

Payback and other Financial Tests for Solar on Your Home

By Andy Black

Solar electric systems can be a good financial investment for California homeowners with good sun (little shade) on a south, southwest, or west-facing roof, if they have a \$75 a month or larger electric bill. The larger the bill, the better the investment pays off.

Rates of return from 10% to 15% are common. If financed, the loan cost is usually less than the monthly utility bill savings. And if the home is sold, the solar system should increase the resale value by more than the system's installed cost.

The above claims are big, so rigorous treatment and critical analyses from several angles including annual Rate of Return, Cash Flow, Lifecycle Payback and Resale Value need to be considered to do a fair assessment. It is helpful to compare the solar investment to other investments on an even basis.

IN THIS ARTICLE:

- Why solar pays off, including incentive programs that help
- How to test the economic value in the ways listed above

WHY DOES SOLAR PAY OFF NOW?

High electric rates, Time-Of-Use metering, and government incentives have contributed to the financial viability of residential solar electricity. The key element for these analyses is the savings on the electric utility bill generated by the solar system. A properly sized, designed and installed solar system can easily eliminate almost all of the total annual electric bill. There are usually only minor monthly minimum charges remaining.

High Electricity Rates and California's tiered rate system (with top rates of 22¢/kWh) penalizes residential customers with high electric usage. The surcharges in the three top tiers (see Fig. 1) for residential customers are among the most important factors in the payback. Rates have also increased steadily at about 6.7% per year for 30 years (Fig. 2), and 5.4% over the last 22 years. To be conservative, 5% is used in the analyses that follow.

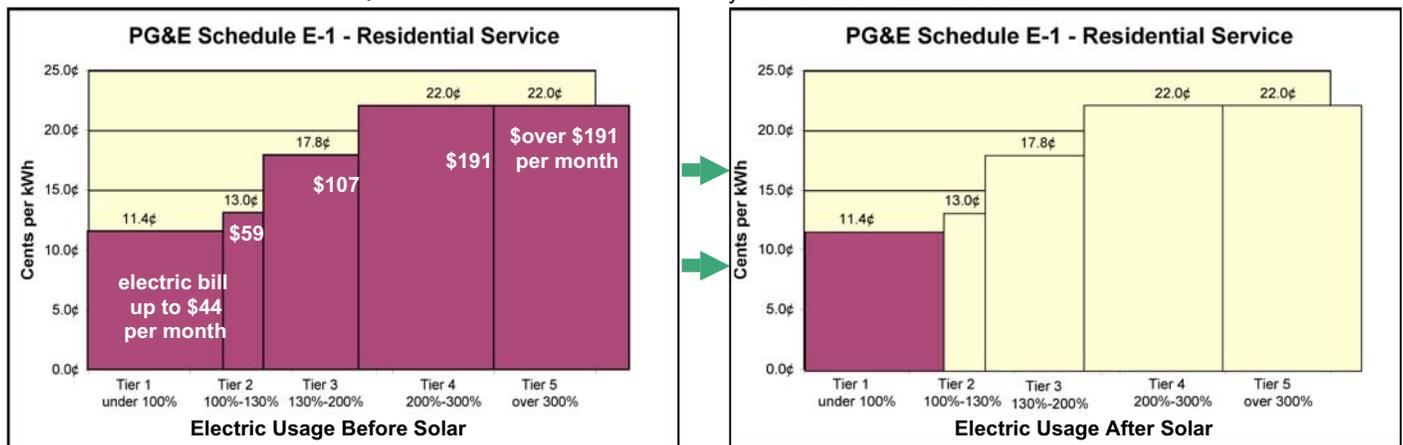


Fig. 1. Tiered rate pricing penalizes large users most with a marginal electricity cost up to 22¢/kWh. Solar offsets highest tier usage first, making the solar customer look like a small user with a marginal cost as low as 11.4¢/kWh. The graphic on the left indicates which tier a user is in for a given monthly electric bill in San Jose, CA.

With **Net Metering on an Annual Basis**, full retail value is credited when excess electricity is produced and "sold" back to the utility. This excess usually occurs during summer daytime hours. This credit gets used up over the winter and at night and can be held on account for up to a year. The utility ends up looking like a 100% efficient battery that can store energy for up to a year.

Electricity is billed to customers on either a flat-rate schedule (PG&E E1 rates), where electricity costs the customer the same any time of the day, or on a **Time of Use (TOU)** schedule, (PG&E E7 or E9), where the cost depends on the time of day and year. The PG&E E7 schedule has peak rates during summer weekday afternoons of 29¢/kWh and winter weekday afternoons of 11¢/kWh, and off-peak rates at other times at a cost of 9¢/kWh. See Fig. 3.

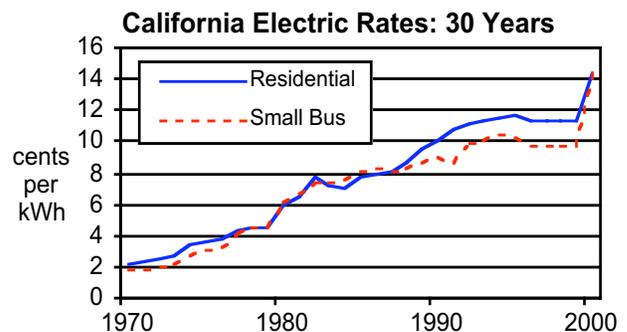


Fig. 2. Rates have gone up an average of 6.7% per year for 30 years. Source: CPUC "Electric Rate Compendium" Nov. 2001. This article assumes inflation will be 5% going forward.

Combining Net Metering with TOU allows a solar customer to "sell" power back to the utility during peak periods at the high rate, and buy back during off-peak hours. The customer gets credited or charged for the value of the electricity when it is bought or sold. The utility then looks like a 350% efficient battery because most solar electricity is produced during peak hours, and most is consumed in a residence during off-peak hours. The customer gets more value for the same kWh produced, and therefore needs a smaller solar system to offset their electric bill.

Residential Time-of-Use Peak Pricing Periods							
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Midnight - 6am	Off-Peak	Off-Peak	Off-Peak	Off-Peak	Off-Peak	Off-Peak	Off-Peak
6am - Noon	Off-Peak	Off-Peak	Off-Peak	Off-Peak	Off-Peak	Off-Peak	Off-Peak
Noon - 6pm	Off-Peak	Peak	Peak	Peak	Peak	Peak	Off-Peak
6pm - Midnight	Off-Peak	Off-Peak	Off-Peak	Off-Peak	Off-Peak	Off-Peak	Off-Peak

Fig. 3. Time-of-Use peak and off-peak periods.

This works especially well if the customer can mount their solar array facing southwest, south, or west, at an angle near 22 degrees up from horizontal (equal to a 5:12 roof). Slopes from 5 to 35 degrees work well also. Southwest is preferred because it maximizes afternoon peak generation at a high value. This orientation also better matches the utilities peak load profile.

There are several **Government Incentive** programs to promote solar. The **California Energy Commission (CEC) Emerging Renewables Rebate Program** cuts final cost 30% to 40% for most systems in PG&E and other public utility territories. This program doesn't apply to municipal utilities, but some have their own programs – see www.dsireusa.org to find these programs.

The CEC program pays a rebate of \$2.80 per rated AC watt of system output (as of September 2005) upon installation of a compliant system. Affordable Housing projects get a higher level of rebate. Please see www.consumerenergycenter.com/erprebate for more information and for reservation forms, or call the CEC at (800) 555-7794. This rebate declines by 20¢ per watt every six months on January 1 and July 1. The funding situation is uncertain, and it is possible that the rebate money will run out faster than expected, possibly as soon as early 2006. To use the rebate program, one only needs to submit a complete reservation request before the rebate level drops. From the time of approval, the project has 6 months to install the system (18 months if new construction).

The good news is that even **after the rebates are gone**, many customers with \$155/month or larger electric bills will receive a greater than 10% annual Rate of Return because of the combination of the other factors discussed in this article. The rebate is helpful, but isn't essential to make solar worthwhile for a larger residential customer.

It is important to note that as of this writing, the IRS considers a rebate given directly to the homeowner as taxable income. The CEC is working to change this. Meanwhile, there is no tax consequence if the dealer/installer applies for and receives the rebate as part of payment for the job, and passes the lower after-rebate price on to the customer. This is much better for the consumer – no tax risk, less cash required during the project, and greater leverage over the installer should they do a substandard job. It is a little less attractive for the installer because it hurts their cash flow, but there is essentially no risk the CEC won't pay assuming the installer completes the job and satisfies the inspector. It doesn't increase the installers tax because it is part of the job's revenue which is already subject to taxation, minus their expenses.

There is a new CEC incentive program called the **"Pilot Performance-Based Incentive Program" (PBI Program)**. Under this program, a solar system owner is paid an incentive based on the production of the system in kWh. The more productive a system is, the greater the incentive. The idea is to reward the best systems that produce the most electricity. The current incentive is 50¢/kWh for the first 3 years of system output.

Whether this system and amount of incentive payment is attractive and preferable to the current up front rebate level of \$2.80 per watt

depends on a user's time-value-of-money calculation, the availability of cash, their confidence in system production, and tax treatment of the payments.

Currently, the author's financial modeling tool shows that the new PBI Program is slightly less economically attractive than the current Rebate Program to a buyer with an ideal production situation, assuming the PBI Program payments are not taxable to the recipient.

The big unanswered question is the tax treatment of the PBI payments. If these payments are received by the system owner, which is most likely since the installer won't want to be involved after the installation is complete, they may be subject to state or federal taxation, just as the Rebate Program payments are be subject to federal taxation. If they are taxable, then this incentive is much less attractive to the consumer, which may explain why so few applications have been made to this new program. Municipal and non-profit entities are not taxed and will not be affected.

The author favors Performance Based Incentives, but believes the market would be most efficient at setting the appropriate incentive level via an auction system. An auction system would reward only the best systems that needed the least incentive, encourage continuous cost reductions, stretch the incentive money supplied by the public to the furthest extent possible, and create maximum long term stimulation and stability for the PV industry who could be certain that the incentive program money would last the length of the program period. For more information on this "PBI Auction" concept, please see www.ongrid.net/papers/PBIViaAuctionSWCph.pdf

Disclaimer: The information in this article regarding taxes, tax credits and depreciation is meant to make the reader aware of these benefits, risks and potential expenses, and help avoid overblown claims by aggressive salespeople. It is not tax advice, and the author is not a qualified tax professional. Seek professional advice from a qualified tax advisor to check the applicability and eligibility before claiming any tax benefits.

California offers a **State Income Tax Credit**. The tax credit is 7.5% of the net system cost for systems installed by the end of 2005. Installed means inspected and legally operational (not just paid for). Any excess credit can be carried forward for 7 years. The tax form is CA FTB form 3508, www.ftb.ca.gov/forms.

For those who itemize their federal tax deductions, the State Tax Credit won't be worth the full 7.5%. When itemizing, state taxes are deductible off federal income. Reducing state taxes by the state tax credit means that federal taxable income will go up. In effect, federal income tax is being paid on the value of the state tax credit. For most people, the state tax credit net value is about 5.4%.

The good news is that even if the 2005 installation deadline for the State Tax Credit is missed, there is a new Federal Investment Tax Credit available for solar electric and solar thermal systems (but not solar pool heating systems). This Federal credit is divided into Residential and Commercial.

Pre-Solar Bill	kWh per Month	System AC Size	System Gross Cost	State Rebate @ \$2.80	Final Net Cost w/ \$2K Fed Tax Credit	Pre-Tax Annual Return	Appraisal Equity / Resale Increase in First Year	Post-Solar Bill /mo	Net Monthly Cash Flow Compared to 7% 30-yr Loan in First Year	Total Savings Over 25 Years
\$77	600	3.0 kW	\$26K	\$8.4K	\$16.6K	10.2%	\$17.4K	\$5	+\$3/mo	\$39K
\$180	1100	5.5 kW	\$47K	\$15K	\$30.1K	13.5%	\$41.4K	\$7	+\$47/mo	\$92K
\$268	1500	7.8 kW	\$64K	\$22K	\$41.3K	14.9%	\$62.8K	\$6	+\$90/mo	\$140K

Table 1. Example residential systems and their financial costs and benefits

The **Federal Investment Tax Credit for Residential** is 30% of net system cost, capped at \$2,000. It is a one-time credit, but may be carried forward (and possibly back) if not completely useable in the installation tax year. It only applies for systems that are installed in 2006 and 2007. As of September 2005, the IRS hasn't defined what "installed" means. It is the author's best guess that they will likely view the municipal inspection date as the "installation" date. Seek professional tax advice before making any expensive commitments.

The **Federal Investment Tax Credit for Commercial and Business** owned systems (including home businesses) will be 30% of net system cost with no cap (the current 2005 level is 10%). This applies for systems that are installed in 2006 and 2007. After 2007, if not extended, the tax credit will revert to the current 2005 level of 10%. The IRS current federal form is 3468 available at www.irs.gov/formspubs. The federal credit may be carried forward 15 or back 3 years.

Business owned systems may also be eligible for **MACRS 5-year Accelerated Depreciation** using IRS federal form 4562. Most home systems don't qualify for depreciation. See the sidebar of questions if this is proposed by a contractor (at the end of the article). Note that the depreciable basis amount is the "After Rebate" system cost minus 1/2 the 10% Federal Tax Credit amount (for a total of 95% of the "After Rebate" amount). It is unknown whether the depreciable basis amount will change with the new 30% tax credit. State depreciation is split between "Corporate" and "Non-Corporate" businesses. Non-Corporate businesses use the same MACRS 5-year accelerated depreciation. Corporate businesses use a standard 12-year depreciation schedule for their state taxes.

Currently in the California Legislature, Senate Bill 1 (SB1) is under negotiations. This bill is intended to spur up to 3000 MW of new solar in the state over the coming decade. There may be significant changes to incentive programs, electric rate schedules, and tax benefits for installing solar. The details of which will be worked out over the coming months (if the bill becomes law, it failed last year).

This information will be continuously evolving for the foreseeable future. The author maintains an updated version of this article at: www.ongrid.net/papers/PaybackOnSolarSERG.pdf or check www.norcal solar.org for the latest information.

A source for information on all state and federal incentive programs around the country is available at the DSIRE project: www.dsireusa.org.

Customers in **higher income tax brackets** see comparatively more value because residential electricity expenses are paid with after-tax dollars – they aren't tax deductible. More on this in the "proof" section of this article.

Installed system costs have generally declined 5%-7% per year due to manufacturing economies of scale, installation efficiencies, new products, and competition. However this trend has recently reversed because of growing worldwide interest in solar, a rapidly expanding market and a shortage of solar panels. Installed system costs are likely to be stable or rising for the next couple of years, then may begin to decline again.

Renewable Energy Credits (RECs, also known as Green Tags or TRCs) are a new and growing way to extract value from a solar energy system. RECs represent the bundle of legal rights to the green part of each kWh produced by a solar system. This green part can be sold for a value, which generates additional revenue for the seller. California system owners can now sell their RECs due to a recent decision is made by the Public Utilities Commission. A market is being established and the price of solar RECs is expected to be between 4¢/kWh and 20¢/kWh in contracts ranging from 1 to 20 years. See www.green-e.org for more information about TRCs/RECs and the buying or selling thereof.

One should take care to consider whether they really want to sell the RECs their system generates. By selling them, they lose the right to claim they are using any of the clean green energy generated by the system. That right would belong to the new REC owner. The system owner could claim they are a host for the generation but not a user. The distinction is important in order to prevent double counting of the RECs, which is important to maintaining their value.

HOW IS THE PAYOFF PROVEN?

Independent tests of the financial viability of solar energy include:

- Rate of Return similar to growth and high yield investments
- Payback in a reasonable time
- Total Lifecycle Payback
- Net increase in property value with respect to system cost
- Positive cash flow when financing the project with equity

RATE OF RETURN:

Annual Rate of Return on an investment is another term for interest rate, which is a way of comparing one investment to another. For example, a savings account might pay 1% interest, and the long-term stock market has paid about 11%. The author chose 10% as the test point for solar, because that is among the higher of long term average returns from common, readily accessible, higher yielding investments such as stocks and bonds.

In order to compare solar to other investments, all investments should be placed on the same side of the tax equation. Since most investments are taxable (i.e. stocks, savings interest, etc.), it is most meaningful to convert solar savings to its taxable equivalent (i.e. *PreTax* value in the equation below).

AfterTax dollars are worth more to a taxpayer than the same number of *PreTax* dollars, because *PreTax* dollars are subject to taxation. Therefore, an *AfterTax* dollar saved (with solar) is worth more than \$1 on a *PreTax* basis, by an amount proportional to the taxation rate. To find the *PreTax* value, the following equation can be used to adjust each *AfterTax* amount, where *TaxRate* is the net total effective income tax rate:

$$Pr eTax = \frac{AfterTax}{(1 - TaxRate)}$$

Once the value of the savings, maintenance costs and other amounts are properly adjusted to their pre-tax values, they can be inserted into a 25-year financial timeline (the warranted life of most solar electric/PV modules) representing the cash flows for each year to calculate the annual Rate of Return. This allows the accurate inclusion of all relevant cost and benefit components.

Investment Type	Investment Amount	Interest Earned or Electric Bill Savings	After-Tax Value the First Year	After-Tax Value the Eighth Year	Payback including inflation
Savings	\$30,000	\$300 (at 1% rate)	\$188	\$188	160 years
Stocks	\$30,000	\$3,300 (at 11% rate)	\$2,069	\$2,069	14.5 years
Solar – 5.5 kW	\$30,000	\$2,069 (1 st year)	\$2,069	\$2,815	12 years

Table 2. Payback Investment Comparisons. Note, solar savings grows due to inflation, so payback is faster.

The initial capital cost is the only amount that doesn't get adjusted. That amount is the net system up front cost (total out of pocket), and is unaffected by the taxation or lack thereof of future savings in the utility bill. Consider it the same as principal that is invested anywhere. The principal is not taxed upon its departure or return.

Tax savings and consequences, inverter replacement, maintenance, and other significant financial events can be included at their appropriate places on the timeline. Inflation and module degradation are also easily included. Then total cash flow for each year in the analysis can be summed. Using the Internal Rate of Return (IRR) tool in a spreadsheet, one can find the effective annual interest Rate of Return for the investment.

Please see Table 1 for several examples showing returns from 10% to 15%. These cases are for full service residential system installations in San Jose, California, using typical installed system costs on a simple composition shingle roof.

Assumptions for Table 1:

- Pre-Solar Bill: electric bill before solar using PG&E E1 Flat Residential Rates
- Post-Solar Bill: electric bill with solar using PG&E E7 Time-of-Use Residential Rates
- System AC Size refers to the CEC AC power rating, which includes some (but not all) loss factors. The analyses here-in include the CEC's and additional loss factors to give a conservative estimate of production (1,580 kWh/yr per kW of CEC AC rating) for use in calculating the Post-Solar Electric Bill
- Final Net Cost refers to the total net cash out of pocket including total of installed system costs, permitting, sales tax, PG&E fees, the new federal tax credit for residential. The state tax credit isn't included because it expires soon, and its net effect isn't substantially different from the new federal tax credit. A system is eligible for one or the other, but not both.
- Assumes the customer is in the 28% federal and 9.3% state tax bracket and is eligible for the Federal Tax Credit. Electric rate inflation is 5.0%. Module degradation is 0.5% per year. System maintenance cost is 0.25% of gross system cost per year, adjusted for inflation. Inverter replacement costing \$800/kW occurs in year 15

An alternative tool to evaluate/verify solar financial results is the Clean Power Estimator: www.consumerenergycenter.org/renewable/estimator

PAYBACK:

What about calculating the **payback**? Payback is a simple but crude tool for comparing investments. Solar is an inflation-protected investment but many others are not. This improves the payback for solar (electric rates double every 13 years at 5.4% historical inflation). To properly calculate the solar payback, it is necessary to add in the inflation adjusted savings of each successive year until payback has been achieved. Savings in the latter years is larger than savings in the first years, so the payback is faster than simply dividing the cost by the savings.

Payback analysis on an after-tax basis does not reflect the true value of the saved utility expense, because after-tax savings are worth more on a pre-tax basis. However, trying to do payback using the pre-tax value gives an unrealistically optimistic view of when "payback" has occurred. The examples in Table 2 show how long

paybacks on other investments really are, when taken on an after-tax basis.

There are numerous other flaws in using payback for a residential long-term investment; it does not properly include the tax savings and consequences, it does not account for maintenance or inverter replacement expenses, and it makes it difficult to compare to other investments such as stocks, savings, etc. because of inflation and other factors.

TOTAL LIFECYCLE PAYBACK:

Comparing the savings of a solar electric system over 25 years of operation to its initial cost is a better way of looking at payback, because it more fairly values the savings due to the compounding effect of electric rate inflation. Because of this effect, the savings in the later years is much greater than the savings in the first few years. Typical systems give back 2.3 to 3.5 times their initial cost. See Table 1 for several examples. One drawback to this analysis is it fails to account for the time value of money. A dollar saved in the future isn't worth as much as a dollar saved today, so that a total lifecycle payback isn't worth quite as much as it might initially appear. The better methods of comparing solar as an investment are the annual Rate of Return, Increase in Property Value, and Cash Flow.

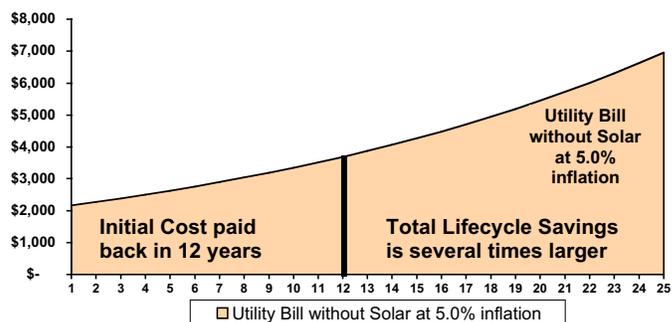


Fig. 4. Simple Payback vs. Total Lifecycle Payback. Total Lifecycle Savings is several times the initial cost represented by the savings up until year 12

INCREASE IN PROPERTY VALUE:

Solar electric systems **increase property value** by decreasing utility operating costs. According to the *Appraisal Journal* (Nevin, Rick et al, "Evidence of Rational Market Valuations for Home Energy Efficiency," Oct 1998, (available at various locations on-line, and at www.ongrid.net/AppraisalJournalPVValue10.98.pdf), a home's value is increased by \$20,000 for every \$1,000 reduction in annual operating costs from energy efficiency.

The rationale is that the money from the reduction in operating costs can be spent on a larger mortgage with no net change in monthly cost of ownership. Nevin states that historic mortgage costs have an after-tax effective interest rate of about 5%. If \$1,000 of reduced operating costs is put towards debt service at 5%, it can support an additional \$20,000 of debt. To the borrower, total monthly cost of home ownership is identical. Instead of paying the utility, the homeowner pays the bank, but their total cost doesn't change.

Please see the column labeled “Appraisal Equity Increase” in Table 1 for examples of the increase in home value. With as little as a \$65/month electric bill, a solar system can increase home value by more than its cost to install. This effectively reduces the payback period to 0 years if the owner chose or needed to sell the property immediately. It could even lead to a profit on resale in cases where the electric bill was higher than \$65/month.

There are two limits to the increase in resale value over system net installed cost. First, why should a homeowner pay in total more for a home with a solar system, when they could buy a non-solar home, and solarize it for less money? Yet this happens with other remodels. Decks, on average across the nation, return 104% of their cost upon resale. However, in certain markets like San Francisco and Boston, decks add more than 215% of their value upon resale (Alfano, Sal, “2003 Cost vs. Value Report”, Remodeling Online – www.remodeling.hw.net downloaded March 5, 2004). Other types of remodels like kitchens and bathrooms had similar results related to geography. So it makes sense that in certain geographies where the sun shines brightly and the electric rates are high, solar would return more than its installed cost, while in other states with less sun and lower rates, the return might be much lower, with a national average comparable to other types of remodel. Table 3 lists projected resale value of various solar systems, compared with nationwide averages for some other home improvements.

Home Improvement Type	Investment Amount / Net System Cost	Resale Value Increase	% Return
Solar 3.0 kW	\$16.6K	\$17.4K	105%
Solar 5.5 kW	\$30.1K	\$41.4K	138%
Solar 7.8 kW	\$41.3K	\$62.8K	152%
Deck Addition	\$6.3K	\$6.7K	104%
Bathroom Remodel	\$10.1K	\$9.1K	89%
Window Replacement	\$9.6K	\$8.2K	85%
Kitchen Remodel	\$44K	\$33K	75%

Table 3. Resale value comparisons of various home improvements

The increase in property value to date is currently theoretical. A very high fraction of the grid-tied solar electric systems in California were installed since the start of the state’s Power Crises and the Deregulation fiasco just four years ago. Most of these homes have not been sold, so there are no broad studies of comparable resale values available.

However, some evidence is beginning to emerge that there are significant jumps in resale value being realized by some solar home sellers. The author is aware of 4 anecdotal cases, in which the sellers believe they got all of their cost as a premium, and have or plan to install a PV system on their new home.

The NREL (National Renewable Energy Laboratory) study Comparative Analysis of Homebuyer Response to New Zero Energy Homes, (www.nrel.gov/docs/fy04osti/35912.pdf), August 2004, by Farhar showed that 15 Shea Zero Energy Homes with 2.4 kW PV systems in San Diego increased in value faster than 12 comparable conventional homes in a nearby community. On average, the Shea homes increased in value \$40,000 more than the conventional homes, at a higher rate of appreciation, and with a shorter length of ownership. This boost in resale value even outstrips the estimates shown in Table 1 and Table 3. It is likely that many factors were involved, and this sample size is not statistically significant. However, it is at least, not negative evidence.

It is also interesting to note that **PV systems will appreciate over time**, rather than depreciate as they age. The appreciation comes from the increasing annual savings the system will yield as electric rates and bill savings rise. All the calculations in this article assume electric rate inflation will be 5%. If so, the PV system will save 5% more value each successive year, and thus gain from the 20:1

multiplier effect. The resale value will then increase 5% per year compounded.

This cannot continue forever, as the increase in resale value runs into the second limit, which relates to the remaining life left in the system. For these analyses, the system is assumed to be worthless at the end of 25 years. This is probably very conservative, since the panels are warranted to be working at 80% of their new value. So if the system is worthless at the end of 25 years, the only value the system has as it nears that time, are the remaining savings it can generate before the end of the 25th year. Fig. 5 shows both the increasing value due to increasing annual savings and the remaining value limitation that takes over at approximately year 11. If the system does have additional resale value, so much the better.

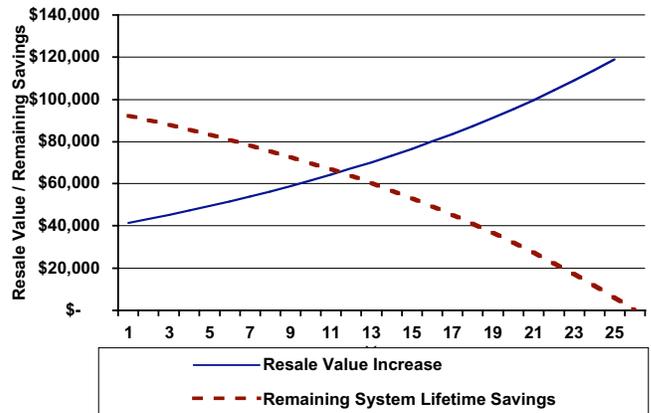


Fig 5. Resale value increases over time because savings get larger each year. Total remaining lifetime savings in the system declines annually, putting a limit on the increase in resale value after year 11

Still, the skeptical homebuyer might question the above assertions in light of the lack of hard evidence. Perhaps the best evidence to present would be a stack of old bills showing usage and cost before solar, and a stack of new bills showing a substantial savings. The question might be posed, “What are a continuous, if not growing, stream of these savings worth to the prospective buyer?” That sort of evidence can’t easily be ignored.

Of course, other factors will weigh heavily in the value. How attractive is the home? A tidy, attractive installation should add all of the value shown above, but like a spa, some prospective buyers may not care or value it, while others may love it.

As an additional benefit, solar systems installed between January 1, 1999 and January 1, 2006, are exempt from triggering Property Tax reassessments (California Taxation Code, section 73).

CASH FLOW: FINANCING vs. BUYING ON CREDIT:

Two ways to look at using loans to finance a solar project include:

- Making the purchase more affordable to a larger audience
- Making a smart investment using borrowed money, the repayment of which (principal and interest) are less than the savings on the electric bill due to the investment

Buying on credit eliminates the large capital outlay for a solar system, making the purchase achievable to more consumers. The key determinant is how large a monthly payment the bank will approve for the borrower. This use of credit can expand the solar market, but isn’t useful as a financial test to demonstrate the economic viability.

Financing the cost of a solar project as an investment through borrowing yields savings on the electric bill. However borrowing has a cost. If the cost of borrowing is lower than the savings, then the project is **Cash Positive**. This result depends on the interest rate

and payment terms for the loan, the tax bracket of the borrower if the loan is deductible, and inflation increasing the savings over time.

Home Equity loans are excellent sources of funds because interest rates on real estate secured loans are relatively low, payment terms can be long, and the interest is generally deductible. The net cost of these loans is often less than the savings on the electric bill. This effectively reduces the cost of ownership to less than \$0 per month. It actually pays the owner, creating a positive cash flow from day one. With a fixed interest rate loan, as electric rates rise, the equation gets more cash positive over time, even when the interest deduction decreases. Fig. 6 shows the net monthly expense of a 5.5 kW system (loan + new utility bill) is less than the original pre-solar utility bill each year for 20 years, until the loan is paid off. Then the savings get really big!

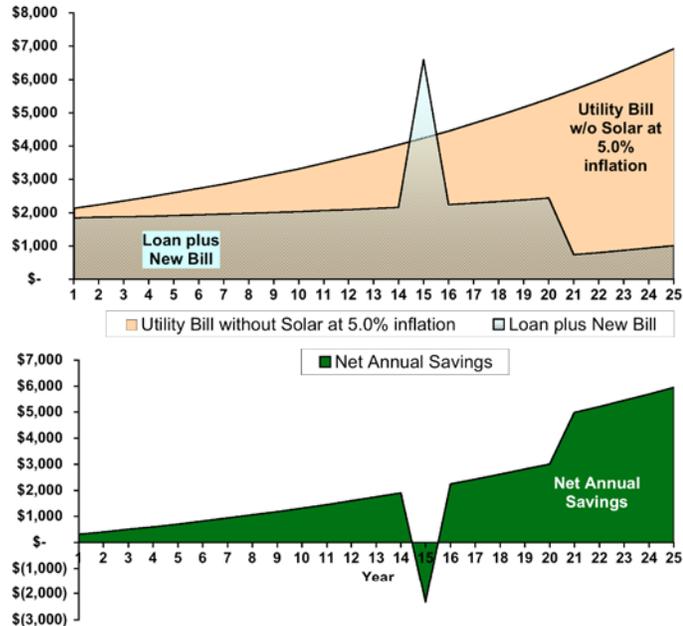


Fig. 6. Effect of 5.5 kW solar system financed over 20 years at 7% on a \$180/mo electric bill.

Refer to Table 1 for several examples showing the initial monthly cash flow assuming 100% financing of a solar system's Final Net Cost using a 7% 30-year loan. The monthly cash flow becomes more positive each year due to the 5% inflation in electricity prices. This inflation increases the savings due to the solar system. The large spike at year 15 is the replacement cost of the inverter. It causes a one time negative cash flow for that year. However, when the total savings are accumulated as in Fig. 7, the dip is negligible compared to the savings to date, and especially to the savings yet to come.

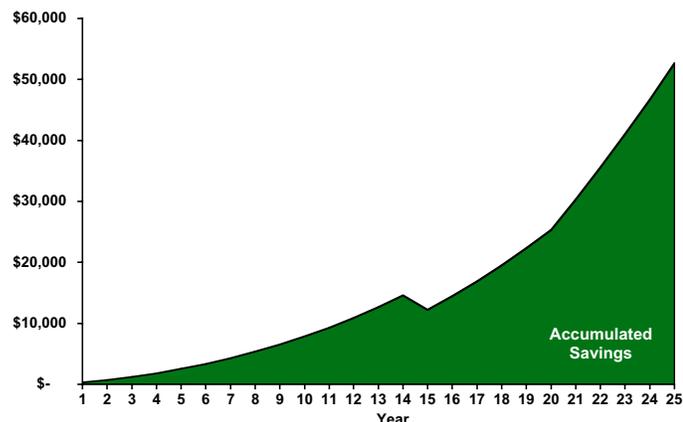


Fig. 7. Accumulated savings of 5.5 kW solar system financed over 20 years at 7% on a \$180/mo electric bill.

Shining Sunlight on Solar Financial Analysis

In the recent past there have been some "optimistic" claims and presentations regarding the financial payback of solar systems. Here are some questions that will help provide a more conservative perspective, clarify where the legitimate tax breaks are, and avoid the liabilities.

1. Is the CEC rebate calculated accurately, based on CEC rating of the equipment?
2. Is the 7.5% state tax credit being applied to the net (after-rebate) installed cost of the system (not the gross, pre-rebate cost)? Systems must be operating by the end of 2005.
3. Is it clear that the net value of the state tax credit will be marginally lower because lower state taxes will generally mean a lower federal tax deduction, and thus a higher federal tax?
4. Are business tax advantages (MACRS accelerated depreciation) being improperly used in a non-business setting?
5. Is the customer being pushed to create a home office to capture the business tax advantages? Strict rules must be met for this benefit, and it attracts audits.
6. Is the proportion of business tax advantages proportional to the square footage of business use in the home? In most homes this is usually 10-25%. Is the loss in business tax deduction due to reduced electrical expense included?
7. Is the 20/20 program benefit being claimed? This was the Governor's conservation program which existed in 2001 & 2002 only, and specifically excluded solar systems.
8. Are annual maintenance costs and inverter replacement costs included?
9. Is the time-value-of-money included (the depreciation is spread over 6 to 12 years, the electricity benefit is over 20-30 years) in the payback and annual Rate of Return (ROR) calculation? Return on Investment calculations can hide the time value of money, and give optimistic results.
10. Does the annual ROR seem reasonable? Normal ranges are 5-20% pre-tax for residential, and 4-15% after-tax for businesses.

As always, have a financial professional review any claims and calculations presented. Protect your exposure. Ask the hard questions. It's your money!

CONCLUSION:

It is important to compare the solar investment to other investments on an even basis. Rigorous treatment and critical analyses from several angles including annual Rate of Return, Cash Flow, and Resale Value need to be considered to do a fair assessment.

Solar will make economic sense for many, but only a hard look at the numbers will tell. The reader is encouraged to check it out. Run the numbers, get evaluations and proposals from solar providers, and take them to a CPA to check them out. The sidebar gives additional thoughts to make sure the presentations stand up to the light of day!

©Copyright 2005, Andy Black. All rights reserved. This information will be continuously evolving for the foreseeable future. The author maintains an updated version of this article at: www.ongrid.net/papers/PaybackOnSolarSERG.pdf. For analysis tools, papers, and more info on payback, see www.ongrid.net.

Andy Black is a Solar Financial Consultant and owner of OnGrid Solar Energy Systems, specializing in the financial aspects of solar electric systems. He is the Treasurer and a board member of the NorCal Solar Association, and is a board member of the American Solar Energy Society. He can be contacted at (408) 428-0808 or andy@ongrid.net for questions about the payback on solar.