

**Delaying Global Climate Change via Efficiency
Lessons from California, Europe, and China
Aspen Global Change Institute
12-14 March, 2004**

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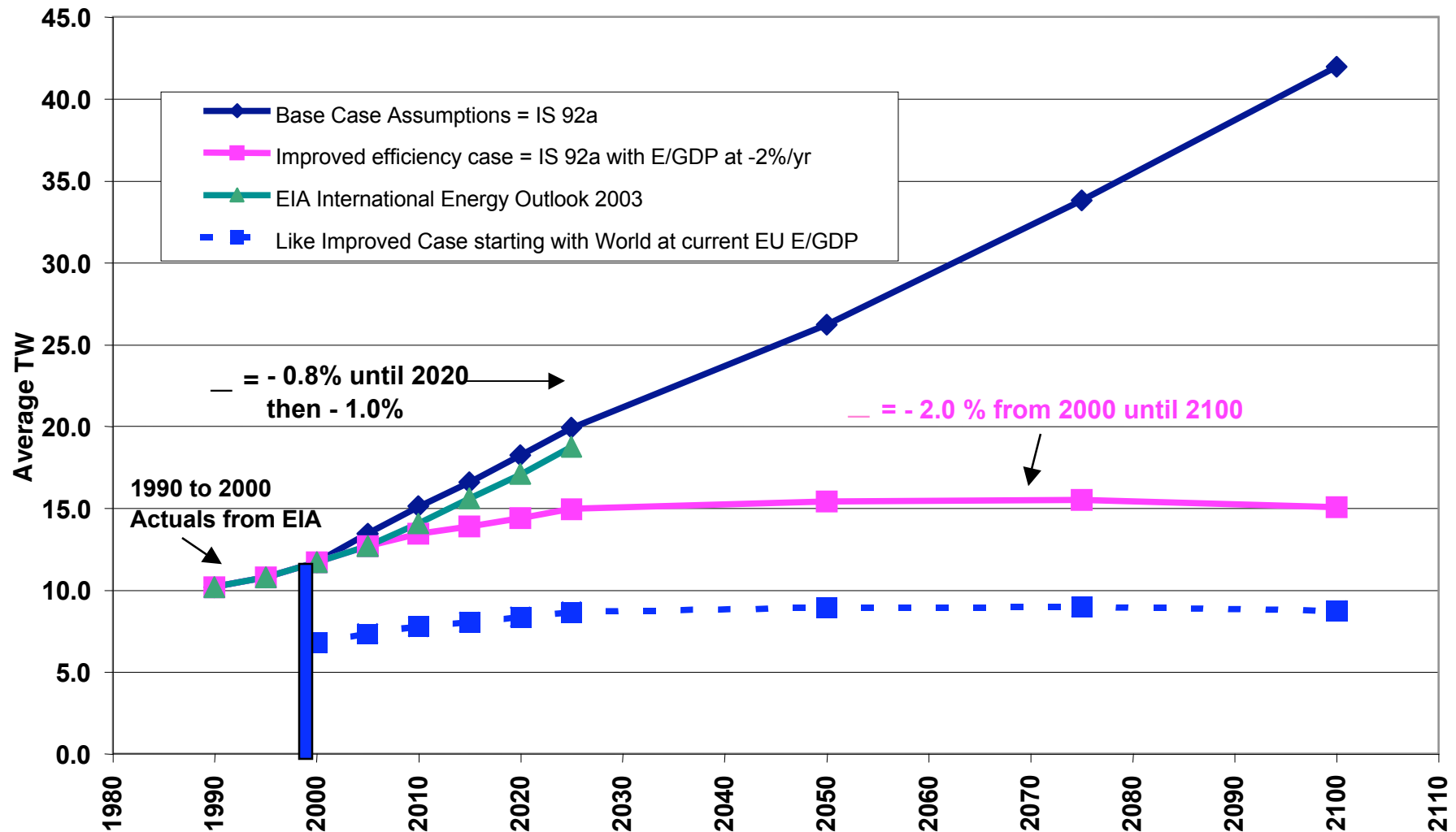
<http://www.energy.ca.gov/commission/commissioners/rosenfeld.html>



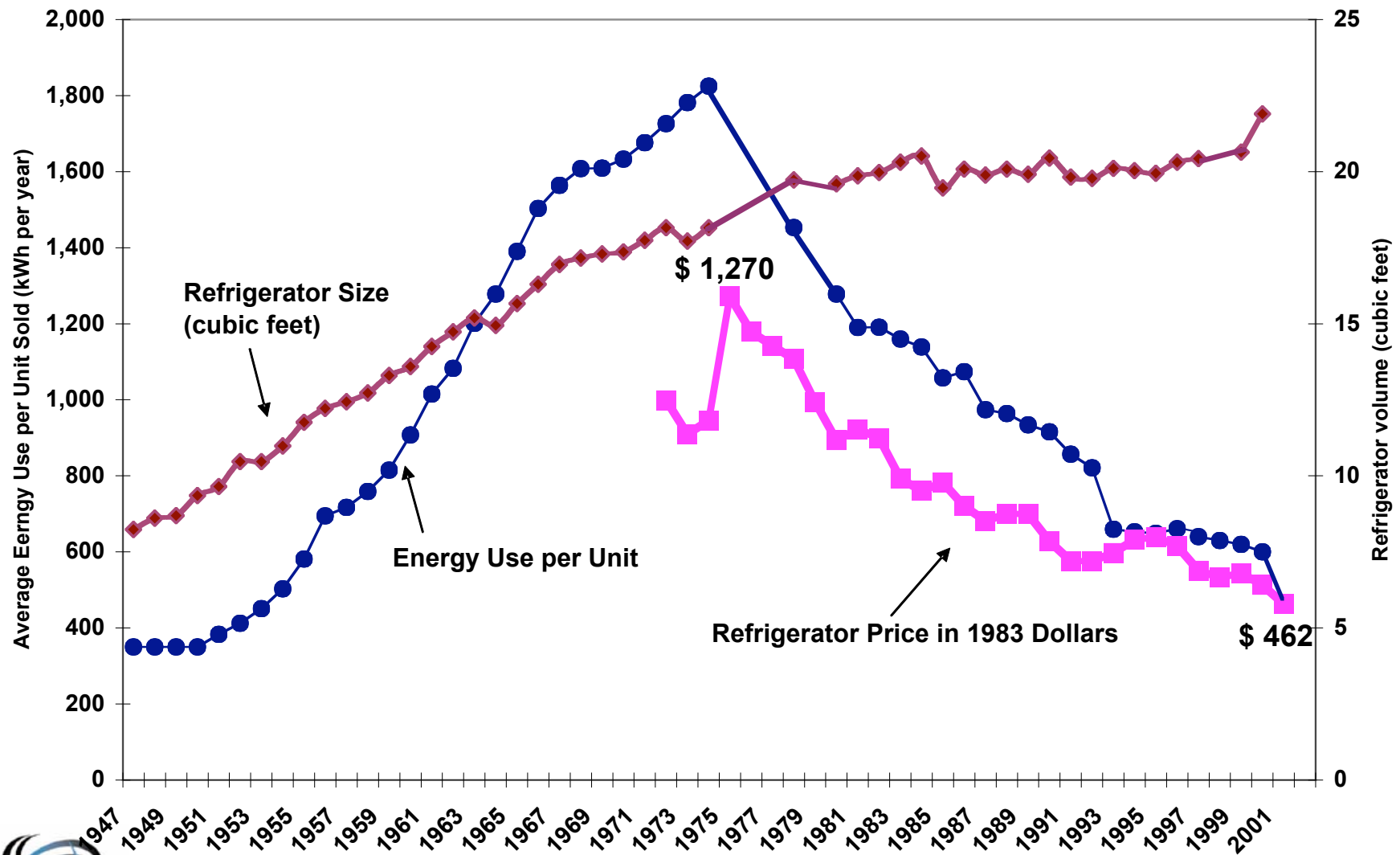
*Efficiency
Energy for the Future*

World Power Demand in IPCC Base Case, and Accelerated Efficiency

_ = Annual change in E/GWP, E= Energy (1TW year = 30 Quads), GWP=Gross World Product



United States Refrigerator Use v. Time



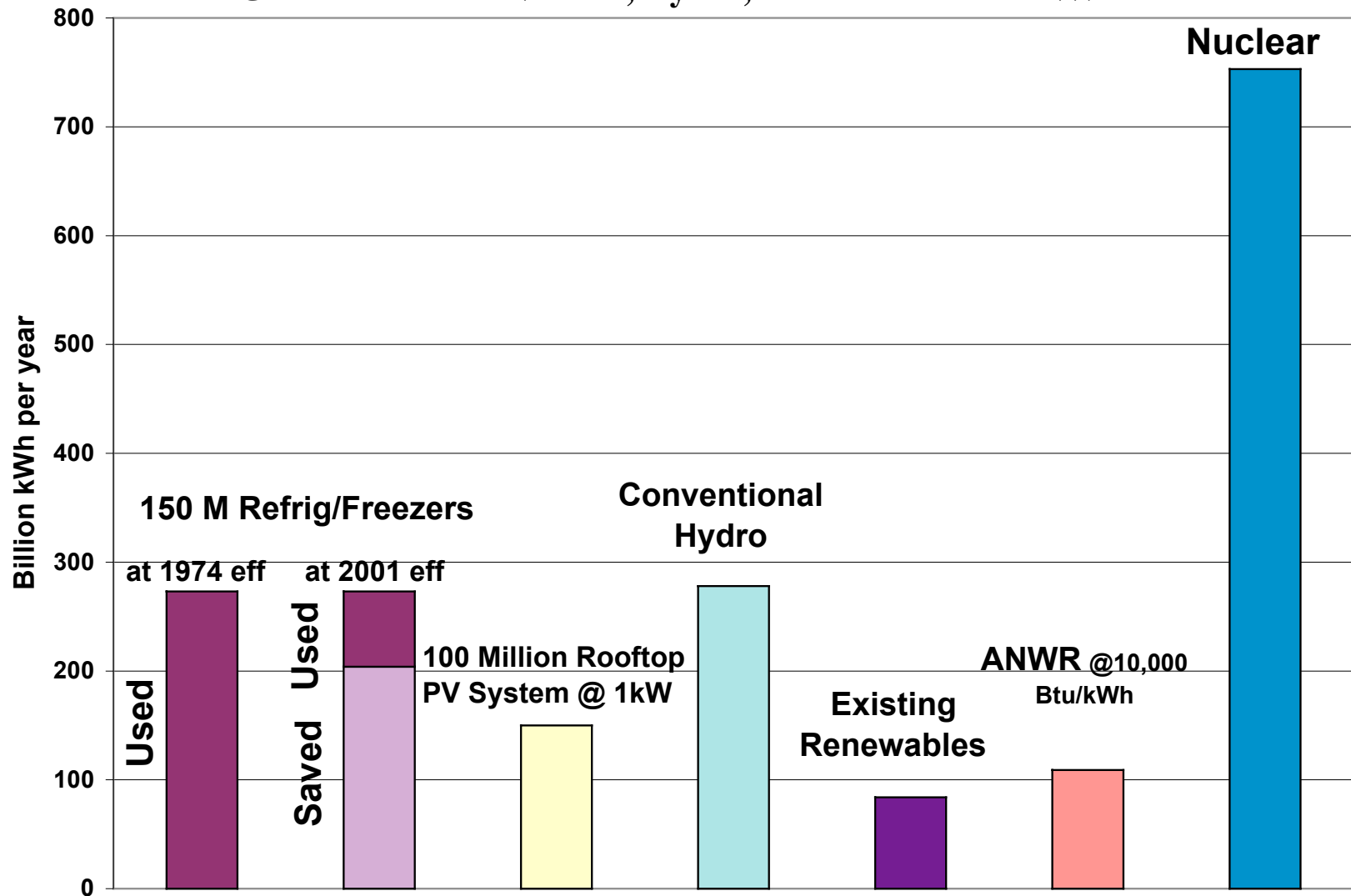
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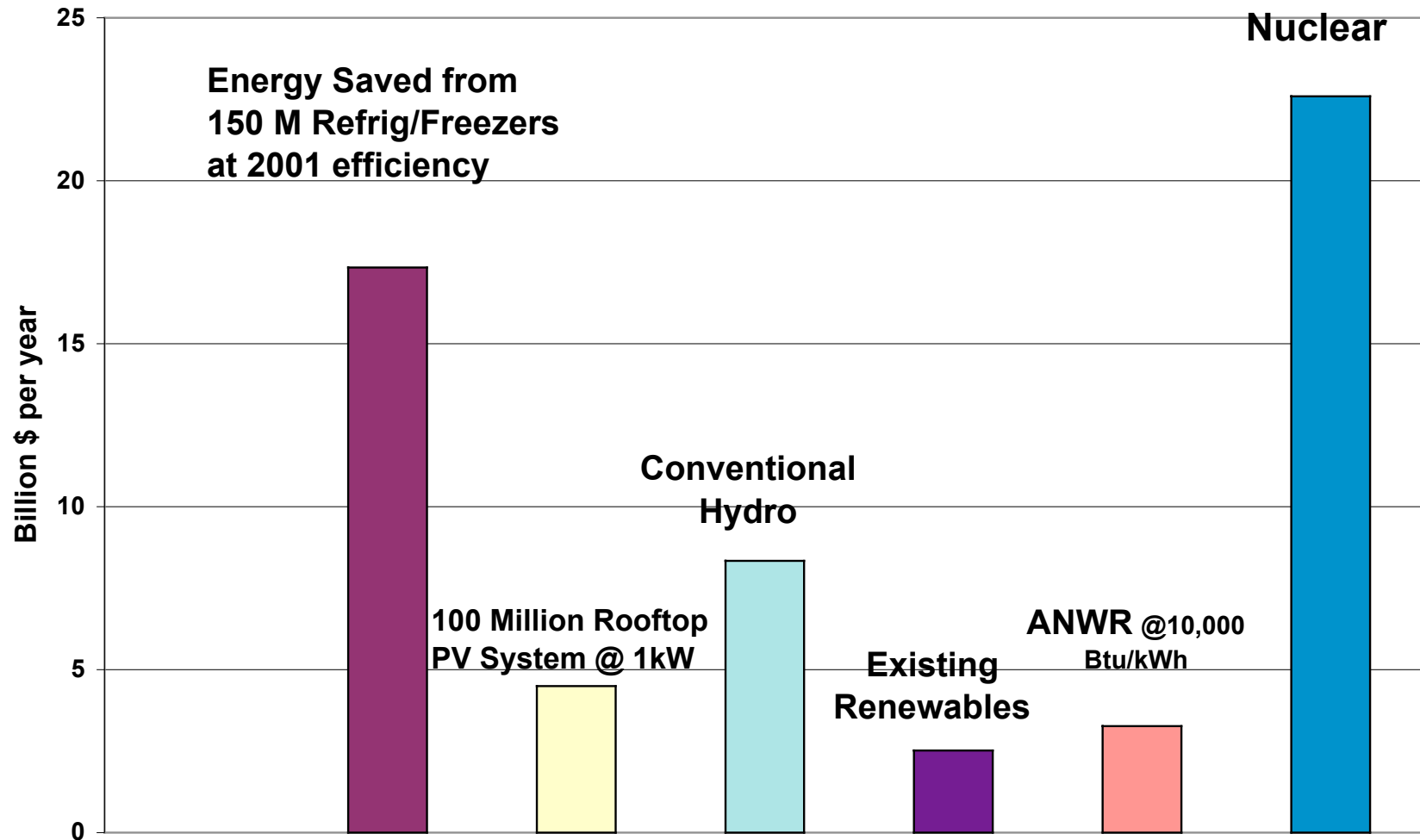
Source: David Goldstein

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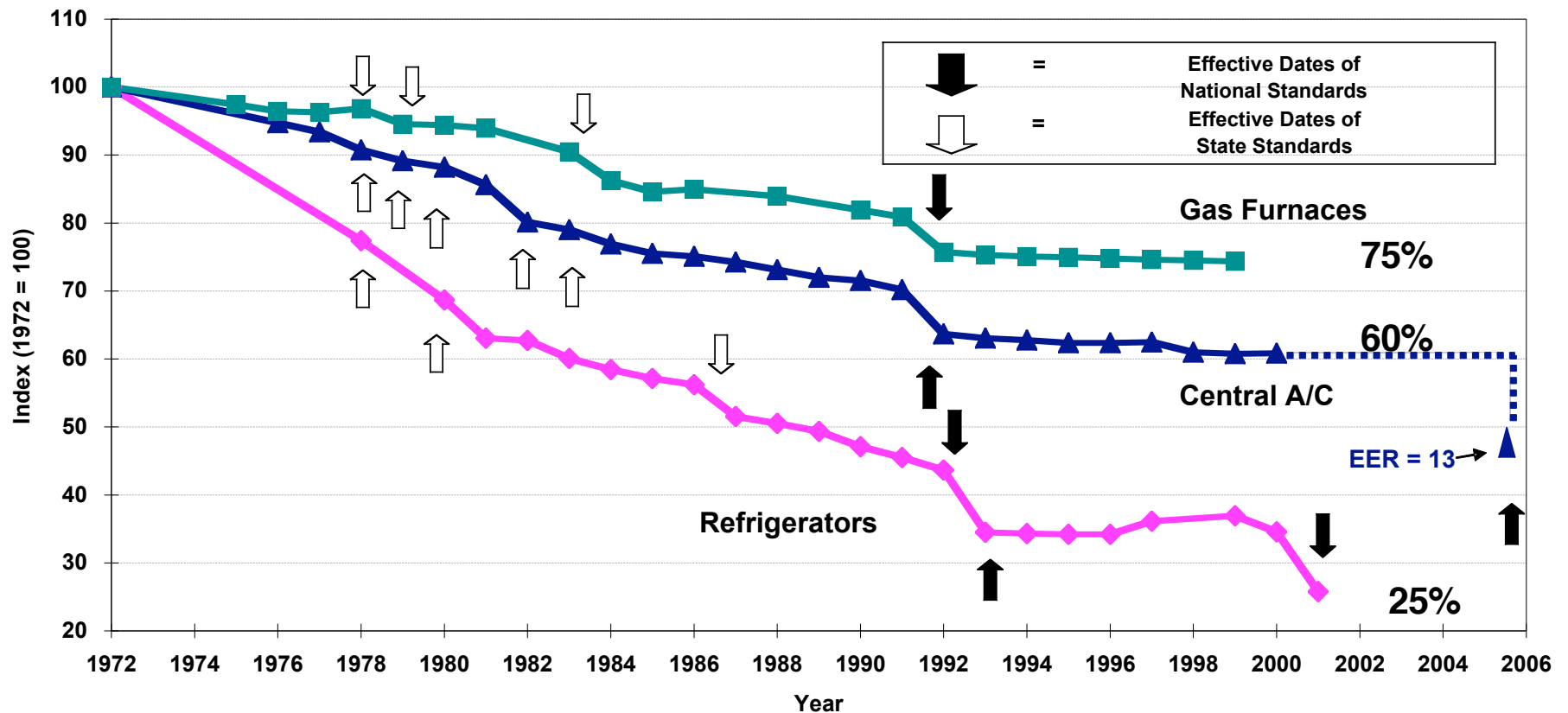
Electricity Use of Refrigerators and Freezers in the US compared to Generation from Nuclear, Hydro, Renewables and ANWR



The Value of Energy Saved and Produced (production @ .03 and savings @ .085 \$/kWh)



Impact of Standards on Efficiency of 3 Appliances



Source: S. Nadel, ACEEE,
in ECEEE 2003 Summer Study, www.eceee.org

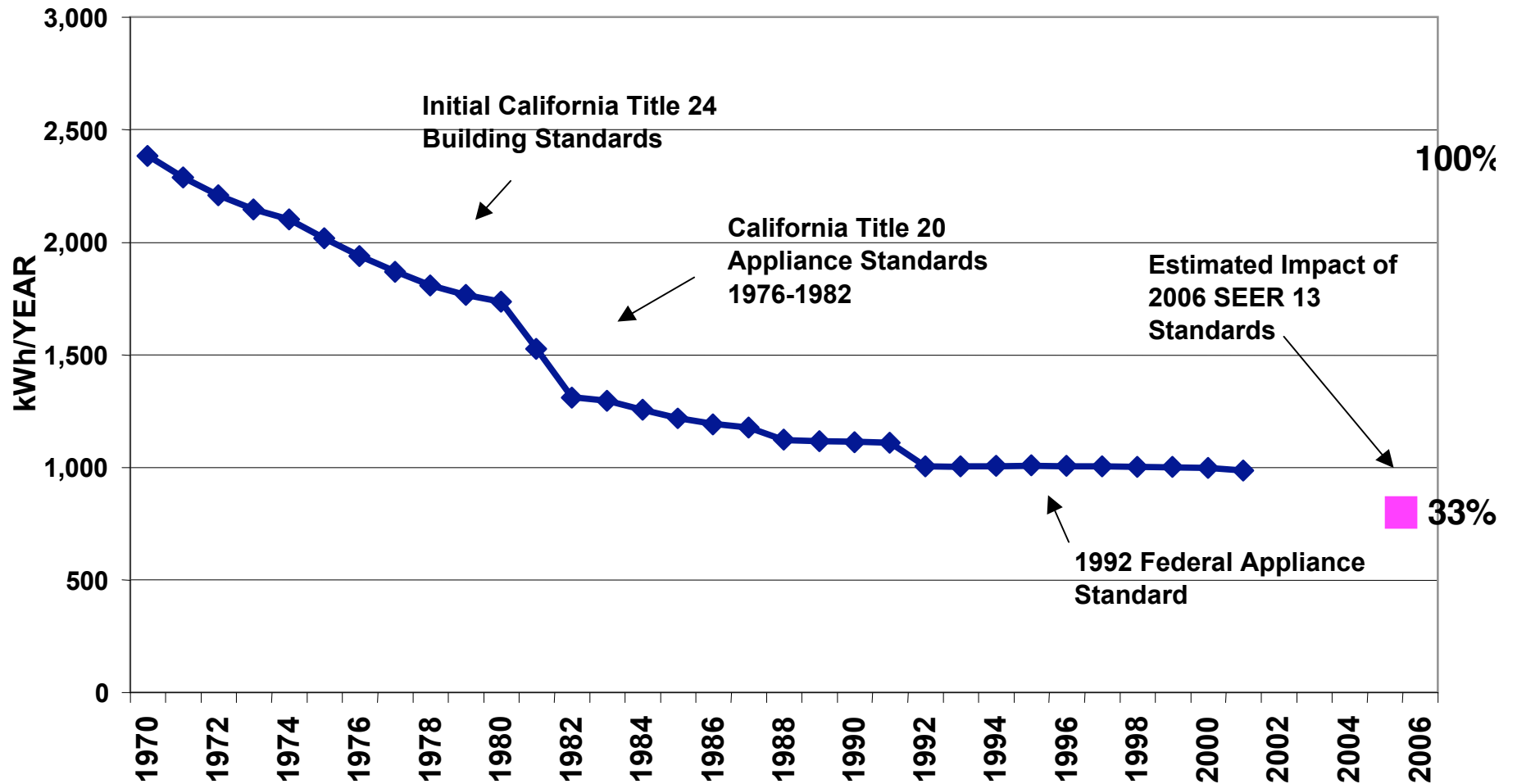


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Annual Usage of Air Conditioning in New Homes in California

Annual drop averages 4% per year



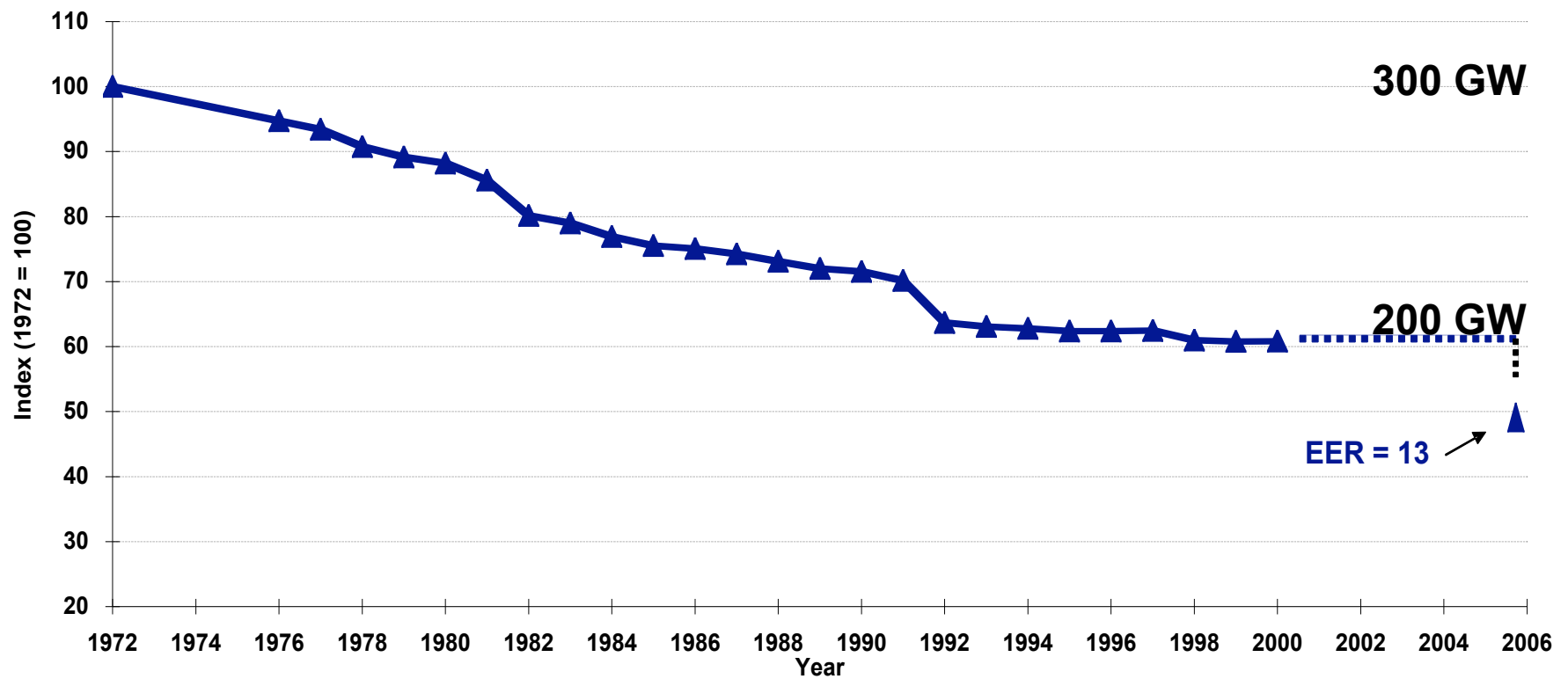
Source: CEC Demand Analysis Office



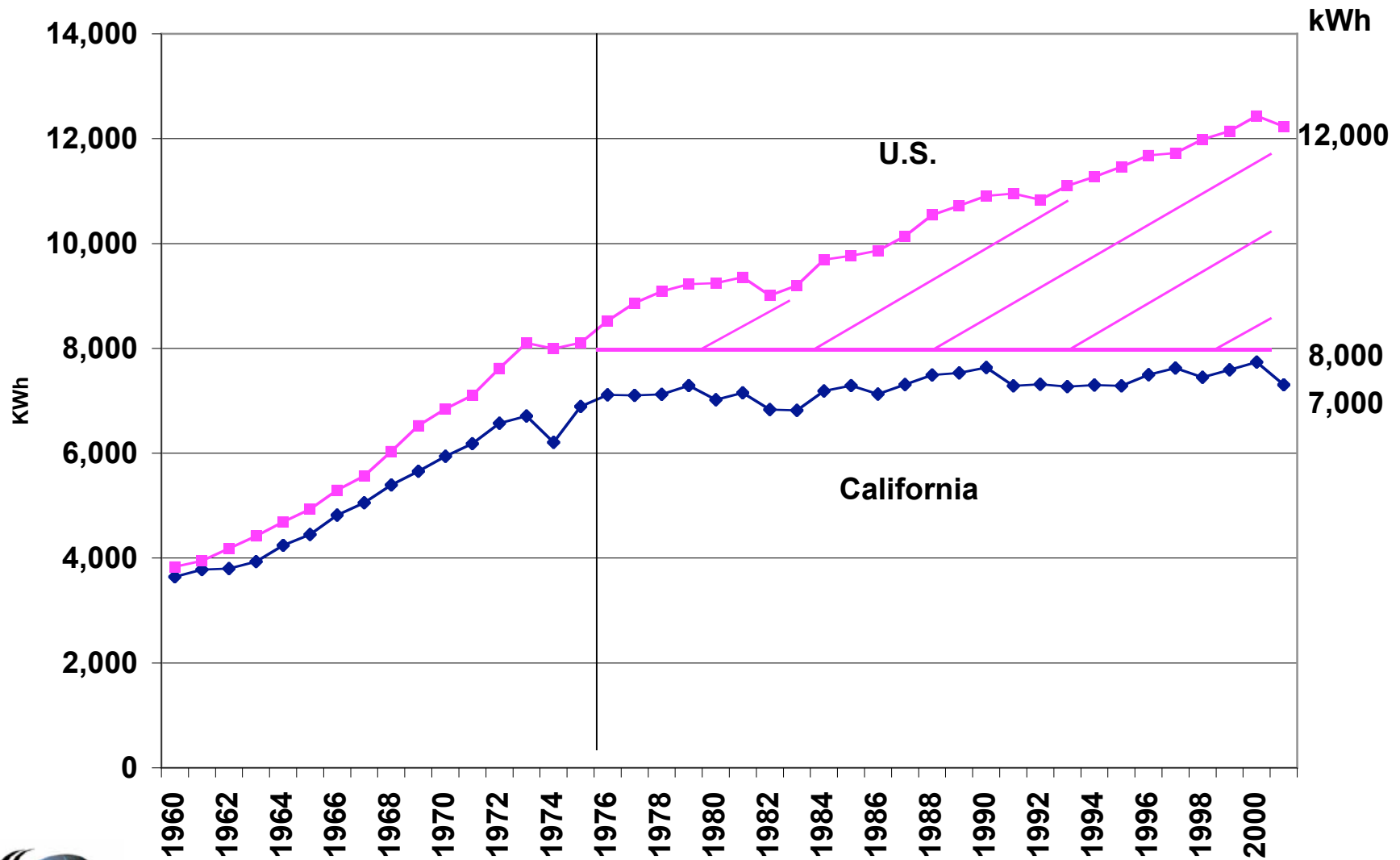
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**After Saturation (16 years)
Impact of Standards on Residential Central A/C
and Roof Top A/C Units in the United States**



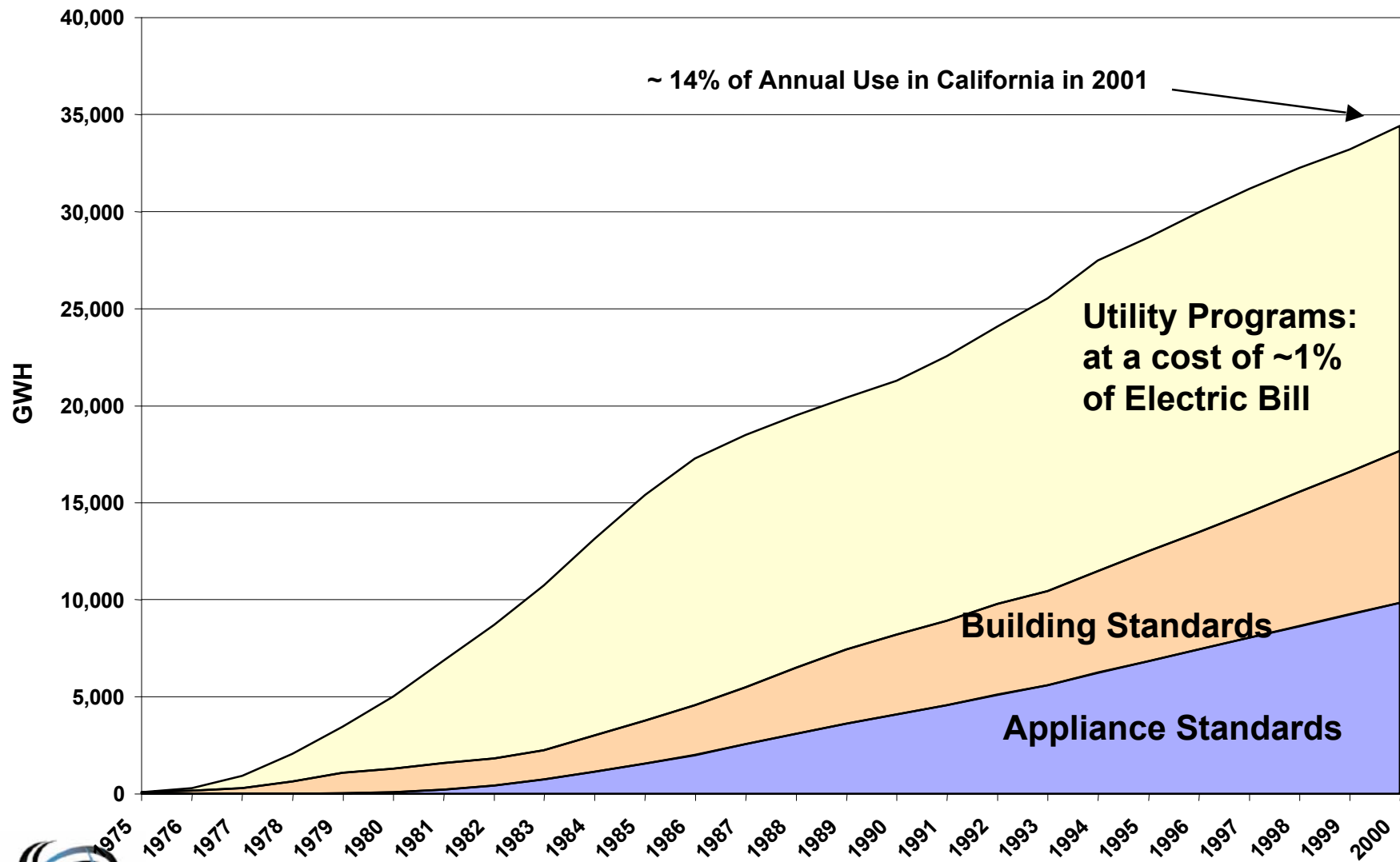
Total Electricity Use, per capita, 1960 - 2001



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GWH Impacts from Programs Begun Prior to 2001



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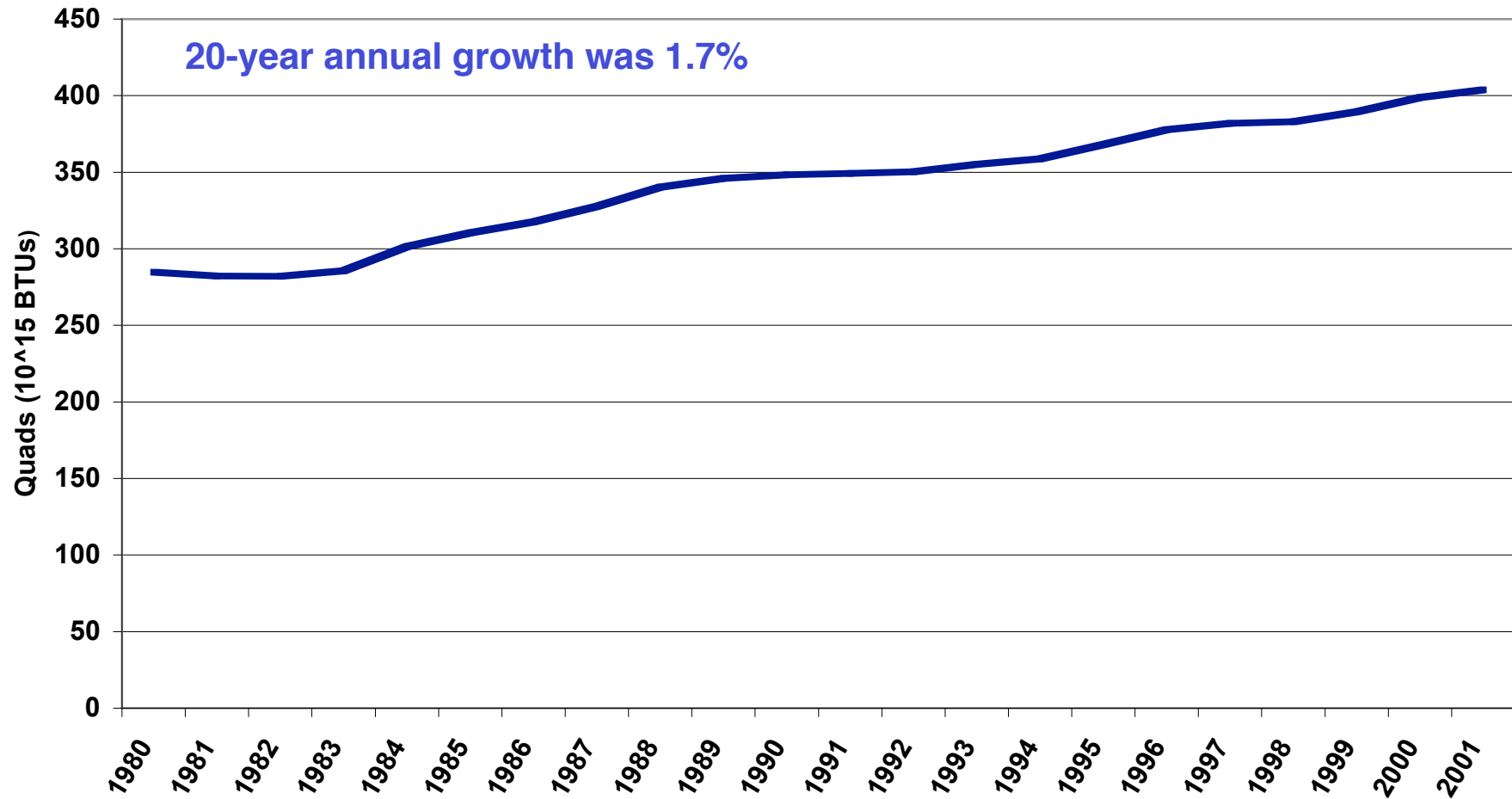
Public Interest Energy Strategies –CEC #100-03-12F

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World Primary Energy Consumption

1980 to 2001

Source: EIA



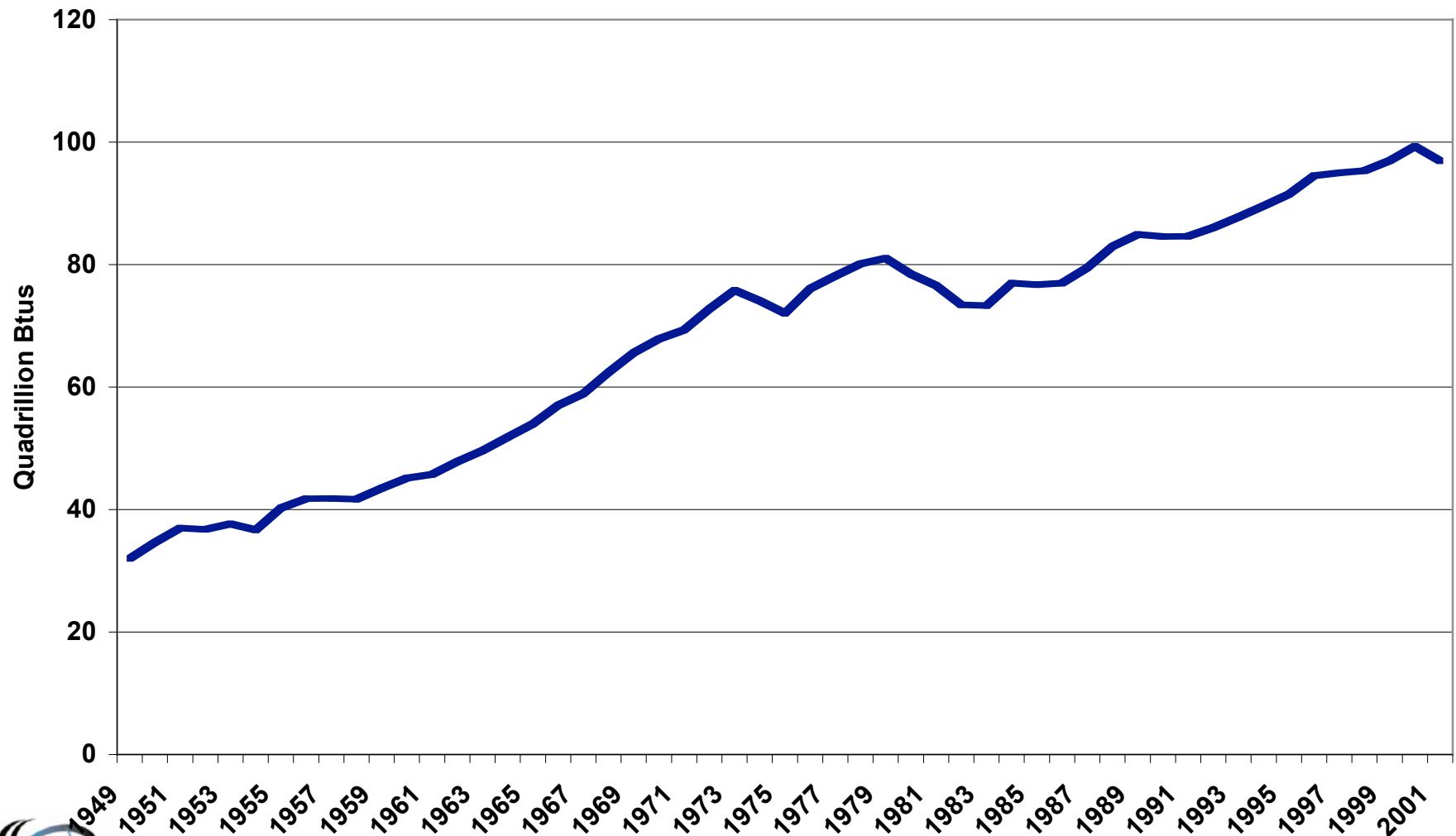
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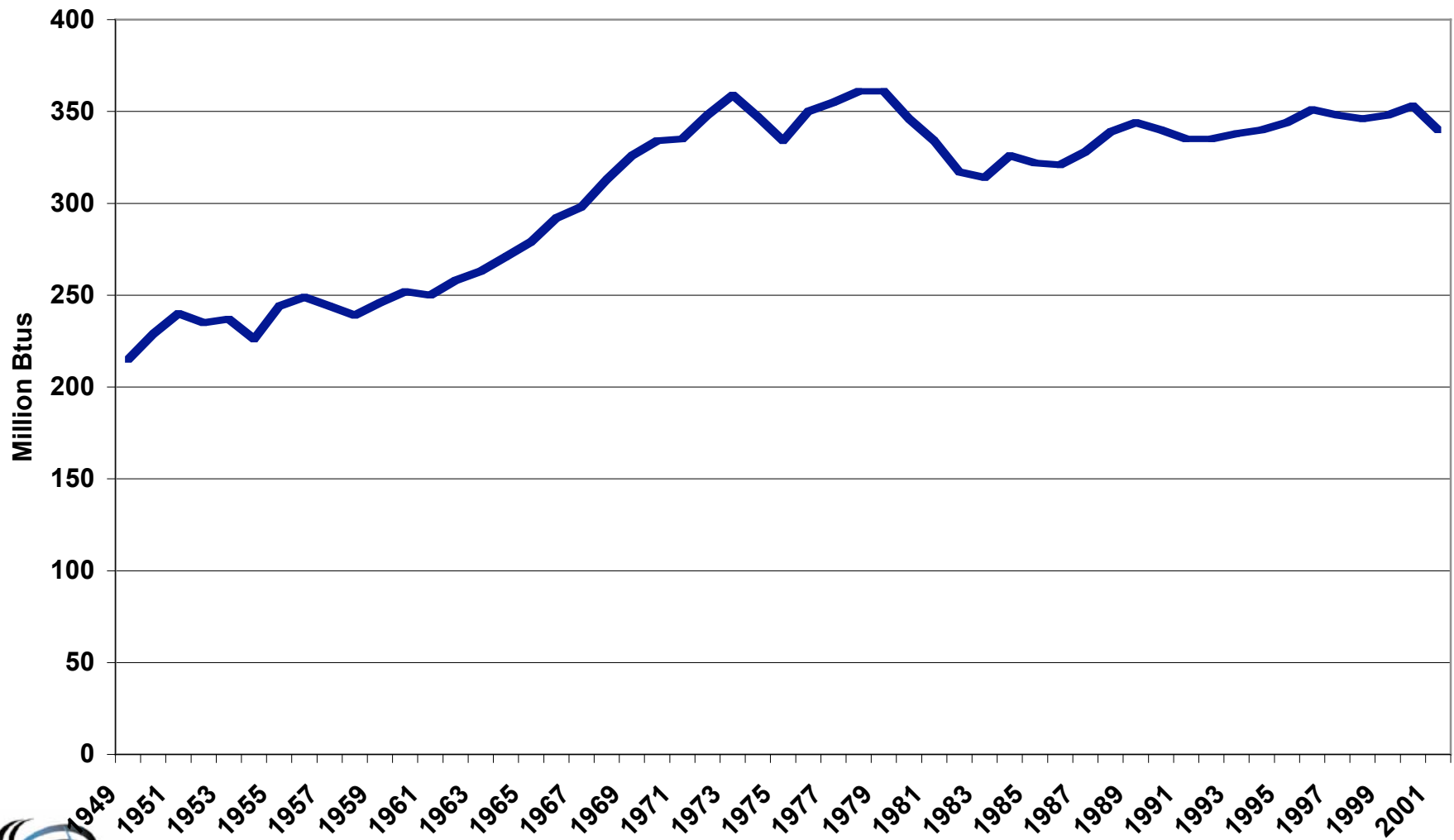
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United States Energy Consumption 1949 to 2001

Source: Table 1.5 Annual Energy Review; data for 2001 is preliminary



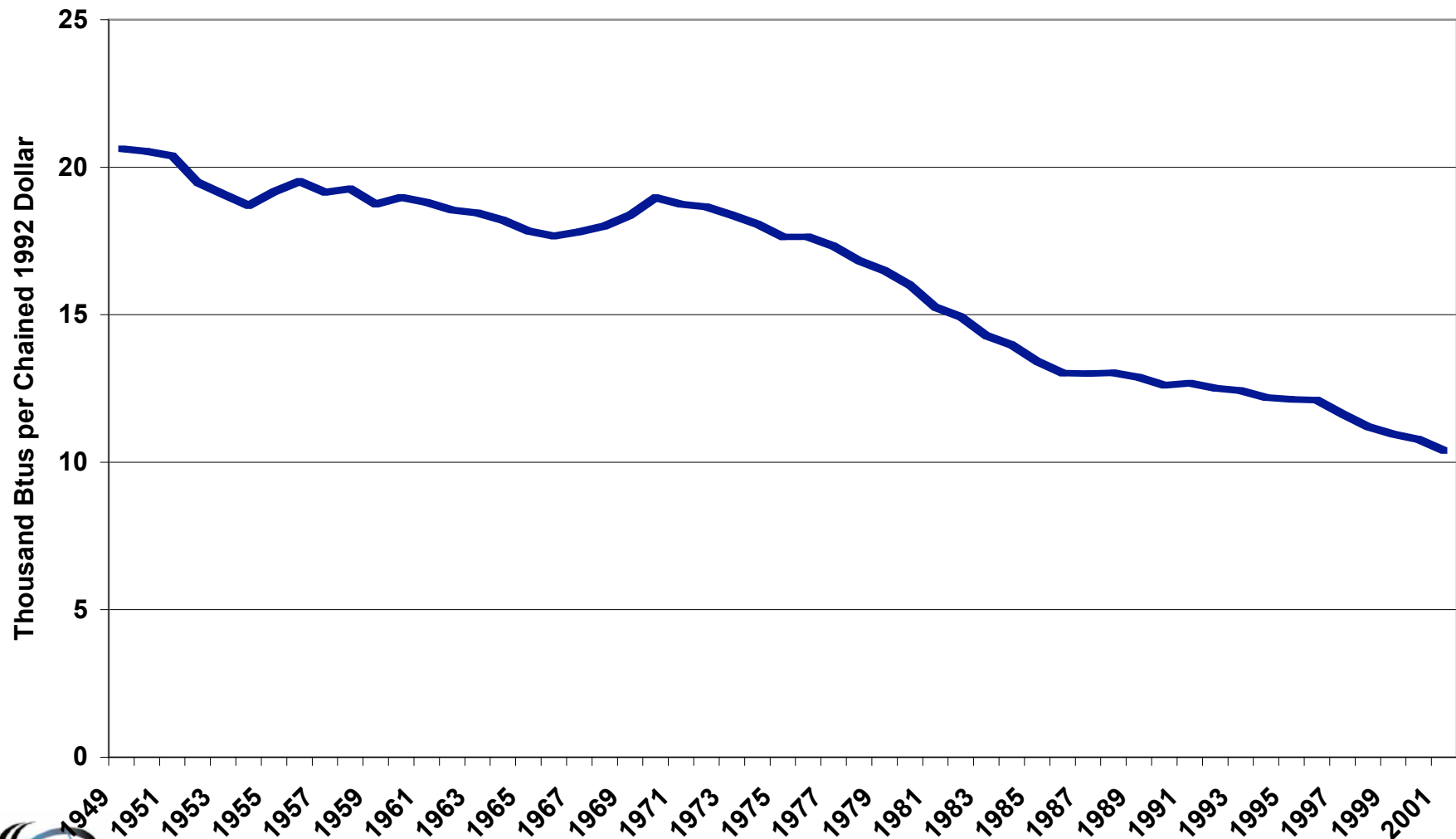
United States
Energy Consumption Per Person 1949 to 2001
Source: Table 1.5 Annual Energy Review; data for 2001 is preliminary



United States

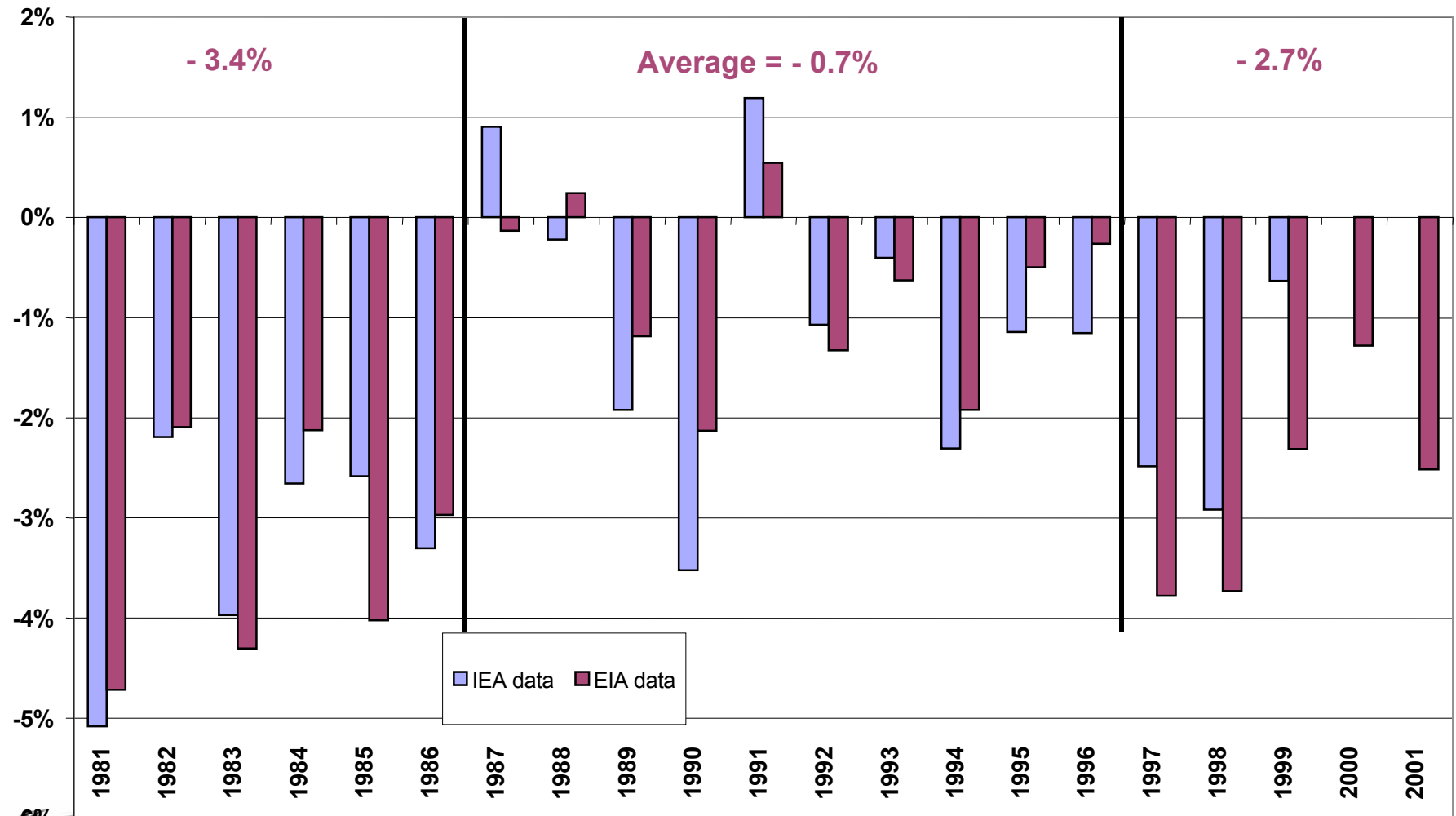
Energy Consumption Per \$ of Gross Domestic Product 1949-2001

Source: Table 1.5 Annual Energy Review; data for 2001 is preliminary



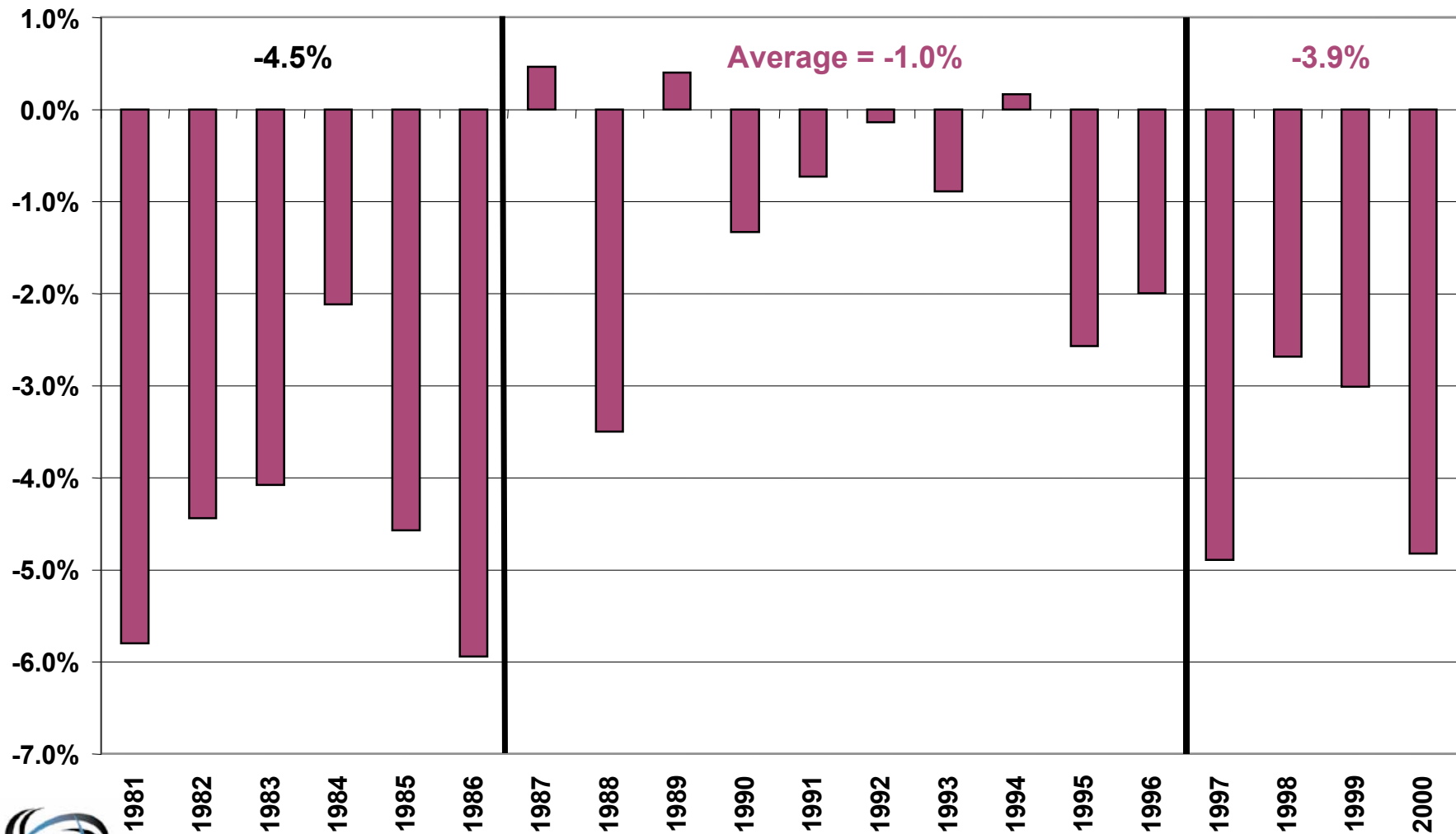
Annual Rate of Change in Energy/GDP for the United States

International Energy Agency (IEA) and EIA (Energy Information Agency)



Annual Rate of Change in Energy/Gross State Product for California

(Sources: EIA and California Department of Finance)



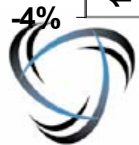
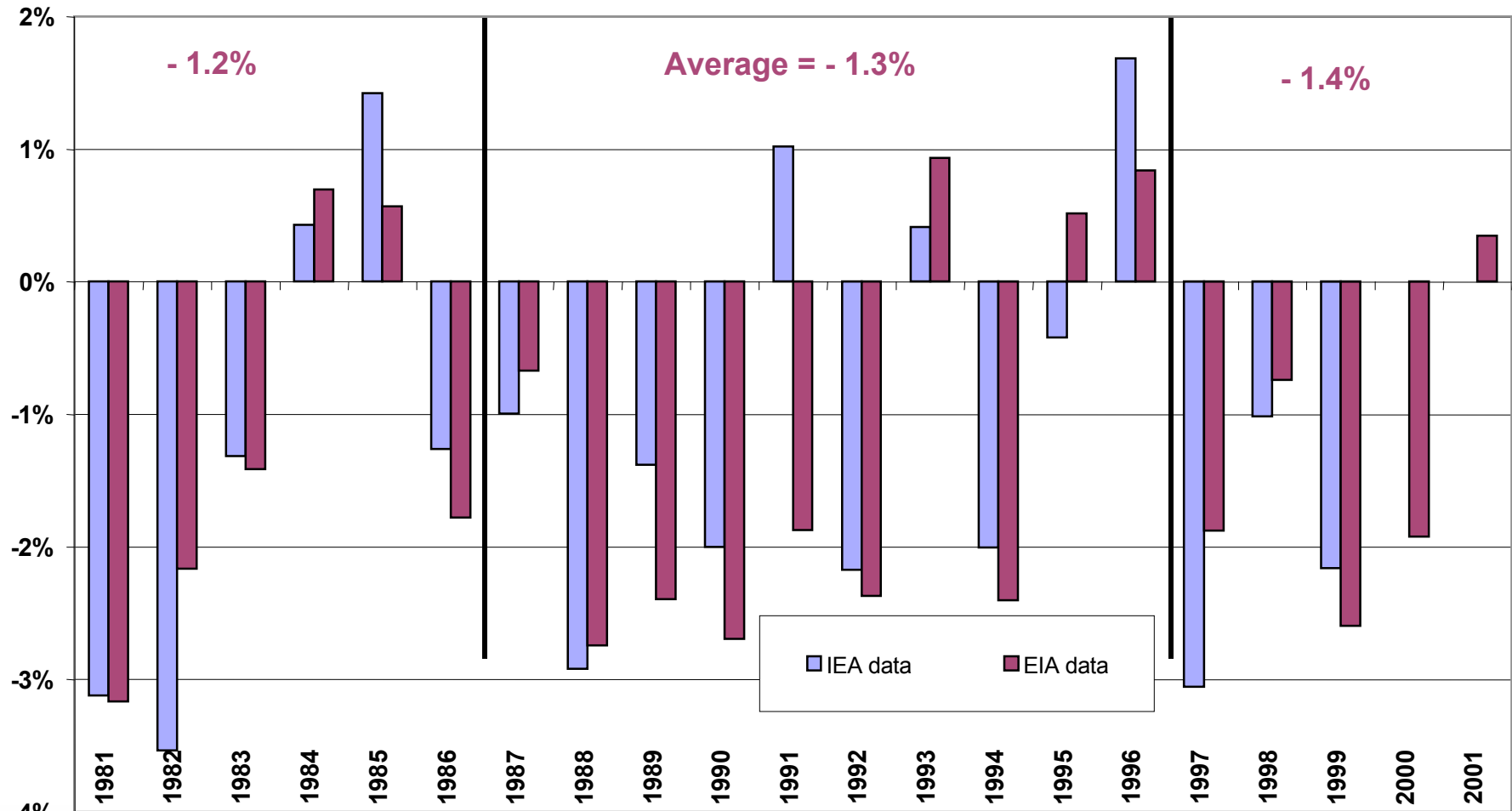
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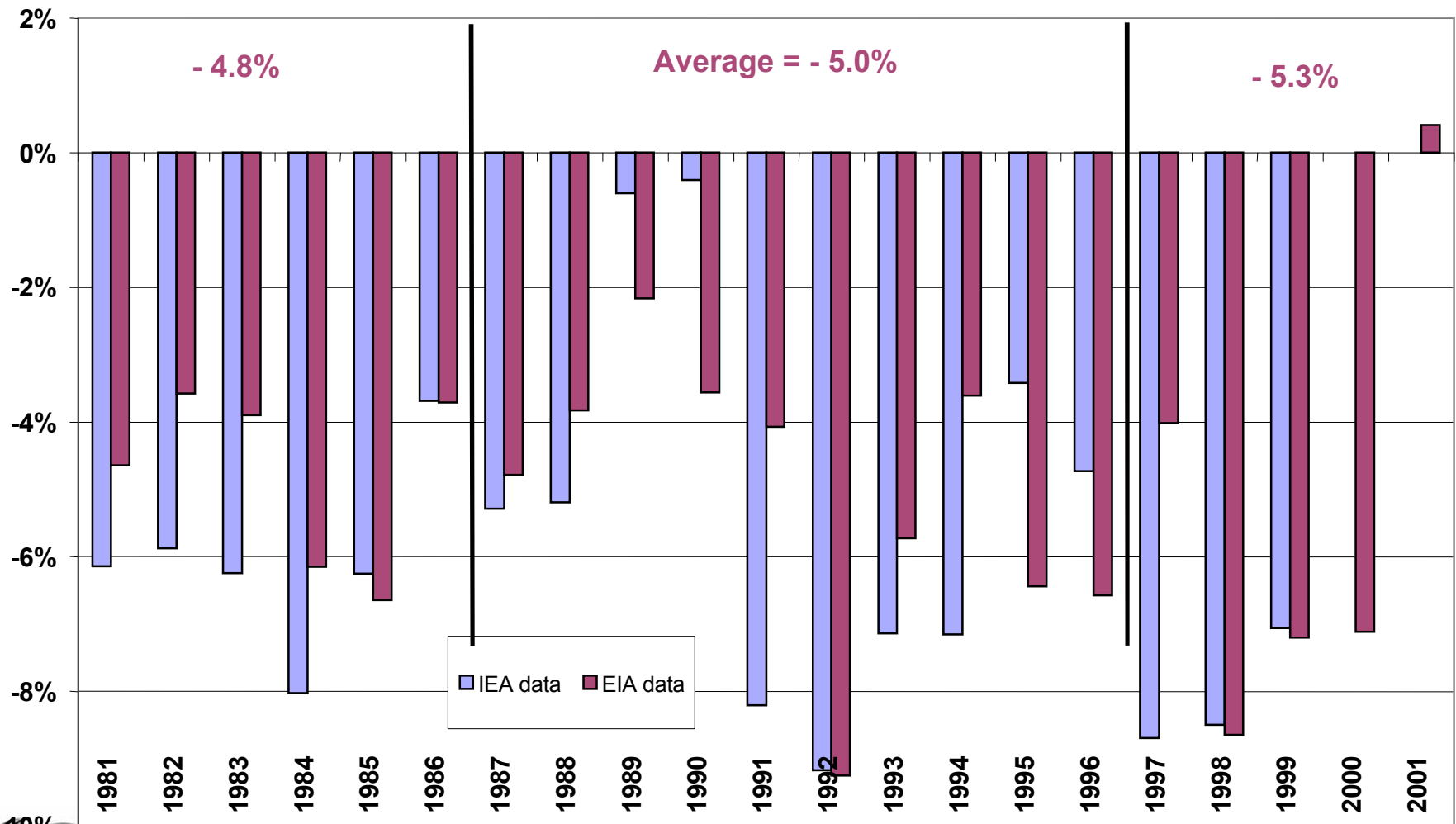
Annual Rate of Change in Energy/GDP for Europe

IEA (Energy/Purchasing Power Parity) for European Union and
Western Europe EIA (Energy/Market Exchange Rate)



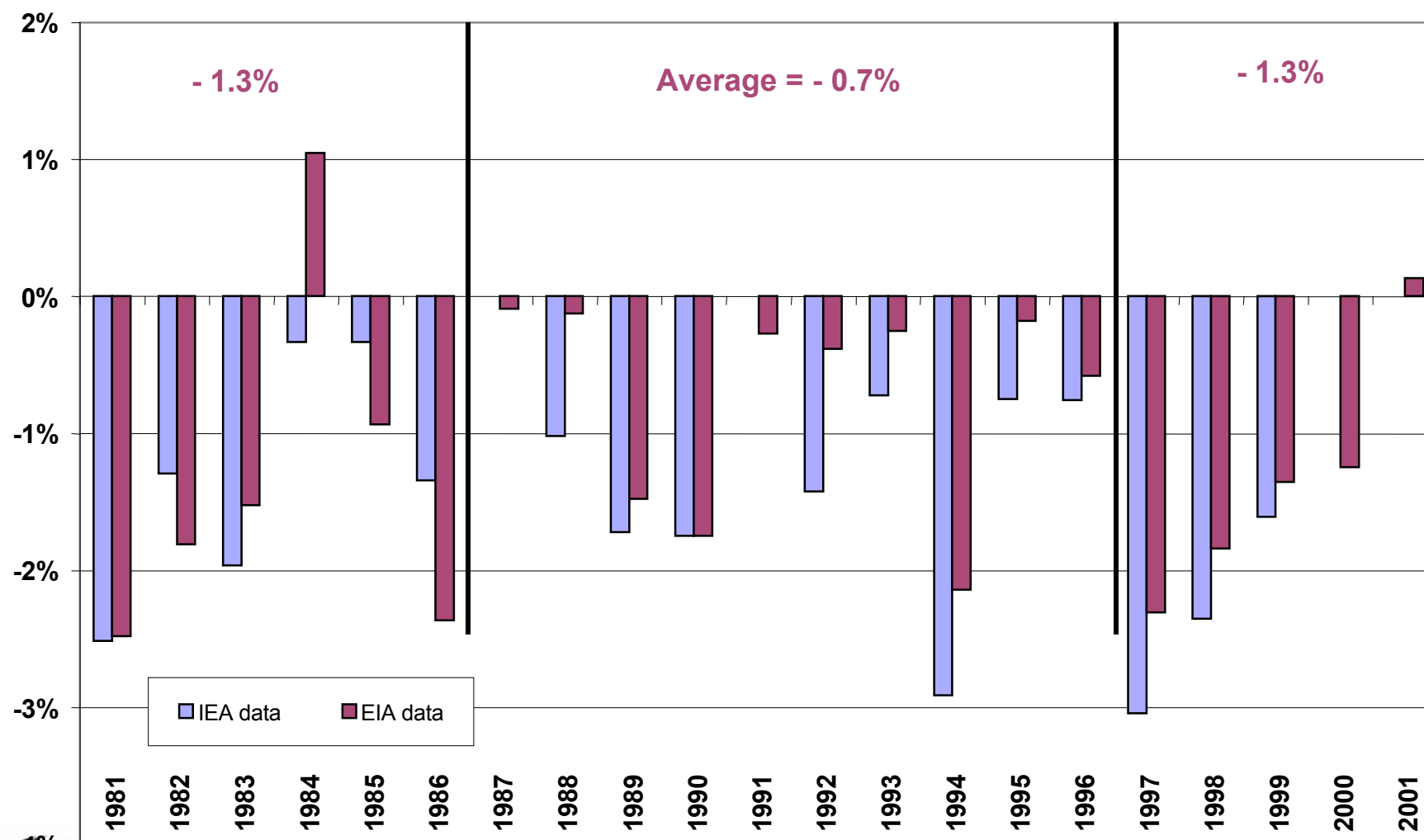
Annual Rate of Change in Energy/GDP for China

IEA (Energy/Purchasing Power Parity) and EIA (Energy/Market Exchange Rate)



Annual Rate of Change in Energy/GDP for the World

IEA (Energy/Purchasing Power Parity) and EIA (Energy/Market Exchange Rate)



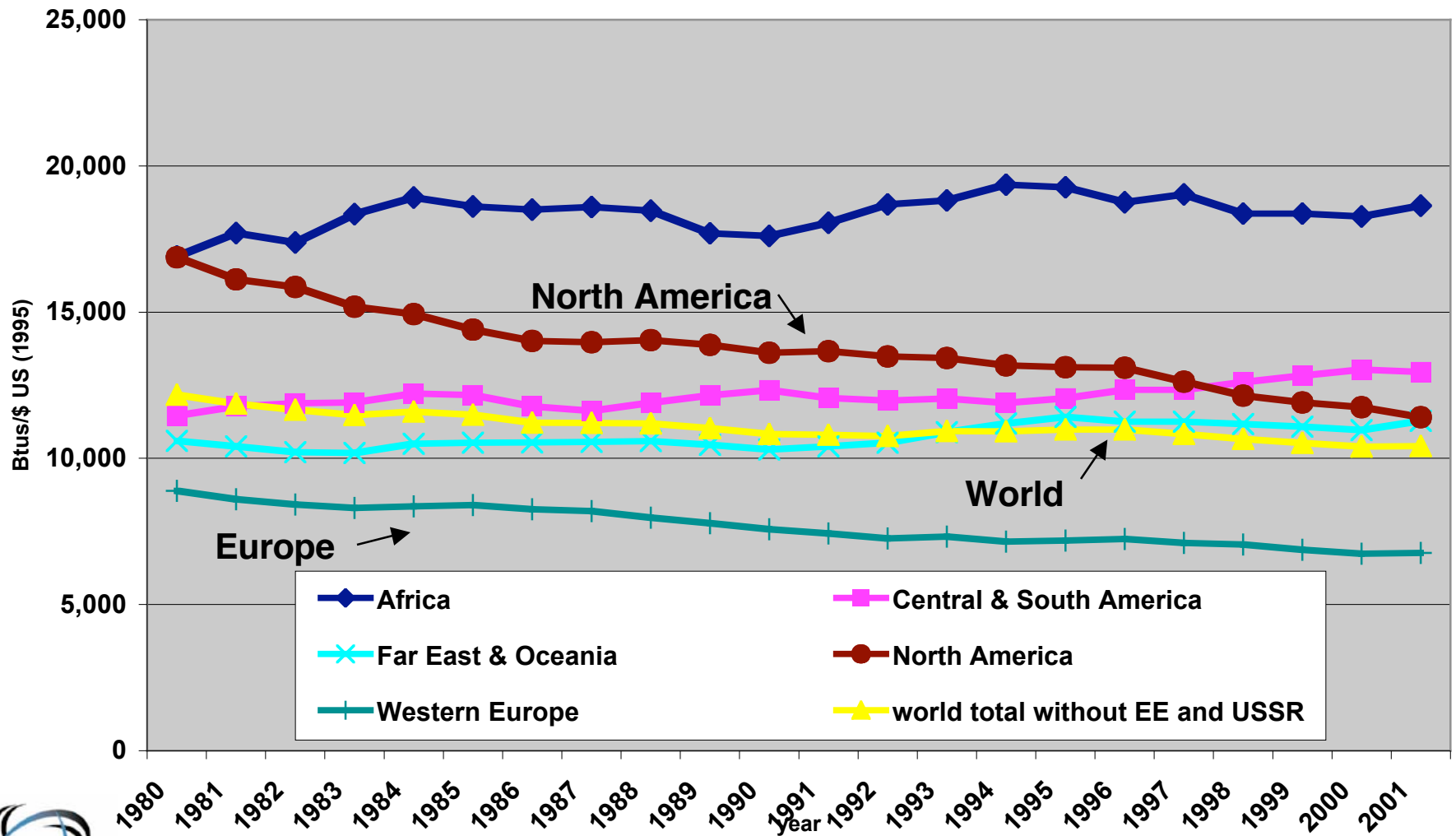
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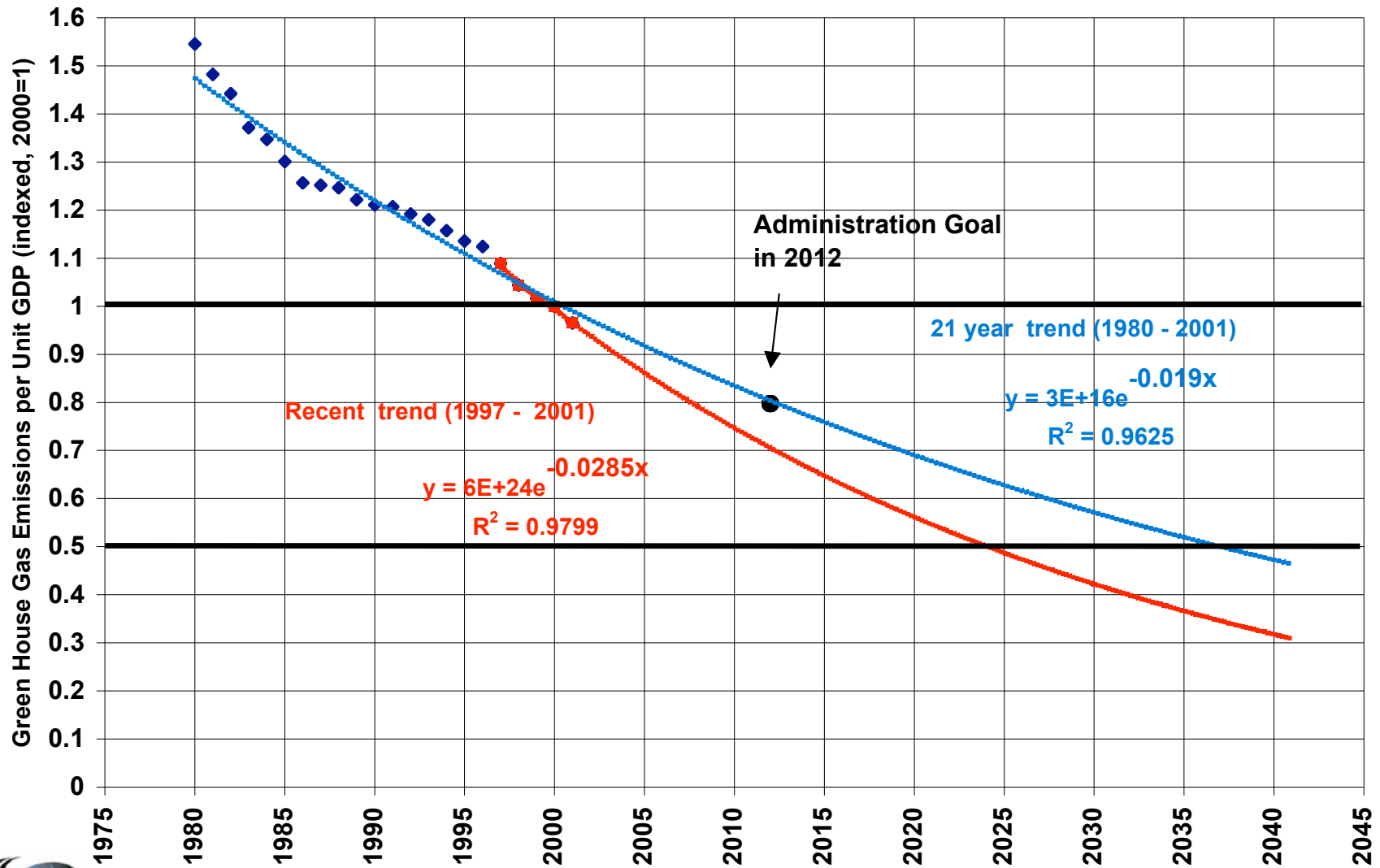
note: Russia not included until 1992 in IEA data and 1993 in EIA data

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Energy Intensity By Geographic Region 1980 to 2001
(Btus/\$US 1995) from EIA data

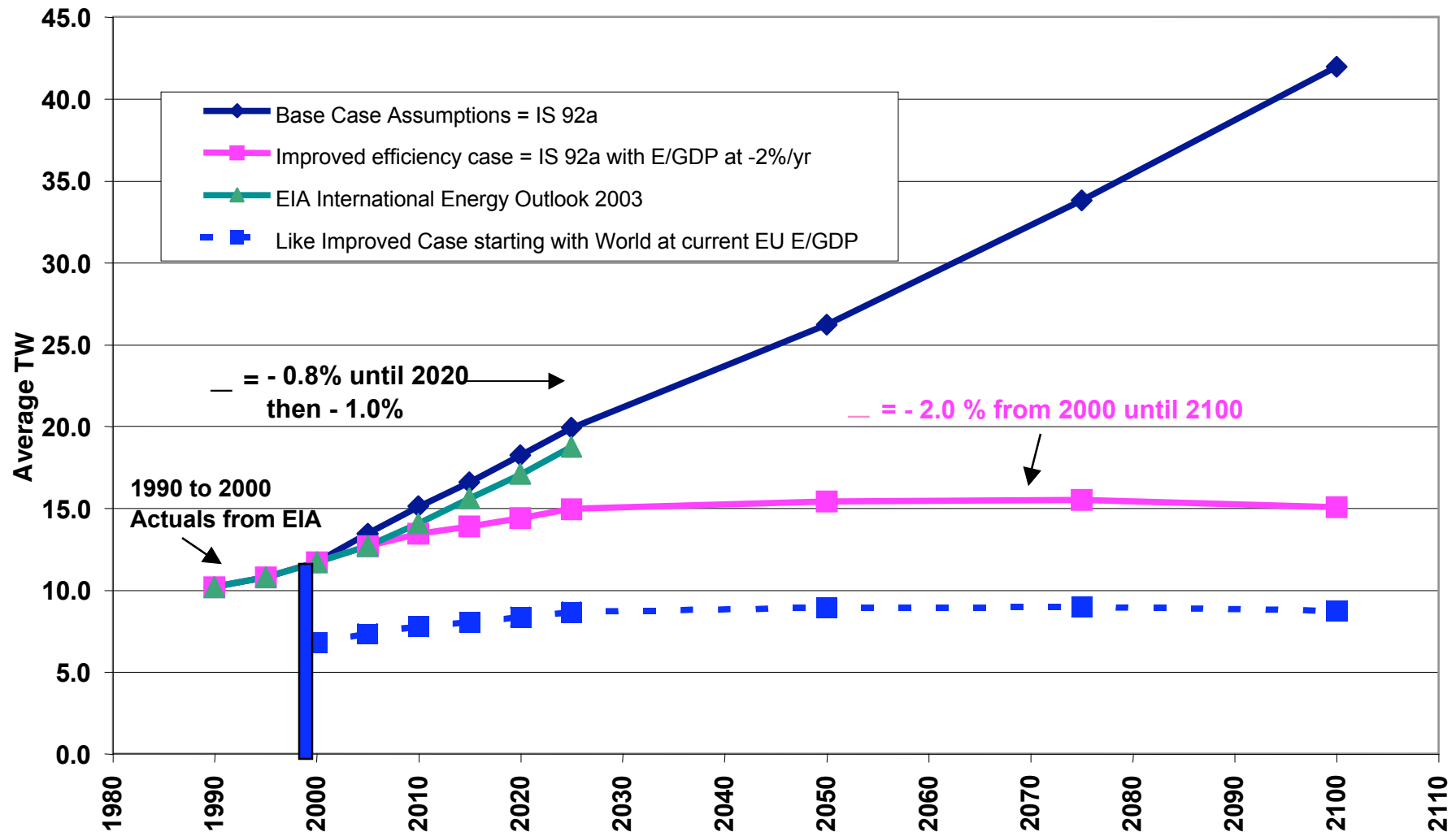


Green House Gas Intensity (GHG/GDP indexed, 2000=1)



World Power Demand in IPCC Base Case, and Accelerated Efficiency

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The Hype about Hydrogen

*Fact and Fiction in the
Race to Save the Climate*

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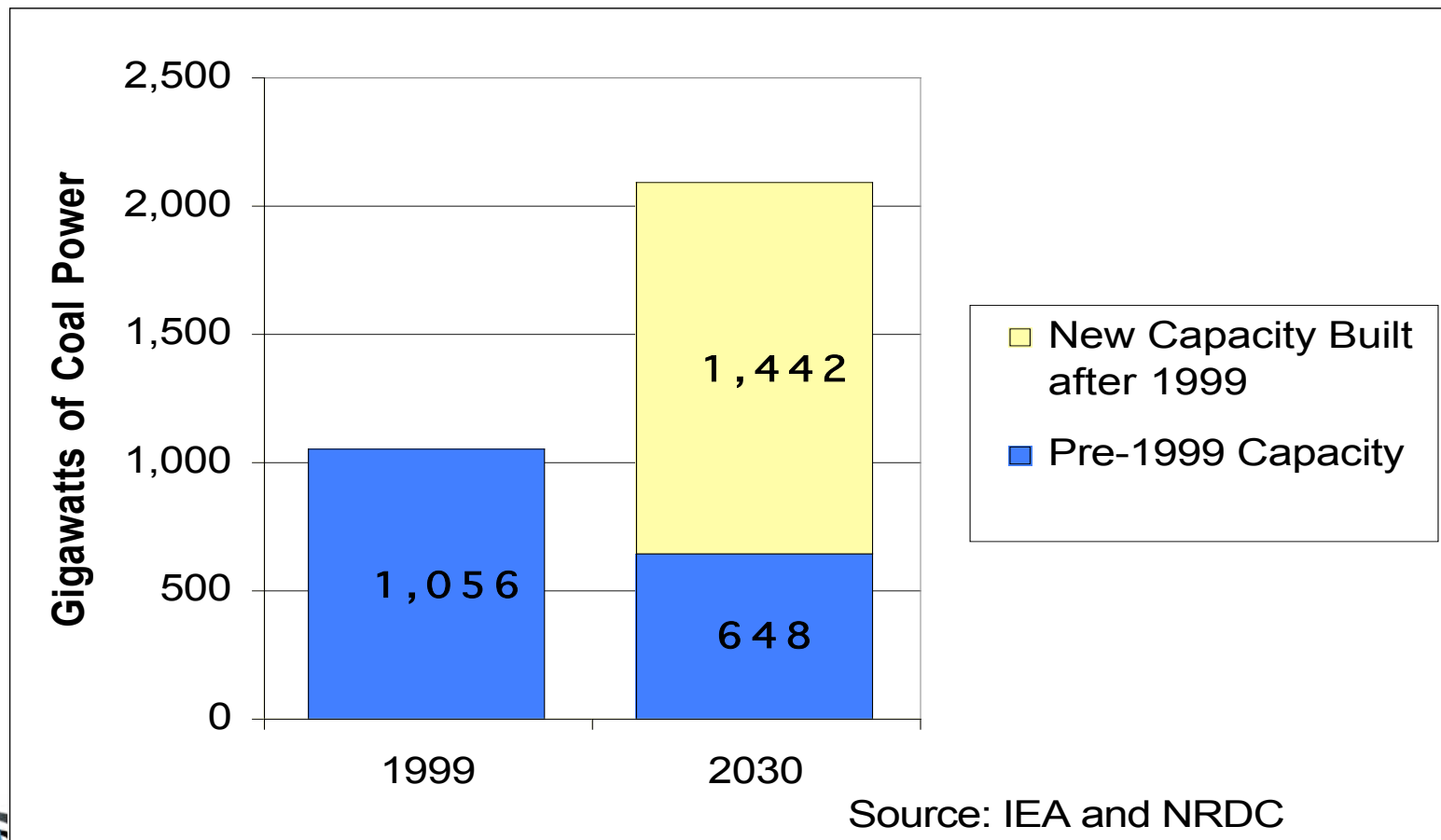
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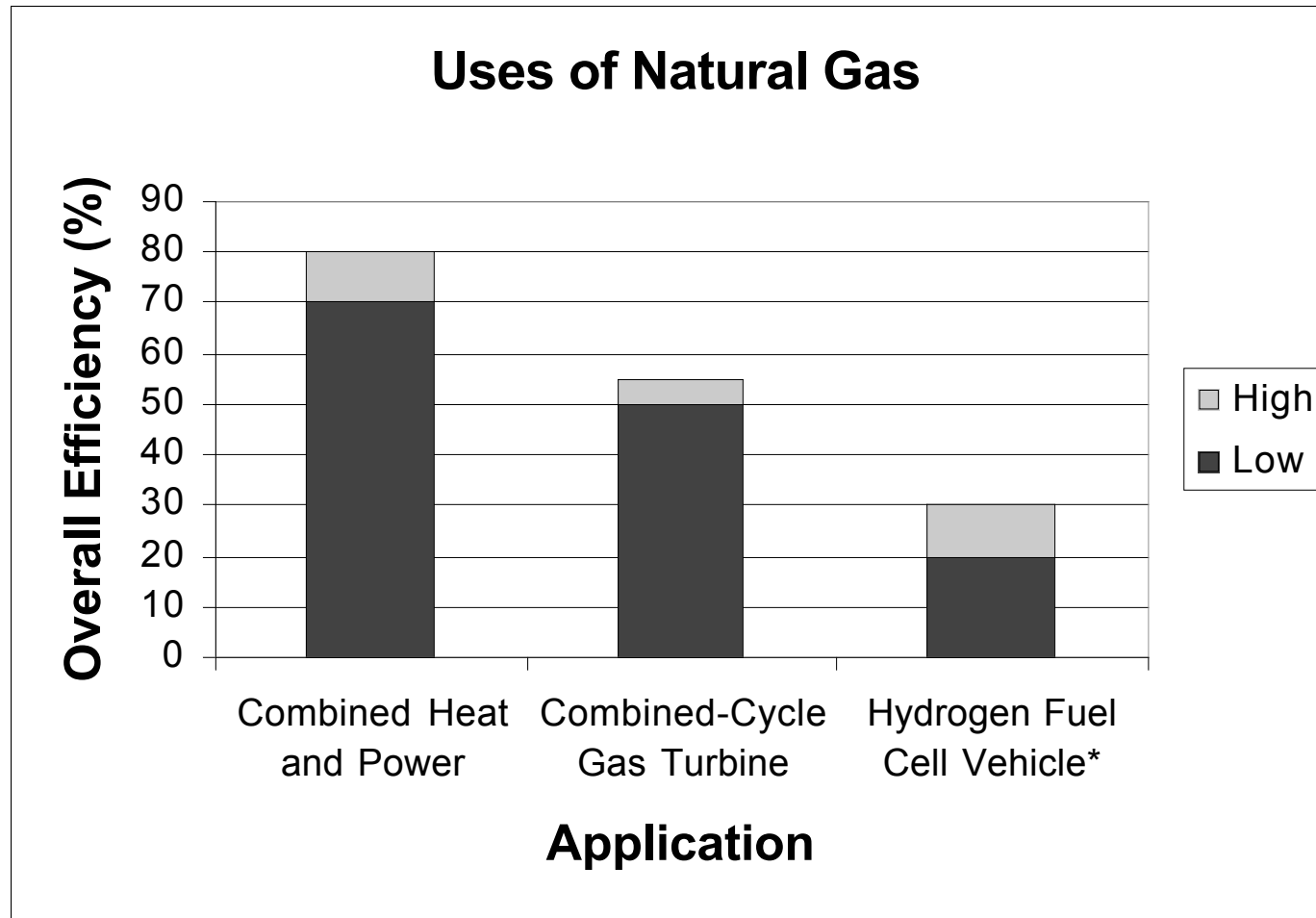
The Hype About Hydrogen

- ◆ Started as a primer
- ◆ Talked to 100 experts, looked at 100 studies
 - DOE Report: Research needs of H2 cars (9-03)
 - NRC Report on H2 cars (2-04)
 - APS Report on Hydrogen Initiative (3-04)
- ◆ Emerging consensus of independent analysts
 - Stationary fuel cells very promising (esp. high-temp)
 - For H2 cars as a climate solution, think post-2035



2/3 of 2030 Coal Plants not yet Built



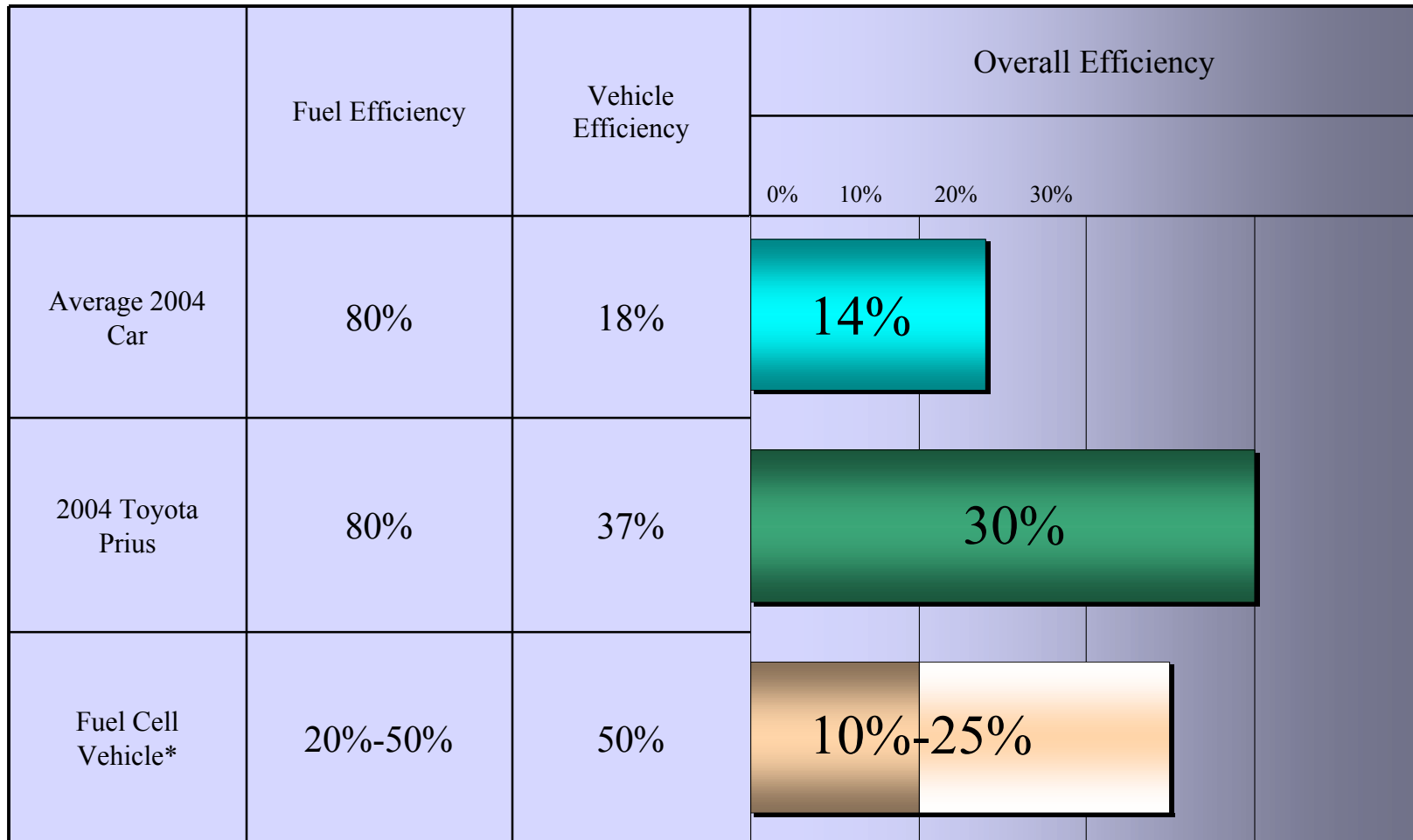


When can Hydrogen Cars Help Fight Global Warming?

- ◆ After “CO2 emissions from electricity generation are virtually eliminated....” (*Science*, 7/03)
- ◆ After “there is a surplus of renewable electricity.” (UK Study, 1/03)
- ◆ So, well past 2030, other strategies--such as efficiency & renewables--will likely be *much* more cost-effective reducing GHGs, probably by a factor of 10.



Prius is Tough to Beat

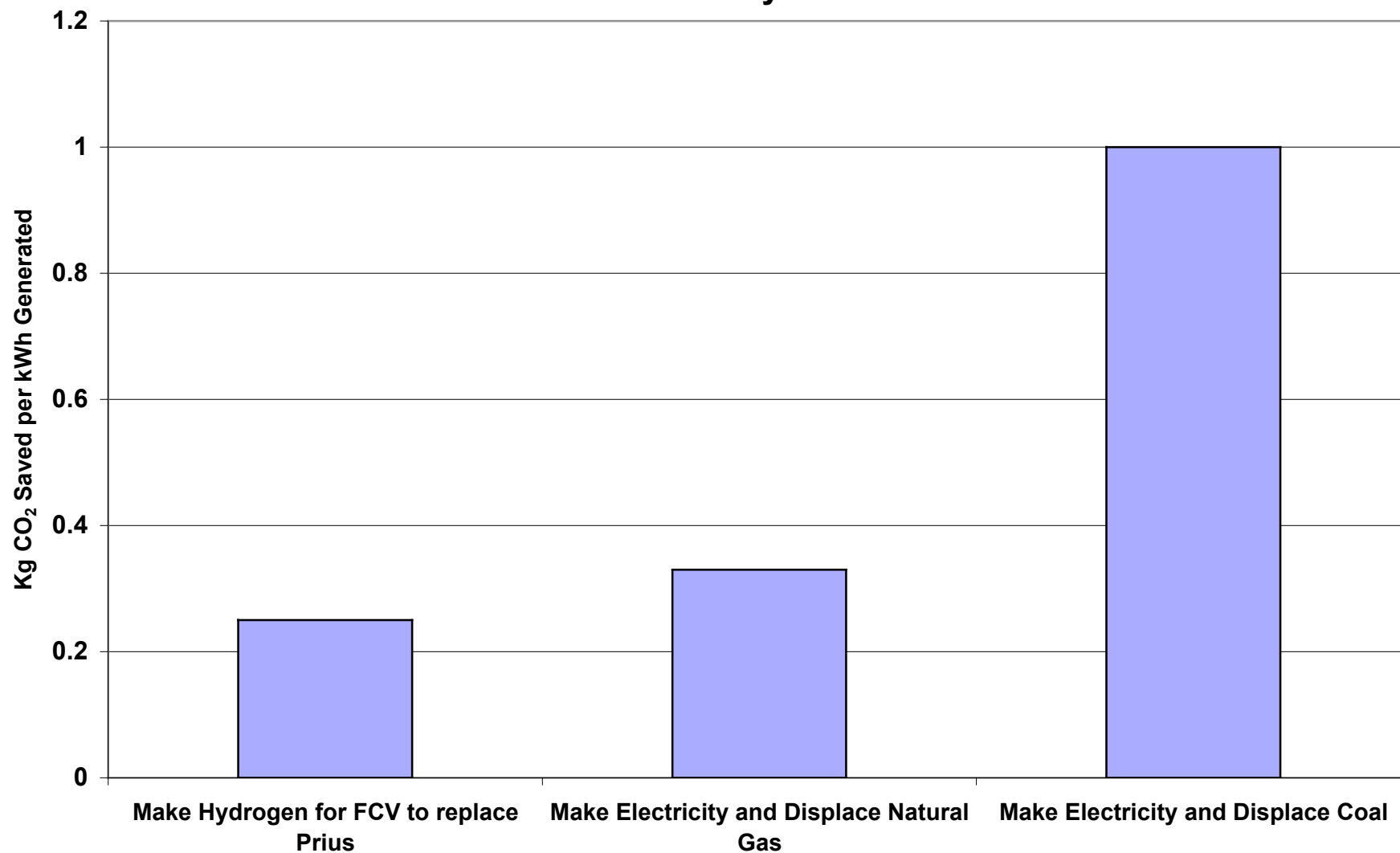


Petroleum to Prius vs. to Fuel Cell Auto

- ◆ Today I can put a gallon of gasoline into a Prius and drive 55 miles.
- ◆ In 10 years I might be able to reform a gallon into H₂ in a fuel-cell vehicle to make about 1 kg of H₂, and drive 75 miles.
- ◆ If I drive 11,000 mi/year, the Prius will use 200 gal, the FCV 150 gal.
- ◆ What does it cost, annually to save this 50 gal/year? At least \$500.



Renewable Electricity Used To



Source : *The Hype About Hydrogen: Fact and Fiction in the Race to Save the Climate*, Joseph Romm, 2004
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Bottom Line I

- ◆ Continued R&D is important
 - Limited number of zero-CO₂ transport fuels
 - “Technical barriers can be overcome *ONLY* with high risk/high payoff basic research.” DOE 9-03
 - “It’s not a sure thing.” NRC panel member 2-04
- ◆ For serious \$\$\$ to H₂ cars and infrastructure, think post-2030.



Bottom Line II

- ◆ Don't base government policy or business investment on belief hydrogen cars will have commercial success in next two decades.
- ◆ First things first: Efficiency & renewables NOW
 - If we can achieve a clean energy revolution, that could enable hydrogen cars and NOT vice versa.

