

SOLAR ENERGY, WARM AND FUZZY, OR BAD INVESTMENT?

Introduction:

When considering solar energy, it's helpful to understand two common uses of solar, generation of electrical power, and use for heating water. Generation of power is commonly done by use of Photovoltaic (PV) panels, which generates direct current (DC), which is then often converted to alternating current (AC) which is more commonly used for power distribution in the modern world. Solar water heating is done by a number of means that collect heat, and transfer the heat directly to water held in a holding tank, sometimes a separate container, and sometimes directly into a more conventional system similar to or the same as a hot water heater tank.

Use of solar energy in both of these ways reduces the need to use power generated from natural gas, coal, oil, hydroelectric, or nuclear power sources. However, both methods of capturing power to be used in a commercial or residential setting are limited by the availability of sunlight.

Therefore, use of solar power has limitations of both geographical and temporal restrictions. Areas with more sunlight can make better use of solar energy, and solar energy can only be captured during daylight hours. While this limitation seems significant, consider that use of power is also cyclic.¹

Peak power use is often midday, when there is also peak ability to generate solar power.²

Since there is a match in this way, solar energy is in a position to help offset this peak usage situation.

We can break down into general scales of the applications of solar power generation: the residential (homes and apartments) generation of solar power, the commercial (small and large businesses) generation of solar power, and the industrial (power plant scale) generation of solar power. Each of these areas currently has significantly different issues, creating opportunity and limitations that distinguish the effectiveness of implementing solar solutions.

Residential:

Residential solar use generally comes in two forms, water heating and electrical power generation. Both the implementation and cost effectiveness of these two differs significantly. Therefore, we shall discuss both of these forms separately.

Considering an example of solar hot water heating for a residential home in Tucson, Arizona, a solar hot water system can be added to a home for approximately \$5,500 total cost to the home owner.³

There are incentives from the local electrical company that can pay the owner back up to \$1,750 to offset this cost, if the owner signs an agreement with the power company to allow the power company to use the system as part of its Renewable Energy Credit (REC) with the federal government.⁴

The home owner may further be able to obtain a onetime personal tax credit on their state income tax that year, however this one time limit applies to both water and electric, so they may not claim it again if they add another system.⁵

While this might sound good, one has to compare it to conventional water heating, where installation of a new water heater is in the range of \$350 to \$750, significantly less expensive. When typical use of an electric hot water heater has a power cost in the area of \$390 to \$585, it can easily take 3 to 5 years before the owner recovers the additional cost of installing a solar hot water heater.⁶

Depending on the life of the system, this may or may not create a financial savings for the home owner. And, with questionable returns on the investment, the upfront costs are clearly higher for installation of a solar hot water system. This is a greatly simplified and general estimate. Additional factors may include the large variations in expense for very different types of solar hot water systems, and installation costs which can vary drastically depending on the type of home, roof, and location of plumbing. Solar water heating systems may have a lifetime of approximately 30 years, the holding tanks may only have a lifetime of a typical holding tank being around 15 years.⁷

By comparison to solar hot water heating, solar electrical systems are significantly more expensive. A solar electric system can range in price from \$4,000 to \$100,000 for an average home.⁸ However, considering again the example of Tucson, Arizona, the power company may offer significantly higher rebates for systems installed, paying up to \$2 per watt of the \$6 to \$8 per watt system cost.⁹

The personal state tax credit is also available for solar electrical systems, but again is only offered one time, and cannot be used again for the installation of a second system even if it is of a different type like water heating.

While heating water is fairly straight forward, the excess heat generation is not something you can easily capture and share. However excess electrical generation can be used easily. Depending on it's size, a grid-tie solar electric system can sometimes generate excess energy during the day. And through programs such as Net Metering, a home owner can install an electrical meter where the excess power generated during the day spins the power meter backwards feeding energy out into the grid, and turns the meter forwards during the night when no solar energy is generated.¹⁰

Through such programs, homeowners are capable of being "energy neutral" and consuming zero net energy. However, due to the significant financial investment of solar electrical systems, the amount of time required to recover the investment in solar electric systems can be up to 20 years.¹¹

Although in the short term, residential installation of solar systems is a significant expense, it is important to consider that, as demonstrated above, the costs are recovered over time. When considering that the costs are eventually recovered, it would seem that solar systems on residential homes are "the right thing to do" to improve our environment. It all sounds wonderful, right? It is a wonderful thing to do, but it's probably not the best first step as a home owner. For two reasons, first, it's very expensive, and second, you have a better option.

Simple practices of adjusting temperatures, shutting off lights, and unplugging unused equipment among other things can reduce your power use, which in turn improves the environment, without any initial cost to the home owner at all, and effectively save money over time.¹²

And when spending significant amounts on home improvement, often new appliances, a more efficient air conditioning system, new windows, and additional insulation can reduce your power usage far more significantly per dollar than trying to offset your electrical use by putting solar panels on your home.¹³

Many of these improvements also qualify for tax credits.¹⁴

If you want to make an environmental impact, it makes sense to get the most bang for your buck. Since they are from no cost, to significantly lower cost, these other ways of decreasing energy use and improving the environment are more widely

accessible to home owners.

So, while solar water and power systems for home owners are a wonderful addition that help the environment in general, they often are not the best use of home owner money if the end goal is to improve the environment. Solar water is a lower cost, quicker cost recovery than solar electric. But both steps should only come after learning to be energy efficient and making home improvements to meet those ends. Only then does the addition of solar technologies become an practical next step.

Commercial:

Commercial use of electrical power cannot be easily estimated because of the variety of energy use by comparison to roof space of commercial buildings. Small manufacturing companies may never be zero energy, where large warehouses could generate a surplus. Currently, the incentives to install solar systems are not as significant as they are for residential applications. Considering again, Tucson, Arizona, a commercial installation can receive only a \$1.50 per watt rebate, less than the \$2.00 per watt available to residential home owners.¹⁵

For larger commercial entities there is the option to sell the power generated directly back to the power company for \$0.102 to \$0.142 per kwh.¹⁶

But to opt in for the ability to sell power back to the utility company, you opt out of the upfront incentives.

With the possibility of larger amounts of available roof space, the installation of large solar electric systems is possible. However, it is not currently encouraged as strongly as it is for residential applications by way of rebates and tax credits. With a governmental push to encourage green energy production, this appears to be a very strong area for growth.

Industrial or Plant Level

There is discussion of creating solar electrical generation facilities on a plant scale to provide green energy. While some costs do decrease with scale, not all costs are equivalent. When comparing a power plant scale solar system to residential or commercial systems, there are significant additional costs. Those costs include land, water, and infrastructure, and some of the costs are not easily estimated in dollars. One cost that is clearly related to dollars is infrastructure. When installing a solar system on a home or business, it is tied directly into existing electrical panels, and the existing electrical grid. Sometimes this can be done without any modification to the existing electrical infrastructure or grid, but occasionally it involves new electrical panels and a larger power line to the home or business. These are not without cost, but they pale in comparison to routing miles of how power electrical lines for miles to a power generation facility.

But it might be more important to consider the other differences, water and land use. Residential and commercial systems are typically “roof-top” grid-tie systems, and use no additional land. They sit on top of existing structures. And they typically employ PV technology, which requires very little water use (only an occasional rinse and wash every year or two). However a power plant level solar system can require 22,927 acres for every 1000 megawatts of power produced, much higher than other methods of power production.¹⁷

And, because not all power plant proposals use PV technology, they can create a significant strain on water use, often because of the power generation method, but also do to the energy storage methods used for overnight power production.¹⁸

Given these issues, it would appear that the requirements for a solar power plant would be directly opposed to the majority of American opinion that is in favor of land conservation.¹⁹

To create a power generation plant based on solar technology remains a difficult and questionable solution. While it is warm and fuzzy to think that we could view solar energy as a source similar to coal, gas, or hydro-electric, we shouldn't do so with a blind eye to the significant physical differences between these types of power generation.

Summary:

Using solar energy for hot water heating and electrical power generation can be a positive step for a better environment. However, all types and uses of solar energy imagined or planned is not necessary beneficial to our environment. Further solar energy may not be the first and best step towards addressing environmental impacts of energy use for the average person. The first clear steps are to address the energy use itself, using more efficient systems and making home and business improvements cut electrical use. Then additional spending on residential and commercial solar systems will be a positive second step. As much as residential and commercial solar applications seem to be a positive step to improve our environment, large scale solar power plants continue to be of debatable positive environmental impact, and potentially negative environmental impact.

Footnotes

- ¹ Electricity Demand, Electropedia, [http:// www.mpoweruk.com/electricity_demand.htm](http://www.mpoweruk.com/electricity_demand.htm) (last visited April 26, 2011).
- ² Your Home Time-of-Use, Tucson Elec. Power Co., [http:// www.tucsonelectric.com/Home/Programs/timeofuse.asp](http://www.tucsonelectric.com/Home/Programs/timeofuse.asp) (last visited April 26, 2011).
- ³ PV FAQ, Progressive Solar, Inc., [http:// www.progressivesolarinc.com/pvfaq.html](http://www.progressivesolarinc.com/pvfaq.html) (last visited April 26, 2011).
- ⁴ Green Energy -- Home Programs, Tucson Elec Power Co., [http:// www.tucsonelectric.com/Green/Home/Solar/spaceheating.asp](http://www.tucsonelectric.com/Green/Home/Solar/spaceheating.asp) (last visited April 26, 2011).
- ⁵ Arizona Incentives/Policies for Renewables & Efficiency, Database of State Incentives for Renewables & Efficiency, http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=AZ47F&re=1&ee=1 (last visited April 26, 2011).
- ⁶ Water Heaters, California Energy Commission, [http:// www.consumerenergycenter.org/home/appliances/waterheaters.html](http://www.consumerenergycenter.org/home/appliances/waterheaters.html) (last visited April 26, 2011).
- ⁷ See Solar Hot Water, Green Design Build for Your Home, [http:// greendesignbuild.net/Solar.aspx](http://greendesignbuild.net/Solar.aspx) (last visited April 26, 2011), and Life Expectancy, The Old House Web, <http://www.oldhouseweb.com/how-to-advice/life-expectancy.shtml> (last visited April 26, 2011).
- ⁸ PV FAQ, Progressive Solar, Inc., [http:// www.progressivesolarinc.com/pvfaq.html](http://www.progressivesolarinc.com/pvfaq.html) (last visited April 26, 2011).
- ⁹ Green Energy -- Home Programs, Tucson Elec Power Co., [http:// www.tucsonelectric.com/Green/Home/Solar/electric.asp](http://www.tucsonelectric.com/Green/Home/Solar/electric.asp) (last visited April 26, 2011).
- ¹⁰ Bi-Directional (NET) Electronic Energy Measurement, Tucson Elec Power Co., <http://www.tucsonelectric.com/Green/GreenWatts/Docs/TEPNetMetering.pdf> (last visited April 26, 2011).
- ¹¹ PV FAQ, Progressive Solar, Inc., [http:// www.progressivesolarinc.com/pvfaq.html](http://www.progressivesolarinc.com/pvfaq.html) (last visited April 26, 2011).
- ¹² How to Reduce Your Energy Consumption, Natural Resource Def. Council, <http://www.nrdc.org/air/energy/genenergy.asp> (last visited April 26, 2011).
- ¹³ See Kelli B. Grant and Sarah Morgan, 13 Simple Ways to Lower Your Electric Bill, Smart Money, <http://www.smartmoney.com/spending/deals/13-simple-ways-to-lower-your-electricbill-22933/> (last visited April 26, 2011), and Twenty Things You Can Do to Conserve Energy, Power Scorecard, [http:// www.powerscorecard.org/reduce_energy.cfm](http://www.powerscorecard.org/reduce_energy.cfm) (last visited April 26, 2011).

- ¹⁴ 2011 Federal Tax Credits for Consumer Energy Efficiency, Energy Star, U.S. DOE, http://www.energystar.gov/index.cfm?c=tax_credits.tx_index (last visited April 26, 2011).
- ¹⁵ Small Commercial Solar Electric Systems (Photovoltaic) -- 50 kW AC or less, Tucson Elec Power Co., <http://www.tucsonelectric.com/Green/Business/Solar/smcommelectric.asp> (last visited April 26, 2011).
- ¹⁶ Large Commercial Solar Electric Systems (Photovoltaic) -- Greater Than 50 kW AC, Tucson Elec Power Co., <http://www.tucsonelectric.com/Green/Business/Solar/commelectric.asp> (last visited April 26, 2011).
- ¹⁷ Pending Solar Projects, U.S. Dep't. of Interior Bureau of Land Mgmt., <http://www.blm.gov/az/st/en/prog/energy/solar/pend-solar.html> (last visited Nov. 17, 2010).
- ¹⁸ Robert Glennon & Andrew M. Reeves, Solar Energy's Cloudy Future, 1 *Ariz. J. Envtl. Law & Policy* 91 (2011).
- ¹⁹ See Alexandra B. Klass, Adverse Possession and Conservation: Expanding Traditional Notions of Use and Possession, 77 *U. Colo. L. Rev.* 283, 283 (2006) (citing 1996 survey mailed to random sampling of 2,000 individuals across the U.S. with equal distribution by gender, location, and socioeconomic profiles indicating 77.7% agreed or strongly agreed that policies protecting open space could be stronger, 86.5% agreed or strongly agreed that everyone should look after open space, 81.7% agreed or strongly agreed that everyone should have access to outdoor recreational areas, 71.2% agreed or strongly agreed that policies protecting farmland from development should be stronger, 54.4% agreed or strongly agreed that lands providing habitat for rare or endangered species are the most important lands to protect, 70.7% agreed or strongly agreed that more areas should be set aside as national parks so they are protected from development, and 57.1% agreed or strongly agreed that more emphasis should be placed on protecting historical landscapes); Zogby International for National Environmental Trust, A Poll of Likely Republican Primary or Caucus Voters in California, Iowa, New Hampshire, New York, and South Carolina, August 1999; Gallup Poll, reported in Roll Call, July 1999.