

Reality Check

The Future of Solar Energy

Every year, approximately 2.5 million exajoules of solar energy reach the Earth. That's about 6,000 times the amount of energy consumed by people each year. While solar-energy lobbying has slowed since its peak in the late 1970s, scientists have continued to develop new technologies to use the sun as a cost-effective and environmentally friendly power plant. But economic viability has remained tantalizingly out of reach. *Wired* asked five experts to shed some light on the future of solar-power technology. - *David Pescovitz*

	5 Cents per Kilowatt-Hour	50 Percent Efficiency	Photovoltaic Roof Shingles	Solar-Assisted Automobiles	Space-Based Generator
Christopher Flavin	2005	unlikely	1998	2002	unlikely
Frank Goodman	2005	2035	1995	2010	2030
NREL	2010	unlikely	1995	1998	unlikely
Donald Osborn	2000	2000	1996	1998	unlikely
Steven Strong	2002	2010	1996	1997	unlikely
Bottom Line	2004	2035	1996	2001	unlikely

5 Cents per Kilowatt-Hour: Although current solar technologies provide power at around 9 cents per kilowatt-hour - a US nickel more than gas-generated electricity - our experts believe that in 10 years, power from the sun will be economically competitive. Flavin thinks a 5-cents-per-kilowatt-hour price point might be reached by using new thin-film solar cells. Thin film, less than 1 micrometer thick, is cheaper to manufacture, store, and ship than conventional solar cells. Strong points out that last year, Enron, a large US natural gas company, announced plans to build a photovoltaic power plant with power at 5.5 cents per kilowatt-hour. However, according to Flavin, that rate is "based on special tax breaks."

50 Percent Efficiency: One way to lower the cost of solar power is to increase its efficiency. The National Renewable Energy Laboratory holds the efficiency record with a solar cell that converts 29.5 percent of the sunlight that hits it into electricity. But Surek and Fitzgerald point out that this was achieved only by using different layers of

photovoltaic material that capture distinct parts of the light spectrum, a method Osborn thinks is the most likely way to increase solar-cell efficiency to 50 percent. Strong points out that while research is being done on an antenna array that intercepts light waves and converts them into AC electricity with a theoretical 80 percent efficiency, no one has been able to build such a device. Agreeing with several other experts, he points out that generally, "higher efficiency will come at too high a price."

Photovoltaic Roof Shingles: Our experts point out that several companies in the US, Europe, and Japan are already demonstrating prototypes of solar cells that double as roofing shingles to replace the array of solar panels mounted on roofs or in backyards. Those polled at the National Renewable Energy Laboratory point out that Sanyo Electric Co., along with other firms, has been making photovoltaic roof tiles and other shingle-like products since the 1980s. Strong says Energy Conversion Devices of Troy, Michigan, is developing a line of metal photovoltaic products for direct mounting on sloped roofs. One product, he says, uses thin films of amorphous silicon deposited on a stainless-steel substrate "to create a metal roofing panel that is compatible and interchangeable" with standard roofing shingles.

Solar-Assisted Automobiles: The annual Tour de Sol solar car race, with its science fiction-style automobiles, still attracts media attention, but most of our experts agree that mass-market solar-propelled cars won't be parked in our garages in the foreseeable future. However, those polled think that in 15 years, most cars will use some onboard solar-power generation. Osborn says solar assistance will be "important to long battery life because of the heavy drain of computer and security systems." He also agrees with Goodman, who says that another beneficial use of the technology is providing "auxiliary power for ventilation while a car is parked." Strong thinks photovoltaic sunroof or rear-spoiler collectors may be incorporated in near-future auto designs.

Space-Based Generator: Although Goodman believes a small-scale demonstration of a space-based solar-power generator transmitting energy to Earth could happen 30 years from now, most of our experts agree with Flavin that at a cost of \$100,000 per kilogram to put something in orbit, "it will always be cheaper to generate solar power on Earth." Our sources at NREL add that even if the once-popular idea is technologically feasible, it's environmentally risky and would create a single point of failure. "It would be much like routing every Internet node through a single, central office," they say. While a space-based power plan may be an idea whose time has passed, Osborn points out that it was "an important concept because it helped us broaden our thinking about the potentials of solar power."

Reality Checkers

Christopher Flavin

vice president for research, Worldwatch Institute; co-author, Power Surge

Frank Goodman

manager, photovoltaic technology and applications, Electric Power Research Institute

National Renewable Energy Laboratory - photovoltaics division

Thomas Surek, program manager; Mark Fitzgerald, communications coordinator

Donald Osborn

supervisor, Sacramento Municipal Utility District, solar program

Steven Strong

president, Solar Design Associates Inc.

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