Energy Efficiency and Conservation

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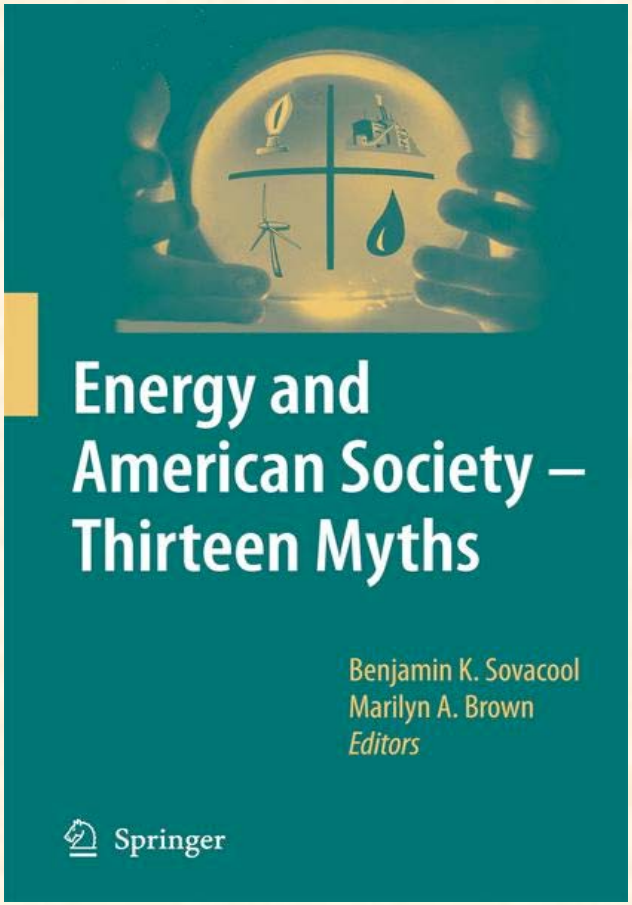
Georgia Climate Change Summit

Georgia Institute of Technology
Atlanta

May 6, 2008



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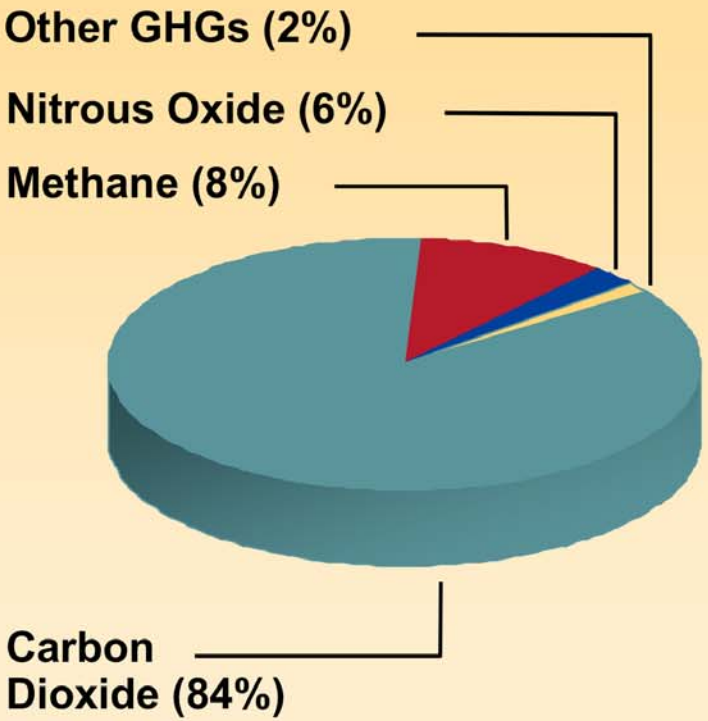
Tackling climate change promises to be one of the biggest challenges of the 21st century

- **It will require considerable scientific and engineering ingenuity to produce entirely new energy systems that curb GHG emissions while simultaneously powering global economic growth.**
- **Success will also necessitate economic, social and policy innovations.**
- **Introducing new climate-friendly technologies to the marketplace involves managing a resource that no one owns, but everyone depends on.**

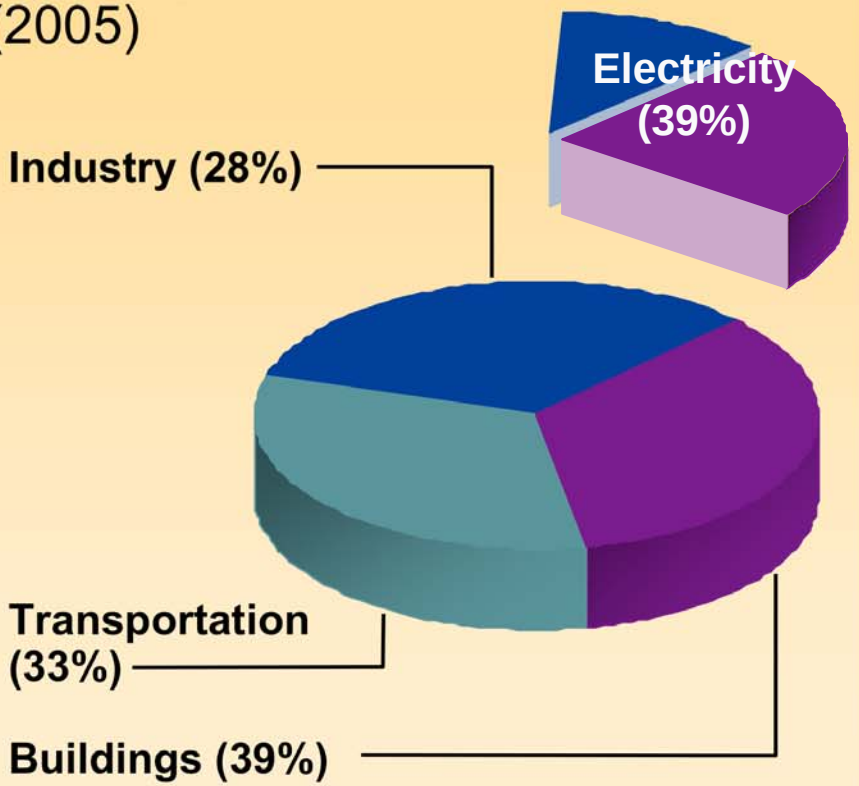
Global climate change is all about energy

U.S. GHG Emissions
88% are energy related



Source: EPA. 2007. *Inventory of U.S. GHG Emissions and Sinks: 1990-1995*, 2007.

U.S. CO_2 Emissions
by Energy Sector
(2005)



Source: EIA. 2007. *Annual Energy Outlook 2007*, Table A18.

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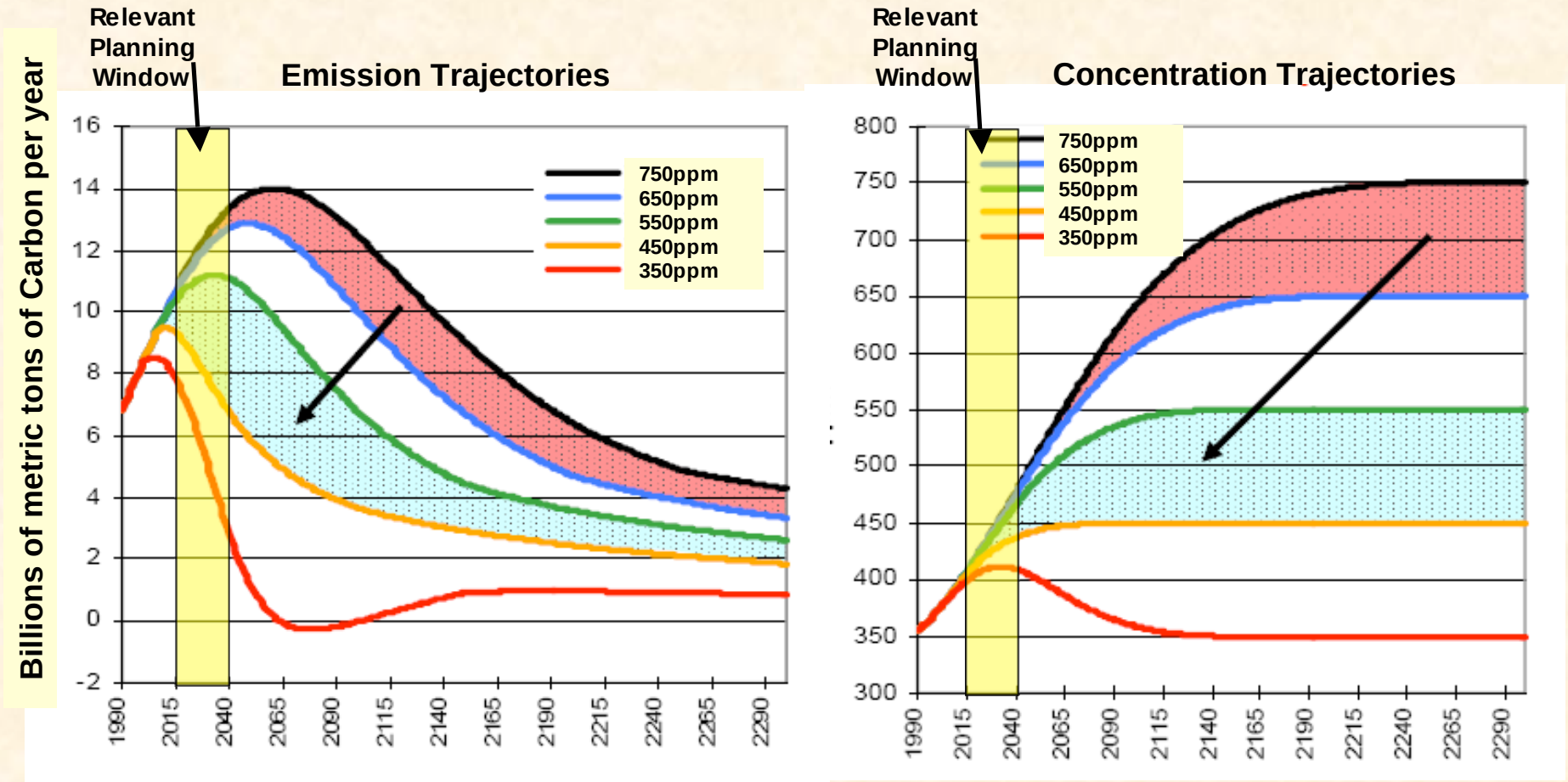
Near-term actions are needed to avoid long-term (potentially cataclysmic) costs



Emission and concentration trajectories based on current funding profile for technology investments

Potential carbon reductions based on proposed technology investments

Action period to influence longer-term outcomes

Source: Derived from Wigley et al. (1996)

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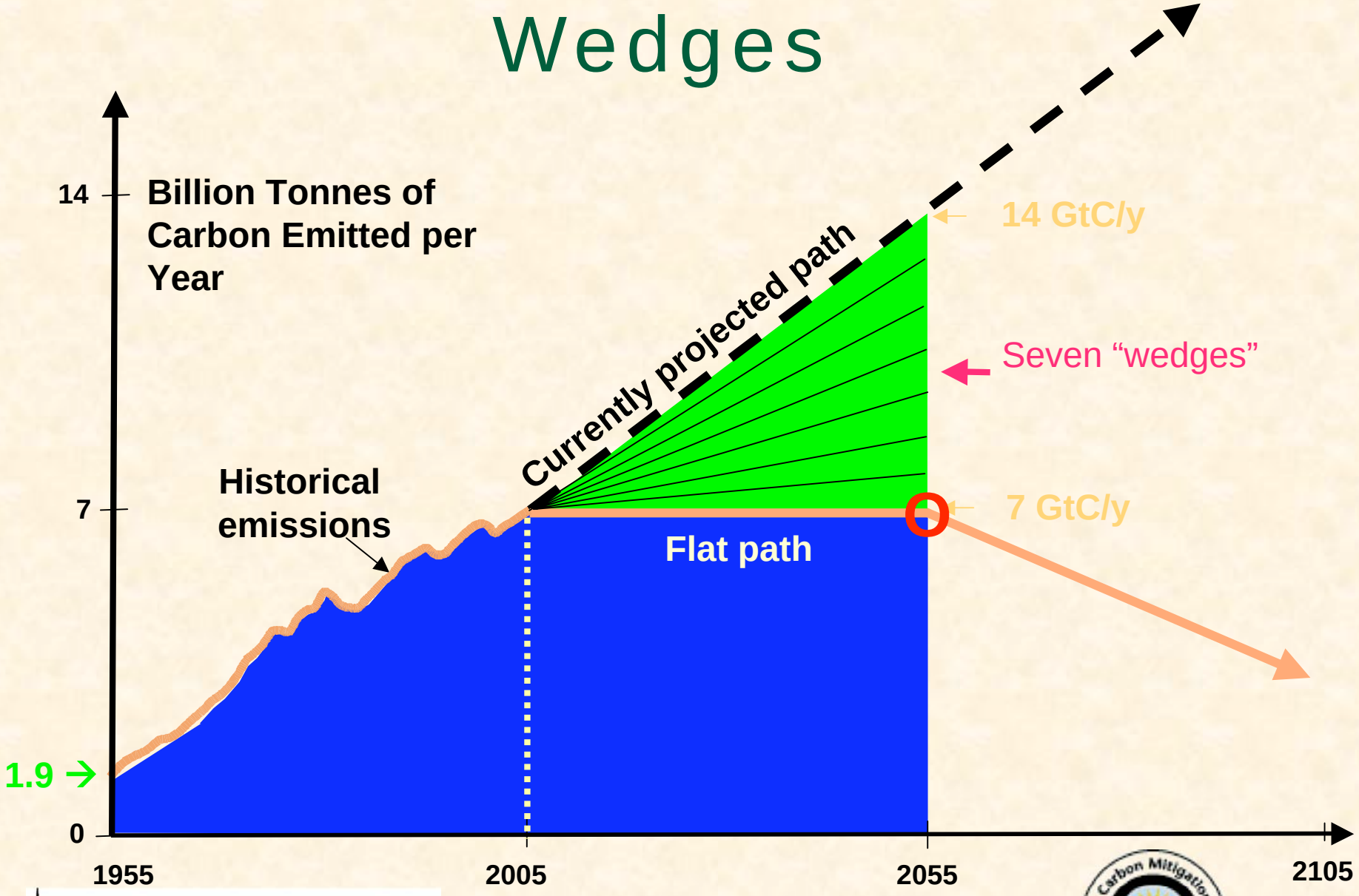
Wedges



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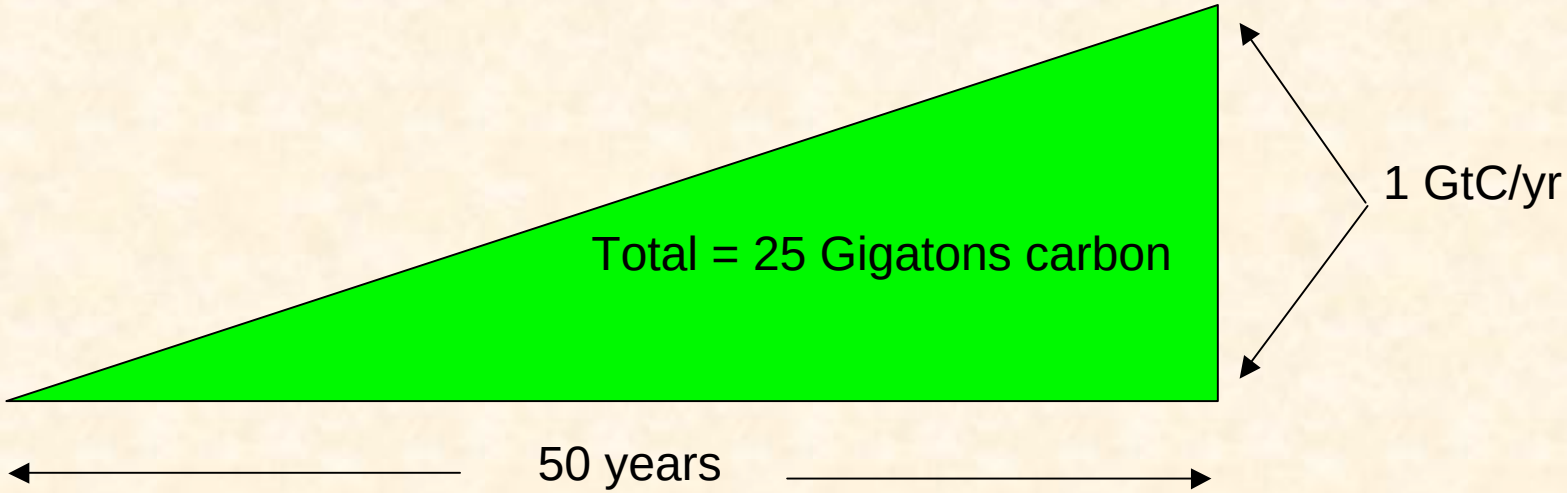
What is a “Wedge”?

A “wedge” is a strategy to reduce carbon emissions that grows in 50 years from zero to 1.0 GtC/yr. The strategy has already been commercialized at scale somewhere.



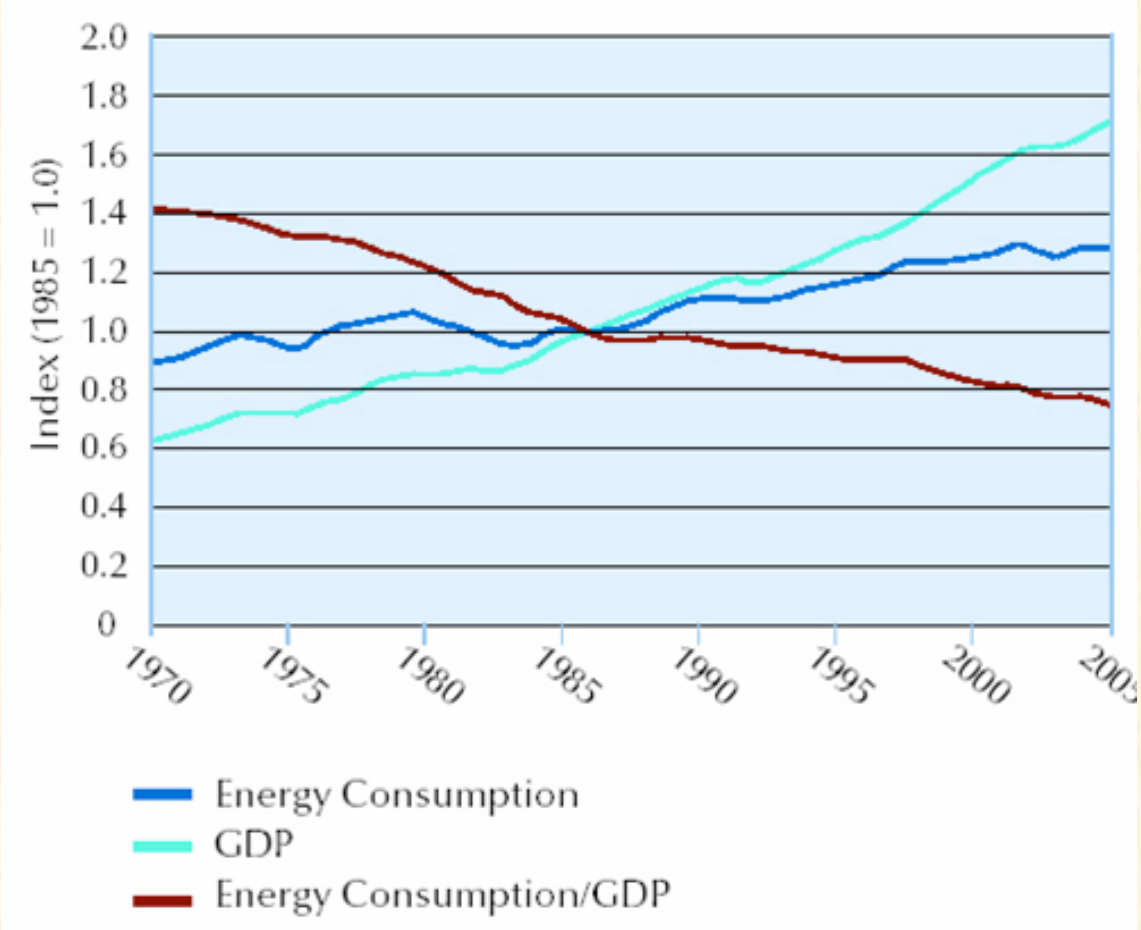
Cumulatively, a wedge redirects the flow of 25 GtC in its first 50 years. This would cost $1.25 trillion at $50/tC. A $50/tC tax or carbon trading value would raise electricity prices by almost 1 cent per kWh.

How Big is a Gigaton?

Today's Technology	Actions that Provide 1 Gigaton / Year of Mitigation
Coal-Fired Power Plants	Build 1,000 "zero-emission" 500-MW coal-fired power plants (in lieu of coal-fired plants without CO_2 capture and storage)
Geologic Sequestration	Install 3,700 sequestration sites like Norway's Sliepner project (0.27 MtC/year)
Nuclear	Build 500 new nuclear power plants, each 1 GW in size (in lieu of new coal-fired power plants without CO_2 capture and storage)
Efficiency	Deploy 1 billion new cars at 40 miles per gallon (mpg) instead of 20 mpg
Wind Energy	650,000 wind turbines at 1.5 MW and 35% capacity (in lieu of coal-fired power plants without CO_2 capture and storage)
Solar Photovoltaics	Install capacity to produce 1,000 times the current global solar PV generation (in lieu of coal-fired power plants without CO_2 capture and storage)
Biomass fuels from plantations	Convert a barren area about 15 times the size of Iowa's farmland (about 30 million acres) to biomass crop production
CO_2 Storage in New Forest.	Convert a barren area about 30 times the size of Iowa's farmland to new forest

Giga-Tonnes = 10^9 Metric-Tonnes (1000 Kilograms)

The Good News:
U.S. Energy Productivity is Improving



Source: National Commission on Energy Policy, 2004. *Ending the Energy Stalemate*

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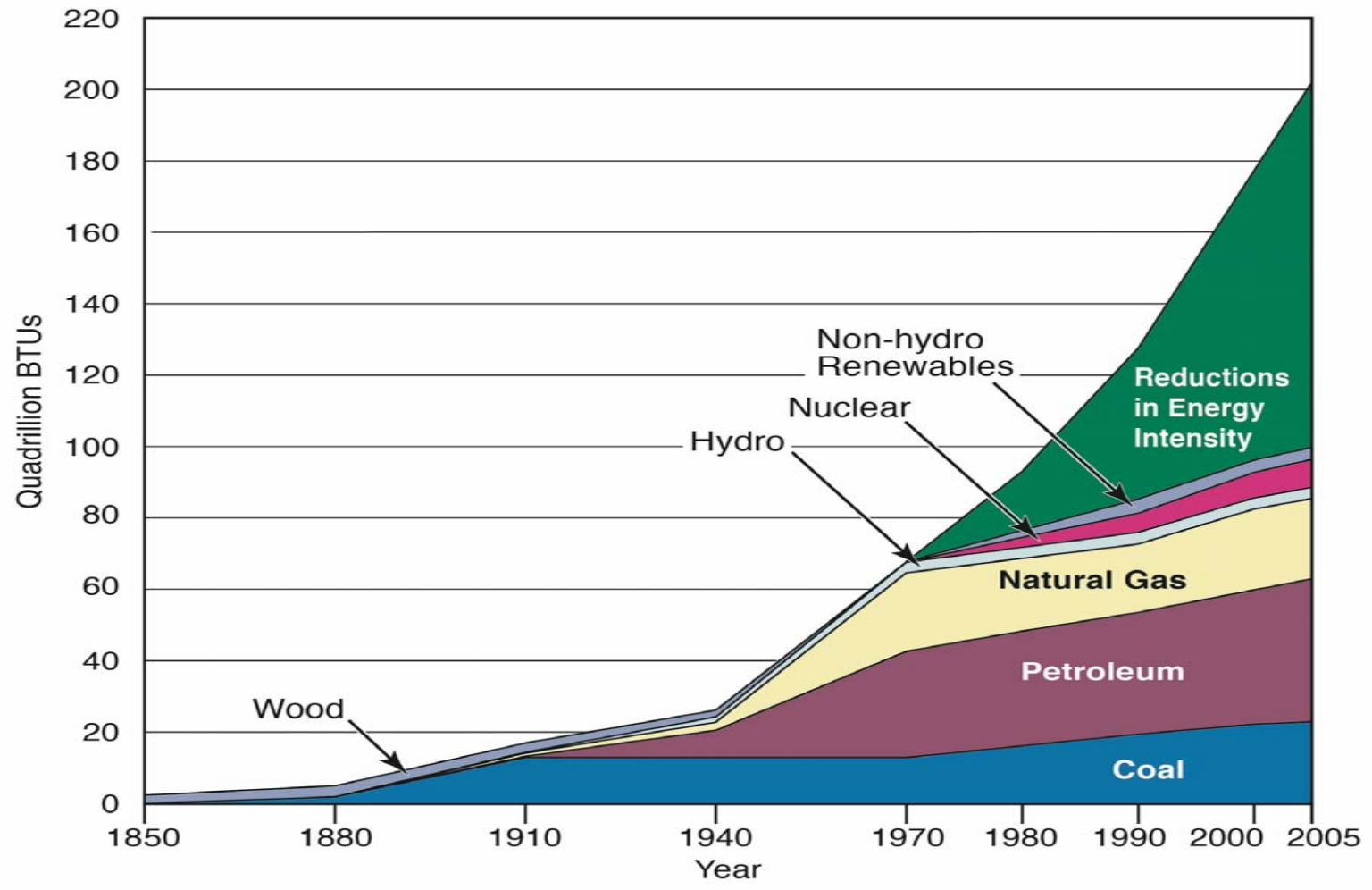
Over the last 30 years, energy efficiency has been the largest U.S. energy resource



Source: Updated from Brown, M. A. 2007. *Energy and American Society: Thirteen Myths*, Ch. 2.

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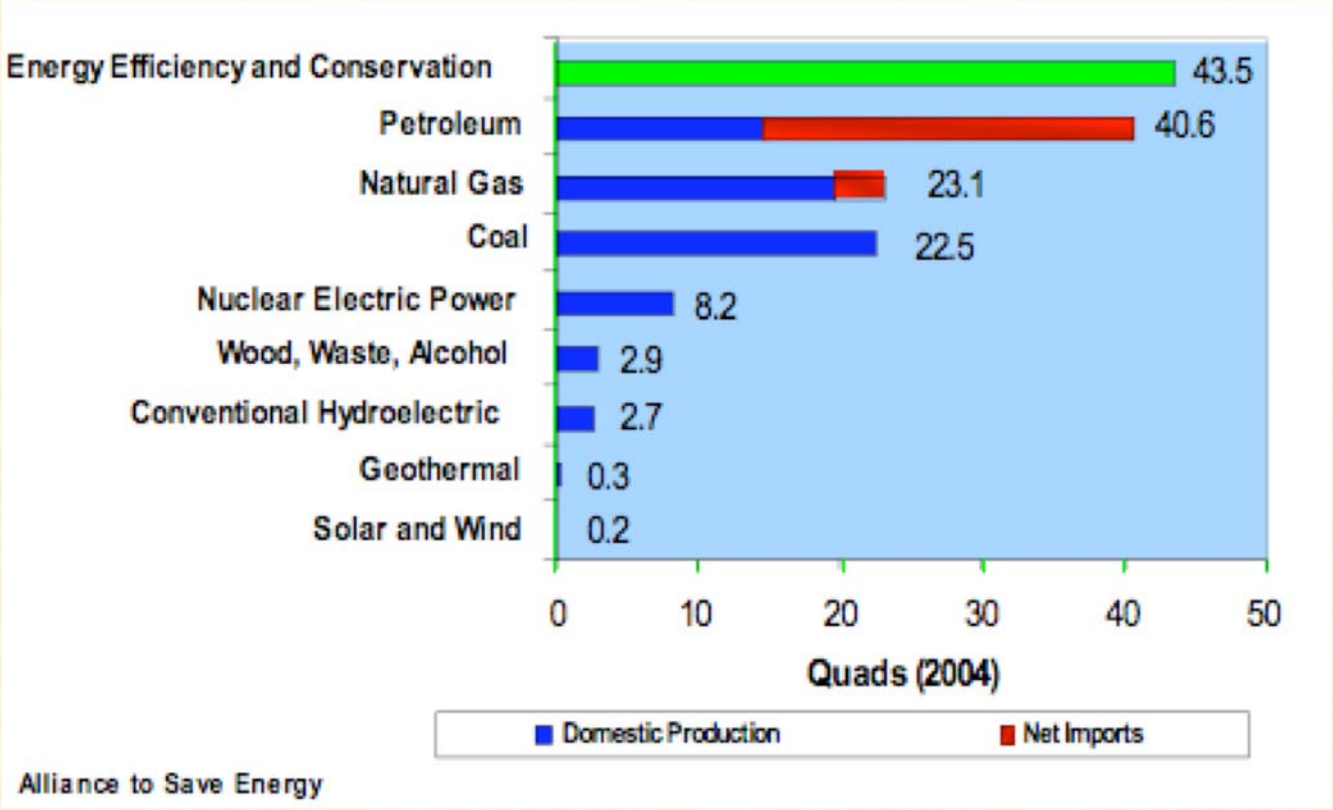
Energy efficiency improvements (and conservation) have reduced annual energy consumption by 40+ quads, since 1973



Roughly $400 billion energy savings per year.

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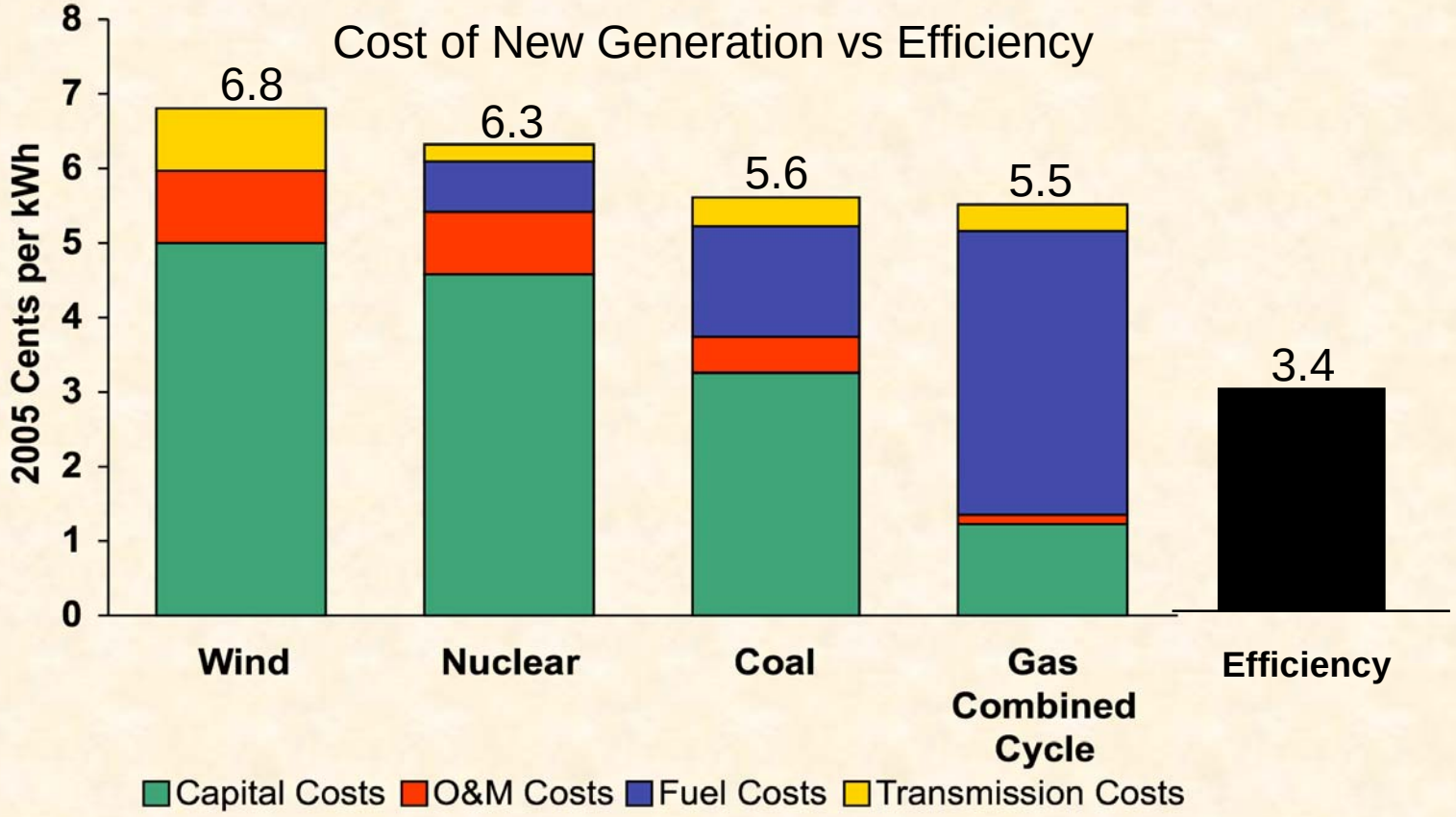
Energy efficiency improvements remain the fastest, cheapest, cleanest energy resource



Sources: *Annual Energy Outlook 2007* (EIA), Figure 56, and "Five Years In: An Examination of the First Half-Decade of Public Benefits Energy Efficiency Policies" (ACEEE, 2004), Table 5.

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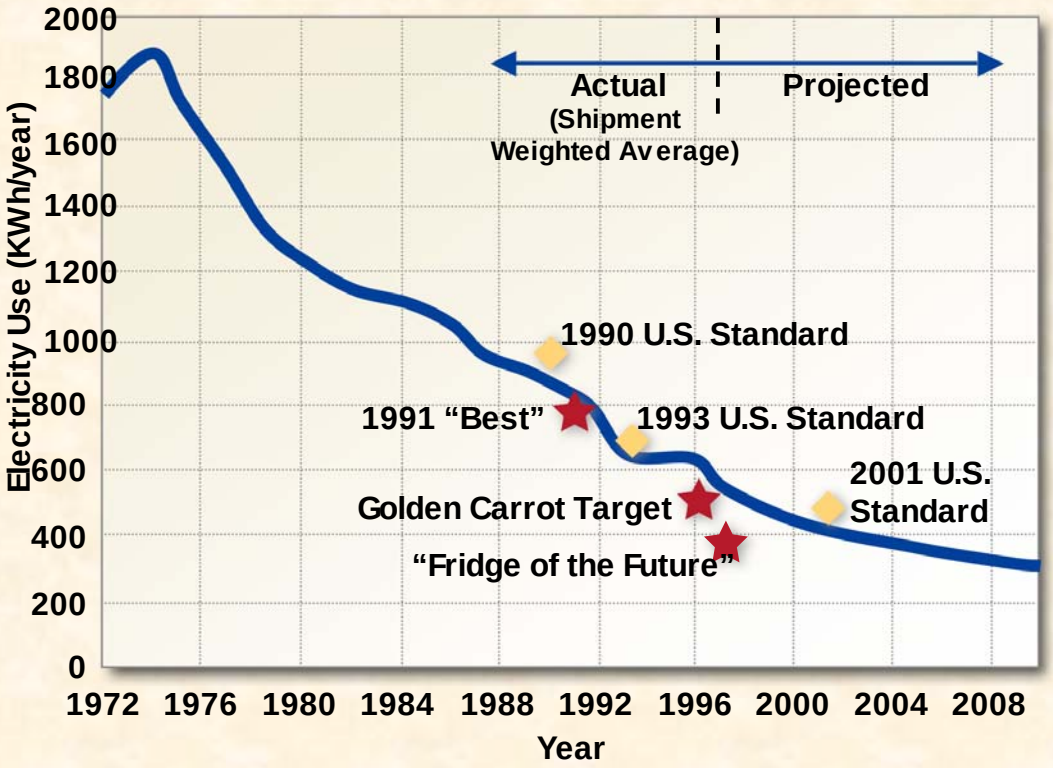
Household Refrigerators Illustrate the Case: Same "Service" with Less Energy



Refrigerator energy efficiency

National Research Council, 2001. *Energy Research at DOE: Was it Worth It?* Washington, DC, National Academy Press

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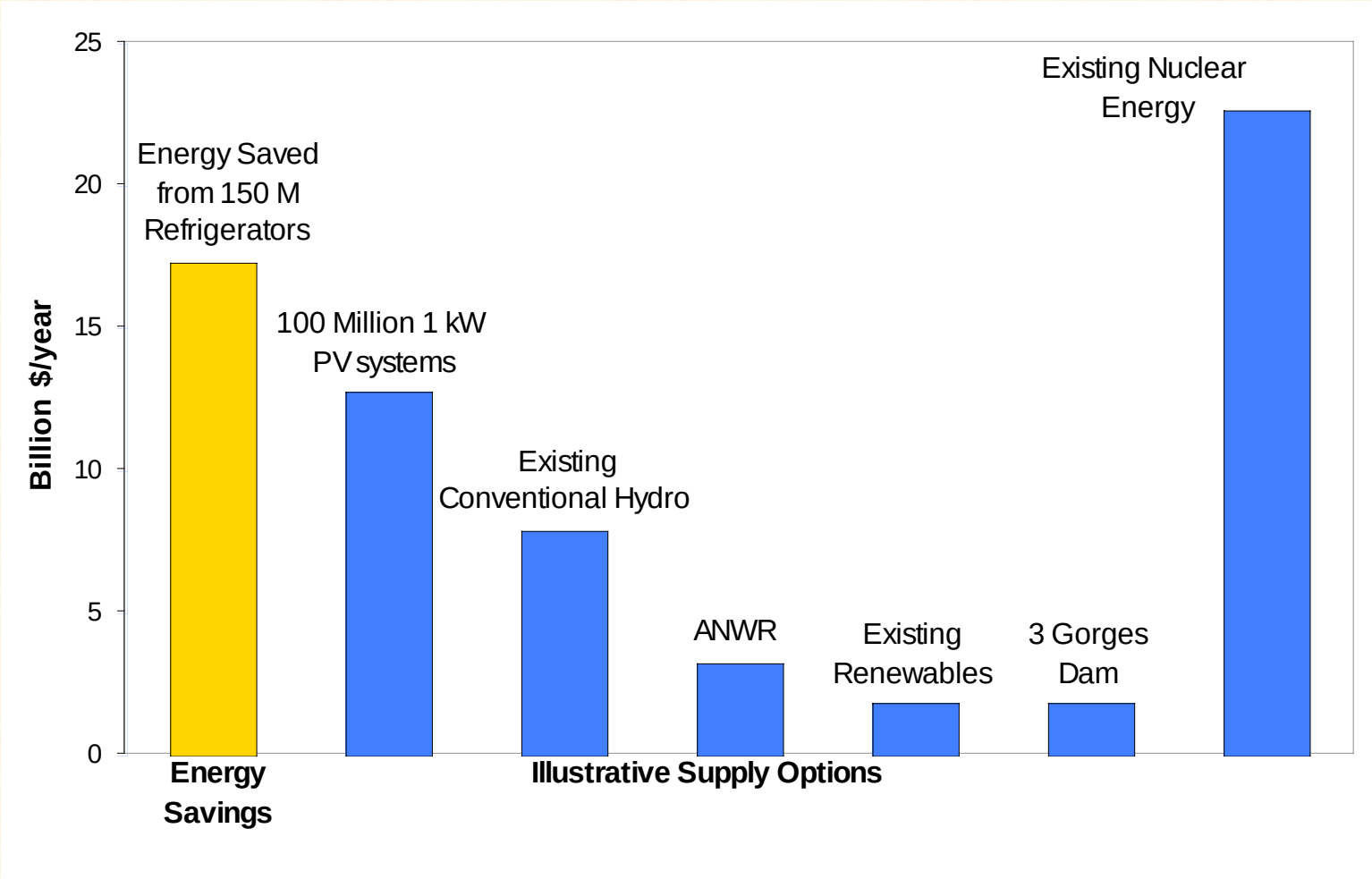
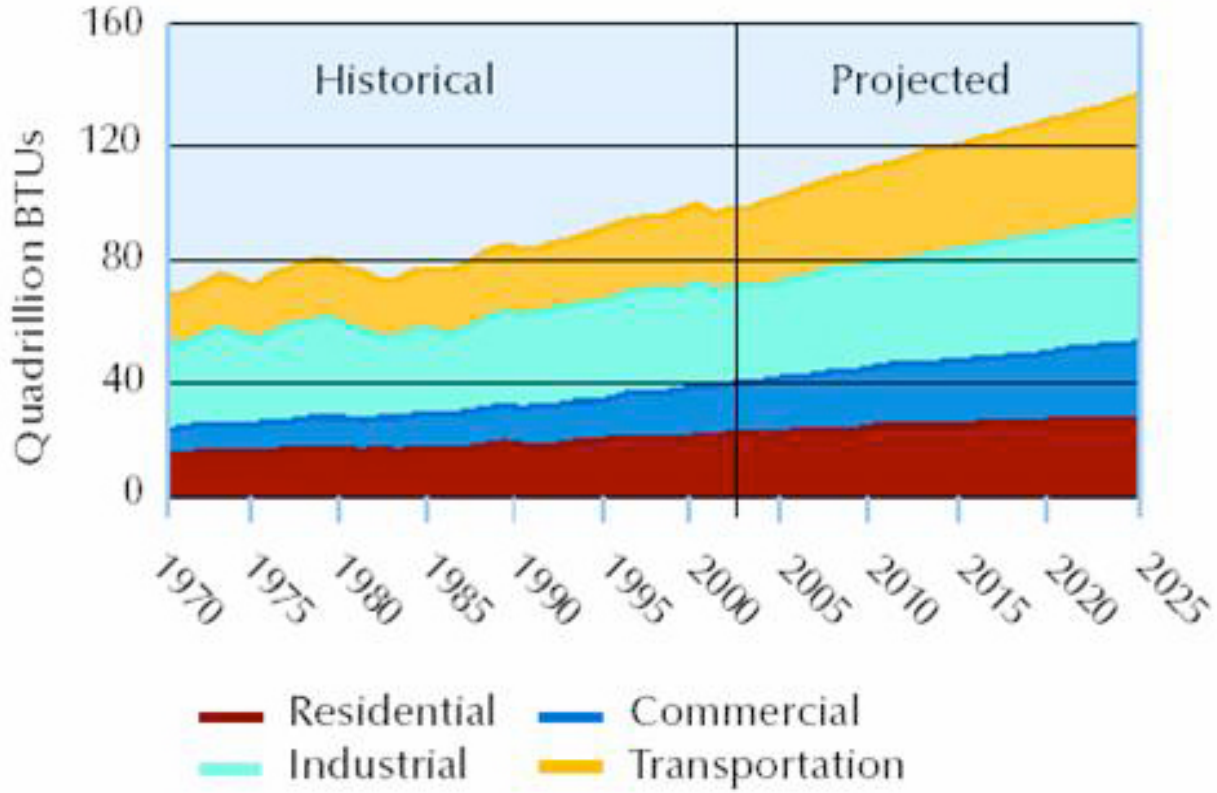
Value of Energy Saved & Produced



Source: Art Rosenfeld (2005)

Energy efficiency must help the U.S. and Georgia meet its future needs

U.S. Energy Consumption:



Continuing to grow our energy use by 1.1% annually would require:

~31% increase by 2030
~183% increase by 2100

Cutting the growth rate in half (0.55%) would result in a more viable pace of resource expansion:

~15% increase by 2030
~68% increase by 2100

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How Much More Energy Efficiency is Available and Worth Buying?

A lot, based on 3 assessments.

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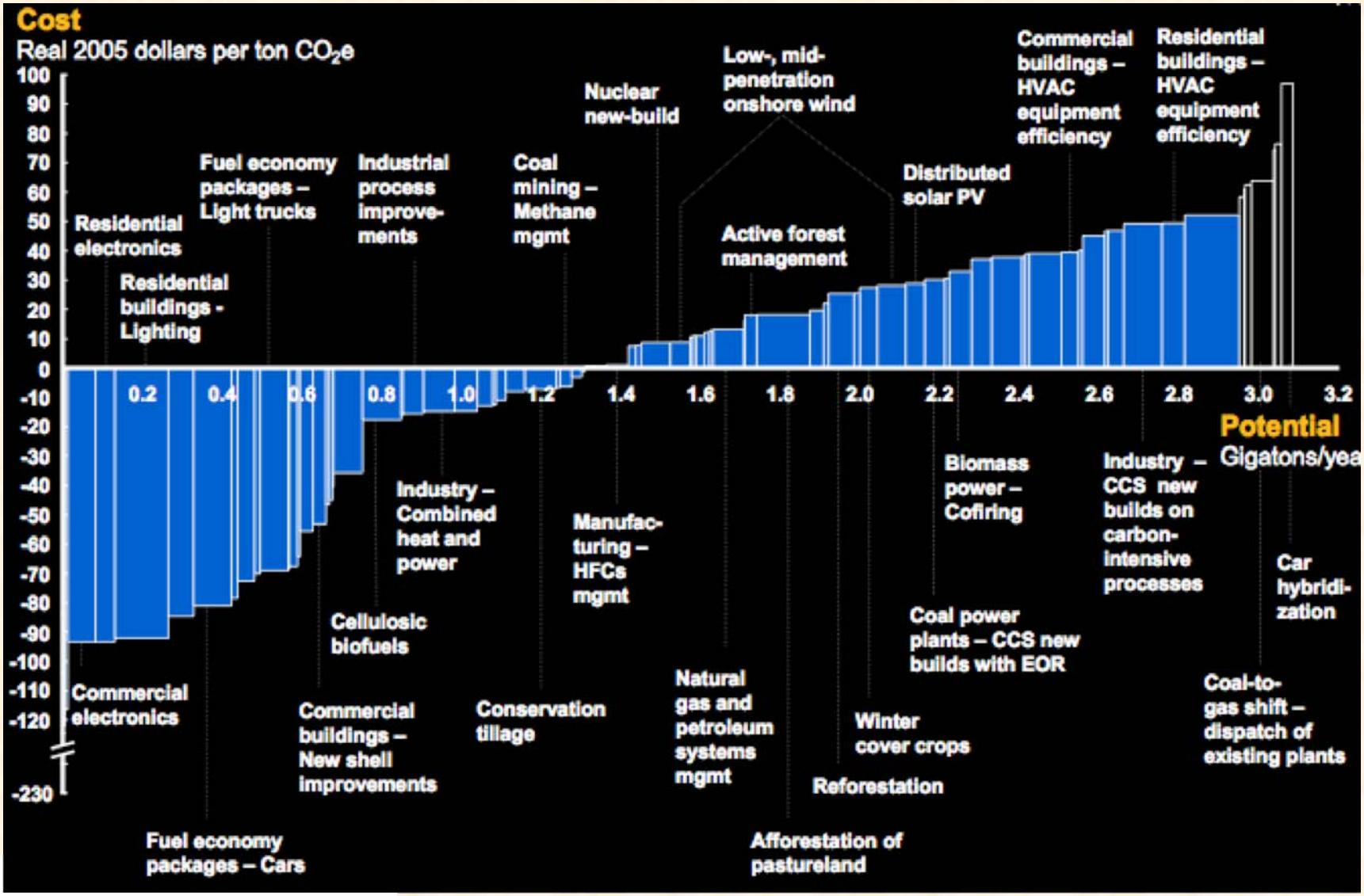
(1) U.S. Mid-Range Abatement Curve – 2030



Source: McKinsey & Company, 2007

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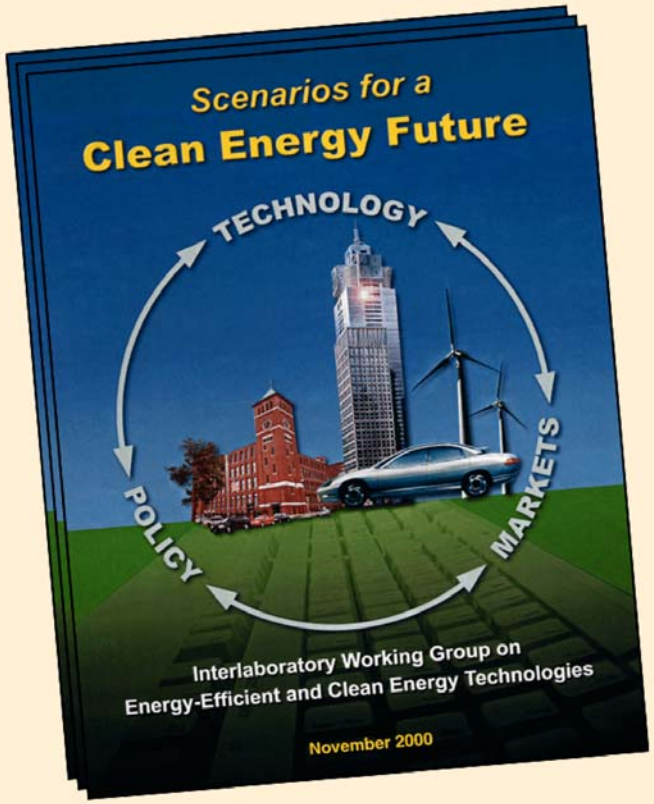
(2) Scenarios for a Clean Energy Future

- **Advanced policies could cut U.S. electricity consumption in 20 years by 24%, at no net cost to the economy.**
  - Funded by DOE and EPA
  - Undertaken by researchers at 5 DOE national laboratories with input from experts groups
  - Published in November 2000



http://www.ornl.gov/ORNL/Energy_Eff/CEF.htm
"Special Issue" of ***Energy Policy***, Vol. 29, No. 14, Nov. 2001

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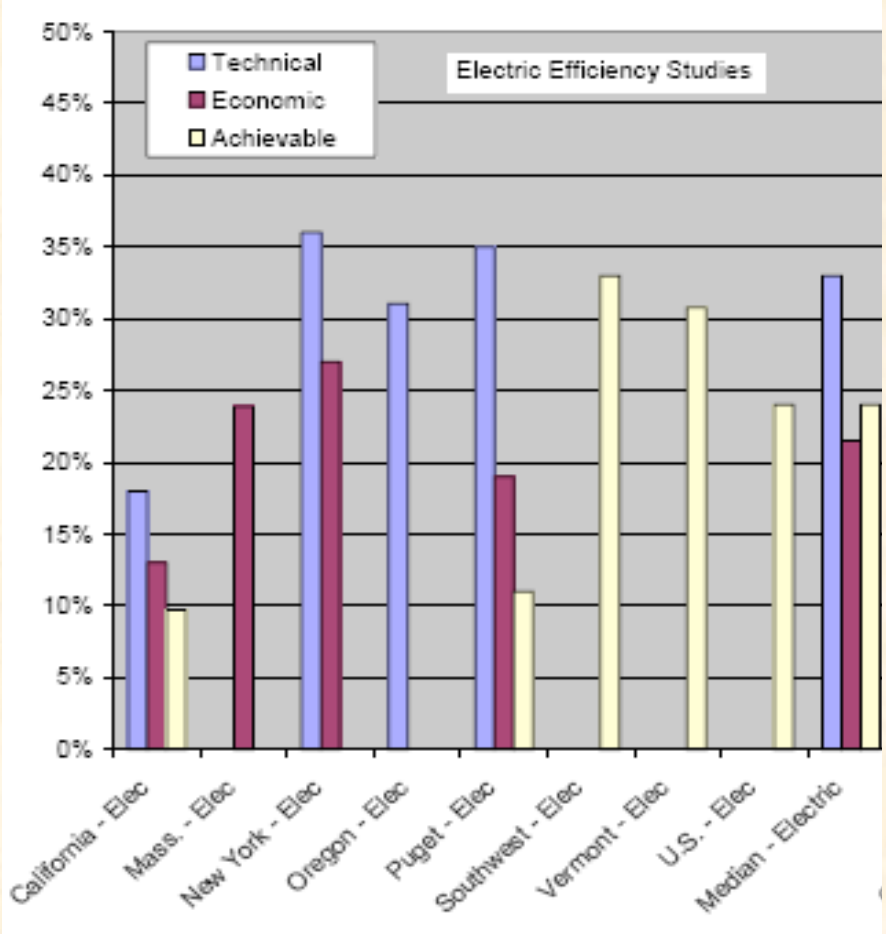
(3) Meta-Analysis of Recent Studies

- **10 - 33% reductions in electricity use are "achievable," depending on timeframe and state/region**
  - No Southeast state had published an electric efficiency potential assessment at that time
  - GEFA/GPC estimates range from 7 to 10% (2015 vs 2018)
  - Maryland study: 15% (2015) and 29% (2025)



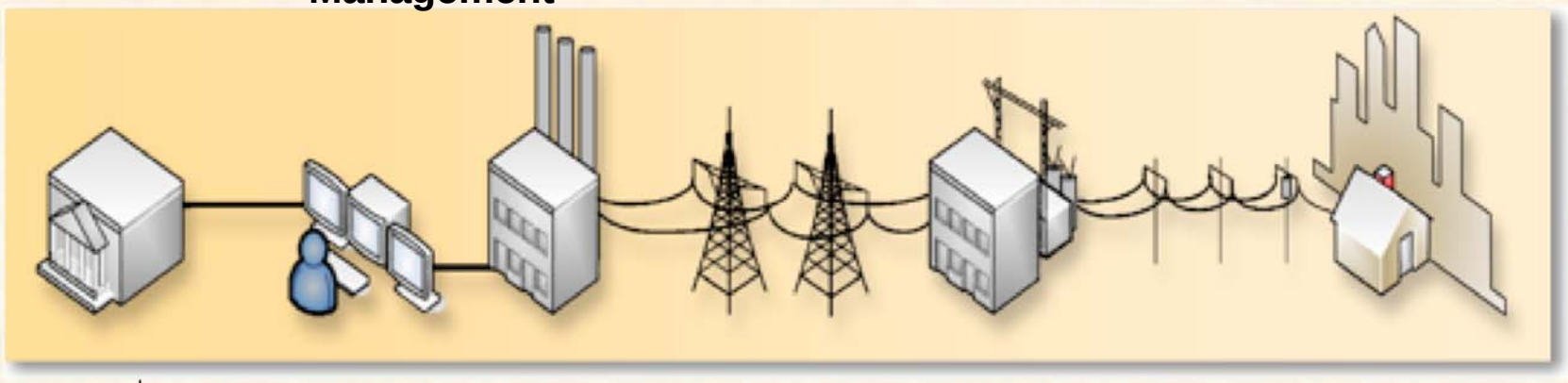
<http://www.aceee.org/conf/04ss/rnemeta.pdf> Steven Nadel, et al., "The Technical, Economic and Achievable Potential for Energy-Efficiency in the U.S.--A Meta-Analysis of Recent Studies" (August 2004)

Layers of Inefficiency Exist

Building Energy Management

Distribution

Transmission



Substation

Coal Plant

3% efficient!

Source: Lovins. 2007 in *Energy and American Society – Thirteen Myths*

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Compact Fluorescents are 4-Times More Efficient, but "Upfront Costs" are a Barrier

Upfront Costs

75 Watt Incandescent Bulb	≈	$0.50
18 Watt Compact Fluorescent	≈	$2.00

1 Year of Energy Costs

Incandescent Bulb	≈ $7.70
Compact Fluorescent	≈ $1.80

10 Years of Energy Costs*

Incandescent Bulb	≈ $59
Compact Fluorescent	≈ $14

Net present cost calculation assumes bulb operates 4 hours/day, $0.07/kWh and a 5% discount rate.

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Bulb Efficiency

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Demand for new and more consumer electronics is growing electricity use

PLASMA TV

42”
250W

vs.

27”
100W

Consumes 2.5x more energy

SET TOP BOX

30W

=

30W

2 set top boxes consume as much energy in one year as a refrigerator

Source: Michael Howard, “Energy Efficiency How Much Can we Count On?” Edison Foundation Conference, April 21, 2008

“You can’t manage what you can’t measure:” New tools abound

Programmable Communicating Thermostats

Source: Michael Howard, “Energy Efficiency How Much Can we Count On?, Edison Foundation Conference, April 21, 2008

Direct Energy Feedback Devices

Kill a Watt Meter: Electric Usage Monitor

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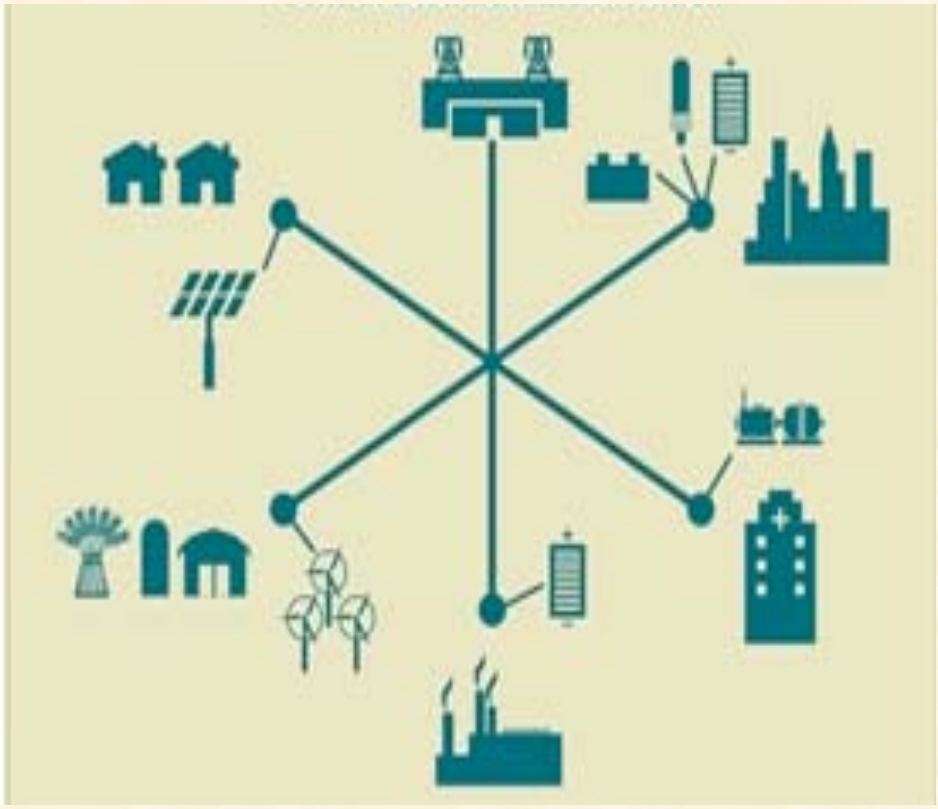
Distributed Generation Also Holds Great Promise, but Requires a "Paradigm Shift"

Today's Central Generation

Tomorrow's System Overlaid with Distributed Generation



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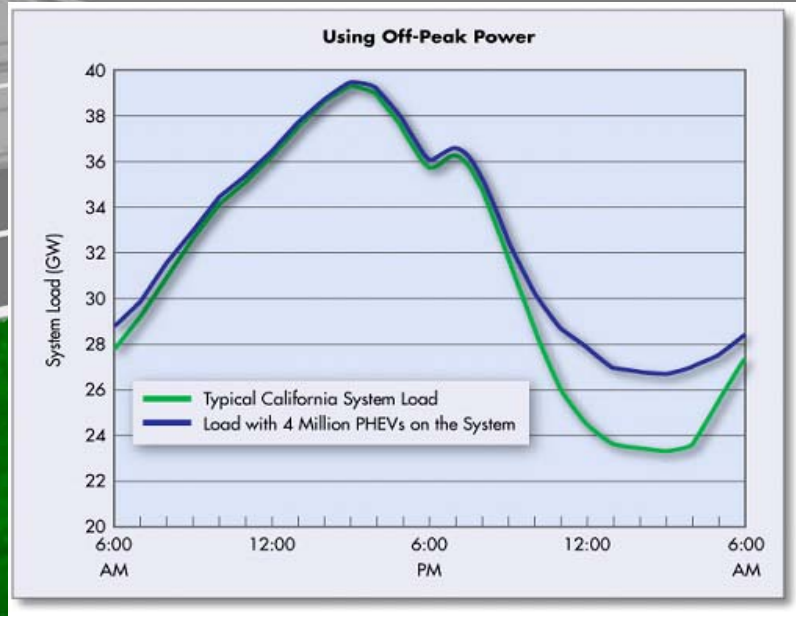
ORNL's Transportation Vision

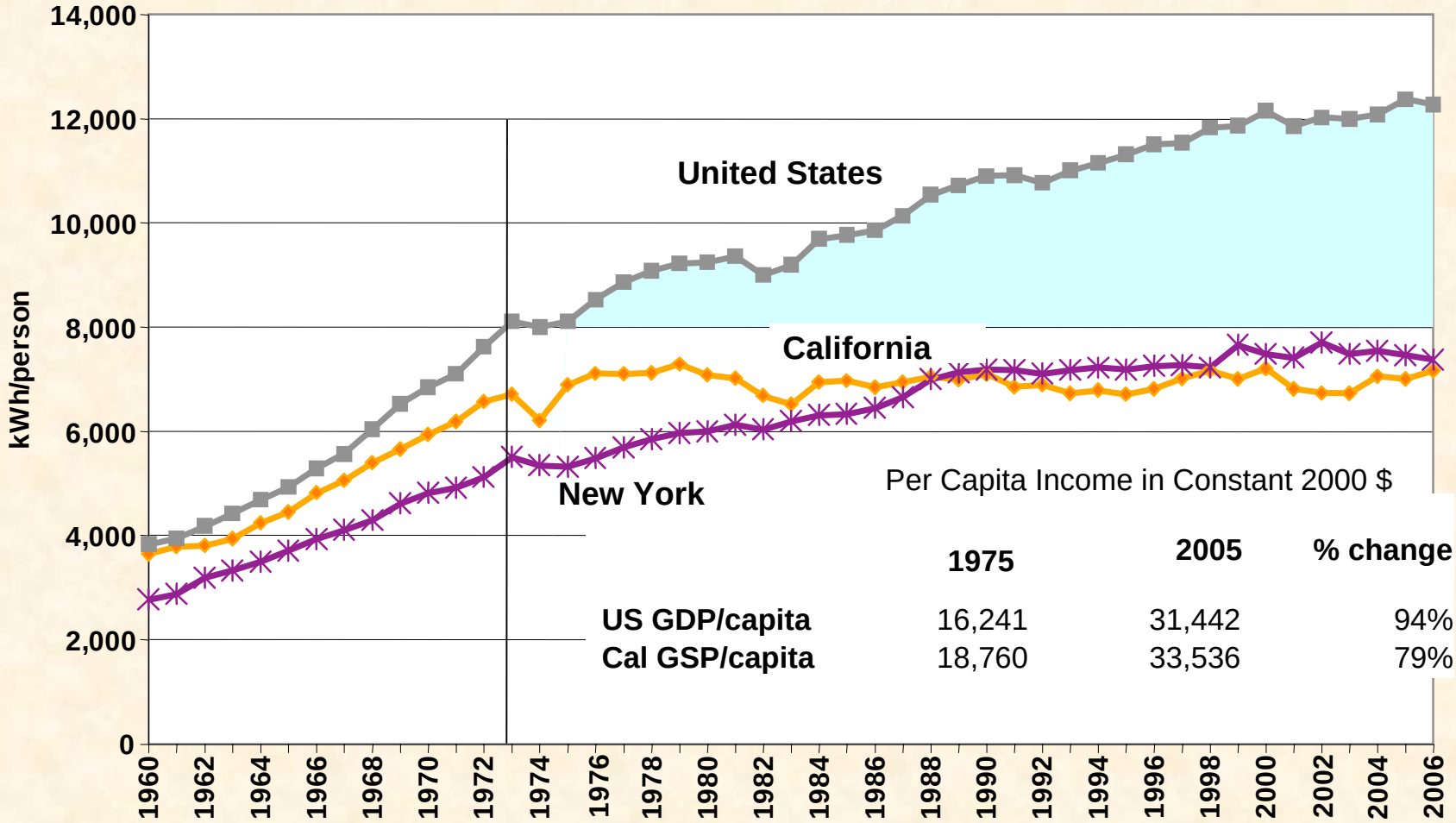
US grid has significant excess capacity (off-peak)



"Plugging In" for Integration and Innovation

- Direct Solar Charging
- Off Peak Charging
- Smart Metering
- Energy Storage for the Grid
- User Incentives/Convenience

State policies are making a difference



Per Capita Income in Constant 2000 $

	1975	2005	% change
US GDP/capita	16,241	31,442	94%
Cal GSP/capita	18,760	33,536	79%

Source: Art Rosenfeld (Commissioner, California Energy Commission), March 11, 2008

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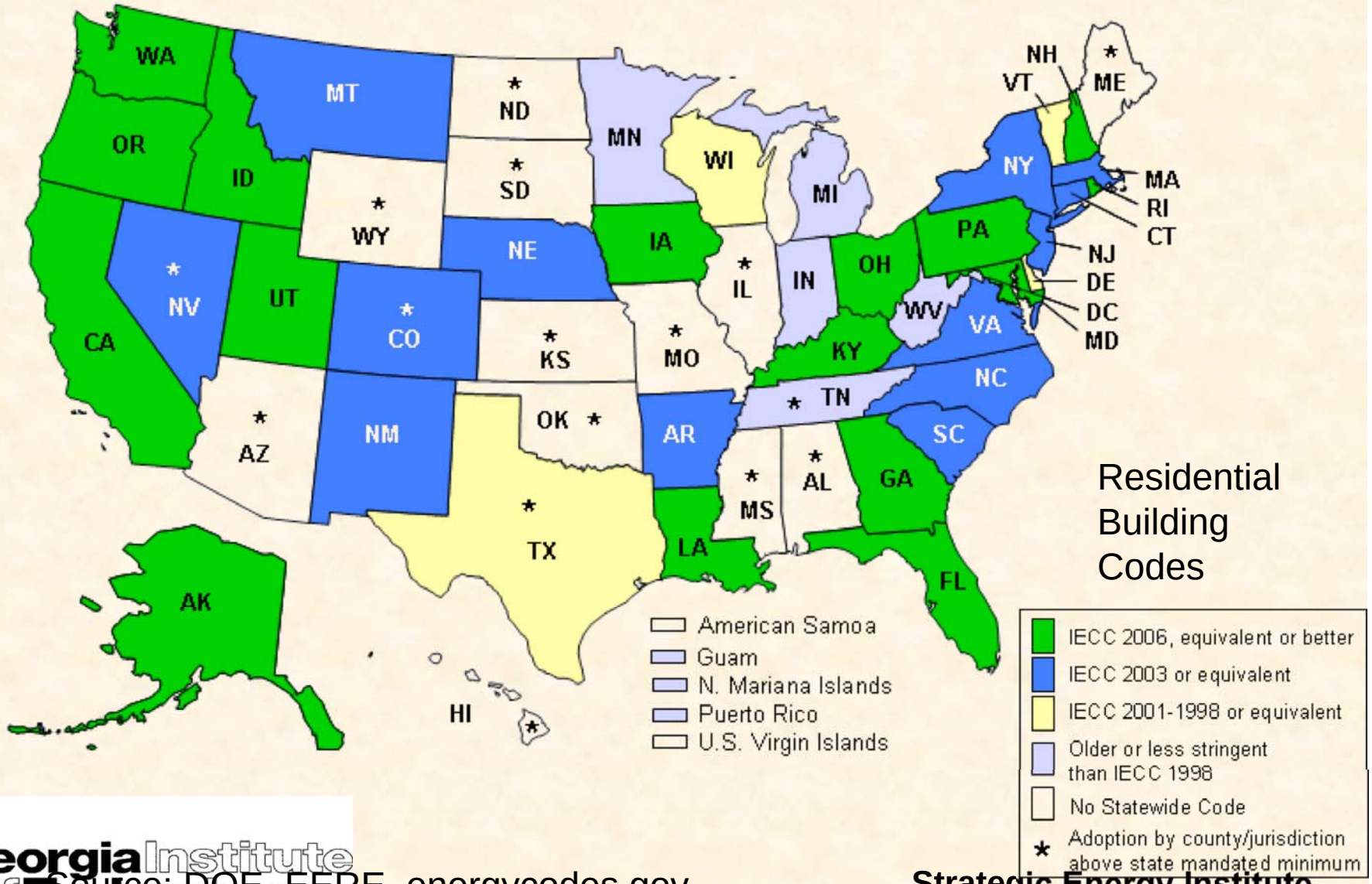
Variations across States and Provinces Spotlight Opportunities for Improvement



Residential Building Codes

Source: DOE, EERE, energycodes.gov

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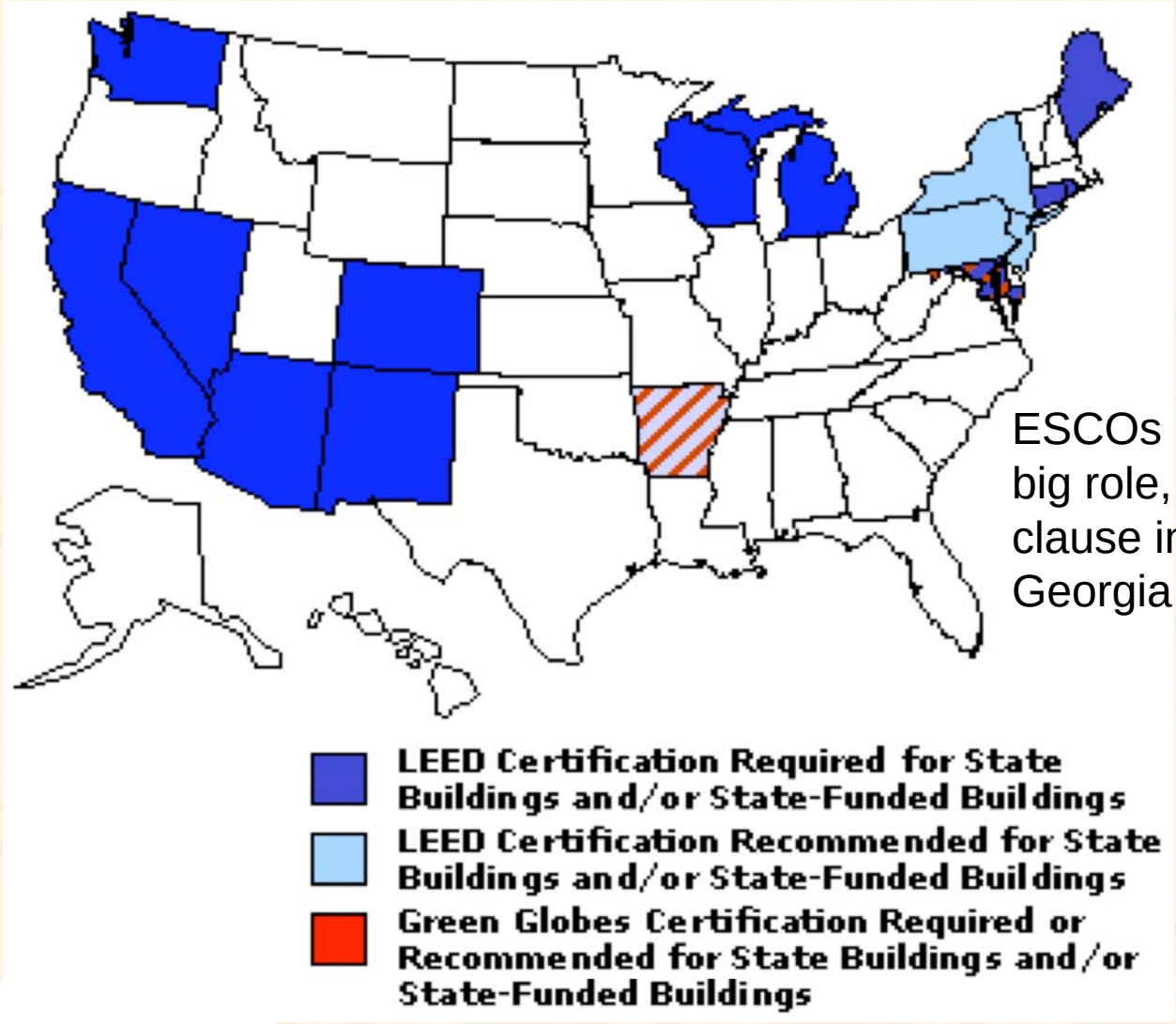
Green Building Standards for State Buildings



ESCOs could play a big role, but for a clause in the Georgia constitution.

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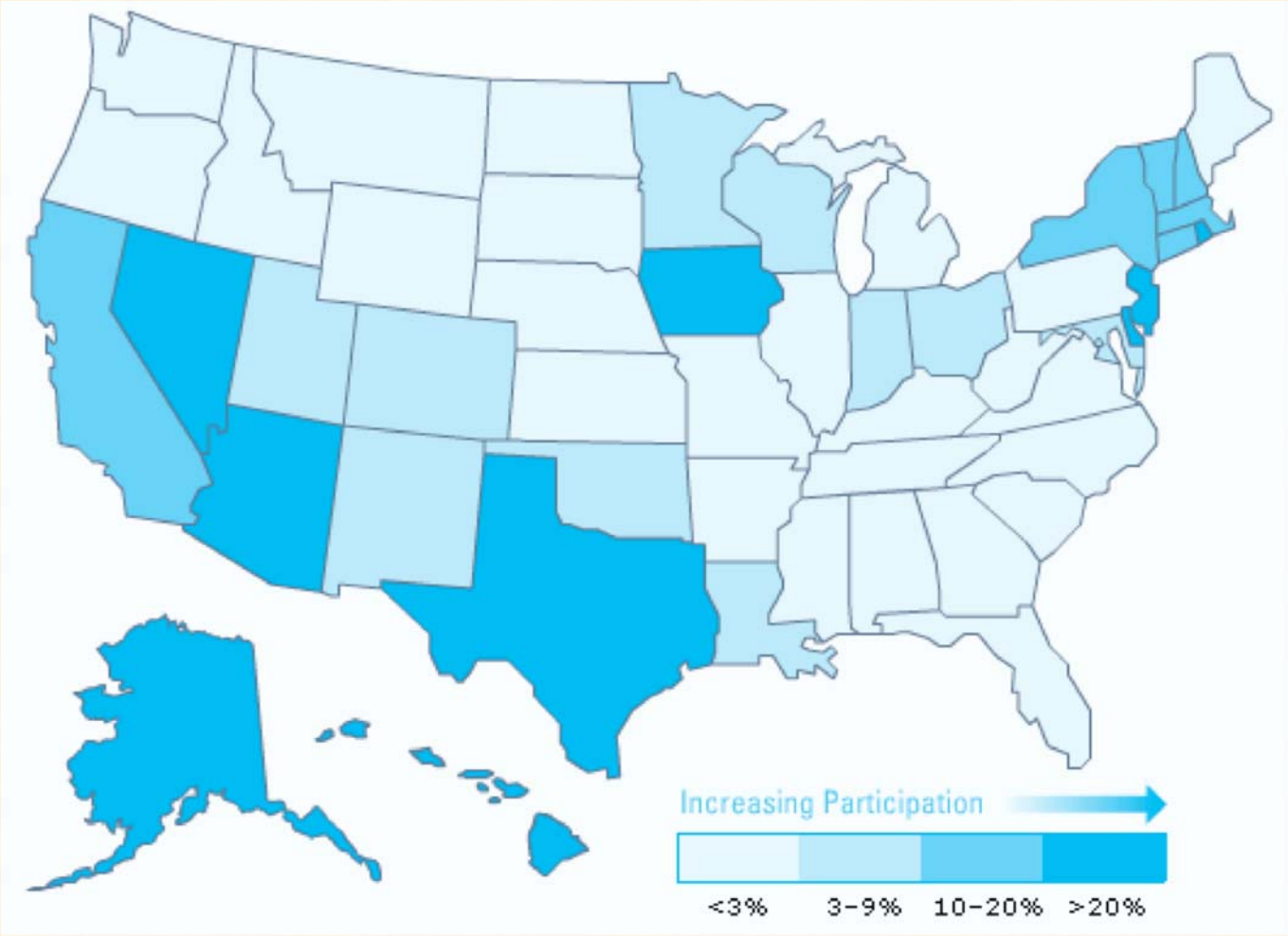
Market Penetration of Energy Star Homes



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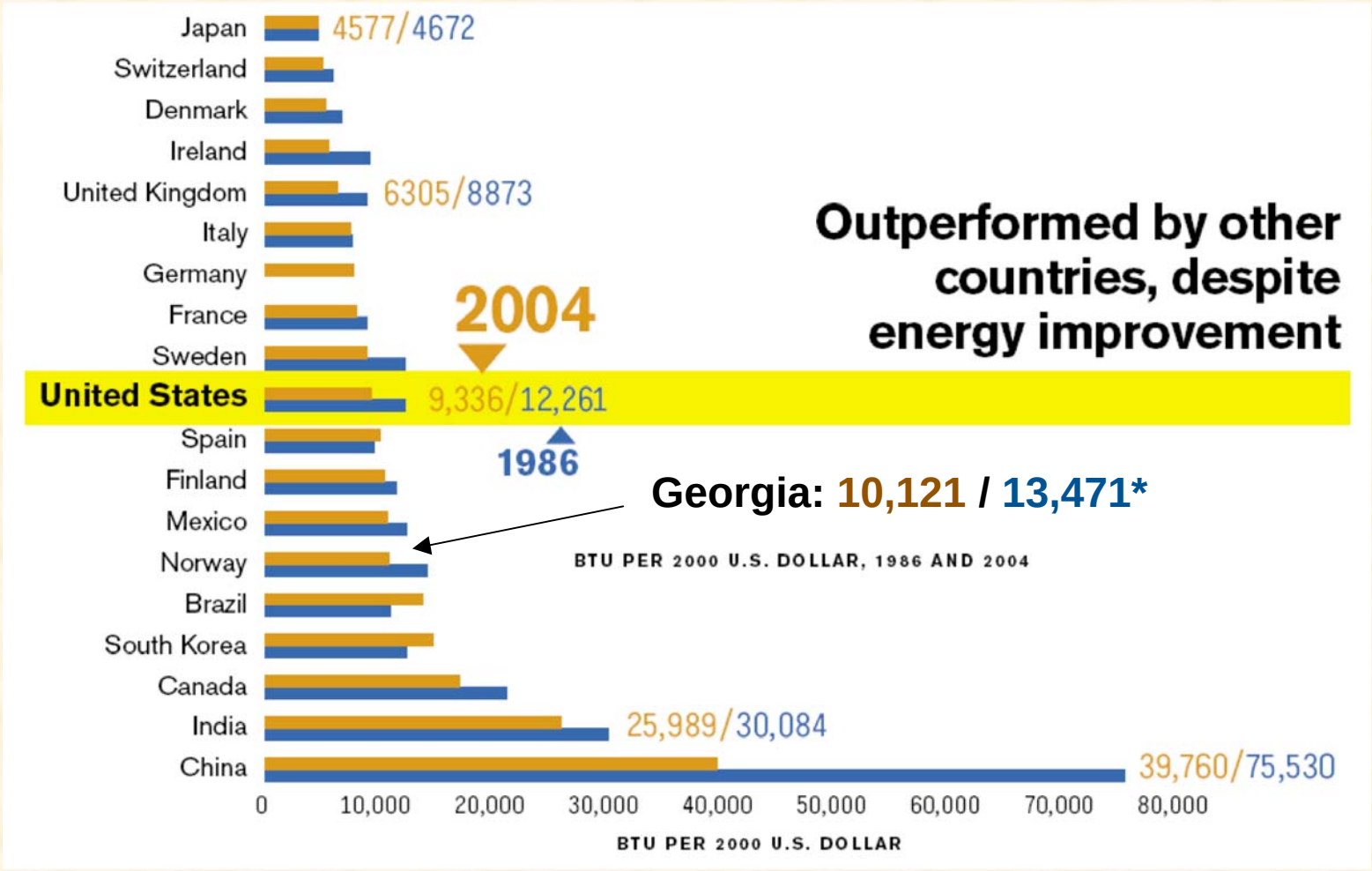
International Comparisons Also Suggest Opportunities for Improvement



Source: Council on Competitiveness. 2007. *Competitiveness Index: Where America Stands.* Figure 4.32, p. 103. *EIA. 2007. Table 7, eia.doe.gov/emeu/states/sep_use/total/use.tot.ga.html (1990-not 1986 for GA)

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Concluding Remarks

- Targeting energy efficiency (the "fifth fuel") is a "no regrets" strategy
- It's good for the environment & it's good for the economy
- But, the commitment to energy efficiency has been more rhetorical than real – especially in the Southeast
- Targeted policies are needed to overcome market barriers
- And some existing policies need to be reformed

seea
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www.seealliance.org

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