

# Creating More Effective Energy Markets

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## Lessons from 20 Years Ago

- Economists told us at USEPA
  - Cost of limiting CFCs was stratospherically high
  - \$6 tax per pound would lead to 14% growth in baseline
  - No substitutes for CFC113
- We did not accept the validity of these conclusions
  - Decided on 10 Year Phaseout
  - Industry and government rallied to meet deadline
    - Institutional changes
    - New Options
  - Cost was negative
    - As innovation developed superior methods
    - Neglected superior options adopted

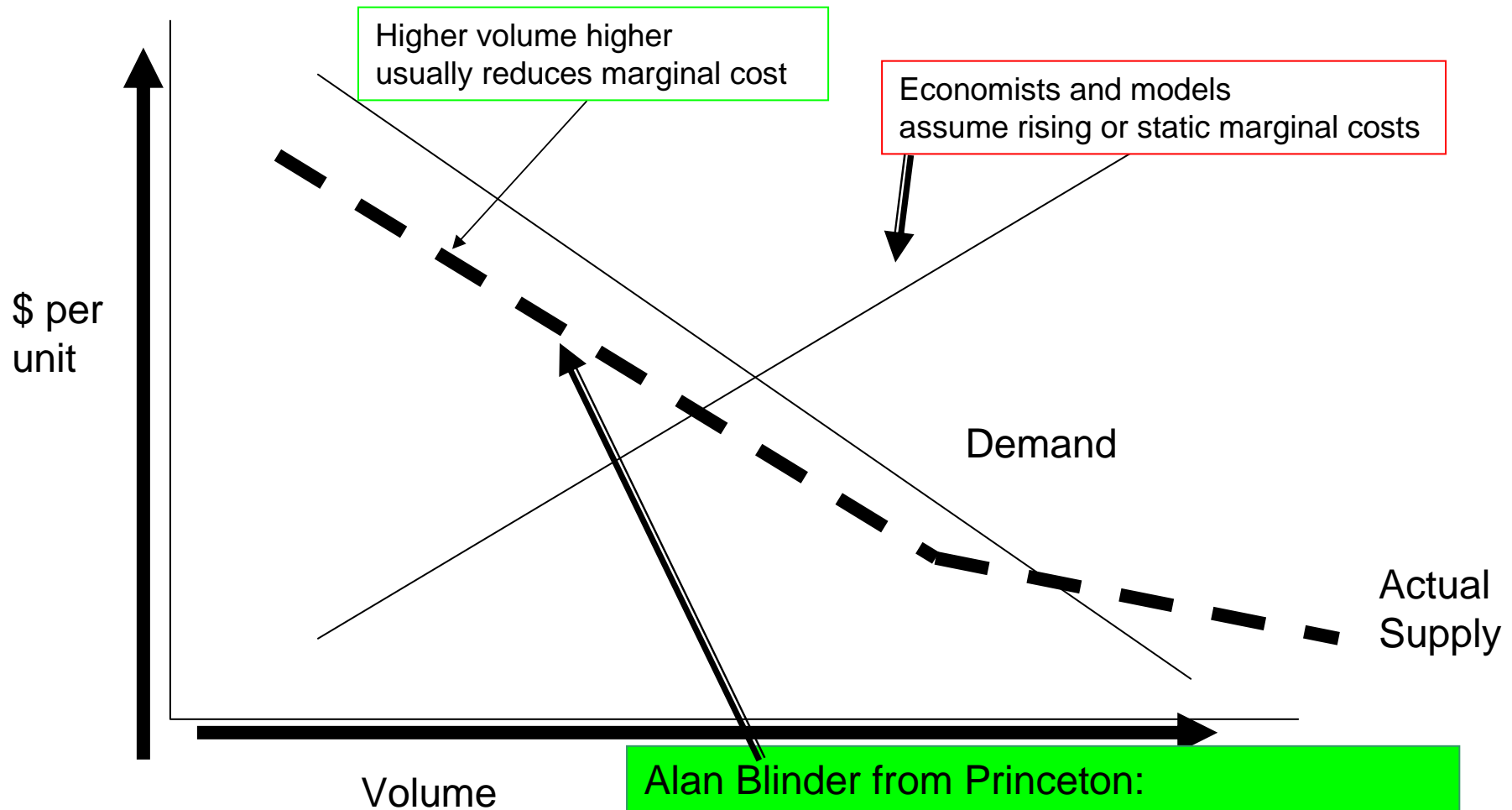
## Faster & Deeper will be less expensive

- Greater Market Acceptance
  - Scale economies
  - Innovation
- More effective markets
  - Untapped savings
- Purpose
  - Institution change that produces new solutions

# Factors that Energy Markets Must Consider to Become Effective

**Marginal Costs decrease with increasing sales**

TRUE FOR ENERGY REDUCING PRODUCTS AND RENEWABLES

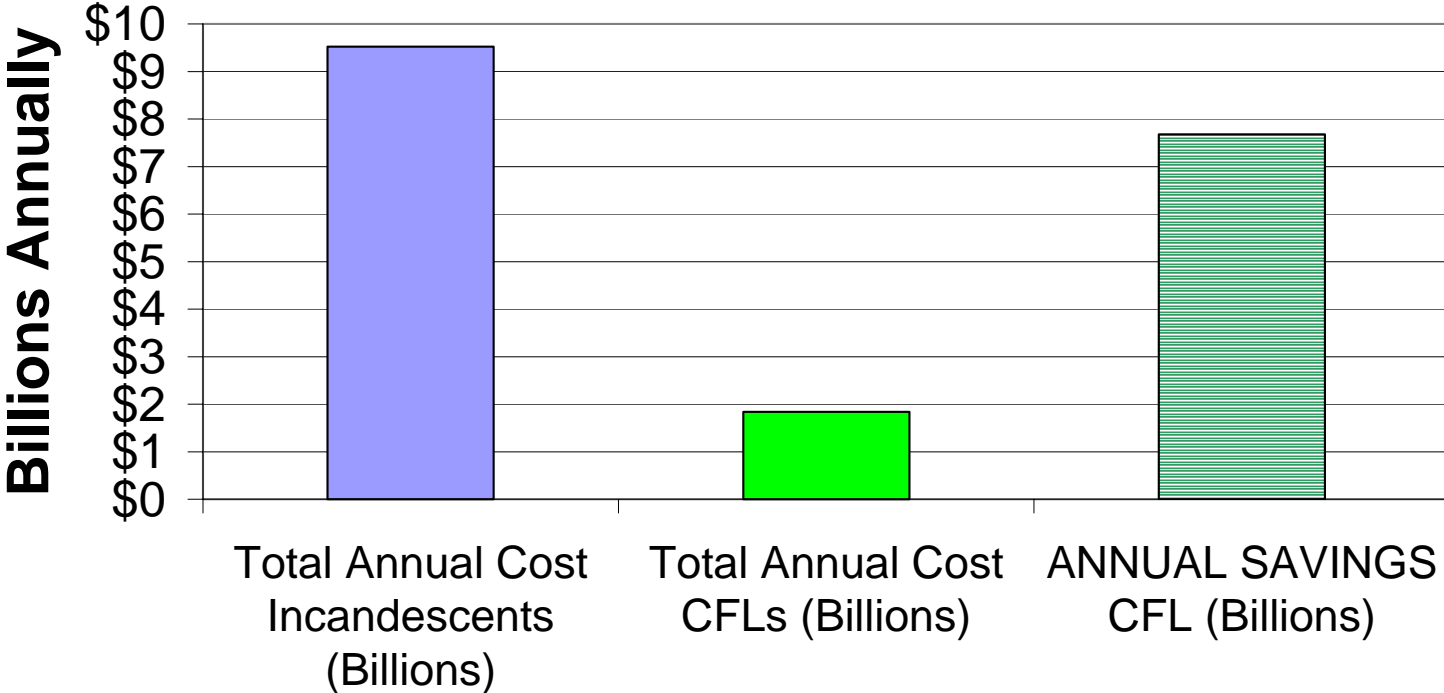


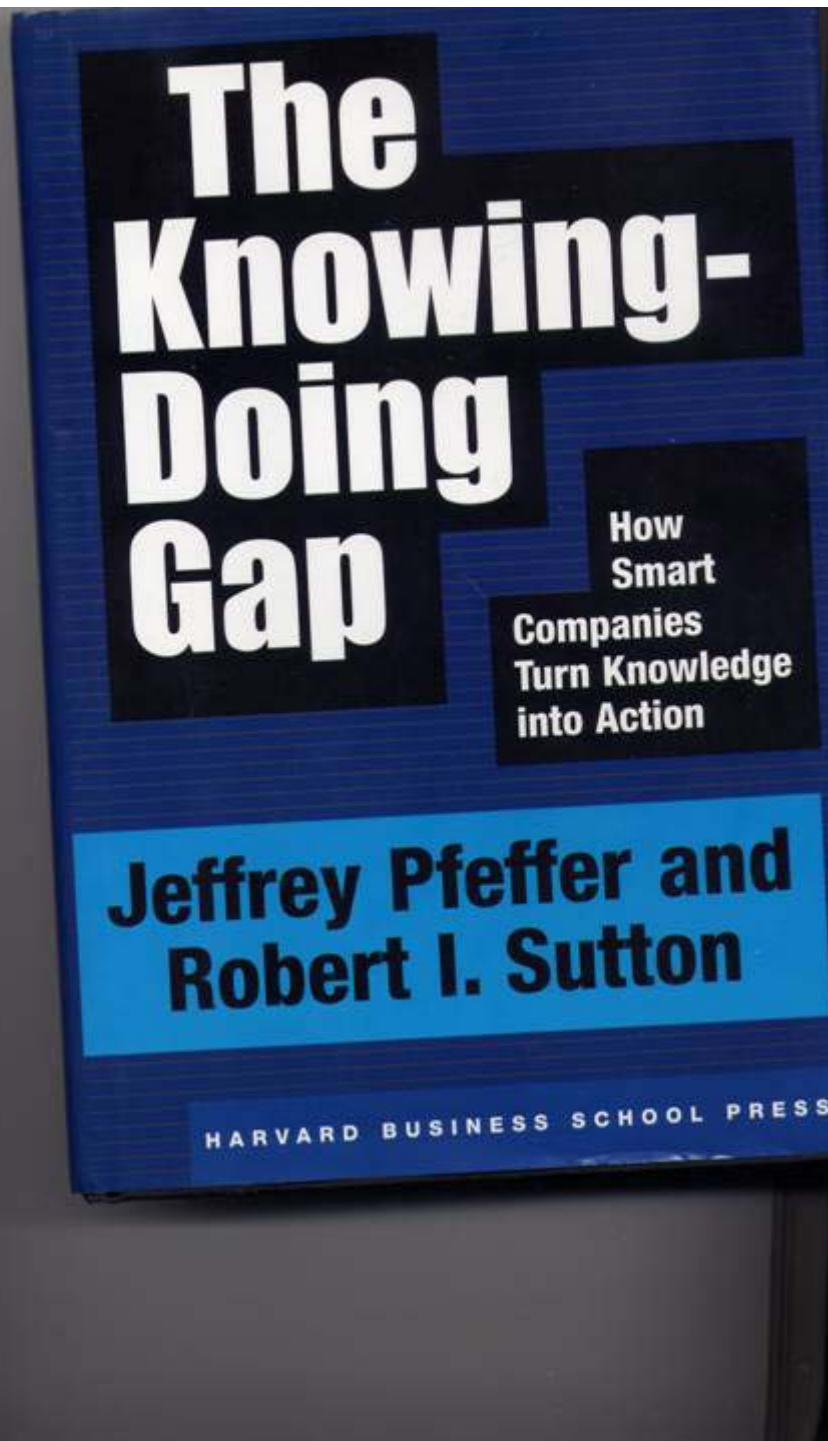
Factors that Energy Markets Must Consider to Become Effective:  
 Buyers Not 'Rational Investors': Lighting Example

Habit		Versus		Economic Logic
	<b>\$85.00</b>	<b>True Cost Over Ten Years</b>	<b>\$23.16</b>	
	<b>\$.50</b>	<b>Purchase Price</b>	<b>\$2.00</b>	
		<b>Ten Year Savings</b>	<b>\$62.00</b>	
	3500	Color Temperature	3500 to 6000	
	\$8.00	Cost to operate 1000 hours at \$0.08 per kWh hour for 100 watt equivalent light	\$2.16	
	n.a.	Internal Rate of Return for Extra 'Investment'	147%	
	10	Times Bulb Must Be Changed Over Ten Years	1	

National Economic Savings from Simple Lighting Measure

# Annual Savings Replacing Incandescents with CFLs





**Not Just a Problem for Consumers**

**Most Firms**

**Fail to Do What They Know Is Right**

**Even For Core Functions.**

**Energy is peripheral**

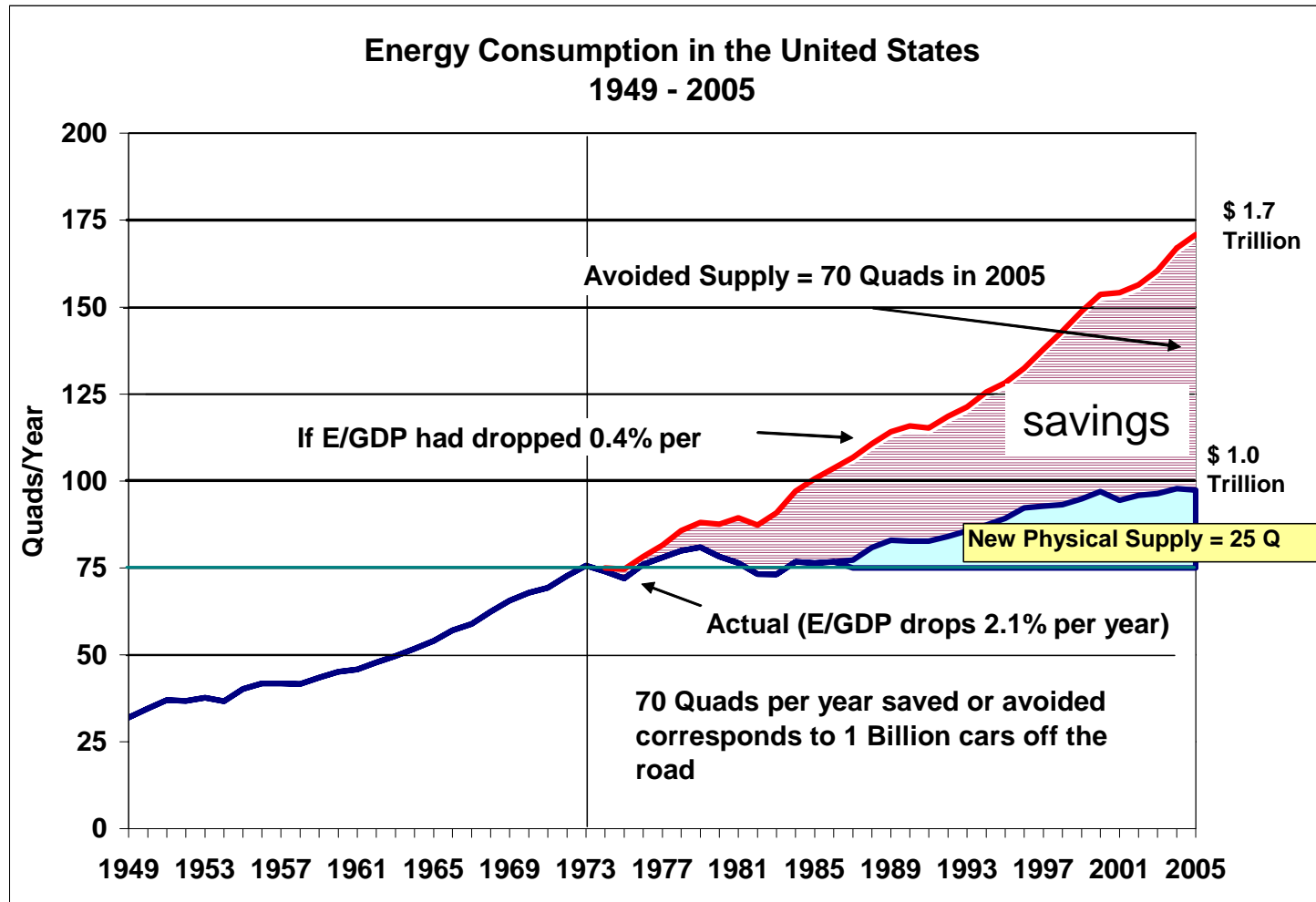
**Most firms use  
Two year payback**

**(same as 36% rate of return)**

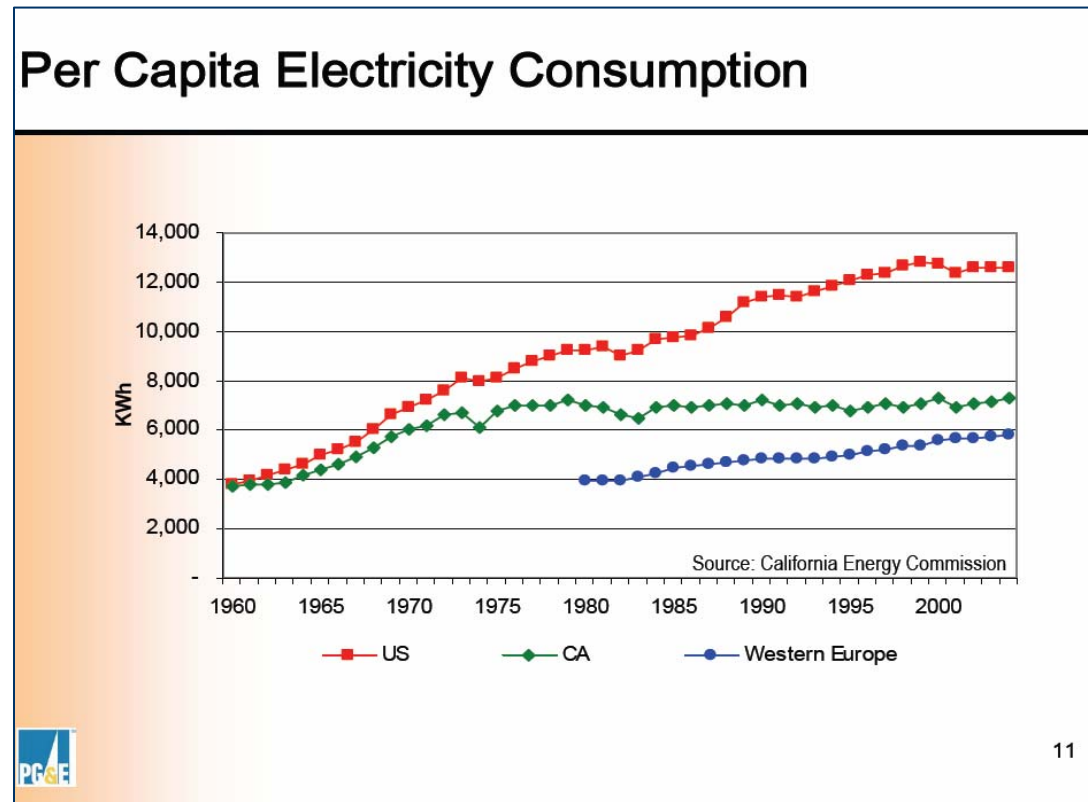
Factors that Energy Markets Must Consider to Become Effective  
Lack of Market Acceptance Partly Caused By Lack of  
Investor Behavior by Buyers Reduces Innovation

- Why Invest in More Productive Products
  - If current ones don't sell well
  - Become niche products with high prices
- Strong Market Acceptance Created by
  - Rapid development of market
  - Development sufficient to reach scale
  - Leads to enormous innovation (**endogenous growth theory--- Paul Romer**)
  - Plasma TV's for example

# Efficiency Has Been Largest Resource For Meeting National Growth In Service Demand



# Much More Can Be Done: California Achievement Greater



The cost per kWh saved was less than half the cost of providing the kWh from the electric grid.

Economists have a lot of explaining to do.

Enormous body of evidence:  
Buyers Do Not Act Like Economically 'Rational Investors'

1. **Habit guides purchasing**
2. **Few include efficiency as needed attribute**
3. **Hardly anyone uses** net present value after taxes
4. **Results**
  - Large cache of untaken opportunities
  - Dynamic efficiency (innovation) lags

**Efficiency is a peripheral buying issue**

Simon 1957 Nobel; Kahneman 2002 Nobel

Policy # 1  
What Can Be Done?  
Higher Prices Don't Remedy Ineffective Market

**Make it easy !!!!!**

Make price of

most efficient products

**The lowest price**

## Standards Remedy Buyer Failure and Achieve Scale

Minimum lumens

per watt

Efficient Product becomes  
lowest priced product

## Option: Create Transaction Bridges On Top of Standards

Transactions bridge:  
a form of social infrastructure  
that creates market intermediaries  
to achieve more effective markets

## Transaction Bridges Already Exist

- Grid acts as agent for buyers
- Assures future power available
  - Constant voltage
  - Provides whatever supply demanded
  - Finances expansion
  - Allocates cost
  - De-regulation has not changed much
- Buyers power never worry

Rialto Bridge in Venezia  
served as a medieval transaction bridge  
for merchants  
(transaction payments booked without physical money transfer)

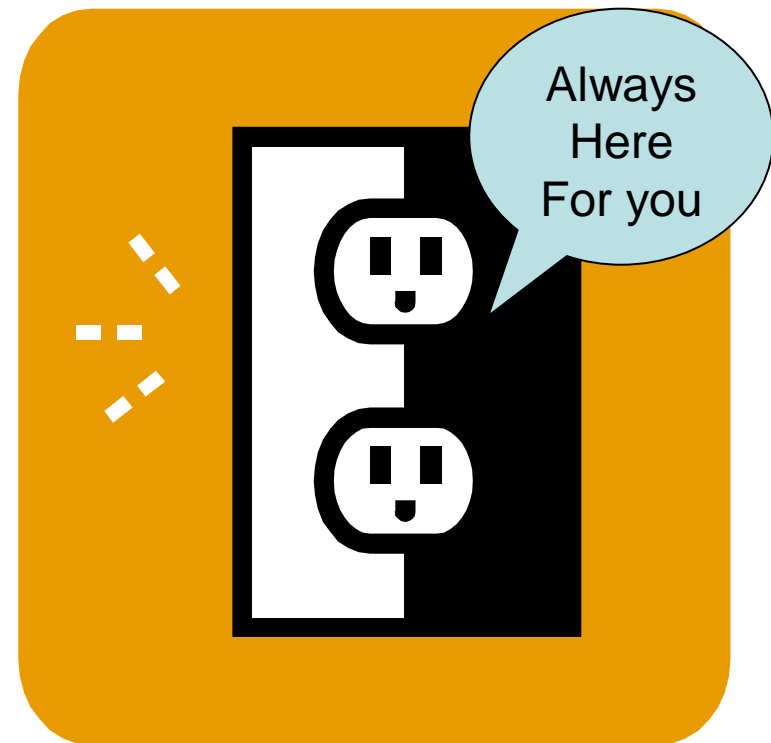


THE FOUNDATION OF EFFECTIVE MARKETS  
SOCIAL AND PHYSICAL INFRASTRUCTURE

## Buyer Never Worries

### No matter how inefficient product

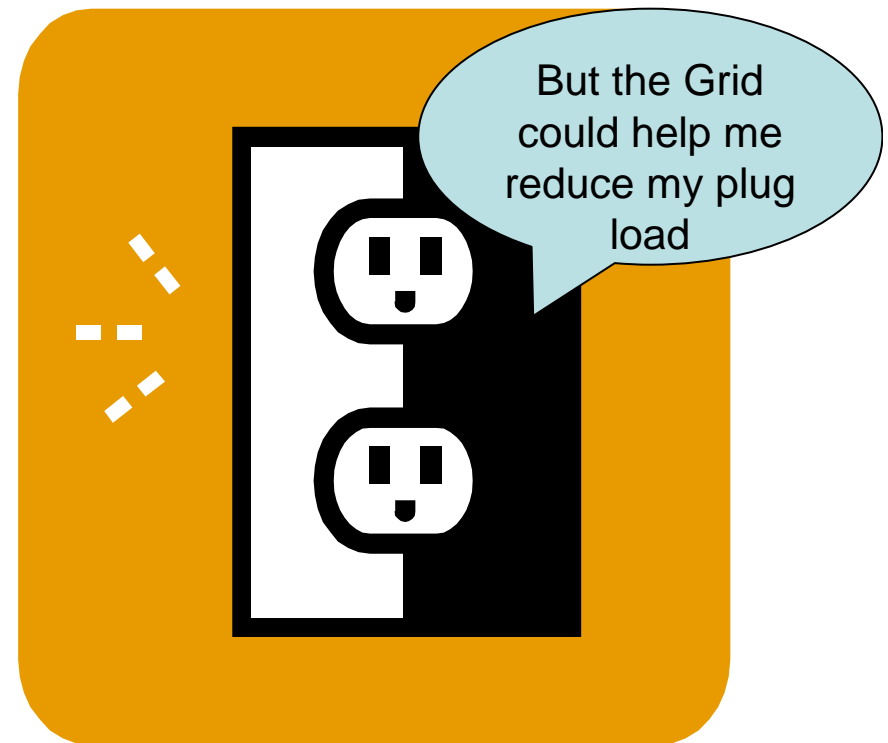
- Grid invests in new generation
- Everyone shares cost
  - End user does not finance/buy new capacity



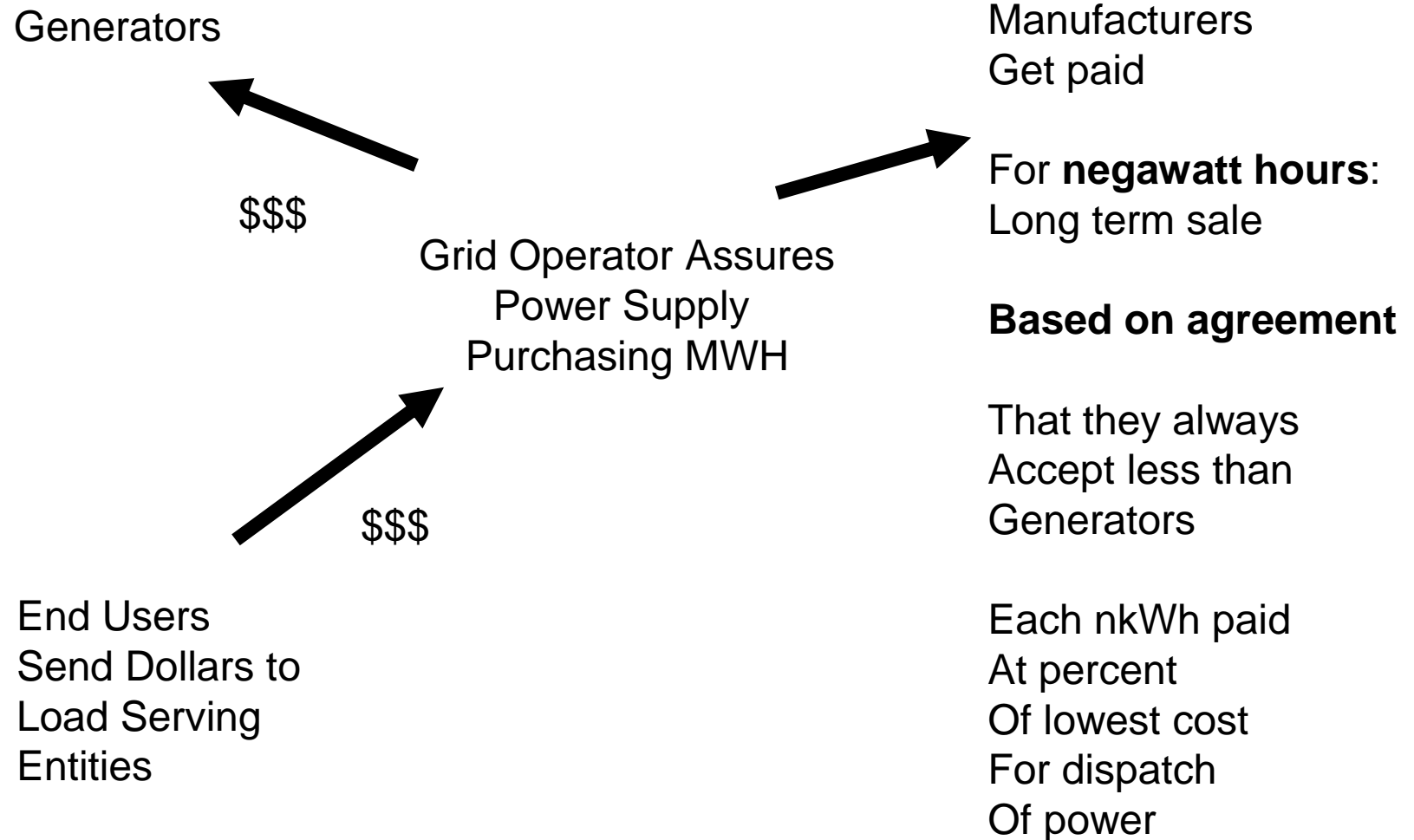
## No Equivalent Transaction Bridge For More Efficient Products

**Buyers on their own:  
inefficient products**

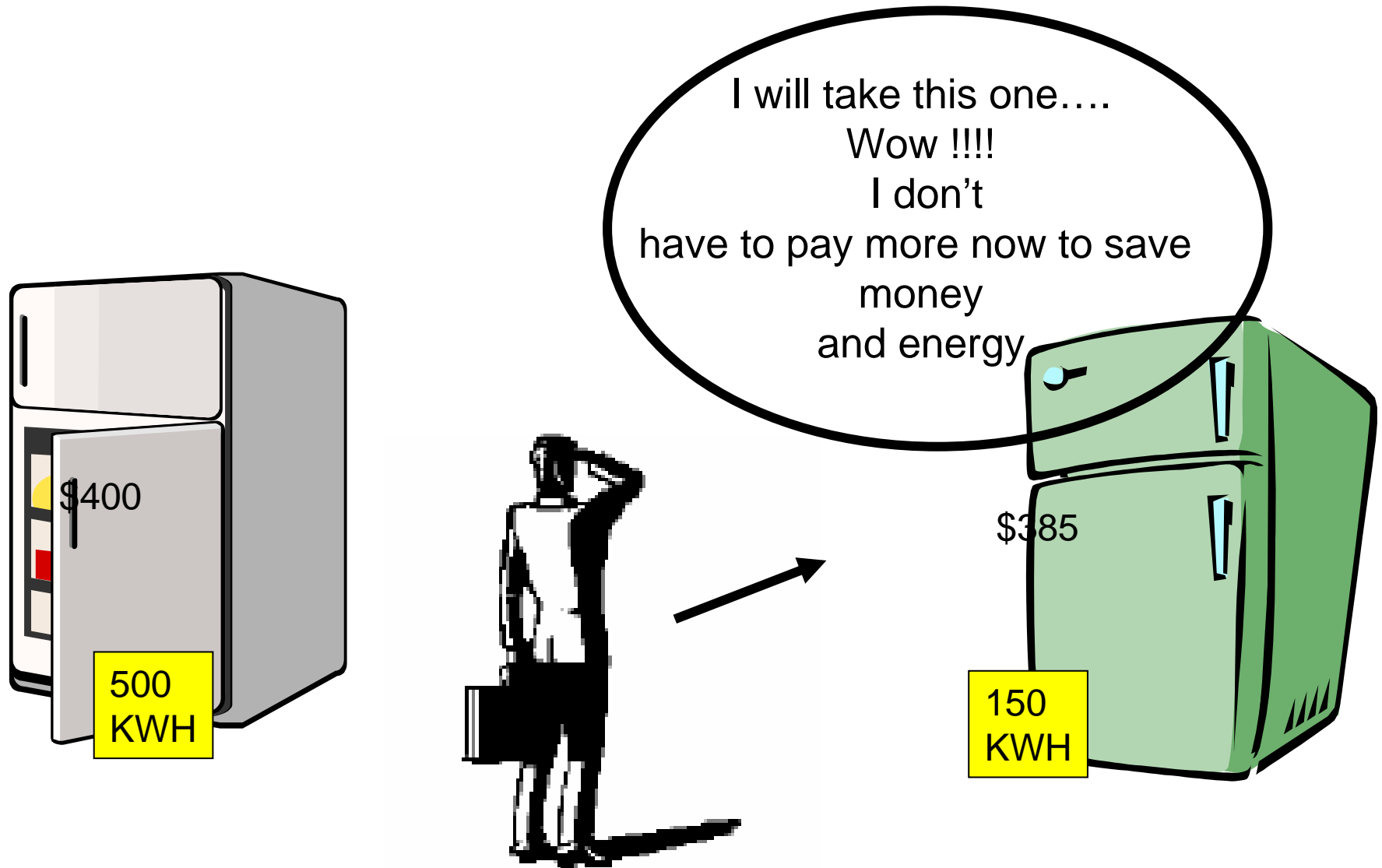
**Result: Grid spends  
more on costly  
generation**



## Option: Transaction Bridges for Buyers



1st Easy Piece: Make it Simple To Buy Lowest Cost



$500 \text{ kwh} \times \$0.055 \times 18 = \$346$  to manufacturer  
cost of adding efficiency and lowering price << than new revenue stream<sub>20</sub>

## Result of Transactions Bridge

- Manufacturers Lower Price
  - to gain market share
  - Revenue stream from energy savings very profitable
- 4 to 1 Markups Avoided
- Scale Economies
- Incentive for *dynamic efficiency: Innovation*

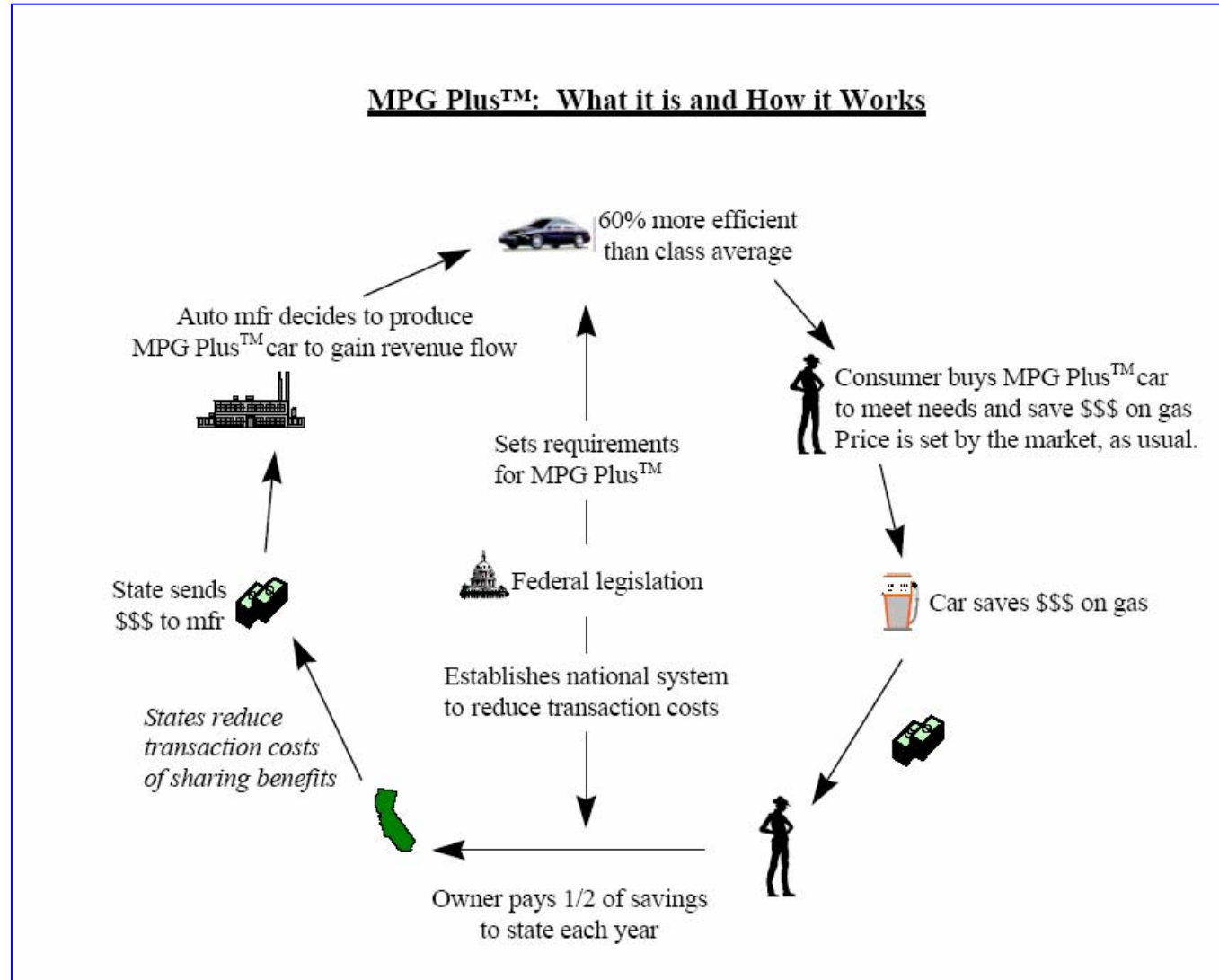


## Incentive for dynamic efficiency: Innovation

- Adam Smith
  - Extent of the market critical
  - Pin factory specialization/innovation
    - Possible because of international trading
- Paul Romer
  - Growth is endogenously determined
  - Scale and rapid market acceptance
- Others studying innovation agree
  - Christiansen: Innovator's Dilemma



## Policy # 2: Transactions Bridge in Auto Sector



## Key Concepts Proposed Transaction Bridges

1. Producers **AUTOMATICALLY** shares in value of energy savings
2. Scale and Market Acceptance Created
3. Watch industries ask for efficiency standards
4. Then watch the rabbit run

## Policy # 3

### Another New Idea

### Infrastructure Parity

- PVC Pipe
  - Natural gas companies pay for its installation to carry gas
- PVC Pipe
  - Electric utilities do not pay for its installation to gather solar energy from ground
- Idea: Create Parity
  - Electric Utility Builds and finances through rate base as infrastructure investment (they last 75 years)
  - Results
    - Scale economies reduce loop costs
    - Buyers find purchase of heat pumps only less expensive than competitors
- Creates Scale and Market Acceptance for Innovation

## Energy Savings

- Geoexchange:
  - Utilizes solar energy stored in ground
  - 1 unit of electric energy moves up to 5 to 6 units energy
  - For heating, hot water, cooling
- With a 55% efficient combined cycle plant  
= Total 'Efficiency' 330%
- Best gas furnaces
  - 95% efficient
- NET: >70% Reduction in use of natural gas when powered by combined cycle power plants
- Double housing insulation: 85% Reduction

## Policy #4

### Utilities Finance Efficient Systems

- Green Credit Card
  - Amortized Payments go on Utility Bill
  - Considered home equity loan & long term loan to firms
- Overcomes budget issues for buyers
  - Provides tax advantages
- Supplements transaction bridges
  - for system of products working together

**Policy # 5**  
**National Power Purchase Corporation (NEPC)**  
**(overcomes reluctance of power producers to buy 'rationally')**

- Bids for LONG TERM MWH (20 Years):
  - Long term power purchase agreements (PPAs)
  - Portfolio of Low or No Carbon Options
  - Output of 10,000 MW per year
- NEPC re-sells MWH
- Bids for Storage of kWh important
  - Creates 24/7 use of capital
  - Matches production time to time of use
- Treasury Risk
  - Difference Between Buy and Sell Price
  - Resolution Risk: Could Go in Either Direction

**CREATES SCALE**

**CREATE MARKET  
ACCEPTANCE**

**WILL FOSTER  
INNOVATION**

**MUST BE LARGE  
ENOUGH TO FOSTER  
A REVOLUTION**

## Potential Opportunities

- Ocean Currents
- Cellulose Biomass
- Solar (Thermal and PV)
- Wind
- Geothermal (Hot Rocks)
- Safe nuclear
  - (Proliferation, security, spent fuel issues solved)
- GAX heating system
- IGCC
- Compressed Air Energy Storage

New Technology in all these areas promises low prices: 2 cents to 5 cents

Never will be realized without scale economies resulting from long term PPAs

US has opportunity to become energy rich nation again

## What Economists Find In Advanced Research That Takes Economics Beyond Econ 101

- **Buyers Limited in Rationality**
  - Herb Simon (1957 Nobel Prize Winner)
  - Kahneman (2002 Nobel Prize Winner)
- **Scale Economies**
  - Alan Blinder: Gordon S. Rentschler Memorial Professor of Economics at Princeton University
- **Transactions Hard to Do/Costly/Market Organization Makes a difference**
  - Coase (1991 Winner of Nobel Prize)
  - Oliver Williamson and many others
- **Growth and Innovation Endogenous and Path Dependent**
  - Paul Romer, Stanford Professor, New Growth Theory
  - Brian Arthur
  - Learning by doing (Arrow: Nobel Prize Winner 1972)
- **Institutions Crucial to Performance**
  - Douglas North (1993 Nobel Prize Winner)
- **Economy is evolutionary; always OUT of equilibrium**
  - Richard Nelson & Sidney Winter:

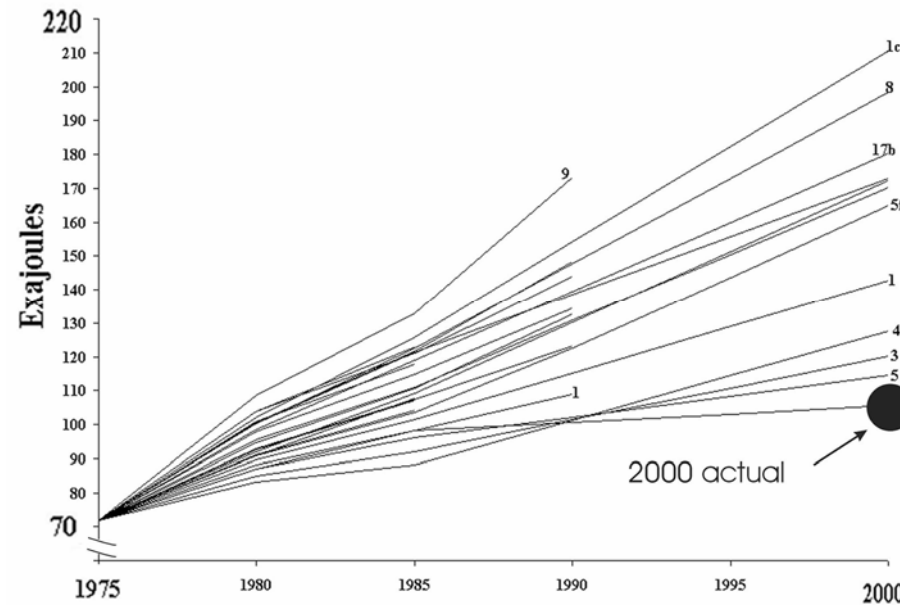
Lessons from Real Economics  
Phase Out of GHG Emissions'  
Faster Is Less Expensive (or even profitable)

- Quicker to economies of scale
- Greater innovation with faster/deeper market acceptance
- Less wasted capital

Modern economics shows that standard neo-classical model sub-optimal in real world; all nations losing economic growth due to inefficiency

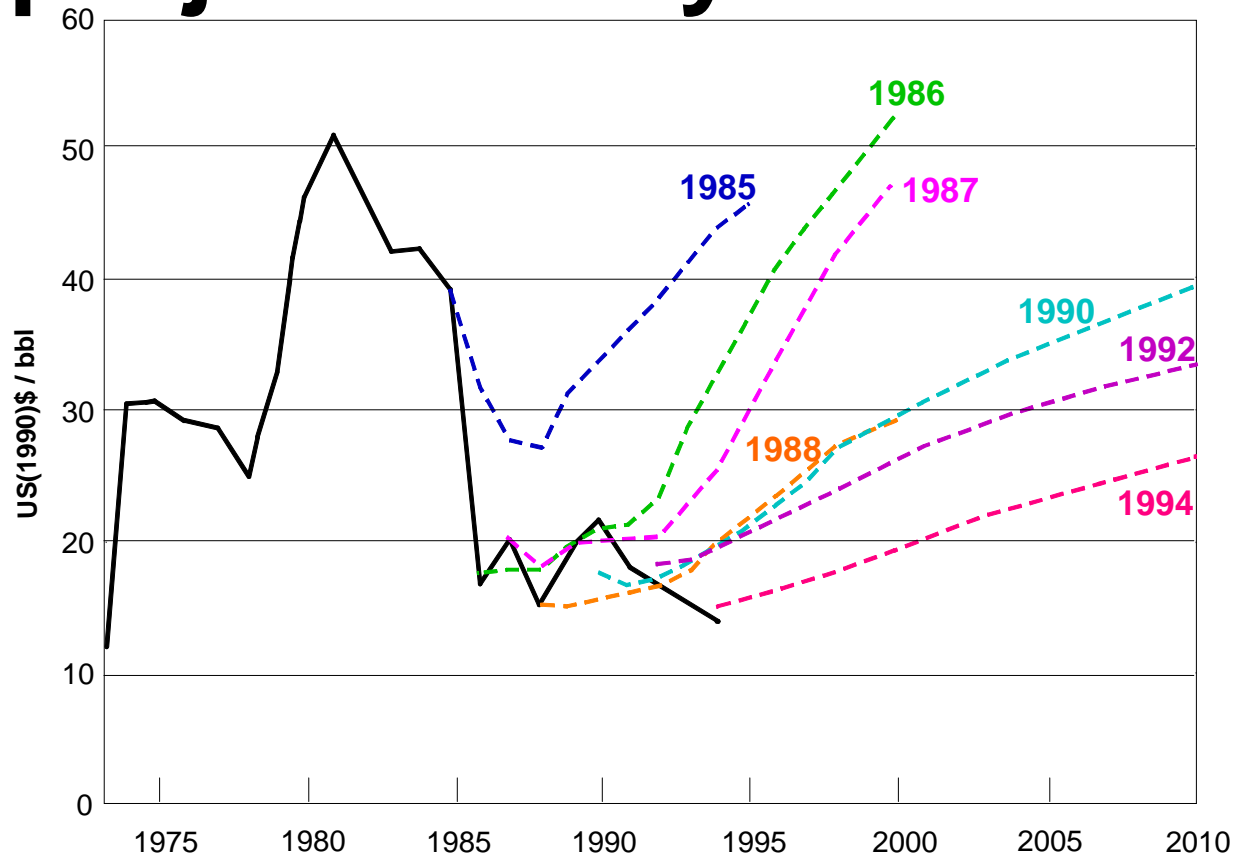
# Extra Slides

# One example: 1970s projections of year 2000 U.S. primary energy



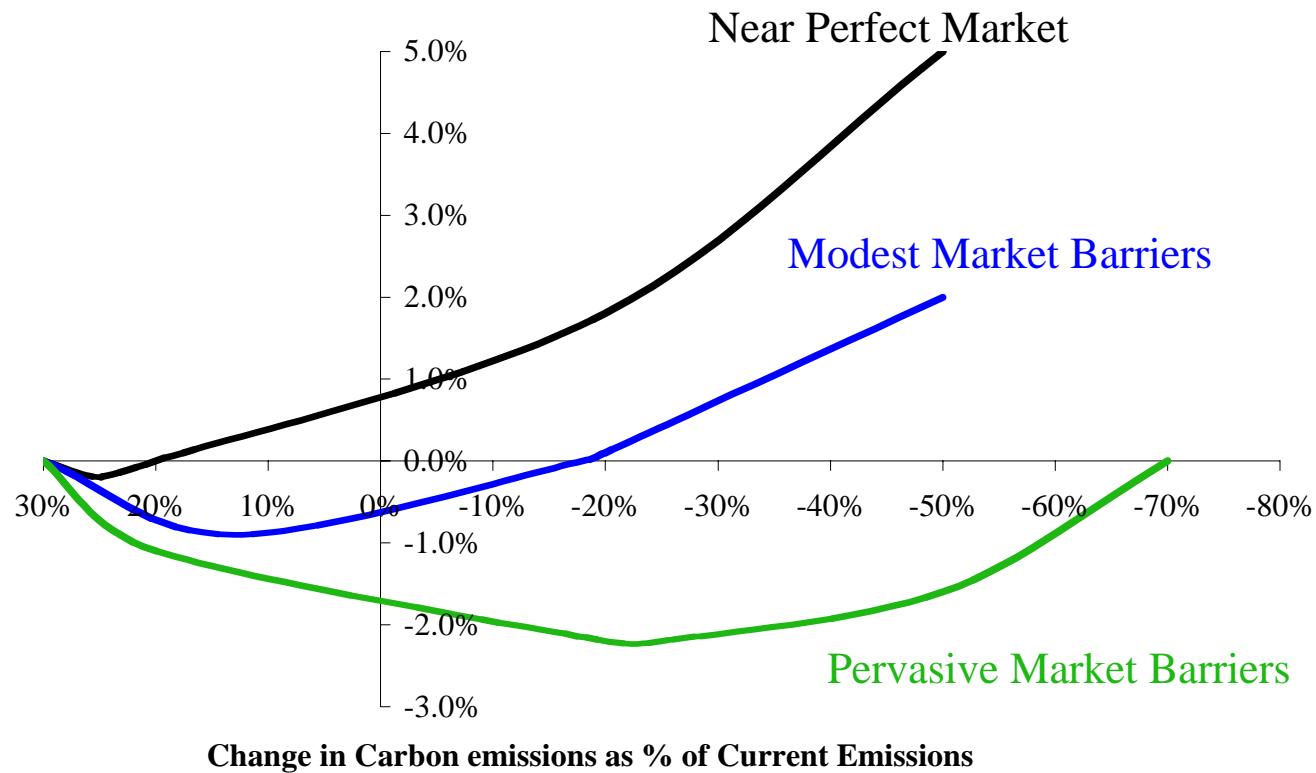
Source: Craig, Paul, Ashok Gadgil, and Jonathan Koomey. 2002. "What Can History Teach Us?: A Retrospective Analysis of Long-term Energy Forecasts for the U.S." In *Annual Review of Energy and the Environment 2002*. Edited by R. H. Socolow, D. Anderson and J. Harte. Palo Alto, CA: Annual Reviews, Inc. (also LBNL-50498). pp. 83-118.

# Another example: Oil price projections by U.S. DOE



Source: BGR, 1998 (graph supplied by Arnulf Grubler, IIASA)

# Three views of the costs of reducing GHG emissions



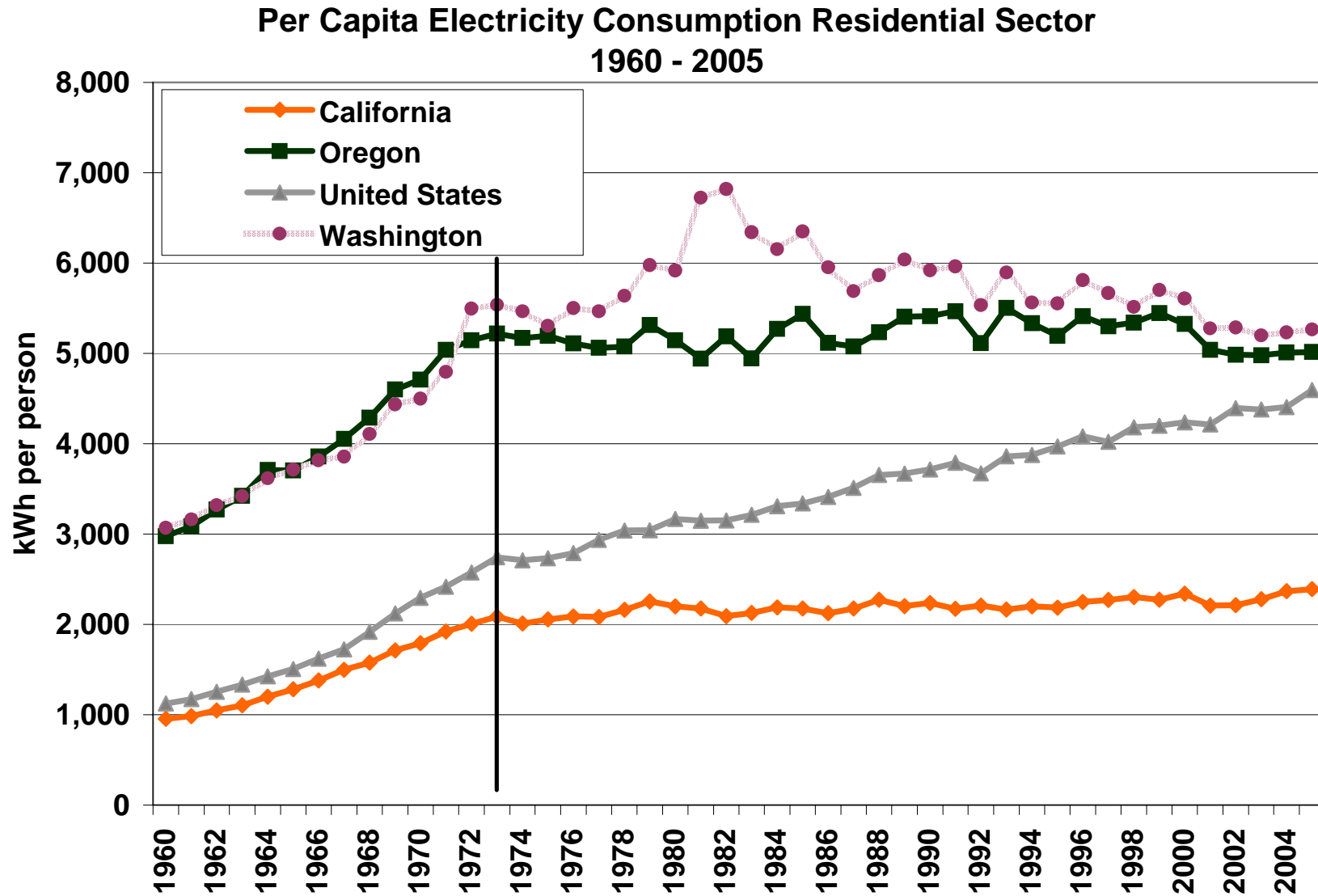
## Cap and Trade

- Still can be implemented
- Risk: Hot air
- Risk: Prices Too Low
- Could a fee for holding set a price floor?

# Business as Usual Attitude

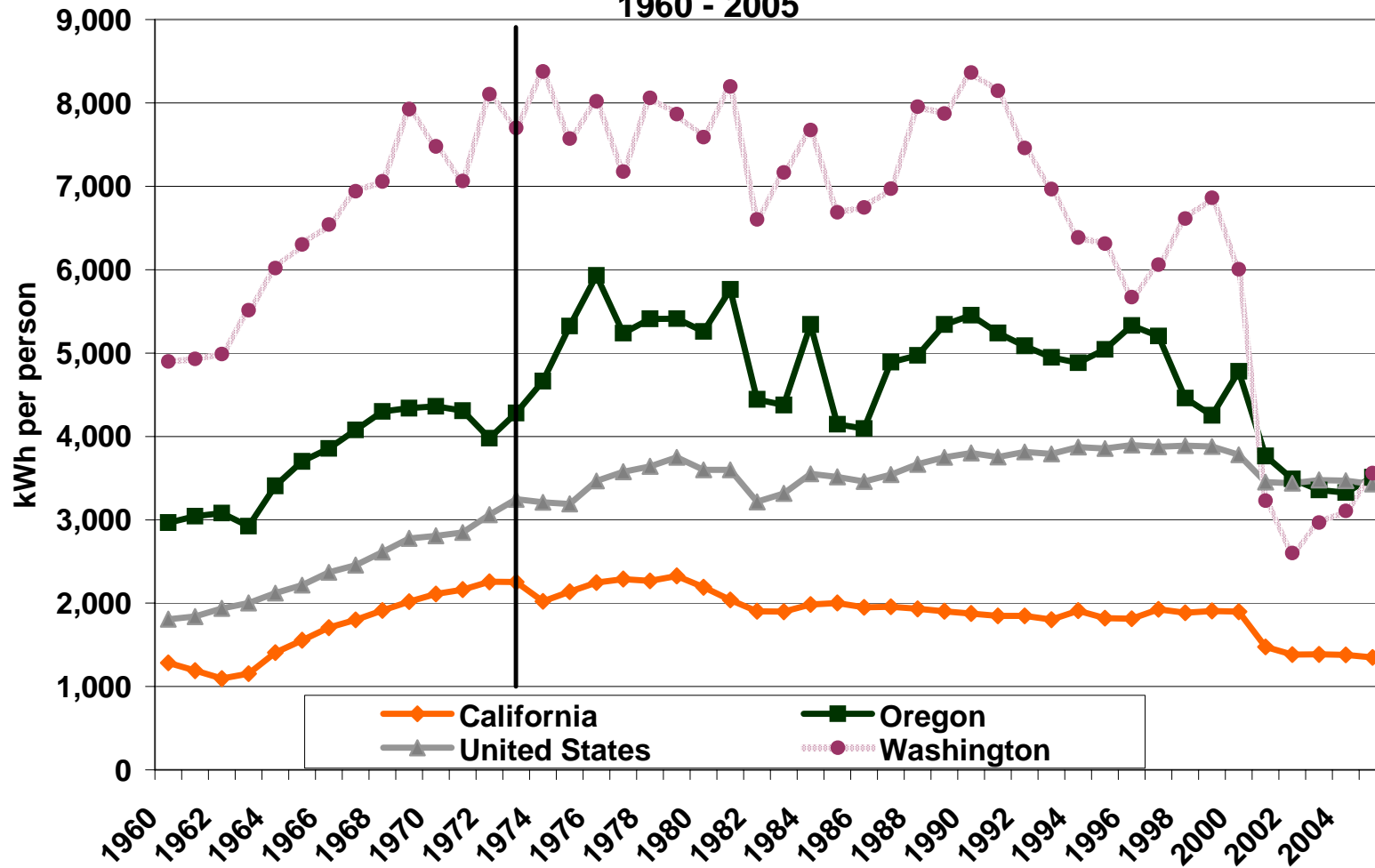
- Failure to recognize
  - ❑ Grave threat of global warming and climate to human future
  - ❑ Large Opportunity to Improve Market Effectiveness
- Failure to overcome inertia and act decisively
- Failure to replace the incandescent an example of unacceptable complaisance
  - ❑ But California may ban !!!!!!!!!!!!!

# Other States Achieved Stabilization of Per Capita Electricity (at higher level)



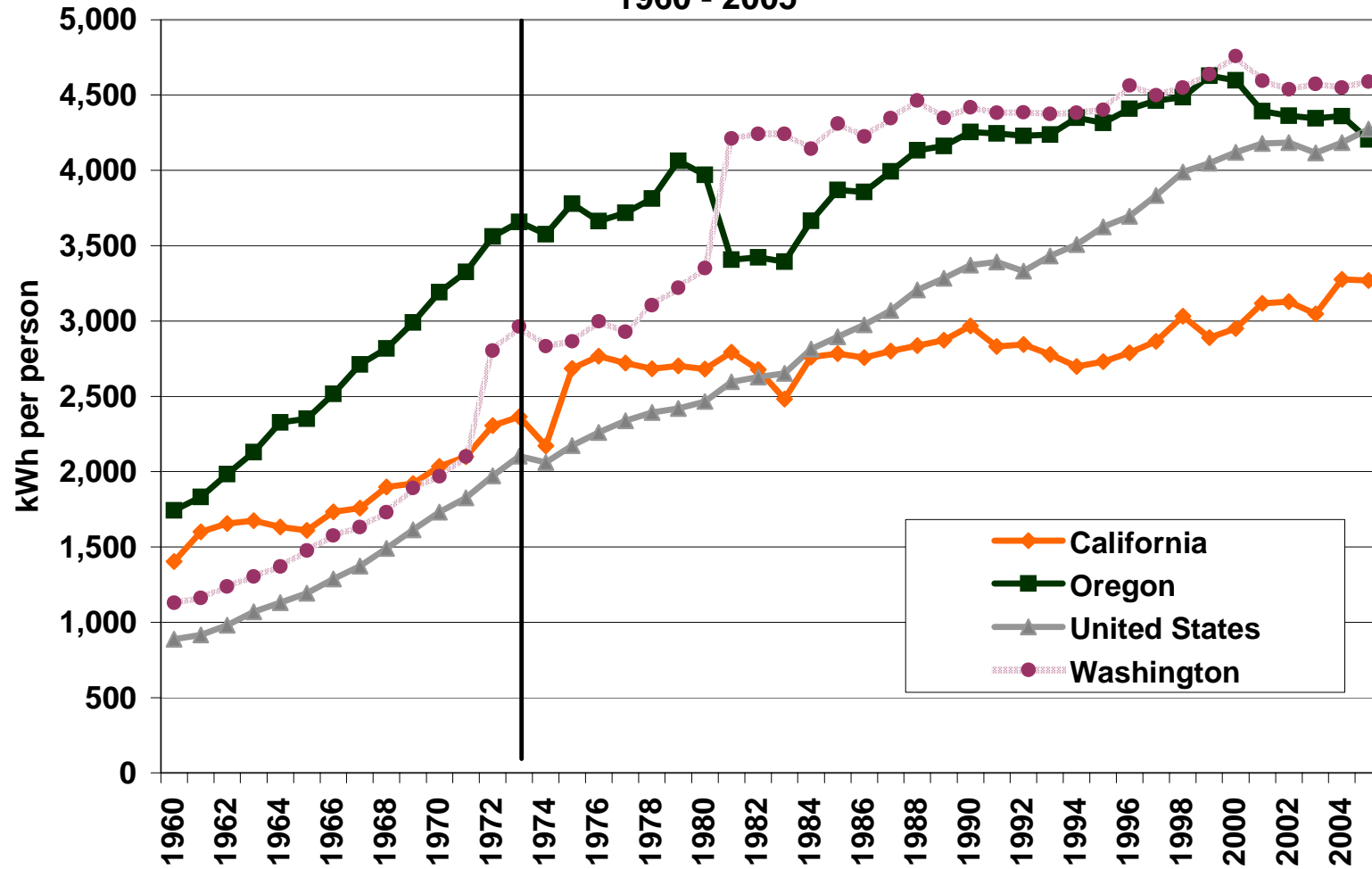
# California Succeed With Industrial Sector

Per Capita Electricity Consumption Industrial Sector  
1960 - 2005

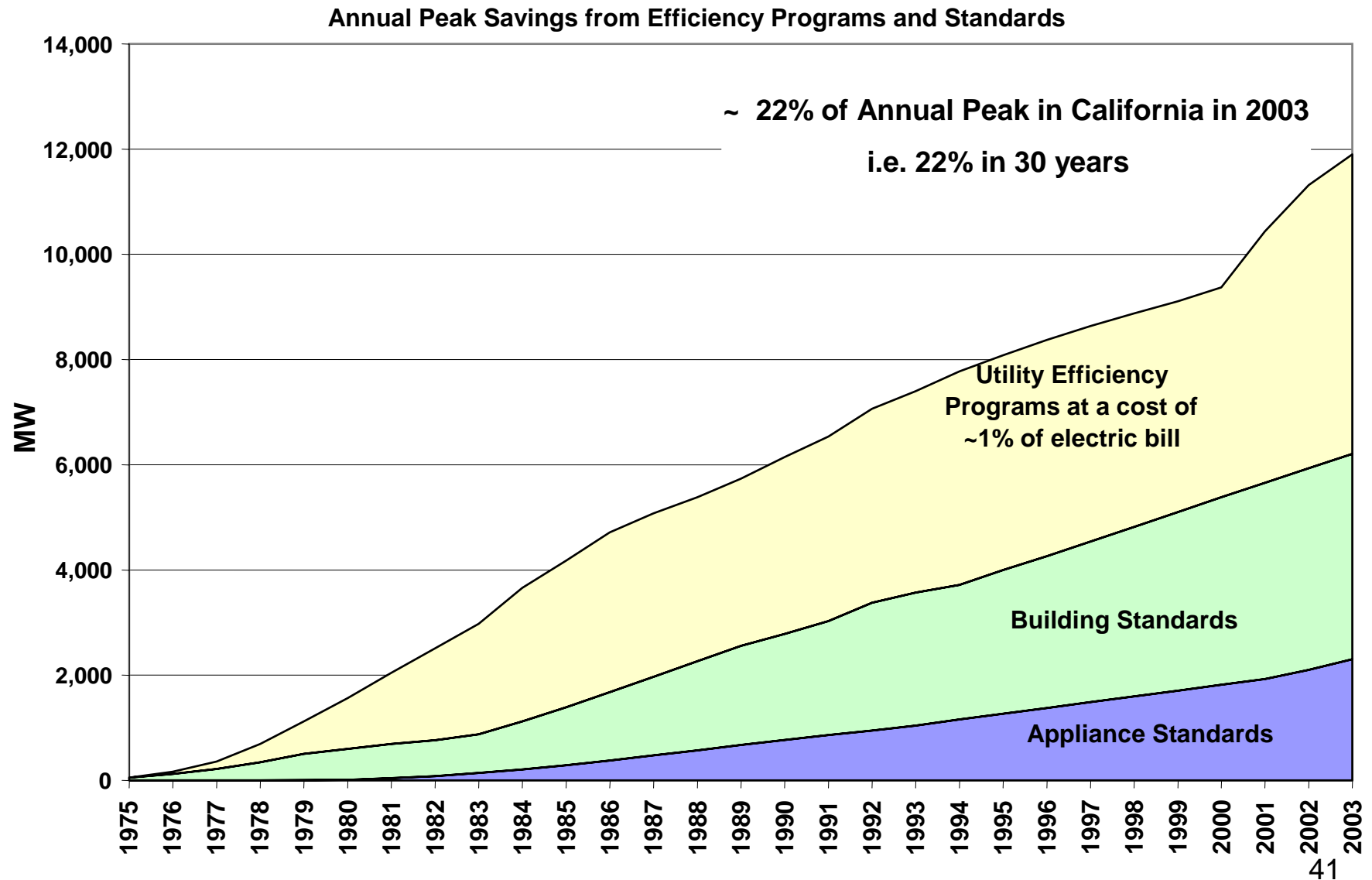


# California Succeeded with Commercial Sector

## Per Capita Electricity Consumption Commercial Sector 1960 - 2005



# California Reduced Peak



## McKinsey & Company Agree

### **TARGETED POLICIES TO REMOVE MARKET FAILURES AND INEFFICIENCIES ARE NEEDED TO DRIVE ENERGY PRODUCTIVITY**

Our microeconomic analysis shows that even higher energy prices will not lead, by themselves, to more rapid energy-productivity growth, or to keep energy-demand from accelerating from historic levels. Higher prices (and different relative prices) will drive significant fuel switching, but relatively little aggregate decline in BTU consumption. Instead, targeted policy intervention to remove market failures are needed to achieve significant change in both. To motivate the framing of effective policies, policy makers need to make energy productivity an explicit indicator of national economic success—much like labor and capital productivity.

—McKinsey&Company