Emerging Technologies Summit
Long Beach CA
26 Oct. 2006

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California Energy Commission

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

Or just Google "Art Rosenfeld"

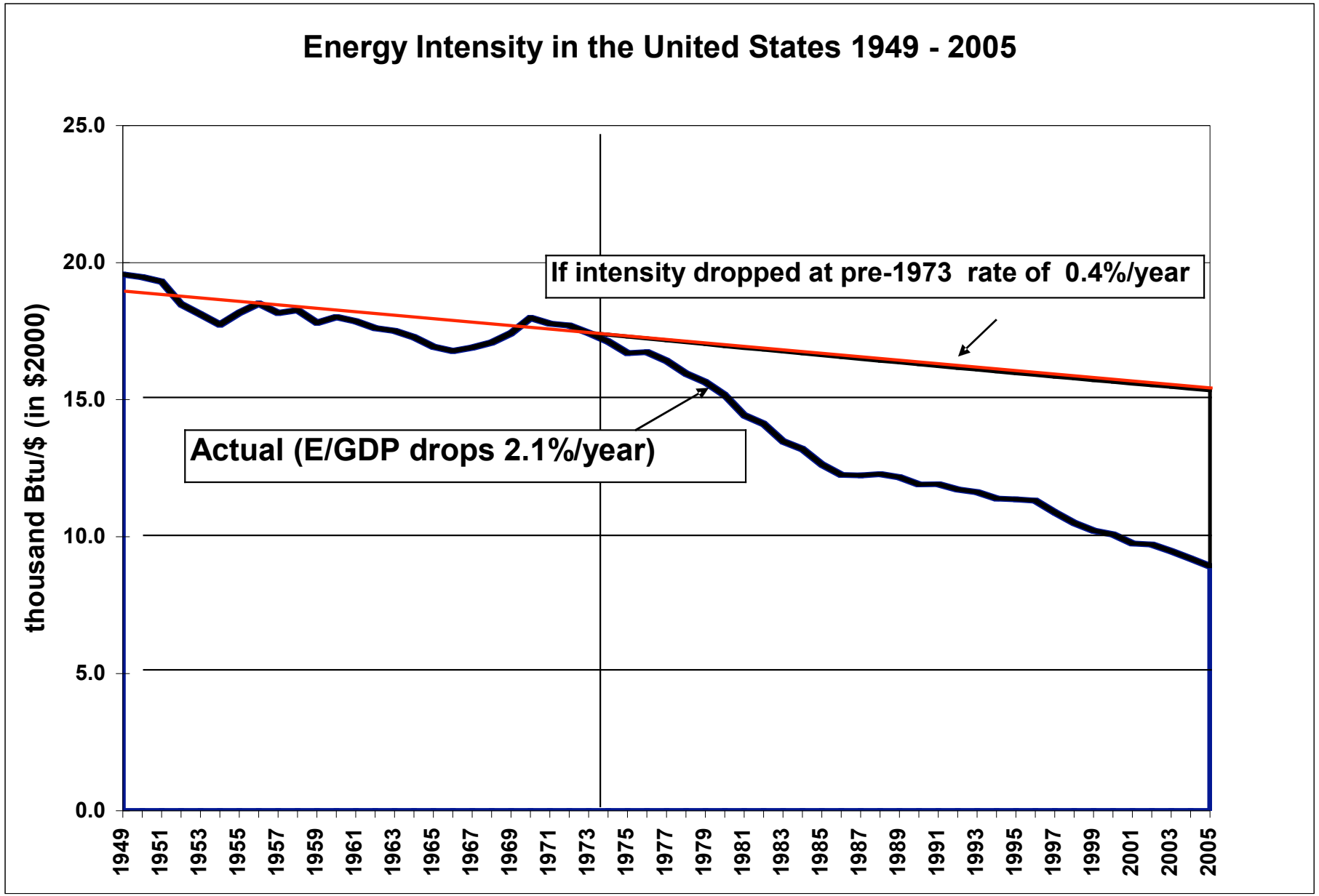
Start =Google, 30 min.

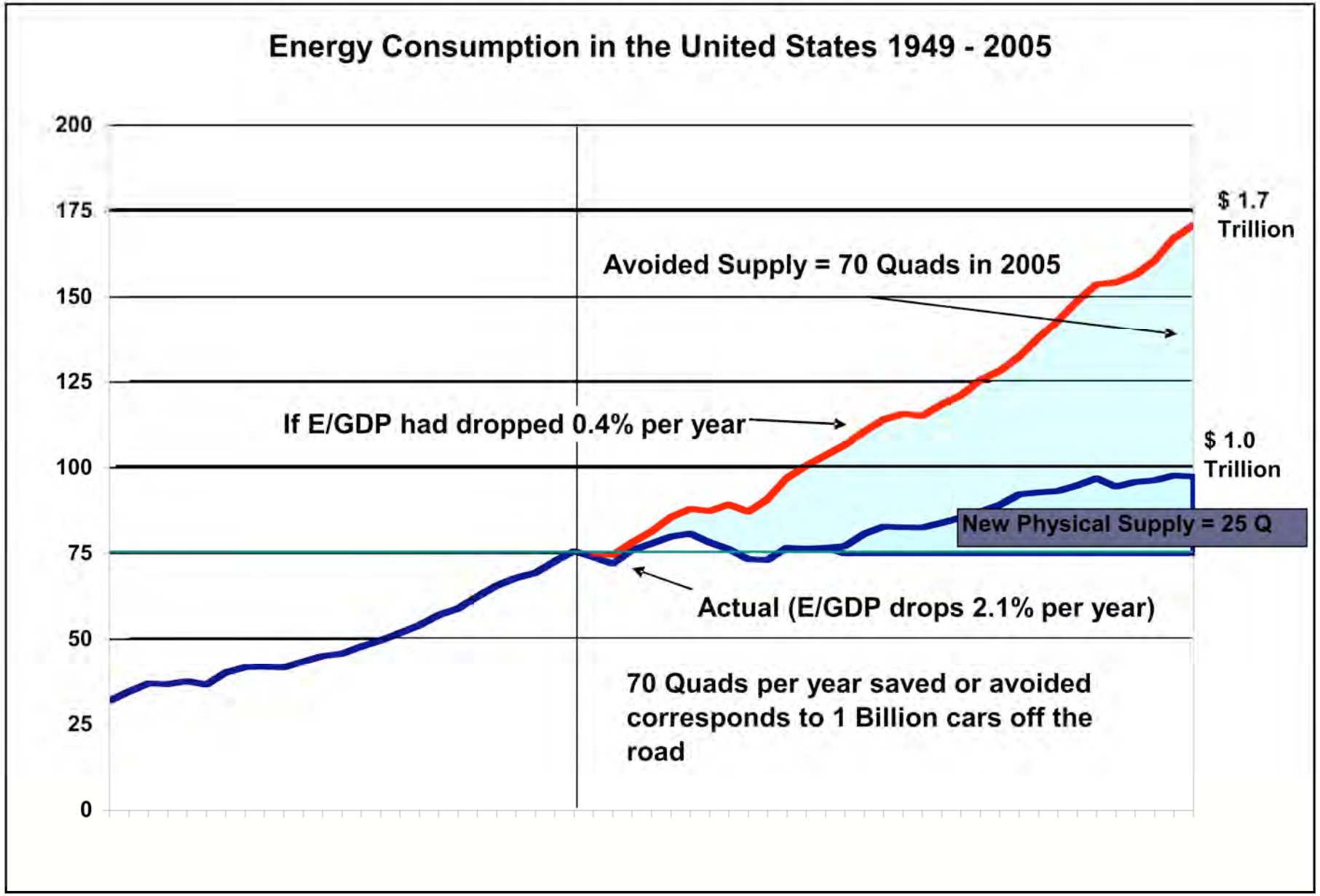
1949

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


Energy Intensity in the United States 1949 - 2005
thousand Btu/$ (in $2000)
25.0
20.0
15.0
10.0
5.0
0.0
If intensity dropped at pre-1973 rate of 0.4%/year
Actual (E/GDP drops 2.1%/year)
1949
1951
1953
1955
1957
1959
1961
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005


Energy Consumption in the United States 1949 - 2005
200
175
150
125
100
75
50
25
0
$ 1.7 Trillion
Avoided Supply = 70 Quads in 2005
If E/GDP had dropped 0.4% per year
$ 1.0 Trillion
New Physical Supply = 25 Q
Actual (E/GDP drops 2.1% per year)
70 Quads per year saved or avoided corresponds to 1 Billion cars off the road

How Much of The Savings Come from Efficiency?

- Easiest to tease out is cars
  - In the early 1970s, only 14 miles per gallons
  - Now about 21 miles per gallon
  - If still at 14 mpg, we'd consume **75 billion gallons more** and pay **$225 Billion more** at 2006 prices
  - But we still pay **$450 Billion per year**
  - If California wins the "Schwarzenegger-Pavley" suit, and it is implemented nationwide, we'll save **another $150 Billion per year**
- Commercial Aviation improvements save another **$50 Billion per year**
- Appliances and Buildings are more complex
  - We must sort out true efficiency gains vs. structural changes (from smokestack to service economy).

How Much of The Savings Come from Efficiency (cont'd)?

- Some examples of estimated savings in 2006 based on 1974 efficiencies minus 2006 efficiencies

	Billion $
Space Heating	40
Air Conditioning	30
Refrigerators	15
Fluorescent Tube Lamps	5
Compact Floursecent Lamps	5
Total	**95**

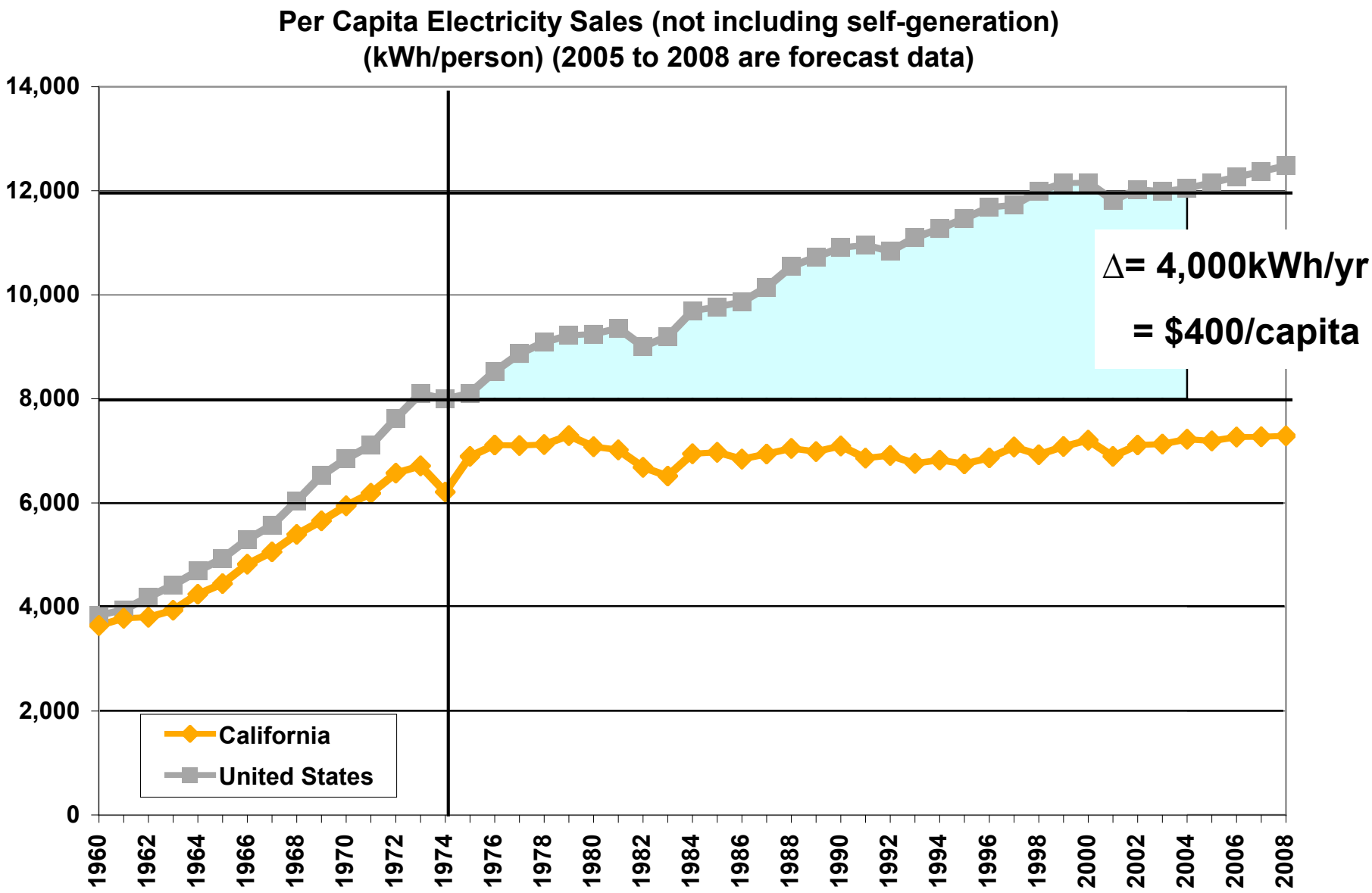
- Beginning in 2007 in California, reduction of "vampire" or stand-by losses
  - This will save $10 Billion when finally implemented, nation-wide
- Out of a total **$700 Billion**, a crude summary is that 1/3 is structural, 1/3 is transportation, and 1/3 is buildings and industry.

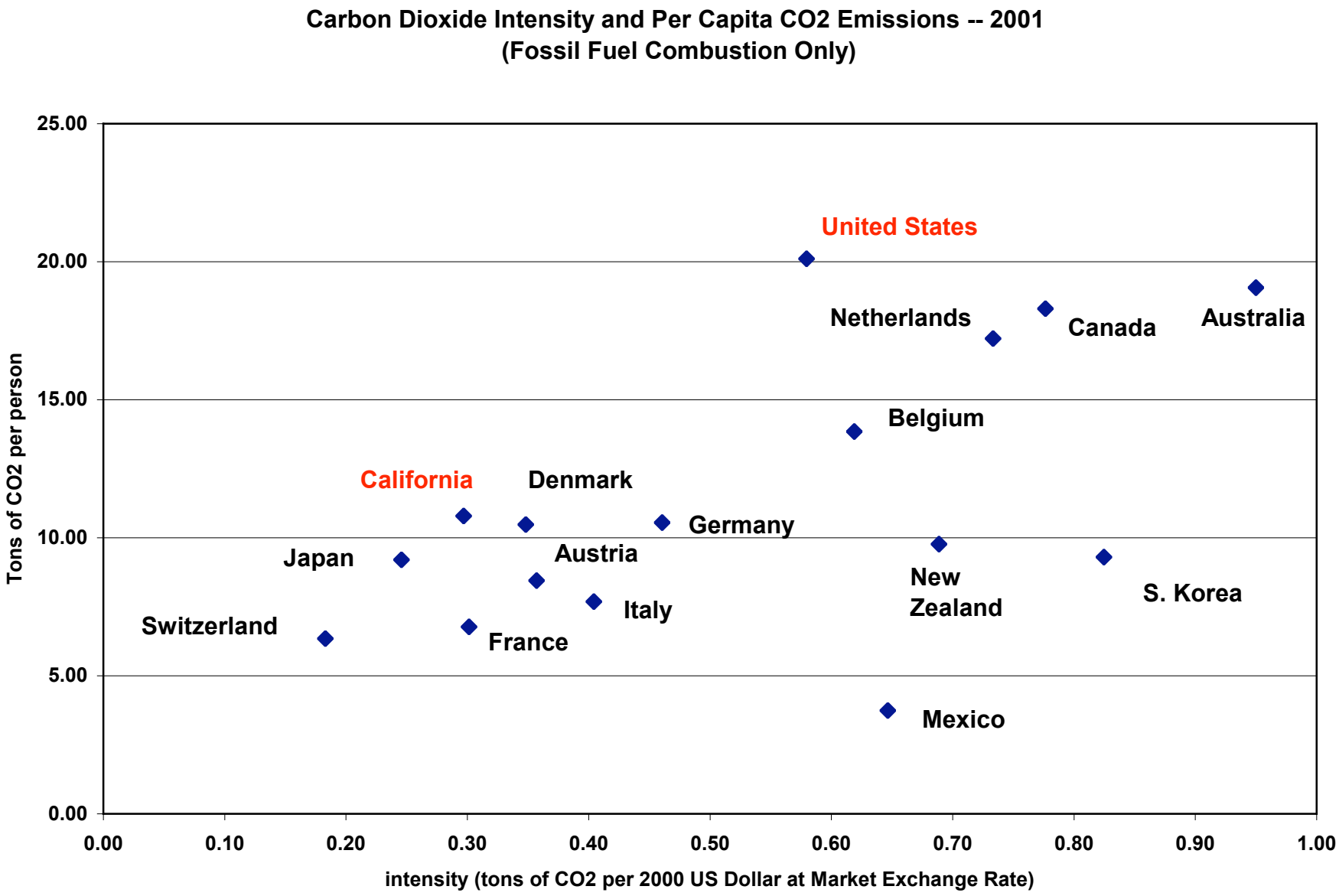
A supporting analysis on the topic of efficiency from Vice-President Dick Cheney

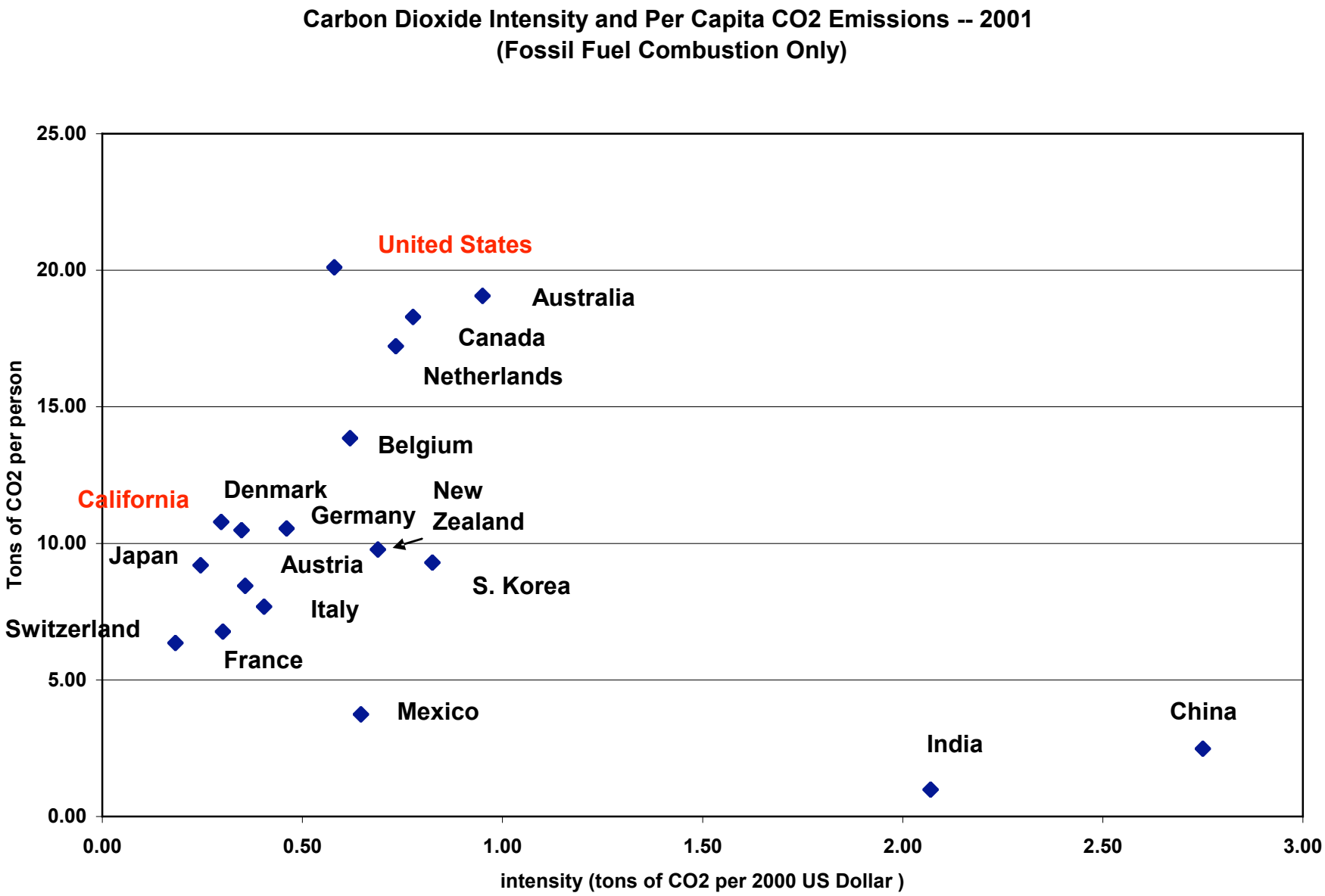
- "Had energy use kept pace with economic growth, the nation would have consumed 171 quadrillion British thermal units (Btus) last year instead of 99 quadrillion Btus"
- "About a third to a half of these savings resulted from shifts in the economy. The other half to two-thirds resulted from greater energy efficiency"

Source: National Energy Policy: Report of the National Energy Policy Development Group, Dick Cheney, et. al., page 1-4, May 2001

Cheney could have noted that 72 quads/year saved in the US alone, would fuel one Billion cars, compared to a world car count of only 600 Million


Per Capita Electricity Sales (not including self-generation)
(kWh/person) (2005 to 2008 are forecast data)
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
California
United States
Δ= 4,000kWh/yr
= $400/capita


Carbon Dioxide Intensity and Per Capita CO2 Emissions -- 2001
(Fossil Fuel Combustion Only)
Tons of CO2 per person
25.00
20.00
15.00
10.00
5.00
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
intensity (tons of CO2 per 2000 US Dollar at Market Exchange Rate)
United States
Netherlands
Canada
Australia
Belgium
California
Denmark
Germany
Japan
Austria
New Zealand
S. Korea
Italy
Switzerland
France
Mexico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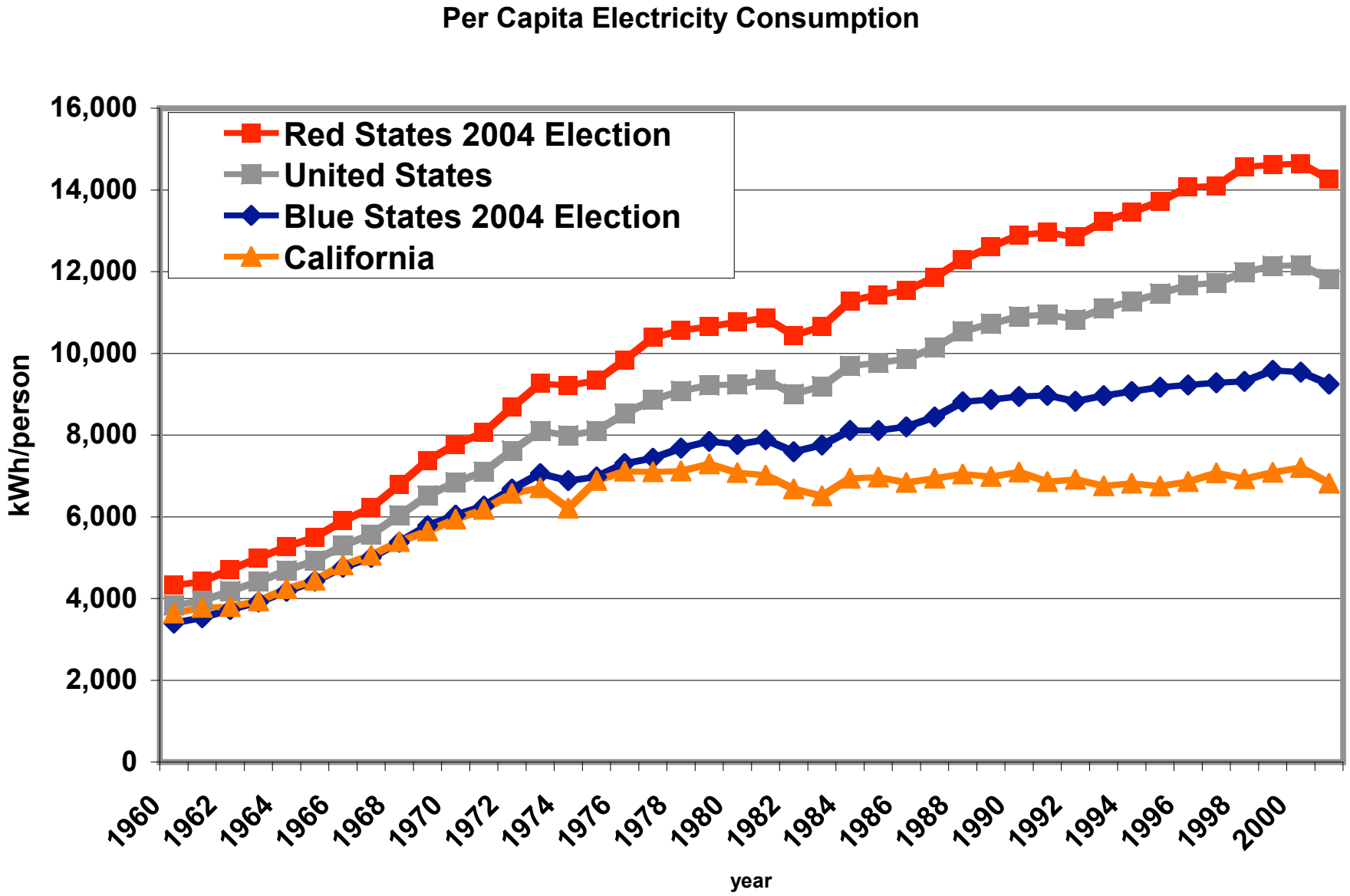
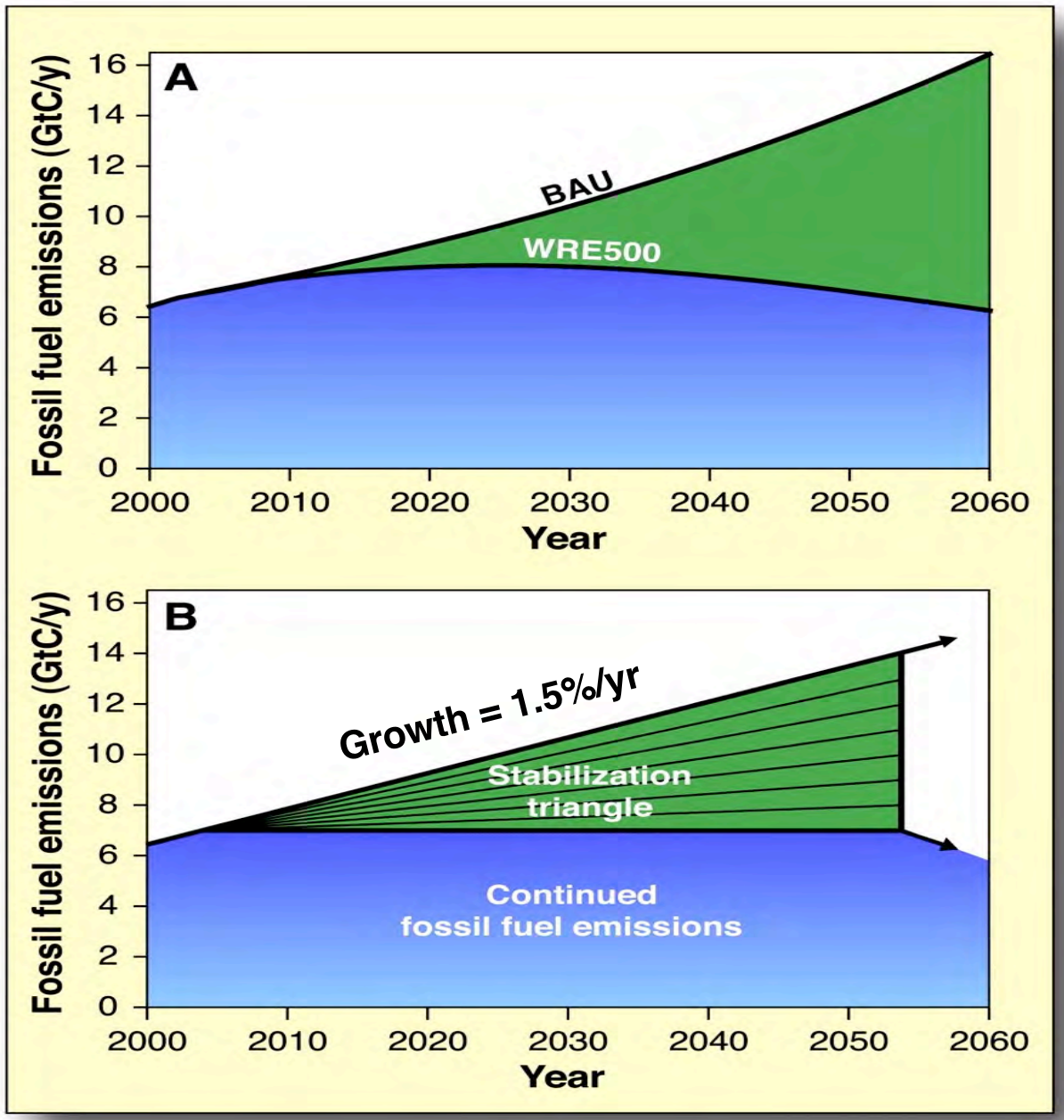
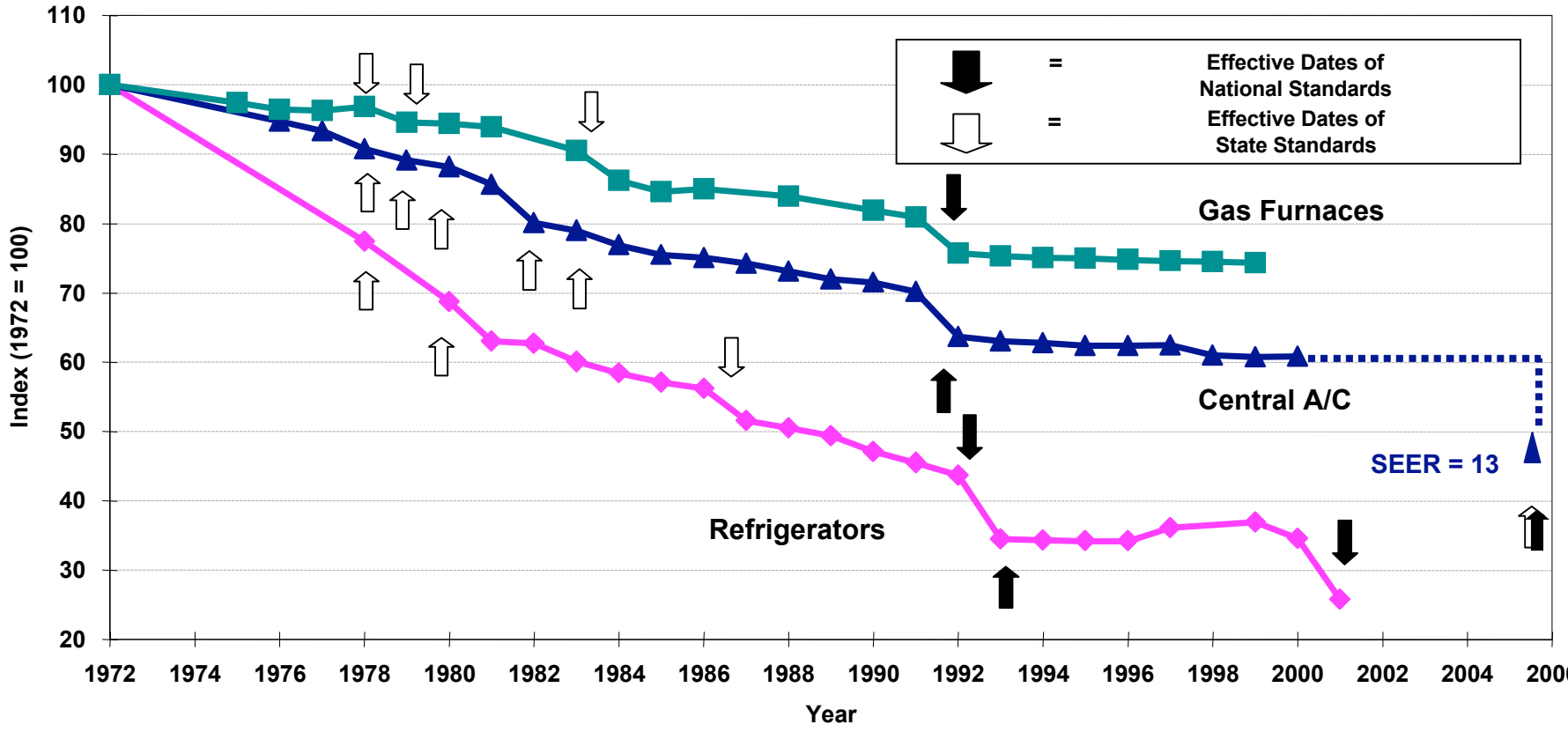
Tons of CO2 per person
25.00
20.00
15.00
10.00
5.00
0.00
0.00
0.50
1.00
1.50
2.00
2.50
3.00
intensity (tons of CO2 per 2000 US Dollar)
United States
Australia
Canada
Netherlands
Belgium
California
Denmark
Germany
New Zealand
Japan
Austria
S. Korea
Italy
Switzerland
France
Mexico
China
India


Per Capita Electricity Consumption
Red States 2004 Election
United States
Blue States 2004 Election
California
kWh/person
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
year



Source: Stabilization Wedges: Pacala and Socolow, Science Vol 305, page 968

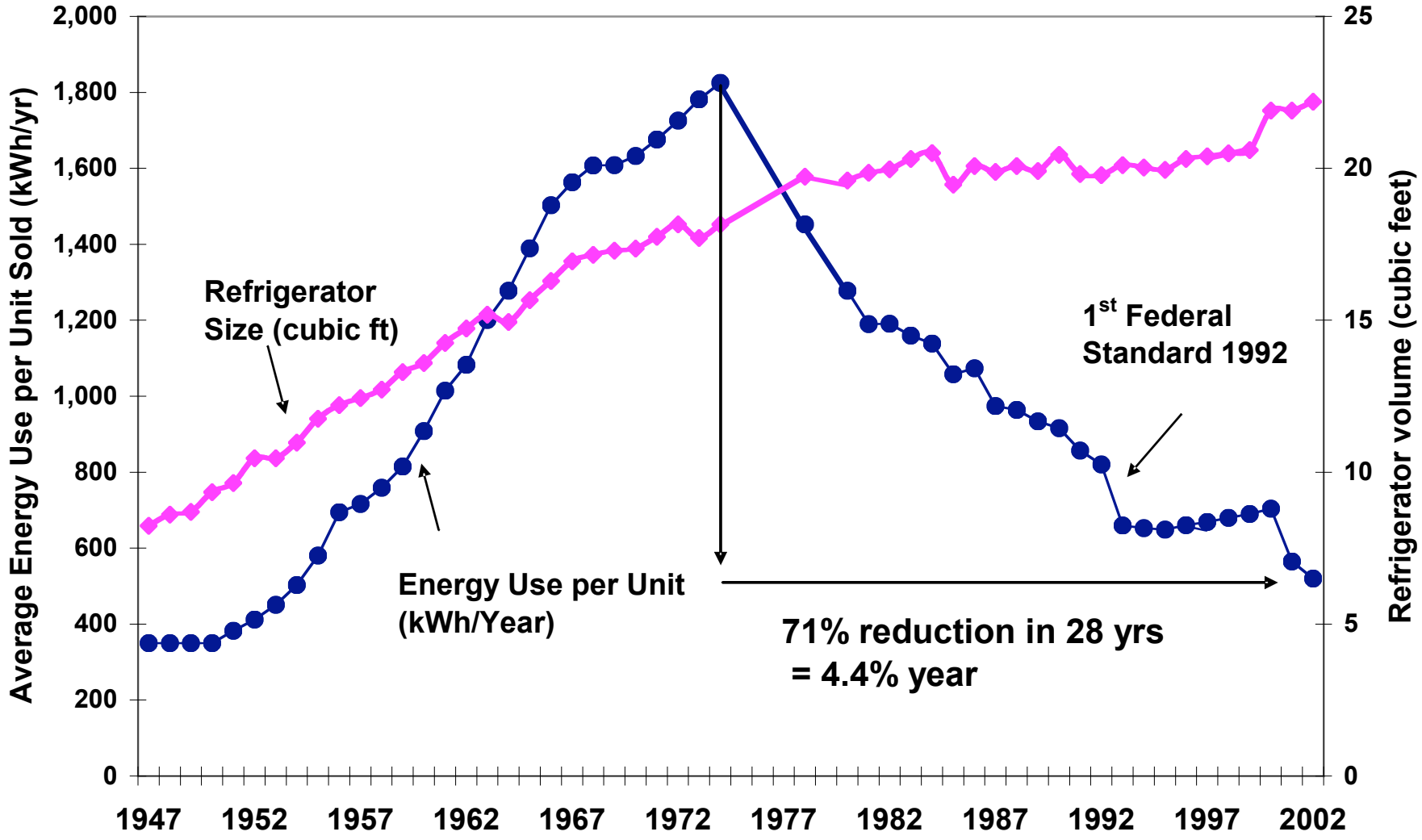
Impact of Standards on Efficiency of 3 Appliances



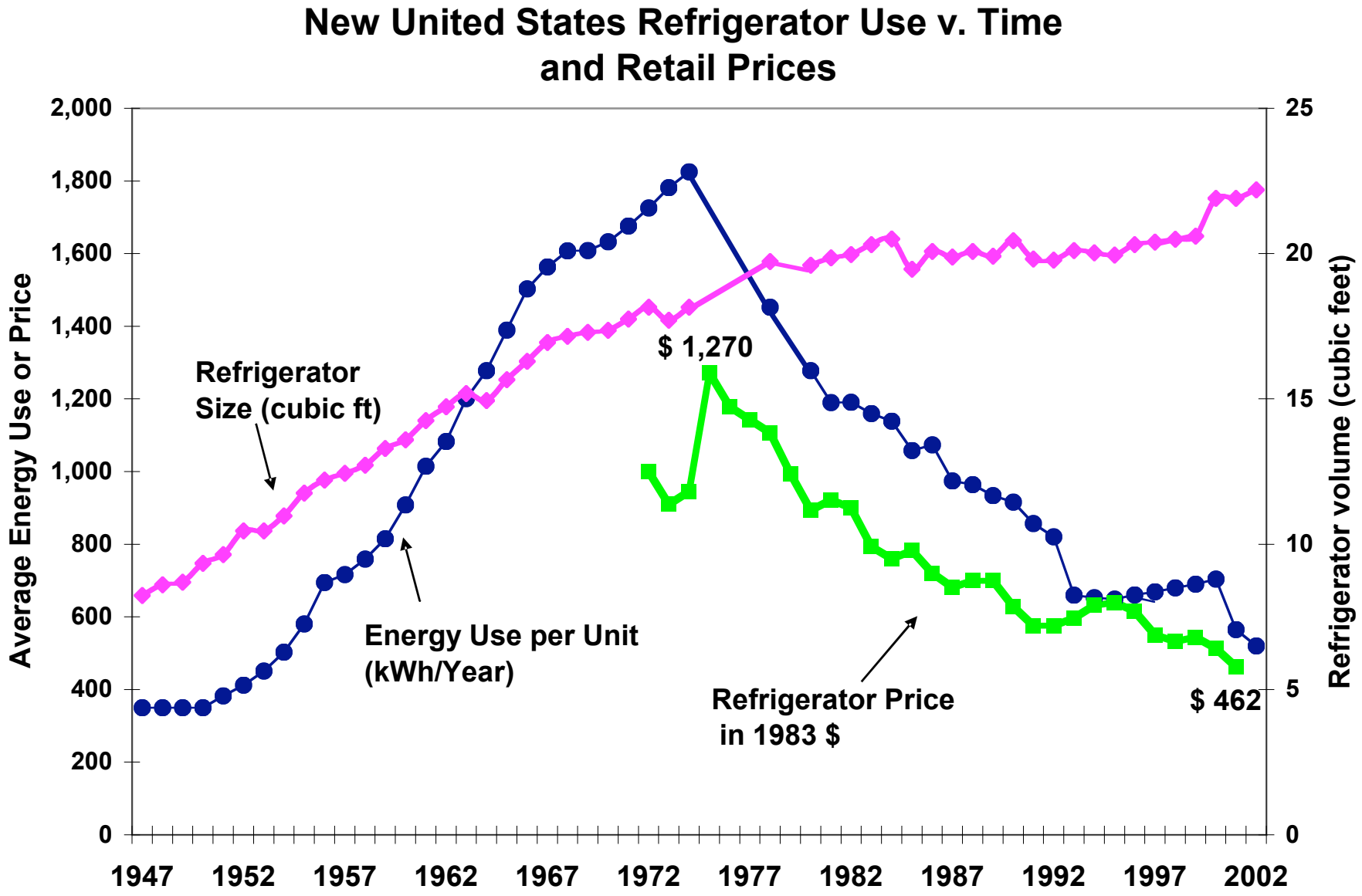
Source: S. Nadel, ACEEE,

in ECEEE 2003 Summer Study, www.eceee.org

New United States Refrigerator Use v. Time

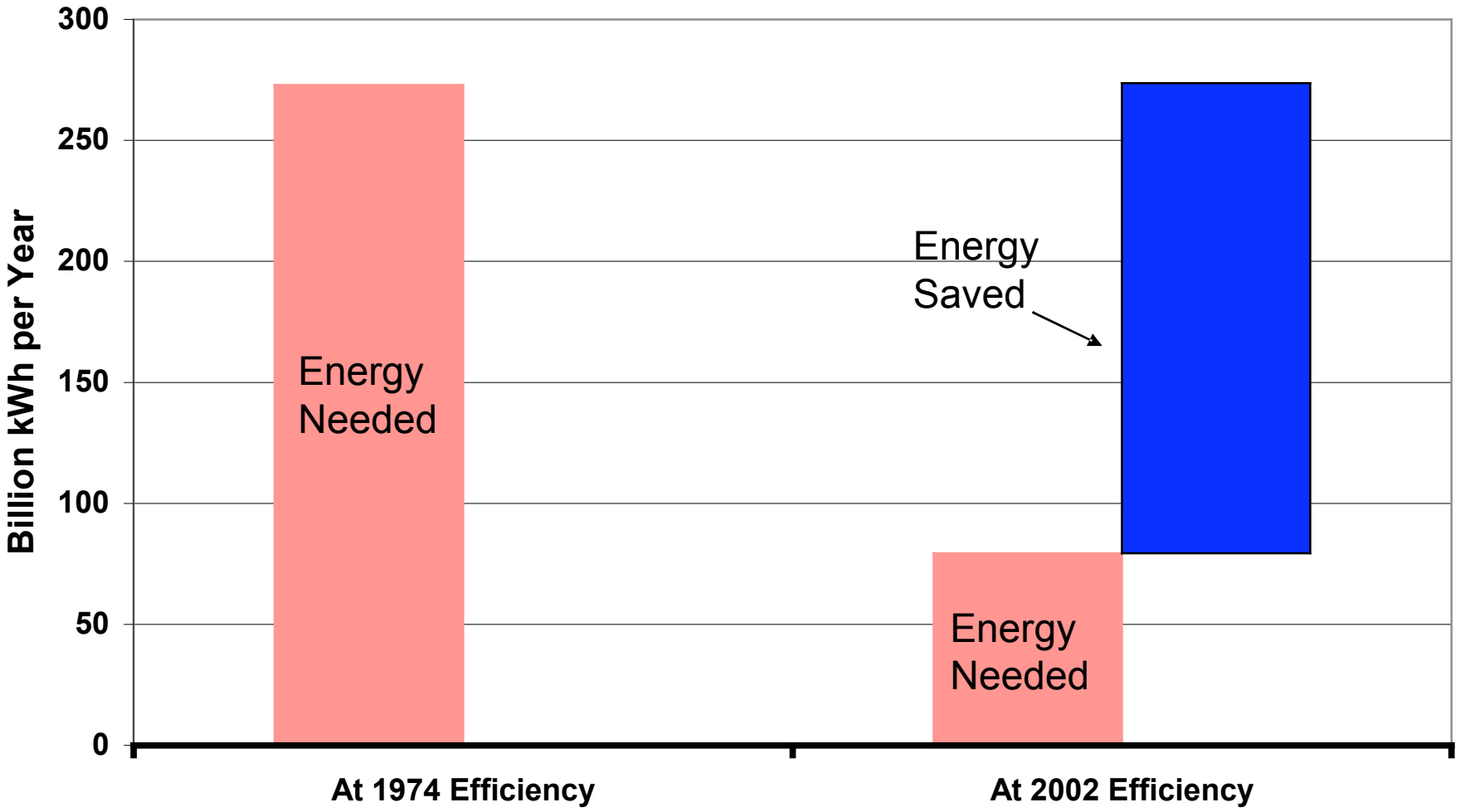


Source: David Goldstein

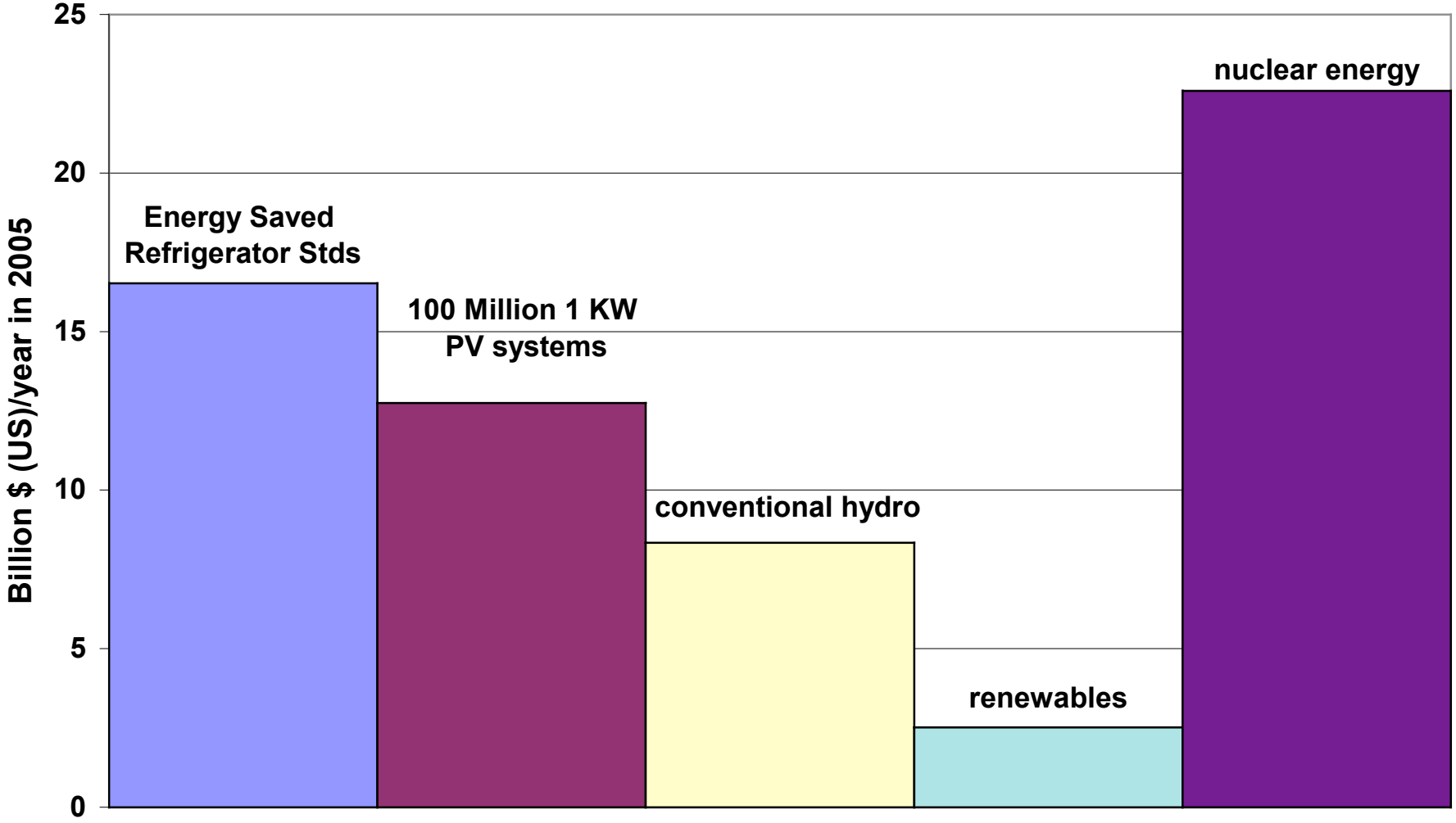


Source: David Goldstein

New Refrigerator Energy Use: 71% will be saved when stock completely turns over to 2001 Standards

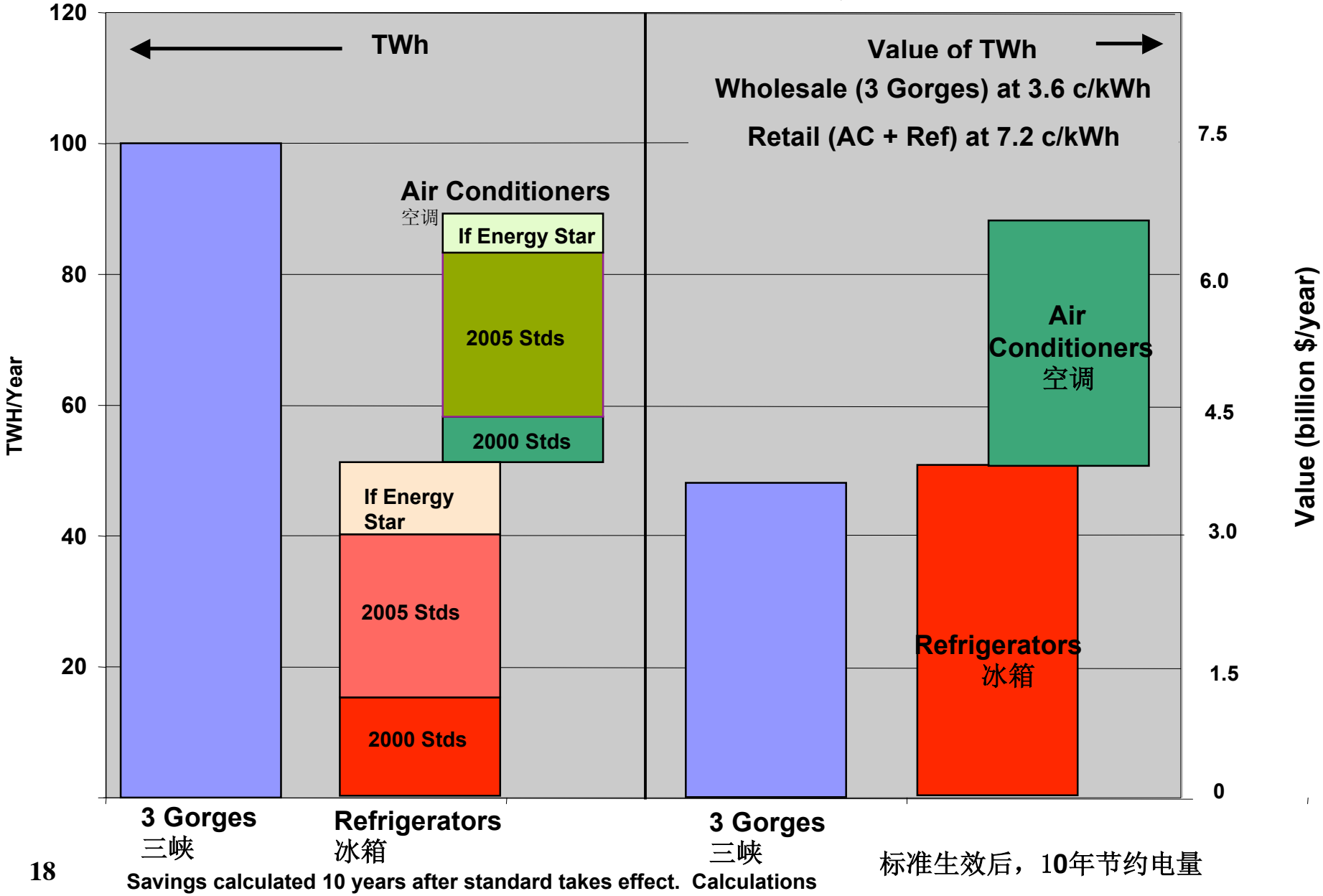


Value of Energy to be Saved (at 8.5 cents/kWh, retail price) vs. Several Sources of Supply in 2005 (at 3 cents/kWh, wholesale price)



Comparison of 3 Gorges to Refrigerator and AC Efficiency Improvements

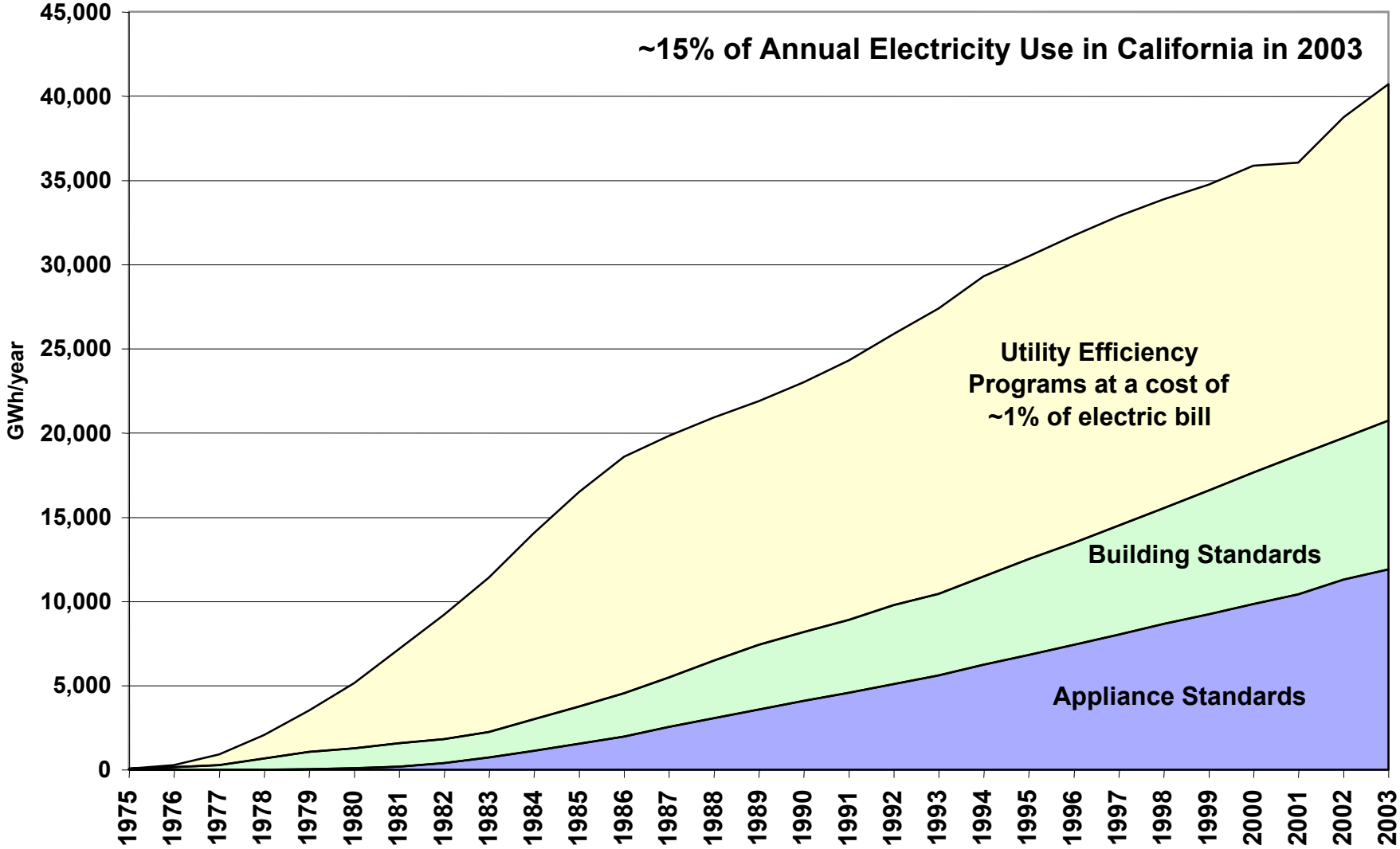
三峡电量与电冰箱、空调能效对比



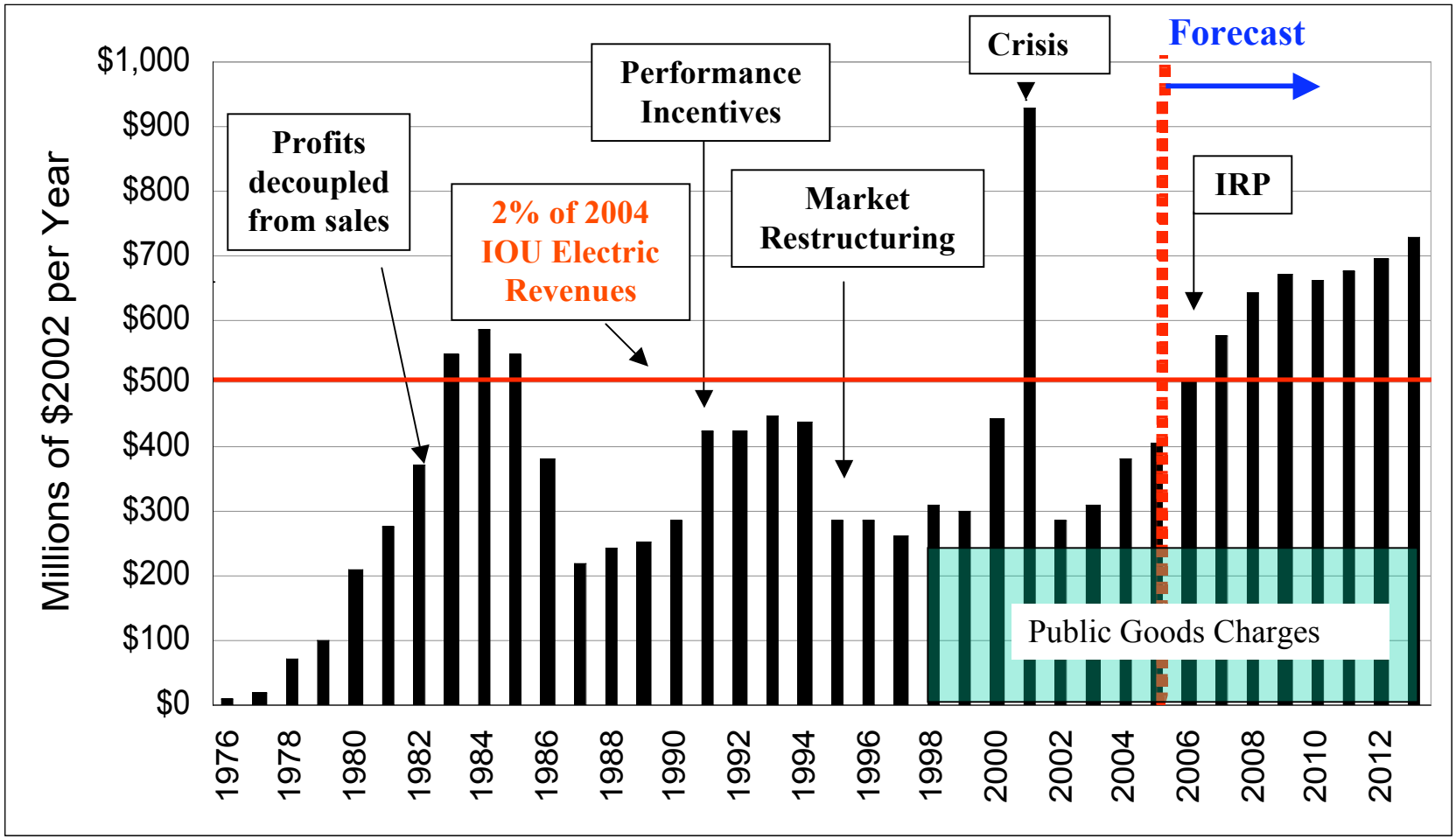
Savings calculated 10 years after standard takes effect. Calculations provided by David Fridley, LBNL

标准生效后，10年节约电量

Annual Energy Savings from Efficiency Programs and Standards



California IOU's Investment in Energy Efficiency



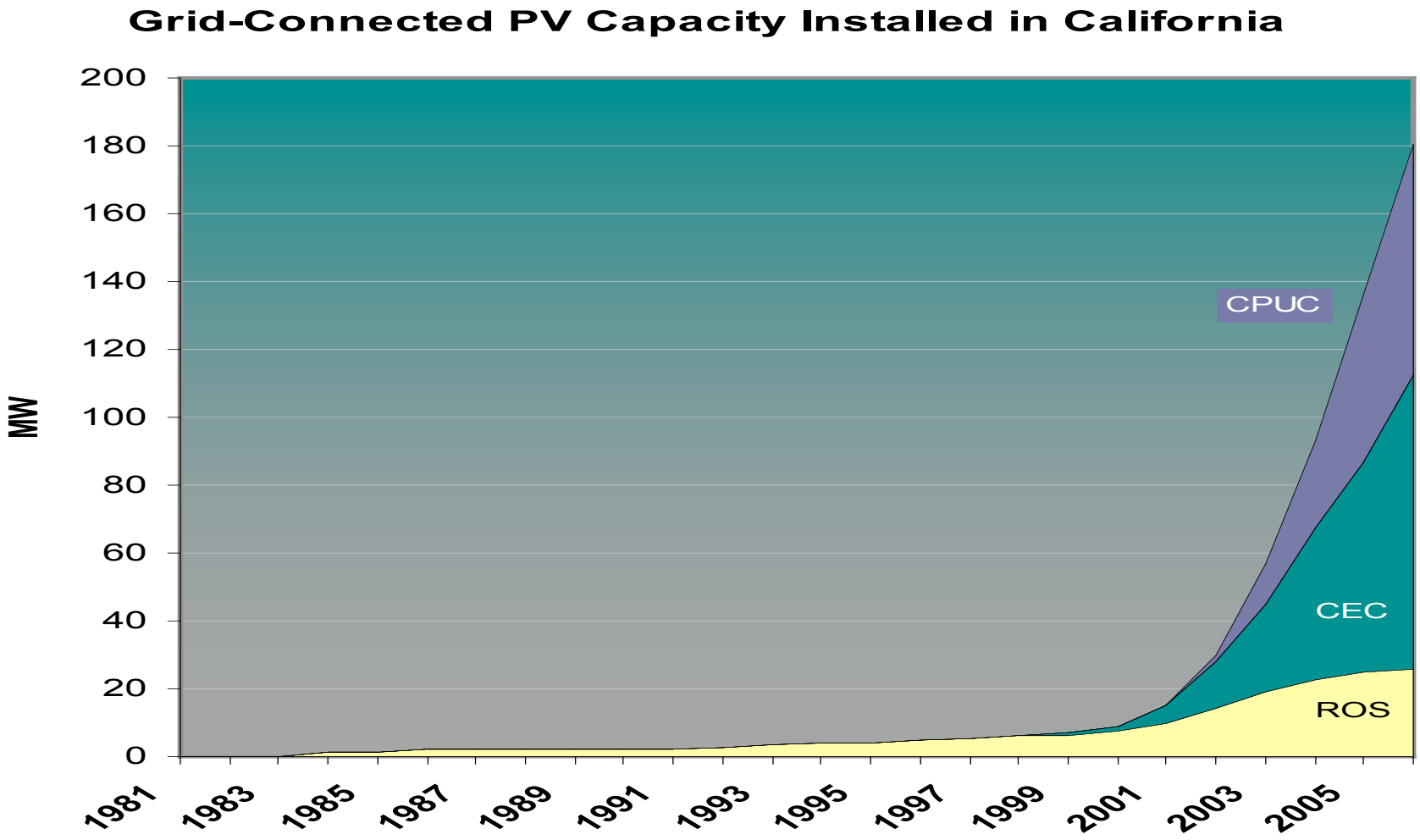
A New Start In Solar –

The New Solar Homes Partnership

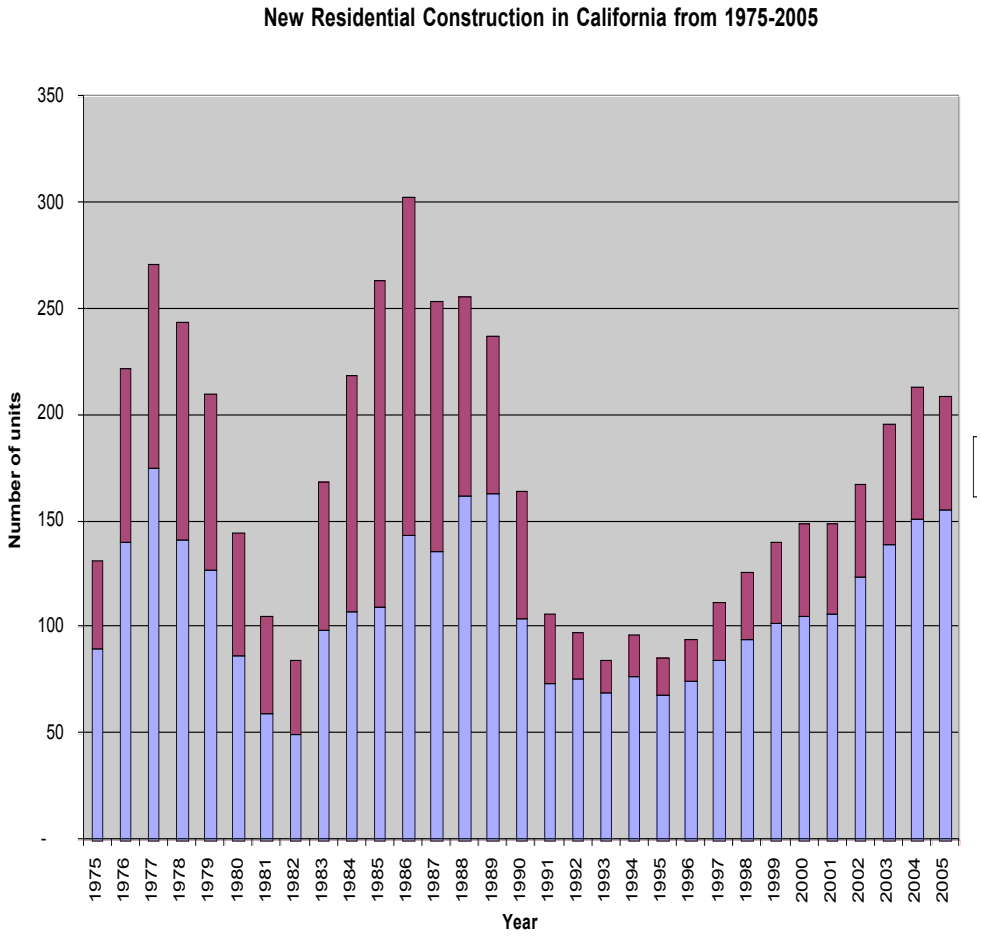
Timothy Tutt
Advisor to
Chairperson Jackalyne Pfannenstiel

Solar Power 2006
October 17
San Jose, CA

Building Off A Running Start



New Solar Homes Partnership



- **$400 Million**
- **10 Years**
- **New Residential Construction**
  - **Production**
  - **Custom**
  - **Affordable**

Renewed Focus On Four Aspects

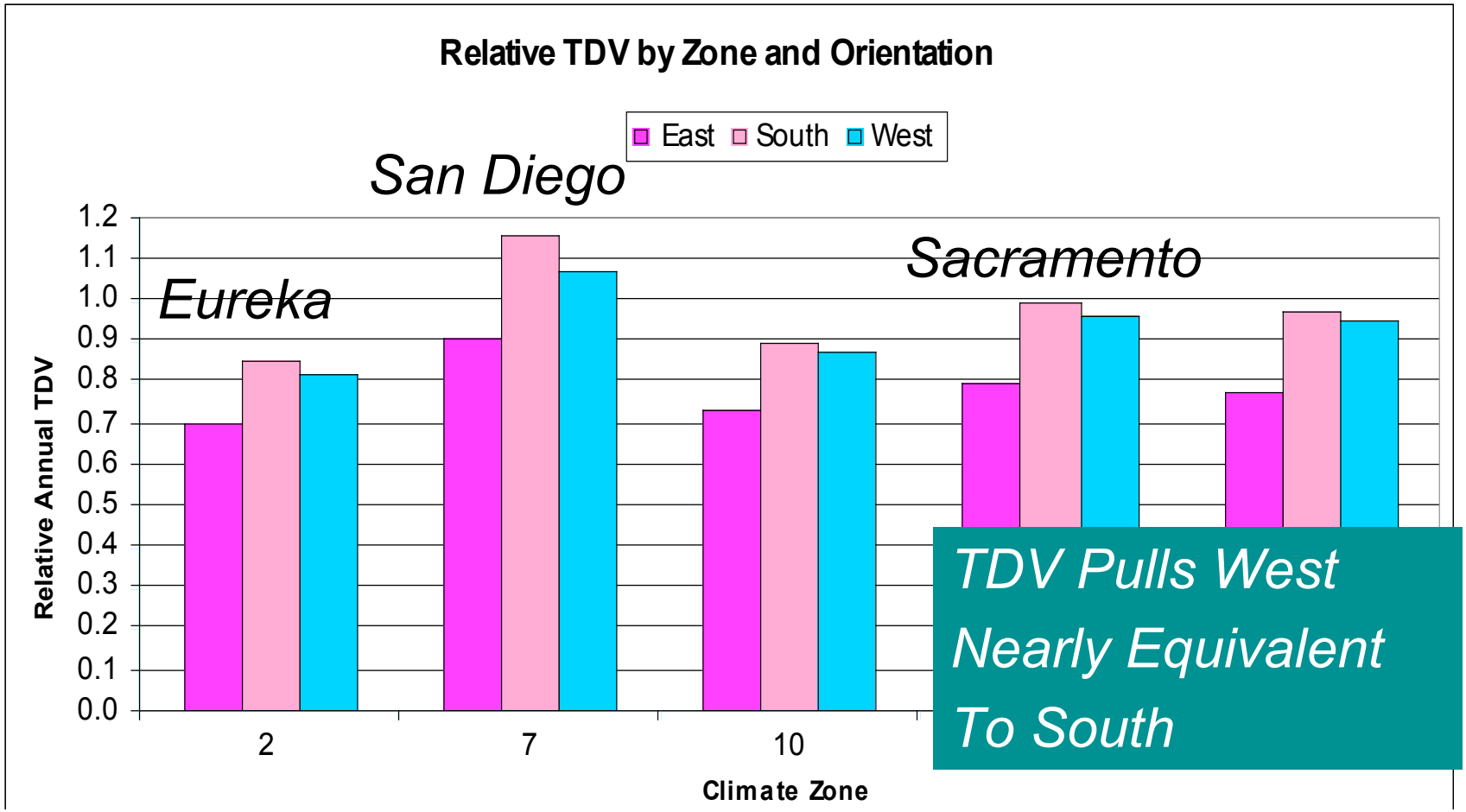
- ***System Performance***
- ***Energy Efficiency***
- ***Utility Role***
- ***Affordable Housing***

Expected Performance Based Incentives

- ✓ **Incentives Based On:**
  - ✓ **Location –**
    - ✓ **Insolation**
    - ✓ **Time Dependent Valuation**
  - ✓ **Equipment**
    - ✓ **Modules**
    - ✓ **Inverters**
  - ✓ **Installation**
    - ✓ **Orientation**
    - ✓ **Tilt**
    - ✓ **Shading**

Performance Focus On Design Stage, Where Most Effective

Location, Orientation, Value



Field Verification

- Visual Inspection
  - Verify Site-Specific Installation Is As Expected
- Performance Verification
  - Verify AC Output Within Expectations
- Installer Checks 100% With Checklist
- HERS Rater Independently Checks Sample

Tier I – Minimum Condition of Participation

- 15% Savings Beyond 2005 Building Standards
- Consistent With Current Utility New Construction Programs
- Include High Efficacy Lighting With Limited Exceptions
- Include Energy Star Appliances
- Expect Energy Efficiency Incentives From Utility Programs

Tier II – Commission Preferred Level

- Everything in Tier I … Plus
  - 35% Savings Beyond T-24 Total Energy Budget
  - 40% Savings Beyond T-24 Space Cooling Budget
- Moves Towards Zero Energy New Homes
- Achieved by Current Building America Homes in California
- Commission Seeks CPUC/Utility Support for New Construction Program Incentives for Tier II

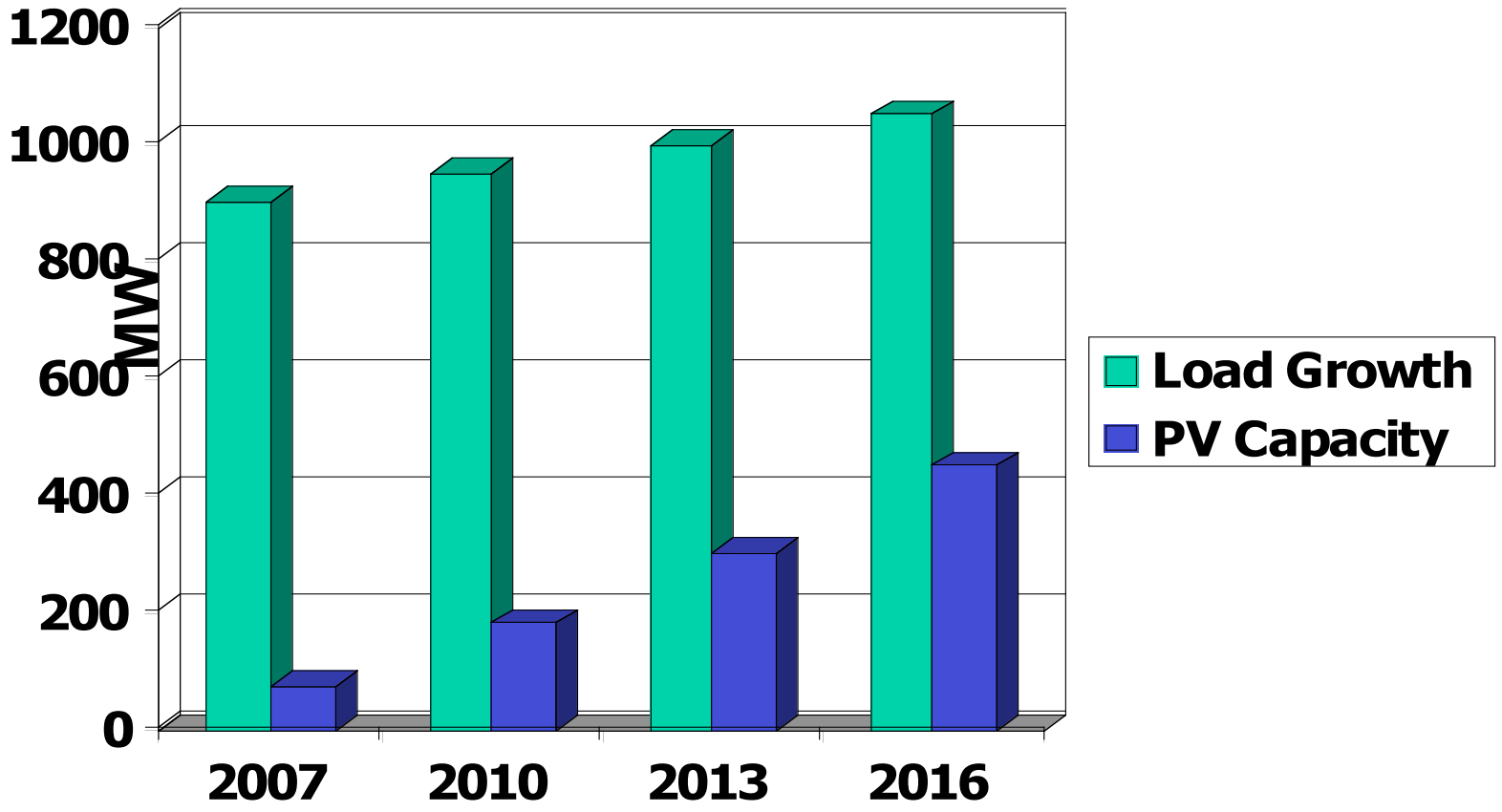
Tier II Efficiency Measures - Examples

- R-38 Ceiling Insulation
- High Efficiency Central Heat (92% AFUE)
- High Efficiency AC (14 SEER with TXV)
- Ducts Sealed, Buried in Ceiling Insulation
- Tankless 0.82 EF Water Heater
- Fluorescent Lighting
- White roofs (instead of just “cool colored”)

Goals Of SB 1

- "… to install solar energy systems with a generation capacity equivalent to 3,000 megawatts …"
- "… to establish a self-sufficient solar industry in which solar energy systems are a viable mainstream option in 10 years…"
- "… to place solar energy systems on 50 percent of new homes in the 13th year … "

PV Pares Peak Growth



So In The End …

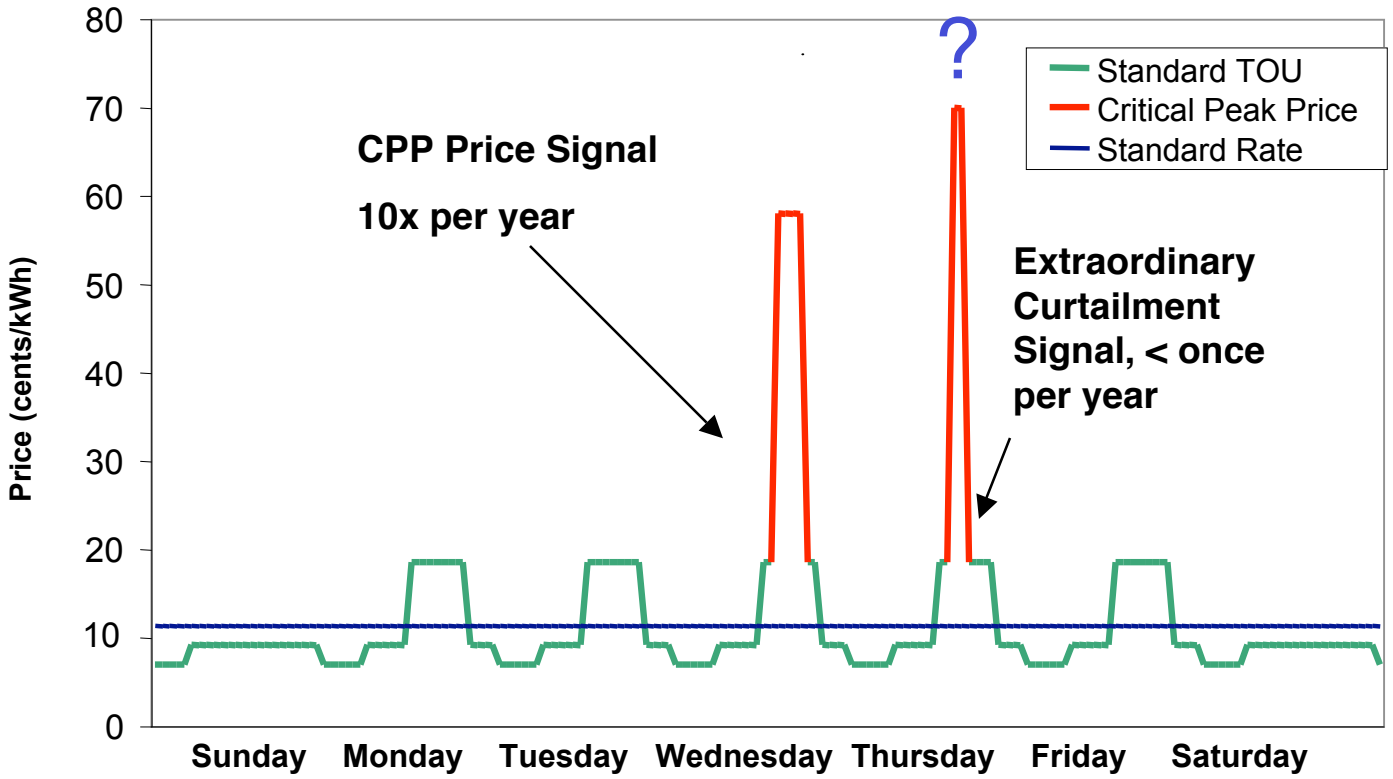
- To Meet Goals Of AB 32 We Have To Slow, Stop, Then Reverse Use of Carbon Producing Technologies

- California's Solar Initiative Is A Major Part of The Beginning Of That Effort

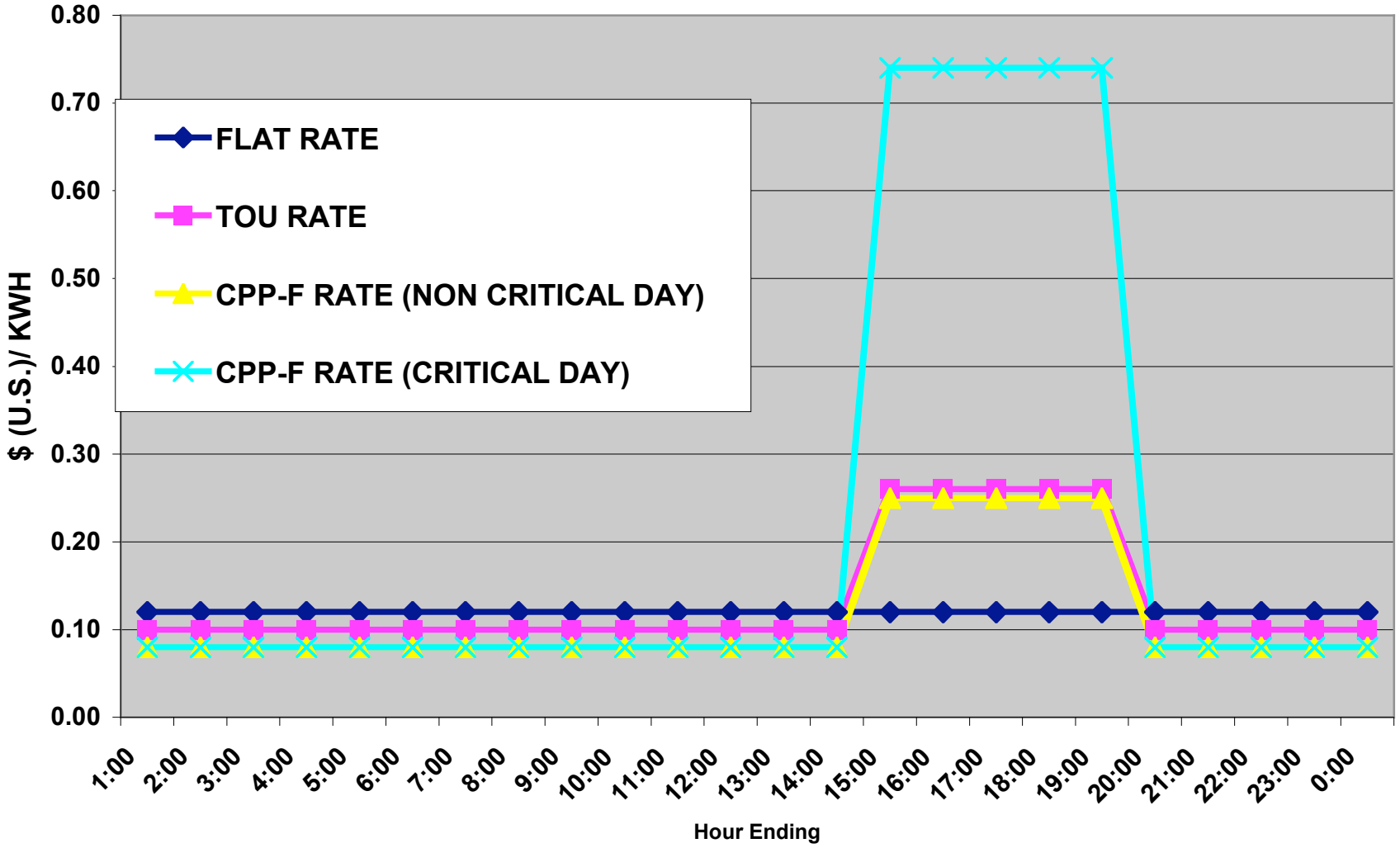
Critical Peak Pricing (CPP)

Potential Annual Customer Savings:

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



Tariffs being Tested in California Pilot



AutoDR - Results

Company	Avg kW Savings	Avg % Savings	Max kW Saving	events *(2003-4/2005)*	Setup Cost
ACWD	52	20%	84	4 (0)	$12,824
B of A	111	2%	227	3 (4)	$1,614
Chabot	18	5%	46	3 (1)	$4,510
50 Douglas	61	21%	85	4 (4)	$2,000
2530 Arnold	61	16%	92	1 (3)	$2,000
Echelon	78	25%	110	4 (3)	$3,620
Gilead	71	10%	208	4 (1)	$7,500
IKEA	219	12%	272	2 (0)	$5,050
Oracle	45	10%	65	1 (0)	$375
Target	33	10%	56	4 (1)	$3,312
USPS	202	15%	265	0 (2)	$12,000
Summary	951	13.4%			$57.62 / kW *

* Note: Average setup cost for AC load control is approximately $250.00 / kW

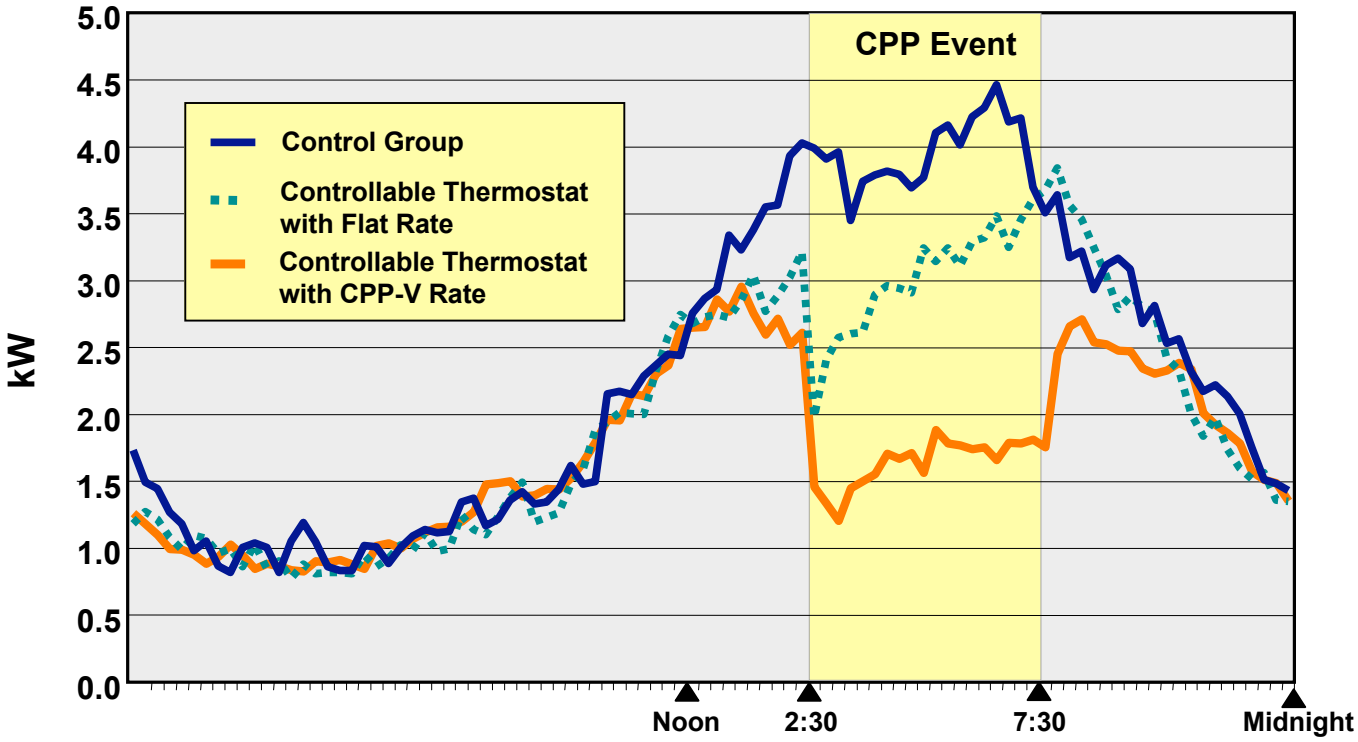
Demand Response, Retail Pricing Pilot, and Advanced Metering Infrastructure

- CPUC and CEC have been testing the impact of "CPP" (Critical Peak Pricing) on demand
  - Two summers of tests ($10 M experiment).
- Results for residential customers
  - 12% reduction when faced with critical peak prices and no technology
  - 30% to 40% reduction for customers with air conditioning, technology, and a critical peak price.
- PG&E and SDG&E will install advanced meters soon
- New Bldg. Standards (Title 24(2008)) will require smart meters and "PCTs" (Programmable Communicating Thermostats) in **all** new buildings and major retrofits, starting late 2008.

CPP rates – Load Impacts

Residential Response on a typical hot day
Control vs. Flat rate vs. CPP-V Rate

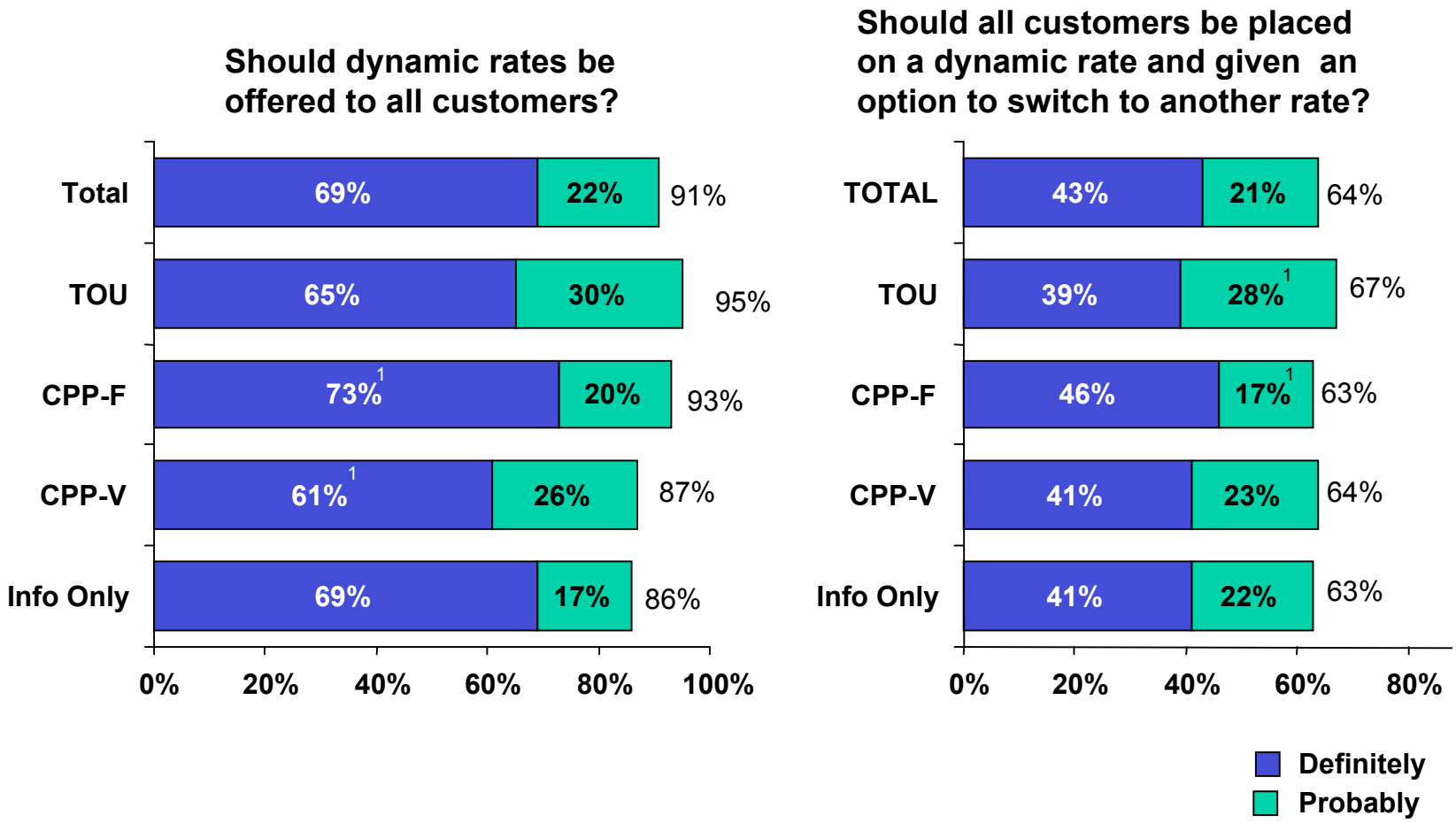
(Hot Day, August 15, 2003, Average Peak Temperature 88.5^0)



Source: Response of Residential Customers to Critical Peak Pricing and Time-of-Use Rates during the Summer of 2003, September 13, 2004, CEC Report.

Customer Acceptance of CPP rates

Residential participants express a strong interest in having dynamic rates offered to all customers.



Source: Statewide Pricing Pilot: End-of-Pilot Customer Assessment, December 2004, Momentum Market Intelligence.