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HD **Consumers --- Shedding Light on Solar: Why is it so expensive? What subsidies are available? And answers to other questions for the perplexed**

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CX Corrections & Amplifications

First Solar Inc. says it makes thin-film solar panels for $1.14 per watt. An article in Monday's Journal Report on Energy incorrectly said the company produces them for about $1.25 per watt.

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LP The idea of solar power sounds so simple. And it seems like it should be cheap compared to other sources of energy. After all, the sun is there, and it's free. But despite federal and some state government subsidies that have helped push up demand, solar power still accounts for less than 1% of power generation in the U.S. That's because even with subsidies, solar power remains expensive compared with energy based on traditional fuels like coal and natural **gas.**

Why is solar power so expensive? And what's being done to bring down the costs? Here are some answers for the befuddled.

TD Q: Let's start with the basics: How much will it cost to put a solar panel on my home?

A: The average cost of a rooftop solar system, also known as a photovoltaic, or PV, system, is roughly $8.25 per watt installed, based on companies' listed selling prices and conversations with industry executives and analysts. What does that mean in English? Well, depending on the size of the system, the price before government subsidies and reimbursements might range anywhere from $8,250 for a one-kilowatt system to more than $40,000 for a five-kilowatt one. The amount of electricity the system produces also varies, depending on factors such as the placement of the panels on the roof and the consistency of the sun in the region where the home is located. In sunny California, a four-kilowatt residential solar system -- a typical size for many homes -- would produce about 5,500 to 6,500 kilowatt-hours of electricity annually, more than 80% of the electricity needs of the average ratepayer there, according to **utility**PG&E Corp., the **utility** serving the San Francisco Bay area. In New Jersey, where the sun is less consistent, it would take a larger, 5.1-kilowatt system to produce as much electricity.

Q: Where does all that money go?

A: The solar panel itself usually constitutes less than half of the total price of installing a residential system. Distributors, installers and manufacturers of components needed to attach the panel to the roof and to connect it to the electricity grid account for the rest. This may be more than you want to know, but the $8.25-per-watt cost breaks down roughly as follows: $1.50 for polysilicon, 75 cents to create wafers from the polysilicon, 75 cents to create solar cells from wafers and another 75 cents to complete the solar panel. Installation costs consist of 50 cents for inverters that convert the current of the solar modules to the alternating current used by the home's appliances, 75 cents for racks, wires and other installation equipment, $1.25 for labor and $2 for installers' overhead.

Q: If computer chips keep getting cheaper, why are solar chips so expensive?

A: Computer chips are getting exponentially smaller in size, and, therefore, require less material to produce the same output. Solar panels, however, must capture the sun's irradiation with their surface, so they can't be reduced to microscopic proportions. "You can either make [the solar panel] thinner, or make it capture light better, but you can't be endlessly shrinking the circuitry," says Rob Stone, managing director and senior research analyst at Cowen & Co.

There are higher-efficiency panels on the market designed to extract more power from the same surface area. Some of the most efficient panels in production, from Sunnyvale, Calif.-based SunPower Corp., can yield about 220 watts of power from one square meter when 1,000 watts of sunlight is shone on it, up from 140 watts to 150 watts for the average panel five years ago.

Still, the rate of improvement in efficiency is nowhere near that found in the chip industry, and prices for solar panels haven't declined in the past five years because most manufacturers are paying multiple times more for raw materials than they were in 2002.

The vast majority of solar modules are made of polysilicon, a material processed out of sand in big chemical plants. Ever since Germany implemented large incentives for solar installations in 2003, the demand for polysilicon has outstripped supply, allowing manufacturers to charge anywhere from $70 per kilogram for polysilicon under long-term contracts to more than $400 per kilogram on the spot market, even though it costs them only about $40 per kilogram to make.

Industry watchers expect the supply of polysilicon to improve dramatically over the next two years because new companies are entering the market and established players are expanding production. That should result in a dramatic decline in the price of solar cells and modules, they say.

A much cheaper alternative already exists: solar panels made of various nonsilicon semiconductor materials that are typically spread on a sheet of glass or stainless steel. These so-called thin-film panels are easier to make, so it doesn't cost as much to produce them. First Solar Inc. of Phoenix makes thin-film solar panels for about $1.25 per watt, which is about two times less than the average cost of making a polysilicon panel.

The problem with thin film is that it captures less of the sun's energy per square meter than polysilicon, so it takes a larger panel to generate the same amount of energy. As a result, thin-film panels usually are too large to fit on residential rooftops and are used more often in power-plant applications.

Q: Will manufacturing get any cheaper?

A: To create solar panels, manufacturers typically cast polysilicon into large slabs, then slice those into thin, wafer-like disks, then add semiconductor junctions, coating and grid wires. These cells are then wired together into a panel encased in a weather-tight package.

Module makers are trying to reduce the amount of polysilicon they use by cutting thinner wafers, decreasing the amount of powder that results from wafer sawing, and by mixing in recycled polysilicon. Several companies have reduced the amount of polysilicon in wafers to between six and eight grams per watt, compared with the industry average of about 12 grams only a couple of years ago. Some companies also are experimenting with wafers made from less expensive raw materials such as metallurgical-grade polysilicon.

Q: What about installation?

A: As the efficiency of solar panels increases, installation costs should fall, because the amount of surface area needed to generate the same amount of power shrinks. Companies are working on other improvements, too.

Some are reducing the number of parts needed to mount rooftop panels. A new panel designed by Akeena Solar[MFA] Inc., of Los Gatos, Calif., can be installed with 70% fewer components than a traditional panel. Although installation is faster and less labor intensive, Akeena charges a 5% premium for the Andalay panels because demand for them is high and the panels, which have fewer seams, are more attractive.

Inverter prices, meanwhile, are hovering at about 50 cents per watt, but some companies are incorporating components that previously required separate purchase and installation.

Q: I understand there are subsidies available. How much are they?

A: Homeowners can get a one-time federal tax credit of as much as $2,000 on an installation, but that is scheduled to expire this year. A proposed extension, now under deliberation in the Congress, would extend the credit's cap to as much as $4,000 and open it up to individuals who make enough money to qualify for the alternative minimum tax.

Some states, such as California, New York and Connecticut, have their own subsidies. California, for example, offers a subsidy for residential solar of as much as $2.50 per installed watt, depending on a system's expected performance. Some states, however, have no incentives for solar power.

Q: Do I have to pay the full price at the time of installation?

A: No. Loans are available, and some banks and other lenders have special programs designed for solar-energy systems. Several installers in California, for example, have formed partnerships with financial firms such as Morgan Stanley and Sun Run Generation LLC to offer homeowners leasing deals. Homeowners make an up-front payment that is significantly less than the cost of installing a solar system and then buy the power they use without ever purchasing the solar equipment itself.

Customers lock in a fixed electricity price -- 13.5 cents per kilowatt-hour in the case of Sun Run and its installer partners in California, which is about three cents cheaper than PG&E's average rate. Sun Run, however, says its average customer pays about 24 cents per kilowatt-hour for grid-supplied electricity. Solar users typically have larger homes than average **utility** customers and pay higher rates in California because of higher usage.

Q: When will we see a significant drop in solar costs?

A: Many module makers predict their selling prices will decline 10% to 20% next year, mostly because of the rush of new polysilicon supply that is expected to be produced. "We're in the process of a dramatic readjustment of system prices in the next couple of years," said Julie Blunden, vice president of public policy at SunPower.

David Chen, head of clean technology investment banking at Morgan Stanley in California, predicts the industry will reach grid parity -- the point at which the cost of solar energy is competitive with conventional grid-supplied electricity without subsidies -- by 2012, "which will open up the floodgates for vendors that can price competitively."

While panel prices may fall in the next year or two, consumers won't necessarily benefit by putting off a switch to solar, some in the industry argue. They say a substantial portion of what a consumer pays for a system today is reduced by government subsidies, and those subsidies are designed to decline as the cost of solar power approaches grid parity.

Nat Kreamer, president of Sun Run, says that for homeowners interested in leasing deals, the sooner they get solar panels installed, the sooner they can lock in the price of power. The price that Sun Run and others charge for electricity in two years may be much higher than it is today, he says.

Q: After all this, how much money can I expect to save on my **electric** bill, and how long will it take to recoup my investment?

A: The rate of payback depends on where the homeowner lives and how the installation was financed. Tax credits and solar incentives vary by state, as do **utility** rates, so residents living in a place like California, where solar rebates are hefty and **utility** rates are high, may get a quicker payback than homeowners living in other parts of the country.

In addition, solar systems in regions with consistent sunshine will produce more power, thus cut a homeowner's electricity bill more quickly. In some states, if a system produces more electricity than is required by the household, homeowners can use the surplus as a credit toward the cost of power purchased on cloudy days or at night, a process known as net metering.

In California, a state with hefty rebates, the average payback time for a residential PV system purchased by a homeowner is seven to 10 years, according to the California Energy Commission. It could be twice as long in states without local incentives or consistently sunny weather.

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