Creating New, Sky-High Power

Stewart Taggart

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SYDNEY, Australia -- Looking somewhat like a huge, upturned golf tee, it would be the highest man-made structure on earth. It would also provide electricity to as many as 200,000 homes.

If built, a proposed 200-megawatt "solar chimney" for rural Australia would become the most daring application yet of a quirky form of generating alternative, renewable electricity. While the engineering would be biblical in scale, the concept itself is simple.

A circular greenhouse with an upward sloping roof toward the center would draw heated air through electricity-generating turbines before allowing it to escape through a central "chimney." The hitch? The greenhouse would cover six square miles, and the chimney would stand more than a half-mile tall.

Over the next two years, the public Australian company EnviroMission Ltd. will be searching sunny, spacious Australia for the ideal site to put such a huge chimney and greenhouse. EnviroMission hopes to break ground on the project in 2003 and be generating electricity --- as much as 500 gigawatt hours per year -- by 2005.

That is, if it can convince the skeptics. Why? Because the closest approximation to such a huge proposed monocle-in-the-desert, which has been built thus far, was a 50-kilowatt demonstration prototype built in Spain in the early 1980s. While that prototype operated successfully for two years, it's an open question just how well the concept will ramp up when 40 times larger.

"Every single independent expert we have spoken to has no doubt that this level of scalability is possible," says Roger Davey, chief financial officer for EnviroMission. "The economics point to 200 megawatts as the optimum size."

The key to the technology lies in creating an environment that maintains a temperature differential between the inside and the outside of the greenhouse. Under those conditions, air inside the greenhouse rushes along the upward-sloping ceiling toward the center, creating a near constant "wind" that then turns the turbines.

At night, heat-absorbing rocks or other heat sources in the greenhouse would slowly release the thermal energy built up during the day, maintaining the indoor-outdoor temperature differential. Then the "solar chimney" could operate around the clock, instead of depending on environmental factors, such as the wind needed for wind farms.

"Unless the chimney falls over, or they pick totally the wrong materials for the greenhouse, the 'solar chimney' idea should work," says Keith Lovegrove, chairman of the Australian and New Zealand Solar Energy Society. "There's no question about the principles, because it's so incredibly simple."

The idea of solar chimneys has been around since the late 1970s, says Daniel Kammen, director of the Renewable and Appropriate Energy Laboratory based at the University of California at Berkeley. But at that time, many believed the 1970's era of high oil prices would prove transitory.

That, coupled with technical challenges and a belief that there was no money to be made in alternative energy, left solar chimneys and other alternative energy technologies unexplored and unfunded until now.

These days, given ongoing worries about energy security and an increased focus on environmental factors, industry players are waking up to just about anything with the word "renewable" attached to it. EnviroMission appears to be one such company.

"In leaner times, an aggressive step like this may have been a mistake, but this is a unique period of time where there is a lot of investment interest in renewables," Kammen says. "It makes sense for them to go for it now."

However, it could be a big sales job. The estimated construction cost of the plant would be around US$342 million, costing about 70 percent more per installed megawatt than a comparable wind farm, Davey says. But he believes that disadvantage could well be wiped away by the solar chimney's ability to generate power more consistently than fickle wind.

Nonetheless, seeing will be believing for some people, he acknowledges. "Building credibility is perhaps our hardest job going forward," Davey says.

First, take the engineering challenges. A 200-megawatt capacity "solar chimney" is going to require a circular greenhouse almost 2.5 miles in diameter, enclosing a total area of more than six square miles.

That would make it one of the largest man-made structures -- let alone greenhouses -- ever built. The second engineering challenge is building the chimney that -- at 3,250-feet high -- would be more than twice as tall as the world's highest building, Kuala Lumpur's 1,569-foot high Petronas Tower.

But Davey says these challenges can be met with largely off-the-shelf expertise.

Next question: Why Australia?

The answer: lots of sunshine, lots of space and a federal law requiring energy retailers to ramp up their purchases of renewable energy by 2010, Davey says. Already, wind farms, biomass furnaces and other alternative energy plants are being planned for Australia. The solar chimney is merely joining the list, Davey says.

For his part, Lovegrove says the project symbolizes welcome risk-taking by private industry.

"Wind power is the world's fastest-growing industry, and the rest of the renewables industry likewise looks set to take off," Lovegrove said. "For those who can spot future trends in this industry, the future looks bright."

Ultimately, if EnviroMission can supply as much as 500 gigawatt hours of power per year, it could help Australia avoid pumping 830,000 tons of gases that would contribute to the greenhouse effect into the atmosphere, Davey says. That's because the plant would largely supplant coal burning --- Australia's major electricity fuel source.

But Eric Hu, a senior lecturer in energy and thermal engineering at Melbourne's Deakin University, suggests any greenhouse benefits could -be a fantasy.

That's because by trapping heat, such a chimney could reduce Earth's "albedo," or ability to reflect light back into space. Thus, by transforming solar radiation into heat, a solar chimney might actually contribute to warming earth's atmosphere -- even while reducing emissions of greenhouse gases.

Hu suggests that more studies ought to be conducted of the potential effects of the solar chimney idea, before any major construction commitment is made to such a large-scale plant.