
Cost-Benefit Analysis

A Solar-Energy 'Investor' Confronts The Economics Of His Choice

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As an advocate of solar electricity (solar photovoltaics, or "PV"), I have followed PV technology, pricing trends, government incentives and electricity prices to determine if a grid-connected PV system is a good investment for the typical homeowner (i.e., me). With such advances in the grid-connected market as utility-approved inverters and net metering, the increasing price of electricity, and the fact that a grid-tied system needs no expensive bank of batteries to store power, I think the time has come, at least in our home in Calais, Vermont.

There are many good reasons to install PV, but earning a financial return on your investment in such a system has not been considered to be one of them. Yet I have determined that for a long-term, income-oriented investor, a grid-tied PV system can be considered an alternative to investing in money market funds, mutual funds, the stock or bond markets. This is because the PV system produces electricity that has a quantifiable cash value. Just as you would "buy and hold" a dividend-paying stock, you can buy and hold a dividend-paying PV system. The money spent on the system is recouped when the house is sold.

I've put my money where my mouth is, and had a .96-kW system installed near our house. At current Co-op residential electricity rates, the average cost per kilowatt hour (kWh) is around 16 cents, based on an average rate of consumption. Vermont now has net metering – a law that allows grid-connected

home-producers of electricity to sell power back to their utility – so the value of each kWh produced by my PV system is the price of the electricity I am not purchasing.

The PV system and installation

Our PV system was installed in June 2002 by Jim Grundy of Elemental Energy, in East Montpelier. The system consists of eight BP Solar MSX-120 (120 watt) PV panels, and the Advanced Energy GC-1000 inverter connected to the grid. In the first 86 days on-line, the system averaged about 3.5 kWh/day production.

Calculating the investment return

Keeping the analysis simple, the value of the electricity produced, expressed as a percentage of the initial cost of the system, is the "dividend." The initial cost of the system is my investment.

Total system cost: \$9,400

Currently in Vermont, no state or federal tax credits are available for residential PV systems (some other states do provide credits), nor are there any buy-downs or other incentives available from any agency in Vermont. The only tax advantage is a waiver of the 5-percent Vermont sales tax on a PV installation.

What is an appropriate return? The 10-year U.S. Government Treasury Bond yields about 4 percent now. A money market fund is returning somewhere below 2 percent, and the stock market is anybody's guess. For the sake of picking a number, let's just target a pre-tax return for a low-risk investment of 5 percent.

Five percent of my investment is \$470. At the current 34.2-percent combined (27 percent federal and 7.2 percent Vermont state) marginal tax rate, after taxes, a 5-percent return turns into \$310. So if the PV system produces \$310 of electricity, it is equivalent to putting money into a



A small solar array in the yard can produce half of this homeowner's power.

taxable investment (like a stock that pays a dividend) paying 5 percent.

Is it reasonable for me to expect that the PV system can produce this amount of electricity?

To produce \$310 worth of electricity per year (365 days) requires an average production rate of \$0.85 electricity per day. At 16 cents per kWh, my PV system needs to produce 5.3 kWh per day.

Is this possible? Looking at this roughly: 960 watts X .90 efficiency X 4 hours average sun per day = 3.456 kWh per day. So it looks like the system could produce a dividend return of between 4 and 5 percent. Of course, this depends on all the factors that influence the output of the PV system (amount of sun, temperature, shade, etc.).

The risk to my dividend is if electricity prices decrease. If this happens, the dollar value of the electricity I produce will be less, and consequently my dividend will be reduced. But I'm willing to take the risk. Historically, electricity prices have risen, and Vermont's electricity costs are higher than the national average.

Calculating the total return on my investment in a PV system requires estimating its value when it is "sold." I am assuming that at any point in the future the value of the system will be comparable to what I paid for it in 2002. Since I'm not planning on selling the system as a unit separate from our house, this is an assumption that I am never going to test. I could make a case that the system will appreciate with the rest of the house, as long as the housing market continues to appreciate (the PV system being considered a part of the house). Or I could make a case that the system itself will depreciate, the modules of the PV system breaking down over time. But who knows the life of a module? (Presently the

modules have no value, if not covered under the 25-year warranty).

My conclusion is that with an electricity dividend of 5 percent, the return on my PV investment is 5 percent.

Further values

What other investment attributes have I gotten with this purchase? Consider these:

1. A hedge against rising oil, natural gas, and electricity prices. In this case, when electricity prices rise, my return increases.
2. As energy prices are a key component of inflation indexes, I have acquired a hedge against inflation.
3. I have diversified away from exposure to the financial markets.
4. Low risk. There is not going to be a lot of variability to this return. It's not likely to be 10 percent, but it also won't be negative.

As an additional, social benefit, installing the PV system has reinforced the economic value of conservation.

The investment return of the PV system is limited to the amount of energy that we, personally, consume at our household. Under Vermont's net-metering law I cannot get cash from the Co-op even if I produce, and supply to the grid, more electricity than I consume. Of course there is no chance of that happening because my system is sized to produce only half of our projected electricity usage, and based on the first half-year of production, this estimate looks accurate.

Looking into the future, as PV manufacturing costs continue to come down and solar electric systems become more affordable, the investment return for newer systems will increase. If additional incentives are forthcoming from federal, state and local governments, the return will also increase.

Conclusion

PV has often been dismissed by otherwise-interested individuals because it is "too expensive." However, if PV makes sense as an investment, that conclusion becomes obsolete. Perhaps the framework I have described for my own calculations as a grid-connected Vermont homeowner might help others assess whether such an investment would make sense, economically, for them. (In many places around the country the combination of government incentives, electricity prices and available sunshine remove any argument that grid-

connected PV systems are "too expensive" an investment.)

From the electric utility's point of view, diversification of its power supply is also a financial hedge. In the past, mistakes were made where all the power supply "eggs" were in one basket; and utilities have experienced losses due to risky contracts and power agreements. The Co-op currently is about 40-percent renewable in its wholesale-power mix, and this continues to be one of the dominant criteria our board uses in its decisions about power-supply choices.

I'll be watching my electricity production for years to come, to evaluate the actual return of my grid-tied PV system. Unlike some stock market investments I have made, I am not subject to accounting shenanigans, corporate malfeasance, or outright fraud. I will receive a dividend each month and I am not subject to the "mood of the market."

With a projected annual dividend of 4-to-5 percent, and a bias toward increases over time, this is an investment I am happy that I made. 