## 'CLEANTECH' TECHNOLOGY

## Focus



# On the vanguard of cleantech

Prematurely misunderstood in Australia, 'cleantech' is a rapidly maturing international paradigm changing the way we see green and clean technologies, investment, business and politics. **Nicholas Montgomery** reports on the emergence of a lucrative industry under the new environmental imperatives.

Thought of as revolutionary as information technology at the start of the 1990s, 'cleantech' – short for 'clean technology' – is a 'perfect storm' of new technologies backed by entrepreneurs, neo-greens, environmental business and technologists. It's already having a significant impact on Australia.

Back in January, the Asia Pacific Partnership on Clean Development and Climate (AP6) generated more than its fair share of controversy. Amongst the debate, an unfamiliar word drifted into the political lexicon: cleantech.

For some, cleantech seemed like a buzzword concocted by the government and the coal industry to again stifle the renewables industry. But to think that would be to misunderstand a new, and important, movement. Internationally, cleantech is a hard to categorise sector, joining entrepreneurs, greens and environmental business with technologists who think new clean technology possesses transformative qualities comparable to those that drove the 'IT' revolution.

Somewhat overshadowed by the recent Asian AP6 climate initiative, the first-ever Australian Cleantech forum late last year sought to explain the new movement in some detail. *Ecos* caught up with the new cleantech pioneers at the event for some insight and working definitions. Solar mirrors or heliostats at the CSIRO Energy Centre, Newcastle, NSW. These are part of an array of 200 mirrors which concentrate the sun's energy on a reactor mounted on a 26-metre-high tower. Nick Pittas, CSIRO

For most of this decade, Chairman of the Cleantech Capital Group, Nicholas Parker, and Chrysalix Energy CEO, Dr Wal Van Lierop, have been busy establishing the Cleantech Venture Network in North America. The network coined the term 'Cleantech' in 2002 to power shift the 'array of alternative energy, energy efficiency and other green technologies' under one mainstream movement.

According to the Cleantech Capital Group, 'cleantech' is defined as 'any knowledge-based product or service that improves operational performance, productivity or efficiency while reducing costs, inputs, energy consumption, waste or pollution. 'Increasingly, clean technologies are developed primarily to meet an economic need; their environmental benefits are a significant but secondary consequence'

'The cleantech concept is not specific to a particular sector; it encompasses energy generation, energy storage, energy infrastructure, energy efficiency, transportation and logistics, water purification and management, air quality, materials and nanotechnology, manufacturing/industrial, agriculture and nutrition, enabling technologies, materials recovery and recycling, and environmental IT.'

On the face of it, environmental technology is spawning a host of new industries, from hybrid electric vehicles to wind power. But cleantech's advocates see it as the new energy vanguard offering a clear divergence from the sometimes politically correct 'envirotech'.

'Clean technology is about becoming the enabling technology of the 21st century industrial society. It's not classic envirotech – more like biotech or information technology,' offers Nicholas Parker. Cleantech is lighter, smarter, stronger and cheaper to manufacture, as well as being less carbonintensive and more energy efficient.

'For some, renewables do not cut it,' explains Wal Van Lierop. 'People, governments and investors are sometimes afraid of renewables – they're big and something we associate risk with. We (cleantech) use the slogan Preferred Energy.'

Developed to meet an economic, consumer or government demand, cleantech makes no qualms about placing environmental needs second. 'Increasingly, clean technologies are developed primarily to meet an economic need; their environmental benefits are a significant but secondary consequence,' says Parker.

Traditional greens might not be ecstatic about such a proposition, and they may feel more uncomfortable still with Cleantech changing the rules on what constitutes green and clean technology. 'While converging around clean energy, clean production, and use of resources with advanced materials, information technology and biotech, cleantech provides technology for industries considered, just a short time ago, "unethical", says Parker. Accepted technology includes clean nuclear power waste disposal, clean coal, bio-clean water products, nanotech solar cells, residential wind, GM cell membranes and even hydrogen for the US navy.

Judging by the above list, the 'whose side are you on' question, so prevalent in Australia at present, doesn't bother the cleantech movement. It isn't into picking sides; 'only winning technology,' says Parker. 'Ideologically neutral', cleantech's advocates simply favour efficient options for changing economic and environmental conditions.

The motto is: 'cleantech that wins will be decided by energy security, energy prices and technology prices.'

And so, remarkably, if cleantech sees massive renewables as hap-hazardous, they will equally criticise current power provision as centralised and expensive, and be made inefficient by carrier systems. As a result, greens may then feel a tad better about cleantech's refusal to be politically correct or to fall back on ideology.

The Cleantech Network sees Australia adopting this unique position. It's not a contradiction for Australia to support both solar and 'clean coal' technology, Parker says, confidently. He sees Australia's strength in cleantech in wave and solar options, based on the 'sun, surf, sand' trademark known so well to tourists. At the same time, he strongly advises embracing clean coal too.

Parker sees Australia's research and development cleantech base as 'world-



Dr Wal Van Lierop, Chrysalix Energy CEO, (left) and Nicholas Parker, Cleantech Capital Group Chairman (also a founder of the Cleantech Venture Network), visited Australia recently to speak about the international momentum of investment in clean technology. Nicholas Montgomery

class.' The Cleantech Network notes that Australia's foremost research and development organisation, CSIRO, is now allocating 40 per cent of its budget to Cleantech. Wal Van Lierop also views CSIRO as foremost in promoting Australian cleantech worldwide.

But, while cleantech pioneers are enthusiastic about the organisation's new cleantech uptake, many in the media and environmental lobbies take the view that cleantech means a backing away from renewables at CSIRO.



The demand for environmental technology is spawning new industries, such as the one for hybrid and electric vehicles. The electric Vectrix motor scooter from the US, soon available from Vectrix Australia, is capable of a top speed of 100kph within 6.8 seconds and gives 5 hours of driving on a 2 hour charge time. Vectrix Australia

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Dr Regg Benito undertakes adjustments on the Solar Thermal Dish at the Lucas Heights Facility. Mirrors in the solar dish concentrate the sun's energy, providing the power for the reactor. In the reactor, steam and methane (natural gas) react to produce a high value, synthetic gas that contains 26 per cent embodied solar energy. This gas, containing hydrogen, can then be used for generating electricity in gas turbines and fuel cells, or providing thermal energy. North Sullivan Photography.CSRO

Weathering the criticism, Australia's Energy Transformed Flagship Director, CSIRO's Dr John Wright, says cleantech is just the sort of new philosophy and direction CSIRO is taking. He points out that CSIRO's solar-thermal cleantech is scheduled to operate alongside Australia's 39 coal-power stations, and that the building of solar thermal projects next to power stations is logical – it makes for an easy transition of power generation technology.

CSIRO's Coal in Sustainable Development (CCSD) Chief Executive, Frank van Schagen, says solar-thermal cleantech doesn't only supplement power; it can also draw power from coal stations by converting methane from natural or 'coalbed gas' to make 'synthesis gas.'

Add the solar gas to CSIRO's hybrid coal gasification, coal sequestration and solar-turbine technologies, and it seems clear that the mix of cleantech under the Energy Transformed Flagship projects appears set to expand.

'The (cleantech) philosophy is about making what we've got clean, and building new energy systems from there,' explains Wright. 'We have to be clear on this: all energy systems are extremely important to getting it right and lowering greenhouse gas. This requires an active research, development and demonstration program to reduce the greenhouse intensity of technologies using fossil fuels, while addressing the need to reduce consumption and develop affordable renewable energy technologies.'

Schagen also sums up CSIRO's cleantech approach when he says: 'In the polarized public debate, Australia's energy challenge is often depicted as fossil-versus-renewables. In reality, the answer lies in an intelligent combination of the best technologies. Australia has sunlight, and it has coal and gas – in vast amounts. We can combine them to create ideal energy solutions in ways simply unavailable to most other countries on Earth.'

Indeed, it is about setting priorities in changing markets and environmental conditions. And increasingly it's about going micro. Micro cleantech, developed with integration in mind, is a crucial element of the cleantech movement says the Cleantech Network. CSIRO's 40 per cent cleantech initiative is focusing on an array of small technologies like the ultra hydrogen battery and residential wind power, says Dr Wright.

'We call micro-power, such as solar and

micro turbines, distributed energy systems that will help with peak power and create an intelligent grid. The intelligent grid itself will employ technologies such as computer networks and energy efficient distribution systems that can flood power to pressure points during peak use.'

Some smaller, but nonetheless important, cleantech is emerging from Australia's other leading research and development organisation, the Centre for Energy and Greenhouse Reduction Technologies (CEGT). Since 2000, the Centre has been moving more towards clean technologies development. CEGT's Jan Dekker says 60 per cent of their cleantech solutions contain three common elements: they are small, they integrate into existing infrastructure and they are energy efficient.

The hundred or so cleantech products developed and funded by CEGT go from the simple Active Reactor Lighting Controller (the installation has seen CO<sub>2</sub> emission reductions equivalent to taking 10 000 cars off Victoria's roads), to the complex: brown coal drying and cryogenic gas sweetening technology; cleantech that turns CO<sub>2</sub> into liquid for coal-sequestration. Then there's the outright radical: the Kinetic Energy Cell that turns vibration into energy.

Queensland's Sustainable Energy Innovation Fund is another good example of the support behind the switch to a portfolio mix of clean technologies. It has been funding solar thermal research since 2000 alongside efficient solar lights, dieselethanol and sugar-mill cleantech, and polymer beams for building.

Other bodies moving to cleantech include Sustainability Victoria, AusIndustry, the CRC for Coal in Sustainable Development, the CRC for Sustainable Resource Processing, Commercial Ready, the Greenhouse Gas Abatement Program, South Australia's Sustainable Energy Research Advisory Committee and Victoria's Energy Technology Efficiency Strategy.

With so many like-minded organisations switching, Australia is positioned well in research and development 'to become the Silicon Valley of cleantech,' says Australia's own cleantech expert, Clean Technology Austral-Asia's Peter Castellas. Castellas, also the Fund Manager of the Sustainable Melbourne Fund, thinks Australia can drive world cleantech with water.

'Australia boasts a long pedigree in the area of innovation in the water quality and wastewater treatment area. Perhaps the greatest market for innovation and growth in the cleantech space is water,' he says.

Clean Technology Austral-Asia points to local company Agralink's automatic spray irrigation machines and wireless C-probe technology, which measures soil moisture, as cleantech world-beaters. Agralink CEO, Peter Hasko, explains why: 'Our revolutionary system allows people like primary producers and environmentalists to log onto the Internet and monitor the status of a crop or soil on their property from anywhere in the world'. The system has since been micro-sized into a device that calculates whether household gardens actually need watering.

Australia's big-name water cleantech also includes advances in desalination, water purifier, water-saving piping and wastewater recycling systems. The diversity is further increased by Melbourne and Sydney Water's 'energy from sewage' cleantech, and the University of Queensland's Advanced Water Management Centre similarly removes algae and sewage from water for energy use.

Australian cleantech is so significant, in fact, that Zurich-based Sustainable Asset Management has added an Australian water fund to its portfolio for European investors. Driving this boom is speculation that water will be seen as the oil of the 21st century.

Green building and infrastructure is another high noon area according to Castellas, and he's not wrong. Garry Weaven, Founder and Executive Chair of Industry Fund Services and now CEO of one of Australia's leading clean energy companies, Pacific Hydro, believes infrastructure provides more than unlimited potential for cleantech application.

But it is the prospect of investment in this new phase technology by big institutional backers such as Weaven, along with the likes of Macquarie's Clean Technology Fund, Babcock & Brown, and James Fielding's Cleantech Capital, that could take cleantech onto roads and into buildings. Australian pension funds are already following the US trend to invest in the technology, stocks and capital. Under California's Green Wave initiative, pension funds are committing \$1.5 billion to investments in 'cutting edge technologies.'

Company wise, Clean Technology Austral-Asia has identified 70 cleantech businesses in Australia with a total capitalisation of '\$7.8 billion and they had raised nearly 15 per cent of their value (\$1.1 billion) by way of new capital since July



Solar and wind energy Cleantech powers research operations at CSIRO's Energy Centre showcase, Newcastle, NSW. CSIRO

2004'. These include Australian Ethanol Limited, Eastern Star Gas, Advanced Nanotechnology, Babcock & Brown Wind Partners, Viridis Clean Energy Group and Geodynamics Limited.

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From the point of view of political buyin to this emerging development phenomenon, Clean Technology Austral-Asia predicts 'seven new government funds totalling \$1 billion set to support clean technologies in future years, mainly until 2009.' Castellas says grants for cleantech will increase five-fold, partly because of government 'keenness to counter (political) criticism and to stimulate market activity by establishing a series of initiatives such as the Low Emission Technology Demonstration Fund, Renewable Energy Development Initiative and Solar Cities program.' Cleantech can deal with both 'conservatives' and 'progressives' adds Castellas. Moreover, the healthy competition between state and federal ideas on climate change – the states favour Kyoto, carbon trading, 20 per cent renewable targets and wind, whereas the federal government favours solar, clean coal, and to 'go it alone' – is closing around a consensus behind cleantech.

Clearly then, Australian cleantech has some political, economic, development and research weight behind it. But it still lingers outside the public consciousness. Small cleantech is as yet unfashionable or hidden, while larger cases – renewables, for example – are currently prone to bouts of instability. Then there are the negative impressions of cleantech that have already developed to some extent through media association with untested clean coal technologies – something the Australian government has yet to counter.

But the Cleantech Network's Dr Wal Van Lierop expects a flagship product to soon 'flex' cleantech into the mainstream. 'We need an iconic "iPod" cleantech device that opens understanding to the possibilities and benefits of cleantech,' rouses Wal Van Lierop.

Australia may already have one such device. CEO of Ceramic Fuel Cells Limited, Brendon Dow, is touting their

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## Nicholas Parker's highlighted imperatives, actions and challenges for Australia:

## Government

- Get serious about carbon across all industry and society
- Promote Australia as a cleantech hub

### Entrepreneurs

- Think global and reflect this in your business plans
- Think China and India
- Think solution not technology; economics not regulation

#### Investors

- Link up internationally with large players
- Invest globally and locally
- Diversify; think carbon

combined heat and power fuel cell, the Netgen micro generator, as a cleantech circuit-breaker. As well as generating hydrogen, Netgen distributes energy to other users via a low voltage network. The all-in-one device could place power generation and delivery in the hands of consumers, business, hospitals or schools.

That an Australian company could hold the key to the cleantech revolution prompts Castellas to ponder whether more 'Bill Gates and Steve Jobs (type) cleantech inventors are tinkering away in Australian sheds.' There are strong indications that this is the case.

Even so, outside the cosy sheds there may be a problem. 'The risk is that more great Australian technologies will go offshore to be profitably commercialised,' warns Castellas. For example, although its testing its device in two Australian universities, a lack of support has actually forced Ceramic Fuel Cells itself to go 'offshore' to Britain.

Economically, this may be good news for Britain but it's bad news for Australia. On the other hand, the Cleantech Network believes cleantech 'clusters' and 'transfers' ultimately benefit the environment.

Interestingly, a Chinese–Australian success story exemplifies international clusters of cleantech knowledge and systems. Worth US\$2.2 billion and number 350 on the *Forbes* world rich list, Dr Shi Zhengrong studied photovoltaics at Sydney University and then moved back to China to run Suntech Power – now the sixth largest solar manufacturer in the world.

On the back of Suntech Power, China already provides solar hot water for some 35 million buildings. And the Cleantech Network predicts China will propel this

#### Corporations

 JVs, marketing, R&D, minority investments, spin-offs, demos and pilots: learn about new business models and technologies, protect against value migration risk

#### His Top Five cleantech areas are:

- Micro fuel cells
- Solar thermal
- Coal filter membranes
- Residential micro wind and solar
- Hybrid cars

new revolution forward by buying cleantech from Australasian nations. With around 70 coal-fired stations going up a year in China, clean coal technologies will play a major role.

Also, let's not forget China's dirt-cheap hybrid cars (a Toyota Prius factory is slated for construction this year) and its recently announced 20 per cent renewable energy target.



Detail of the Netgen unit showing the central fuel cell stack. The unit provides power and hot-water heating in one. crc Limited

'Don't underestimate China,' says Cleantech Capital Group's Nicholas Parker, referring to the perception that China is just a manufacturer.

Indeed, the big two of the Pacific Partnership – Japan and China – tend to exist in Western minds as manufacturing hubs. Yet, if the Japanese are anything to go by, we are in for a cleantech shockwave. Hybrid cars are placing it squarely as an early first mover. Developed in Japan, the Toyota Prius broke cleantech wide open last year. The next generation Prius will employ cleantech that needs little or no petrol.

Similarly, Japan's Micro energy 1MW solar systems are already popular with consumers, and the fact that Sharp has claimed 'the largest manufacturer of solar technology' title in Japan holds some product-bending possibilities.

But even with Australasia showing its potential, the US still points the way forward for cleantech. America's energy giant, GE Energy, is the leading proponent of cleantech with hybrid-electric locomotives, fuel-efficient aircraft motors, membrane water purifiers and pesticide superspreaders. Even cleantech washing machines are among their arsenal.

Other US cleantech includes kites that generate power from high altitude winds, recycled plastic cardboard coatings, green dry cleaning technology, UltraCell micro fuel cells and Recycle Bank – a product that identifies how much a home recycles and then pays the home for the amount recycled.

Of course, cleantech's advocates do not hold all their faith in consumer products. What they are doing, however, is addressing the possibilities of the coming 'clean economy'. The mere notion that cleantech could rival the information technology revolution provokes visions of a clean and green planet. Google or Microsoft on your solar-hydrogen-powered PC anyone? While the size of the cleantech picture is still becoming clear, it is already offering government, industry and consumers a unique way to break free of some ideological thinking and move forward with solutions to the challenges.

#### More information:

CSIRO Energy Transformed Flagship: www.csiro.au/csiro/channel/ppch1d.html Cleantech Venture Network: www.cleantech.com AustralAsian Cleantech Finance and Investment Forum: www.cleantechforum.com