

SOLAR POWER'S NEXT STAGE

Within the decade, many solar power experts believe that the cost of solar power per watt will reach parity with the cost of ordinary power generation. Already, in the past five years, the cost has dropped sharply, from more than five euros per watt to less than two. For humanity, this is undoubtedly good news. But beyond the raw technology, experts say that many complications lie ahead.

Solar power should be the perfect solution to the world's energy problems. Clean, inexhaustible, universally available – the advantages are obvious. Yet something that every green plant on earth accomplishes every day has proven surprisingly difficult to replicate.

For many years, technology was the limiting factor. Scientists and engineers achieved real progress only in fits and starts. More recently, however, the technology has improved so dramatically that [some analysts at the International Energy Agency believe](#) the price of solar-generated power will fall enough to match the cost of conventional power generation by 2015, even without subsidies. In fact, the biggest challenges now appear to be more questions of industry structure – the classic ‘chasm’ between prototype and broad market adoption that every new technology must cross.

Worldwide, solar now generates about 160gw of energy, the equivalent of the power needs of more than 7 million homes, according to International Energy Agency statistics. Nearly 150gw of that is in small scale heating and cooling systems, where in a sunny country, the payback period for an installation can be as short as seven years. Aided in many countries by various tax incentives, the installed heating base grows by about 10-15% every year.

Photovoltaic generation is much less established, but growing at a more dynamic pace – 50% a year on average since 2002, according to the IEA. The pace of adoption is also accelerating, pushed by widening government support and growing scale economies of mass production, particularly from Chinese manufacturers. In 2008, the installed base increased by 150%, to 13.4gw.

Although still expensive, prices are dropping dramatically. Alexis Saada, a Paris-based director at AXA Venture who specializes in solar investments, says that solar panels that sold for over 5€ per watt five years ago now sell for less than 2 € pushed by the entry of low-cost Chinese manufacturers into the market.

These days, Saada says, the question is no longer whether solar power will ever reach cost-parity with conventional sources, but when.

Technical advances could accelerate that progress even further. Three technical developments seem particularly promising.

- the development of thin-film photovoltaic cells, which are less efficient at converting sunlight into power but cheaper to manufacture and can be handled and installed more easily than the more delicate silicon cells, also promises to accelerate adoption. Although silicon cells remain dominant, sales of thin-film are accelerating rapidly.
- solar cell arrays that follow the sun, like flowers, have been shown to improve efficiency as well, by as much as 30%.
- technologies pioneered by Spanish engineers that super-heat a liquid core, which is then used to power electric turbines.

But as with most innovations, a viable technology is only part of the story. Distribution is often just as important. Thomas Edison, for instance, wasn't the first to invent the light bulb. However, the "wizard of Menlo Park" invented something just as important: the electric company.

When it comes to distribution, the possibilities for solar power are complex. Standalone systems have already proven economical for powering remote installations and villages located far away from conventional electrical grids, according to the IEA. They could even provide a way to jumpstart power in areas lacking conventional infrastructure in the same way cellular phones have given telephone communication to the most remote corners of the world.

Some observers speculate solar power may be one of those technologies finds some of its more effective application may be in the developing world. "I could imagine at the village level a reasonably efficient solar system of a modest scale might actually be a superior solution alternative to developing the infrastructure and the transmission lines of a traditional grid system," says Daniel A. Levinthal, a professor of corporate management at Wharton.

However, solar growth so far is much stronger in long-electrified markets where solar cells are attached to the power grid, with 73% growth as opposed to 12% growth in standalone systems last year, according to the IEA.

In long-electrified developed markets, the distribution model for solar also remains unresolved. In some countries, policymakers favor the growth of centralized "solar farms" that send electricity out to customers, much as nuclear or coal plants do now. Spain, for example, favors large-scale solar farms.

In other countries, policymakers favor small-scale, home generation. Germany has tried both approaches, but in France, industrial policymakers are more convinced about the value of home-based installations.

Most scattered, home-based schemes feature a “smart grid,” a distributed system that makes it possible for consumers to combine power from an external power source with power from an internal source, such as a solar panel. Consumers will be able to either top up their home-generated power with external commercial power or sell their excess power to the grid.

This ability to sell excess power back to the grid overcomes one of the biggest expenses of solar power: storing power at night. It also takes advantage of the special trait of solar power to deliver most of its energy on hot days, at precisely the time consumer energy needs peak, experts say.

For his part, Christian Terwiesch, a professor of operations and information management at the Wharton School who studies innovation, thinks industry fragmentation is holding up adoption.

It’s a bit like plumbing, he says, where despite a universal need and the advantages a trusted name would have, plumbing is still a local business — Joe Plumber rather than McPlumber.

Terwiesch, who recently investigated installing a solar array at his home, found a highly fragmented industry. “It’s a nightmare,” he says. “You start with an energy consultant and then they refer you to a number of options, then you go out to contractors who do this and their bids vary all over the place.”

In Europe too, homeowners have had similar problems with installation. Saada says that many homeowners haven’t been satisfied with the result. Often, he says, installers are either electricians or carpenters. When complete, either the former electricians had left a leaky roof or the carpenters had left a system that didn’t generate the power promised.

At the business-to-business level, however, some more scalable distribution models are beginning to emerge. For example, [SunEdison](#), a unit of MEMC Inc., has an innovative agreement in which it will install solar arrays on top of commercial buildings for free in exchange for a long-term power purchase agreement that sells the company power.

The model is attractive to the client company because it ends up with solar power without tying up capital, as the arrays are owned and operated by SunEdison. One of SunEdison’s biggest successes to date is an agreement with Staples, the office supply store chain, which has installed

solar arrays on the roofs of 12 stores, generating 2.8 mw, which SunEdison sells at or below grid power cost to Staples, according to SunEdison publicity.

Another emerging business challenge looms now at the manufacturing level as well. For decades now, western Europeans have subsidized solar power through feed-in tariffs and other advantageous terms. Germany, in particular, has succeeded in building an industry and an installed base of solar plants.

Now, in Germany, perhaps the world's leading solar market, legislators are now proposing cuts in the feed-in tariffs by up to a third, citing falling industry costs. This should be happy news – a success story for industrial policy – but the pending cuts are coming at a tricky time for the industry.

Today's solar manufacturers will likely have difficulty making the transition from being small producers of nearly handcrafted products to mass-market production, says Philip Grothe, a partner with Simon Kucher Partners, a Bonn-headquartered strategy and marketing consultancy. "This is a very, very dynamic industry, which is managed quite unprofessionally," he adds.

"A couple of years ago, the people in the industry thought that this is not a commodity market but you can differentiate yourself by the technology itself, especially by the efficiency grade," says Grothe. In fact, he says, it's rapidly turning into a commodity market.

It's a classic, perilous stage for startups in an emerging industry, known by a number of dramatic names to early-stage strategists, such as "Crossing the Chasm" or "the Valley of Death," and Grothe is not confident about their prospects of making the leap.

If the competition were just between other small firms, this would be perilous enough for the Europeans, but faced with tough Chinese competitors who are growing rapidly in scale and sophistication, the outlook begins to look darker.

"Given the cost structure of the European players, they don't have any chance against the Chinese competition, unless they themselves produce in Asia," Grothe says.

And the Chinese advantage may soon extend beyond labor costs. Some Chinese companies are rapidly working to build a European sales organization to take advantage of the fact that the market doesn't yet have established brands.

For Western policymakers, this creates some complex tradeoffs, in Grothe's view.

Taxpayers in countries that have underwritten an industry for decades, especially Germany, may view this development with alarm, seeing it as Chinese companies swooping in to destroy the value their subsidies have nurtured.

On the other hand, in the Darwinian world of global capitalism, the most adaptable are supposed to be the ones that survive. If those companies prove themselves more adaptable than others, the world will still be better off – particularly since the products in question reduce global warming.

For his part, Grothe can see it both ways, noting that as a European taxpayer it's distressing to see that value and those jobs go away, along with deep expertise in an important emerging industry. On the bright side, however, he says it's likely to mean cheaper solar modules.

For investors, of course, every transition is also an opportunity. In the immediate future, the three biggest plays Saada sees are in solar technology startups, specialized developers, and leveraged buy-outs that help the industry consolidate.

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