Summing Up
Energy Symposium: The "Rosenfeld Effect"
April 28, 2006

Arthur H. Rosenfeld, Commissioner

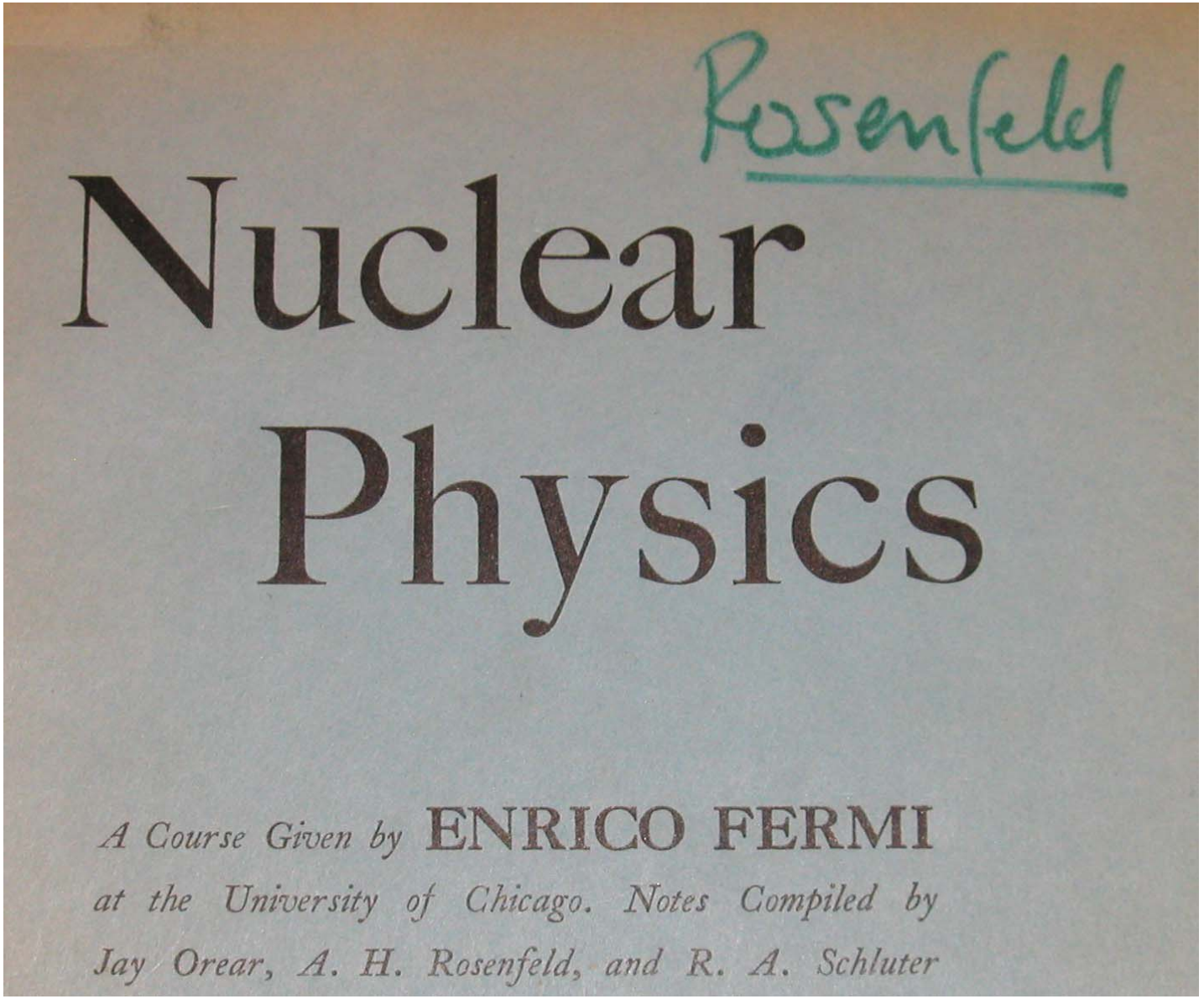
California Energy Commission

(916) 654-4930

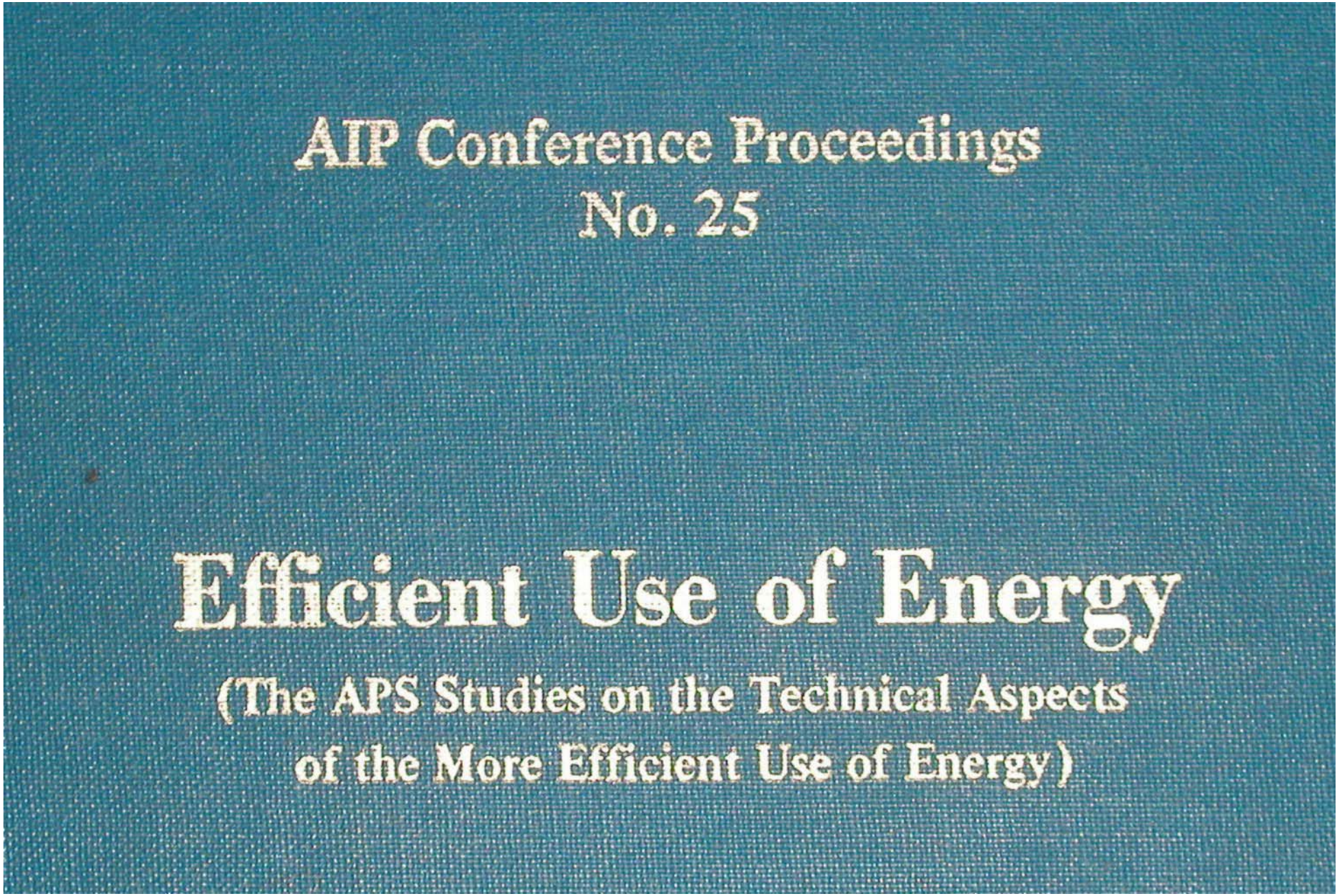
ARosenfe@Energy.State.CA.US

http://www.energy.ca.gov/commission/commissioners/rosenfeld.html

1949


Rosenfeld
Nuclear
Physics
A Course Given by ENRICO FERMI
at the University of Chicago. Notes Compiled by
Jay Orear, A. H. Rosenfeld, and R. A. Schluter

1974

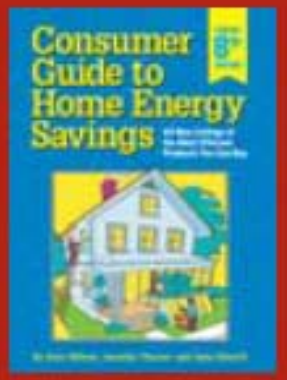

AIP Conference Proceedings
No. 25
Efficient Use of Energy
(The APS Studies on the Technical Aspects
of the More Efficient Use of Energy)

1980 Leading Researchers form ACEEE

1982 National experts gather for first "Buildings" Summer Study

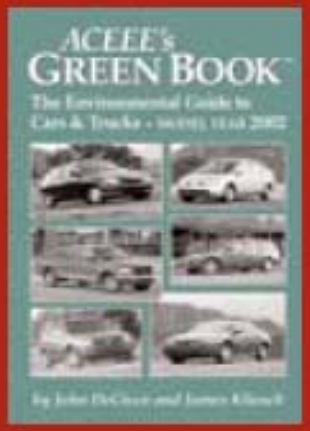
1987 Manufacturers, advocates and Congress agree on appliance standards

1991 ACEEE issues 1st edition, *Consumer Guide to Home Energy Savings*



1992 Congress passes the Energy Policy Act of 1992

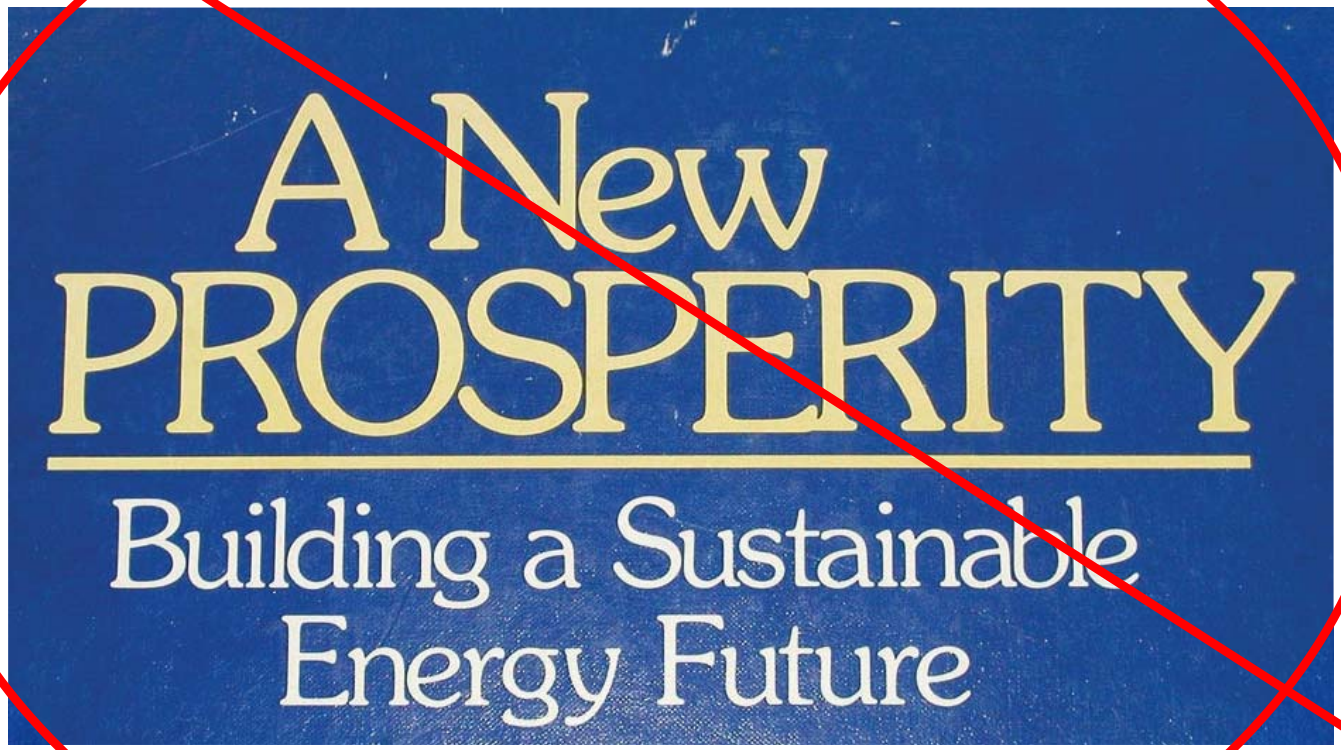
1998 1st edition of *ACEEE's Green Book®: The Environmental Guide to Cars & Trucks*



2005 Congress passes the Energy Policy Act of 2005

2030 Our children inherit the fruits of the work we do today, and tomorrow.

Brickhouse Press, 1981



Banned by Reagan Transition Team, brought into public domain as House Committee print.

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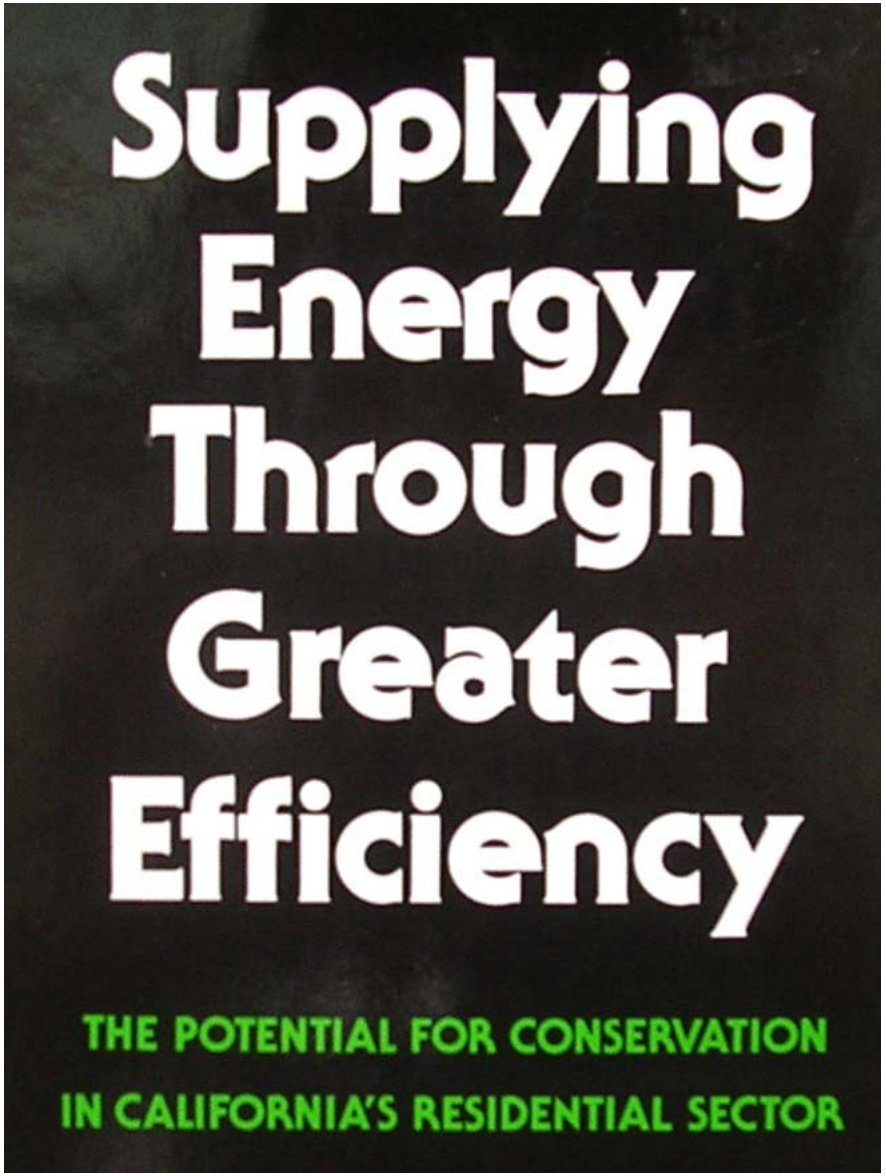
1983



Meier,

Rosenfeld and

Wright

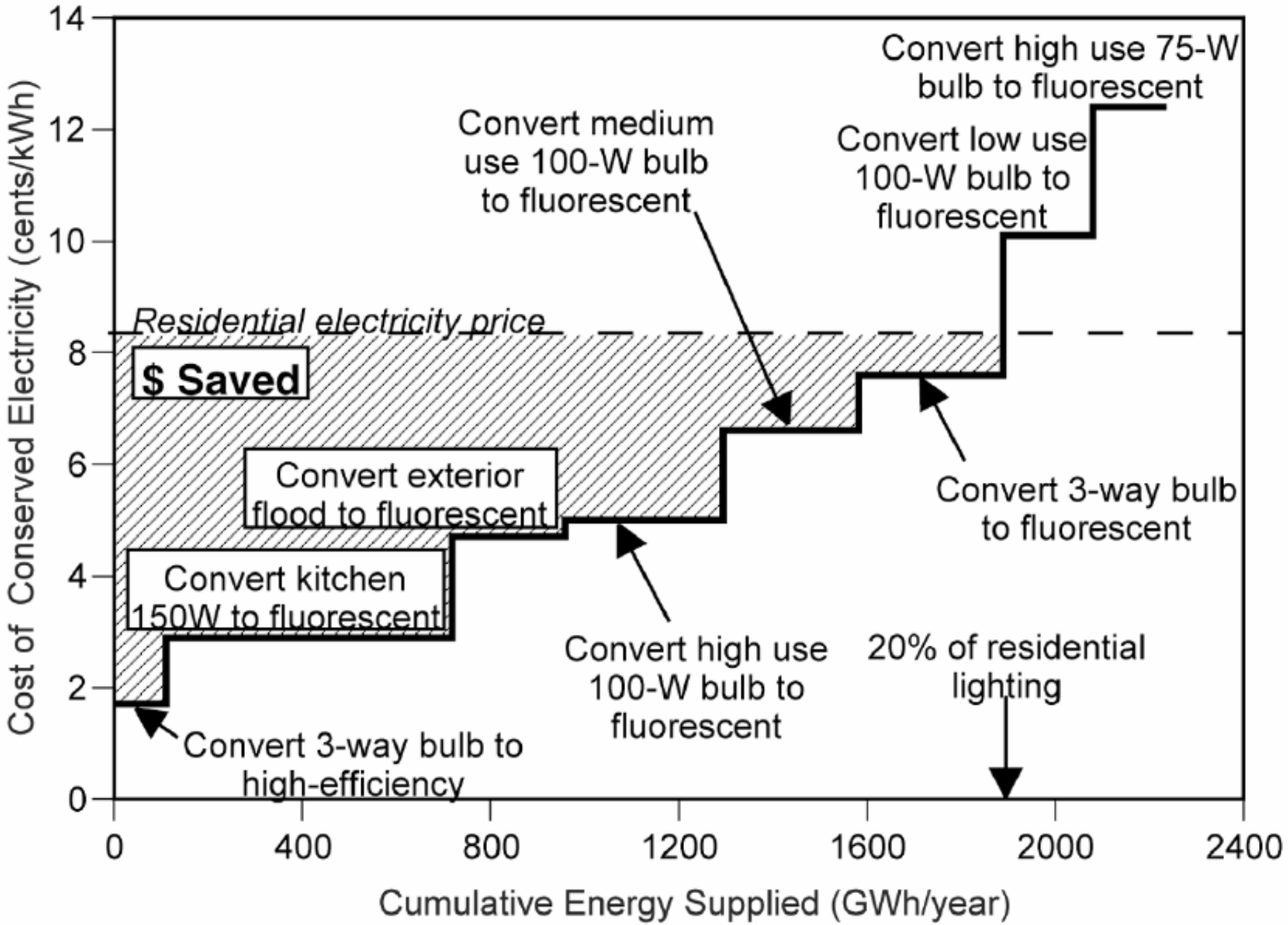
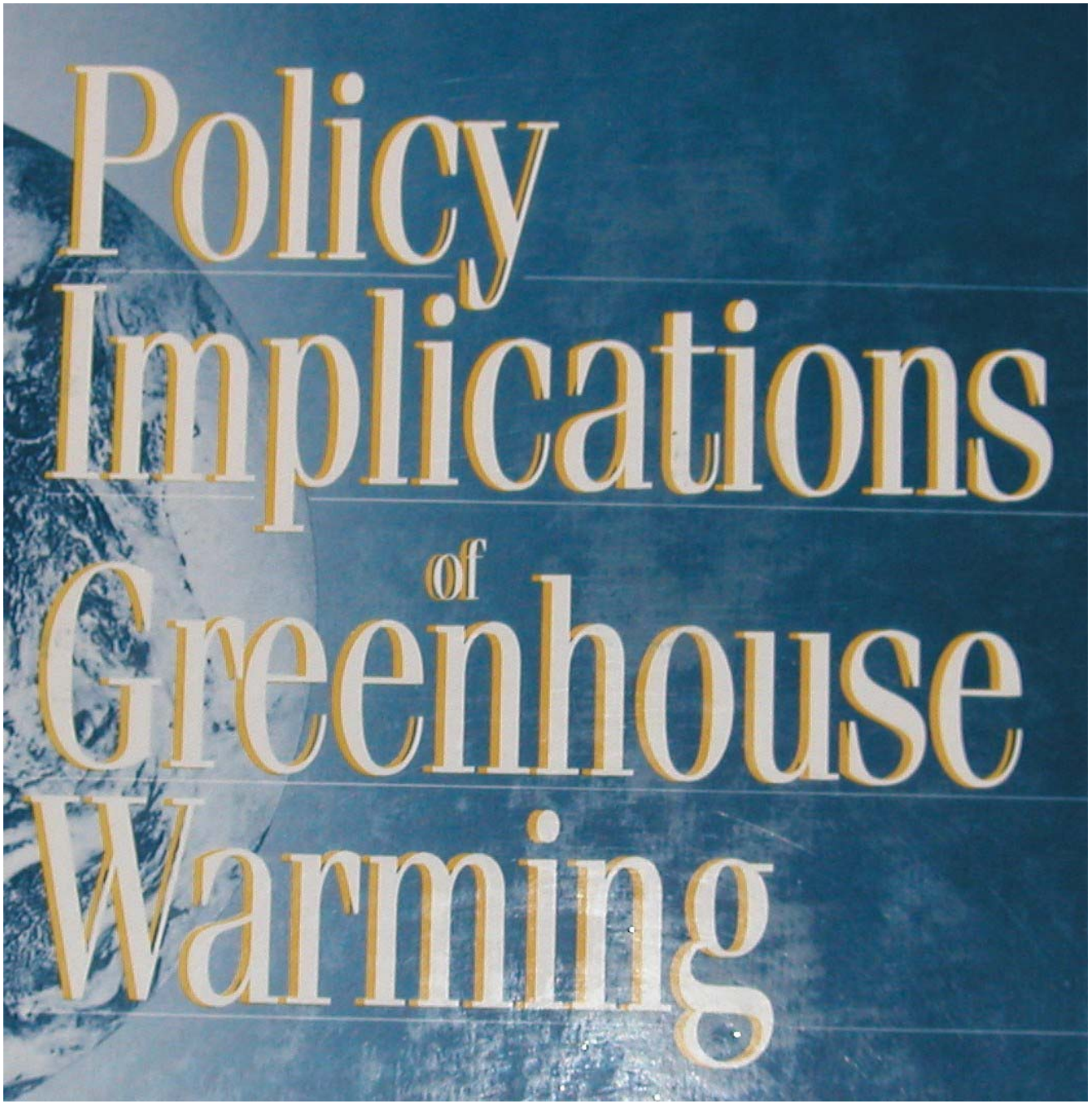
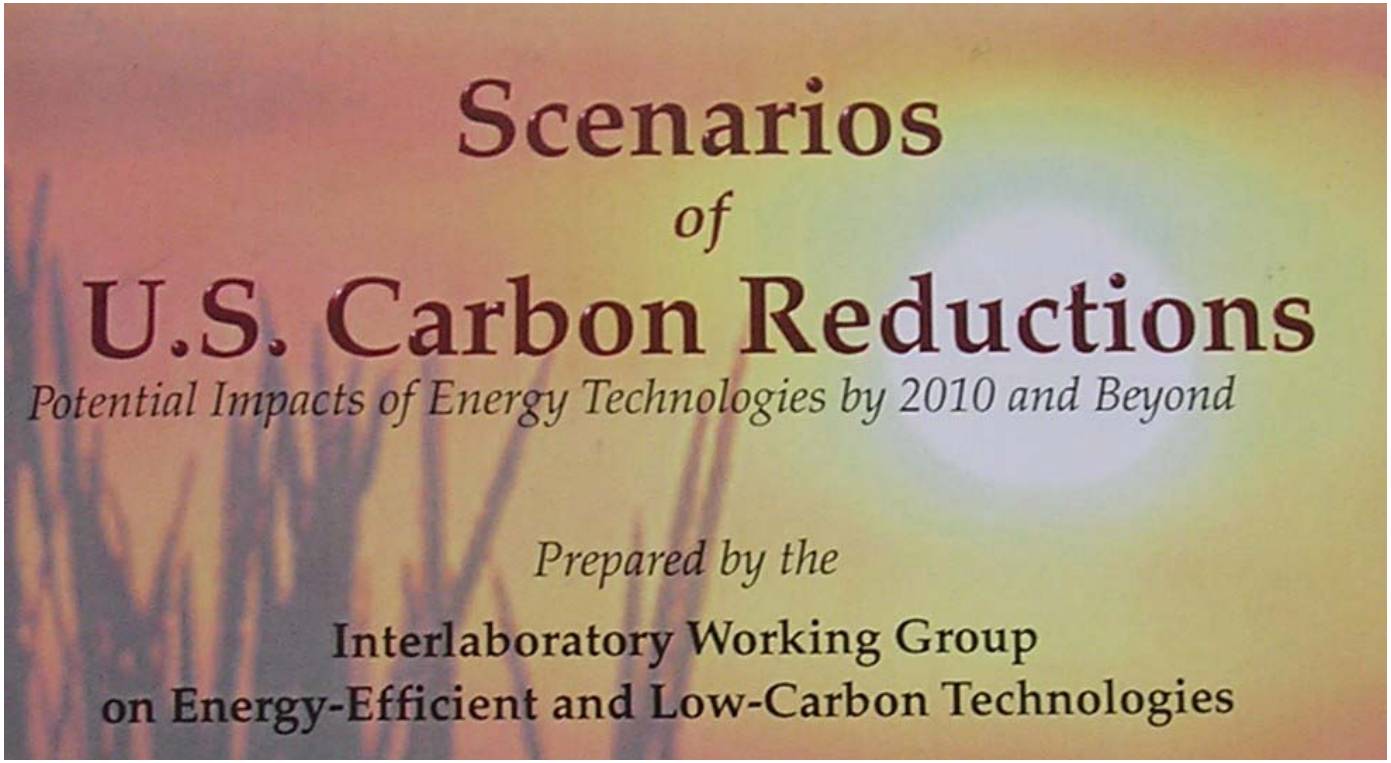


Figure 4 Macro supply curve of conserved residential lighting in California. Although the last cost-effective step costs 7.6 cents/kWh, the average CCE is only 4.8 c/kWh. This is adapted from Figures 3–12 of Meier et al (20).

National Academy Press, 1992

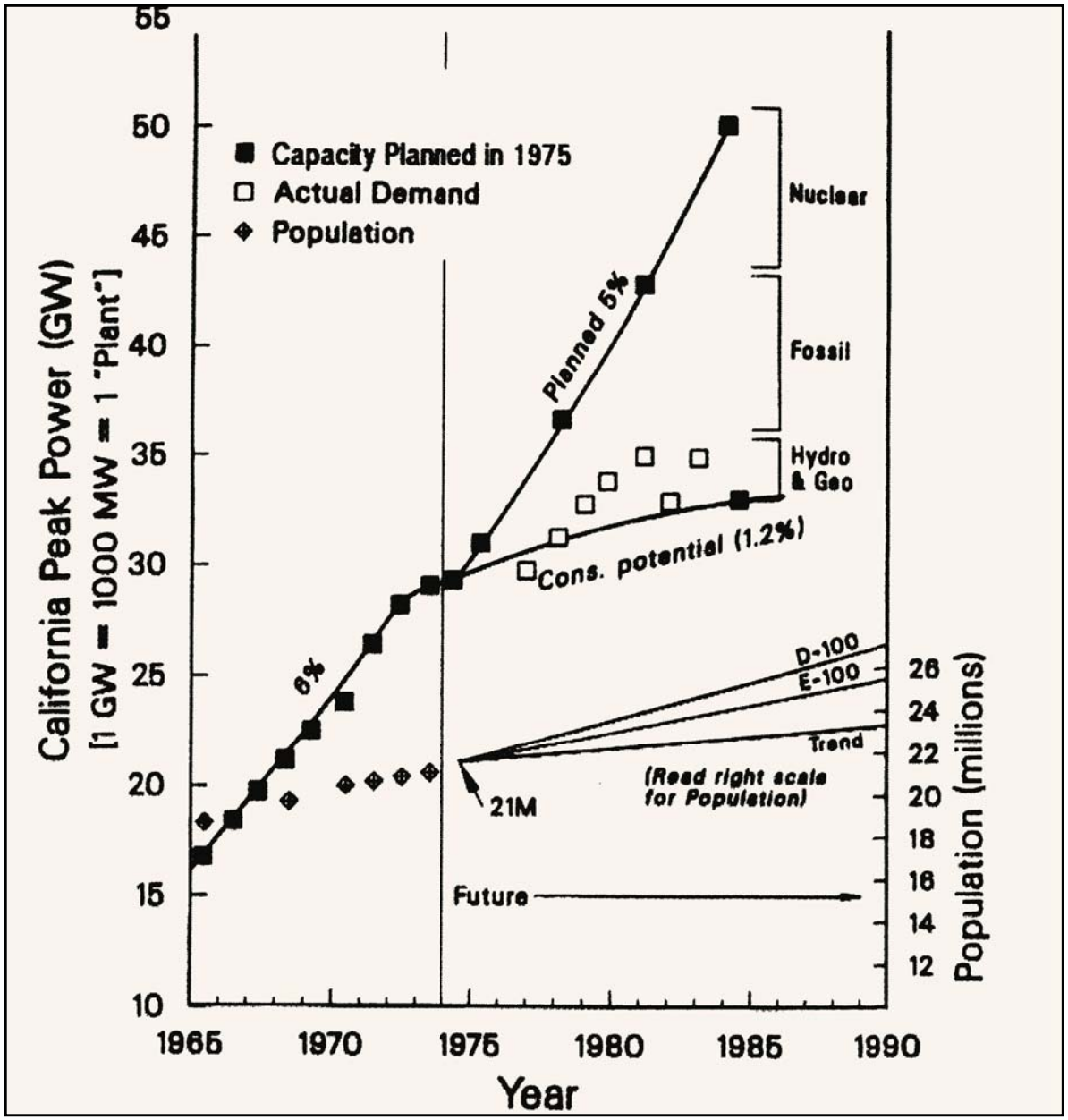


Five Lab Study, 1997

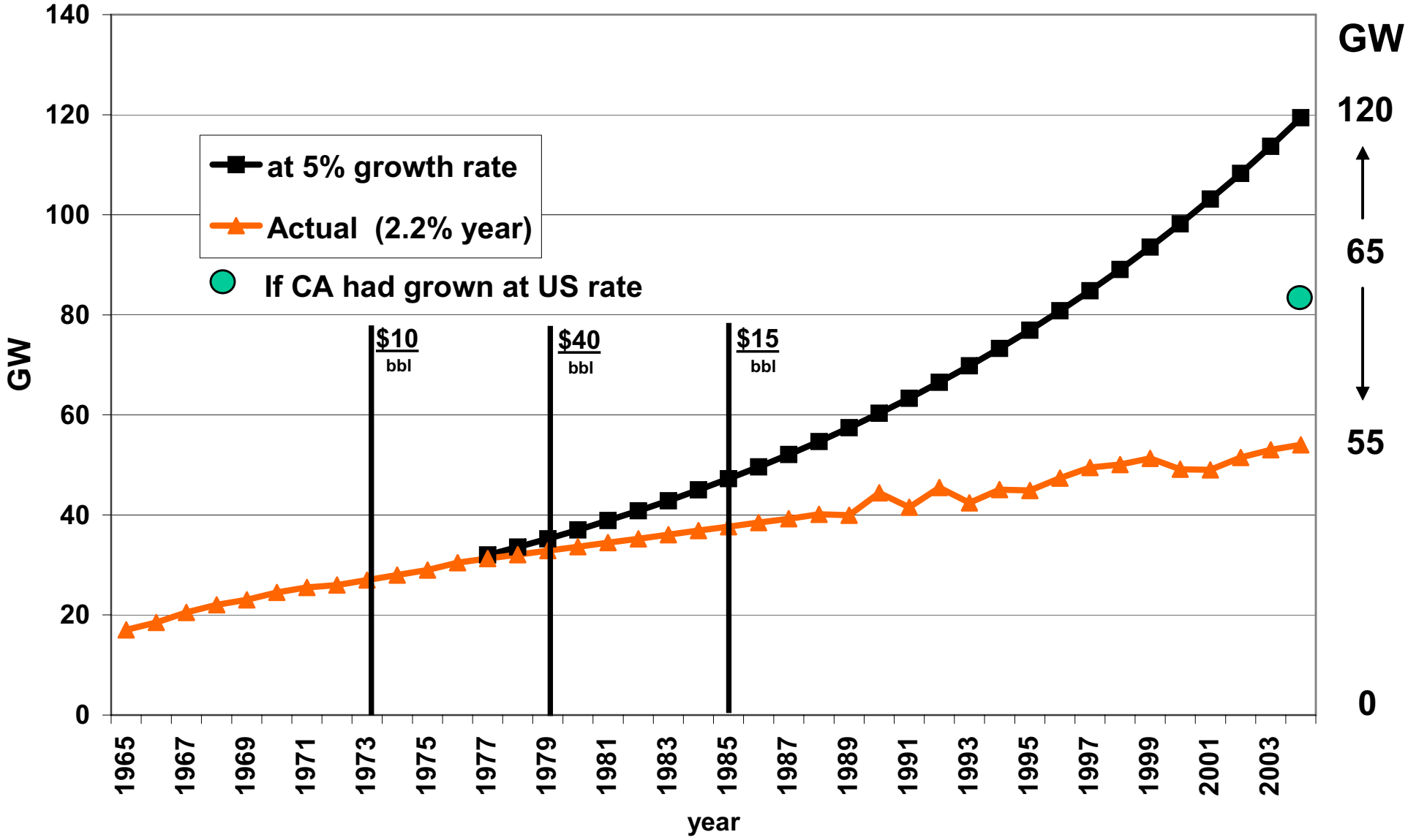


California Peak Power Demand:Planned in 1974, and Actual to 1984

Goldstein and Rosenfeld, at Calif. Energy Commission, Dec. 1975



California Peak Demand 1965 - 2004



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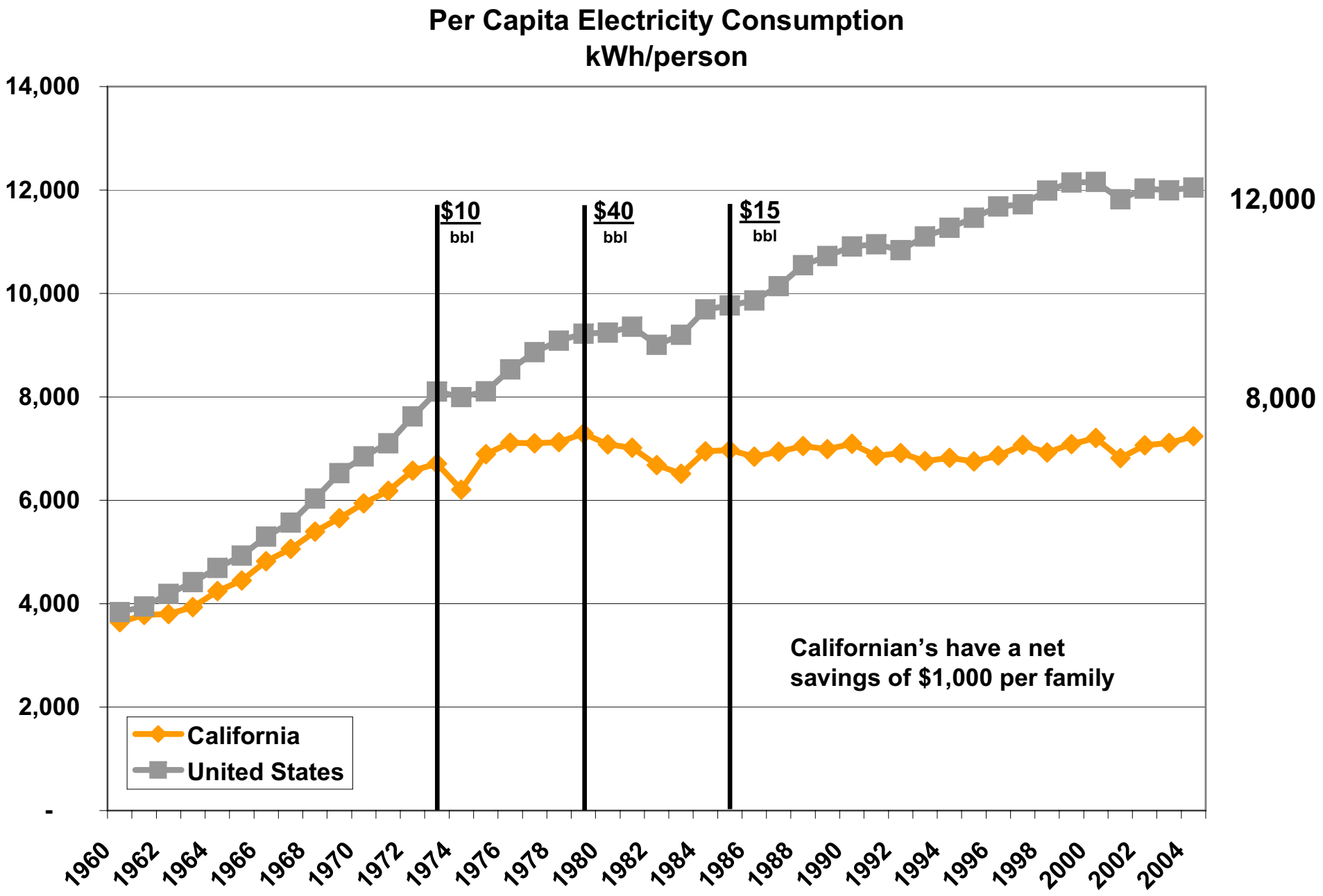

Source: http://www.eia.doe.gov/emeu/states/sep_use/total/csv/use_csv

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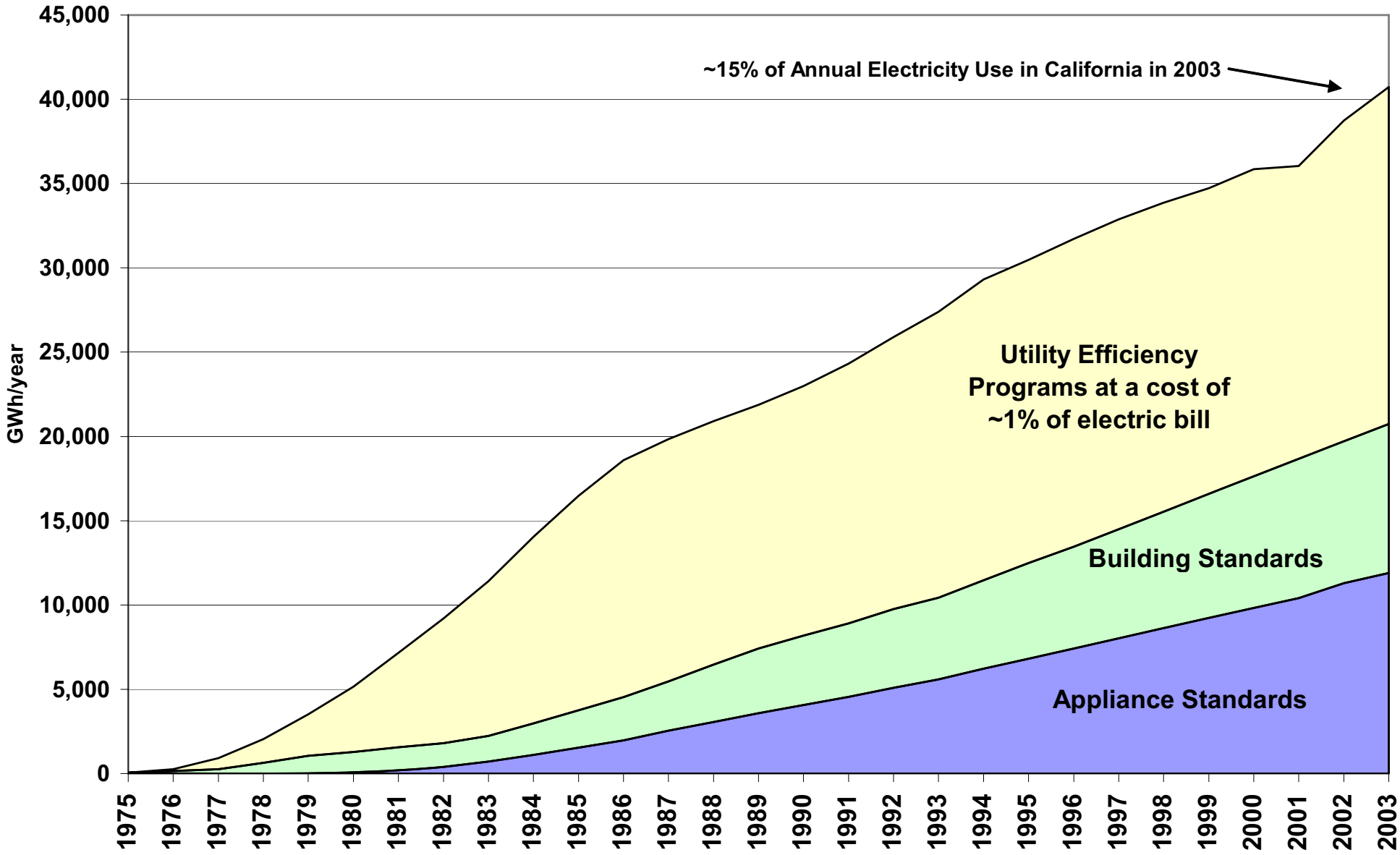
Annual Energy Savings from Efficiency Programs and Standards



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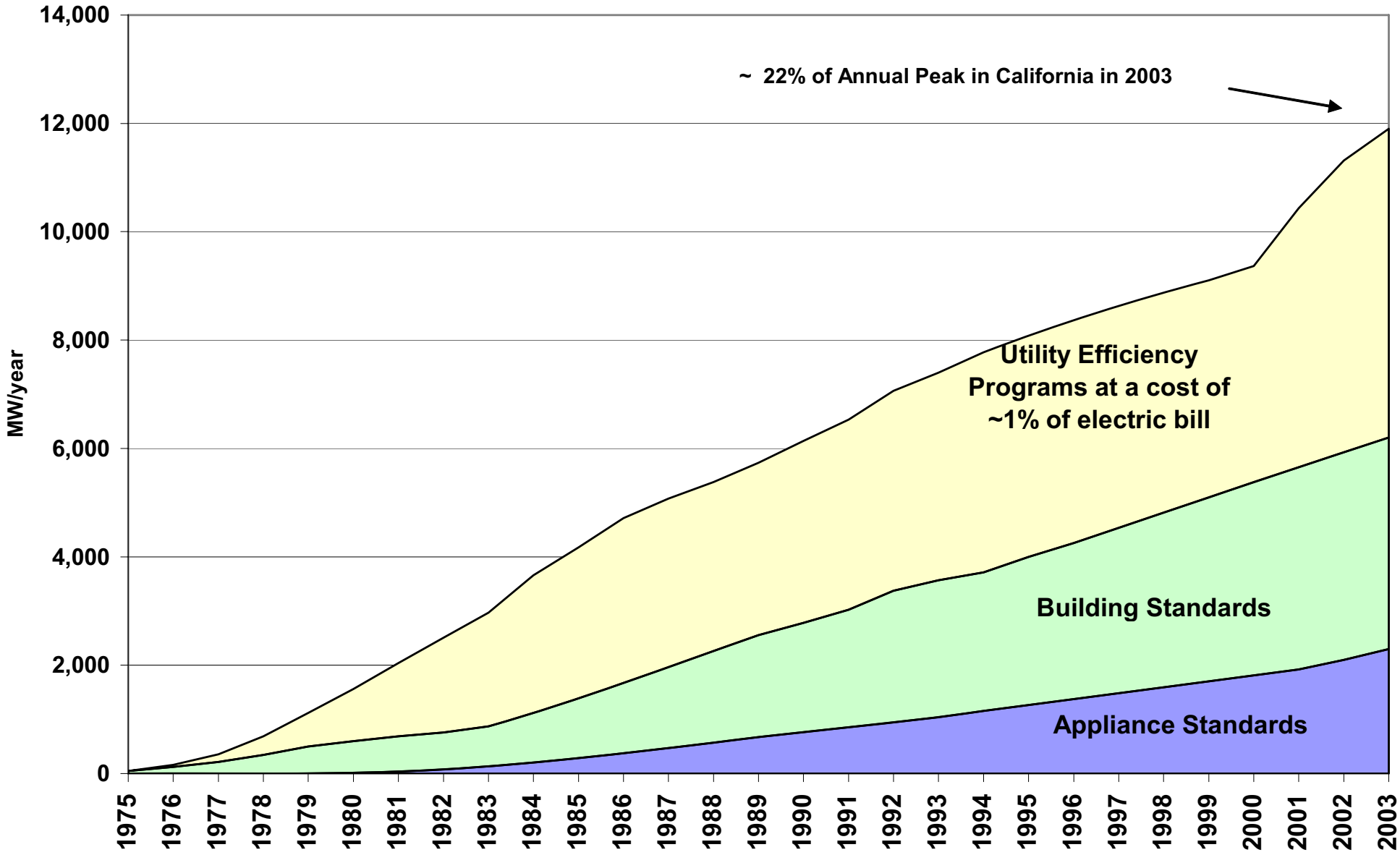
Annual Peak Savings from Efficiency Programs and Standards



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1975

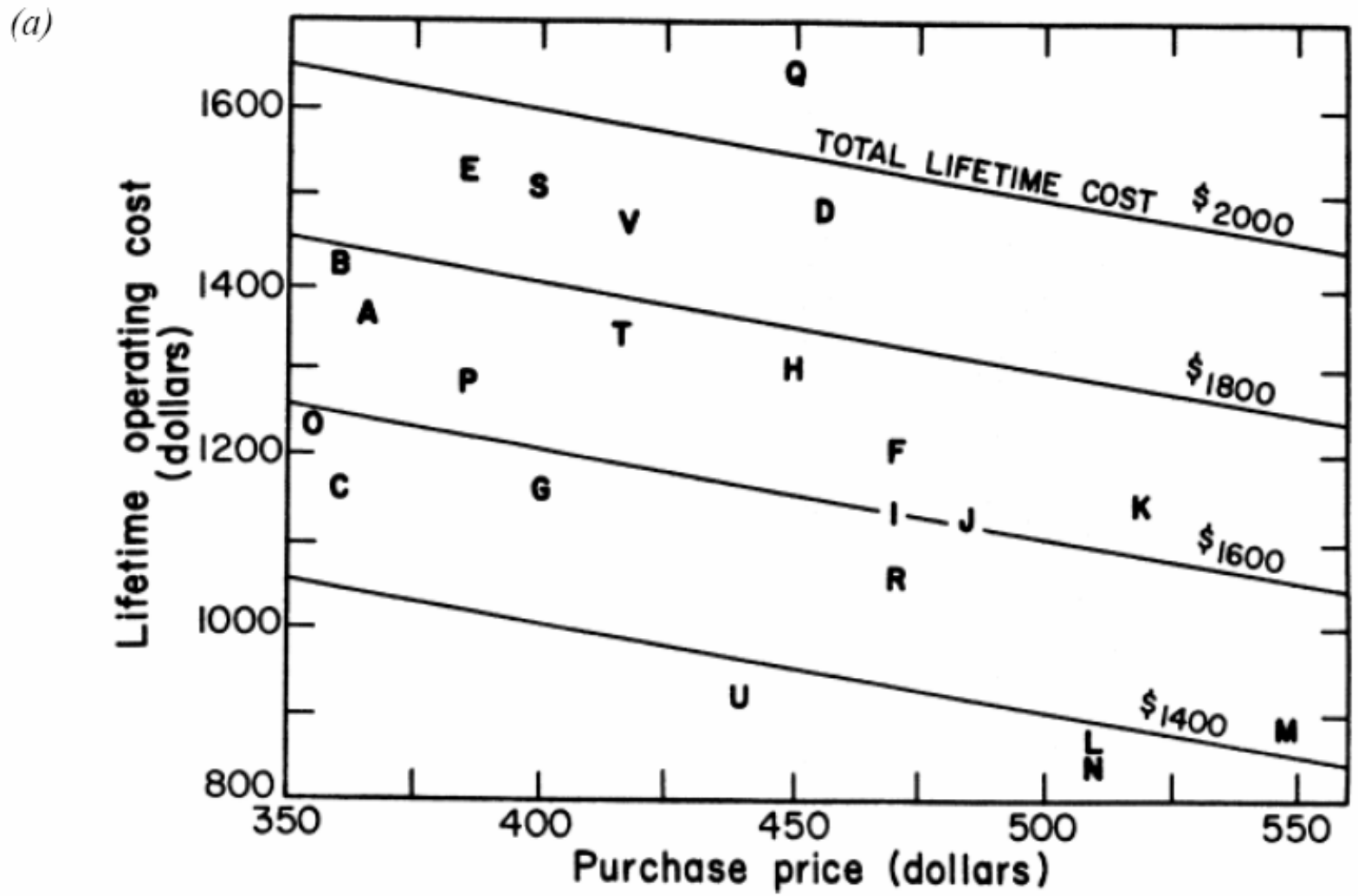
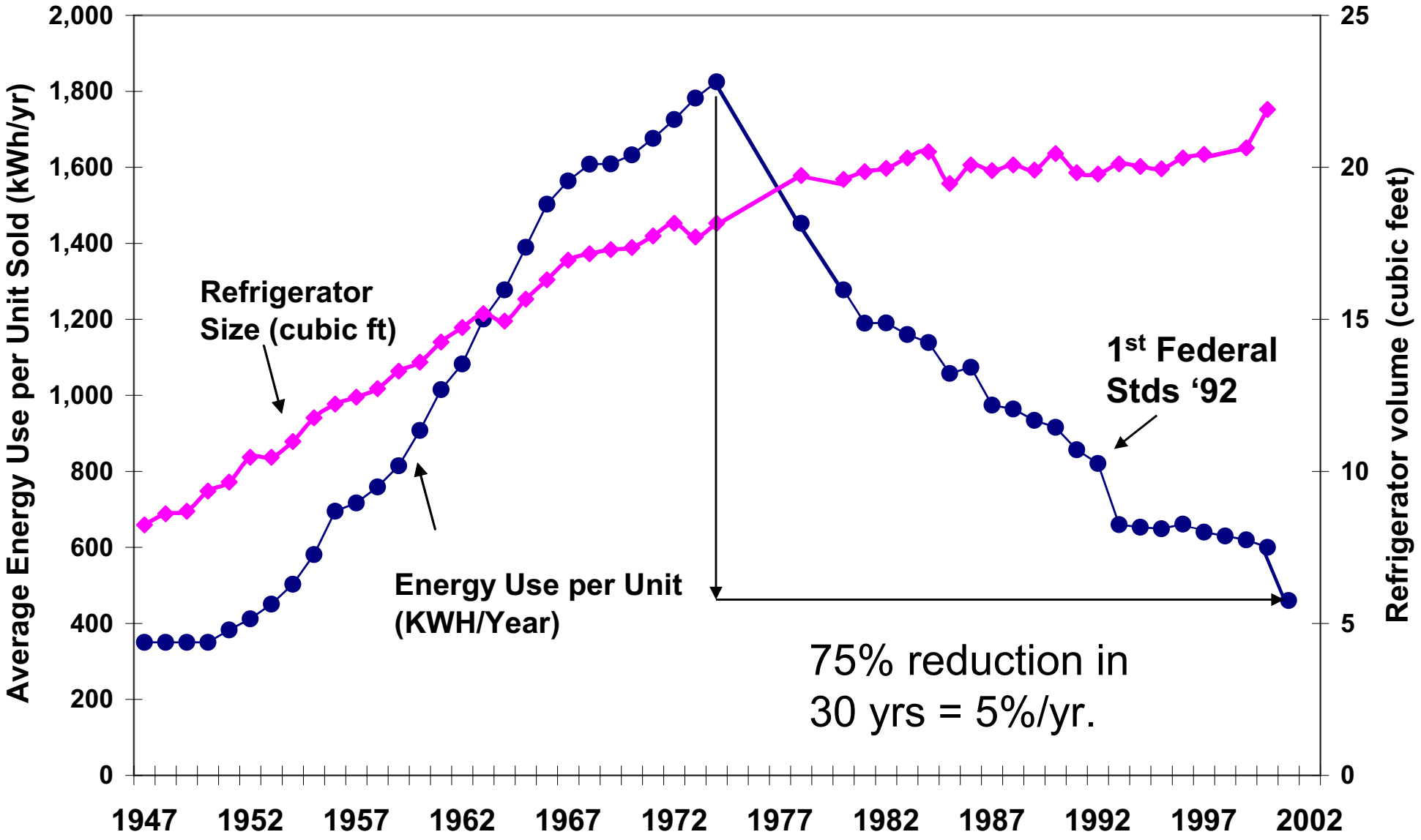


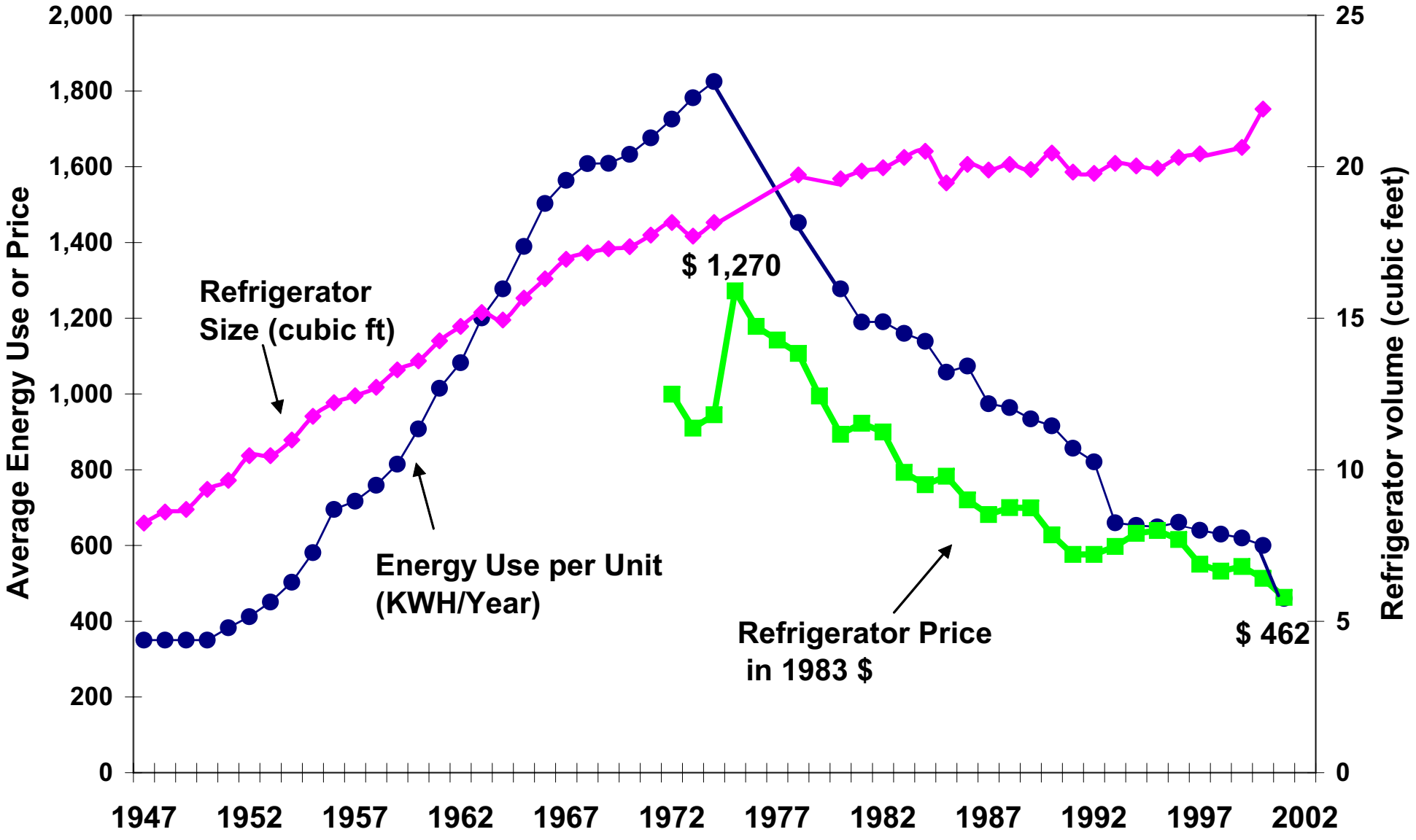
Figure 2 Scatter plot and cost data on 22 1976 refrigerators. The scatter plot (and Table on page 47) show little correlation between purchase price and efficiency. Source: Goldstein & Rosenfeld (13).

United States Refrigerator Use v. Time



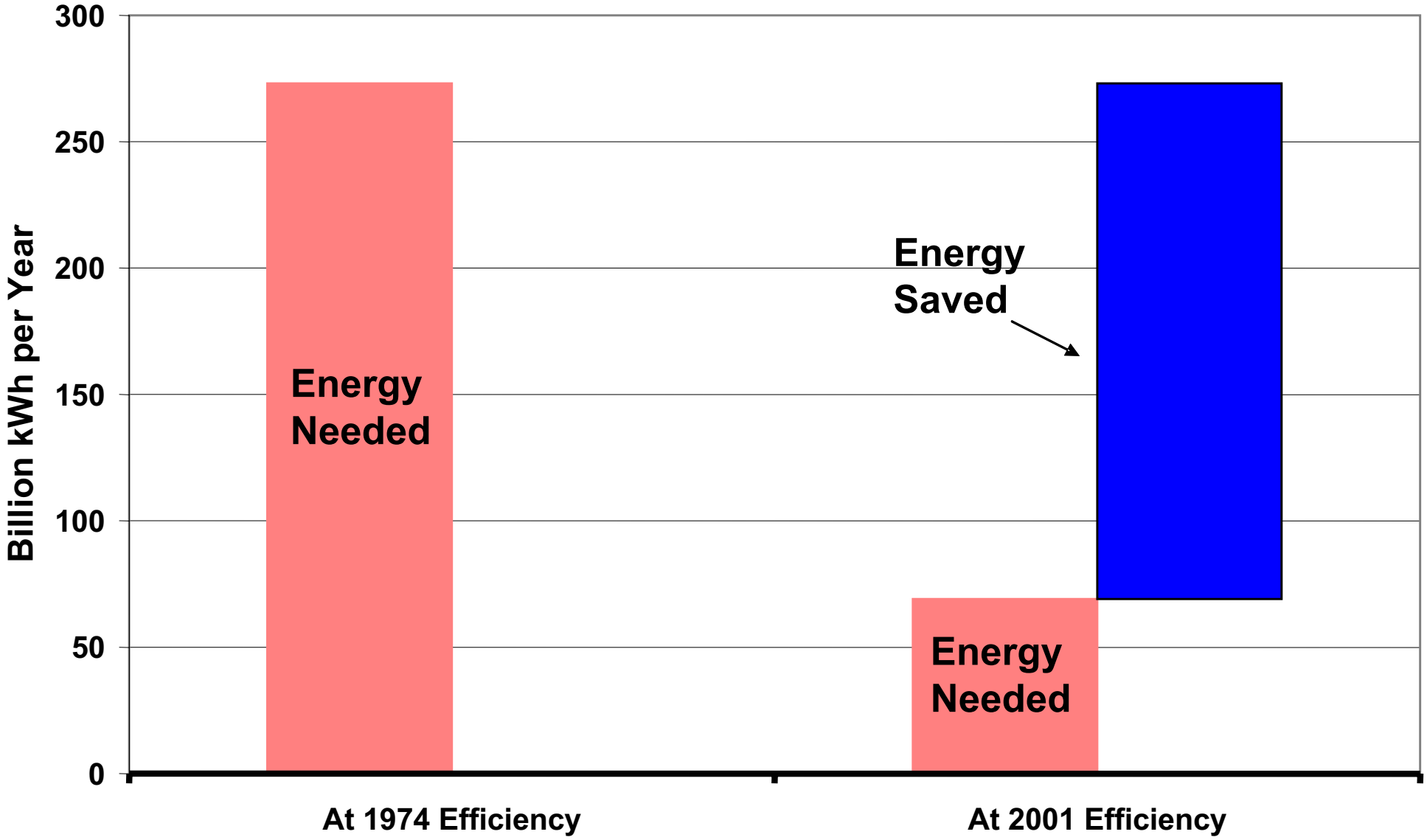
Source: David Goldstein

United States Refrigerator Use v. Time



Source: David Goldstein

Refrigerator Energy Use: 75% has been saved



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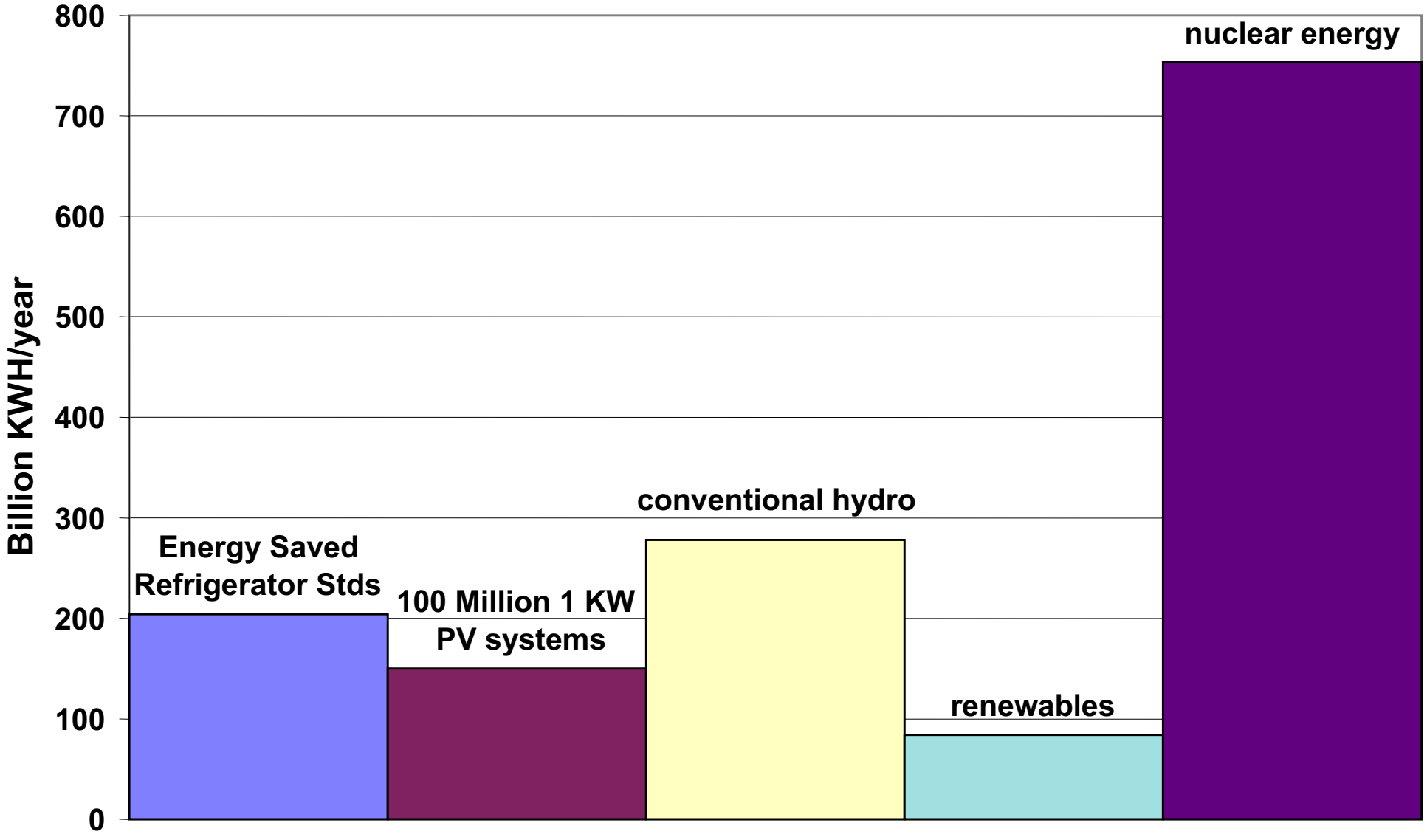
Energy Saved vs Energy Generation in Billion KWH



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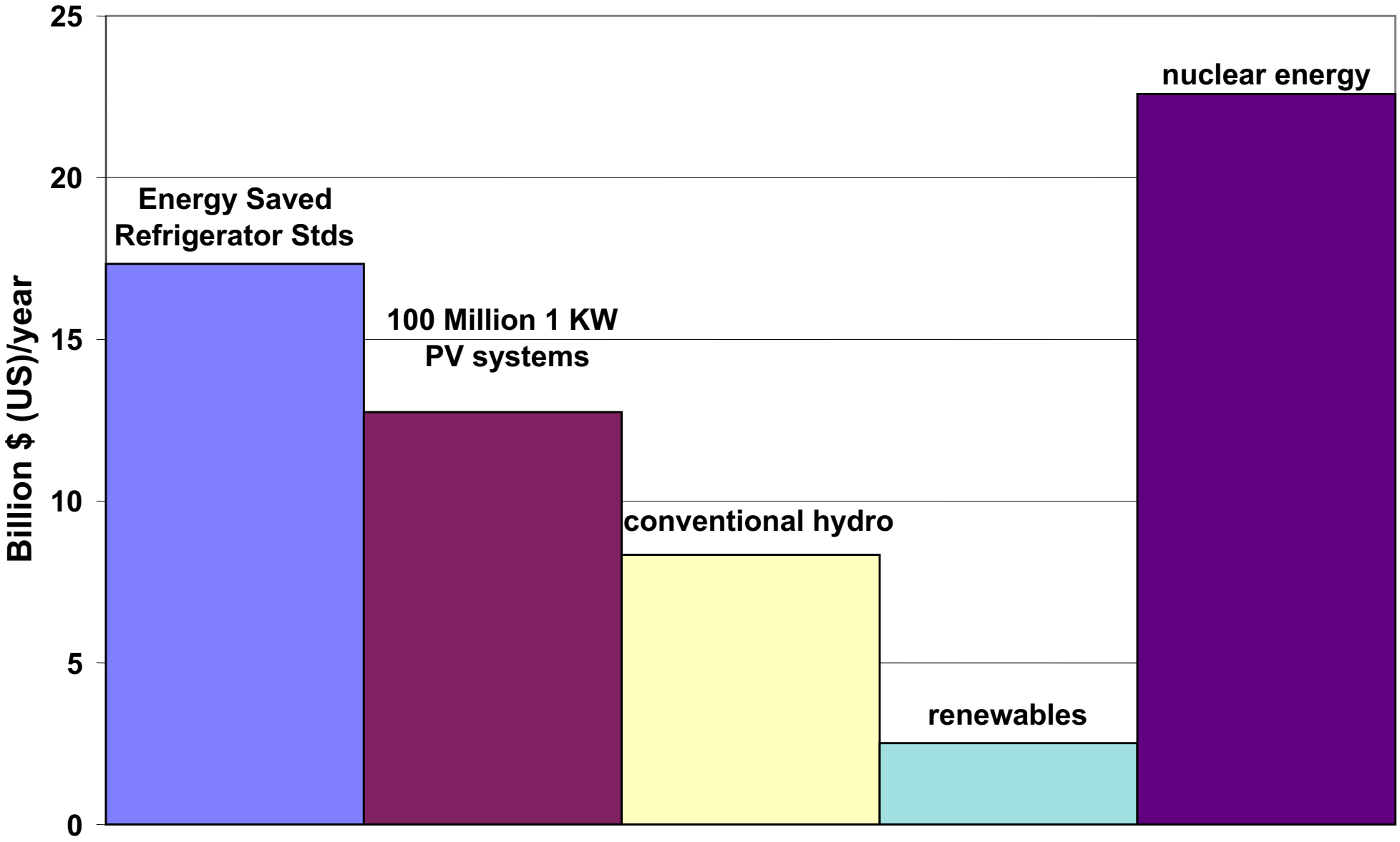
The Value of Energy Saved and Produced

Valuing a kWh at 3 cents wholesale (busbar) and 8.5 cents to buildings



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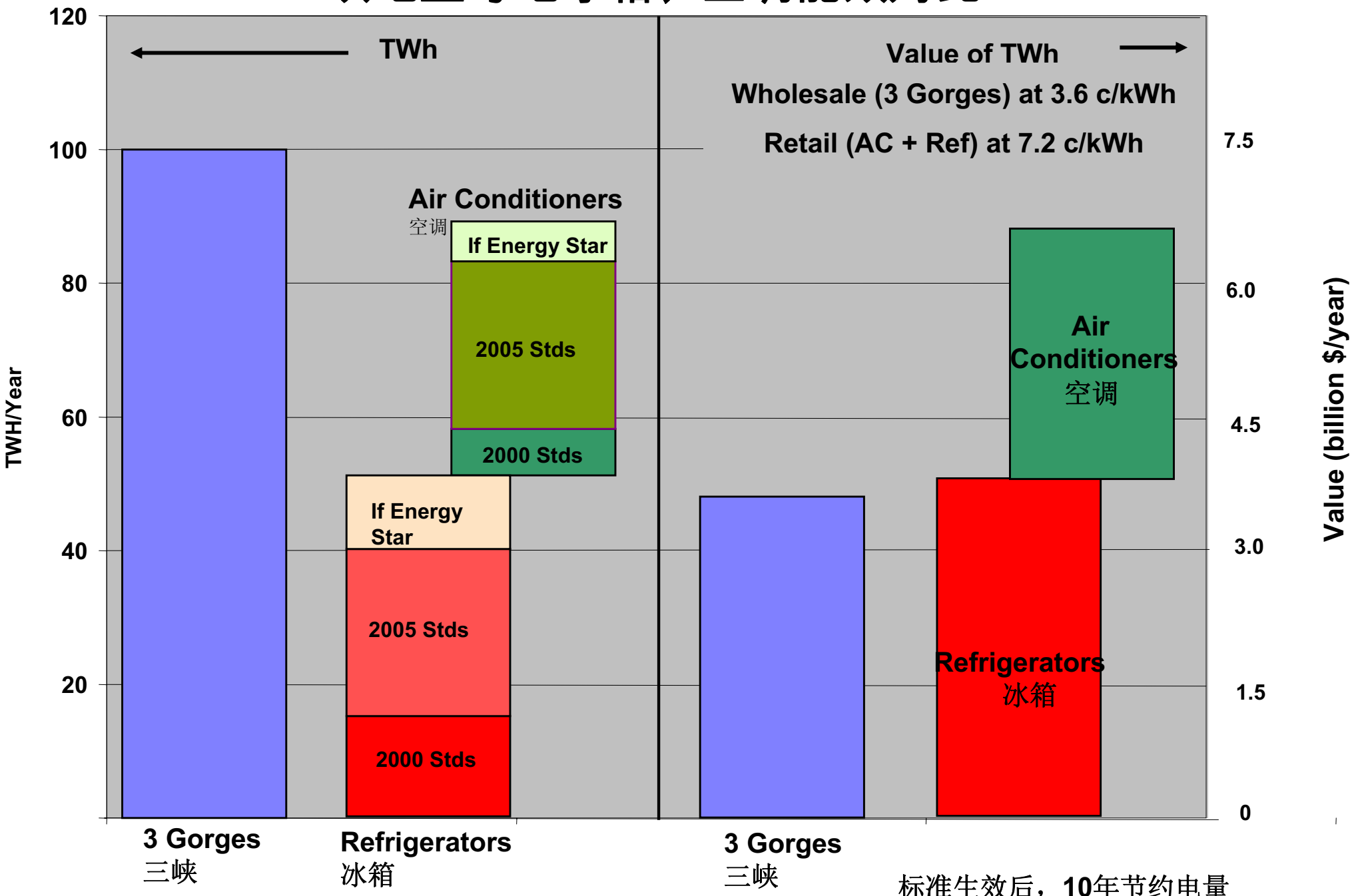
Comparison of 3 Gorges to Refrigerator and AC Efficiency Improvements

三峡电量与电冰箱、空调能效对比



Savings calculated 10 years after standard takes effect. Calculations provided by David Fridley, LBNL

标准生效后，10年节约电量

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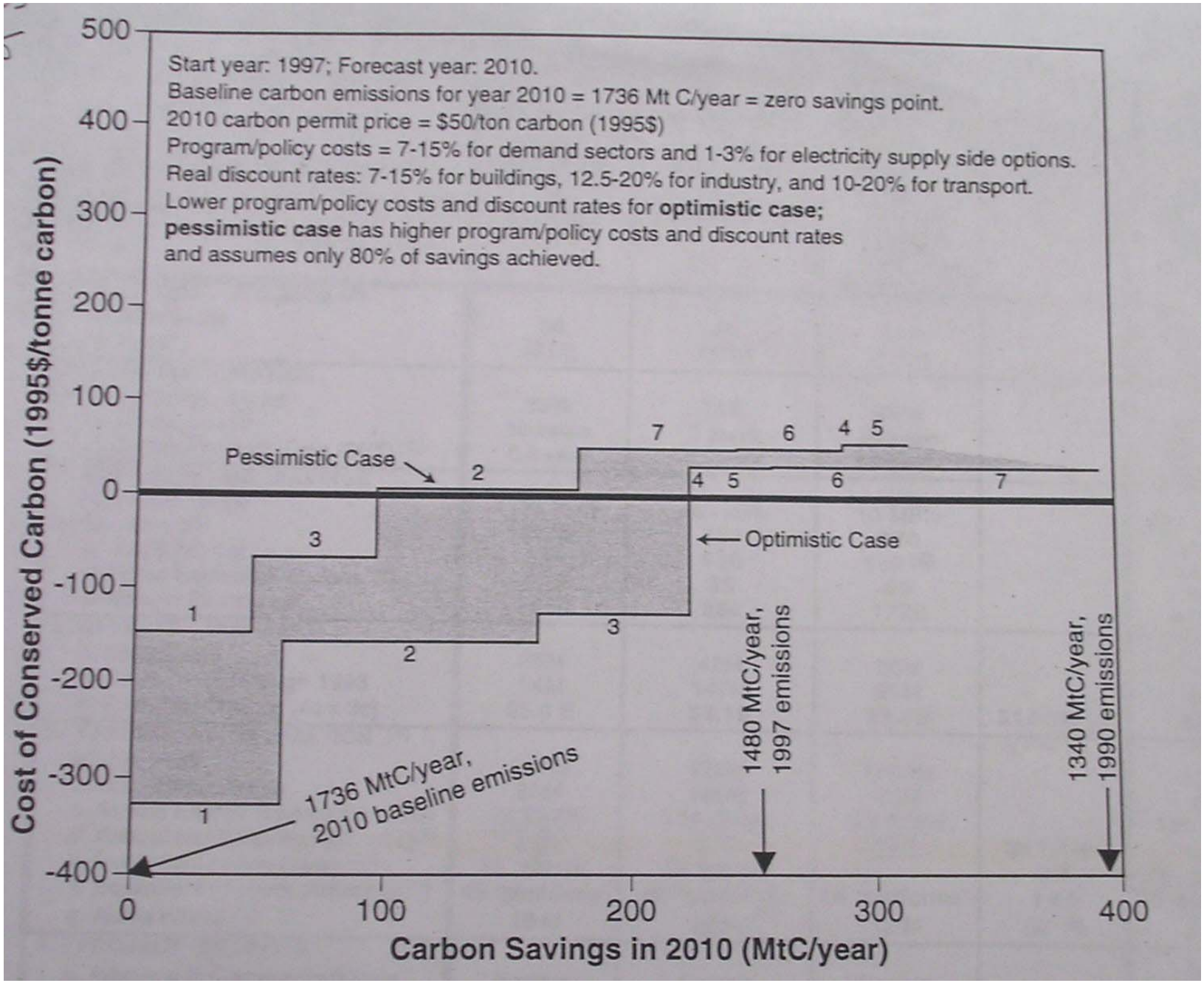
DOE Carnot Award, 1993

Table 1. Economics of Three New Energy Efficiency Technologies and Appliance Standards. A 1993 update of Tables 1 & 4 of Geller et al., *Annual Review of Energy* 1987, Vol 12.

1 GW base load (Note 10) = 5. Bkwh = 10^6 cars
More precisely at 400gal/yr.
Primary Ener 5Bkwh = 1.1 M cars
CO_2 = 5/6 M cars

Note 11, CO_2 Equivalent

	RESEARCH & DEVELOPMENT				STANDARDS
	HIGH-FREQUENCY BALLASTS VS. CORE COIL BALLASTS	COMPACT FLUORESCENT LAMPS (1) VS. INCANDESCENTS	LOW-E (R-4) WINDOWS VS. DOUBLE GLAZED WINDOWS Per small window (10 ft2)	TOTAL	REFRIGERATORS AND FREEZERS '76 base case vs. '92 CA Stds.
1. UNIT COST PREMIUM (2)					
a. Wholesale	$8	$5	$10		$100
b. Retail	($12)	($10)	($20)		($170)
2. CHARACTERISTICS					
a. % Energy Saved	33%	75%	50%		60%
b. Useful Life (3)	10 years	3 years	20 years		20 years
c. Simple Payback Time (SPT) (4)	0.8 year	0.5 year	2.9 years		1.3 year
3. UNIT LIFETIME SAVINGS					
a. Gross Energy	1330 kWh	440 kWh	10 MBtu		20,720 kWh
~~b.~~ Gross $(5)	$100	$33	$70		$1550
c. Net $ [3b-1a]	$92	$28	$60 (6)		$1450
d. Gross Equivalent Gallons (7)	106	35	69		1660
e. Miles in 25 mpg car	2660	880	1720		41,440
4. SAVINGS 1985-1993					
a. 1993 Sales	25M	42M	20M		6M
b. Sales 1985 through 1993	54M	147M	96M		50M
c. Cum. Net Savings [4b x 3c]	$5.0 B	$4.1B	$5.8B	$15B/8yr	$73B
5. SAVINGS AT SATURATION (8)					
a. U.S. Units	600M	750M	1400M		125M
b. U.S. Annual Sales	60M	250M	70M		6M
c. Annual Energy Savings [5b x 3a]	80 BkWh	110 BkWh	0.3 Mbod		130 BkWh
d. Annual Net $ Savings [5b x 3c](9)	$6B	$7B	$4B	$17B/yr	$9 B
e. Equivalent power plants (10)	16 "plants"	22 "plants"		38	26"plants"
f. Equivalent offshore platforms(10)	45 "platforms"	60 "platforms"	35 "platforms"	140	70 "platforms"
g. Autos offset(11)	16 M	22 M	12 M	50 M	26 M
6. PROJECT BENEFITS					
a. Advance in Commercialization	5 years	5 years	5 years		5 years
b. Net Project Savings [6a x 5d]	$28 B	$35B	$21B	$84B	$45 B
7. COST TO DOE FOR R&D	$3M	$0(12)	$3M	$6M	$2M
8. BENEFITS/ R&D COST [6b/7]	9,000:1		7000:1	14,000:1	23,000:1



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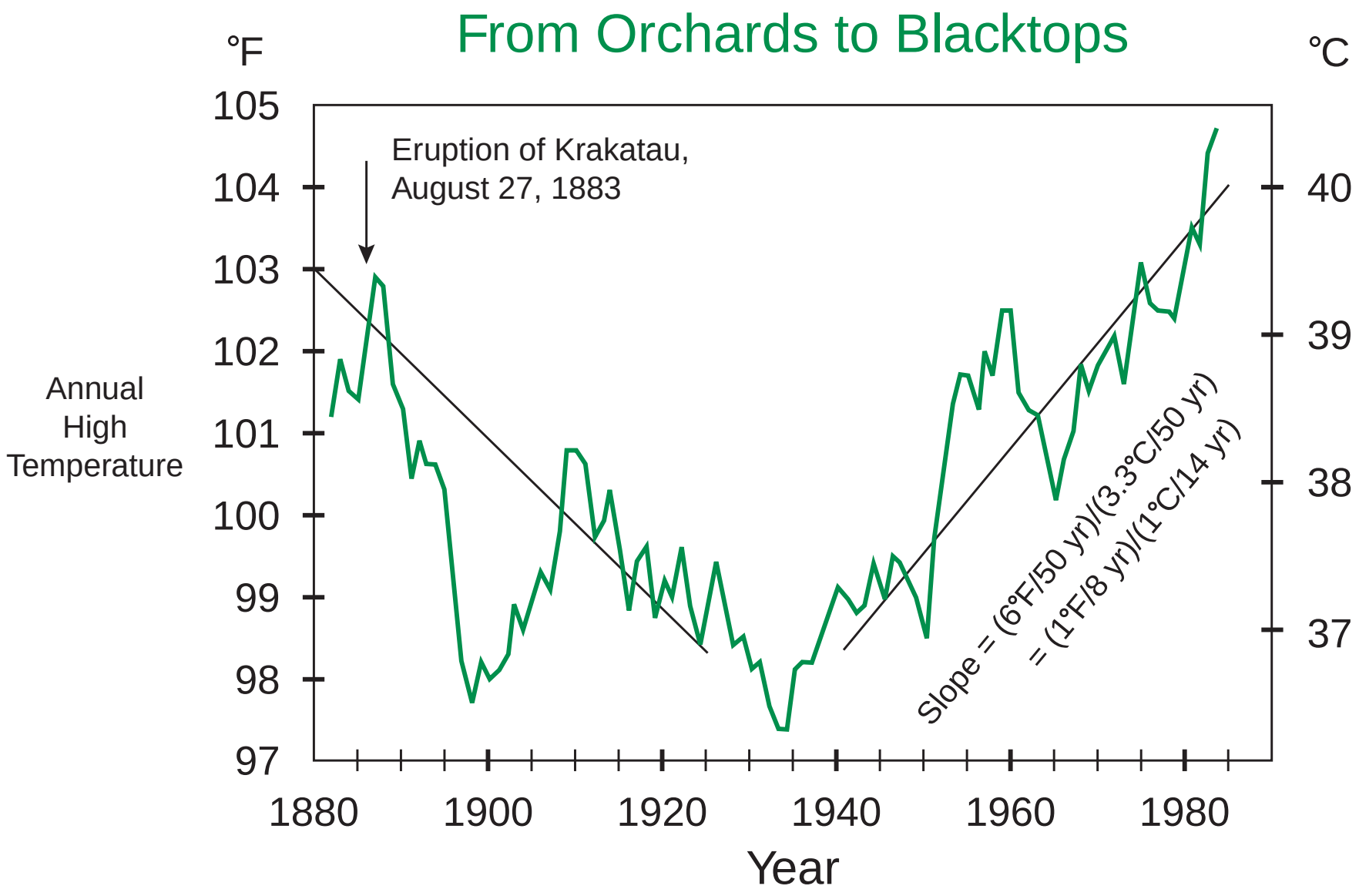
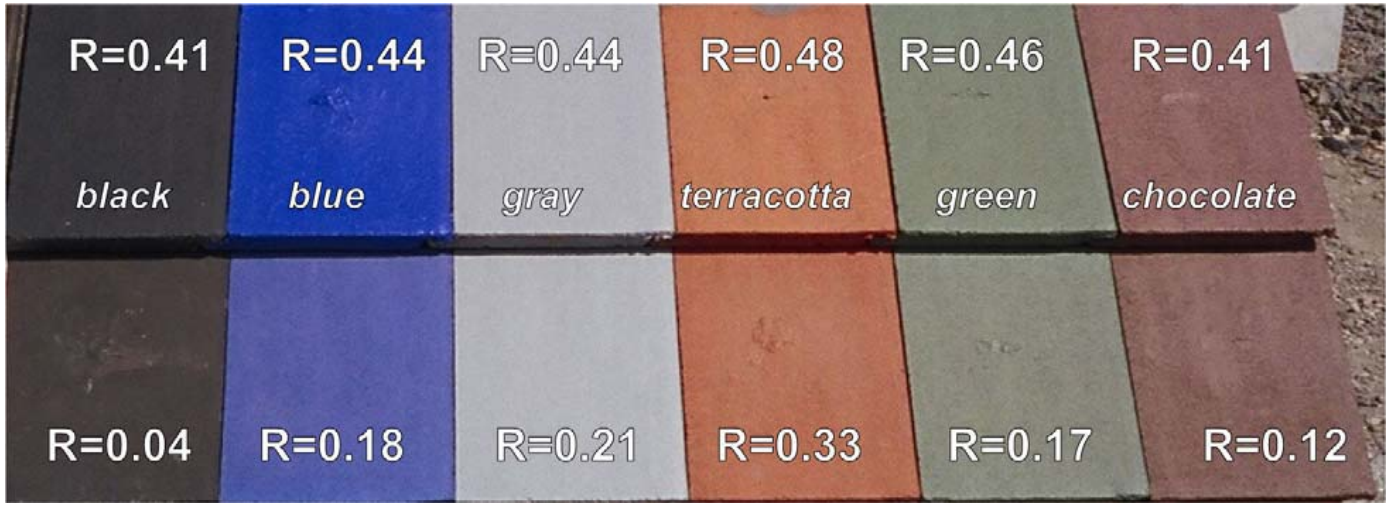
Temperature Trends

in Downtown Los Angeles



Cool and Standard Color-Matched Coatings for Concrete Tiles



cool

standard

ΔR=0.37 **ΔR=0.26** **ΔR=0.23** **ΔR=0.15** **ΔR=0.29** **ΔR=0.29**

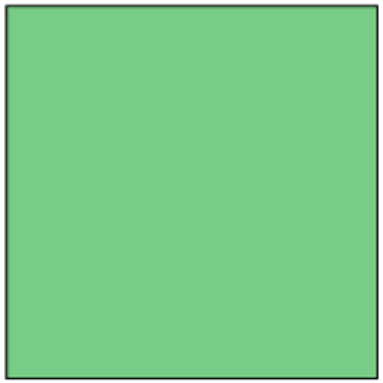
- Can increase solar reflectance by 0.3 or more
- Gain greatest for dark colors

Courtesy: American Rooftile Coatings

green metal panel

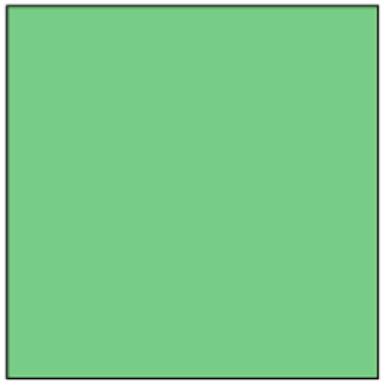
COURTESY BASF CORPORATION

cool

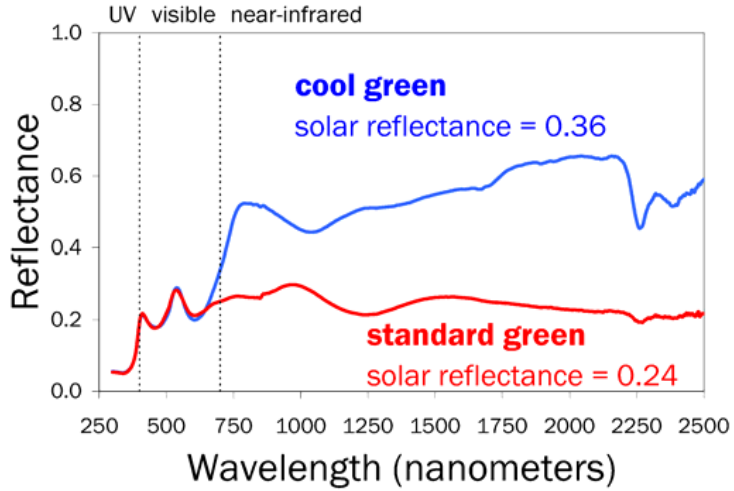


solar reflectance = 0.36
thermal emittance = 0.85
roof temp – air temp = 31°C (56°F)

standard



solar reflectance = 0.24
thermal emittance = 0.85
roof temp – air temp = 38°C (68°F)



Source: Hashem Akbari, LBNL

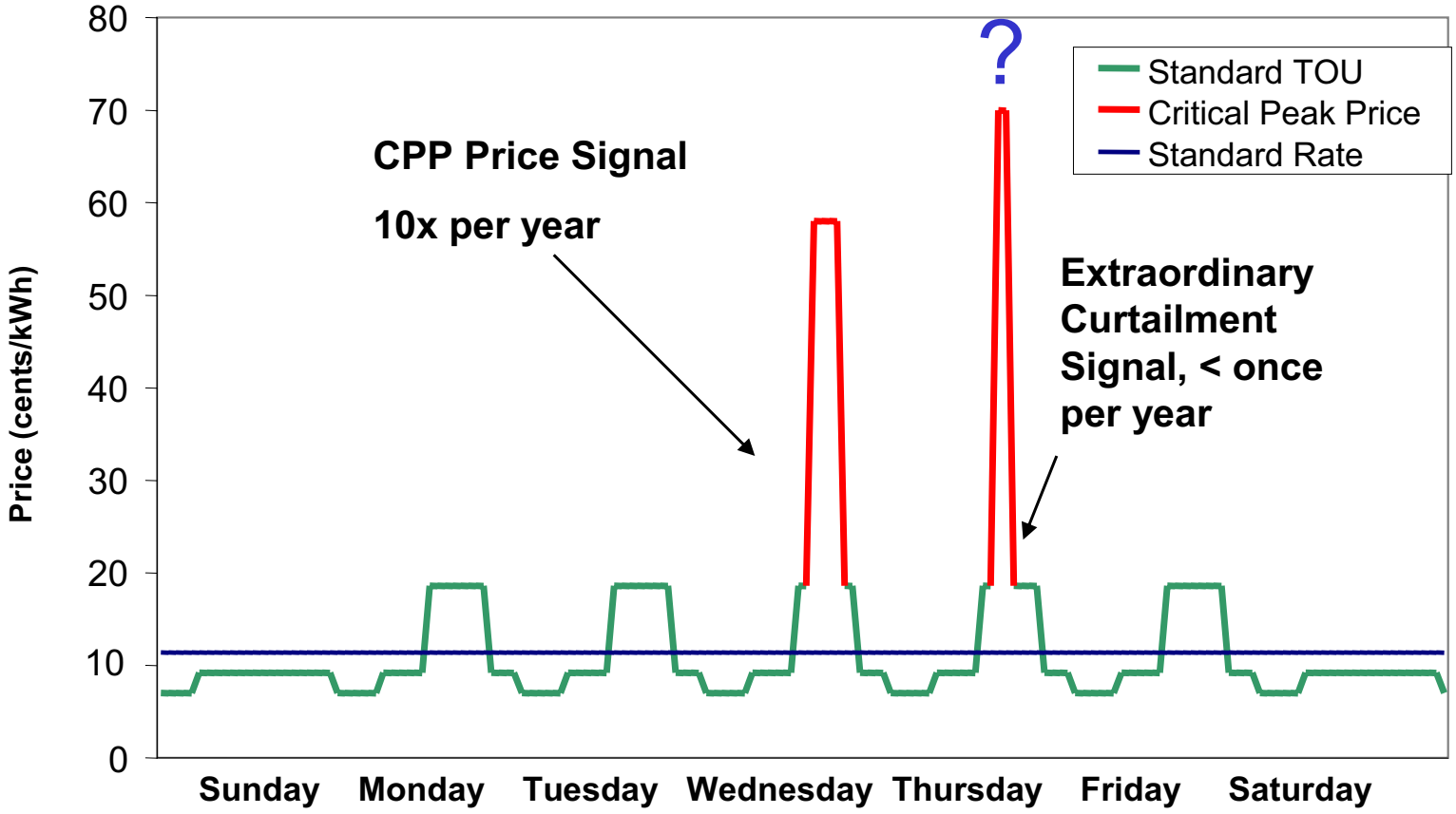
If cool roofs are good for buildings, then cool pigments are good for cars.

- Fleets should start ordering only white, silver, or gold cars
  - thus reducing emissions by ~4%
- Cars world-wide should use light colors or cool-colored pigments.
  - This allows the manufacturer to downsize the air conditioner and thus reduce first cost and reduce emissions.

Critical Peak Pricing (CPP)
with additional curtailment option

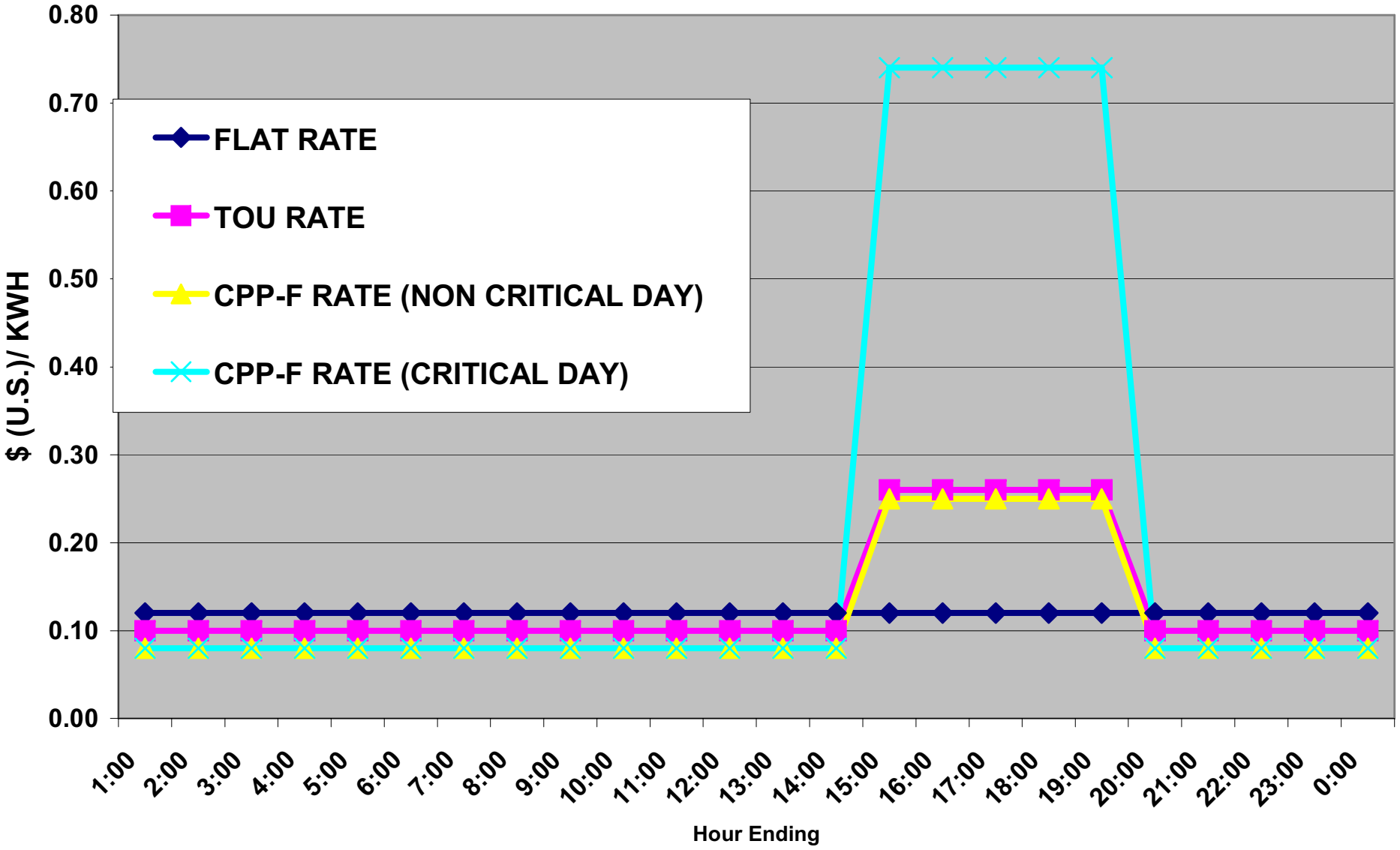
Potential Annual Customer Savings:

10 afternoons x 4 hours x 1kw = 40 kWh at 70 cents/kWh = ~$30/year



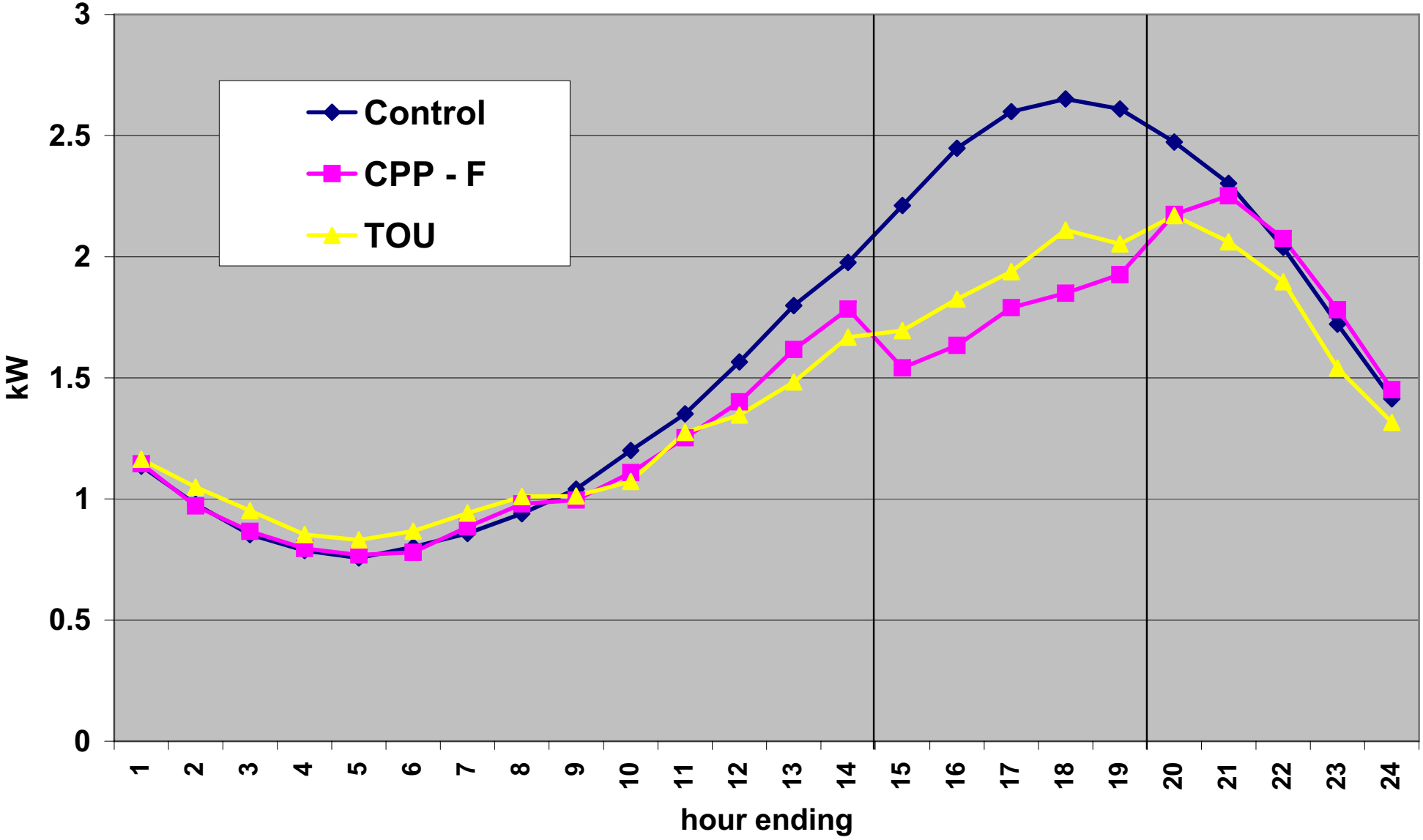
2004

Tariffs being Tested in California Pilot



2005

Climate Zone 4 (Very Hot Areas) on CPP Days



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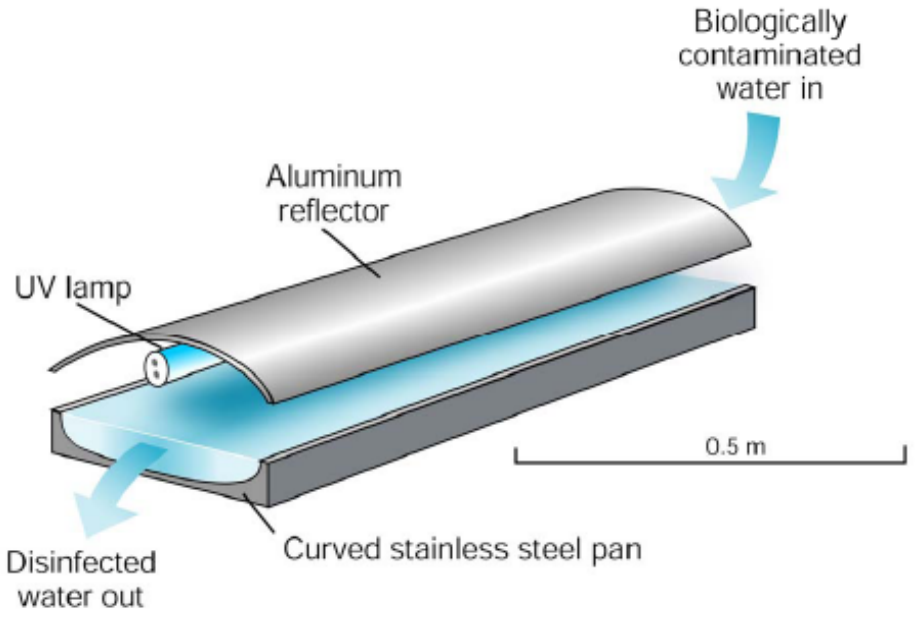
1993
UV Water Works



UV Water Works

- Unique water purification system
- Effective on all water-borne bacteria and viruses
- Inexpensive to buy and operate
- Simple to use, low maintenance
- Uses 6,000 times less energy than boiling
- Accepted by villagers, universal use
- Works with the flow from a standard hand pump (treats 4 gallons/min)

Source : EETD.LBL.gov or WaterHealth.com

Afghan Refugee Housing, 2002

Arthur Rosenfeld, 34

Truck Supported by Panels

(6” expanded polystyrene clad with plywood. Pickup supported by 2 panels each 4’ x 24’)