

Observations on an Installed Solar System

In thinking about what we can do to act on the Encyclical Pope Francis has given us, it seems to me that one of the most effective contributions available to us to reduce carbon dioxide emission is to install a solar photovoltaic system on our roofs. While it is not feasible for everyone for sitting and financial reasons, many of us can do this. Below I have tried to share what I have learned from my experience with my own roof mounted PV system. While I believe there is a moral imperative to do this whenever possible, the financial considerations are also important, and I have included the relevant economic analysis.

Overview

In December 2012 I had a photovoltaic (PV) system installed on the roof of my house in the Woolen Mills in Charlottesville. I offer this report for those who might be considering something similar. Included also is a discussion of the solar energy limitations specific to Virginia in the hope that future installations will become economically more favorable, as they currently are in many other states.

I contracted with AltEnergy, a Charlottesville PV installer. I was impressed by their professionalism and quality of work as seen below.



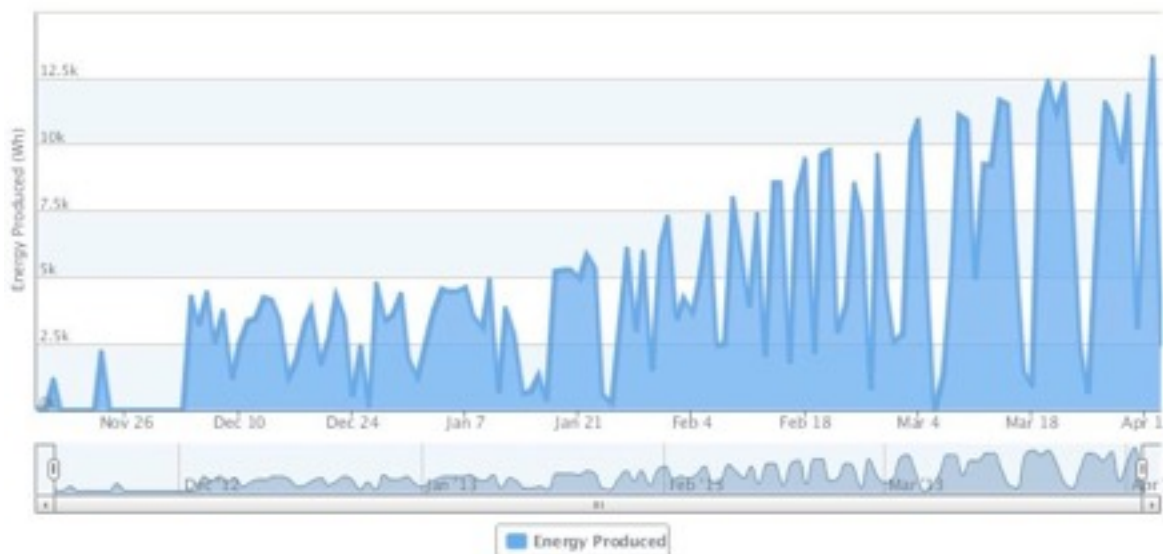
My grid-connected system had 10 panels with a 2.4 kilowatt nominal capacity. It was sized to produce about 90% of my fairly low annual electricity use based on the previous year's electric bills. The installation cost was \$11,605 and with a 30% federal tax

rebate, the net cost to me is \$8,124. Analysis of “return on investment” and “payback period” is given below.

This federal tax credit is scheduled to drop to 10% at the end of 2016. It could be extended, but most observers are not optimistic given our current Congress. What this means is that the best time to install a PV system is probably now. Those who wait until next year might run up against a last minute rush on PV installers and supplies resulting in higher prices or unavailability.

On-line monitoring of electricity produced

My system includes a comprehensive on-line monitoring system that sends operating data from the 10 independent Enphase micro-inverters to the internet so that I can see the real time performance of the PV panels on a computer anywhere. It also keeps track of cumulative energy and power output, and calculates environmental impact in terms of trees saved and carbon equivalents. The dips in the graph below are due to rain or snowy days. Day and night variations are averaged out on this time scale.



The system is set up so that the electricity produced by the PV system is fed directly into the house, but if it is generating more electricity than I am using at the time, the excess is fed into the Dominion Virginia Power grid. My electric meter credits me with the excess electricity the PV panels produce. This electricity is then sold by VA Power as with any other electricity they generate from their nuclear and fossil fuel sources. I chose not to install battery backup because of the additional cost, complexity, and the infrequent need in our location. In the near future this should become a much more attractive option and could be added to an existing system.

Limitations:

Every installation site has its own advantages and limitations. In this case my roof is not inclined at an optimal angle although I used two different perpendicular slopes to improve things a bit. Nearby trees also provide some shading, particularly in the winter.

However, I have been very surprised at the high output even with these limitations and especially the significant output during overcast skies. Even at 8:00 in the morning on an overcast day the system produces enough electricity to power the computer I am using or the passive load of several devices on standby.

Cost and payback time

The conventional way people calculate the value of PV systems is the monetary payback period - how long it will take to recover the cost of the installation through electricity cost savings. Realistically under current political policies in Virginia, the answer for this system is uncertain. Assumptions of projected increase in the cost of electricity and future interest rates can be used to estimate various times, some positive and others not. But I don't think this has to be the primary way to calculate the economic viability of a PV system.

A much more favorable analysis is to calculate current return on investment. If as projected, my system produces 3,171 kWh annually at the Virginia Dominion retail charge 10.5 cents a kWh, this gives a saving of \$333. This yields:

$\$333 / \$8124 = 4\%$ as an annual rate of return. My actual return has born this out.

Of course if you borrow the cost of installation, the cost of interest on the loan might exceed this. In which case a favorable pay-back depends only on assuming that electricity rate will continue go up as they historically have. Currently the UVA Credit Union is offering a 3.5% home equity rate which is slightly favorable.

On the other hand if you have some savings of your own to invest, the cost of withdrawing that money from a CD or savings account would currently be less than 1%. Then the rate of return from a PV system becomes very favorable and comparably secure as it simply adds to the value of your house.

But for me the real payback is instantaneous satisfaction from feeling that I did something worth while. Even the small amount of electricity my system produces reduces fossil fuel burning and the need for nuclear reactors and uranium mining in Virginia a little. It was much less than the cost of a new car and I find my 18-year old Toyota so far still works as well as it did when it was new.

Political economic analysis

One of the current arguments the anti-solar folks use is that those who install PV systems increase the bills of those who don't have such a system by free loading on the grid. If this were true it would be a serious concern. But in fact my electric bill shows a distribution charge as well as various taxes and fees above the charge for the electricity delivered by VA Power. I pay \$7.70 a month including taxes for the grid connection.

This is probably a little high as independent studies in other states have found, but in principle it is completely reasonable.

In addition, the even slightly reduced need for their new generation facilities means we don't have to pay for it through higher tax subsidies and future rates. In the system used in many other countries to promote clean energy development, the power company pays the home owner the "avoided cost" to install new central generating facilities. Va Dominion uses 15 cents/kWh for this. Such a rate would lead to a very favorable pay-back period.

Policies in many parts of the world has been responsible for the dramatic reduction in the cost of photovoltaics to the point that it has reached grid parity, as it has in some parts of the United States.

Expanded System

I was so pleased with the performance of my initial system and the resulting economic benefits that in December 2013 I added another 5 panels.

The now 15 panels on the roof produce electricity during the daylight hours which is fed through micro-inverters to change the naturally produced direct current to the 110 volt alternating current electricity the houses use. It all happens automatically. The second installation cost about \$3,000 after the 30% federal tax rebate.

Economic Benefits

As of October 2015, since the first part of my system was activated, the total electricity I have generated is over 10 megawatt hours, at a value of \$1,050. The amount of electricity my house uses may be unusually low due to conservation measures, and the fact that I heat both space and water with natural gas. But the result is that I have not had to pay for any electricity in over a year.

Net Metering

The system by which the local utility buys the excess electricity a customer delivers to the grid at the same price they charge to sell you electricity is called net metering. The rapid growth of solar energy has depended on this. However, some utilities have tried to eliminate this. Others have decided to adapt and accept the benefits of competition and clean energy. So far even when an attack of net metering is successful, as most recently in Hawaii, those with existing installations are grandfathered in. This is another reason to install now instead of later.

Sale of Carbon Credits, SRECs

SRECs (Solar Renewable Energy Certificates) represent way to receive direct income from your photovoltaic system. These certificates can be created by the renewable electricity you produce. Envisioned as a way to encourage responsible green energy production, they must be bought by utilities and other polluters to offset some of their damage to the environment using a "free market" concept. A few years ago these were quite valuable rising to as much a \$700 a SREC, but then falling to as low as \$10 each

this year. As the Pope's encyclical says, this was a bad idea from the start for other reasons.

But to take advantage of this you need to open an account with an aggregator such as SREC Trade or Sol Systems. Since there is currently no market in Virginia, these companies promise to sell your accumulated certificates at open auction on a Pennsylvania exchange and pay the proceeds to you minus a small commission.

At the recommendation of AltEnergy I signed up with Sol Systems but apparently they are currently not very interested in new small Virginia systems like mine. My system has sold 5 SRECs for which I have received \$151.26. The current recommendation is to try SREC Trade. This might still provide some financial benefit, but the predicted amount is usually exaggerated by most pay-back calculations I have seen.

Solarize Charlottesville

There has been coordinated effort in our area by the Local Energy Alliance program (LEAP) to reduce the cost of PV installations even further through collective contracting and purchasing. After a successful couple years, it is no longer available for new customers. But current prices are still lower than when I had my system installed and more options are available. Each person's situation is different, and any installer will give a free estimate.

Taxes and Insurance

I understand from city and county officials that solar installations are not included in real-estate taxes. My home insurance company has told me that as long as PV is a permanent part of the house, it is covered by my existing policy.

I hope this has been helpful. I would be happy to talk with anyone further.

Sincerely,
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