

# PJM

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December 2, 2009 • Wilmington

Lawrence J. Makovich

*IHS CERA Vice President and Senior Advisor*



CERA

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# **The Road to Recovery**



# The Road to Recovery

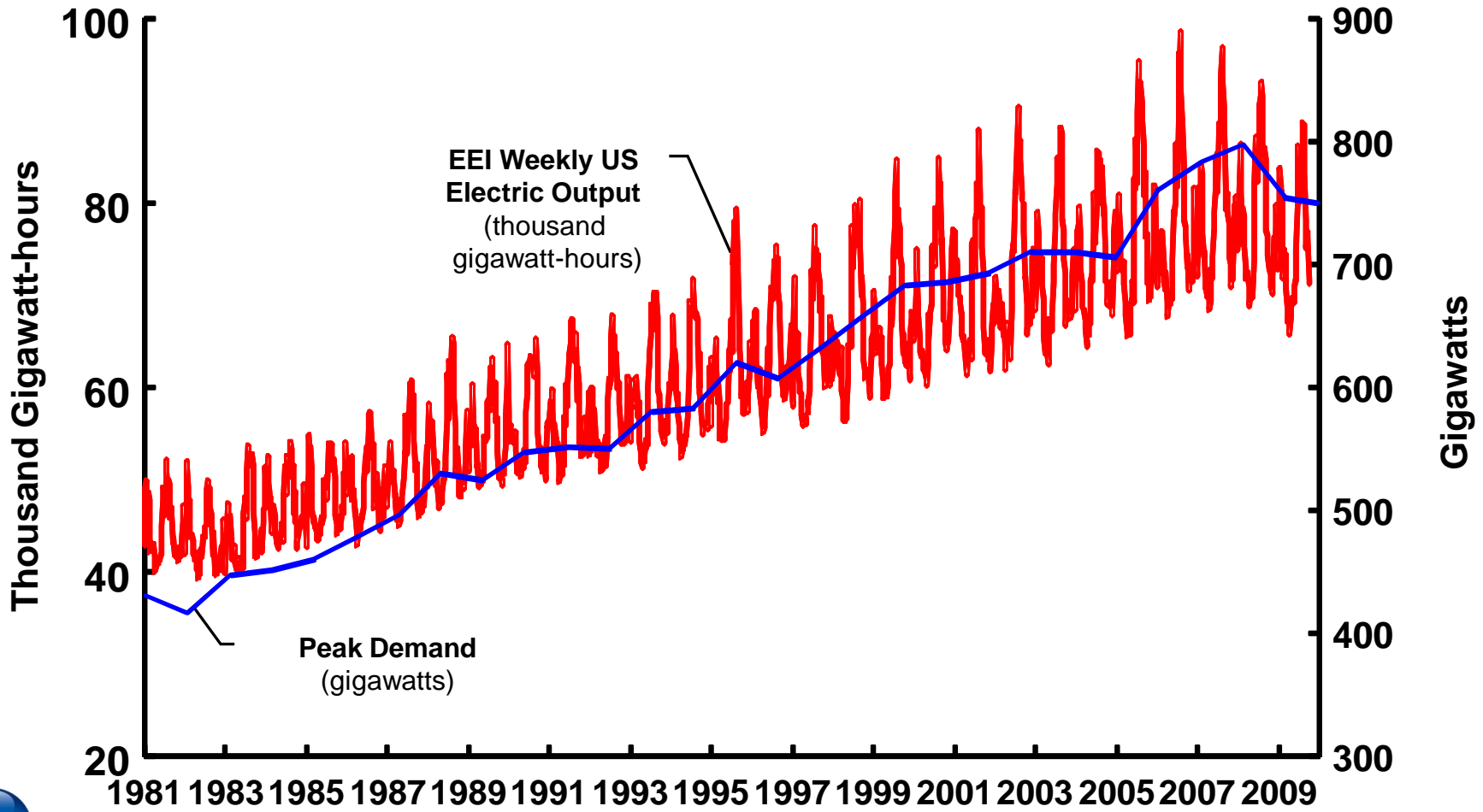
- **Electric consumption is coincident with economic activity.**
- **Electric consumption forecasts tend to underestimate demand.**
- **Stopping electric growth is a contagious idea reflecting wishful thinking and a confusion between cyclical and structural changes.**
- **Expect power demand growth in 2010 to exceed the underlying 2 percent per year trend rate of growth.**



Source: IHS Cambridge Energy Research Associates.

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# EI Electric Output and Noncoincident Peak Demand, 1981 Through Q3 2009



Source: IHS Cambridge Energy Research Associates.

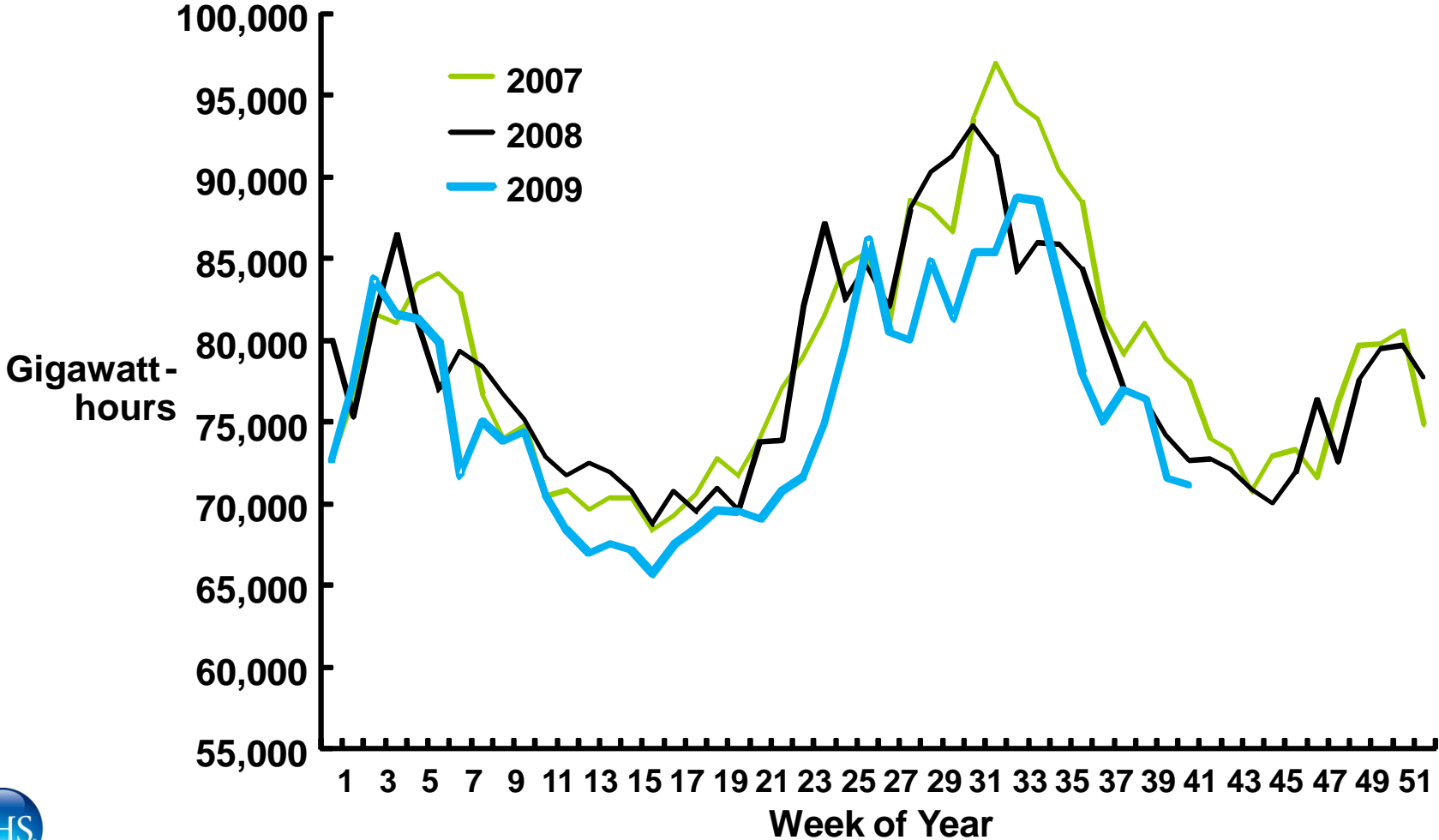
Data source: Edison Electric Institute.

GDP\_Elec-Output\_Oct2009

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# Total US Electricity Use, All Sectors, 2007-09

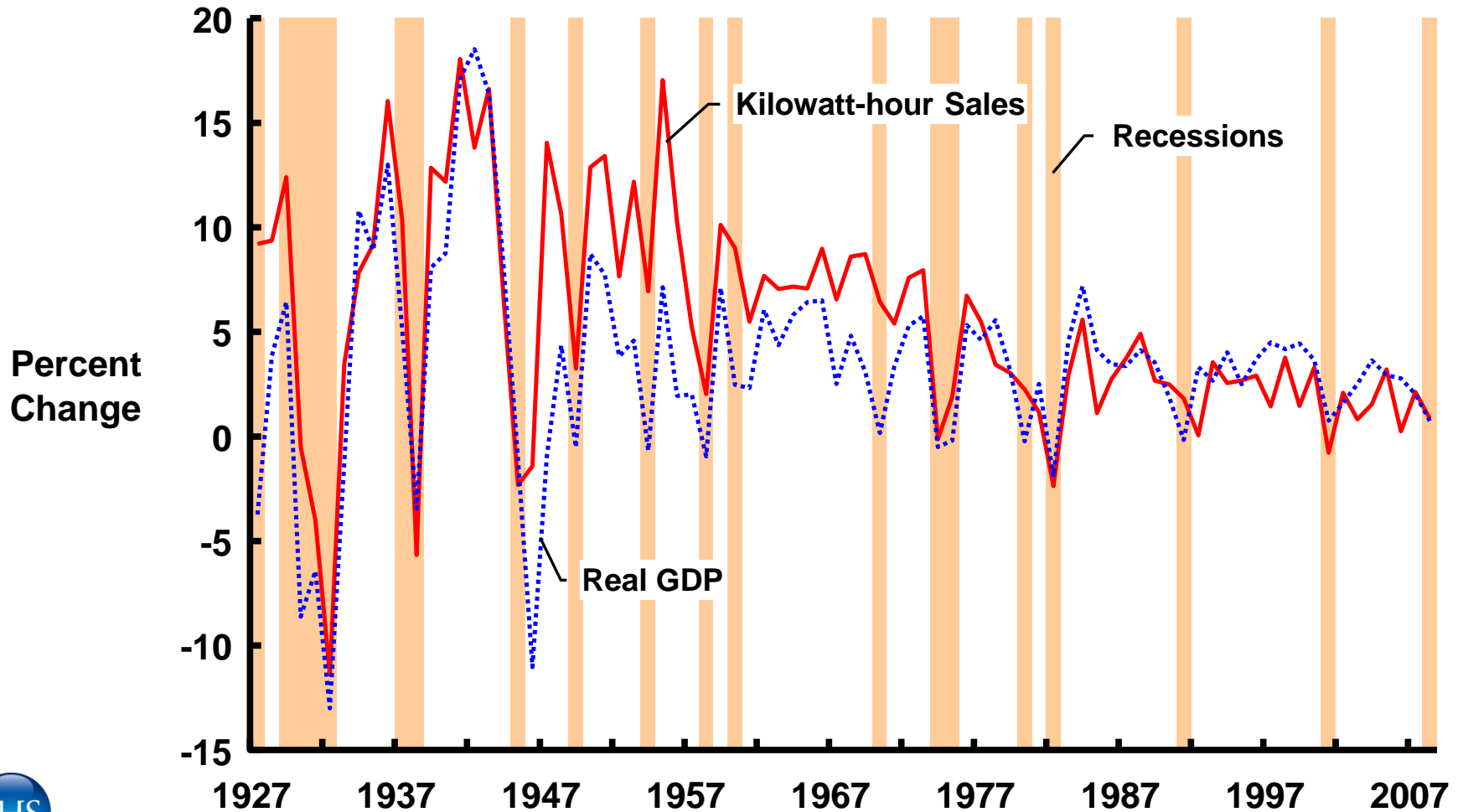


Source: IHS Cambridge Energy Research Associates.  
Data source: Edison Electric Institute.  
GDP\_Elec-Output\_Oct2009

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# Annual Percent Change in US Kilowatt-hour Sales and Real GDP

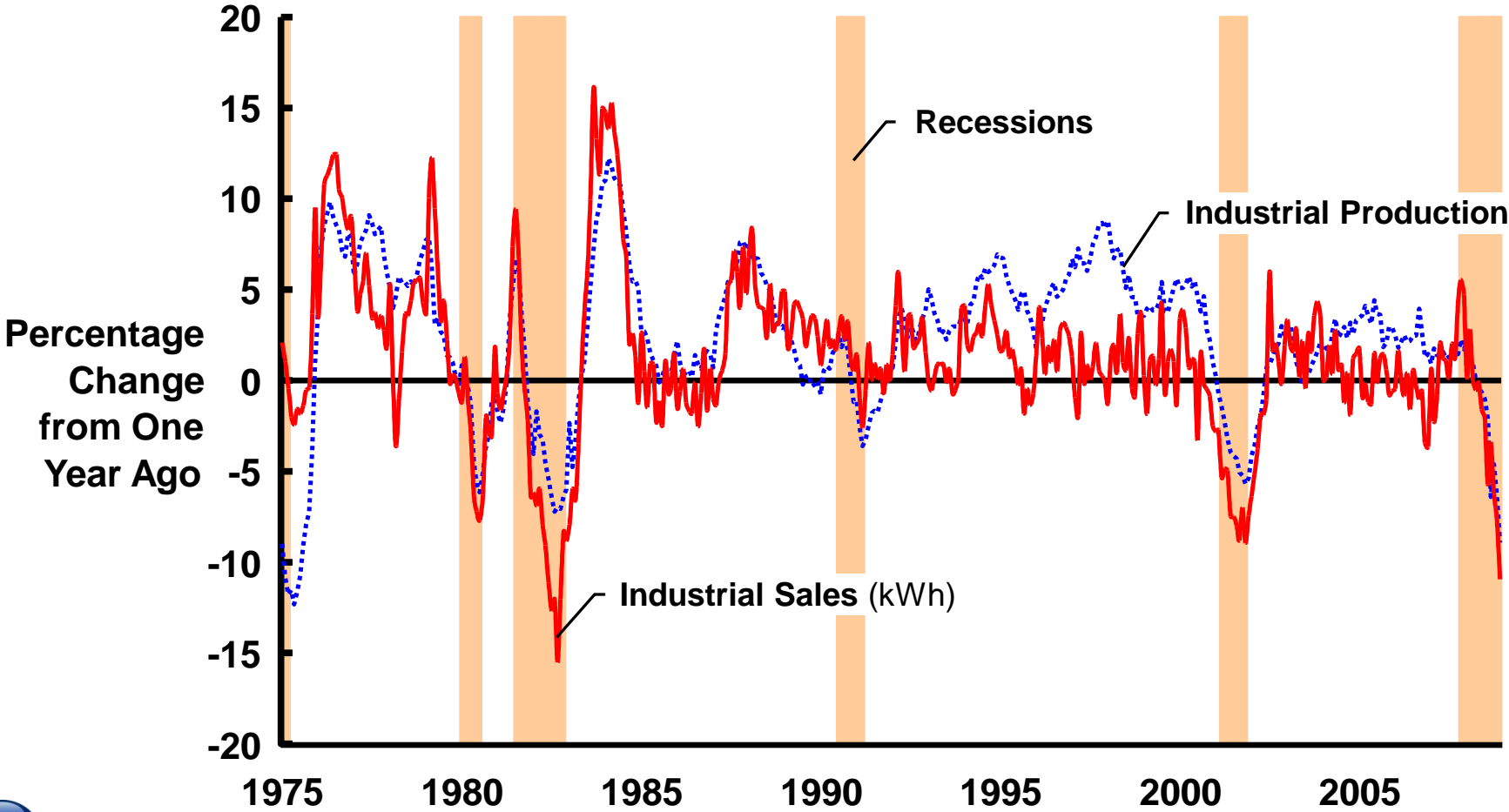


Source: IHS Cambridge Energy Research Associates, US Bureau of Economic Analysis and National Bureau of Economic Research.  
Notes: Shaded areas indicate recessions, as determined by the National Bureau of Economic Research. Kilowatt-hour sales are not weather normalized.  
U/O 81205-1 / Percent Change\_US kWh Sales\_Real GDP

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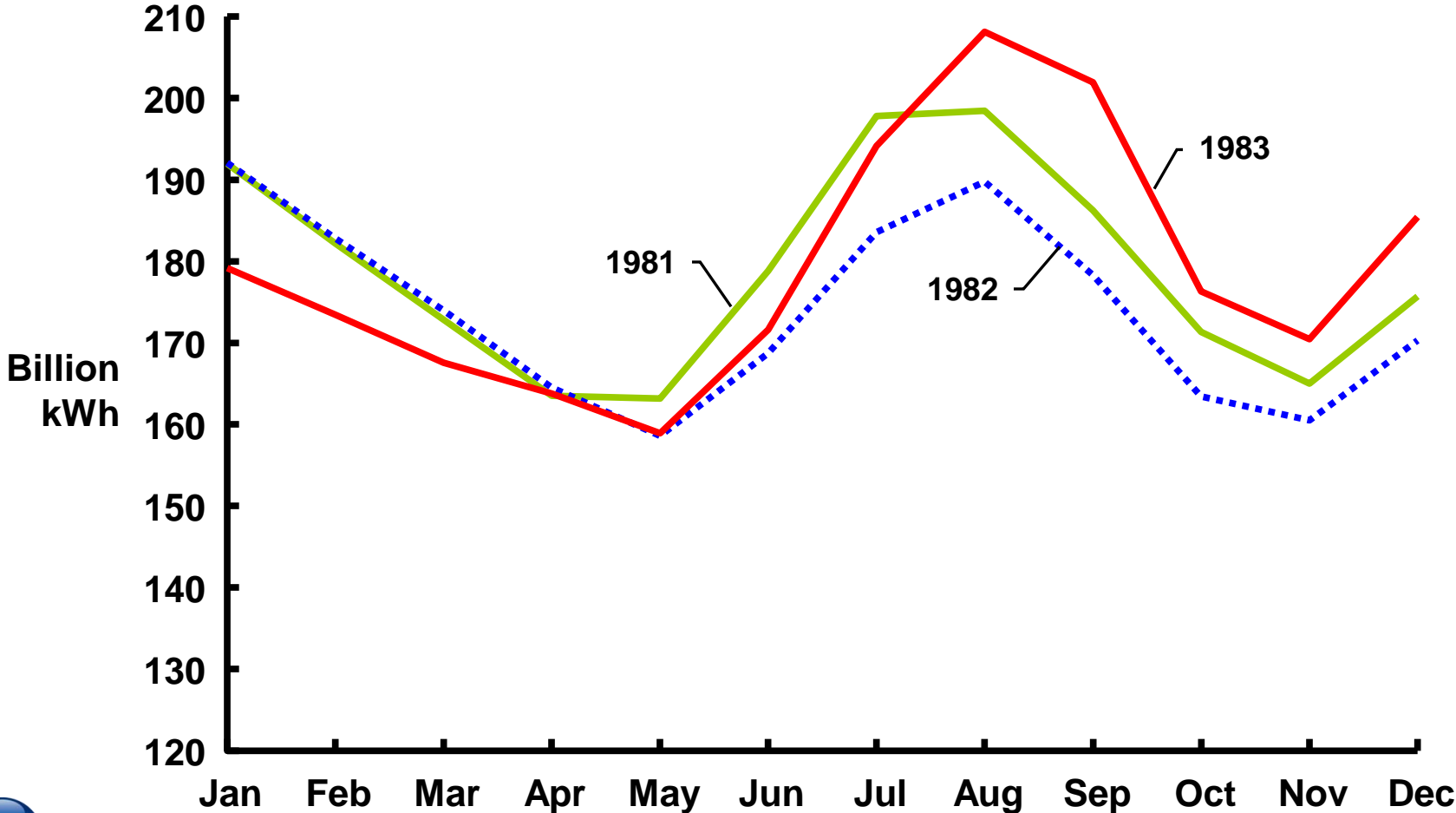
# US Monthly Industrial Production and Industrial Kilowatt-hour Sales, January 1975–December 2008



Source: IHS Cambridge Energy Research Associates.  
Data sources: Board of Governors of the Federal Reserve System, National Bureau of Economic Research, and US Energy Information Administration.  
Note: Shaded areas indicate recessions, as determined by the National Bureau of Economic Research.  
Industrial Prodn and Retail Elec Sales\_Apr09

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# Total US Electricity Use, All Sectors, 1981-83

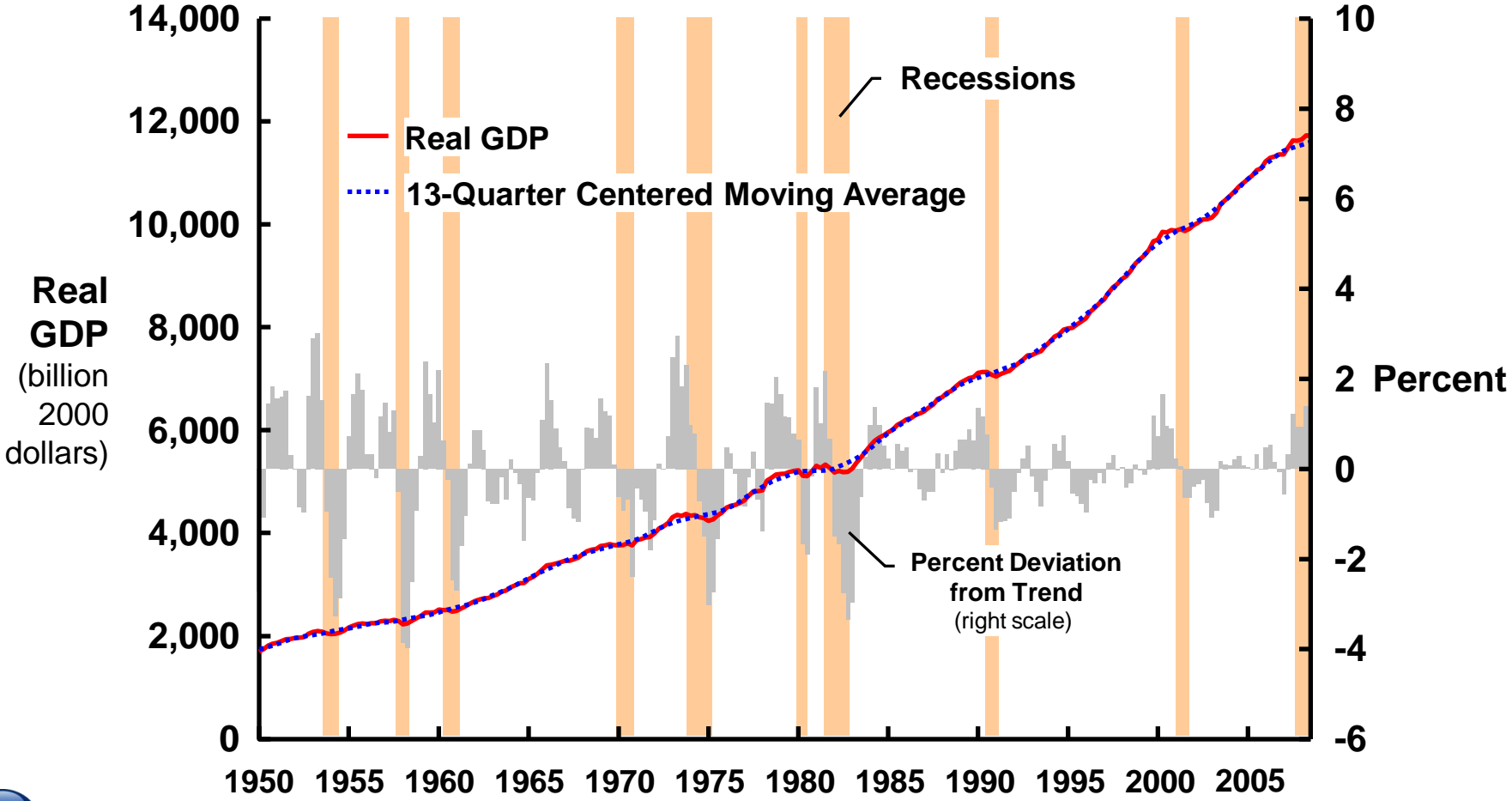


Source: IHS Cambridge Energy Research Associates.  
Data source: US Energy Information Administration.  
Monthly US Electricity Use

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# Real US GDP (SAAR) versus Trend

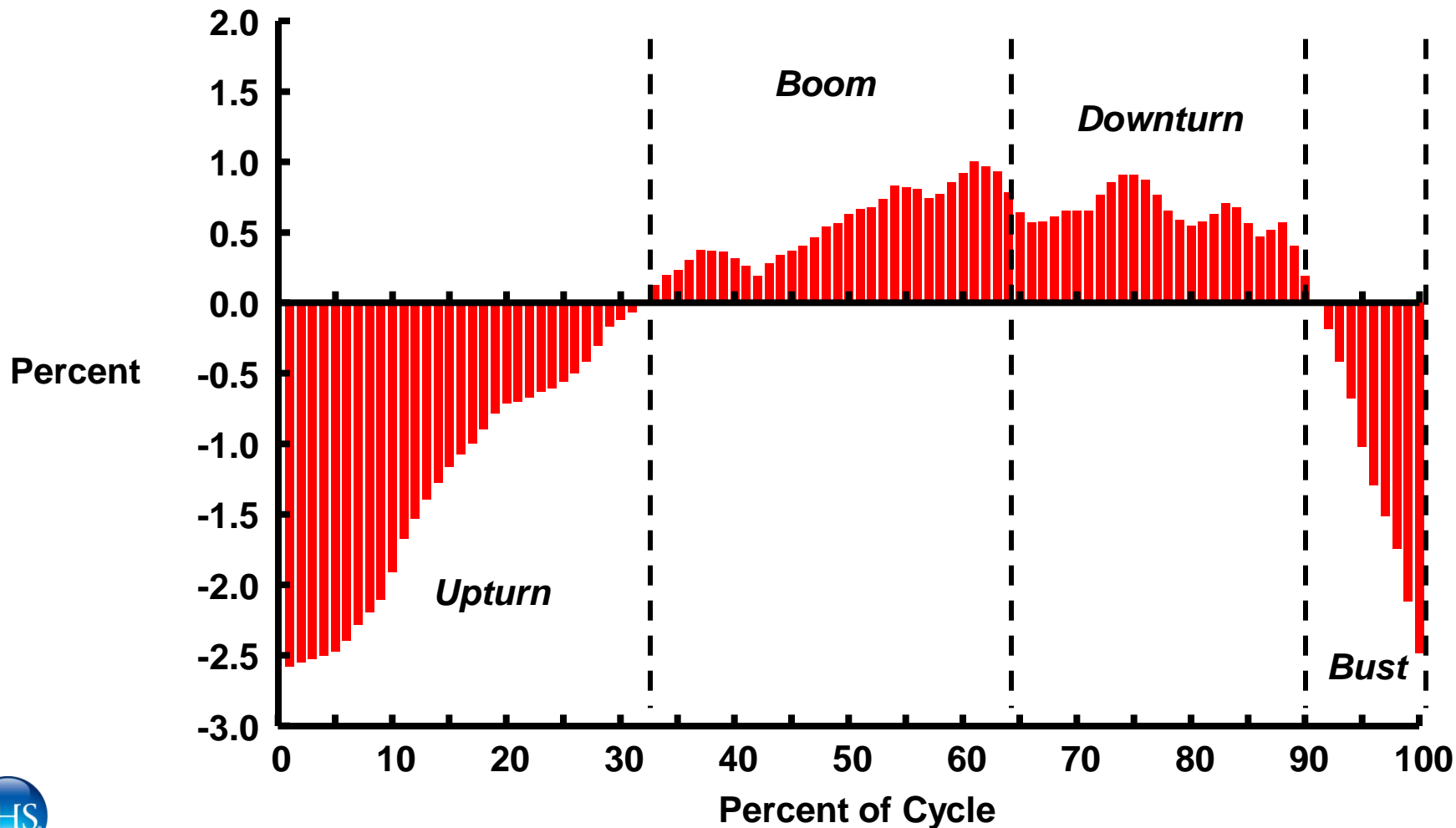


Source: IHS Cambridge Energy Research Associates.  
Data sources: National Bureau of Economic Research and IHS Cambridge Energy Research Associates.  
Note: Shaded areas indicate recessions, as determined by the National Bureau of Economic Research.  
US kWh Sales and Real GDP.xls

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# US BUSINESS CYCLE PHASES: Real GDP Average Deviation from Trend, 1954–2001



Source: IHS Cambridge Energy Research Associates.

Data Source: US Bureau of Economic Analysis

Based on US business cycles 1950–2007

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# Characteristics of Business Cycle Phases

Business Cycle Phase	Characteristics
<b>Upturn</b>	<ul style="list-style-type: none"> <li>• Mixed economic data</li> <li>• Starting point identified with considerable time lag; no identification of ending point due to focus on full employment level of GDP rather than trend level of GDP</li> <li>• Lack of situational awareness</li> </ul>
<b>Boom</b>	<ul style="list-style-type: none"> <li>• Positive economic data</li> <li>• Bottlenecks and inflation</li> <li>• Optimism, irrational exuberance, and overvaluations</li> <li>• Underestimation of risk and penalty for prudence</li> <li>• Peak identified with considerable time lag</li> </ul>
<b>Downturn</b>	<ul style="list-style-type: none"> <li>• Mixed economic data</li> <li>• Lack of situational awareness</li> <li>• Day of reckoning for optimists</li> </ul>
<b>Bust</b>	<ul style="list-style-type: none"> <li>• Negative economic data</li> <li>• Price declines</li> <li>• Pessimism</li> <li>• Bottom recognized with considerable time lag</li> <li>• Government stimulus efforts</li> </ul>



# Predictions of Power Efficiency Gains, 1984, 2007, and 2009

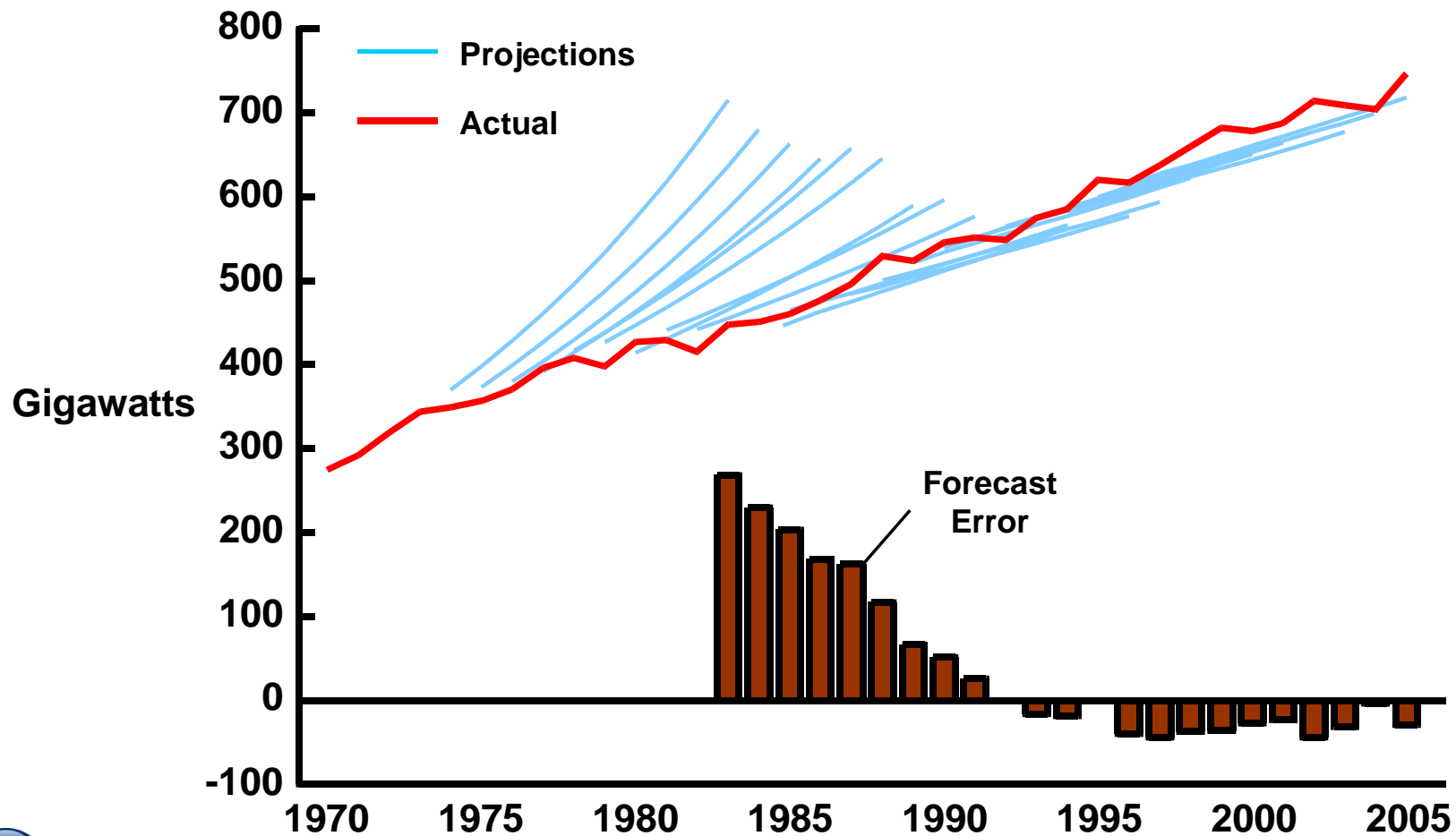
**“Improving energy efficiency in the buildings-and-appliances and industrial sectors could (assuming substantial barriers can be addressed) offset some 85 percent of the projected incremental demand for electricity over the next 25 years.”**

**“Electricity conservation has come of age and it is less expensive to save electricity than to use it. New light bulbs and other electricity-saving devices will reduce power consumption by 80 to 90 percent—eliminating the need for new power plants and requiring the closure of many existing ones.”**

**“We may not need any [new baseload power plants], ever. If you can shape your renewables, you don’t need fossil fuel or nuclear plants to run all the time... And if you have the ability to ramp up and ramp down loads in ways that can shape the entire system, then the old concept of baseload becomes an anachronism.”**



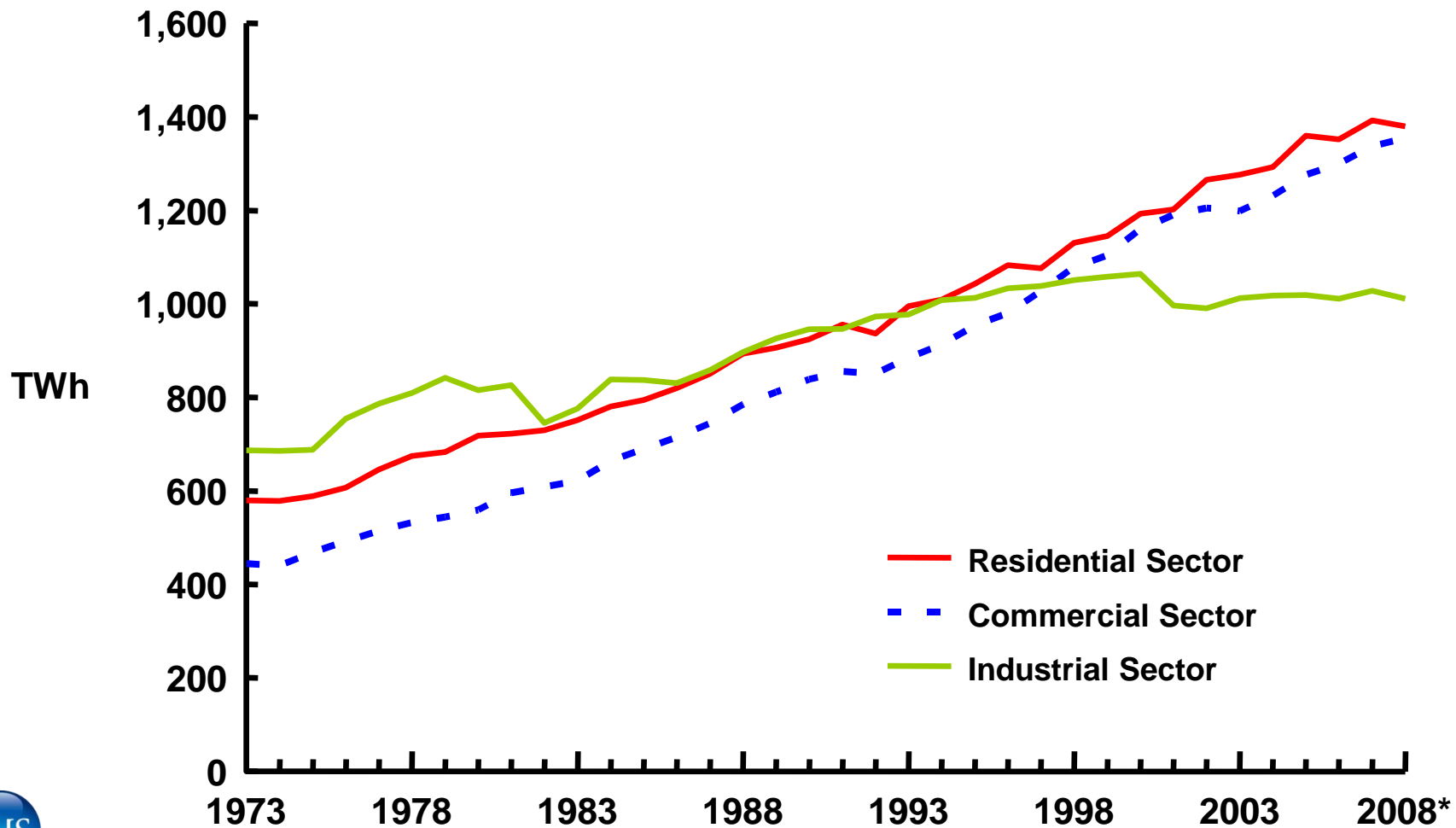
# US Power Demand: Projected versus Actual



Source: IHS Cambridge Energy Research Associates.  
70408-1



# US Retail Electricity Sales by Sector, 1973–2008



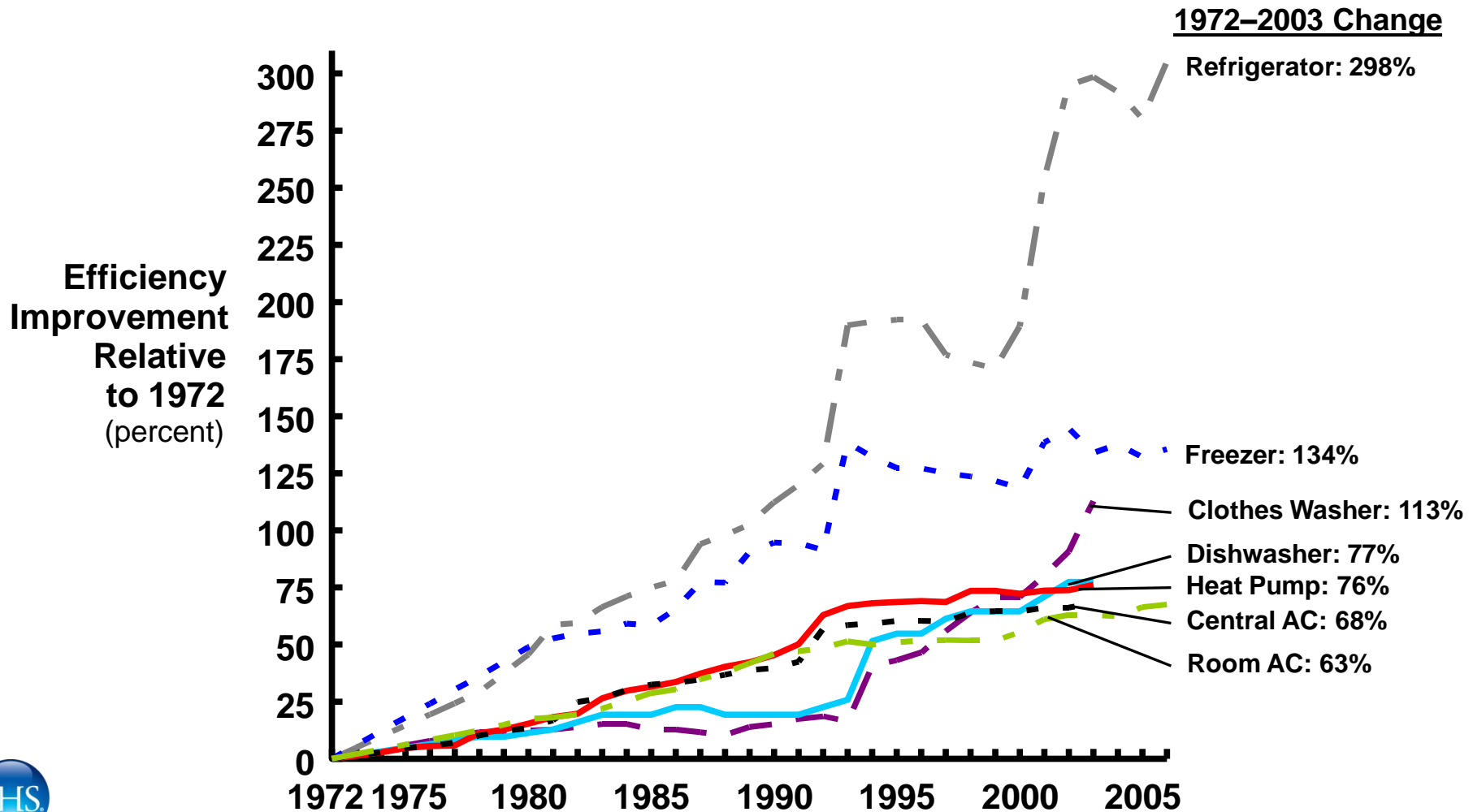
Source: IHS Cambridge Energy Research Associates and Energy Information Administration.

\*2008 data reflect twelve-month total ending November 2008.

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# Electric Efficiency of New Appliances

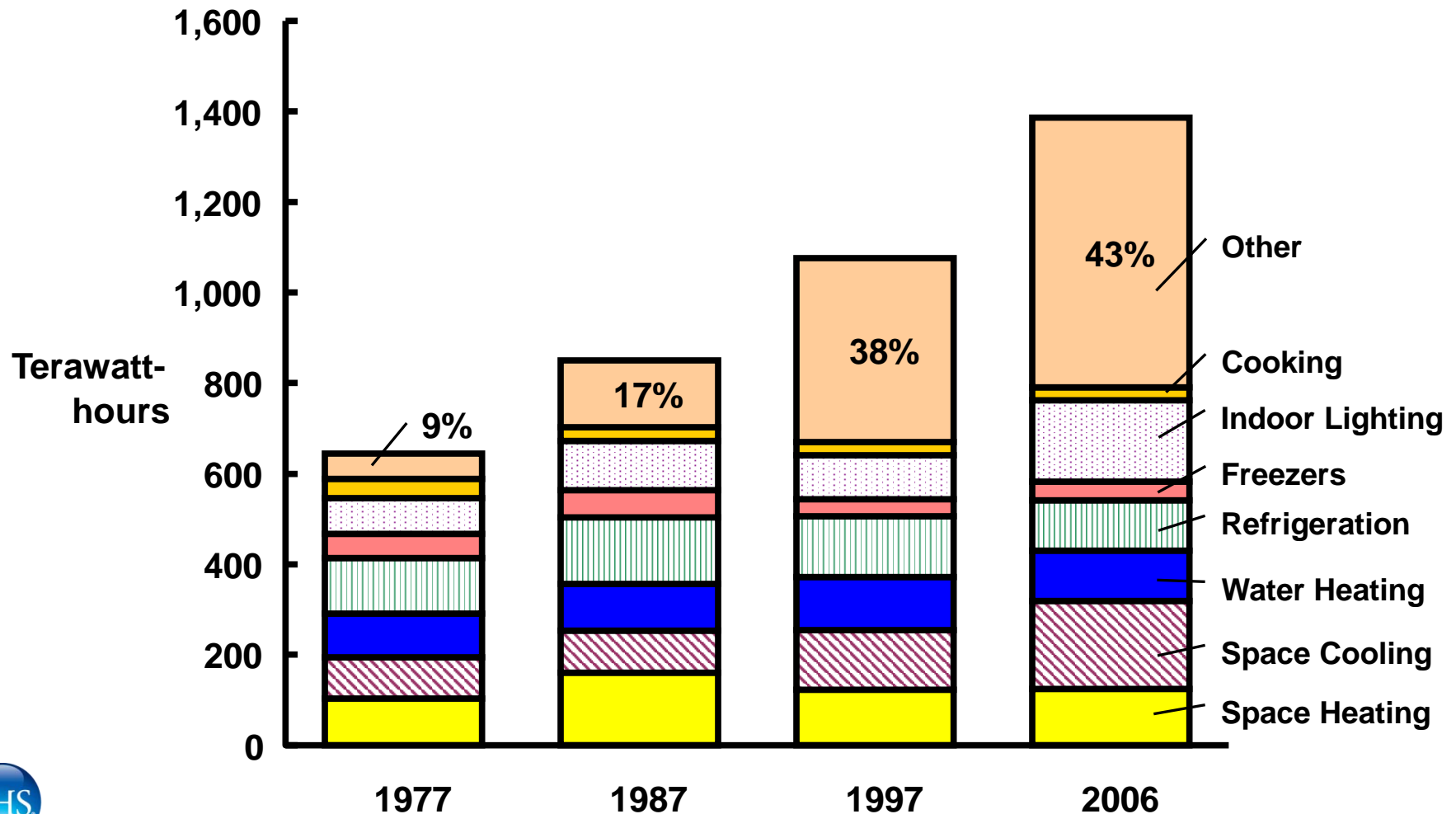


Source: Cambridge Energy Research Associates and Lawrence Berkeley National Laboratory.  
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# US Residential Electricity Consumption by End Use



# Investment Outlook



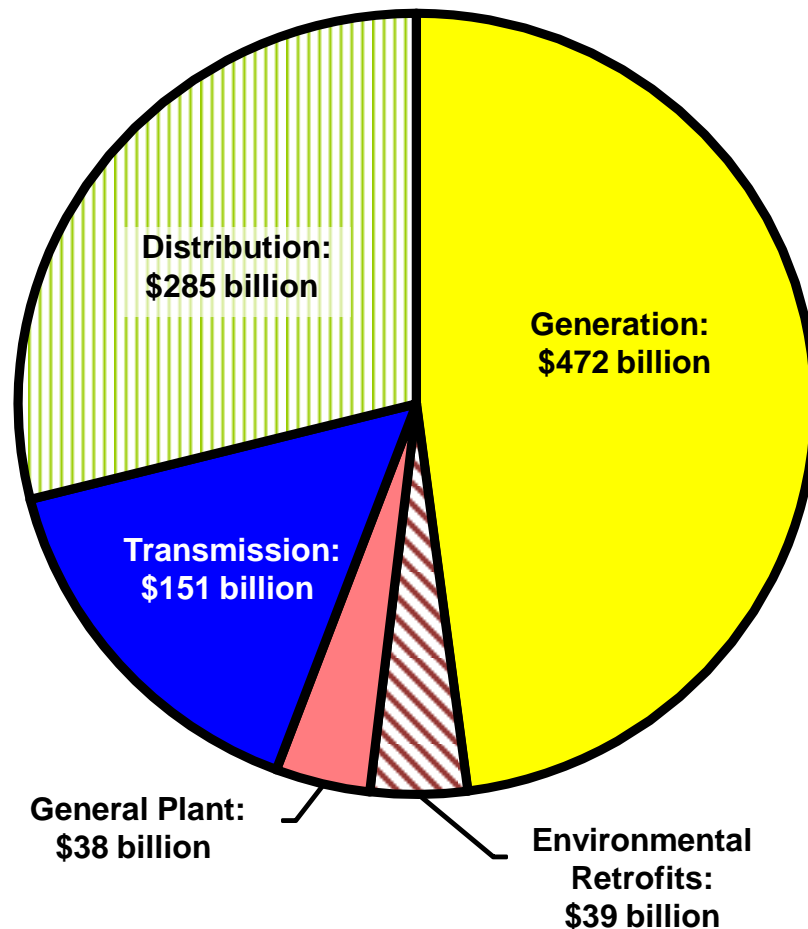
# Investment Outlook

- **The US power sector is at the front end of an upswing in capital expenditures**
- **In the next decade, the typical power company doubles its balance sheet as electric energy use increases about 15 to 20 percent.**

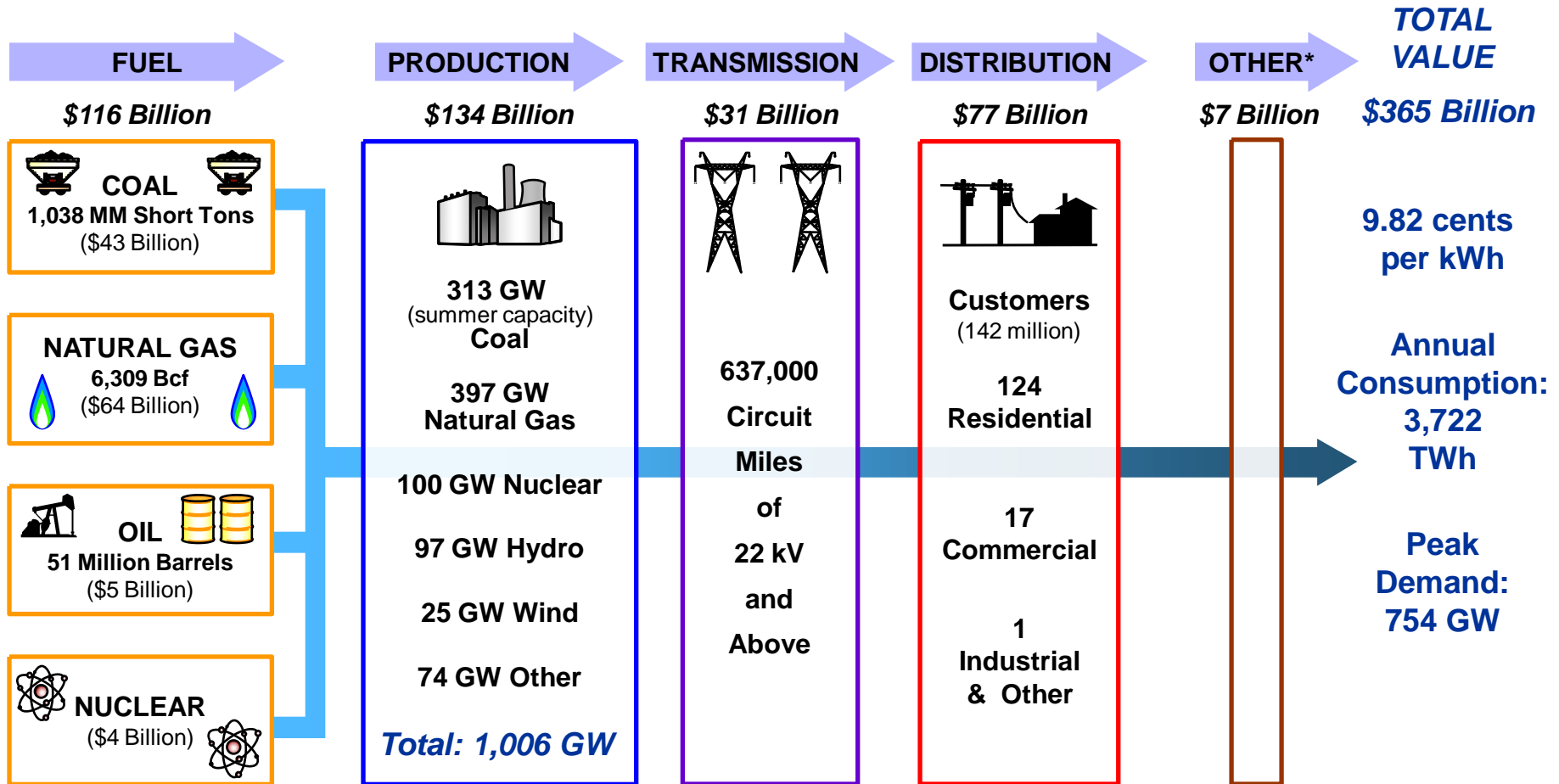


# US Power Industry Investment Outlook

*Investment Need (Reference Case), 2010–20*  
**\$984 billion (2008 dollars)**



# US Electric Value Chain, 2008



Source: IHS Cambridge Energy Research Associates.

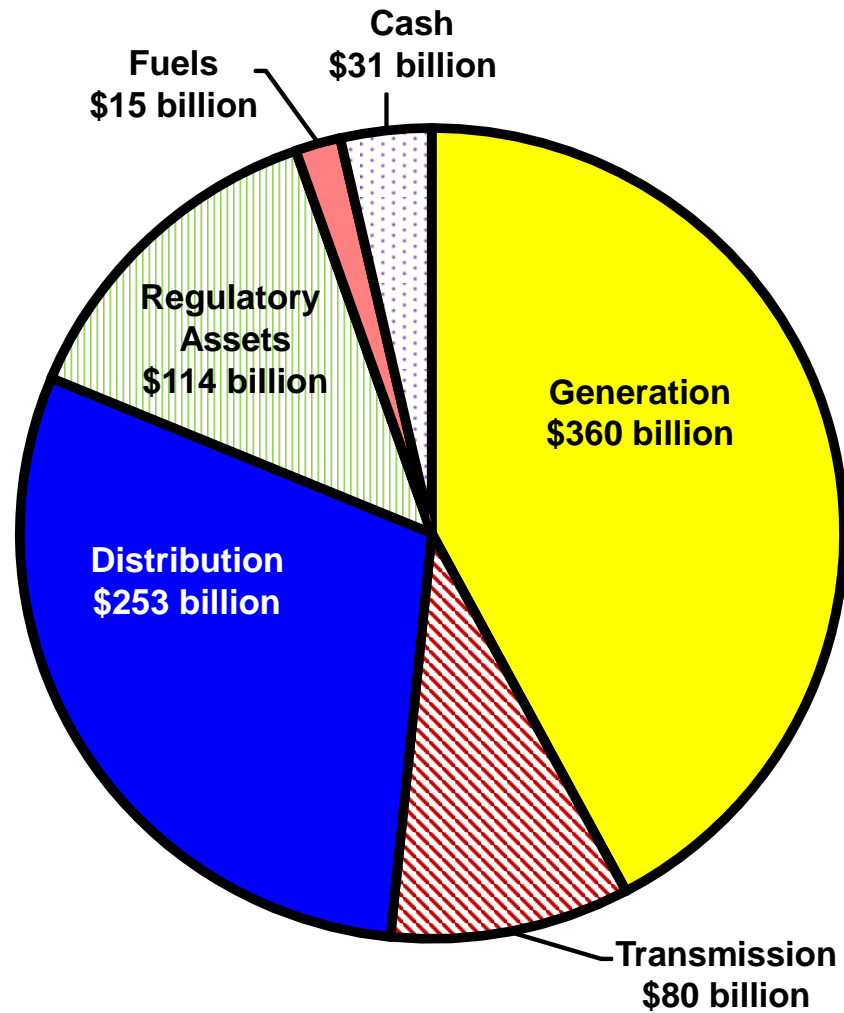
\*Includes trading.

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# US Power Industry—Existing Net Plant in Service: \$852 Billion (end of 2008)



Source: IHS Cambridge Energy Research Associates.

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# **Climate Change Challenge**



# Climate Change Challenge

- **Global greenhouse gas emissions are moving inexorably upward**
- **Greenhouse gas emission abatement costs are often grossly underestimated**
- **The impact of proposed US climate change legislation on the US power sector is transformative and uncertain**

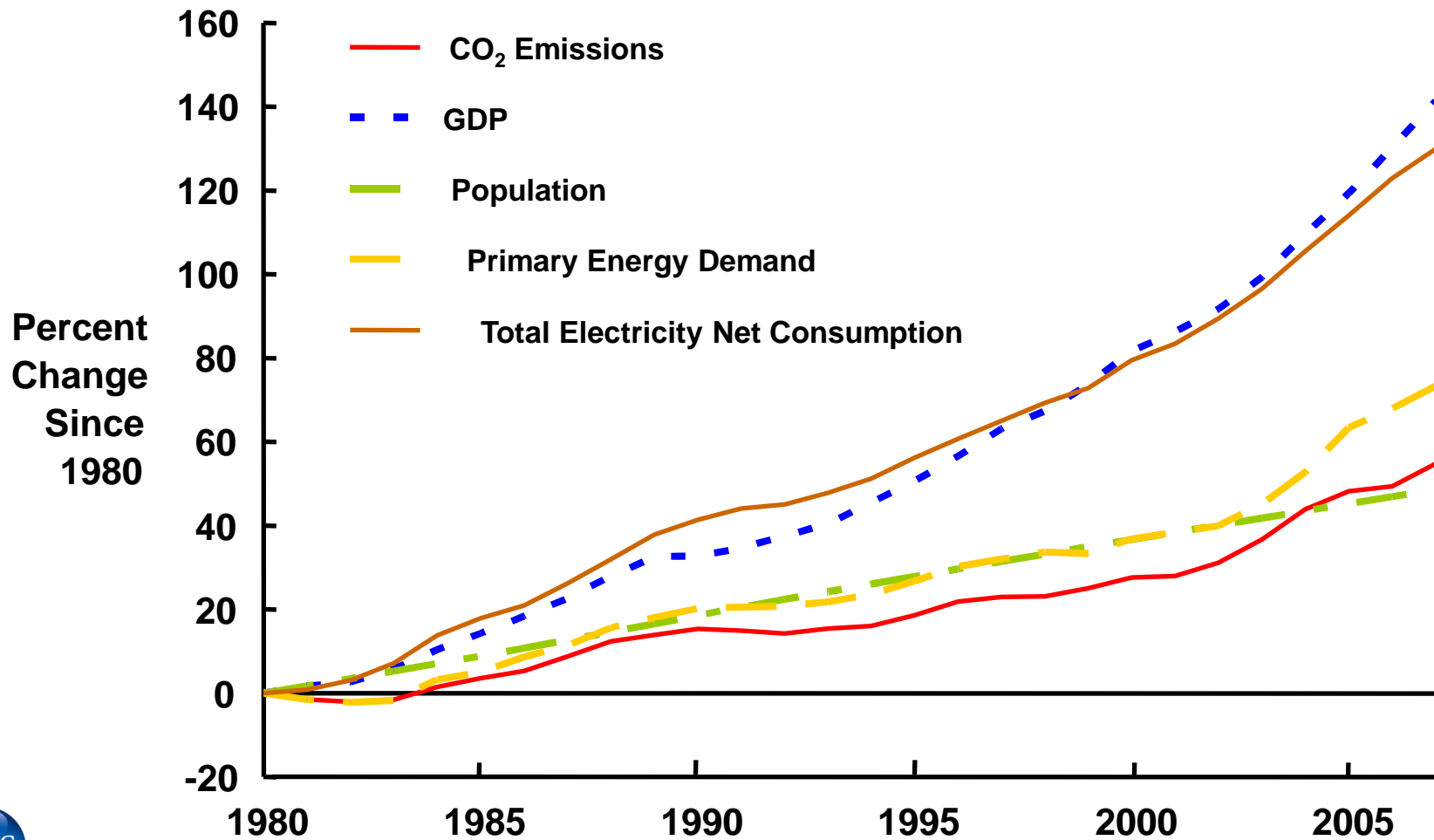


Source: IHS Cambridge Energy Research Associates.

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# Global Trends

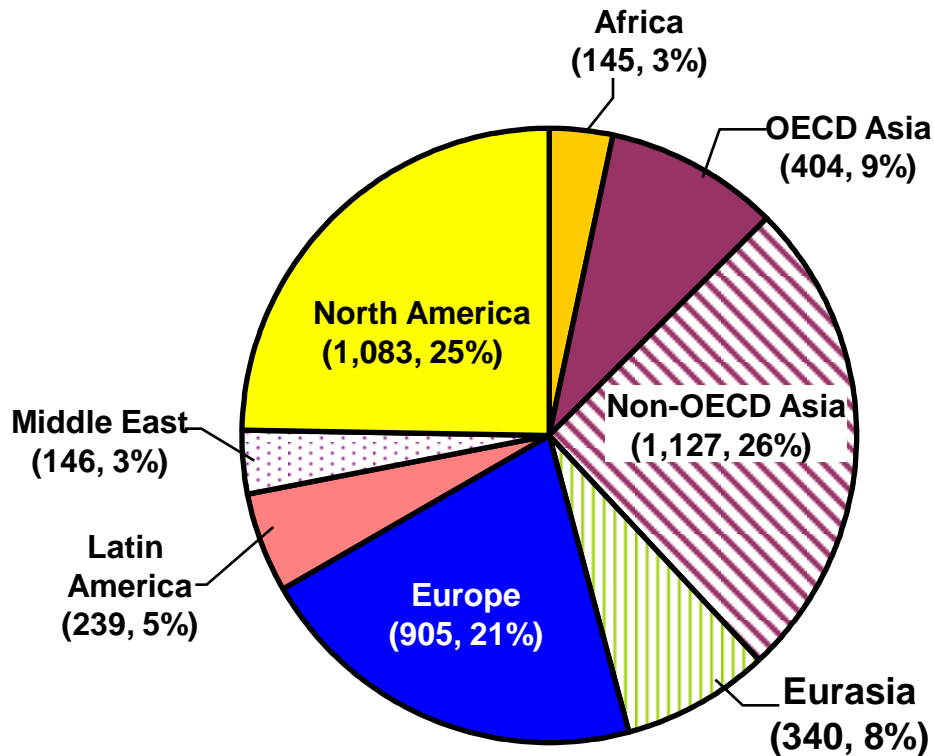


Source: IHS Cambridge Energy Research Associates.

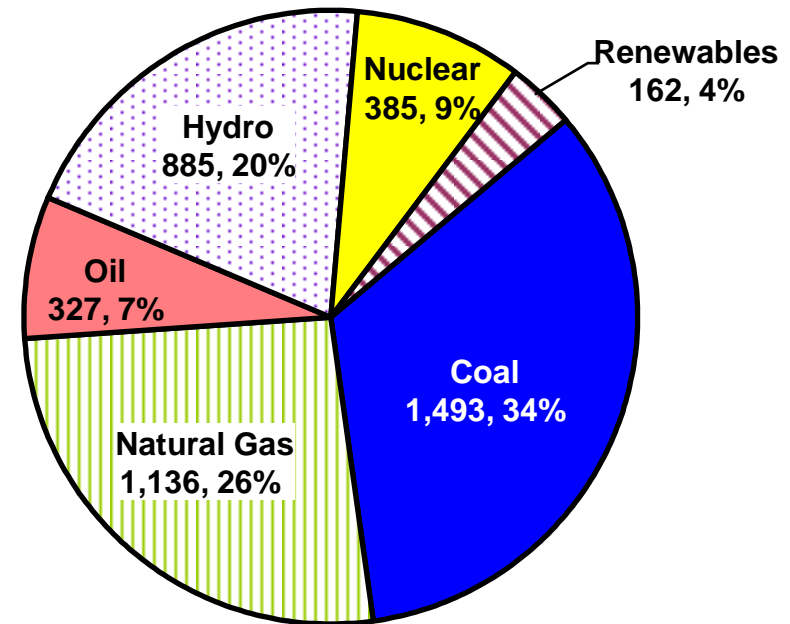
# Global Installed Generation Capacity, 2007

(total gigawatts, percent share of global total)

## By Region



## By Fuel Type/Technology



**Total Global Capacity: 4,390 GW**



Source: IHS Cambridge Energy Research Associates.

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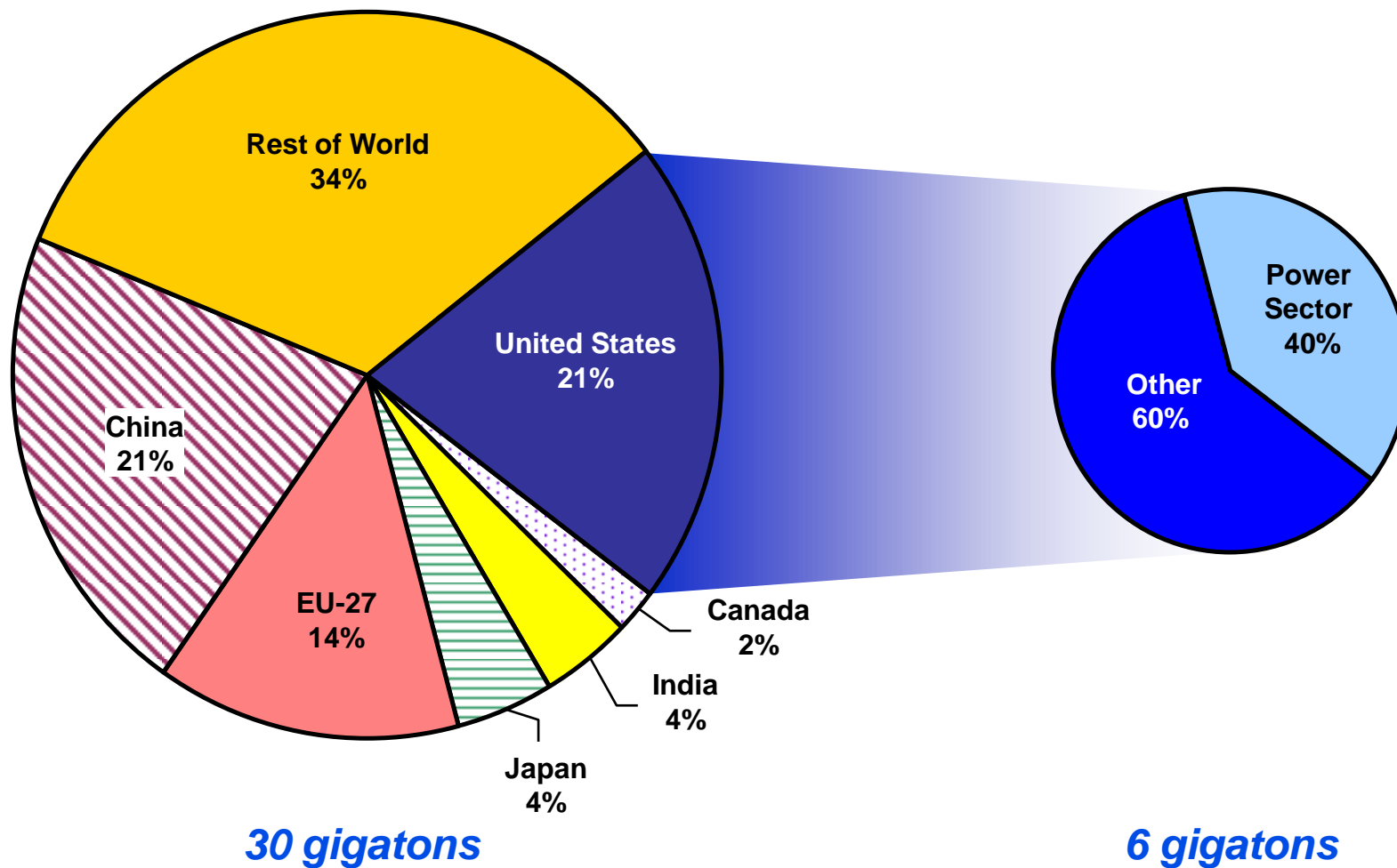
# CO<sub>2</sub> Emissions of Fossil Generation by Fuel and Technology (pounds of CO<sub>2</sub> per kWh)

Prime Mover	Fuel		
	Coal	Petroleum	Natural Gas
Steam Turbine	2.2	1.77	1.29
Gas Turbine	—	2.23	1.43
Combined Cycle	—	1.87	0.92



Source: Calculations by IHS Cambridge Energy Research Associates using US Energy Information Administration data on average heat rates.

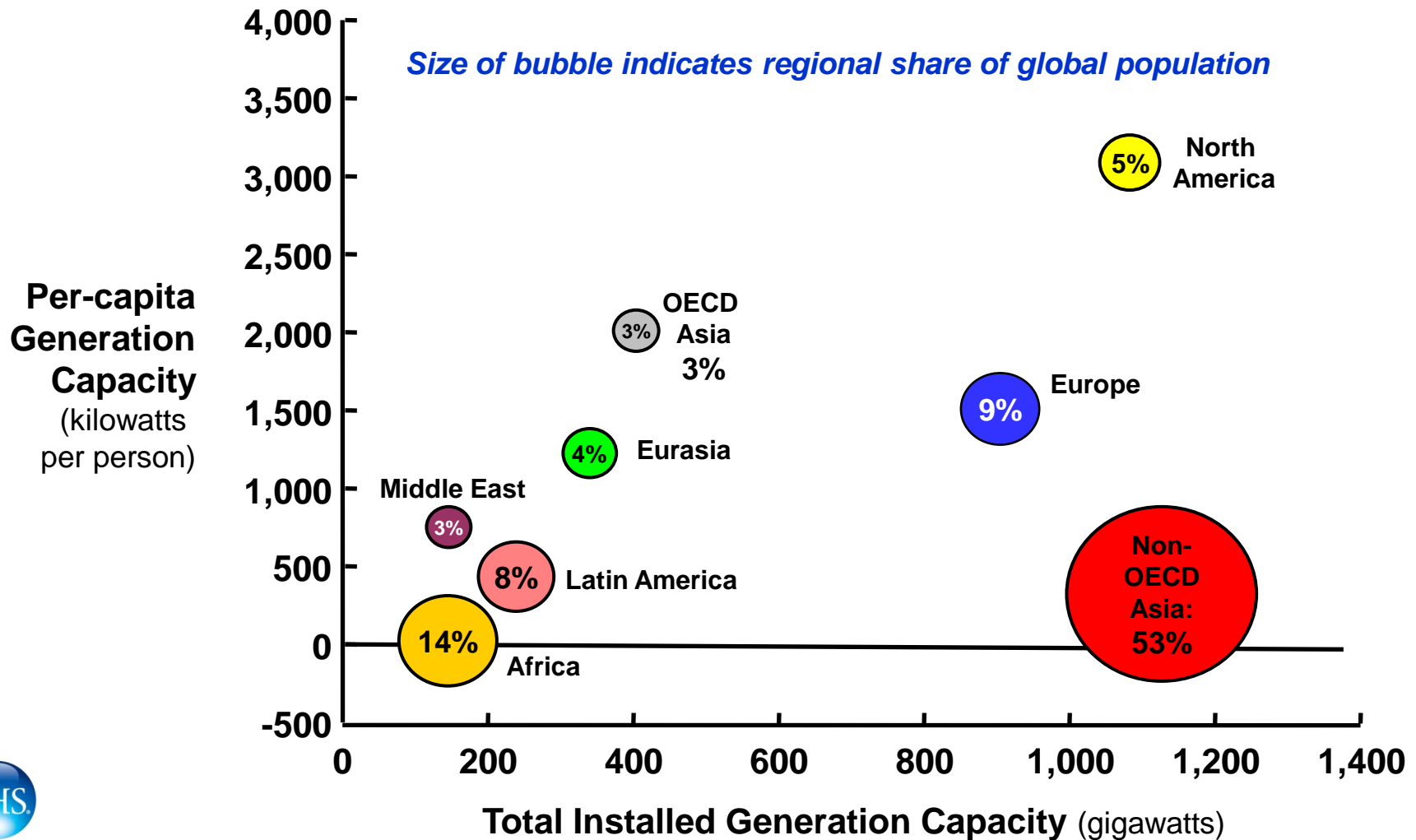
# Global and US CO<sub>2</sub> Emissions, 2007



Source: IHS Cambridge Energy Research Associates.  
90316-2

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# Per-capita Regional Power Generation: Capacity versus Share of Global Population



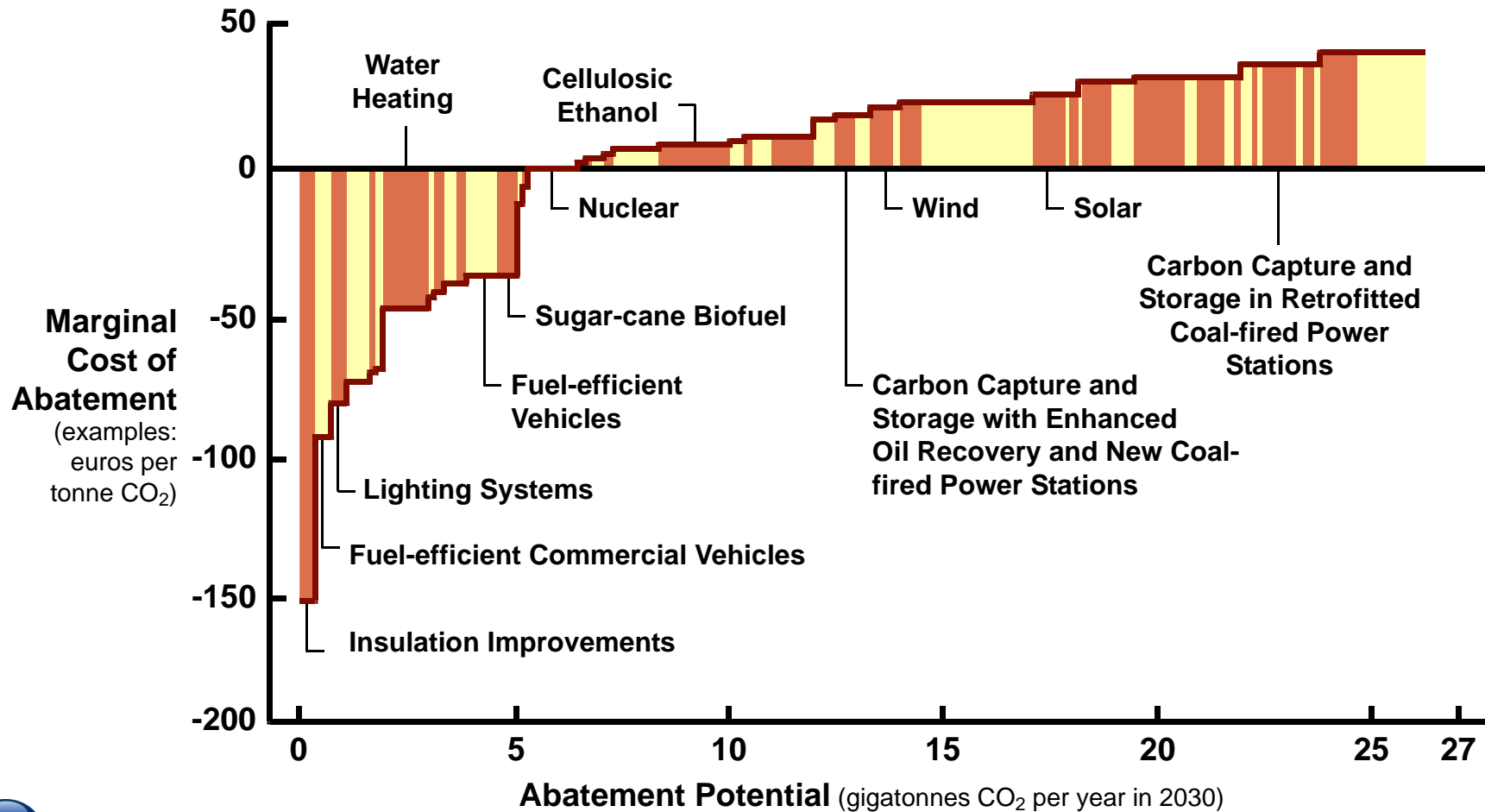
Source: IHS Cambridge Energy Research Associates.

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# The Cost of Cutting Carbon in Different Ways

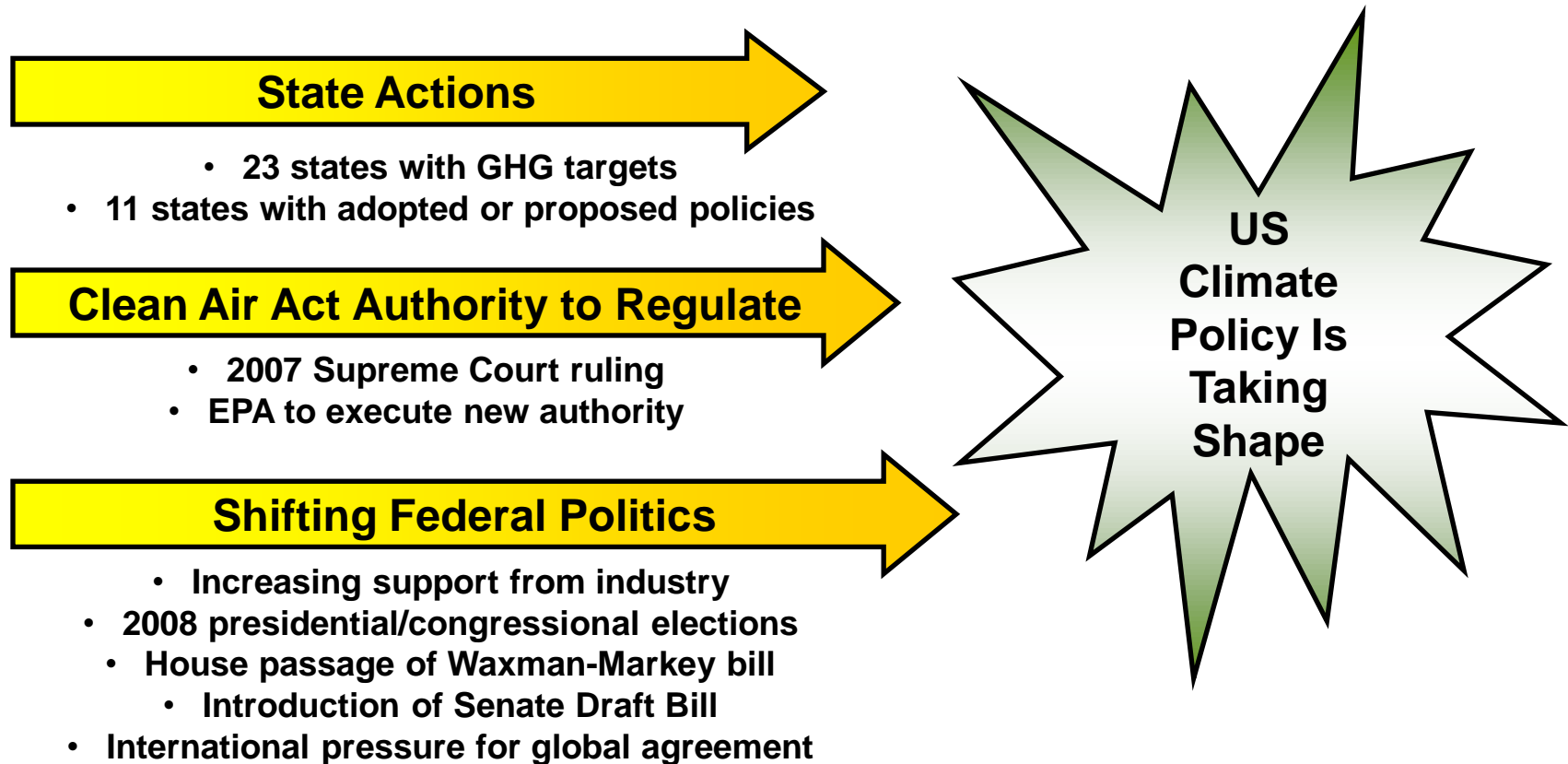


Source: Vattenfall; reproduced with permission.  
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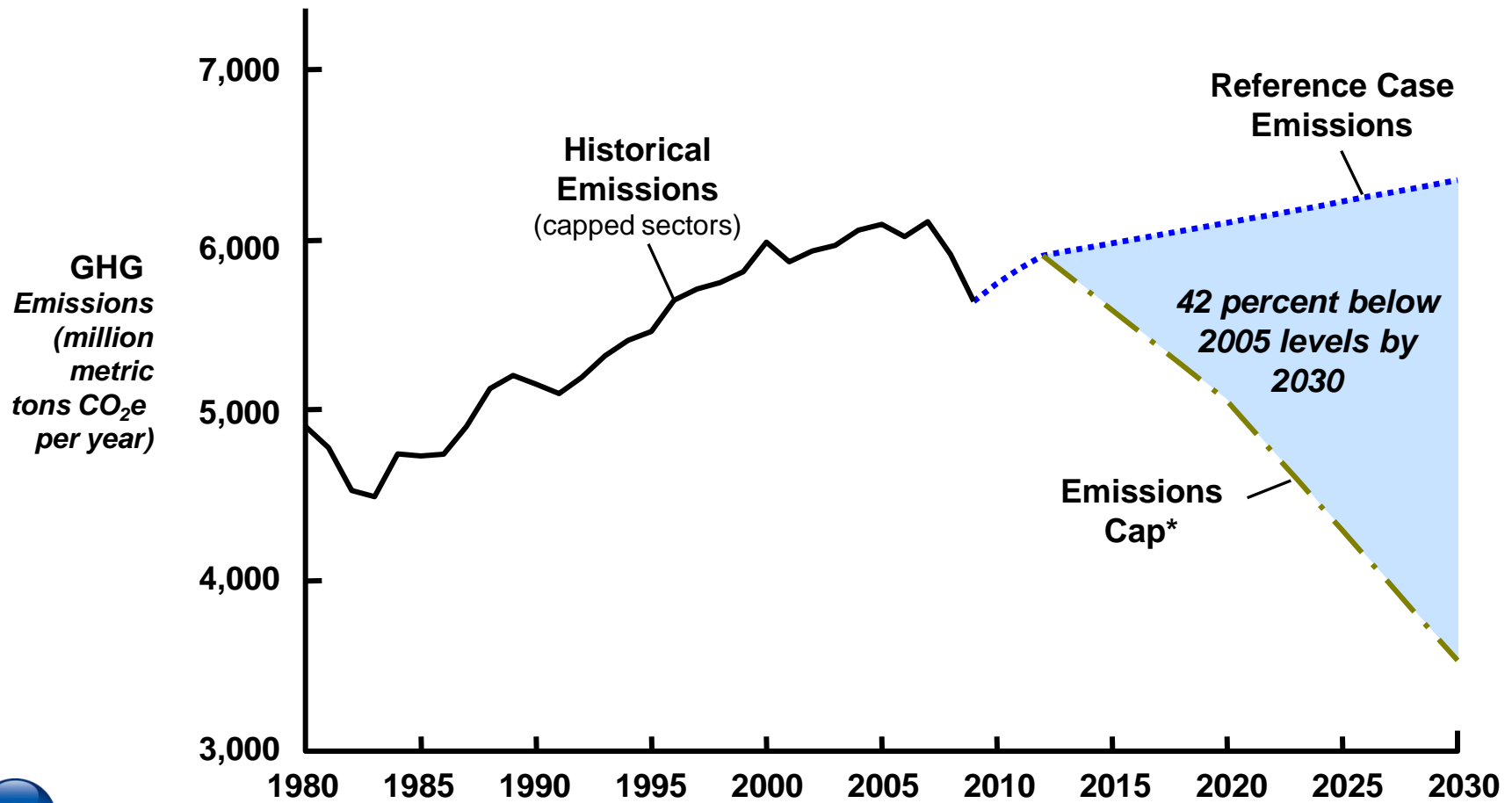
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# Diverse Drivers Are Shaping Federal Climate Policy



# HR 2454: Transformational GHG Target

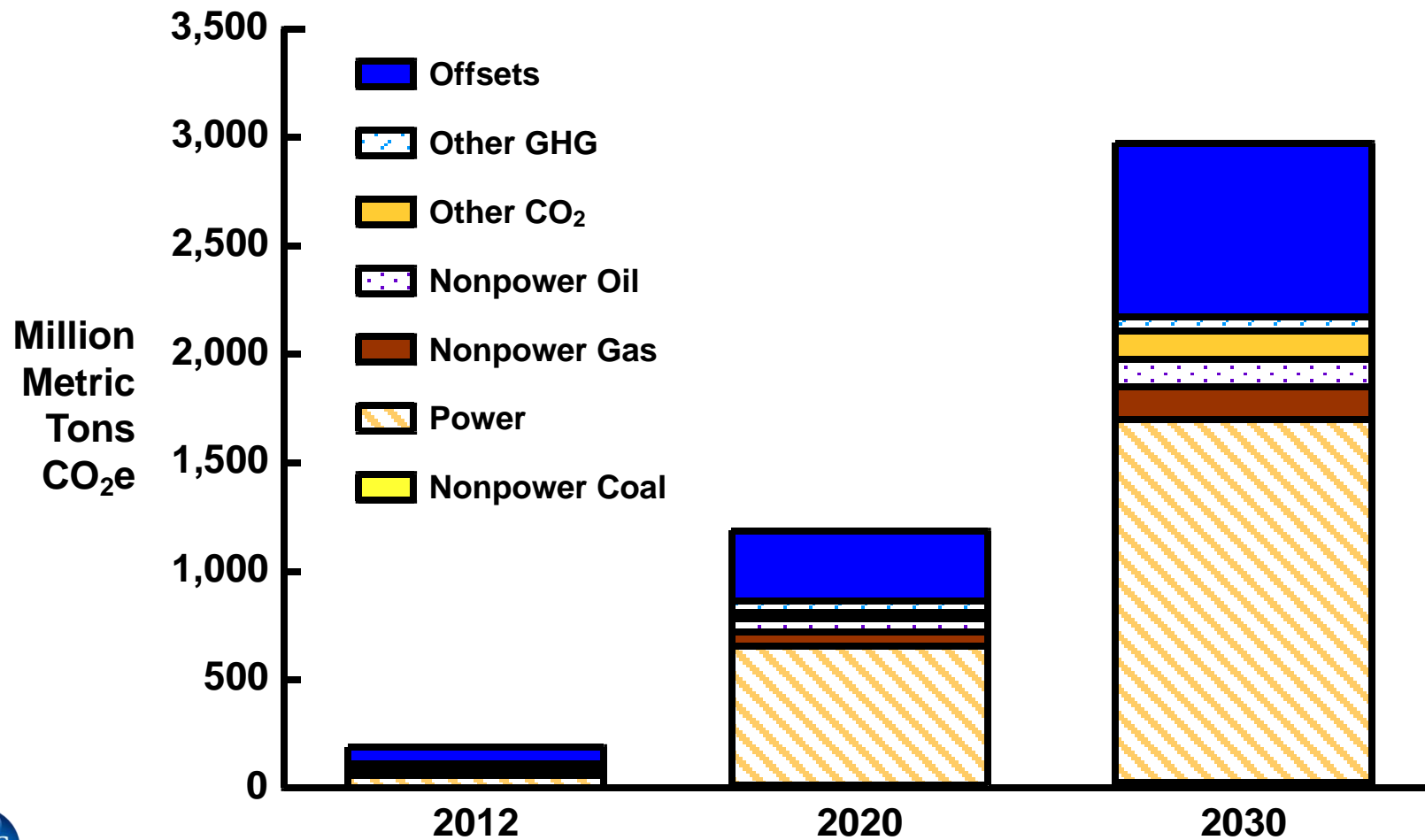
*Chart displays GHG emissions from capped sectors: 85 percent of the US total of 7.1 billion metric tons of CO<sub>2</sub>-equivalent emissions in 2005*



Source: IHS Cambridge Energy Research Associates.  
90609-1

# Annual GHG Emissions Reductions from Control Case

## IHS CERA Analysis of HR 2454



Source: IHS Cambridge Energy Research Associates.  
90919-2

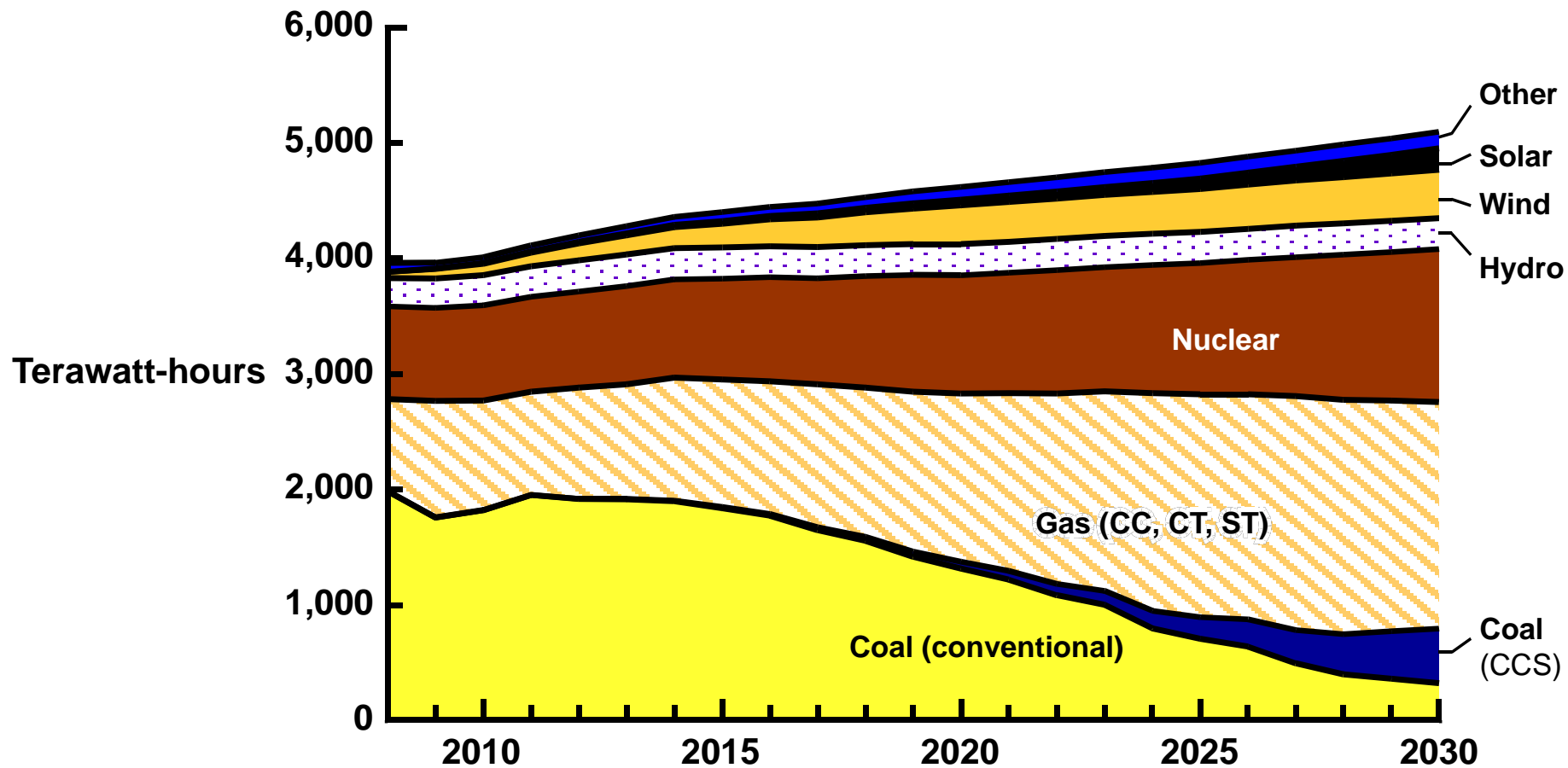
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# Generation by Source

## IHS CERA Analysis of HR 2454



Source: IHS Cambridge Energy Research Associates.  
90919-8

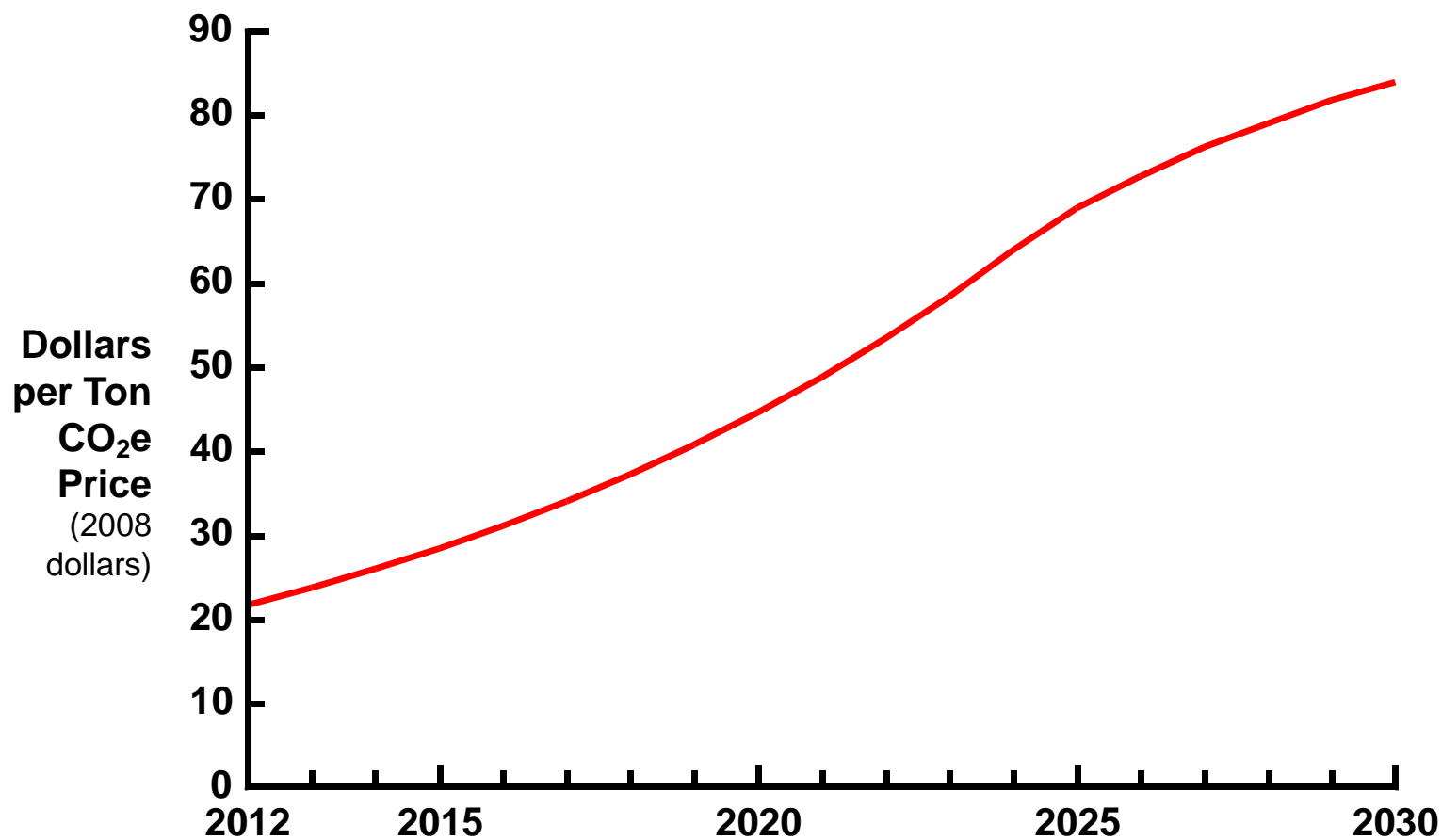
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# CO<sub>2</sub>e Allowance Price Outlook

## IHS CERA Analysis of HR 2454



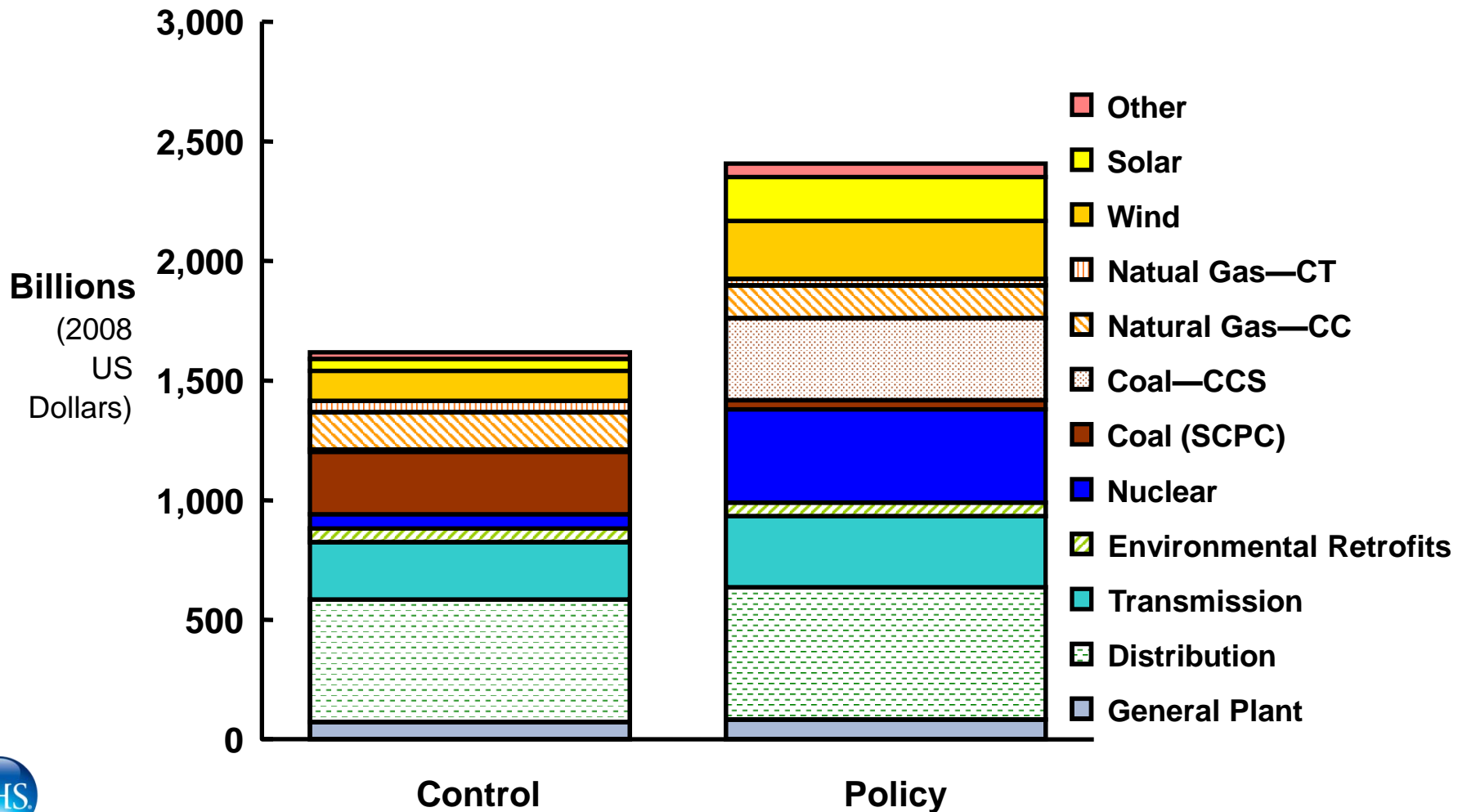
Source: IHS Cambridge Energy Research Associates.  
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# Power Sector CAPEX, 2010–30



Source: IHS Cambridge Energy Research Associates.  
WM\_Capex

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# **Cost and Price Challenge**

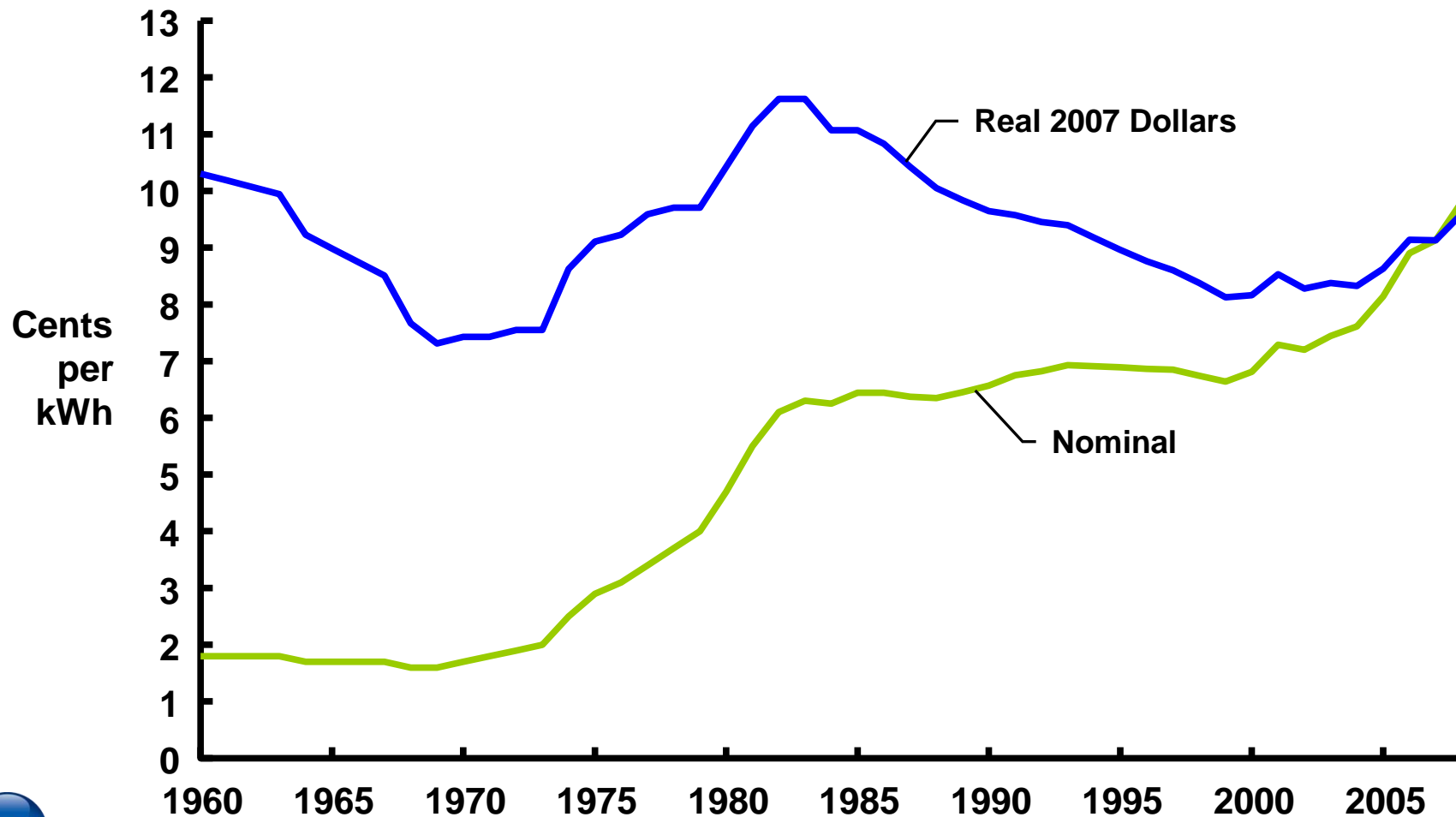


# Cost and Challenge

- **Eight reinforcing cost factors are pushing up real power prices.**
- **The political tolerance for power price increases is likely to pace the transformation of the power sector in the years ahead.**



# Average Annual US Electricity Prices (All Sectors), 1960–2008



Source: Cambridge Energy Research Associates.  
 Data source: US Energy Information Administration.  
 U/O 81205-3 / Retail Prices and Reserve Margins

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# Managing Power Price Increases

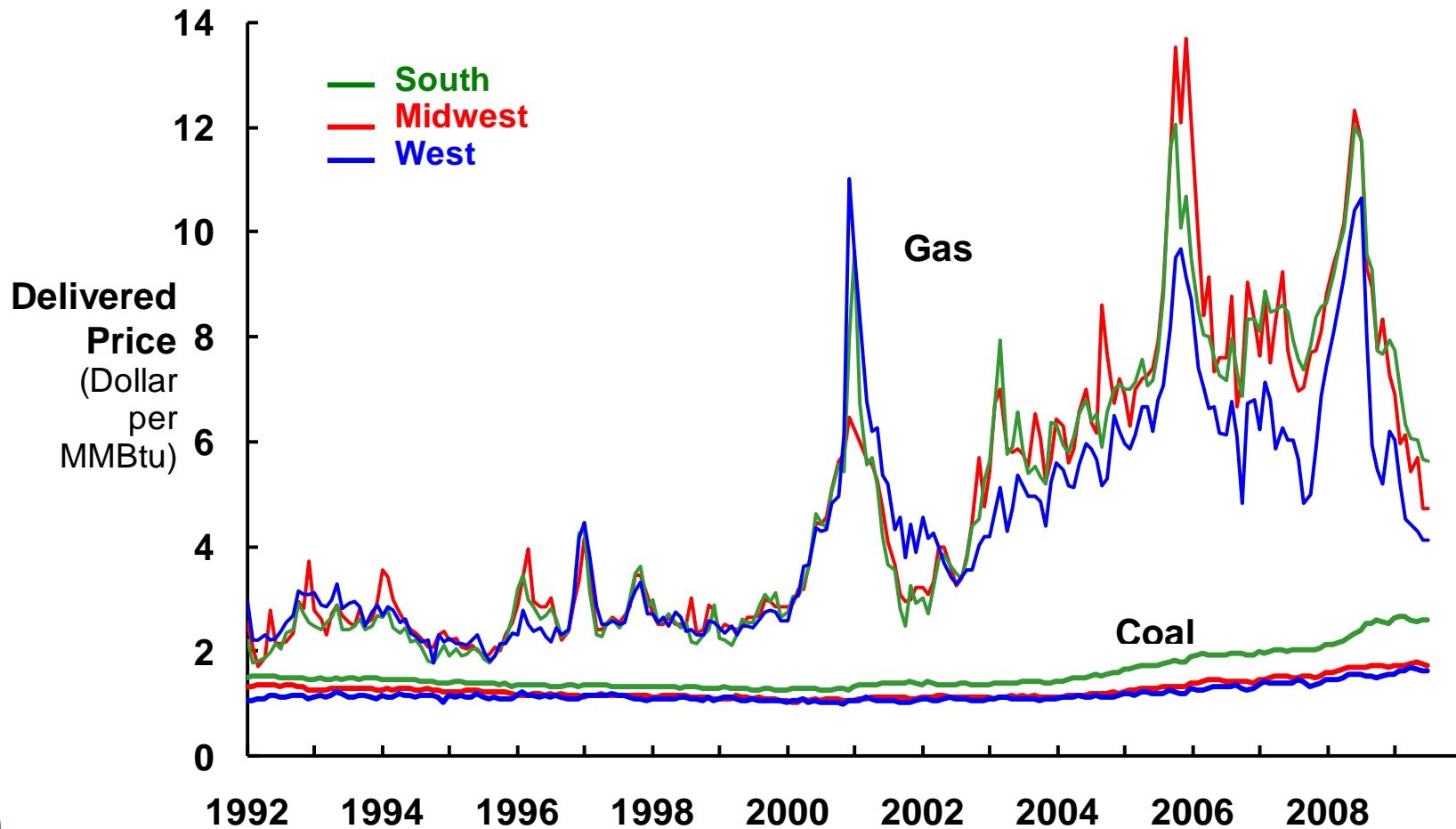


- **Current cyclical lows in fuel prices position power prices for increases in the years ahead.**
- **A reduction in coal use and an increased reliance on natural gas will push average fuel costs for power generation higher through time.**
- **Load growth increases average costs because new supply costs at least 20 percent more than the embedded cost of existing supply.**
- **Renewable power mandates will increase power costs because renewable power supply is at least 30 percent more expensive than new conventional power supply.**
- **Efficiency programs add costs and reduce sales and therefore increase average costs.**
- **The financial crisis has repriced risk and added to the cost of capital.**
- **Putting a price on CO<sub>2</sub> emissions will increase power prices on average and at the margin by at least 10 percent by 2020.**
- **Annual grid investments are increasing because of renewables integration and demand management enhancements.**



Source: IHS Cambridge Energy Research Associates.

# Monthly Average Costs of Natural Gas and Coal Delivered to Power Plants by Power Region, January 1992–July 2009



Source: IHS Cambridge Energy Research Associates.

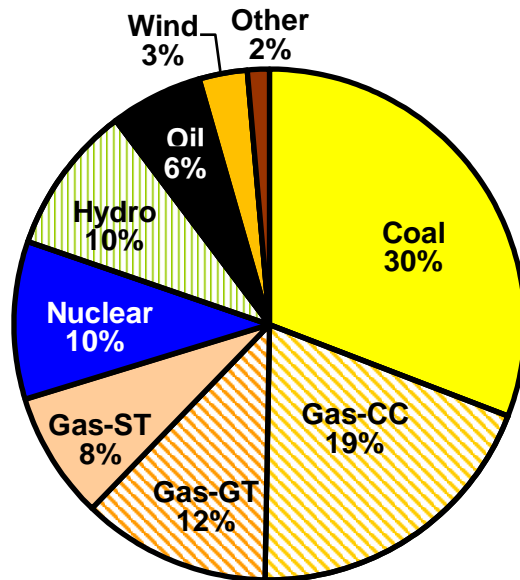
Data source: Ventyx.

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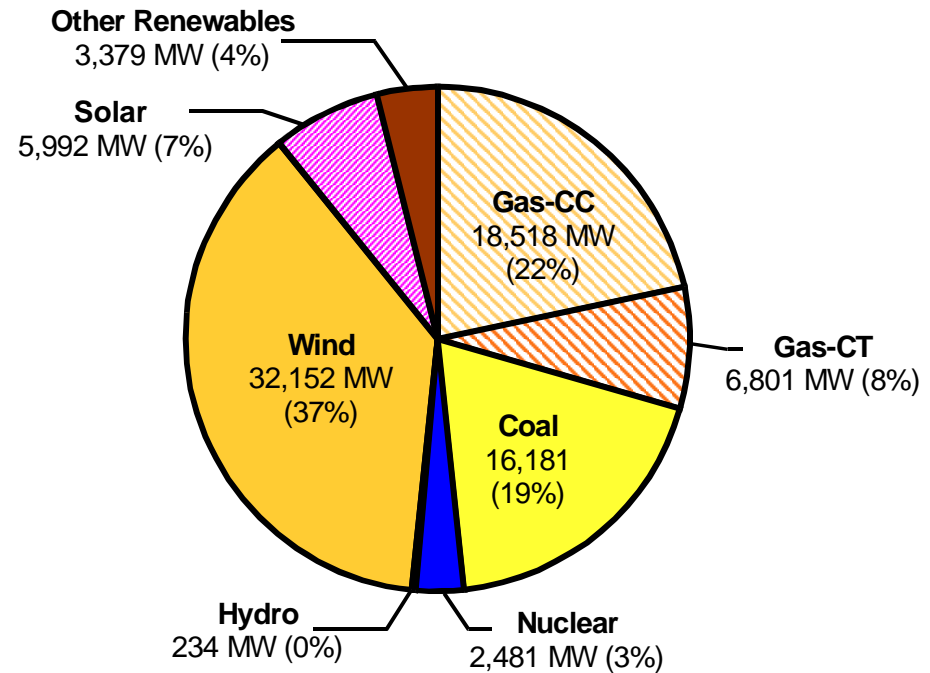
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# Existing US Generation Mix versus New Build

**Existing Generation Capacity,  
2008**  
*Total: 1,017 GW*

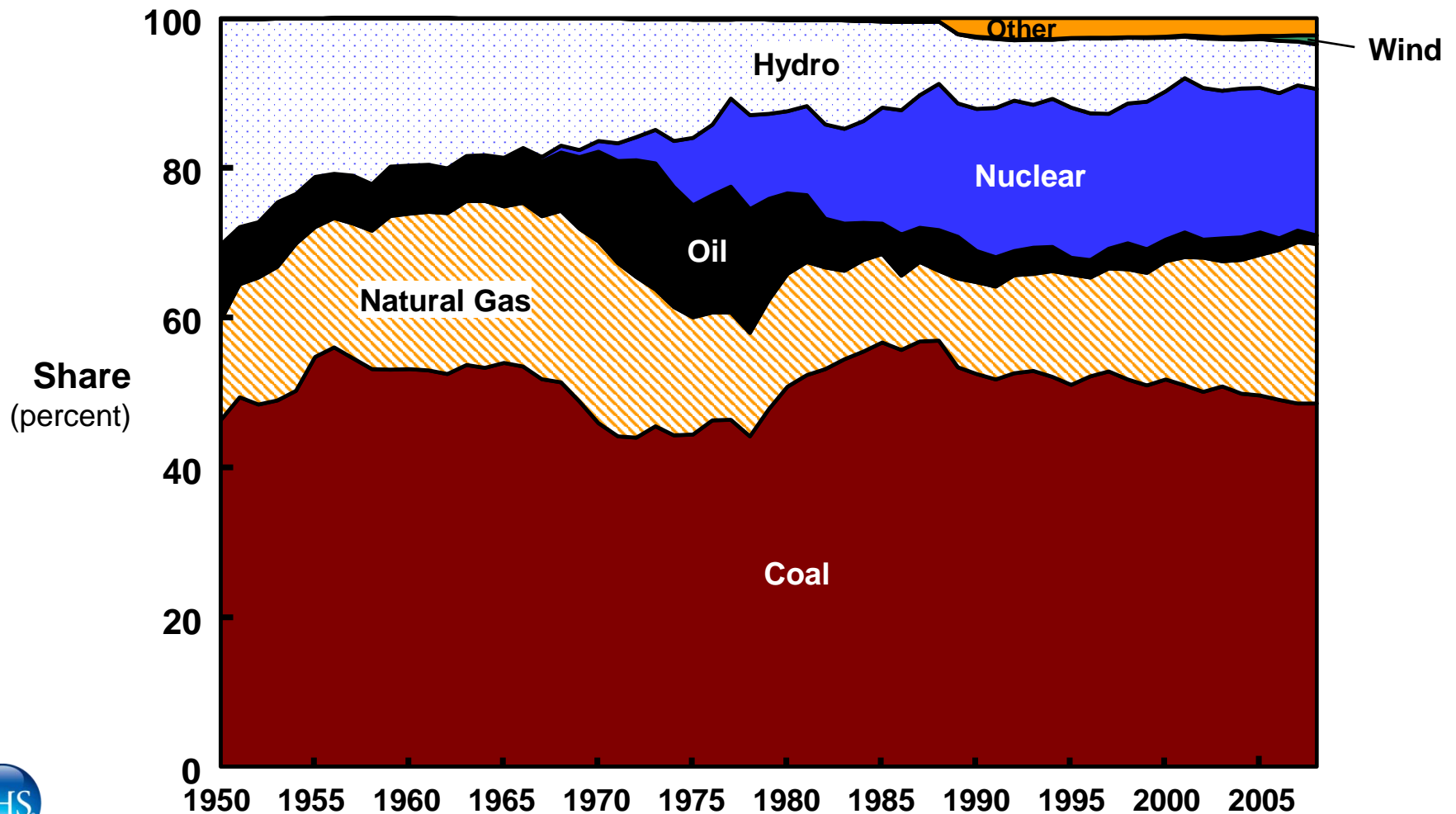


**Anticipated Capacity Additions,  
2009–14**  
*Total: 85,737 MW*



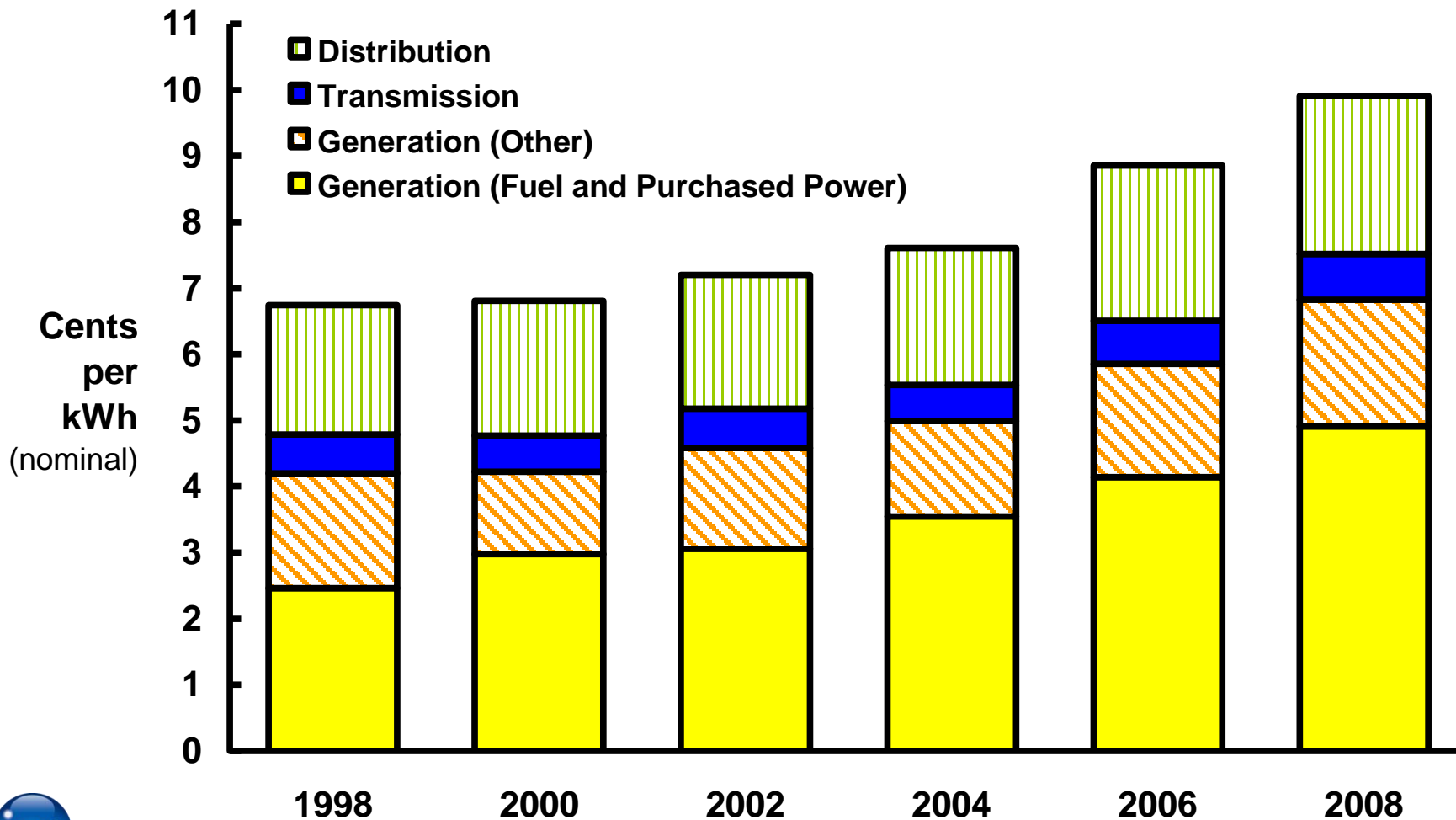
Source: IHS Cambridge Energy Research Associates.  
Note: CC = combined cycle; CT = combustion turbine.  
B/O 90805-6 and 90608-13

# Share of US Power Generation, 1950–2008



# Composition of US Retail Electricity Prices

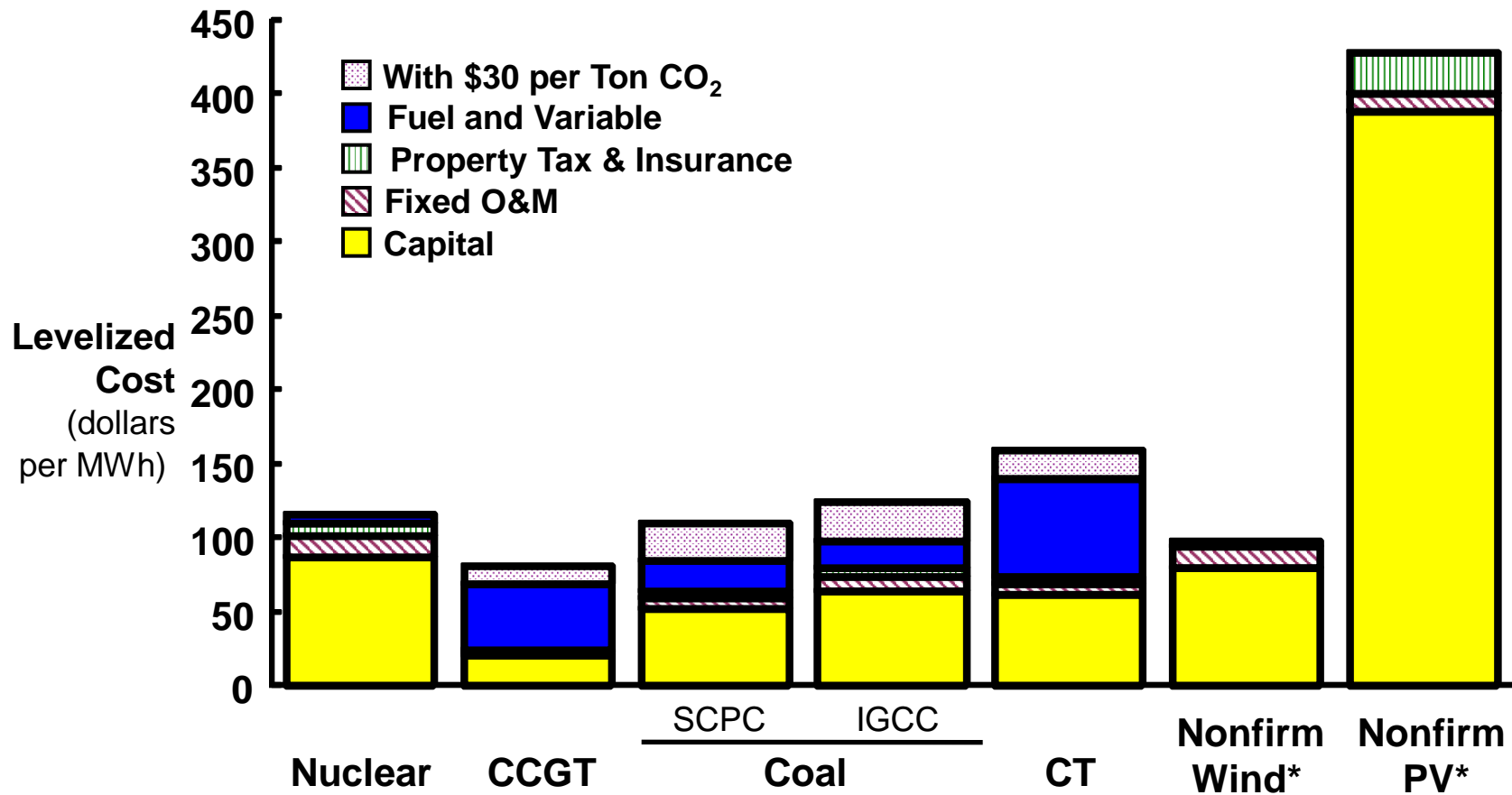
(all sectors)



Source: IHS Cambridge Energy Research Associates.

Data sources: US Energy Information Administration and IHS Cambridge Energy Research Associates.

# Busbar Cost of Competing Generation Options in North America (September 2009)



Source: IHS Cambridge Energy Research Associates.

\*Includes MACRS but not the production or investment tax credit

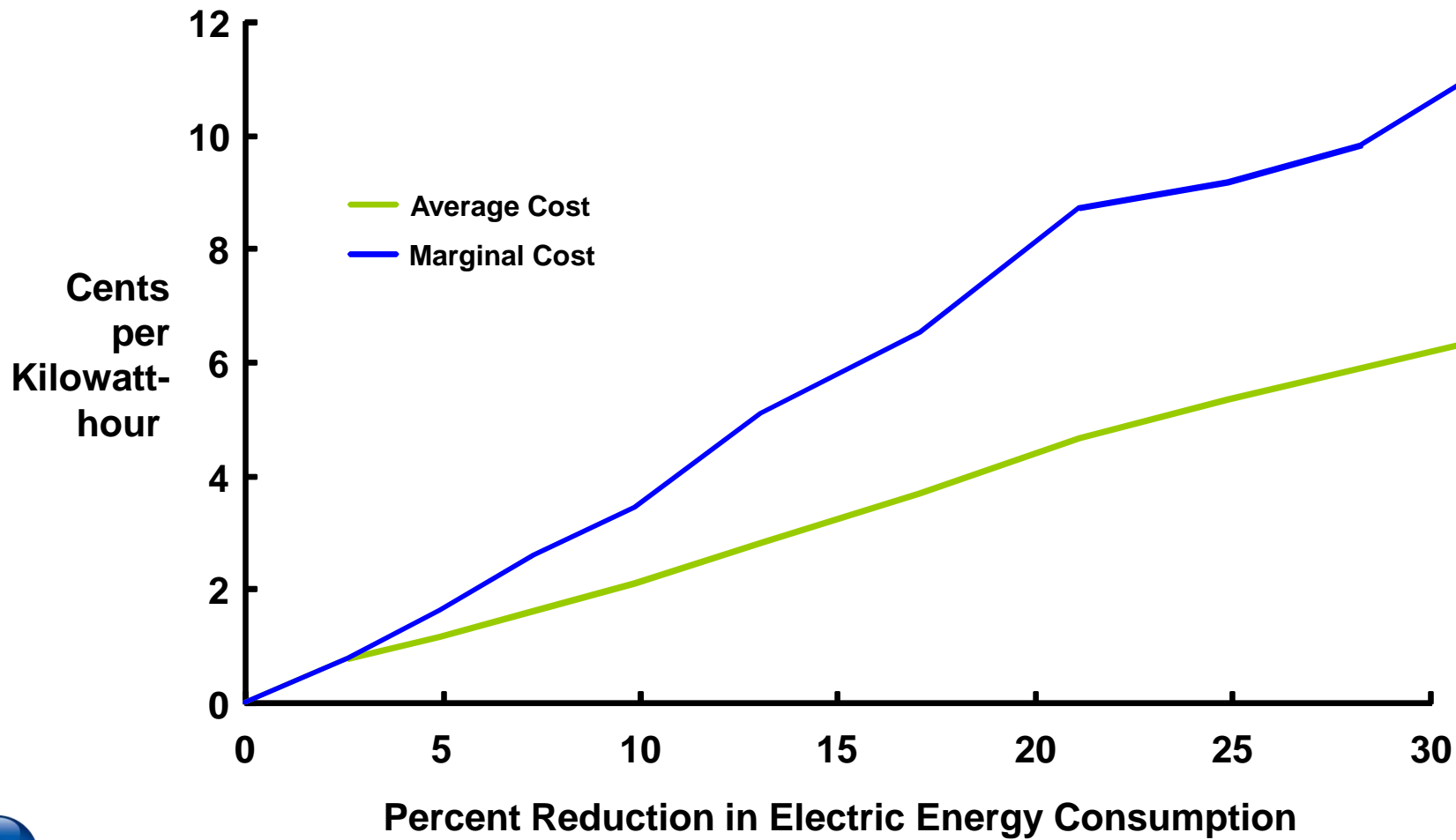
Notes: CCGT = combined-cycle gas turbine; CT = combustion turbine; CFB = circulating fluidized bed; IGCC = integrated gasification combined-cycle; SCPC = supercritical pulverized coal; PV=photovoltaic.

Delivered fuel prices: natural gas=\$6 per MMBtu; coal = \$2 per MMBtu for SCPC and \$1.80 per MMBtu for IGCC; biomass = \$3 per MMBtu.

LCOE model\_20090917



# Cost of Increasing US Electric Energy Efficiency



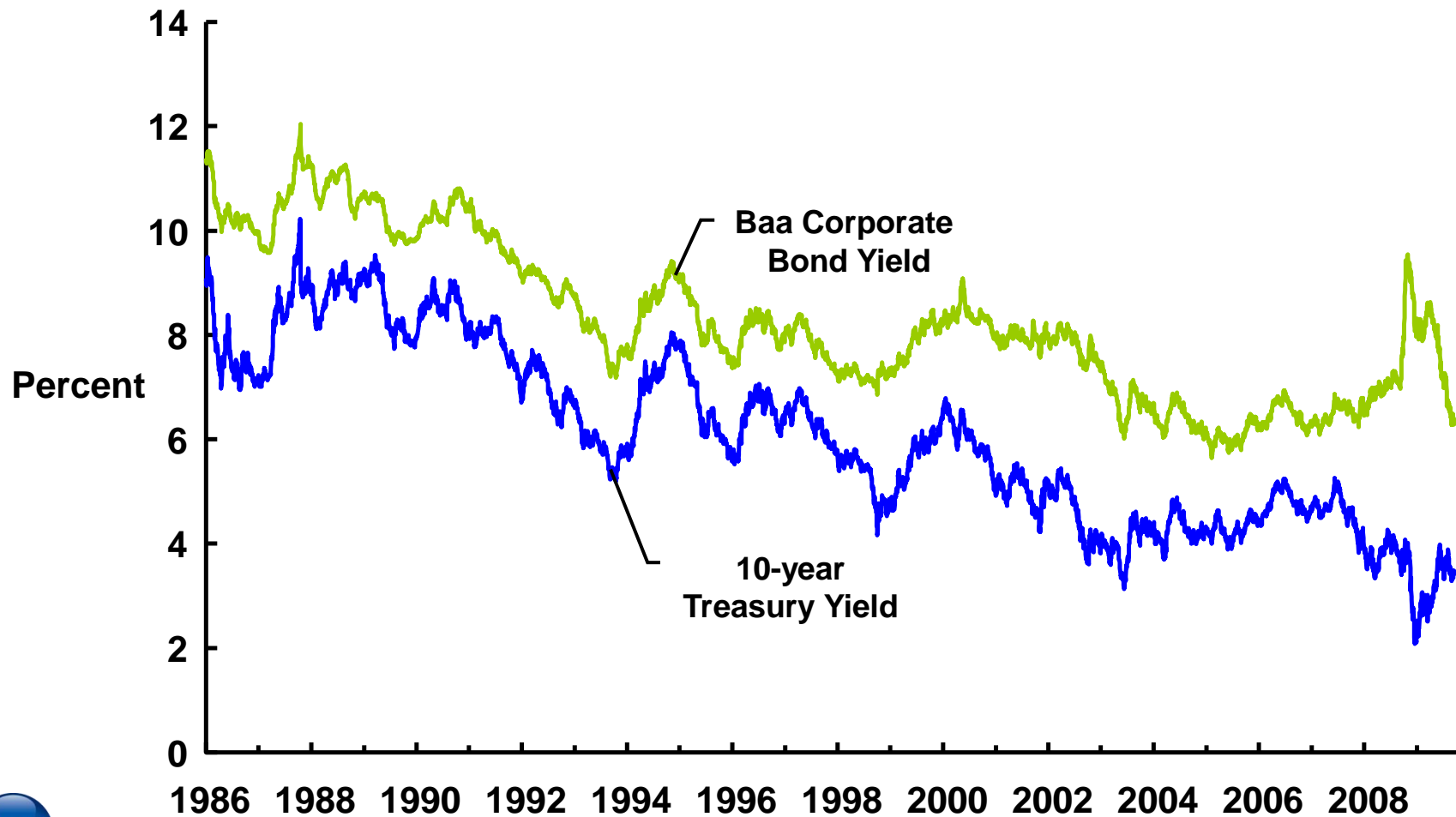
Source: IHS Cambridge Energy Research Associates.

Note: Increasing electric energy efficiency is having consumers use less electric energy without making them worse off relative to a reference case.

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# Historical Bond Yields (through September 21, 2009)



Source: IHS Cambridge Energy Research Associates.

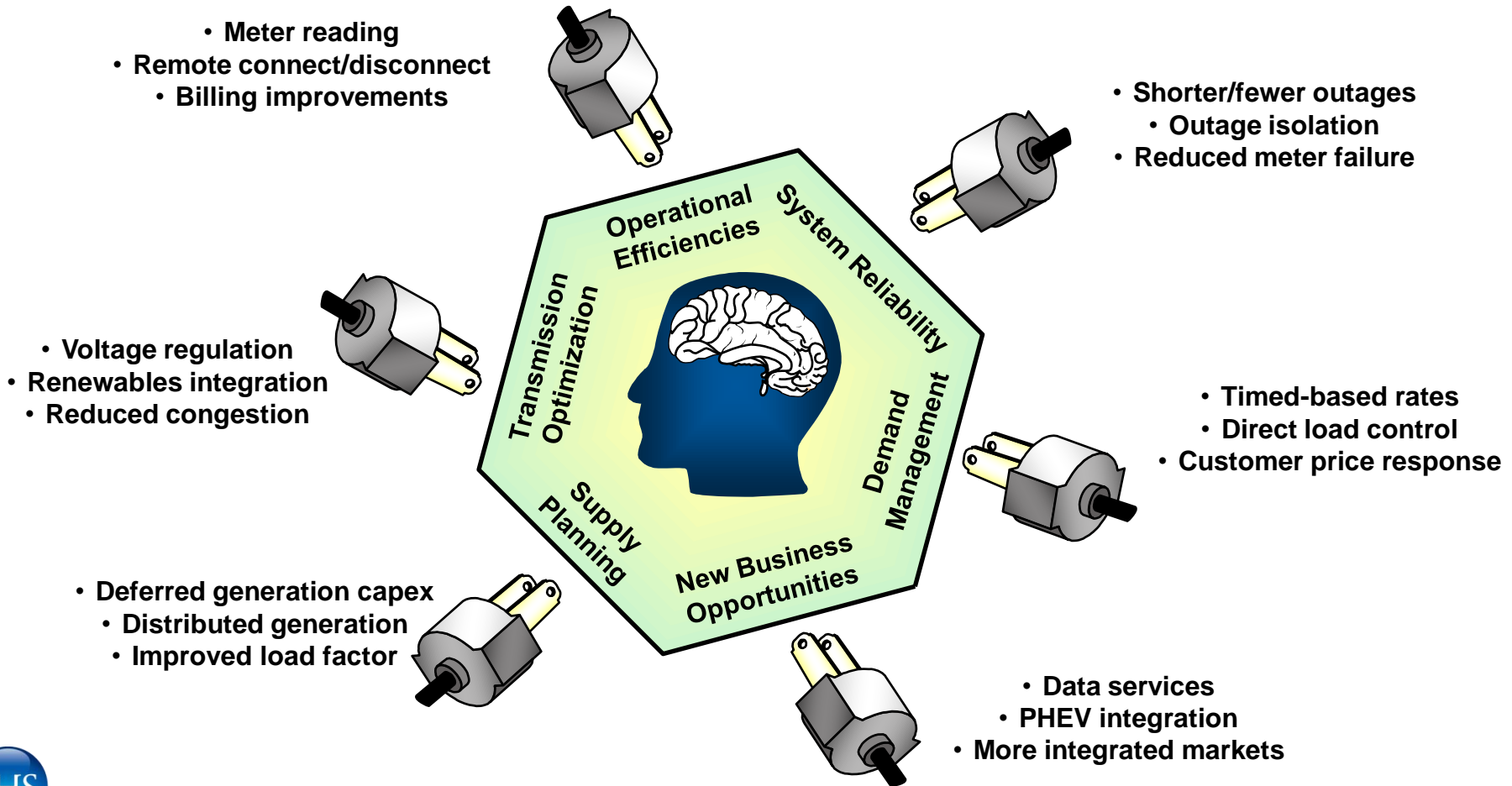
Data sources: Board of Governors of the Federal Reserve System, and Moody's Investor Services.

U/O 81010-4 / Interest Rate Figures\_Sept2009

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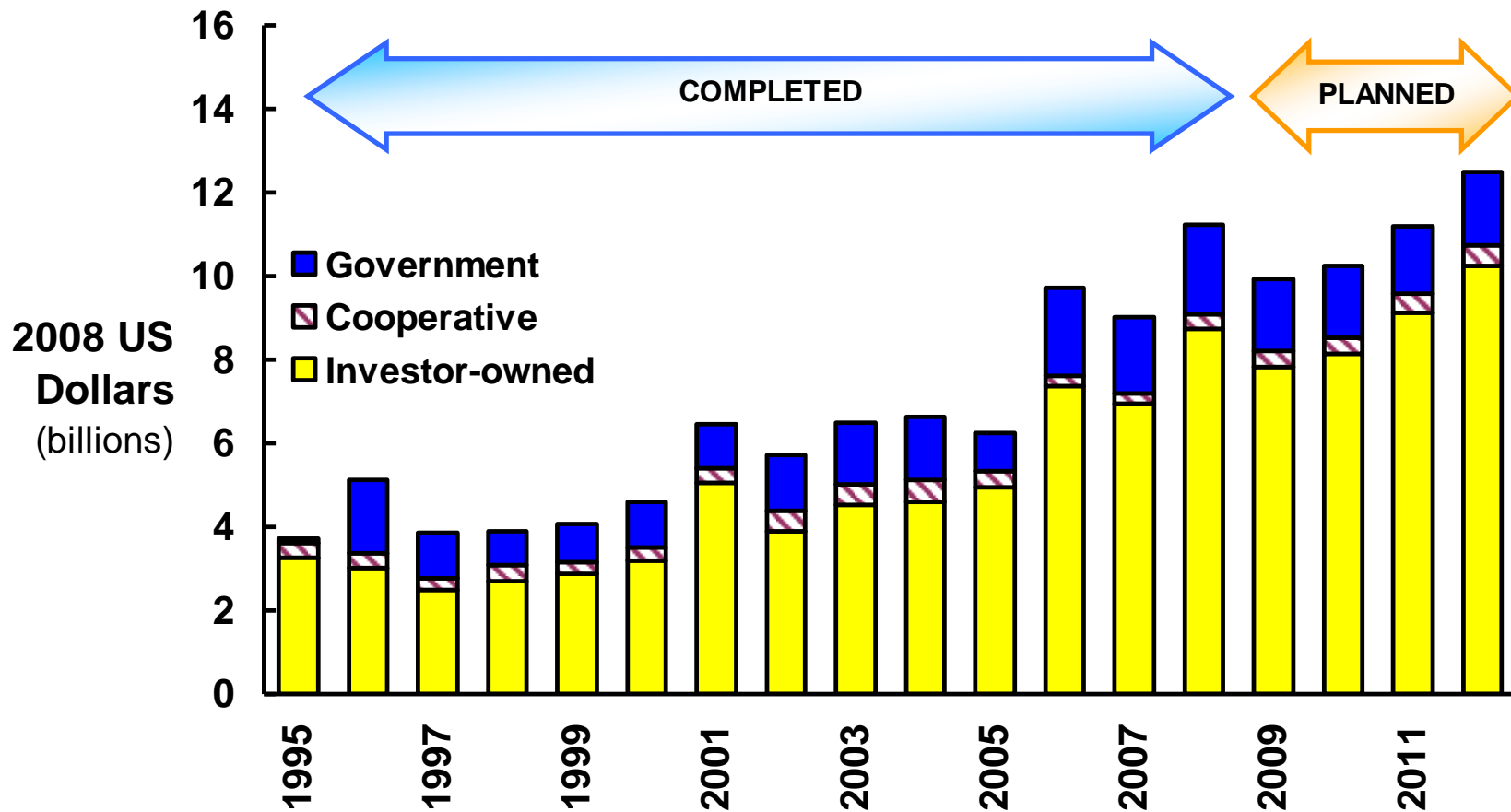
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# Plugging into a Smarter Grid



Source: Cambridge Energy Research Associates.  
80913-4

# US Completed and Planned Transmission Investment, 1995–2012



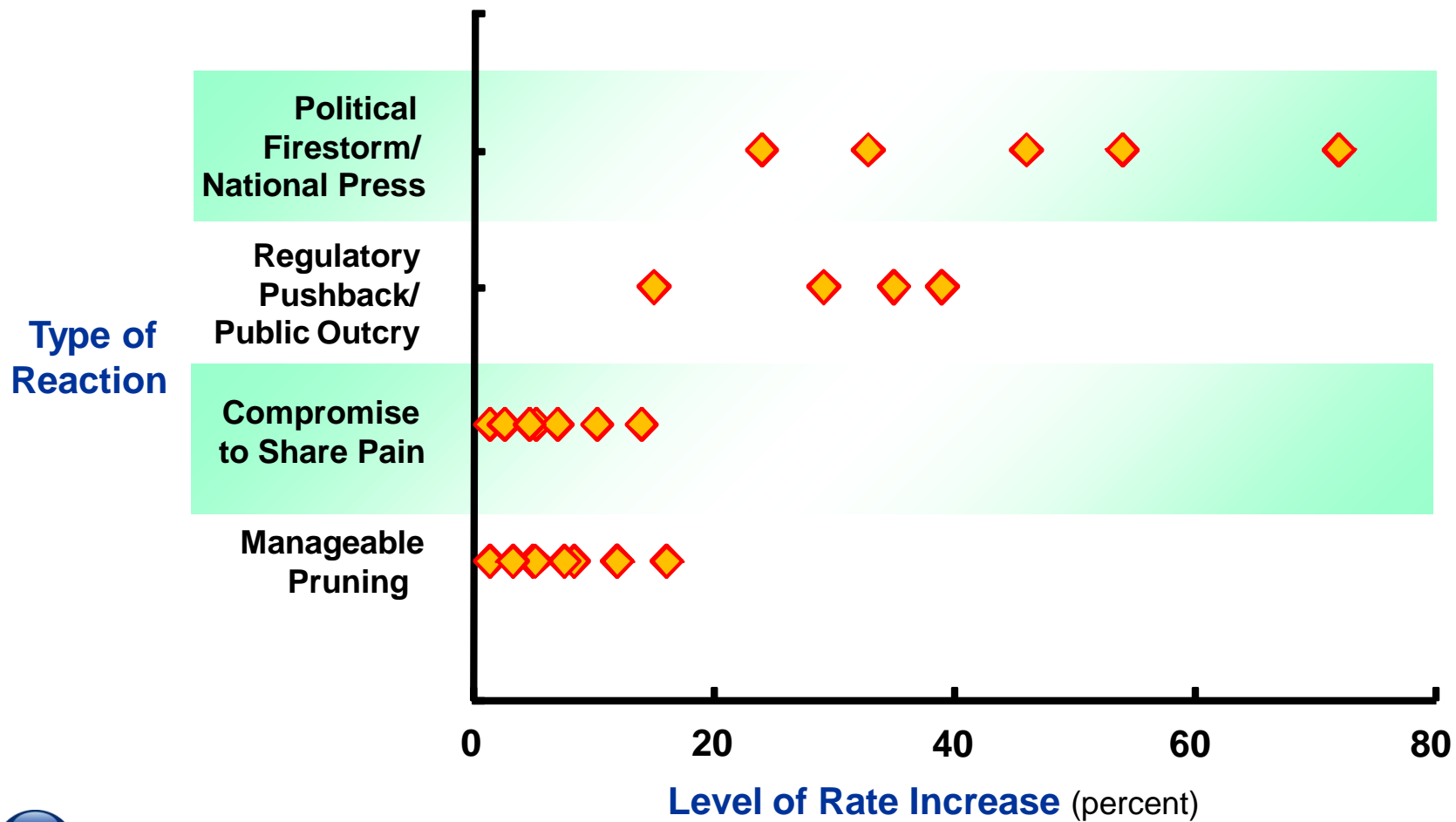
Source: IHS Cambridge Energy Research Associates, Edison Electric Institute, EV Power®, Ventyx, Inc.

Notes: Planned investment for government and cooperative utilities was not available. The planned investment for these sectors are CERA estimates. Data for 2009–12 are preliminary.

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# Reaction to IOU Rate Increases

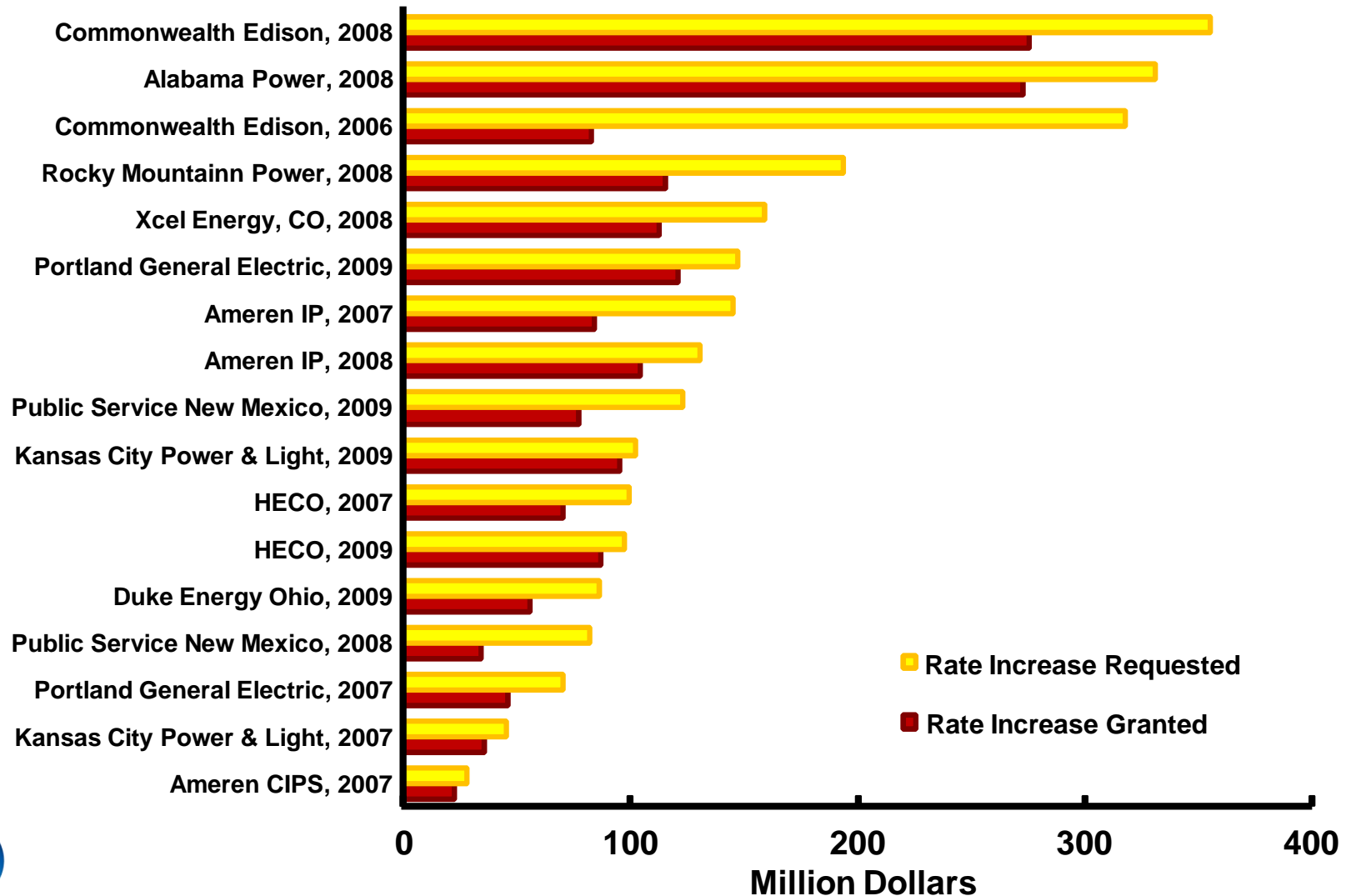


Source: IHS Cambridge Energy Research Associates.  
 Note: Sampling of IOU rate cases from 2001 to 2009.  
 GPF Rate Case

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# IOU Revenue Increases: Requested versus Granted—A Sampling of Recent Rate Cases



Source: IHS Cambridge Energy Research Associates.  
GPF Rate Case

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