

FINANCIAL EVALUATIONS OF RETROFIT SOLAR ELECTRIC HOMES

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Solar Power 2004

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Attractive Economics

- CA PV systems can be financially attractive to customers who use more than \$85/mo in electricity, defined as:
 - Annual Rate of Return greater than 10%
 - Increase in property value greater than system net cost
 - Positive cash flow using equity financing compared to utility bill savings

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Why is this Needed?

If we're going to put solar on every roof, it needs to make \$ense.



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Factors That Make Solar Viable

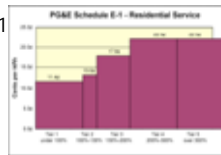
- Net Metering on an Annual Basis & Time of Use Billing
- California's Tiered Rate System with High Electric Rates & High Inflation
- Incentives: State Solar Rebate Program & 7.5% State Tax Credit for Solar

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Tiered Rate System

- Severely penalizes larger residential users for their excesses
- As their usage increases, the rate for incremental usage increases
- The highest rates top out at \$.21
- Solar systems offset the most expensive usage first



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Residential "E7" Time Of Use

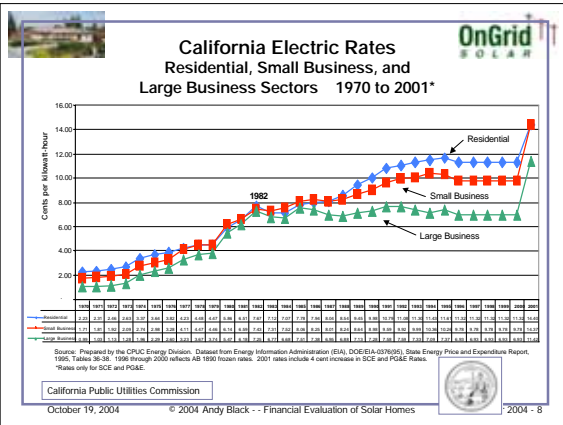
- Peak rates are Summer Afternoons ...

Residential "E7" Time-of-Use 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

... the best time to sell

Available only in some areas (e.g., PG&E, usually not municipal utilities)

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Solar's Viability

- Tests for financial viability:
 - Internal rate of return analysis
 - Cash flow when financing
 - Increase in appraisal valuation

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Rate of Return Analysis

- Determines an interest rate yield on the solar investment that can be compared with other investments.
- For customers with electric bills over \$85 per month, residential solar projects in California often have Pre-Tax Internal Rates of Return in the 10% to 15% range
 - Compare to long-term stock market
 - 10.5% over the last 80 years

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Set Up & Inclusions

- 25-year timeline
 - Cash flows for each year
- Include cost and benefit components
 - Electric bill savings
 - Tax savings and consequences
 - Inverter replacement
 - Cleaning & maintenance

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Adjustments


- Add inflation factor to the electricity savings & maintenance
- Include module degradation
- Convert the entire analysis to the appropriate pre-tax values.
 - Meaningful and comparable to taxable alternatives

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Analysis

- Sum cash flow for each year
- Apply "Internal Rate or Return" analysis to the string of annual cash flows
- Effective interest rate
- See ASES paper for spreadsheet example


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Rate of Return Examples

Pre-Solar Bill	kWh per Month	System Size CEC AC	Final Net Cost	Pre-Tax Annual Return
\$85	650	3.0kW	\$18K	10.8%
\$170	1100	5.2kW	\$31K	13.4%
\$250	1500	7.3kW	\$40K	15.5%


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Cash Flow

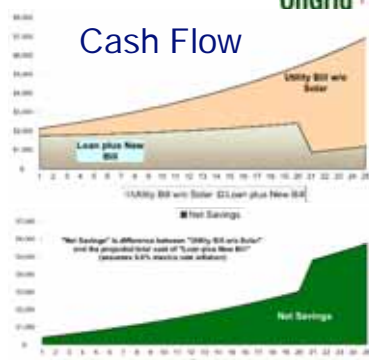
- ★ Compares the savings on the utility bill with the cost of financing the system.
- ★ At today's rates (<6.5%) and including rebate benefits, cash flow is positive immediately.
 - Cost of borrowing is less than savings on electric bill.
 - Stabilizes long term utility costs.

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Cash Flow

- ★ 20 year loan
- ★ Cash positive in Year 0
- ★ Savings Increase over time
- ★ Future costs stabilized




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Solar Mortgage

- ★ Like buying a house vs. renting
 - House costs more up front
 - Pays off over time
- ★ Solar costs less up front
 - Pays off immediately & over time
- ★ Protects against inflation
 - Savings grow over time


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Home Equity Financing

- ★ Often the most cost effective
 - Lowest rates
 - Deductibility of interest
- ★ Minimizes large capital outlay
- ★ Makes ownership more achievable to some consumers



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Cash Flow Examples

Pre-Solar Bill	kWh per Month	System Size CEC AC	Final Net Cost	Net Monthly Cash Flow
\$85	650	3.0kW	\$18K	+\$7/mo
\$170	1100	5.2kW	\$31K	+\$42/mo
\$250	1500	7.3kW	\$40K	+\$86/mo

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Increase in Appraisal Valuation

- * Solar electric systems add value to homes by:
 - o Reducing or eliminating electric energy operating costs
 - o Hedging against inflation
 - o Providing an attractive financial vehicle for investment as a home improvement
- * If true, reduces risk of ownership or investment



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Reduced Risk of Ownership

- * Safer investment
- * Opens the market to more risk-averse customers
- * Risk vs. Reward ratio
 - o Lower returns acceptable if lower risk - broader market



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Some Risks of a Solar System

- * System Performance
- * Depreciation of the asset
- * Liquidity
 - o Ability to sell the asset for its cost



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Reduced Cost Increases Value

- * \$1000/year savings in CA residence.
- * Nevin in the *Appraisal Journal* states: 'The increase in appraisal value for a home is about twenty (20) times the annual reduction in operating costs due to energy efficiency measures.'
- * Electric bill savings: \$1,000 per year -
- Increased appraisal value: \$20,000.



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The Rational

- * The \$1,000 not spent on electricity, is available to be spent on an equity loan payment...
... at no net change in the cost of living.


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20:1 Ratio

- * Based on 5% after tax cost of money
- * Typical long term mortgage average rates (8.3% before tax)


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Ratio Varies

- * Depends on mortgage loan rates
- * Has varied from 10:1 to over 25:1
- * Rates are low now (6%), so ratio is 28:1
- * Unfair to assume high ratio in future when home will be sold
- * Use 20:1 to be conservative

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Examples in California PG&E Territory

Pre-Solar Bill	kWh per Month	System Size CEC AC	Final Net Cost	Appraisal Equity Increase @ 20:1
\$85	650	3.0kW	\$18K	\$18K
\$170	1100	5.2kW	\$31K	\$39K
\$250	1500	7.3kW	\$40K	\$57K

- * Note: Penalty surcharges increase as the electrical usage increases.
- * Larger systems pay relatively higher electric rates and see larger savings.
- * Variables: \$3.00/W Rebate, 7.5% State Tax Credit, 31% Federal Tax Bracket
- * Net cost includes \$600 Permit Fee & \$277 Time-of-Use meter fee
- * Simple full service roof installation. Utility Territory PG&E XB.

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Other Home Improvements

Remodeling Online capital recovery rates

Improvement Type	Net Cost	Equity Increase	% Return
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%

Source: www.remodeling.hw.net, 2003 Cost vs. Value Report


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Comparison to Solar

Pre-Solar Bill	System Size	Net Cost	Equity Increase	% Return
\$85	3.0kW	\$18K	\$18K	100%
\$170	5.2kW	\$31K	\$39K	126%
\$250	7.3kW	\$40K	\$57K	142%
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%

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Limits to Appreciation?

- * Would a homebuyer pay more for a used solar system on an existing home?...

42% more than it's cost?



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Buyers Do Pay More

- * 4% more for homes with decks
 - o Nationwide average
- * Some areas are much higher:
 - o In Boston, San Francisco and St. Louis, buyers paid 215% of cost of a deck.
- * Similar phenomenon for other types of improvements in some cities, despite the national average being less than 100%.



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Price Support

- * Even if a future buyer won't pay more than contemporary costs for a new system, The 20:1 ratio product shows there should be price support for paying at least 100% of what a new one costs.
- * Some assurance of getting money out of the system if need to sell.
- * In the mean time, enjoy the savings.



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Few Examples in the Marketplace

- * Few comparables & documented cases
 - o Need a study and more evidence
- * 12,000 grid tied solar homes in California
 - o 95% installed in last three years
- * Normal occupancy is 7 years
 - o Most have not been offered for sale
 - o Most solar homeowners seem to be planning on staying longer than average



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Reasons For Confidence


- * Market support:
 - o 15,000+ homeowner purchases in three years.
 - * Higher likelihood they'll want solar on their new homes when they move.
 - * 4 cases known
- * Likely that many others are interested
 - o Especially if the perceived risk is reduced

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Counter Examples and Caution

- * Homebuyer opinions about aesthetics.
 - o Some like it, some won't
- * If the home looks weird it can hurt value.
- * Resale value can be lowered when the energy-conserving home looks noticeably different from other homes





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Wrap-up & Recommendations

- * A survey is needed of actual retail sales of solar homes.
- * Evaluate the change in resale value when both buyer and seller are informed of the ways of valuing a solar system on a home.



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Bring It To Your State

- * Most important factors to improve solar financial viability in other areas are:
 - o Time-of-Use Net Metering
 - o Established tiered electric rates penalizing high users
 - o A declining feed in tariff or other small and declining subsidies

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Conclusion

- * Demonstrable increased home value with PV
- * Reduced risk
- * Provides an attractive vehicle for financial investment.

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Variables & Assumptions

- 31% Federal Tax Bracket and 9.3% state tax bracket.
- Each system is facing south at an 25° pitch, with a simple roof installation by a full service provider with no complications near San Jose, CA.
- System AC Size refers to the California Energy Commission rating of the AC power production capability of the system. It includes some loss factors, but not others. Those other loss factors have been included elsewhere to adjust the estimated system productivity to the conservative side of realistic for the region. Assumes no shading losses.
- Final Net Cost refers to the total net cash out of pocket including total of installed system costs, \$600 Permit Fee, \$277 Time-of-Use meter fee, 7.5% State Tax Credit savings, and federal costs on the state tax credit. No rebate.
- Billing starting on PG&E E-1 flat rate residential tariff and switching to PG&E E-7 Time-of-Use Net Metering.
- 30-year fixed home equity loan equal to the final net cost with deductible 7% interest.
- Electric rate inflation is 5.4%. 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 \$2,700 occurs in year 20.

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