

## Tower of Power

With innovations like a skyscraping solar energy system, Australian entrepreneurs have taken the lead in finding fossil-fuel alternatives - and grabbed a beachhead in a huge global market.

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(Business 2.0 Magazine) -- Rattling down a red dirt road on the edge of the Australian outback, Roger Davey hits the brakes and hops out of a rented Corolla. With a sweep of his arm, he surveys his domain - 24,000 acres of emptiness stretching toward the horizon, the landscape bare but for clumps of scrubby eucalyptus trees and an occasional sheep.

It's a dead-calm antipodean winter's day, the silence of this vast ranch called Tapio Station broken only by the cry of a currawong bird. Davey, chief executive of Melbourne renewable-energy company EnviroMission, aims to break ground here early next year on the world's first commercial "solar tower" power station.

"The tower will be over there," Davey says, pointing to a spot a mile distant where a 1,600-foot structure will rise from the ocher-colored earth. Picture a 260-foot-diameter cylinder taller than the Sears Tower encircled by a two-mile-diameter transparent canopy at ground level.

About 8 feet tall at the perimeter, where Davey has his feet planted, the solar collector will gradually slope up to a height of 50 to 60 feet at the tower's base. If Stanley Kubrick had put a power station in 2001: A Space Odyssey, it would've looked like this. Acting as a giant greenhouse, the solar collector will superheat radiation from the sun. Hot air rises, naturally, and the tower will operate as a giant vacuum. As the air is sucked into the tower, it will produce wind to power an array of turbine generators clustered around the structure.

### Clean, renewable energy

The result: enough clean, green electricity to power some 100,000 homes without producing a particle of pollution or a wisp of planet-warming gases. Unlike wind farms and traditional solar panels, which generate electricity only when the wind blows or the sun shines, the solar tower is designed to replace carbon-spewing power plants.

"We're aiming to be competitive with the coal people," says Davey, 60. "We're filling a gap in the renewable-energy market that has never been able to be filled before." And although its final dimensions are still being tweaked, the 50-megawatt Tapio Station plant is just the small model: A half-mile-tall version is in the works for China, and EnviroMission is scouting sites in the American Southwest for other possible skyscraping power plants.

The solar tower is the most audacious of a host of renewable-energy projects under way in Australia that are making the country the global hotbed of alternative-energy entrepreneurship. Concerns over greenhouse gases, the oil crisis, and China's voracious appetite for energy may have stirred only faint interest from the U.S. government and, to date, halting efforts by American entrepreneurs.

But Down Under, people see a big upside, and a swarm of innovating Aussies are busily staking out turf in what is sure to be a massive global market for renewable energy in coming years.

In the sugarcane country of the tropical north, Queensland startup Pulse Energy is developing biomass power stations designed to produce electricity out of everything from sugarcane waste to chicken poop. The company recently signed a deal to build 30 biomass power plants in China.

Down in the island state of Tasmania, wind-power company Roaring 40s has inked agreements to put up \$228 million worth of wind farms in the People's Republic. And who's pumping money into EnviroMission? Shanghai investors. In the Australian capital of Canberra, alternative-energy startup Windlab Systems is hooking up with international investment banks that want to use the company's virtual wind-farm software to scope out the best places overseas to build the real thing.

Energetech in Sydney has created wave-energy technology that taps the power of the surf to generate electricity, while Queensland's Geodynamics drills miles into the earth to mine the geothermal power of "hot rocks."

### **Australian entrepreneurship**

Australia is an improbable epicenter of alternative-energy innovation. It is sparsely populated and holds vast coal deposits; coal-fired power plants provide 86 percent of the nation's electricity at bargain-basement rates. The coal also makes Australia the world's highest per capita producer of greenhouse gases.

Like the United States, Australia rejects the Kyoto Accord to combat global warming. The government does run a crack R&D agency, the Commonwealth Scientific and Industrial Research Organization, which has jump-started some alternative-energy efforts, licensed technologies to private companies, and provided seed capital.

CSIRO will even give those who invest in its technologies an equity stake in any startups that are spun off. But CSIRO aside, the government has been fickle, offering incentive programs for renewable energy and then abruptly scaling them back.

Australia's homegrown venture capitalists haven't been much better. "One of the drawbacks of innovating in Australia is that the risk markets don't actually like taking risks," Windlab executive Luke Osborne observes dryly.

Yet these very obstacles have done much to propel Australian entrepreneurs to the forefront of renewable energy. For one thing, they've provided a painfully earned understanding that success in alternative energy means going global from the start--for funding, for partners, and for potential markets.

The hard-won momentum is creating vast opportunities for outside investors and foreign tinkerers to come along for the ride. "It's unbelievable how many good deals there are here in terms of companies to invest in and technologies that are immature and have yet to spin out of labs," says Ivor Frischknecht, a Silicon Valley veteran now specializing in clean tech at Starfish Ventures in Melbourne.

In a sense, the progress of Australian renewable-energy innovators is another twist on the fundamental national narrative: grappling with an isolated, harsh environment and persevering through imagination and grit. "I think there is something about Australia," says CSIRO commercialization chief Jan Bingley of the Aussie approach to innovation. "It's that whole tyranny-of-distance factor. We came from that background of having to make do with what we have down here."

One of the things Australia has, in abundance, is sunlight.

Among the sea of slicksuits the Qantas Club at Melbourne Airport just after dawn on a clear June morning, Davey, who bears a resemblance to the actor Wilford Brimley, stands out in his brown-checked sports jacket.

EnviroMission communications director Kim Forté leans over and whispers to Davey; she thinks she spots a familiar face amid the preflight caffeinating: a government bureaucrat involved in dispensing \$370 million to low-emission energy projects. EnviroMission has applied for a \$75 million piece of that pie, and a decision is imminent.

It's a crucial time in Davey's eight-year quest to turn the space-age images on EnviroMission's website into steel and glass. Secure the cash from the feds and a third of the cost of the solar tower's construction is in the bank. That in turn will likely open the wallets of Australian investment banks. EnviroMission has reconfigured the solar tower with the aim of winning the grant. Lose and it's back to the drawing board.

So today Davey and Forté are taking a 36-seater prop plane to Mildura--"Gateway to the Outback"--to rally support in the rural towns near the tower site. Always selling the dream, Davey stops to chat up an acquaintance he bumps into in the concourse on his way to the departure gate.

Davey's transformation from a longtime Melbourne stockbroker and securities dealer into an alternative-energy evangelist began one night in the late '80s when he flipped on his TV. A popular science show featured a story about a solar tower prototype tested in Spain in the early 1980s. Designed by a German engineering firm in the wake of the oil shocks of the '70s, the 50-kilowatt plant proved the solar tower's feasibility. But once oil prices crashed, its economic viability evaporated. "I saw this, and it grabbed me," Davey recalls. "It was so green and so clean, and it could be a large producer of power."

The Kyoto Accord was reached in 1997, and the following year Davey acquired a license from Germany's Schlaich Bergermann & Partner to use the technology in Australia, China, and the United States. Oil prices hit rock bottom in late '98 and then began to rise sharply.

### **Advanced technology: The rising sun**

Davey incorporated EnviroMission in late 2000. Shortly thereafter, the Australian government unveiled a program requiring that 2 percent of the country's then-total electricity production come from renewable sources by 2010. With the emergence of a renewable-energy market in Australia, Davey announced plans to build a solar tower.

The initial specs were outlandish to say the least: The station would be a 200-megawatt monster with a 3,300-foot-high tower surrounded by a 4.5-mile-wide solar collector. The tower would be nearly twice as tall as the tallest structure on earth, the CN Tower in Toronto. Google Earth it and you'd see the half-mile tower from space.

"People thought I was stark raving mad," Davey chuckles. "They said you couldn't do it, that it would never be commercial because it was so big and such a construction nightmare."

Not to mention the estimated \$700 million price tag. Still, there was no arguing that Australia's vast expanses of flat, empty, sun-drenched terrain made Down Under an ideal locale for such a project.

And no denying the sci-fi sex appeal of the solar tower - or its allure as a deus ex machina solution to the seemingly insoluble problem of reducing greenhouse gases and pollution while boosting electricity production for an energy-hungry world.

With a solar tower, there's no fuel to dig out of the ground, transport, or dispose of, no smog, no scarred landscapes from open-pit mining. The sun rises every day and is not subject to embargoes, geopolitics, or commodity markets.

And once the solar tower's capital costs are paid off, the price of producing electricity should drop dramatically, as operating and maintenance costs are expected to be minimal. Despite its monolithic scale, the technology behind the tower is based on an elemental scientific truth: Hot air rises. The solar tower's only moving parts are its turbines.

But the Tapio Station solar tower as originally proposed represented a textbook case of "extreme engineering." To get the thing built, Davey needed to establish EnviroMission's credibility while persuading some big players to buy into his clean, green dream.

An initial victory came in 2002, when the federal government granted the solar tower "major project" status to streamline the regulatory approval process. The tower, a government minister noted, "confirms Australia as a world leader in renewable-energy production."

EnviroMission bought 24,000 acres of Tapio Station, the wheat and sheep farm located near the southwest New South Wales town of Buronga. The site is hot, sunny, flat as a roadkill 'roo, and within a few miles of the power grid.

While tower inventor Schlaich Bergermann worked on the engineering, Davey signed up Australia's biggest construction firm to conduct a feasibility study with the right to build the project. "The thing that we have to do, which we have done, is have independent people verify everything," says Davey, who earned about \$190,000 from EnviroMission last year. "The independence of those people and the credibility of those people has made the project credible."

His mobile phone trills. "Hello? Yes, mate. 2:30 at your office. Done. Thanks, mate." On the line was an executive with [AGL \(Charts\)](#), one of Australia's largest utilities. Early on, EnviroMission locked up a deal to provide AGL with electricity produced by the solar tower.

Davey has also secured the services of Macquarie Bank, one of the country's most prominent investment banks and a financier of major infrastructure projects in Australia and overseas. Companies like [General Electric \(Charts\)](#) and [PPG Industries \(Charts\)](#) are providing free design services - with the expectation, obviously, that they will win contracts to supply components for the solar tower.

"That's been one of the skills in putting this together," Davey says. "A small company couldn't afford to take this project to fruition without the support and belief of the other majors that have been working with us."

## **Chinese energy demand**

The latest believers are the Chinese. IN 2002 executives at Xiang Jiang Industrial, a Shanghai developer and construction company, stumbled across press mentions of the project. They flew to Melbourne to meet Davey and learn more about the technology.

Xiang Jiang subsequently became EnviroMission's second-largest shareholder when its Australian holding company invested \$1 million in EnviroMission and \$1 million in SolarMission Technologies, the vehicle for Davey's U.S. operations.

The Chinese also invested \$8 million in a joint venture with EnviroMission to build and operate solar towers in China.

"We truly believe the technology will be successful," says Yue Tang, a Xiang Jiang director. "Every country needs renewable energy, and China will be a big market."

The joint venture has applied to build a 200-megawatt, half-mile-high solar tower outside Shanghai. "We want to build the tallest in the world," Tang says. "Reaction at all levels of government and from technical officials is all positive, but because this is a new technology, they still need more technical information to get final approval."

The market for renewable energy in China is massive. The government last year enacted a law requiring that 10 percent of power production come from renewable sources by 2010.

And it's prepared to spend \$62 billion to make that happen. China's renewable-energy target represents about 60 gigawatts. Australia's total energy production is about 45 gigawatts.

The timing of the 2004 Chinese deal was propitious. Three months later, Australian prime minister John Howard's government declined to extend beyond 2010 the mandate that a percentage of the nation's electricity production come from renewable sources.

The government reasoned, in part, that since the 2010 targets for renewable-energy production are likely to be hit by 2007, there's no reason to maintain the incentives for smokestack utilities to buy clean energy. (To soften the blow, the government set up the \$370 million fund to finance low-emission demo projects like the solar tower.)

The policy reversal stepped up renewable-energy companies' efforts to look offshore. "We would continue to maintain and operate the wind farms we created, but basically it wouldn't be a growing business," says Mark Kelleher, managing director of Roaring 40s, a wind-energy spinoff of Hydro Tasmania, the state's hydroelectric provider. "So it was either prepare to close down or go overseas."

In 2005, Hong Kong power company CLP took a 50 percent stake in Roaring 40s, and now the Tasmanian company is building \$228 million worth of wind farms in China.

For its part, EnviroMission's U.S. arm will soon open an office in Phoenix, and Davey has been meeting with local officials about potential solar tower sites in the Southwest.

Likely locales: Arizona, New Mexico, and Texas, where a group of investors injected \$1.8 million into EnviroMission last year. Among those who have expressed interest are California governor Arnold Schwarzenegger's energy advisers.

### **Redesigning the tower**

A technology breakthrough and the Australian government's creation of the low-emission project fund led EnviroMission last year to downsize the solar tower plant to 50 megawatts.

The company's contractors had concluded that the original half-mile-tall tower could be built - but only at great cost. The technology would work as advertised, they said, but with one significant drawback: Power production would drop off dramatically once the sun set.

EnviroMission hired consultants at Melbourne's RMIT University and engineering firm Ove Arup to incorporate solar ponds into the solar tower to allow the power station to run 24/7.

That required a redesign of the solar collector roof, using technology developed by the University of Melbourne and CSIRO. The ponds sit outside the solar collector and trap heat in layers of saltwater. At night the heat is released to power the tower's turbines.

Davey starts scribbling on the proverbial cocktail napkin, drawing a diagram - verified by computer modeling, he says - to show how the integration of the new technologies will allow a smaller and cheaper tower to operate at greater efficiency.

At some point, almost everyone who comes across Davey and his tower ends up asking the same question: Is this for real?

And as far as Davey has come in his quest, many hurdles remain. Unforeseen problems inevitably arise when building such a massive structure. Then there's the matter of whether technology untested on such a staggering scale will work as expected, regardless of what all the sophisticated computer modeling shows.

Exporting green technology comes with its own pitfalls: Foreign governments can do a 180 on energy policy as abruptly as domestic ones. Even admirers like Frischknecht, the Silicon Valley veteran, have their doubts. "I ran the economics on it a couple of years ago and couldn't figure out how it made sense," he says.

There's also the question of how EnviroMission will make money. Davey says it depends on the financing of the Tapio Station solar tower. Regardless, he says, EnviroMission will profit from owning the land and technology plus any renewable-energy credits that might become associated with the project.

As 163 nations implement the Kyoto Accord's limits on greenhouse gases and U.S. states - including California and New York - move toward imposing their own Kyoto-style caps, such credits are certain to become increasingly valuable in a carbon-constrained world.

Davey does have additional evidence that his vision, wild though it may be, is sound. An analysis by Waterville Investment Research in New York concluded that a 50-megawatt solar tower would be competitive with other renewable-energy sources, while a larger version could produce electricity for the same cost as conventional power plants, and possibly less.

Moreover, the very quality of the people who have bought into Davey's vision - from the Chinese investors to top government officials to Macquarie, the storied Australian investment house - lends credence to his solar mission.

Indeed, it's as if EnviroMission had painted a huge smiley face on the tower, given the absence of any noticeable opposition to the project. Something about the solar tower's ability to produce clean energy from a source as abundant and, well, cheerful as the sun strikes a chord. No worries about carcinogenic soot, no Chernobyl nightmares. Or maybe it's just because the solar tower looks so bloody cool.

Whatever the reason, the public and politicians' embrace of the solar tower has been a boon to EnviroMission. The agricultural towns surrounding the solar tower site certainly have rolled out the welcome mat.

"This will put our region on the world stage; it will be of world significance," enthuses Andrew Millen, CEO of the Sunraysia Mallee Economic Development Board in Mildura. Up the road in Wentworth, the economy is already getting a boost from the busloads of Japanese and European tourists who come to snap photos of the empty solar tower site. (Tourism can be a profitable offshoot of renewable-energy projects: During the past four years, some 25,000 people have paid to see Roaring 40s's gleaming white, 200-foot-tall wind turbines erected on a bluff on Tasmania's remote northwest coast.)

Out at Tapio Station, Davey insists that the solar tower will be built whether or not the government gives EnviroMission \$75 million. "This used to be a dream," he says, staring out at the horizon where the tower will rise. "Then it became a concept. Now it's becoming reality." ■

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