



CEC/CPUC Affordable Housing Solar Initiative
June 13, 2006

The Energy Efficiency Threshold For Solar Cost Effectiveness

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HESCHONG MAHONE GROUP, Inc.



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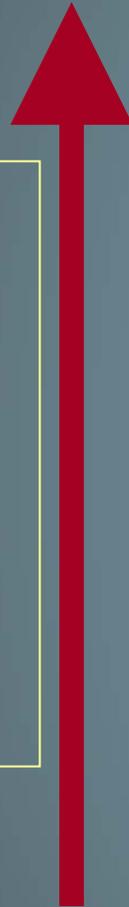
“Inability to pay utilities is second only to inability to pay rent as a reason for homelessness.”

Karen Brown, Ex Dir, Colorado Energy Assistance Foundation.
James Benfield, Ex Dir, Campaign for Home Energy Assistance.
(as quoted on HUD's web site)



Affordability Facts

The *average* middle-income household spends about 5% of its monthly income on utilities...



In the worst months of 2001, many low-income households spent up to 70% on utilities.

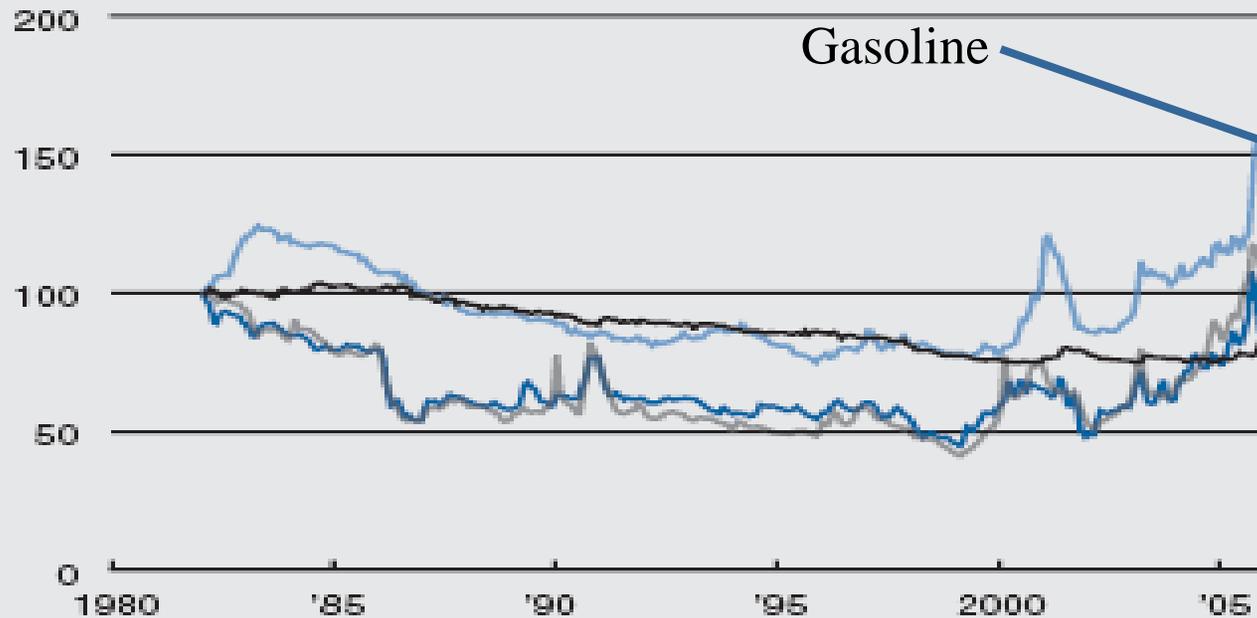
Retired elderly on SSI spend over 25% on utilities.

Affordable-qualified tenant spends about 20% on utilities.



1. Real monthly energy price indexes in the U.S., 1982–2005

energy price indexes (1982 = 100)



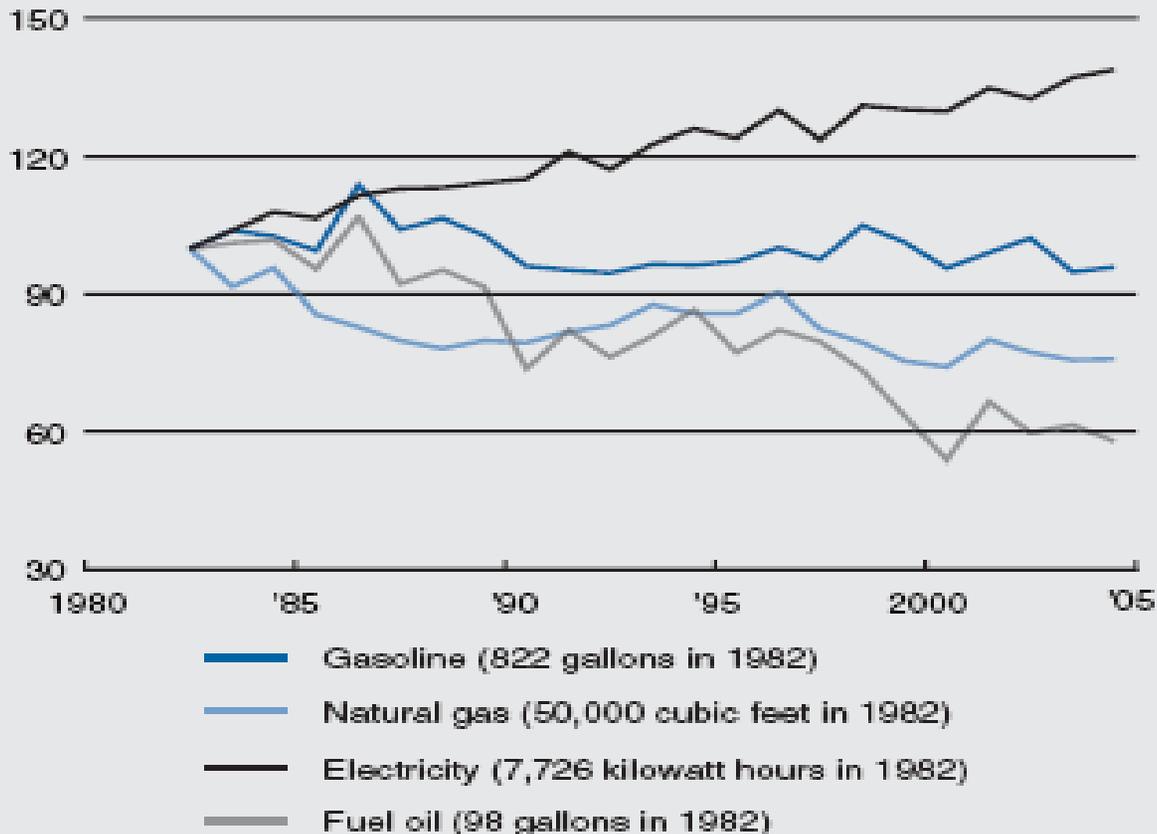
- Gasoline (\$2.19/gallon in Dec. 2005)
- Natural gas (\$15.84/1,000 cubic feet in Dec. 2005)
- Electricity (10.04 cents/kilowatt hour in Dec. 2005)
- Fuel oil (\$2.41/gallon in Dec. 2005)

Sources: Authors' calculations based on data from the U.S. Bureau of Labor Statistics and U.S. Department of Energy, Energy Information Administration.



2. Annual household energy consumption indexes, 1982–2004

energy consumption indexes (1982 = 100)

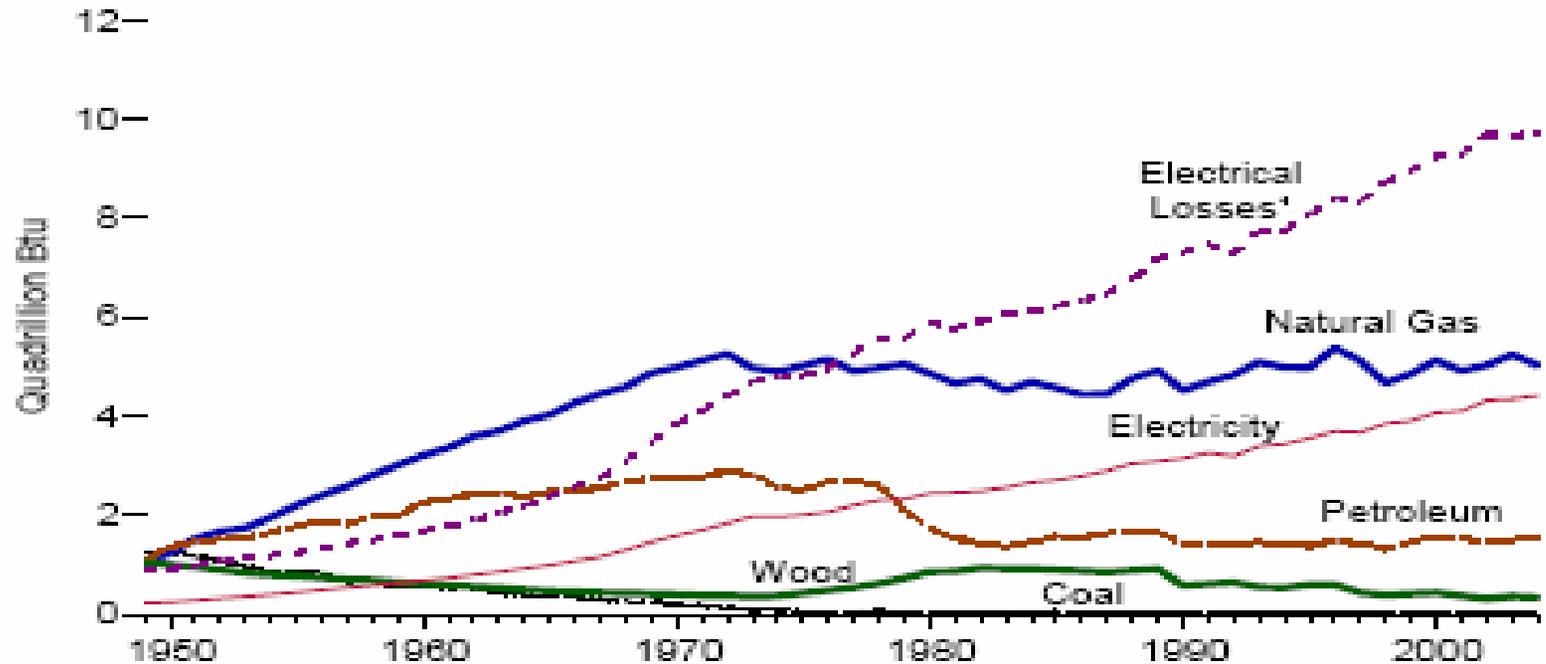


Sources: Authors' calculations based on data from the U.S. Bureau of Labor Statistics; U.S. Department of Energy, Energy Information Administration; and the Consumer Expenditure Survey, 1982–2004.



Energy Used by Type (1949-2004)

Residential, By Major Sector





Energy Costs By Household

Total Expenditures per Household, Fuels Used		Annual Energy Dollars Per Household				
		Total All Households	2001 Household Incomes			
			<\$10k	\$10k- \$29.9k	\$30k- \$49.9k	\$50k+
Electricity	938	628	772	922	1,172	
Natural Gas	702	555	634	677	805	
Fuel Oil	737	578	648	693	857	
Kerosene	178	235	232	154	115	
LPG	605	422	601	608	662	
Total	1,493	1,039	1,260	1,456	1,836	
Median Percent		15%	6%	4%	3%	



Energy Costs By Household

Categories of End Uses	Annual Energy Expenditures by Household Income				
	Total All Households	2001 Household Incomes			
		< \$10K	\$10k - \$29.9	\$30k - \$49.9	\$50k +
Space Heating	\$480	\$380	\$441	\$474	\$543
Air Conditioning	\$197	\$129	\$148	\$182	\$257
Water Heating	\$203	\$149	\$177	\$204	\$237
Refrigerators	\$135	\$112	\$123	\$129	\$155
Other Appliances & Lighting	\$535	\$328	\$420	\$518	\$699
Total Cost	\$1,550	\$1,098	\$1,309	\$1,507	\$1,891
Total Electrical Cost	\$867	\$569	\$691	\$829	\$1,111
Avg. Percent of Income Spent on Electricity		8.1%	3.1%	1.7%	1.6%





Energy Costs Rising

Energy costs for residential customers in California are up 22.4% since 1999

Natural gas prices were expected to rise further this winter, but leveled off at a rate **only** 2 or 3 times higher than historical averages.

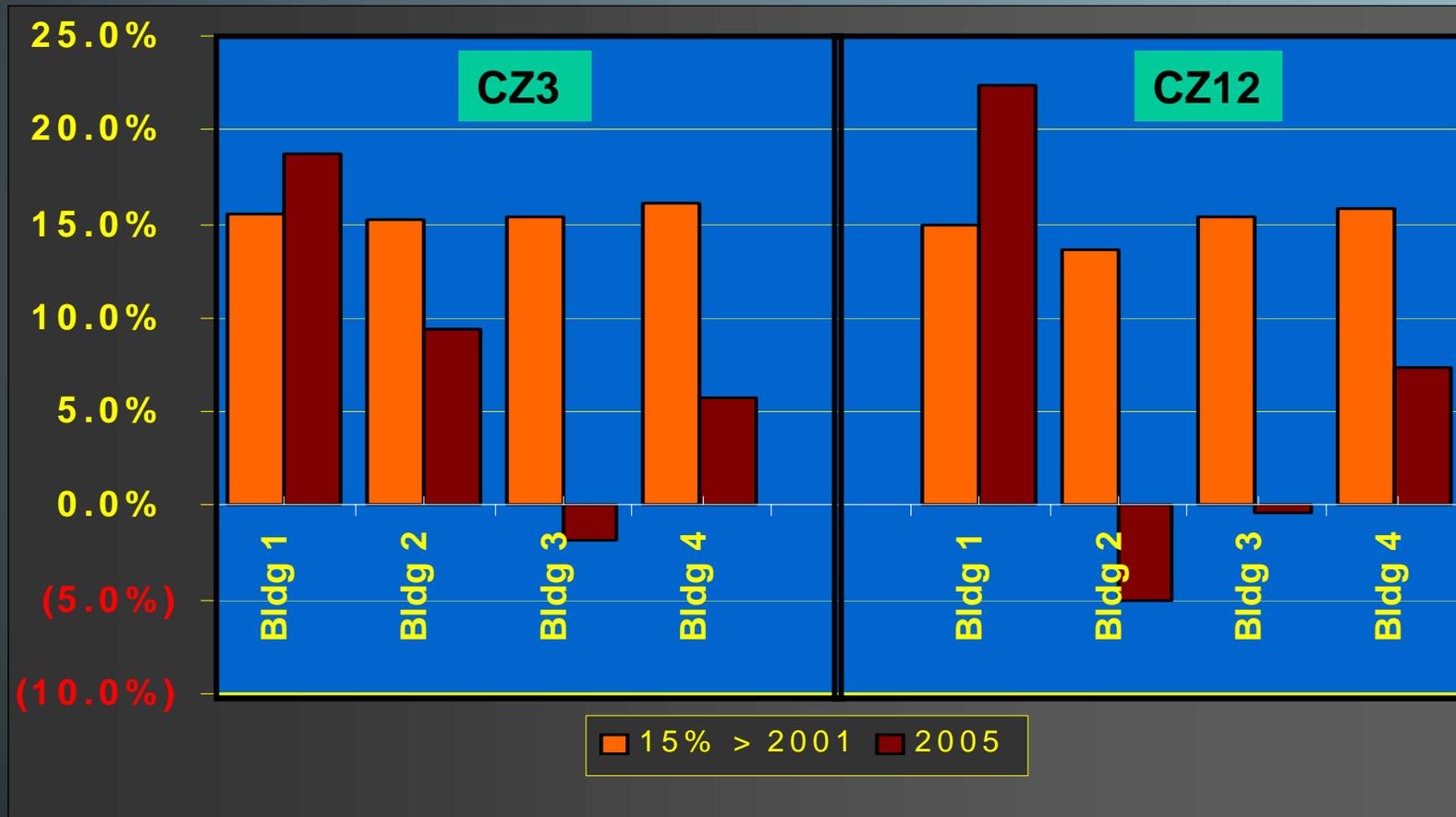


Examples

- Note the following examples represent efficiency gains in heating, cooling, and water heating
- An Affordable Housing PV Program should focus on savings in cooling, lighting and appliances
- 30%-50% cooling reductions are cost-effectively possible
- Significant variance by building type and CZ



Efficiency Improvements and the Savings Results Vary by Building and Location





First Example: Tremont Green Apartments

- 36 units of affordable rental housing
- Climate zone 12 – Davis, CA
- Exceeded code by 30%
- Increased tenant comfort



Tremont Greens: A Case Study



BUILDING TYPE B.1 ELEVATION



Tremont Green Apartments

- **Envelope**

- Roof: radiant barrier (@ \$0.08/sf @ avg. 800 sf = ~ \$32.00/unit)
- R-38 attic insulation
- Walls: R-15 insulation (@ \$0.05/sf average – 150 sf = \$7.50/unit)
- Windows: U-factor of 0.35 and SHGC of 0.32 (no additional cost)

- **Space Heating and Cooling**

- .80 AFUE furnace (no additional cost)
- SEER 12 split air condition systems (\$150-\$200 per unit)
- Most ducts in conditioned space
- Duct leakage < 6%



Tremont Green Apartments

36-unit affordable housing project

- **Water Heating**
 - 0.62 EF water heater (approx \$25/unit)
- **Appliances and Fixtures**
 - ENERGY STAR dishwashers and refrigerators
 - Efficient fluorescent lamps

Total incremental costs at \$377/unit
Utility program paid \$150 per unit



Tremont Green Apartments: Balance Sheet

- Incremental First Costs (\$376.29/unit)
- Program Rebate
- NET First Costs

- Value of First Year Energy Savings

\$ 13,546

\$ 5,400

\$ 8,146

\$ 7,000



Second Example: Treo at Kettner

- 328 townhomes and condominiums
- Mixed use 20 story High rise
- Designed by Carrier Johnson
- Built by Intergulf Development Group
- Initially **4% better** than Title 24





Treo EE Measures

- Spectrally selective glazing
- Water source heat pumps with:
 - Chilled water from a cooling tower, and
 - Hot water from 80% RE boiler
- DHW supply using 8 staged boilers (82% RE) and temperature controlled re-circulation pumps
- R-19 wall insulation



Treo Results

- **47% more energy efficient than required by Title 24**
- Projected savings of **\$295/year** per apartment - AT OLD UTILITY RATES!
- Saves 60% of the gas, and 23% of the electricity for heating, cooling and water heating



kW Reduction Through Energy Efficiency

PV System		Savings Due to Efficiency		Demand Reduction	
kW	PV Cost	\$	PerCent	kW	% EE
1.0	\$5,000	\$4,200	45%	1.40	58.3%
1.2	\$5,600	\$3,600	40%	1.20	50.0%
1.4	\$6,200	\$3,000	33%	1.00	41.7%
1.6	\$6,800	\$2,400	25%	0.80	33.3%
1.8	\$7,400	\$1,800	20%	0.60	25.0%
2.0	\$8,000	\$1,200	13%	0.40	16.7%
2.2	\$8,600	\$600	7%	0.20	8.3%
2.4	\$9,200	\$0	0%	0.00	0.0%



kW Reduction Through Energy Efficiency

PV System		Savings Due to Efficiency		Demand Reduction		Cost of Efficiency Upgrades
kW	PV Cost	\$	PerCent	kW	% EE	
1.0	\$5,000	\$4,200	45%	1.40	58.3%	\$900
1.2	\$5,600	\$3,600	40%	1.20	50.0%	\$700
1.4	\$6,200	\$3,000	33%	1.00	41.7%	\$500
1.6	\$6,800	\$2,400	25%	0.80	33.3%	\$400
1.8	\$7,400	\$1,800	20%	0.60	25.0%	\$200
2.0	\$8,000	\$1,200	13%	0.40	16.7%	\$50
2.2	\$8,600	\$600	7%	0.20	8.3%	\$0
2.4	\$9,200	\$0	0%	0.00	0.0%	\$0



Are California Energy Costs High?

2001 Data

End-Use Category	Annual Per-Household Energy Costs By End-Use Category				
	U.S.	New York	California	Texas	Florida
Space Heating	\$480	\$658	\$274	\$302	\$103
Air Conditioning	\$197	\$109	\$125	\$384	\$436
Water Heating	\$203	\$214	\$190	\$196	\$220
Refrigerators	\$135	\$167	\$125	\$171	\$166
Other Appliances & Lighting	\$535	\$630	\$542	\$597	\$554
Total Electrical Costs	\$867	\$906	\$792	\$1,152	\$1,156



What Impact Does Investing in Energy Efficiency Have on the Local Economy?



Economic Development

From a community perspective:

- Additional money available to be spent in the community (the multiplier effect)
- The impact of construction activity on a community's economy



Multiplier Effect of Energy Efficiency

For every dollar spent on energy:

- Over **70 Cents** leaves the community
- That means that energy dollars have a multiplier effect of about \$1.39



Multiplier Effect of Energy Efficiency on the Community

Iteration	Value	Cumulative
1	\$1.00	\$1.00
2	\$0.28	\$1.28
3	\$0.08	\$1.36
4	\$0.02	\$1.38
5	\$0.01	\$1.39
6	\$0.00	\$1.39



Multiplier Effect of Energy Efficiency on the Community

For a family in affordable housing, of every dollar spent on the *average* market basket of goods:

- About \$0.25 leaves the community
- That means a multiplier effect of about \$4.00
- For perspective, income spent on childcare yields a multiplier of \$2.50



Multiplier Effect of Energy Efficiency on the Community

Iteration	Value	Cummulative
1	\$1.00	\$1.00
2	\$0.75	\$1.75
3	\$0.56	\$2.31
4	\$0.42	\$2.73
5	\$0.32	\$3.05
6	\$0.24	\$3.29
7	\$0.18	\$3.47
8	\$0.13	\$3.60
9	\$0.10	\$3.70
10	\$0.08	\$3.77
11	\$0.06	\$3.83
12	\$0.04	\$3.87
13	\$0.03	\$3.90
14	\$0.02	\$3.93
15	\$0.02	\$3.95
16	\$0.01	\$3.96
17	\$0.01	\$3.97
18	\$0.01	\$3.98
19	\$0.01	\$3.98
20	\$0.00	\$3.99



Multiplier Effect of Energy Efficiency \

Projects that are energy efficient:

- Allow tenants to spend less on energy and more on the **average** market basket of goods
- Therefore, every \$1.00 saved by energy efficiency is worth an **additional \$2.60 to the community!**



Impact of High Utility Bills

“Inability to pay utilities is second only to inability to pay rent as a reason for homelessness.”

Karen Brown, Ex Dir, Colorado Energy Assistance Foundation.
James Benfield, Ex Dir, Campaign for Home Energy Assistance.

[Quoted on HUD's web site.]



Public Housing Authorities Impact

Local Housing Authorities spend
25% of their operating budget on
utilities

Dee NaQuin, editor, National Association of Housing and
Redevelopment Officials (NAHRO)

Journal of Housing and Community Development