

PAYBACK ON SOLAR ELECTRICITY

Andy Black



Los Altos Library

January 28, 2006



Introductions & Thanks

- * Los Altos Library
- * Kurt Newick, Horizon Energy Systems

- * You for coming!

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About OnGrid Solar

- * 10 Years involved with Solar
- * 4.5 Years as salesman
- * Now a Solar Broker & Consultant
 - o Help customer find best solution & offer
- * Also offering Solar Financial Analysis software - check website

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Learn More

- * Upcoming classes & events at:
www.ongrid.net/classes.html
- * Or visit www.ongrid.net/papers for more information, articles & other presentations
- * Software at www.ongrid.net/payback

- * Solar Today & ASES - discount offer

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Financial Payback

- * Payback on solar isn't the most important thing...
- * ... it's the only thing the vast majority of potential solar homeowners care about

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Right or Wrong


- * 95% see energy as a commodity
- * Few will pay more
- * Must meet them on their terms:

FINANCIAL!

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Attractive Economics

- * CA PV systems can be financially attractive to customers who use more than \$75/mo in electricity, defined as:
 - * Annual Rate of Return greater than 9%
 - * 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 & \$2,000 Federal Tax Credit for Solar

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Net metering

- * Net metering
 - o Exchange of Energy at full value
 - * Both ways
 - * 100% efficient battery
 - o Annual Cycle

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Net Metering


Sell Power to the Utility by Day



Buy Power at Night and Winter




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Time of Use Billing

- * Time Of Use metering
 - o Energy Charge based on time of day
 - * 29.4¢ in summer afternoons (peak)
 - * 11.5¢ in winter afternoons
 - * 9¢ (off-peak)
 - * Plus usage surcharges

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Residential "E7" Time Of Use


- Peak rates are Summer Afternoons ...

	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, but usually not municipal utilities)


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Time of Use with Annual Net Metering

- Net Metering on an annual basis Combined with
- Time Of Use metering


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Value of Time Of Use Net Metering

- Sales during peak = 29.4¢
- Purchases off-peak = 9¢
- Ratio is about 3 to 1 in customer favor
- Can reduce system size up to 40%:
 - Reduction depends on % on-peak usage
 - Shading and orientation


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Time of day shading analysis




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Factors That Make Solar Viable

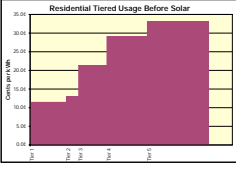
- Net Metering on an Annual Basis & Time of Use Billing
- California's Tiered Rate System with High Electric Rates & High Inflation
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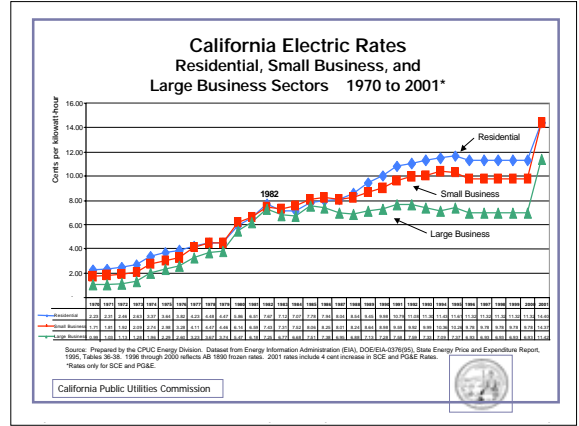
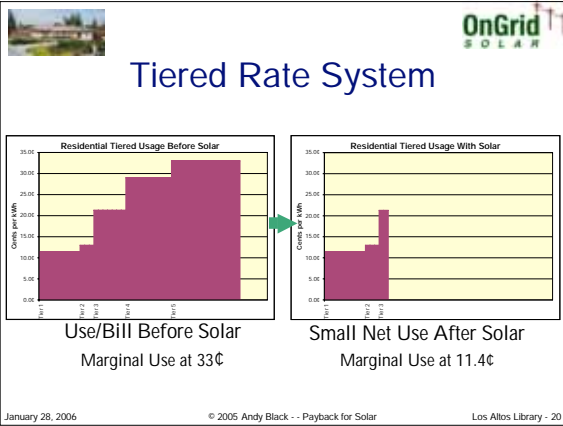


Tiered Rate System

- Severely penalizes larger residential users for their excesses
- As their usage increases, the rate for incremental usage increases
- The highest rates top out at 33¢
- Solar systems offset the most expensive usage first



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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 & \$2,000 Federal Tax Credit for Solar
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- ## Current Incentives
- * \$2.80/Watt rebate
 - o (\$2.60 after July 1)
 - * 30% Federal tax credit up to \$2,000
 - o Installed in 2006 & 2007
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- ## The Ideal Situation
- * Residence electric bill > \$75/month
 - * No Shade
 - * Facing Southwest, South
 - o Second best is West or Southeast
 - * 5:12 roof pitch
 - * PG&E Territory
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- ## Test the Viability of Solar
- * Total Lifecycle Payback
 - * Rate of Return analysis
 - * Cash Flow when financing
 - * Increase in Appraisal Valuation
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Total Lifecycle Payback


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Total Lifecycle Payback

- * Total amount saved over 25 year life of system compared to system net cost
- * Assuming electric inflation in savings
- * A better measure than simple payback


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Total Lifecycle Payback

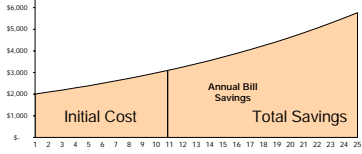
- * Usually shows savings of 2x to 3x times initial cost
- * Shows the future savings better than Simple Payback - a more fair test
- * Drawback: Doesn't reflect the time value of money: Today's \$ are worth more than future \$

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Total Lifecycle Payback

- * Total Savings (whole area) is much larger than Initial Cost




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Total Lifecycle Payback Residential Examples

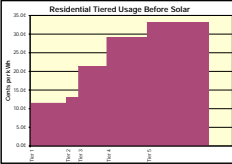
Pre-Solar Bill	kWh per Month Usage	System AC Size	Final Net Cost w/ Tax Benefits & Rebate	Cumulative Savings over first 25 years (including inflation)	Lifecycle Payback Ratio
\$80	600	2.5 kW	\$16.2K	\$33K	204%
\$192	1030	5.0 kW	\$32.3K	\$91K	282%
\$326	1450	7.5 kW	\$47.2K	\$158K	335%

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Residential Lifecycle Payback

- * Residential Lifecycle Payback gets better with higher usage: - High Tiers
- * As usage increases, the rate for incremental usage increases
- * The highest rates top out at 33¢
- * Solar systems offset the most expensive usage first




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Rate of Return Analysis


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Rate of Return Analysis

- ★ Means: Compare the interest rate yield on the solar investment with other investments.
- ★ Ideal residential customers can see pre-tax IRR (Internal Rate of Return) of 10% to 16%
 - Comparable to long-term stock market (~10.5% over the last 80 years)
 - Many Californians have ideal situation
- ★ Must adjust for "pre-tax" conditions


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Residential Pre-Tax

- ★ Most investments are taxable
 - Stocks, Bonds, Savings interest, etc.
 - (the 10.5% yield is pre-tax)
- ★ Convert solar analysis to pre-tax value so all investments are on even playing field and are comparable
- ★ Must convert to the appropriate pre-tax values for savings, tax benefits, etc.


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Residential Pre-Tax Conversion

- ★ Convert all costs & benefits to pretax value as appropriate
 - Initial capital cost is not increased
 - This is the "principal"
- ★ All other values get inflated by tax bracket [divided by (1-tax rate)]


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Other Residential Adjustments

- ★ Federal taxes increase because of State Tax Credit
 - If federal taxes are itemized, customer deducts state taxes
 - State Tax Credit reduces this deduction, increasing fed taxes
 - Equivalent to federally taxing credit

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Careful Set Up

- ★ Include all factors affecting the results
- ★ Look over long term - 25 years
- ★ Include cost and benefit components
 - Bill Savings, Inflation, & Tax Benefits
 - Maintenance & Inverter replacement
- ★ Include all real factors that affect system performance

See Andy or ASES paper for details


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Residential Variables & Assumptions

- 28% federal tax bracket and 9.3% state tax bracket
- Facing south, 22° pitch, simple comp roof, full service provider, no complications near San Jose, CA
- Slightly conservative real system performance (approx 1,585 AC kWh per CEC AC kW), no shading
- Final Net Cost is total installed system costs-Rebate+\$500 Permit+\$277 TOU meter fee. System maintenance cost is 0.25% of gross system cost per year, adjusted for inflation
- Billing starting on PG&E E1-XB, switching to PG&E E7-XB TOU Net Metering
- 5.0% electric inflation. Module degradation 0.5% per year
- Inverter replacement costing \$700/kW each occurs in year 15


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Ideal Rates of Return Residential Examples

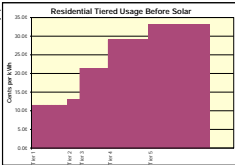
Pre-Solar Bill	kWh per Month Usage	System AC Size	System Gross Cost	Final Net Cost w/ Tax Benefits & Rebate	Pre-Tax Annual Return
\$80	600	2.5 kW	\$24.4K	\$16.2K	10.7%
\$192	1030	5.0 kW	\$47.5K	\$32.3K	14.0%
\$326	1450	7.5 kW	\$69.4K	\$47.2K	16.2%

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Residential Annual Rate of Return

- Residential Annual Compound Rate of Return gets better with higher usage: - High Tiers
- As usage increases, the rate for incremental usage increases
- The highest rates top out at 33%
- Solar systems offset the most expensive usage first




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Cash Flow


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Cash Flow

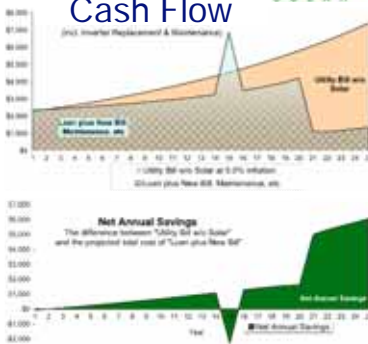
- Compares the savings on the utility bill with the cost of financing the system.
- At today's rates (<7.25%) and including rebate benefits, cash flow is positive immediately.
 - Cost of borrowing is less than savings on electric bill.
 - Stabilizes long term utility costs.

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Residential Cash Flow

- 5kW residential system offsetting a \$190/month bill
- 7.25% 20 year loan
- Many Systems are cash positive from Year 0
- Spike is Inverter Replacement Cost




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Solar Mortgage

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


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Home Equity Financing

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


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Cash Flow Residential Examples

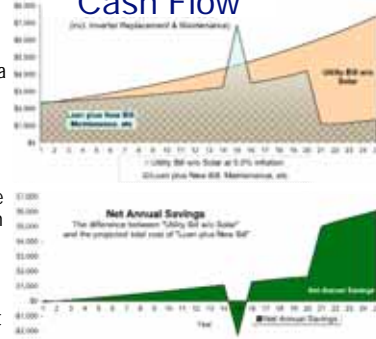
Pre-Solar Bill	kWh per Month Usage	System AC Size	System Gross Cost	Amount Financed	Net Cash Flow Compared to 7.25% 30-yr Loan
\$80	600	2.5 kW	\$24.4K	\$16.2K	\$-8/mo
\$192	1030	5.0 kW	\$47.5K	\$32.3K	\$30/mo
\$326	1450	7.5 kW	\$69.4K	\$47.2K	\$91/mo

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Residential Cash Flow

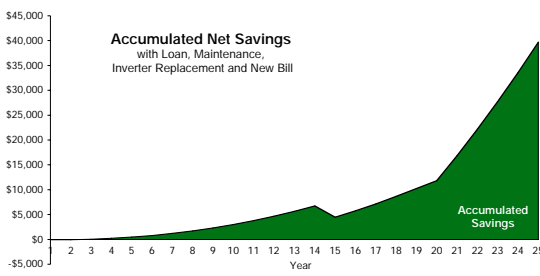
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- * 7.25% 20 year loan
- * Many Systems are cash positive from Year 0
- * Spike is Inverter Replacement Cost




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Cumulative Cash Flow




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Increase in Appraisal Valuation


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Increase in Appraisal Valuation

- * Solar electric systems add value to homes by:
 - o Hedging against inflation
 - o Reducing or eliminating electric energy operating costs


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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 (7%), so ratio is 23:1
- * Unfair to assume high ratio in future when home will be sold
- * Use 20:1 to be conservative

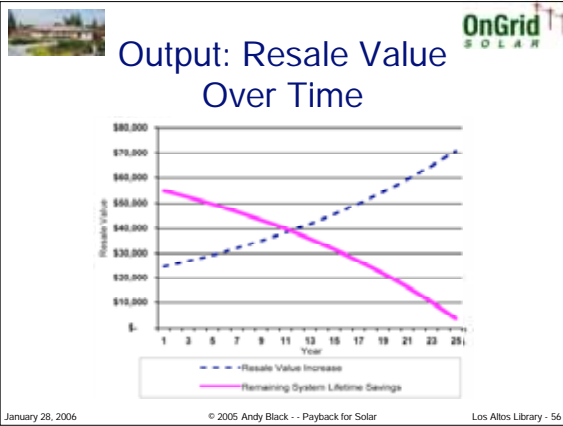
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Equity Increase Residential Examples

Pre-Solar Bill	kWh per Month Usage	System AC Size	Annual Savings	Final Net Cost w/ Tax Benefits & Rebate	Appraisal Equity Increase
\$80	600	2.5 kW	\$785	\$16.2K	\$15.7K
\$192	1030	5.0 kW	\$2,129	\$32.3K	\$42.6K
\$326	1450	7.5 kW	\$3,674	\$47.2K	\$73.5K

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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
\$80	2.5 kW	\$16.2K	\$15.7K	97%
\$192	5.0 kW	\$32.3K	\$42.6K	132%
\$326	7.5 kW	\$47.2K	\$73.5K	156%
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?...
56% more than it's cost?


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- ### Buyers Do Pay More
- 4% more for homes with decks
 - Nationwide average
 - Some areas are much higher:
 - 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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Comparison to Solar

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Window Replacement		\$9.6K	\$8.2K	85%
Kitchen Remodel		\$44K	\$33K	75%

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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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Just a Few Examples in the Marketplace

- ★ Most systems are new (< 4 years old)
- ★ A few comparables & documented cases
 - Need comprehensive a study and more evidence
 - Shea Homes small study
 - Anecdotes for 4 customers
- ★ Strong market support:
 - 14,000+ system purchases in four years
- ★ Governorator is strongly behind solar
 - SB 1 - Million Solar Roofs legislation

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Biases

- ★ It has to look good too




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Counter Examples and Caution

- ★ Homebuyer opinions about aesthetics.
 - 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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Conclusion

- ★ On Grid Solar Electric Systems can:
 - ★ Demonstrably increases home value
 - ★ Reduces risk of future electric costs
 - ★ Provides an attractive vehicle for financial investment.
- ★ Oh, it's kinda nice environmentally & socially too...

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