

# Energy Concerns - Missouri

Presentation to Rolla City Council

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Missouri Public Service Commission

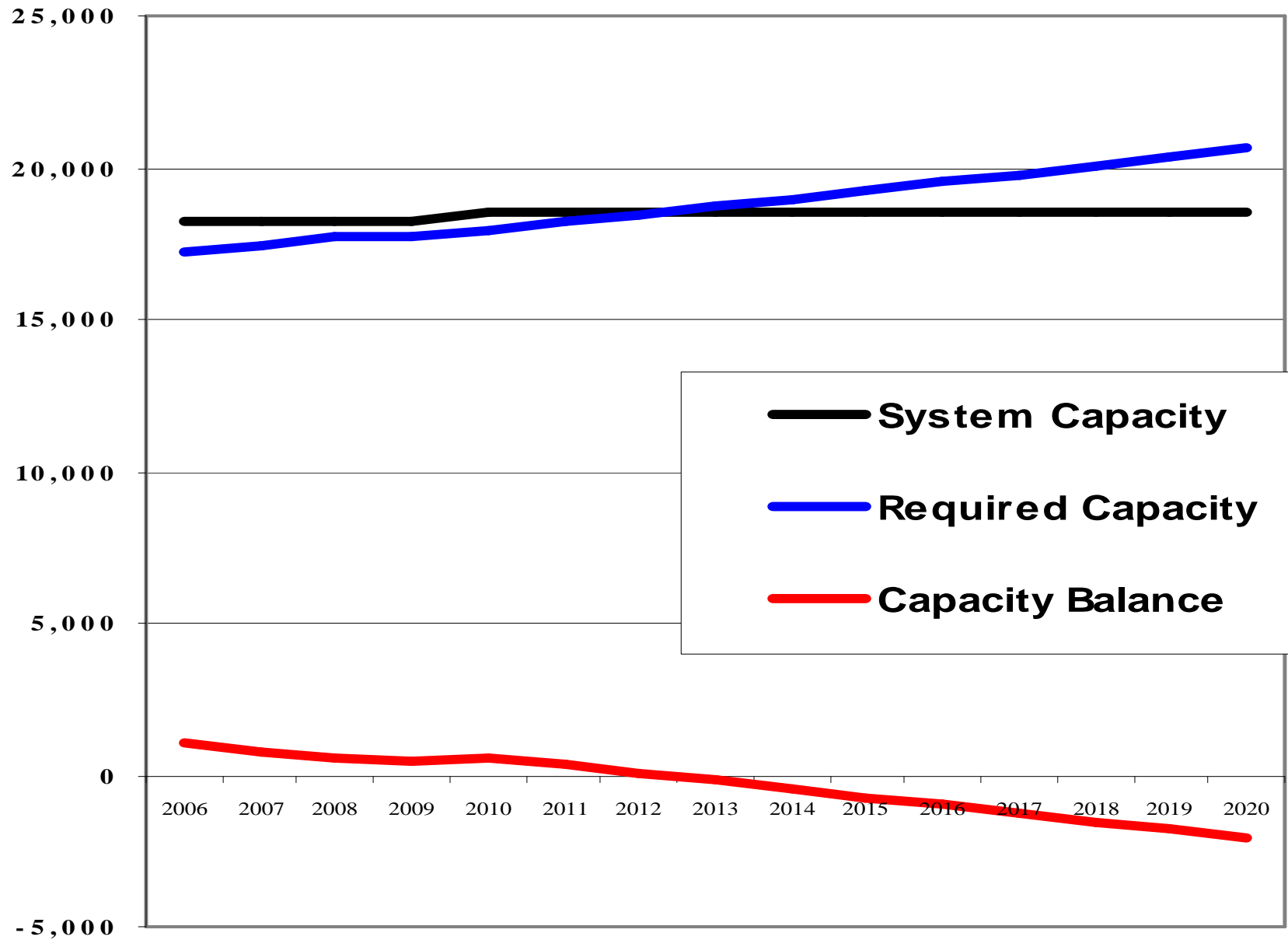
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# Energy Concerns - Missouri

- Electricity Demand Growth
- Changes in Wholesale Markets
- Environmental Compliance Costs & CO2 Legislation
- Renewable Portfolio Standards (RPS) - National & State Policies, Implementation & Costs

# Electricity Demand Growth

# Missouri IOU Capacity Needs 2006 to 2020



**System Capacity**

**Required Capacity**

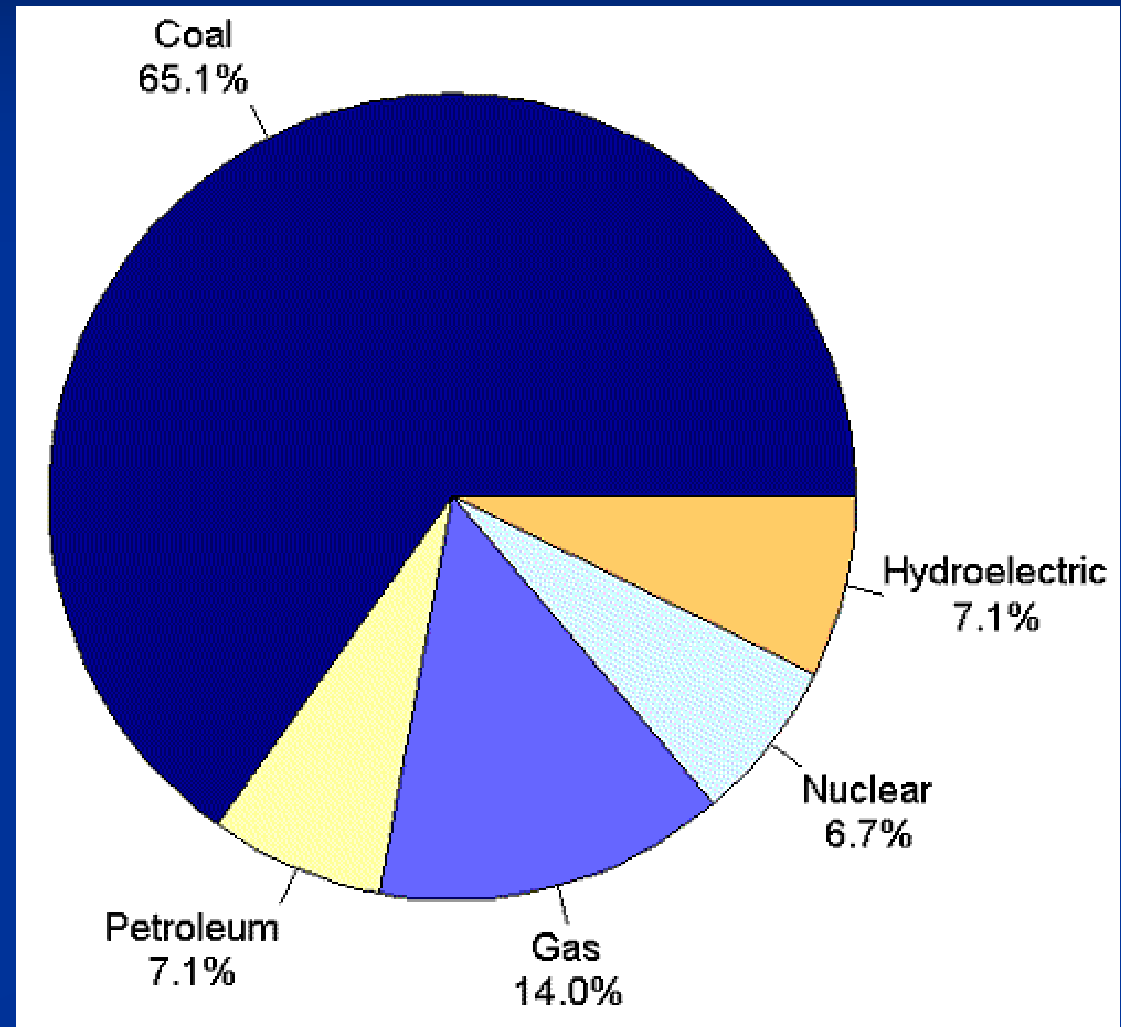
**Capacity Balance**

# Missouri's Baseload Generation

- Missouri's fleet of coal-fired baseload power plants has contributed to the highly reliable power supply we have in Missouri and our lower than average electric rates.
- The baseload power plants we receive service from were largely built in the 1970s and early 1980s.

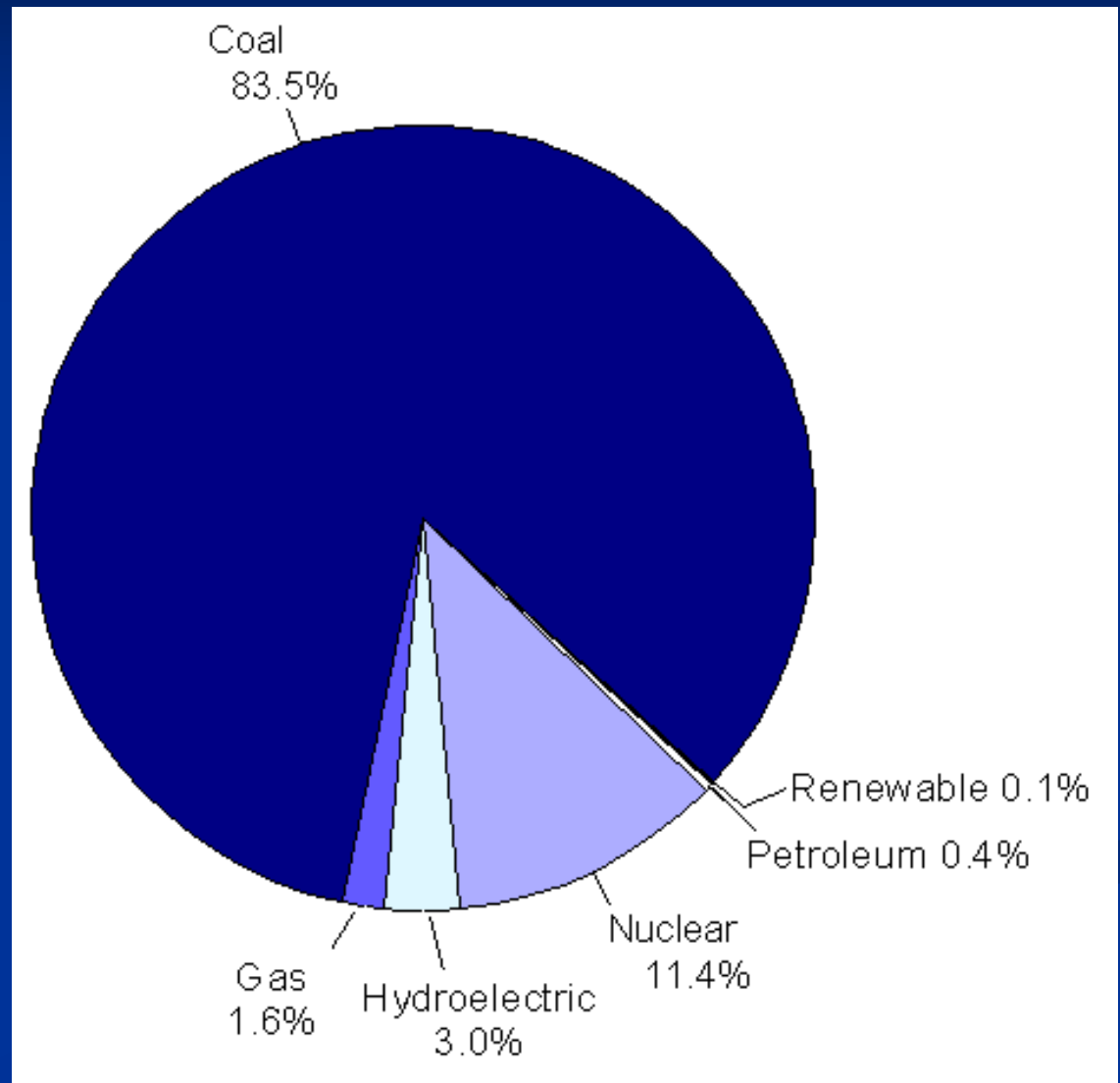
# Missouri Generating Capability (MW) By Primary Energy Source

- Shows sources for plants in Missouri in 2001
- Coal – almost 2/3
- Gas – 14%
- Other sources: oil, nuclear, and hydro.

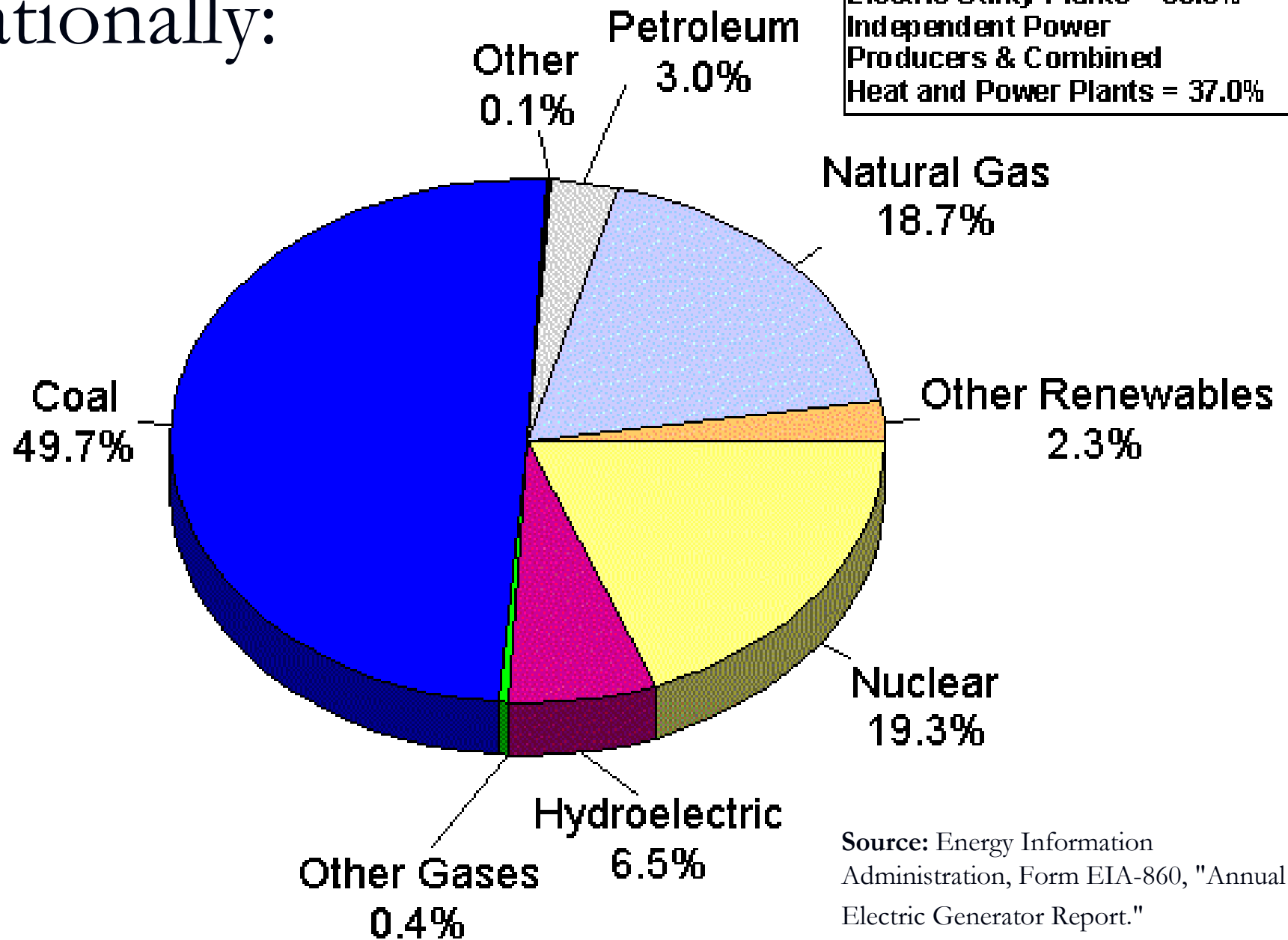


# Missouri Generation (MWh) By Energy Source

- MO plants only
- Proportion of energy generated by coal (83.5%) exceeds coal capacity (65.1%) because coal plants have lower variable cost (except for nuclear) so are dispatched first.

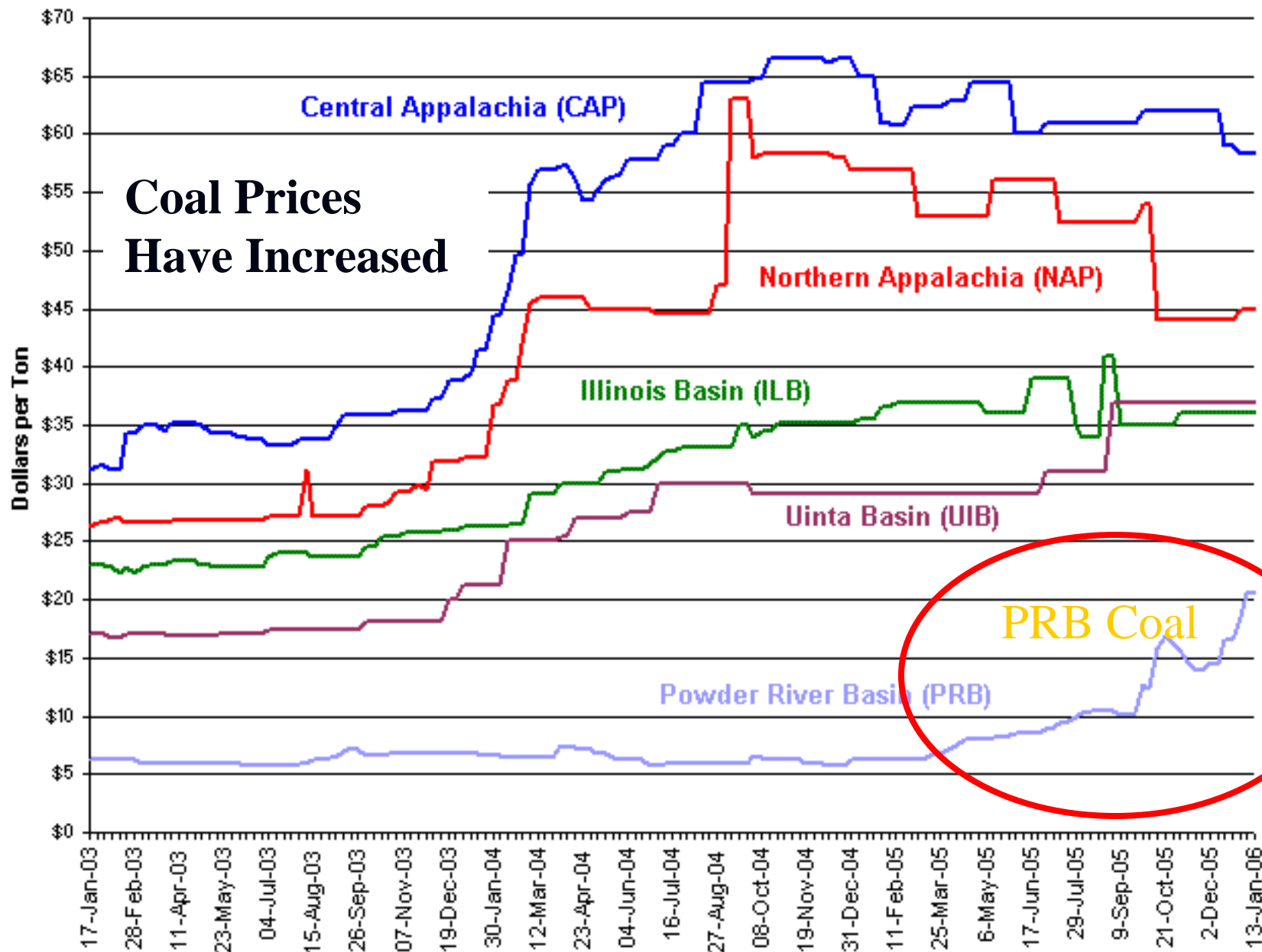


Nationally:



Source: Energy Information Administration, Form EIA-860, "Annual Electric Generator Report."

# Coal Prices Have Increased

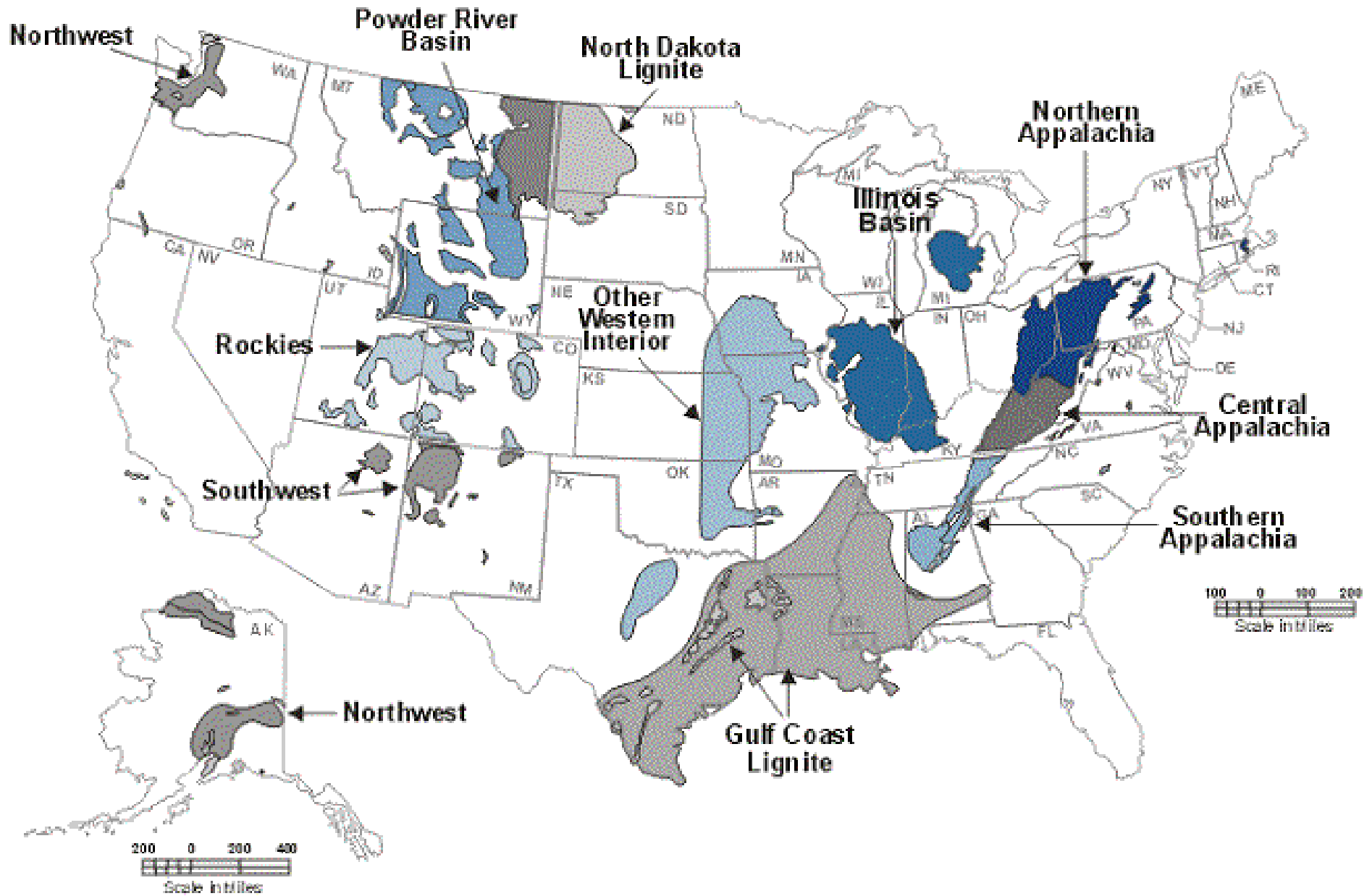


## Key to Coal Commodities by Region<sup>1</sup>

Central Appalachia: Big Sandy/Kanawha 12,500 Btu, 1.2 lb SO<sub>2</sub>/mmBtu  
Northern Appalachia: Pittsburgh Seam 13,000 Btu, <3.0 lb SO<sub>2</sub>/mmBtu  
Illinois Basin: 11,800 Btu, 5.0 lb SO<sub>2</sub>/mmBtu

Powder River Basin: 8,800 Btu, 0.8 lb SO<sub>2</sub>/mmBtu  
Uinta Basin in Colo.: 11,700 Btu, 0.8 lb SO<sub>2</sub>/mmBtu

# US Coal Supplies



# Electricity: Usage Outlook

- By 2020, the Missouri PSC staff projects that the state will need more than 2,100 MW of additional generation resources and/or purchased power contracts.
- Retirement of old plants may add to the need for new plants.
- Assuming 1.4% growth on a baseload of 18,000 MW, you'll have to add a nuclear plant the size of Callaway every five years to meet new demand.
- Conclusion: More generation/conservation!

# Building New Power Plants: The Options are Limited

- There are very limited additional hydroelectric power sites available and permitting would be nearly impossible.
- Wind power can be fairly cheap once the upfront costs are depreciated out and tax credits (if any) are considered; however, capacity from these sources is not always available when you need it and transmission from good wind sites can be a problem.

# Building New Power Plants: The Options are Limited

- Natural gas fired plants are relatively cheap to build and have fewer environmental problems, but a volatile fuel market makes them expensive to operate:
  - Construction costs average about \$500/kW.
  - Expect natural gas to stay in the \$7 to \$9 per MMBtu range, but several uncertainties could impact this price significantly and cause it to go much higher.

# Building New Power Plants: The Options are Limited

- If you're going to operate a power plant most of the time and you depreciate construction costs over 30+ years, coal-fired electricity may be cheaper than gas-fired electricity or purchased electricity. Carbon legislation may impact this assumption.
  - Construction costs estimated to be over \$1,900/kW (depending on size of unit and assuming few problems with site or permits).
  - Coal costs less than \$20/ton delivered (PRB), over \$1/MMBtu

# Building New Power Plants: The Options are Limited

- Nuclear power:
  - Large upfront construction cost estimated at \$1,700-\$3,000/kW (including a number of uncertainties and assumes few problems with site location or environmental permits).
  - Is the public ready?

# Increasing Supply to Meet Demand:

Our agency recently approved an agreement permitting construction of an 800+ MW coal-fired power plant and 100 MW of wind generation.



New Unit Is  
Being Built Here

Iatan Power Plant

# Increasing Supply to Meet Demand:

Missouri's Electric Cooperatives have announced plans to build a 600+ MW coal plant.



New Plant Similar  
to Thomas Hill Plant

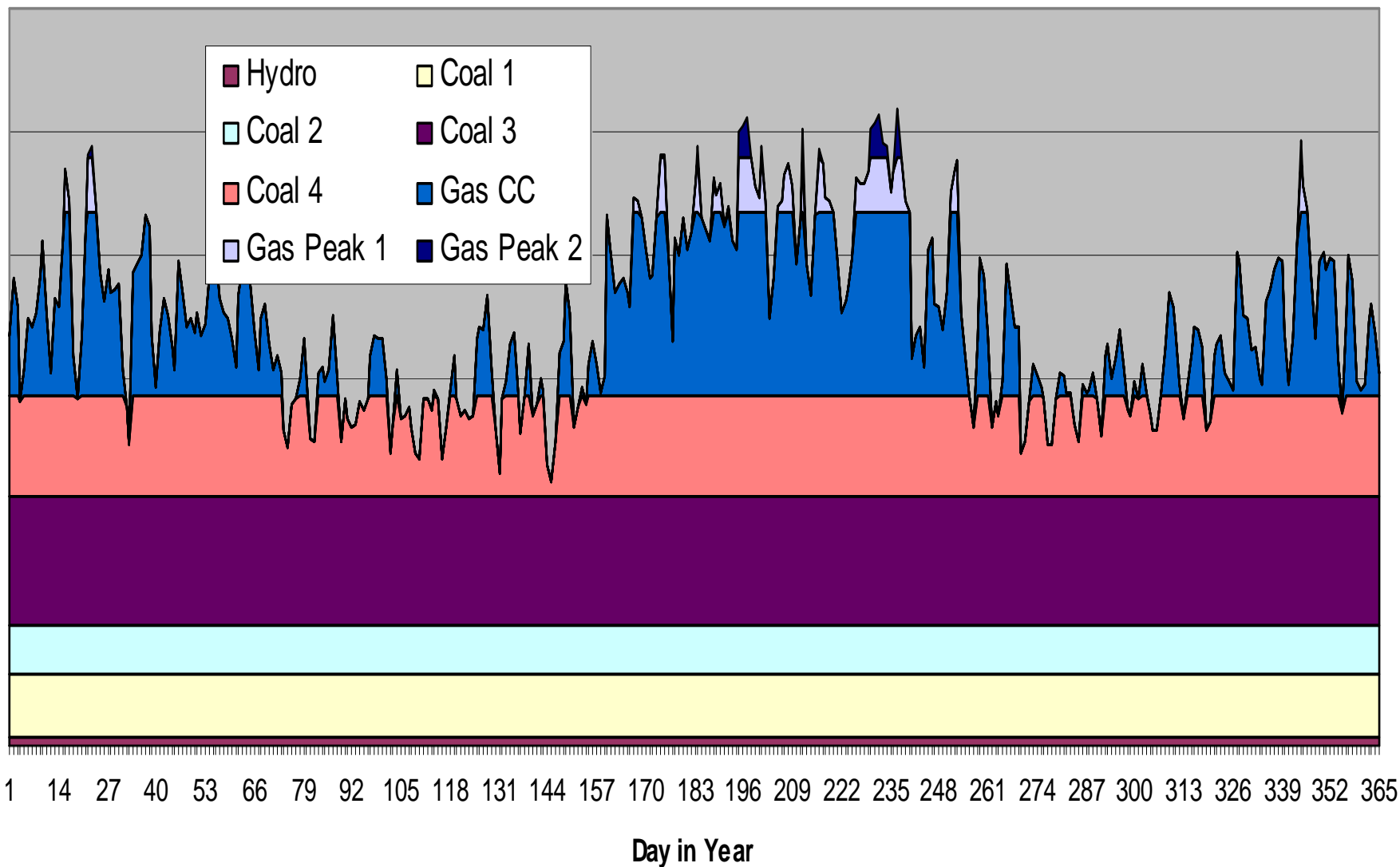
# Increasing Supply to Meet Demand:

City Utilities of Springfield has determined that a coal-fired plant would be an appropriate addition to their generation portfolio.

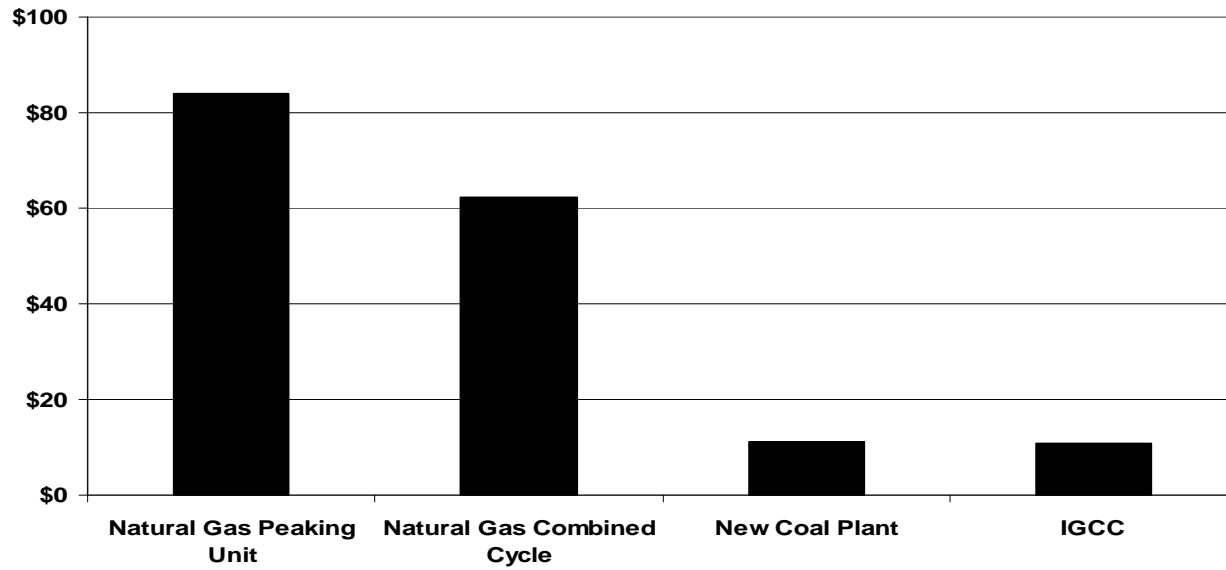


# Changes in Wholesale Markets

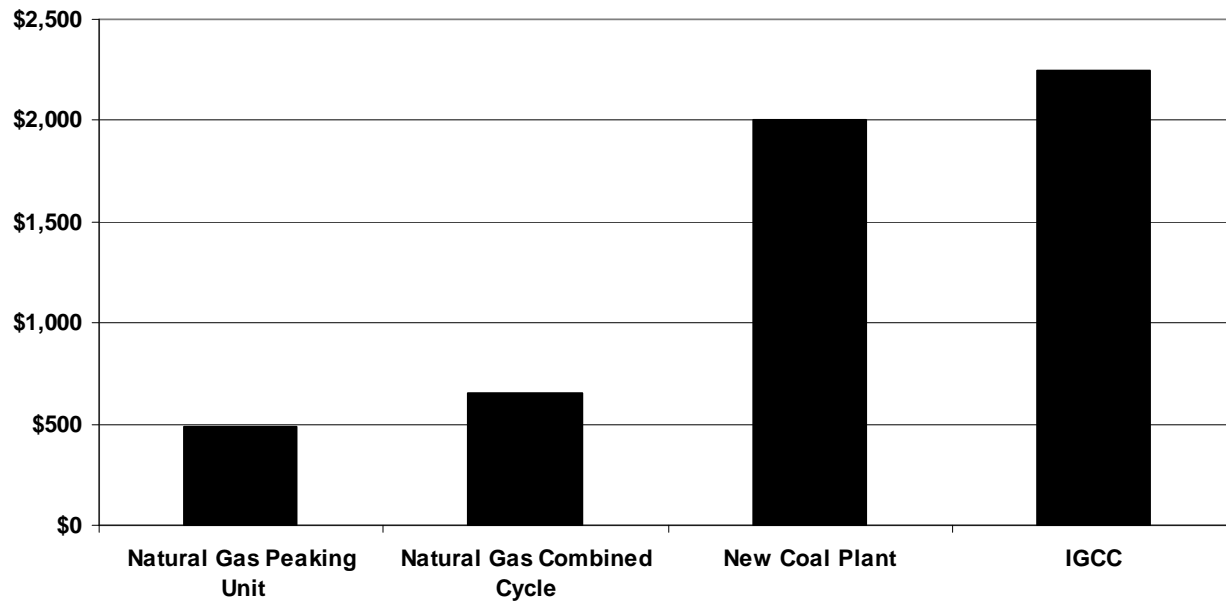
# Total System Load vs Unit Dispatch



### Energy Cost per MWh



### Capital Cost per kW



# Changes in Wholesale Market

- Trend Toward Fewer Investor Owned Utility (IOU) Electric Sales to Municipal Electric Utilities
- Available Contracts Are for Higher Rates and/or Shorter Terms
- Rates in Contracts Typically Include Escalation Clauses or Point to a Market Index

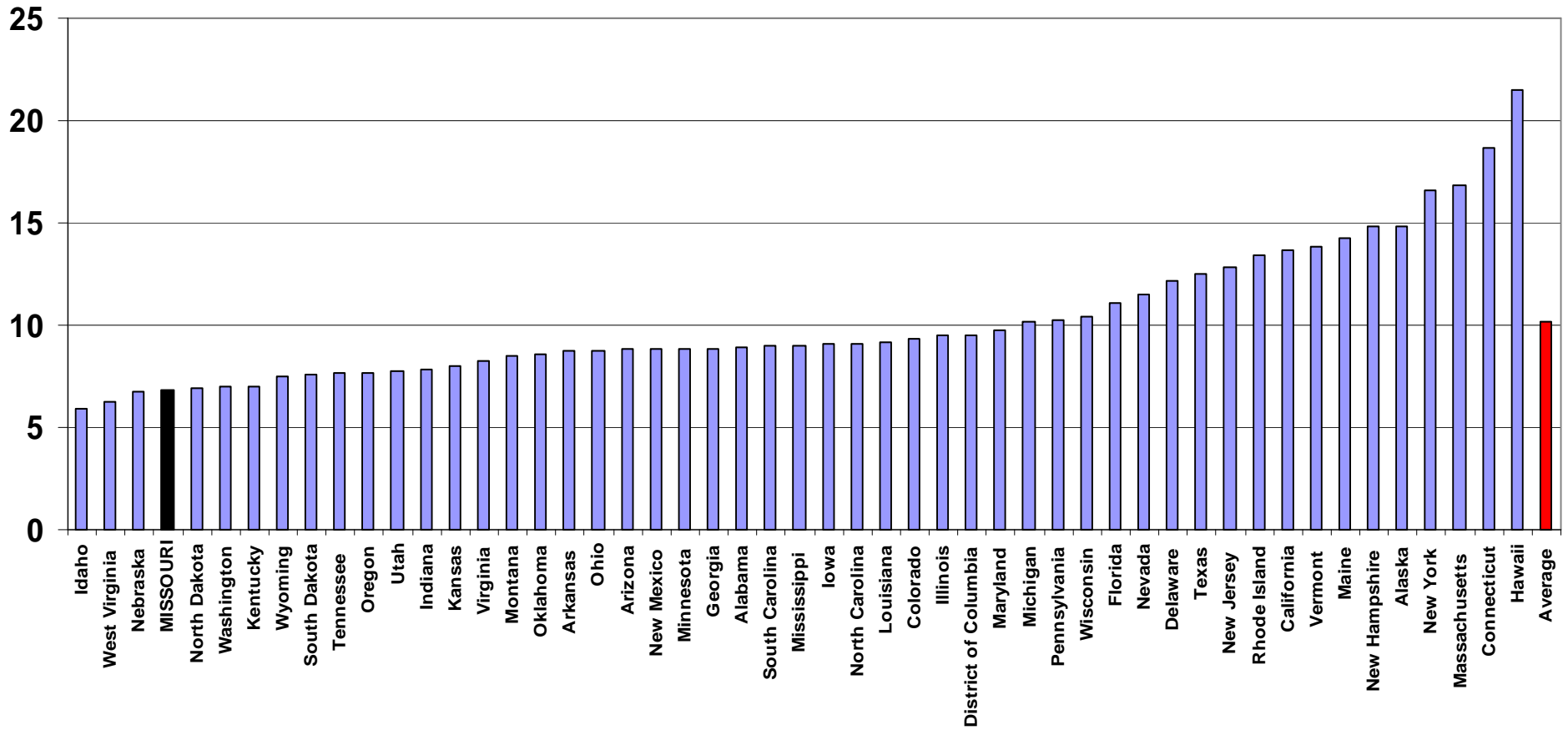
# Changes in Wholesale Market

- Capacity Margins Have Declined Recently in Many Regions
- As Capacity Margins Decline More Energy is Priced at Natural Gas Peaking Unit Variable Cost and Demand Premiums Increase
- Utilities With Available Capacity from Low-Cost Units Can Bring in Significant Revenues from Off-System Sales
- Utilities With Limited Low-Cost Power Options and/or Dependent on the Market Are Paying More

# Changes in Wholesale Market

- It is my Understanding That Municipal Pool Members in Missouri Are Receiving Energy for ~ \$0.0684 / kWh in 2007
- Each Municipal Adds its Distribution Cost to Arrive at the Delivered Energy Rate

## Residential Electric Rates in Cents / kWh (March 2007)



**Missouri is Ranked 4th in Residential Electric Rates,  
2<sup>nd</sup> in Commercial Rates, and 6<sup>th</sup> in Industrial Rates.**

## Recent Increases in Investor-Owned Electric Utility Rates

<b>PSC Regulated Electric Utility</b>	<b>Fiscal Year</b>	<b>Rate Increases Granted</b>
<b>AmerenUE</b>	<b>2006</b>	<b>\$44,000,000</b>
<b>Aquila MPS</b>	<b>2005</b>	<b>\$38,500,000</b>
<b>" "</b>	<b>2006</b>	<b>\$45,100,000</b>
<b>Aquila L&amp;P</b>	<b>2005</b>	<b>\$6,300,000</b>
<b>" "</b>	<b>2006</b>	<b>\$13,600,000</b>
<b>Empire District Electric</b>	<b>2005</b>	<b>\$25,700,000</b>
<b>" "</b>	<b>2006</b>	<b>\$20,000,000</b>
<b>Kansas City Power &amp; Light</b>	<b>2006</b>	<b>\$50,000,000</b>

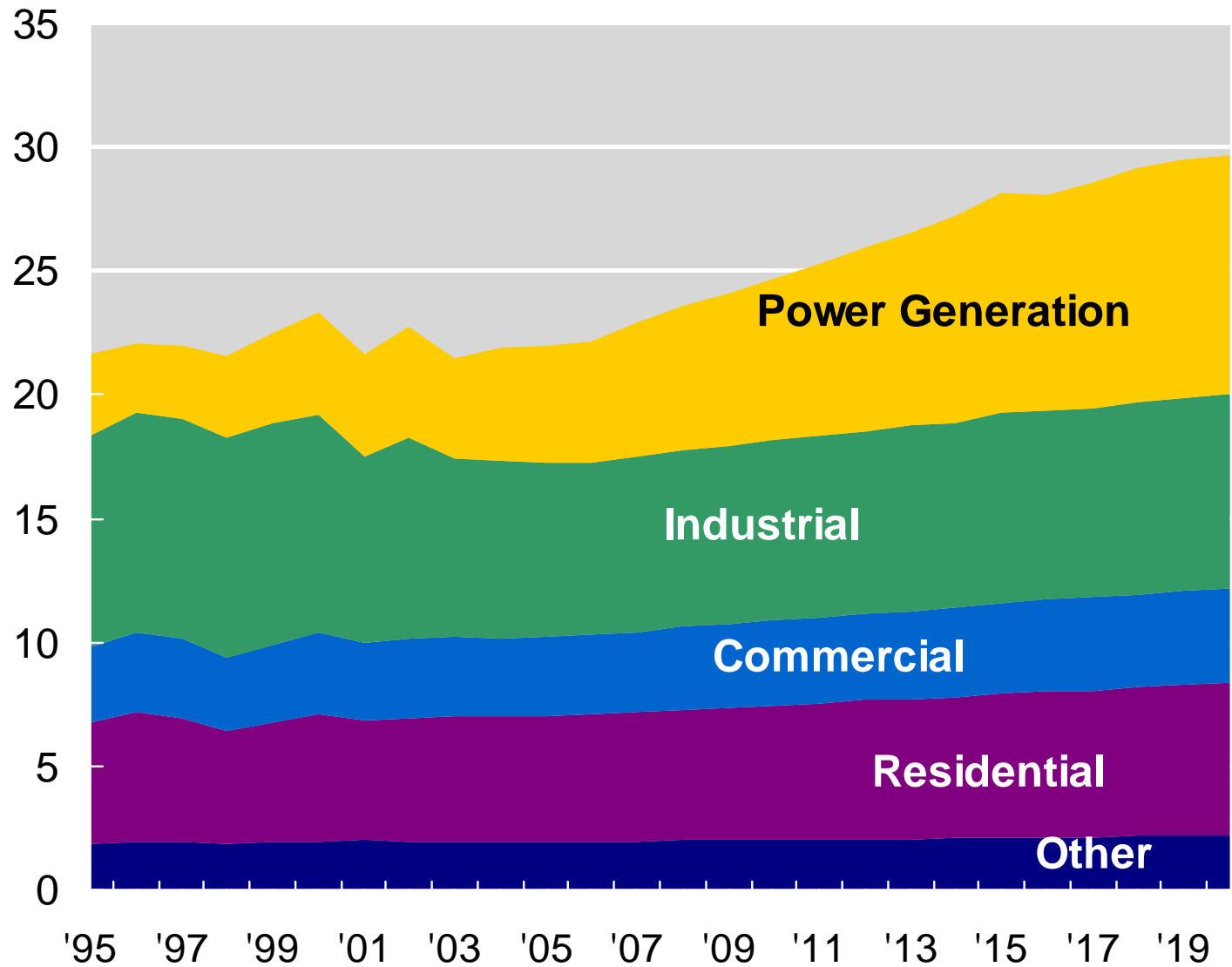
# Changes in Wholesale Market

- Any Discussion on Market Electric Rates Needs to Include Data on Natural Gas Price Trends and Forecasted Demand Increases
- Natural Gas Prices Have Increased Significantly and Influence Electricity Prices
- If Natural Gas Hits \$10/MMBtu That Means Energy from a Peaking Unit Would Cost  
~ \$0.10+ / kWh

# Gas Demand Outlook

## Gas Consumption

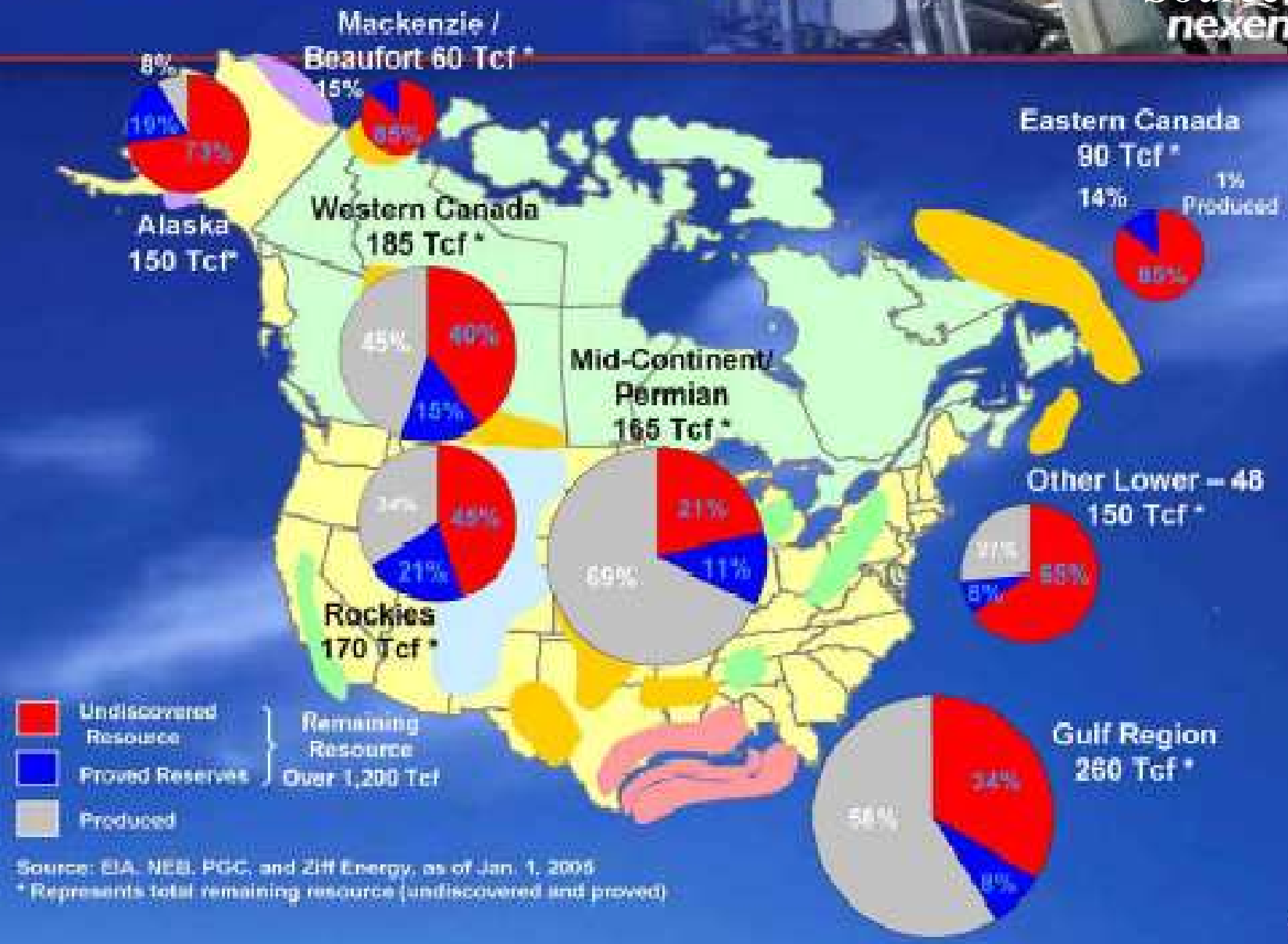
(Trillion Cubic Feet, Tcf)



Source: Energy and Environmental Analysis (EEA)

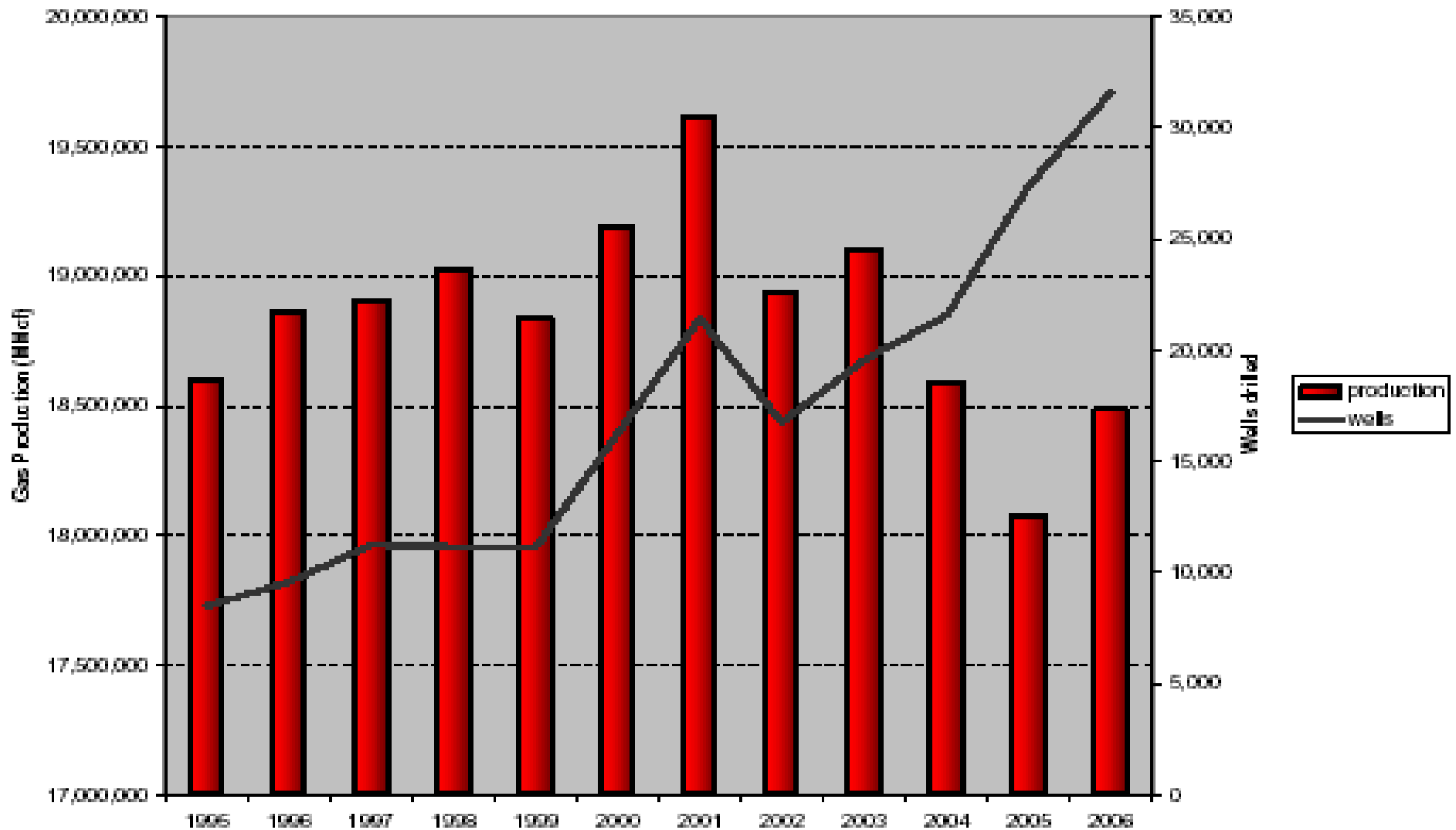
# North American Remaining Gas Resource (Tcf)

Source:  
nexen



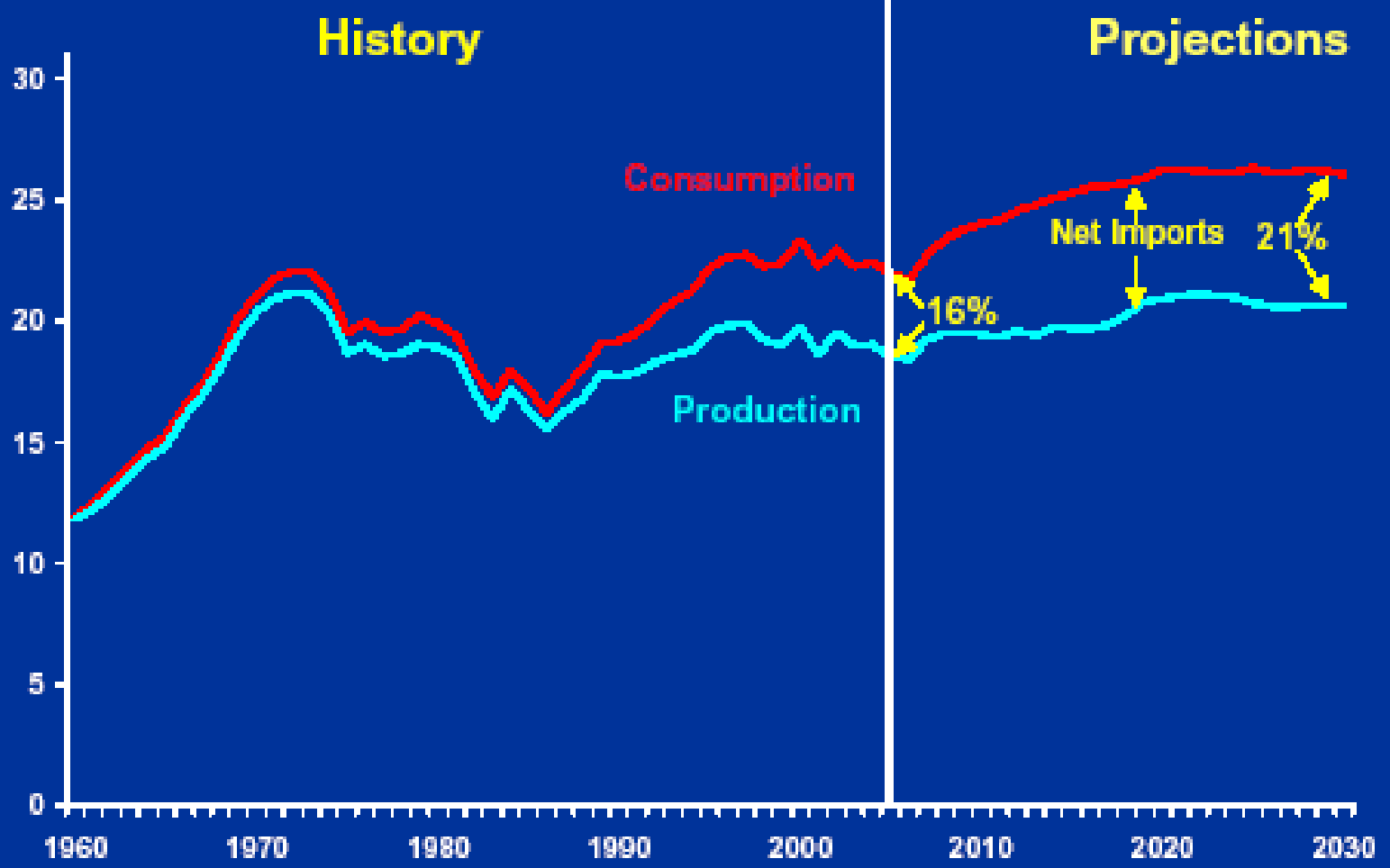
Source: EIA, NEB, PGC, and Ziff Energy, as of Jan. 1, 2009  
 \* Represents total remaining resource (undiscovered and proved)

# Does More Drilling = More Production?



Source: EIA / Baker Hughes

# U.S. Natural Gas Production, Consumption, and Net Imports



Source: EIA: Annual Energy Outlook 2007

# Natural Gas – Historical Market Monthly Closings @ NYMEX:

05/31/2007 C=7.935 +.072 O=7.740 H=8.230 L=7.490 Mov Avg 3 lines



\$/MMBtu

# Critical Issues at National Level

- Tight Market with Little Margin for Error
- Continue Development of LNG to Better Connect U.S. to the World Market
- Continue Development of Deepwater Gulf Production
- Continue Development of Non-Conventional Domestic Supplies (Rockies, Shale Gas, Tight Sands, Coal Bed Methane)
- Natural Gas Producing Countries – Organizing Into a Type of “OPEC”?

# Environmental Compliance Costs & CO2 Legislation

# Implementation of CAIR/CAMR

- Clean Air Interstate Rule (CAIR) was Issued by EPA on March 10, 2005
- Will Impact SO<sub>2</sub> and NO<sub>x</sub> Emissions Across 28 States and the District of Columbia
- Clean Air Mercury Rule (CAMR) Will Impact Mercury Emissions Across the Same Regions
- Implements Cap-and-Trade System

# Implementation of CAIR/CAMR

- St. Louis was designated as a “non-attainment” area by the EPA a few years ago and Kansas City will likely experience an ozone limit violation this summer.
- St. Louis does not meet new emissions standards (See Post-Dispatch 12/17/04).
- Emission permits have become increasingly more difficult to acquire.
- Many of the large power plants operating in Missouri will need significant upgrades in the next 10 years (because of CAIR & CAMR).

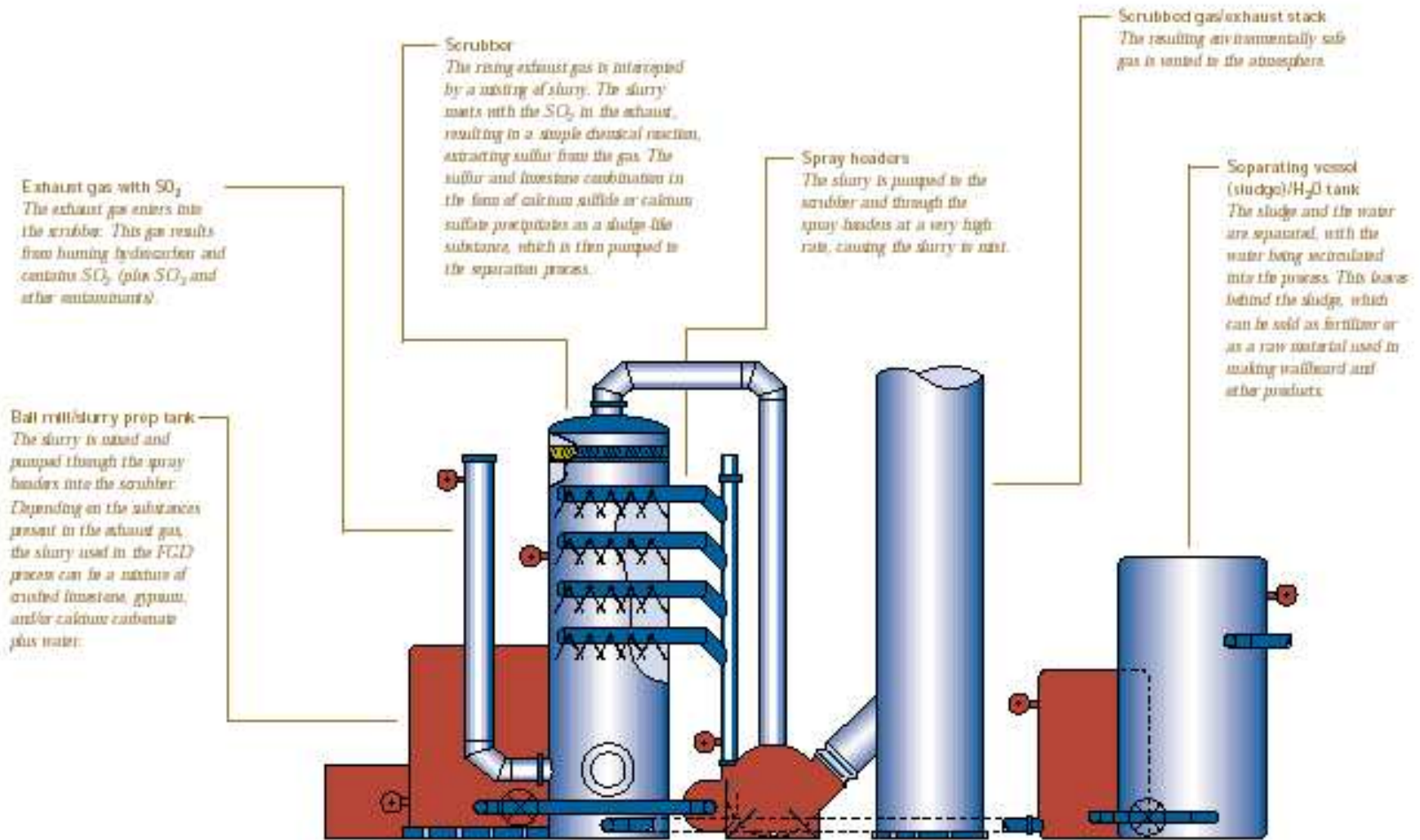
# New Emission Standards - Impacts

- These Emission Standards Will Result in Significant Reductions in Emissions of SO<sub>2</sub>, NO<sub>x</sub> and Mercury.
- The Most Heavily Impacted States Are Likely Ohio, Pennsylvania, Indiana, Georgia and Texas.
- In Ohio the Cost for Emissions Equipment Upgrades Is Anticipated to be Between \$4 Billion and \$6 Billion.

# New Emission Standards - Impacts

- In Missouri the Cost of Emissions Equipment to Comply with CAIR/CAMR is Expected to Exceed \$2 Billion.
- This Cost Does Not Include Impacts Associated With Choices to Retire Older Units vs. Upgrading Them.

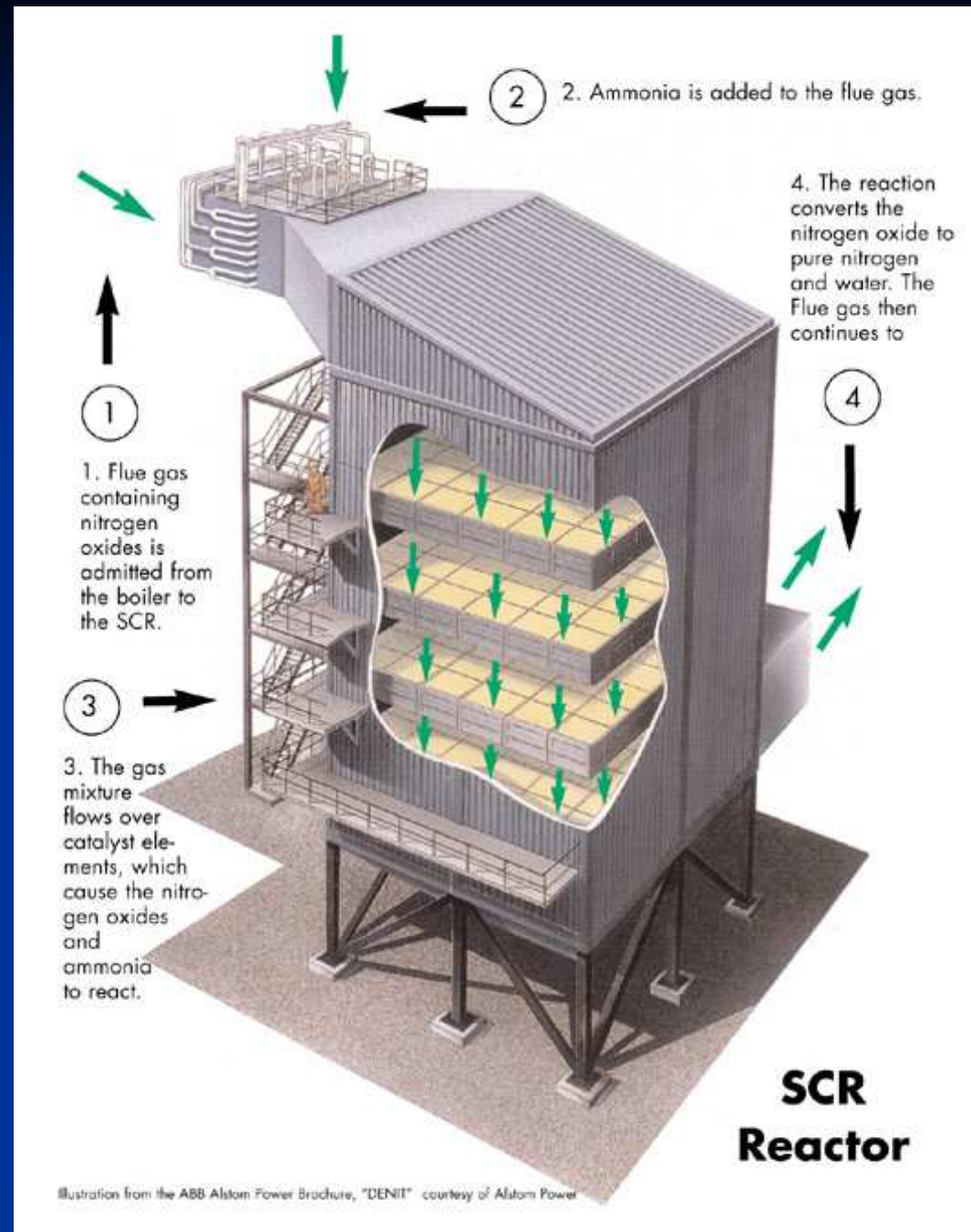
# Flue Gas Desulphurization Equipment



Source: Denali Inc.

*A typical system: Flue gas desulphurization*

# Selective Catalytic Reduction (SCR) Equipment



# Fabric Filter (Baghouse) Equipment



Source: Hamon Research-Cottrell

# Carbon Tax

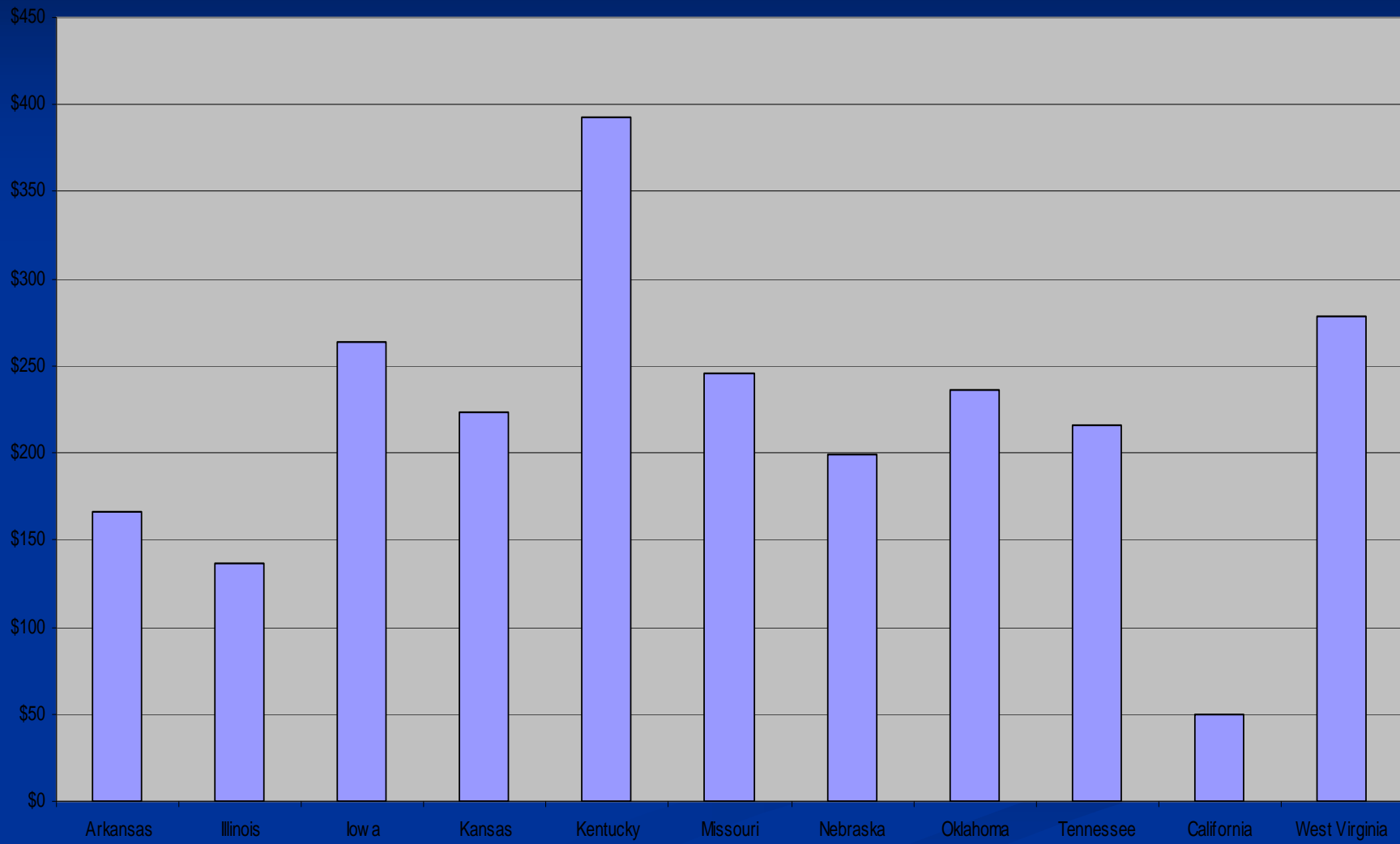
- Approximately 1 ton of CO<sub>2</sub> is produced per Megawatt-hour of coal-fired generation

For a carbon tax = \$10 per ton of CO<sub>2</sub>

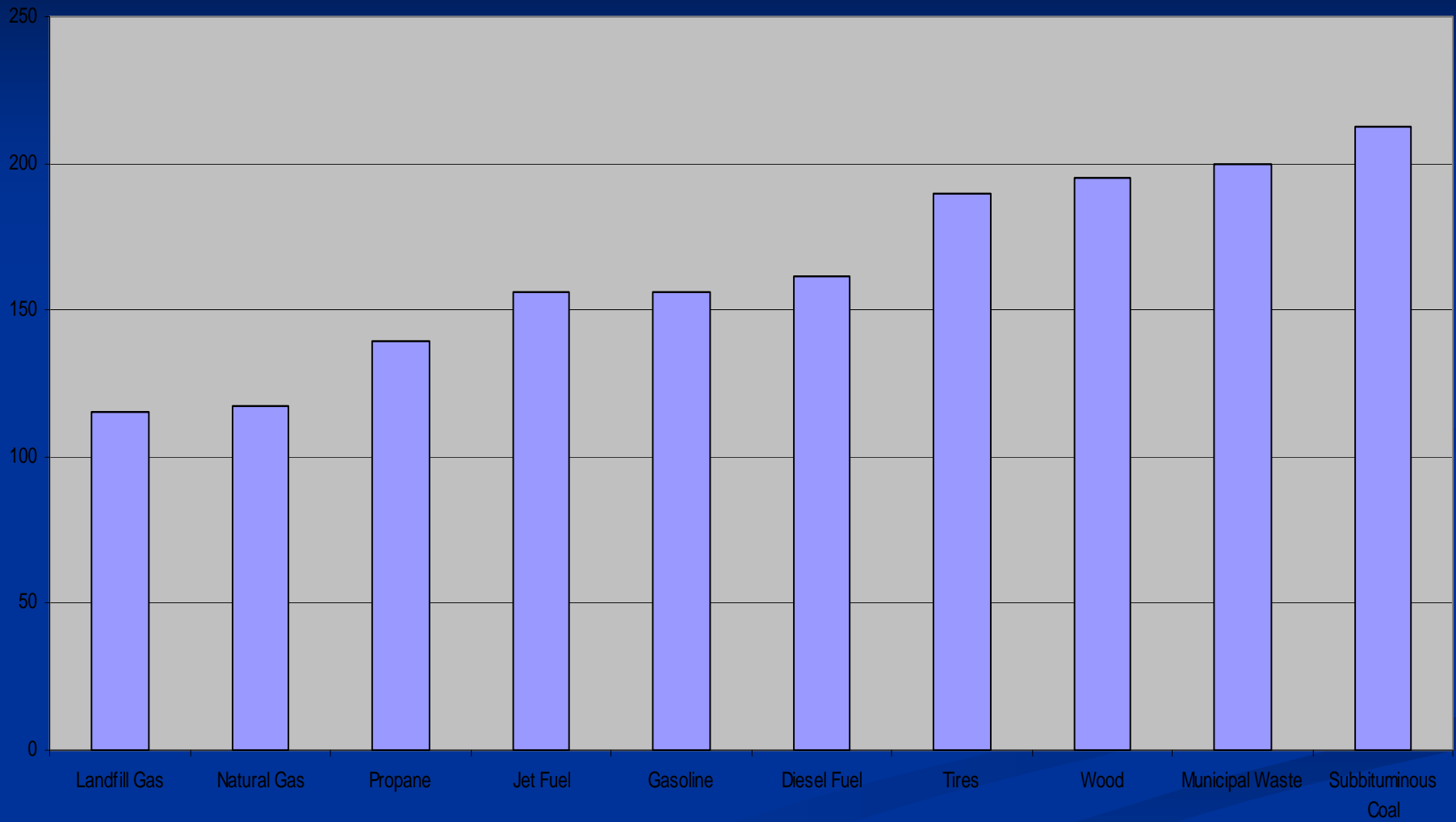
Cost per megawatt-hour will increase by \$10

This is equivalent to a \$0.01 per kilowatt-hour increase. If average retail price is currently \$0.07 per kilowatt-hour => each \$10 per ton carbon tax => 14% increase for retail electricity

## Average Annual Tax on Electrical Generation per Retail Customer for \$10/ton Carbon Tax



# Pounds of CO<sub>2</sub> per MMBtu

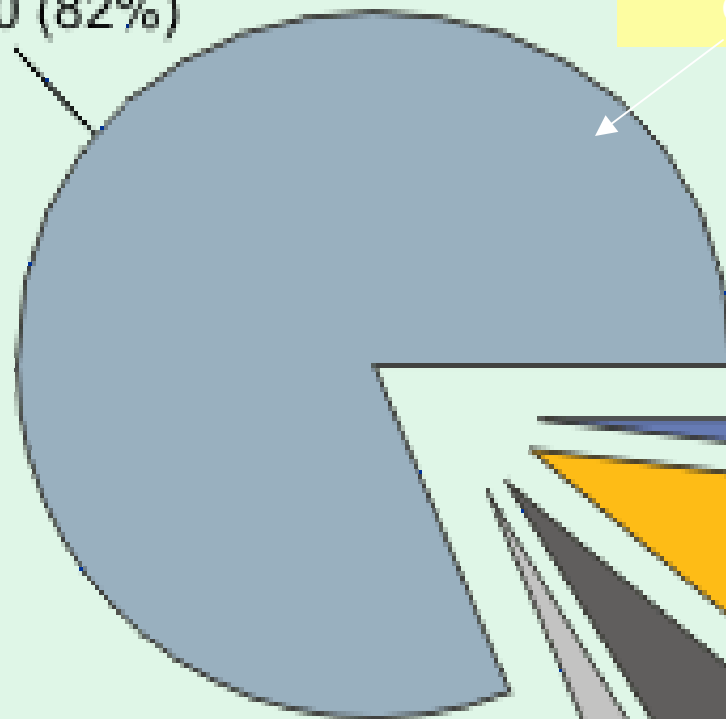


Source: Energy Information Administration

## U.S. Anthropogenic Greenhouse Gas Emissions (million metric tons of carbon equivalent)

Carbon Dioxide from  
Fossil Fuel Combustion  
1,547.0 (82%)

611 of 1,547 from electrical  
Generation (39%)



Other Carbon Dioxide  
31.7 (2%)

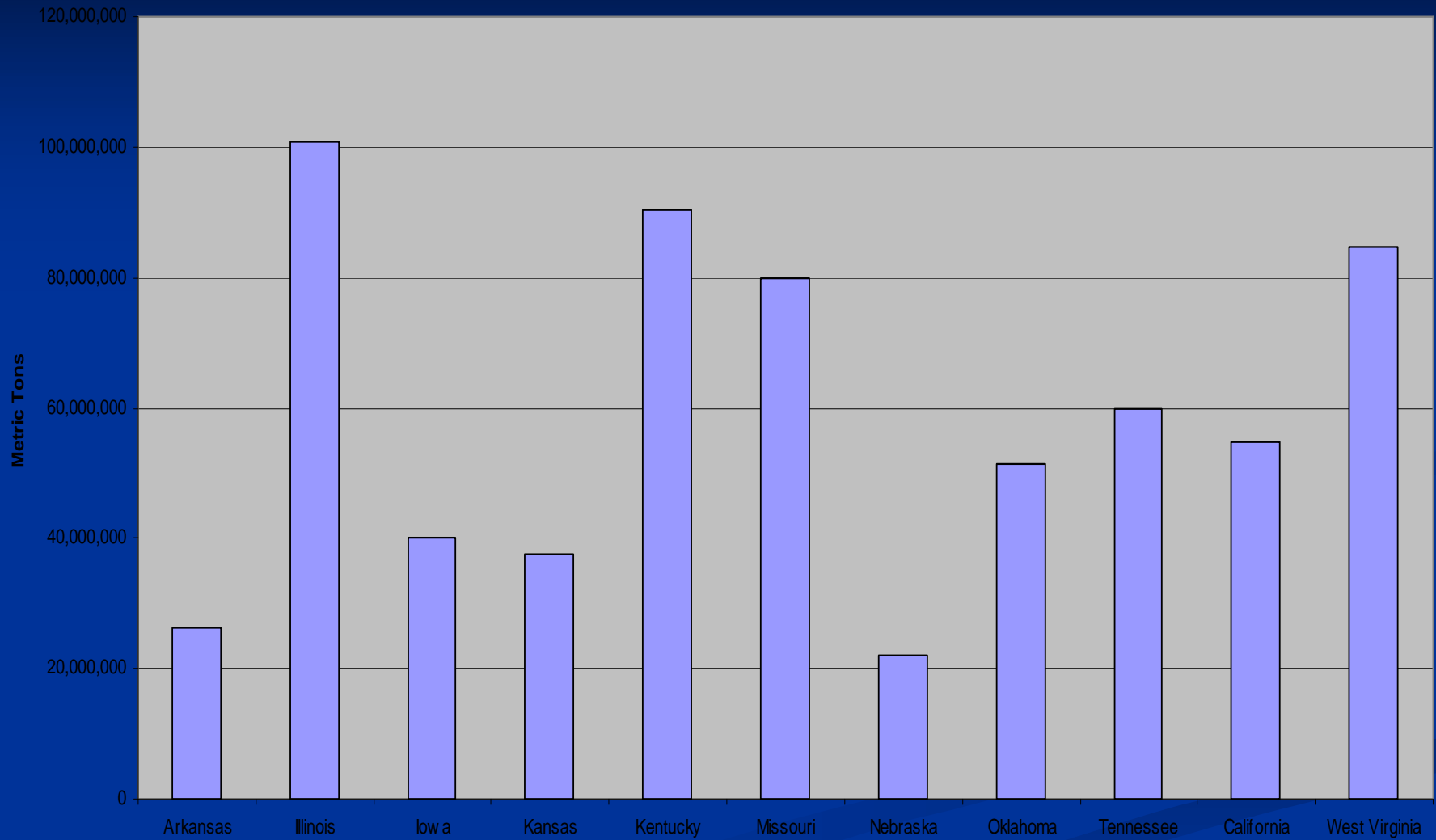
Methane  
175.8 (9%)

Nitrous Oxide  
97.5 (5%)

HFCs, PFCs, and SF<sub>6</sub>  
31.4 (2%)

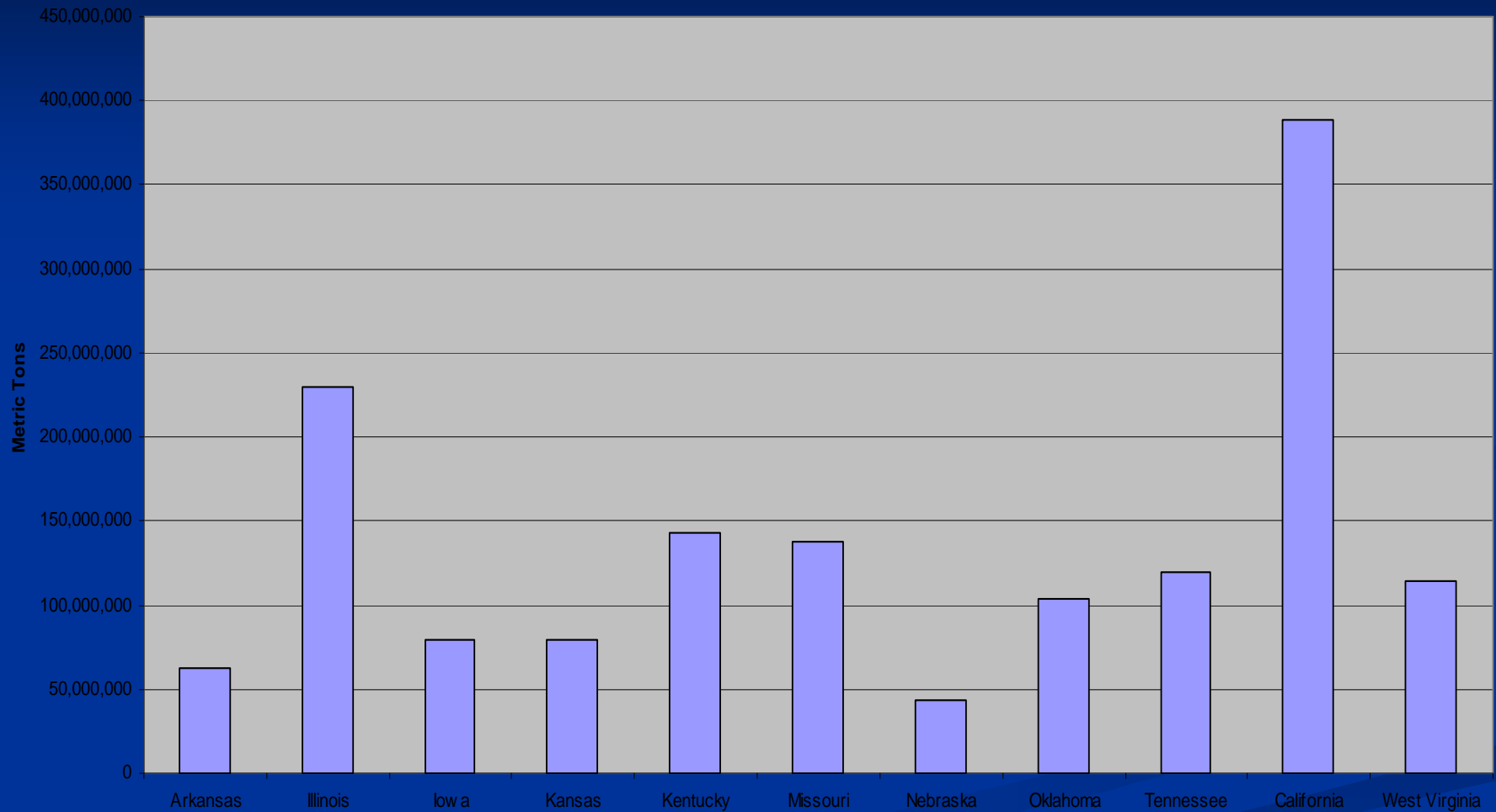
Source: Energy Information Administration, Emissions of Greenhouse Gases  
in the United States 2001 (Washington, DC, 2002)

# Electric Power Generation CO<sub>2</sub> Emissions, 2005



Source: Energy Information Administration

# Total CO<sub>2</sub> Emissions, 2003



Source: Energy Information Administration

Renewable Portfolio Standards  
(RPS) - National & State Policies,  
Implementation & Costs

# A Renewable Portfolio Standard (RPS)?

- A minimum percentage of capacity and/or energy would come from renewable energy technologies (*and conservation*).
- These energy sources are more sustainable over the long-term.
- Renewables:  
Solar, Wind, Hydroelectric and Biomass (from a broad range of renewable organic materials)

# A Renewable Portfolio Standard?

Great Idea!

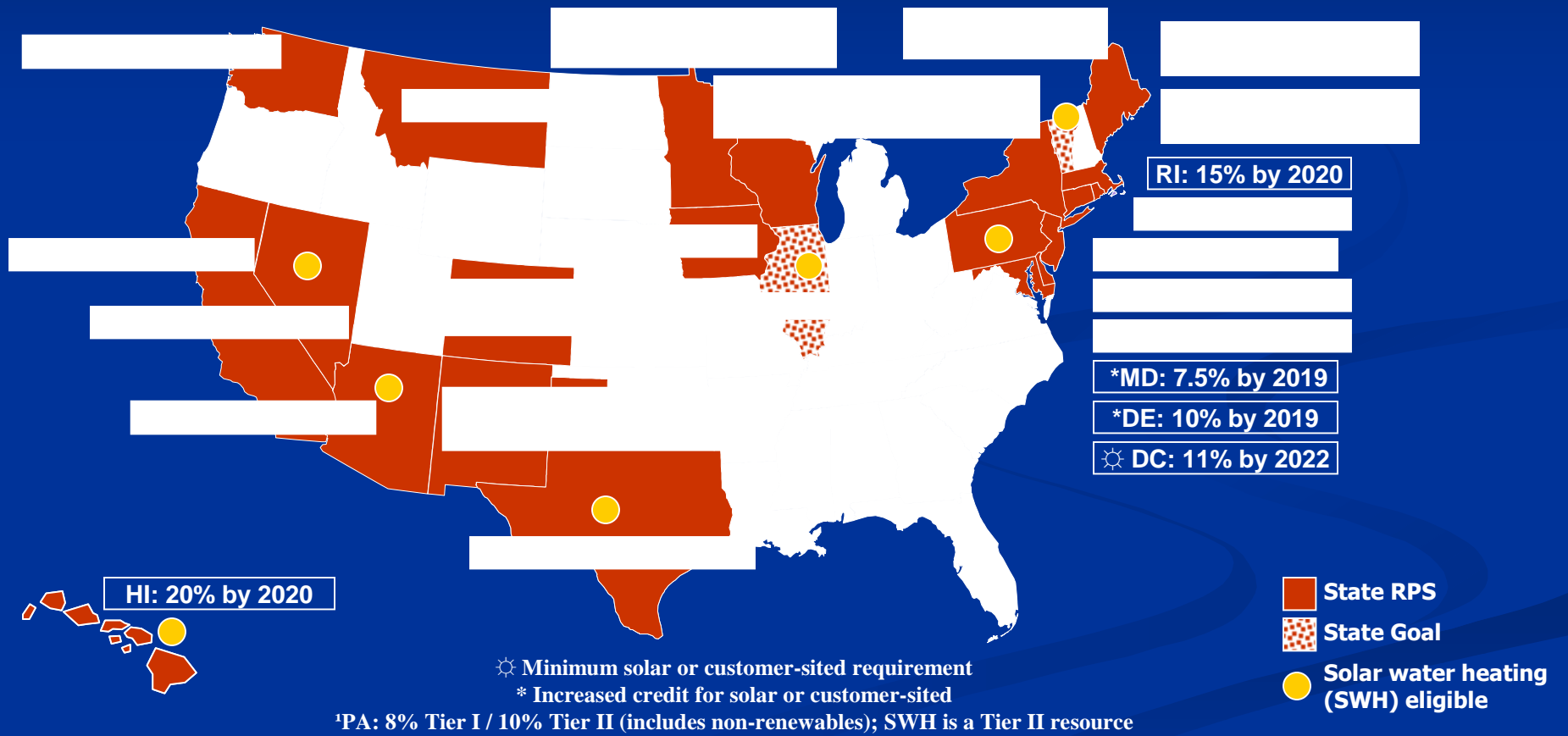
- Could act as a strong incentive to develop in-state energy technologies like biomass and wind.
- Could act as a strong incentive to build more small scale distributed generation.
- Could act as a strong incentive to develop meaningful conservation programs.
- Improving conservation efforts could help us keep rates low and maintain reliability.

# A Renewable Portfolio Standard?

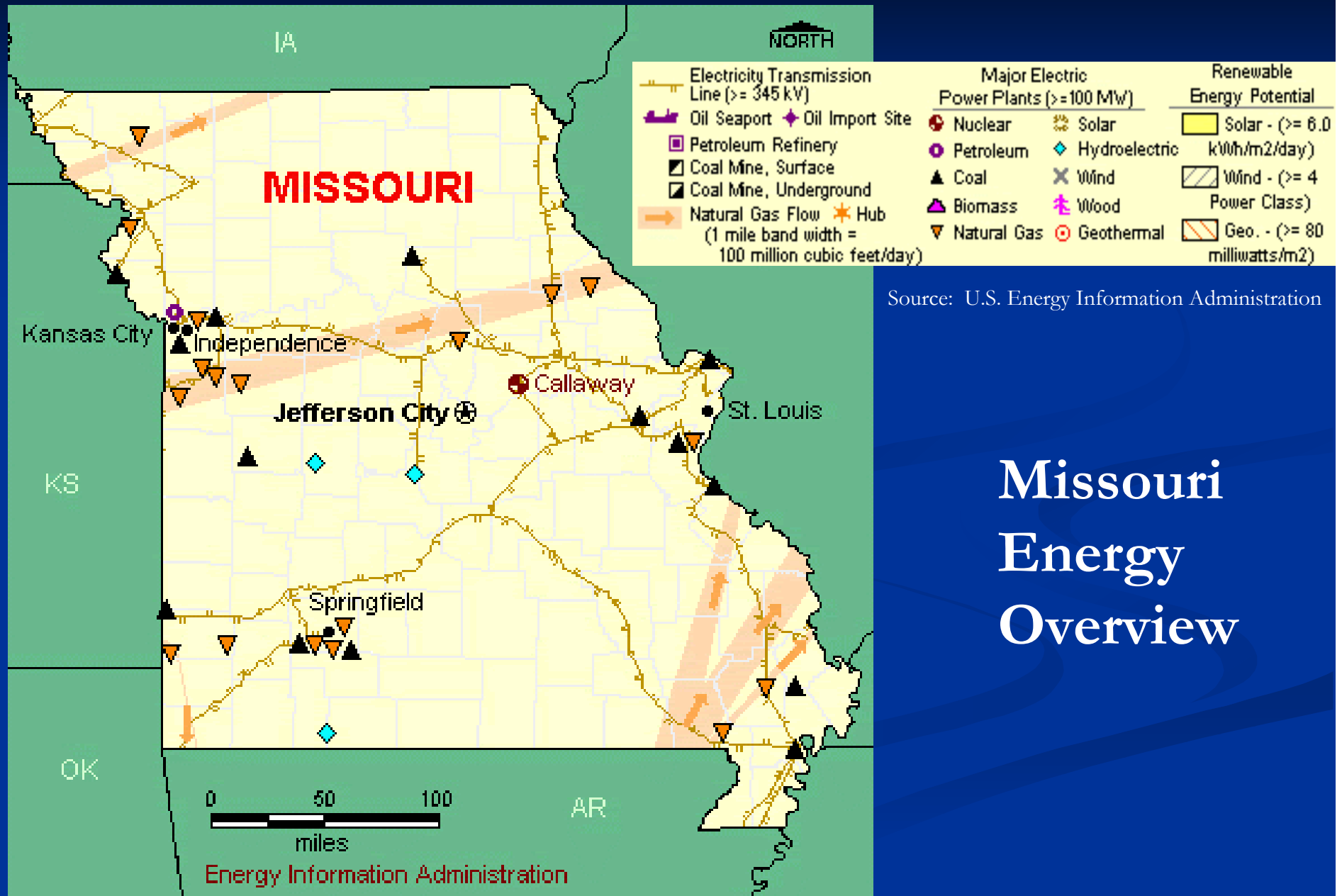
On the Other Hand...

- Could result in non-economic generation source additions...and higher electric rates.
- Could result in reduced capacity margins and lower system reliability.
- Could provide strong incentives to implement technologies that have not been fully developed and are not ready for full-scale commercial operation.

# Renewables Portfolio Standards



Missouri was the first State west of the Mississippi River to produce coal commercially, but output today is minimal. Coal is the dominant fuel for electricity production in Missouri and typically supplies more than four-fifths of the electricity market. The transportation and residential sectors lead State energy consumption.



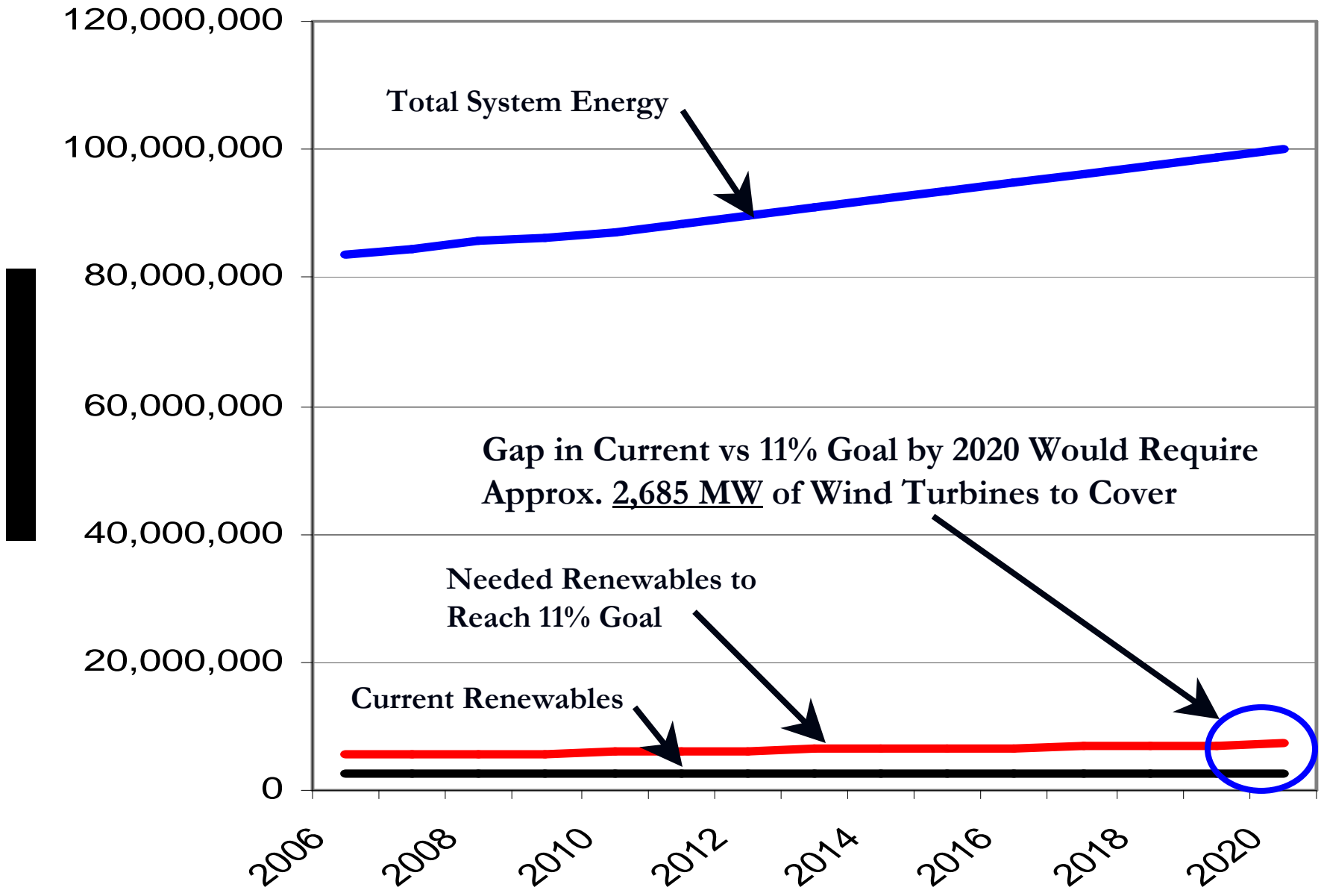
# Current Renewables in Missouri

- On an “Energy” basis, approx. 4 % of Missouri’s electric energy comes from renewable sources (hydroelectric and wind).
- On a “Capacity” basis, Missouri’s electric utilities receive about 8% of their capacity from renewables (mostly hydroelectric).

## Reaching 11% Renewables Goal by 2020

- Currently about 4% of the electric energy from Missouri's IOUs comes from renewables.
- This energy generally comes from almost equal shares of hydroelectric and wind.
- The gap in 2020, if current energy growth trends continue, would require approx. 2,685 MW of installed wind turbines to cover.
- If coordinated with conservation measures would lower probability of adverse economic impacts.

### Missouri IOU Energy & Renewable Levels



# Energy Concerns - Missouri

Questions?

# Energy Concerns - Missouri

## Contact Information:

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