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Thin Film's Time in the Sun

First Solar's thin-film technology is now challenging silicon panels at large-scale solar-power facilities.

By Peter Fairley

The low manufacturing cost of photovoltaics that employ thin films of cadmium-telluride semiconductor have long been seen as having the potential for lifting solar power from its niche status as a very expensive power source, delivering less than a twentieth of 1 percent of U.S. electricity.

Now, after two decades in which cadmium-telluride technology was dogged by low power output and reliability problems, it's suddenly elbowing its way into renewable-energy markets and competing with today's dominant solar technology: silicon solar panels. The company behind this technology turnaround is Phoenix-based [First Solar](http://www.firstsolar.com/) (<http://www.firstsolar.com/>), which says that the technology could eventually be cost competitive with conventional fossil-fuel sources of electricity.

First Solar has racked up a string of large contracts and investments over the past year for its thin-film technology. First Solar closed a \$400 million initial public offering in November and clinched a deal three months later to supply a 40-megawatt solar-panel farm in Germany that will be one of the world's largest. And earlier this month, the company revealed that it has signed long-term contracts with European and Canadian buyers to supply 685 megawatts of modules worth \$1.28 billion. The latter figure is especially impressive considering that all the solar-module factories in the United States shipped less than 200 megawatts' worth of photovoltaics last year.

Ken Zweibel, who directed the U.S. National Renewable Energy Laboratory's (NREL) [Thin Film Partnership Program](http://www.nrel.gov/pv/thin_film) (http://www.nrel.gov/pv/thin_film), for more than a decade, says that First Solar has "broken out of the pack" by simultaneously achieving low-cost mass production and respectable power output. Zweibel, who left NREL in January to launch his own thin-film company using similar technology, expects more improvement on both fronts. "Cadmium telluride has a clear route to cost competitiveness with conventional energy," he says.

Thin-film panels are produced by layering shallow coatings of semiconductor materials on sheets of glass, plastic, or metal--a seemingly simple concept that is hard to implement on a large scale. Cadmium-telluride panels in particular seemed finished five years ago when [BP Solar](http://www.bp.com/modularhome.do?categoryId=4260) (<http://www.bp.com/modularhome.do?categoryId=4260>), an arm of the London-based oil company, shut down what had been the largest cadmium-telluride commercialization effort.

BP Solar had opened a cadmium-telluride module plant in 1998 designed to make eight megawatts of modules per year, but it never exceeded one megawatt. Creating films to exacting specifications proved harder than expected. And the company was concerned about the product's image, given the use of the toxic heavy metal cadmium. And BP stumbled in the market when the efficiency with which its first commercial cadmium-telluride modules absorbed solar energy slipped from 8 percent efficiency to 6 percent after just a few weeks on rooftops.

First Solar, founded in 1999 from a predecessor startup called Solar Cells and with an infusion of \$250 million from Walmart founder John Walton, kept on tweaking its manufacturing process. The company addressed concerns about the toxicity of cadmium by creating a recycling program guaranteed to take back panels at the end of their useful life. Company officials would not comment in advance of an earnings statement. But company documents say that it progressively ratcheted up production at its first plant in Perrysburg, OH, from a few hundred kilowatts of modules per year in the early years to 75 megawatts last year. First Solar now produces more than 100 megawatts' worth of panels per year, thanks to a new plant in Germany.

First Solar says that it transforms two-by-four-foot glass plates into ready-to-ship modules in 2.5 hours, with

power efficiency exceeding 9 percent, up from about 7 percent in 2004. That combination, claims First Solar, has slashed the cost per watt from \$2.94 in 2004 to \$1.29 today--a period in which growing demand for high-grade silicon inflated the cost of producing silicon panels to between \$2.50 and \$3.00 per watt, or more.

German renewable-energy developers such as [Juwi Solar \(http://www.juwi.de/international/frame.htm\)](http://www.juwi.de/international/frame.htm), [Gehrlicher Gruppe \(http://www.gehrlicher.com/\)](http://www.gehrlicher.com/), and [Blitzstrom \(http://www.blitzstrom.de/eng/home.php\)](http://www.blitzstrom.de/eng/home.php) began using First Solar modules in large rooftop installations and field-based solar parks in 2005. In February, Juwi Solar picked First Solar's modules for its 40-megawatt solar park in Saxony; upon its completion in 2009, the park's 550,000 First Solar modules will cover an area equal to 160 football fields.

At the Solar 2007 conference in Cleveland earlier this month, First Solar COO Chip Hambro said that the company anticipates slashing the price it charges for modules (as opposed to its manufacturing cost) from more than \$2 per watt today to \$1.25 per watt or less within five years. The company would do this largely by further boosting the modules' power output.

Zweibel's startup, [PrimeStar Solar \(http://www.primestarsolar.com/\)](http://www.primestarsolar.com/), based in Golden, CO, is also betting on higher efficiency. PrimeStar seeks to commercialize a more sophisticated module design developed at NREL, which holds the efficiency record for laboratory-made cells at 16.5 percent (compared with 14.5 percent for First Solar's best lab cells). Zweibel says that cadmium telluride technology offers a "clear physical pathway" to cut the cost of solar energy from 15 to 30 cents per kilowatt hour today to 5 cents per kilowatt hour--just above the average cost of coal-fired power in the United States.

However, First Solar's original plant in Ohio is now largely depreciated, meaning the loss of an economic benefit. As First Solar produces more from its new module plant in Germany and a third plant that's under way in Malaysia, the company may have more work to do to deliver on its promise to cut its price for a watt of module to less than \$1.25.

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