WHY IS A SOLAR ELECTRIC HOME WORTH MORE?

Andrew J. Black
Member of the American Solar Energy Society, OnGrid Solar
4175 Renaissance Dr, #4
San Jose, CA 95134
andy@ongrid.net
(408) 428-0808

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ABSTRACT
Solar electric systems increase the value of homes in several ways. They can reduce or eliminate the energy operating cost of the home. They hedge against or eliminate the effect of electric rate inflation. As a component of the home, in many cases they can provide an attractive vehicle for financial investment.

These monetary benefits are financially quantifiable. A solar electric system increases home value by $20,000 for each $1,000 in annual reduced operating costs, according to the Appraisal Institute. A solar electric system compares very favorably with other home improvements in percentage of cost recovered. Often, a solar system can recover much more than 100% of its cost, and this percentage actually increases over time as electric rates rise.

A solar electric system can also supply numerous intangible benefits that may be valued by some buyers.

1. INTRODUCTION

For solar to be accepted by the broadest spectrum of society, it must compete on the financial terms society expects, regardless of the intangible health or social benefits it provides. These intangible benefits are highly valued by some, but seem not to be something for which the broader cross section of society will pay more. To compete on a financial basis, it must provide a "good" financial rate of return. However "good" is relative to its comparative risk. In financial circles, this is termed "Risk vs. Reward."

For solar to be evaluated as an investment, the risk must be quantifiable and understandable. The solar industry is getting beyond the feared risk that the systems won't work. There is now much proof that they work very well. Another risk is liquidity. If the owner must sell the property before the system has achieved payback, can they get some money back out of the system? How much and at what rate does it depreciate?

This paper will show that solar electric systems in California will increase a home's value. The increase in value is often as much or more than the systems initial net cost. Hence the payback risk may be eliminated from the beginning. This paper will also show that the solar system's value as a component of the home's value will appreciate, not depreciate over much of its 30-year design lifetime.

2. DIRECT SAVINGS INCREASE VALUE

2.1 Solar Reduces Home Cost Of Operation

A properly designed and installed solar electric system can reduce the net electrical consumption and electric bill of a home. Electric bills can often be reduced to nearly $0.00 per month. In some cases there are minimum fees. Factors affecting the reduction in the electric bill include:

- How much energy was generated by the solar system.
- When the energy was generated.
- When energy was consumed in the home.
- Net-Metering of energy exported to the utility.
- Time-of-Use rate tariffs on the imported and exported energy.
- Reduction in penalty surcharges due to offsetting high usage amounts (see Fig. 1).

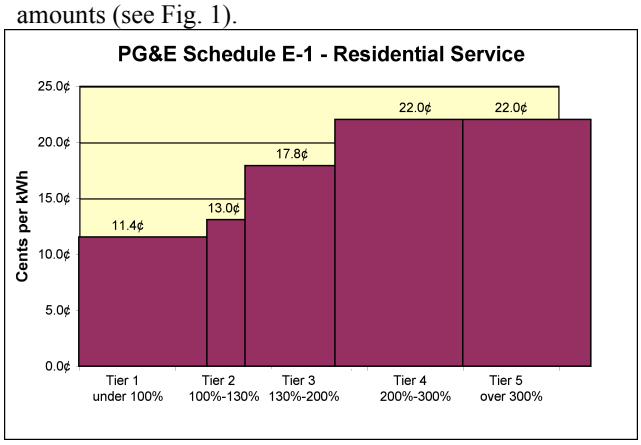

Fig 1: PG&E Rate Tiers with penalty surcharges for high levels of usage.

Average users use 130% of baseline (the first two tiers). High users are penalized for excess energy consumption. Usage above average (130% of baseline) is charged at $0.194, $0.238, or $0.258 per kWh.

2.2 Reduced Cost Increases Value

According to articles by Nevin in the *Appraisal Journal*[1,2], the increase in appraisal value for a home with an energy efficiency measure (in this case, a solar electric system) is about twenty (20) times the annual reduction in operating costs due to that energy efficiency measure.

That is to say, if a solar system can reduce the electric bill by $1,000 per year, the home is worth about $20,000 more in increased appraisable value.
The rational is that if the $1,000 is not spent on electricity, it is available to be spent on a larger mortgage payment at no net

change in the cost of living. The amount of mortgage that can be supported by $1,000 depends on mortgage rates and the tax rate of the borrower.

Nevin states that after-tax mortgage rates have averaged about 5% over the longer term. At 5%, a $20,000 mortgage costs $1,000 per year, hence the 20:1 ratio. Mortgage rates vary, so depending on market conditions, the ratio has ranged from less than 10:1 to over 25:1. As of March 2004, long term mortgage rates at historic lows of 5.5% before tax, or 3.3% after-tax. At these very low rates, the ratio is about 30:1.

The assurance to a consumer of good resale value for the solar system may be important over the near-term, mid-term and long-term futures. It would be inappropriate to assume rates will stay at low levels over the mid-term and long-term, so it is more reasonable to continue with Nevin's estimate of 5% after-tax, giving the 20:1 ratio. This will be referred to as the "20:1 ratio product."

Table 1 illustrates the relative increases in appraisal value compared to system net cost for several examples in California's PG&E service area. In California the penalty surcharges increase as the electrical usage increases. Therefore, the larger systems in the example are paying relatively higher electric rates and see substantially larger savings in proportion.

2.3 Comparison To Other Home Improvements

A solar electric system compares very favorably with other home improvements in percentage of cost recovered. Often, a solar system can recover much more than 100% of its cost. The last column in Table 1 shows the percentage of cost recovery for the three solar cases.

Remodeling Online[3] reported in its "2003 Cost vs. Value Report" on the relative cost recovery of common types of home improvements based on data from national home remodeling and home resale surveys. Some of these projects are highlighted in Table 2. The best cost recovery of all common remodeling projects was the addition of a deck. On average it returned 4% more in resale value than it cost.

It should be noted that all these resale values are in addition to the benefit enjoyed by having and living with each project after completion. The same can be said of solar. The solar owner gets to enjoy the utility bill savings and any desired non-financial benefits.

TABLE 2: 2003 NATIONAL AVERAGES OF COST RECOVERY FOR REMODELING PROJECTS.

Project	Project Cost	Resale Value	Percentage of Cost Recovered
Deck Addition	$6.3K	$6.7K	104%
Bathroom Remodel	$10.1K	$9.1K	89%
Window Upgrade	$9.6K	$8.2K	85%
Kitchen Remodel	$44K	$33K	75%

2.4 Probable Limits to Immediate Appreciation

Will a homebuyer pay more for a used solar system on an existing home than the net cost of a new system that they could retrofit to the home after purchase? That is, why should a buyer pay 153% (see Table 1) for a used solar system, when they can get a new one at 100%? This is an open question.

However, buyers apparently do pay about 4% more for homes with decks than if purchased a home without a deck and contracted for its installation. Even more striking, Remodeling Online[3] reports that in Boston, San Francisco and St. Louis, homebuyers paid over 215% of the cost of the retrofit. This same phenomenon occurred with other types of improvements in certain cities, even though the national average was less than 100%.

2.5 Appreciation, then Depreciation

As the systems age, they should appreciate if electric rates rise. The more rates rise, the larger the 20:1 ratio product on savings. This will continue until near the end of life when depreciation can be assumed to occur (Note: "depreciation" here refers to the real loss in financial value, and is unrelated to the "depreciation schedules" used in taxation).

Depreciation will begin to occur a few years before the 25 year warrantees on the solar modules expire, as the inverters begin to need replacement, and as the system requires more maintenance due to age. During this period, it is anticipated that the system's 20:1 ratio product based on the much larger future savings will be discounted by the depreciation into end of practical life.

2.6 Price Support

In the future, homebuyers may not be willing to pay more than 100% of contemporary costs for a new system. The 20:1 ratio product shows there may be price support for paying at least

TABLE 1: EXAMPLE APPRAISAL INCREASES IN VALUE FOR CALIFORNIA HOMES

Pre-Solar Bill	Pre-Solar Usage (kWh per Month)	System AC Size	Monthly Savings	Final Net Cost	Appraisal Equity Increase @ 20:1	% Cost Recovered
$80	600	2.6 kW	$73	$17.5K	$17.6K	100%
$190	1100	5.2 kW	$184	$31.4K	$44.2K	141%
$310	1575	7.8 kW	$303	$46.3K	$72.6K	157%

Variables: $3.00/W Rebate, 7.5% State Tax Credit, 31% Federal Tax Bracket
Net cost includes a Permit Fee of $600 & Time-of-Use meter fee of $277
Simple roof installation by a full service provider with no complications. Utility Territory PG&E XB.

100%. This will provide a current owner the assurance that they can get their money back out of the system if they need to sell. In the mean time, they can enjoy its benefits.
The "100% of contemporary costs for a new system" level will vary over time. In much of the world, this is a declining amount. In California, where the rebate on solar systems is declining more quickly than gross system installed costs, the net price to consumers is increasing. In California this should lead to increasing levels of price support compared to costs paid.

3. HEDGE AGAINST INFLATION

3.1 Electric Rates Have Generally Increased

Throughout history, electric rates have generally trended higher. Fig 2. illustrates the average 6.7% annual compounded increases from 1970 to 2001. This is an effective doubling of rates every 12 years.

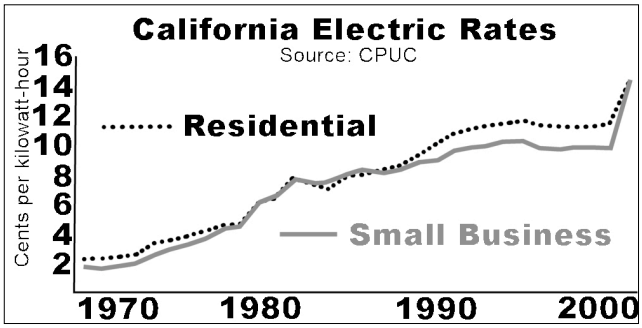

Fig 2: California Public Utilities Commission 30 Year California Electric Rate History[4].

3.2 Hedging

Hedging is a financial term meaning "to counterbalance with another transaction to limit risk." A solar system offers a "hedge" or protection against continued rate increases.

A home that substantially cuts its net electric usage is less subject to inflation and price spikes. The present value of these future savings can be quantified using discount rates and estimates for inflation rates. Larger California residential customers were also subjected to changes in the rate structure established by the tiered pricing (see Fig 1).

3.3 Kilowatt-Hours Not Purchased

There are many small charges bundled with the electric generation charge for each kWh. Charges for Nuclear Decommissioning, Trust Transfer, Transmission, Distribution, Bonds, and taxes are all eliminated for each kWh that is not purchased. Future charges added to the electric rate will be avoided as well.

4. ADDITIONAL INVESTMENT IN THE HOME

A solar system offers an additional avenue for investment in the home. Like adding another room, the solar system allows the owner to put more money to work in the real property investment. There are several ways to view and test this investment.

4.1 Financial Investment Viewpoints and Tests

A financial life cycle analysis can test the feasibility of a solar project. The simplest test looks at all the costs and all the savings, including inflation, over the 30-year life of the project. If the net savings are larger than net costs, then the project pays for itself in these simple terms. Generally solar systems pay back 2 to 4 times as much as they cost. This test does not account for the "Time Value of Money" which is akin to not accounting for the lost interest you could have earned elsewhere if you didn't have to pay for the solar system up front.

This test can also be expanded into the Payback test, which asks when a system has "Paid For Itself." This is considered a crude test, because it does not account for the future value of all the assured savings that will be accrued due to the long warrantees on solar electric modules. Usually paybacks occur in 7 to 15 years, leaving 13 to 20 years of system life remaining to be enjoyed.

A more detailed test looks at the Rate of Return over the same 30-year project life. All the costs and all savings are accounted for in their relative timeframe. Using an "Internal Rate or Return" analysis, the effective interest rate paid by the project can be found. This interest rate can be compared with other investments. Residential solar projects in California often have Internal Rates of Return in the 10% to 20% range, which compares favorably with the long term stock market at 10.5% over the last 80 years.

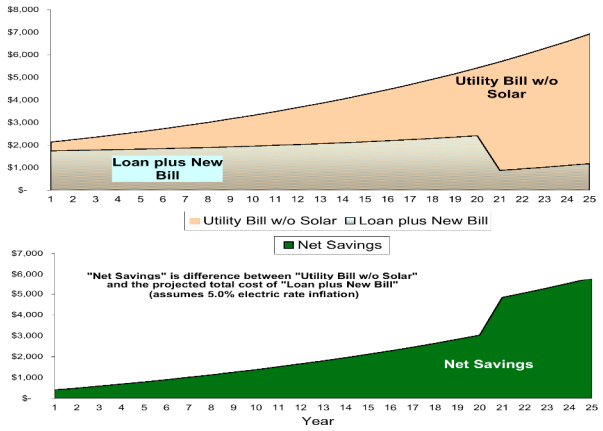

Fig 3: Cash flow effect of 5kW solar on a $175/month bill.

Cash flow is another type of test. It compares the savings on the utility bill with the cost of financing the system. In many cases starting the first month, it costs less to borrow the money to put a system in, than it does to keep paying the utility. Borrowing at a fixed interest rate gets more advantageous as the electric rates go up and the effective savings grow, but the loan payment stays the same. These projects often achieve positive cash flow right away, and improve as inflation increases the electric bill savings. See Fig. 3 for an example of a 5kW PV system offsetting a $175/month bill.

Generally, homes that spend $65 or more a month on electricity tend to be good candidates. Cases that show solar to be a good investment will naturally attract homebuyers who will want to get that good investment.

5. INTANGIBLE BENEFITS

There are numerous intangible benefits that will attract buyers as well; environmentally sound energy use & self-production, the feeling of independence from the utility and its high or rising rates, and incorporation of high technology that some will enjoy having built into their home.

6. EXAMPLES IN THE MARKETPLACE

6.1 Few Comparables To Date

There are few if any documented cases where a solar electric home clearly sold for a quantifiable higher amount vs. its comparables.

In California, as of March 2004, there are about 9,000 grid tied solar homes, 94% of which were installed in the last three years, since the power crisis. There are about 4,000 more in the queue to be installed in the next year.

Since the normal occupancy time of a home is about 7 years, many of these new solar homes have not sold. It is likely that most homeowners who install solar are planning on staying in their homes longer than average, or they would likely not have made the investment. Therefore, relatively few solar homes have sold throughout the state.

Once these homes begin going on the market in large numbers, and the market can evaluate the claims of reduced operating costs and assign them a value, studies can be conducted to determine the validity of the claims in this paper. It will then be possible to compare a solar home side by side with a similar non-solar home.

6.2 Reasons For Confidence

Approximately 13,000 homeowners in the last three years have seen enough value in solar systems to make a major financial commitment. As long as their systems perform, they are likely to have that value realized. This will support the market in two ways. They have a higher likelihood of purchasing solar on their new homes when they move. The author has already seen this happen in three individual cases. They will provide examples and word-of-mouth in their communities that the systems have and create value.

While the 13,000 may have purchased primarily for their own use, it is reasonable to conclude there are others who would be interested in purchasing, thus creating a market support for some extra, but as yet unquantified value.

A survey conducted for the California Energy Commission's Renewable Energy Program showed that 50% of Californians would be willing to pay more for a home already equipped with solar technology, and more than 60% would be more interested in a home that has a renewable energy system than in one that doesn't[5].

6.3 Counter Examples and Caution

Many homeowners and purchasers have opinions about the attractiveness of various solar technologies on residential roofs. Some like it, some do not, some don't know what they are looking at and don't object. If the home looks weird it can hurt value.

Toronto real estate appraiser Alan Wood finds that while homeowners are willing to invest solar, most are unwilling to purchase a more expensive home custom-built for this purpose[6]. Wood further states that market appeal and resale value are lowered when the energy-conserving home looks noticeably different from most others.

7. CONCLUSION

Several ways of demonstrating that solar electric systems increase the value of homes have been shown, reducing the financial risk to purchasers. Solar electric systems can reduce or eliminate the current and future energy operating cost of the home. They hedge against or eliminate the effect of electric rate inflation. As a component of the home, in many cases they can provide an attractive vehicle for financial investment. These tangible benefits are financially quantifiable. A solar electric system increases home value by $20,000 for each $1,000 in annual reduced operating costs due to the system. In California, a solar electric system compares very favorably with other home improvements in percentage of cost recovered, often recovering more than 100% of its cost.

8. RECOMMENDATIONS

8.1 Future Areas of Study

A survey is needed of actual retail sales of solar homes. The study might test resale value against comparable homes and contemporary local net installed system costs.

Another study might evaluate the change in resale value when both buyer and seller are informed of the ways of valuing a solar system on a home.

8.2 Suggestions for Implementation in Other Areas

In the author's opinion the most important factors that could improve solar financial viability in other areas are:

- Implementation of Time-of-Use Net Metering
- Establishing a tiered electric rates penalizing high users
- Small and declining subsidies as needed

Small subsidies may be needed in certain regions with low electric rates until electric rates rise and solar costs fall as has happened in California. There are several states that have sufficiently high electric rates. If those states adopted Time-of-Use Net Metering and a tiered rate structure, solar for large users to be very close to financially viable without any subsidy, as is the case in California.

9. REFERENCES

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