.edu.au/DEresearch/solarthermal/high_temp/concentrators/basics.php (Accessed 2 June 2007).

14 Lovegrove K and Dennis M (2006). Solar thermal energy systems in Australia. *International Journal of Environmental Studies* **63** (6), 791–802. http://engnet.anu.edu.au/DEresearch/solarthermal/pages/pubs/IJES06.pdf (Accessed 2 June 2007).

15 See 'Solar thermal power warms up'. *Ecos* **129**, 4 (2006). http://www.publish.csiro.au/?act=view_file&file_id=EC129p4b.pdf (Accessed 7 November 2007).

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