

# America's Electricity Evolution:

New Policies, Regulations, and Technologies Converging  
to Change the Future of Power Production and Use

**Sue Tierney, Analysis Group**

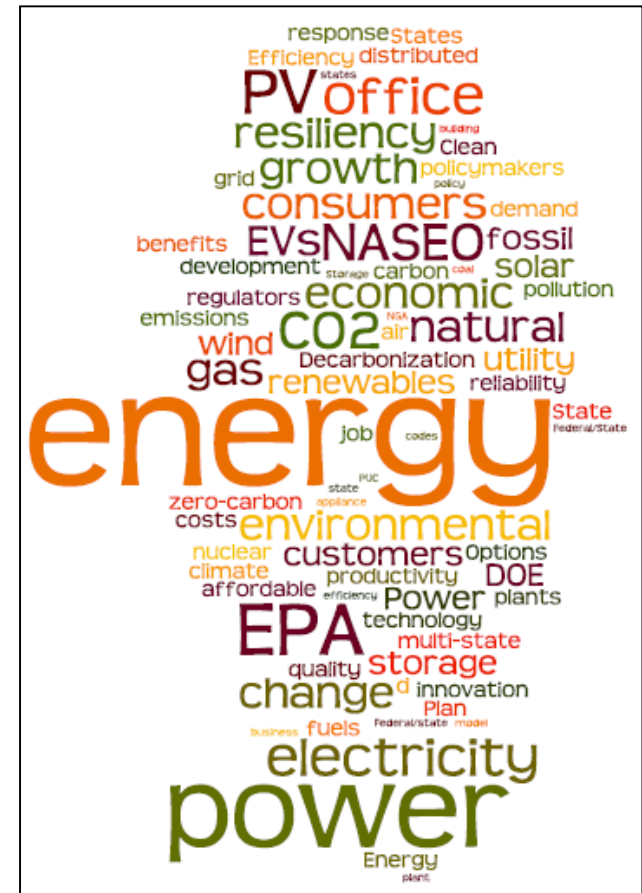
**2014 NASEO Annual Meeting  
September 2014 – Savannah**



## It's a complicated time in the U.S. electricity sector.....

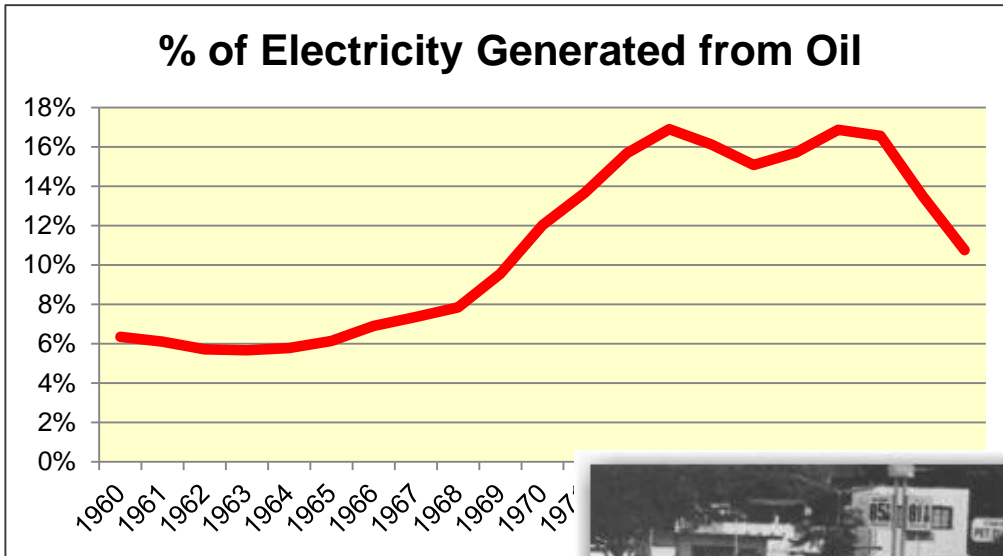
Looking back, and looking ahead

- My Savannah summer in 1970:
  - **What's changed since then?**
- Looking ahead from the same vantage point, different year:
  - **What's in store for the electric industry?**
  - **What does the past inform us about the future?**

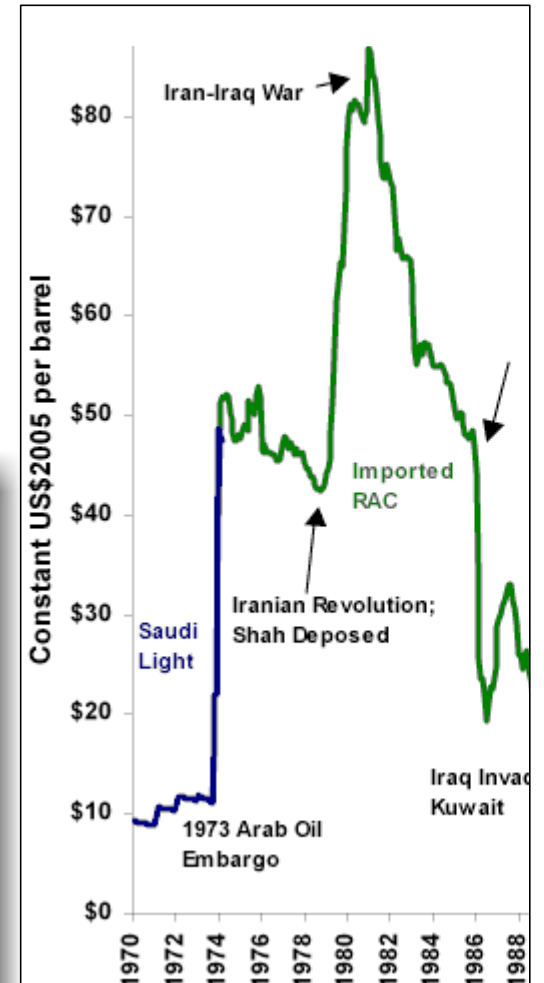


**What was it like, back in 1970.....?**

# Oil Dependence and Price Shocks



## Crude Oil Prices



1973

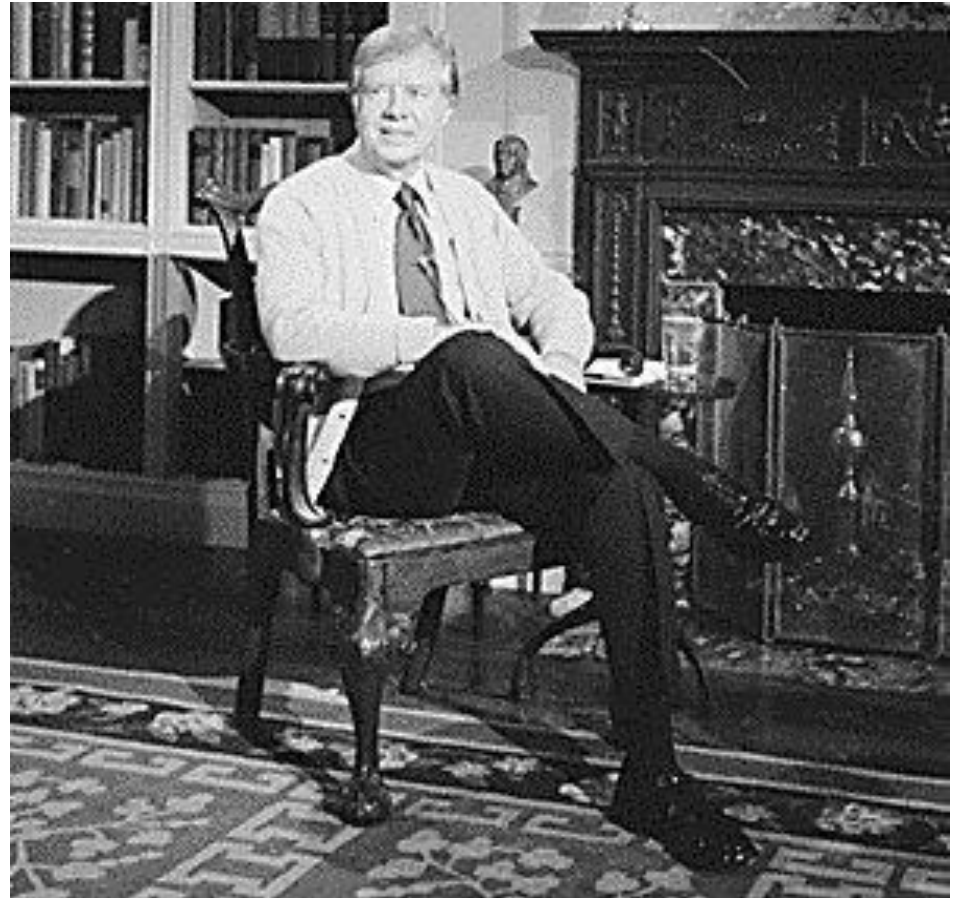
## Energy resources viewed as very scarce...

....the energy crisis is the “moral equivalent to war,”

... energy conservation runs counter to economic growth

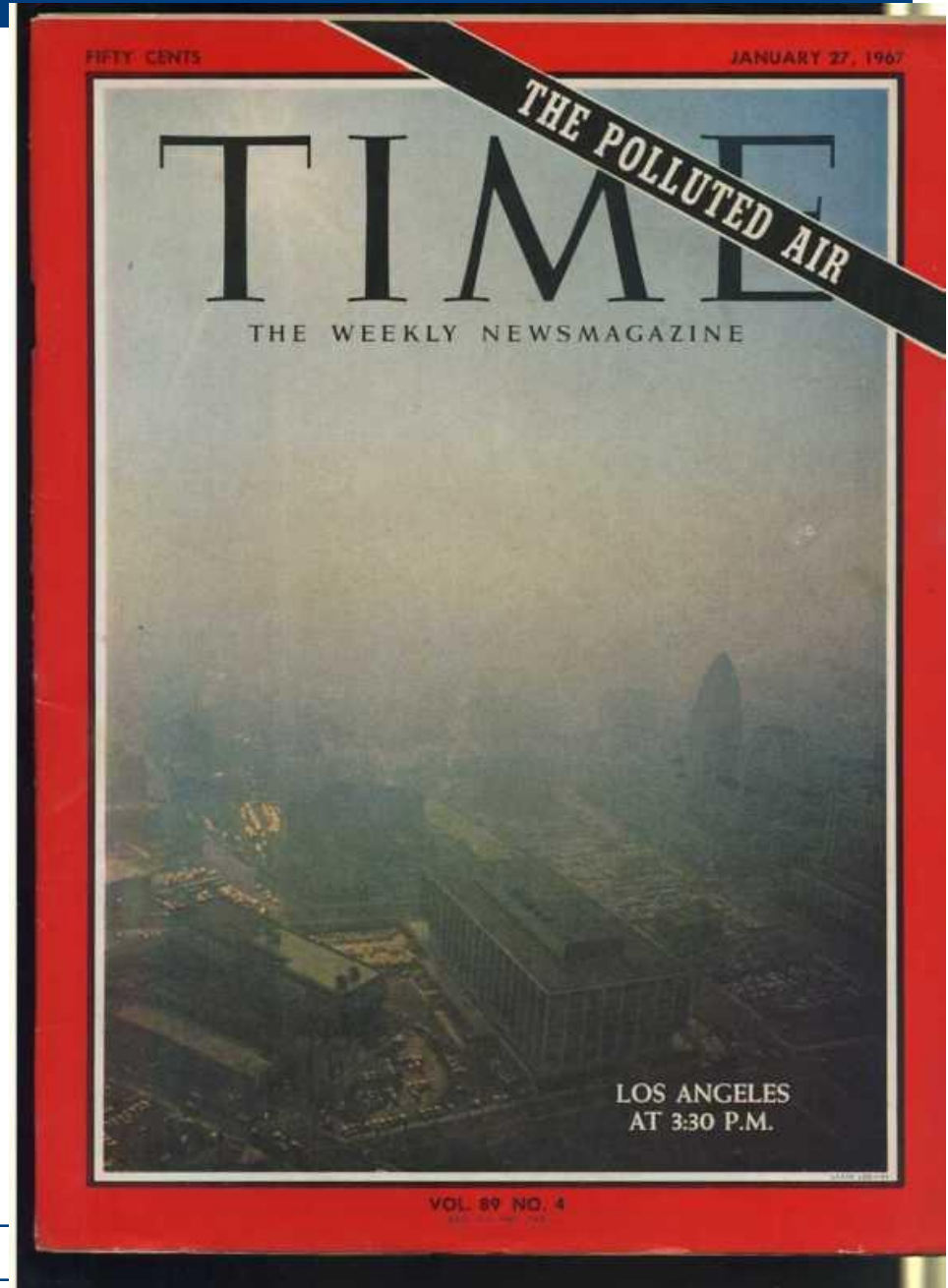
....energy conservation is all about sacrifice....

1973





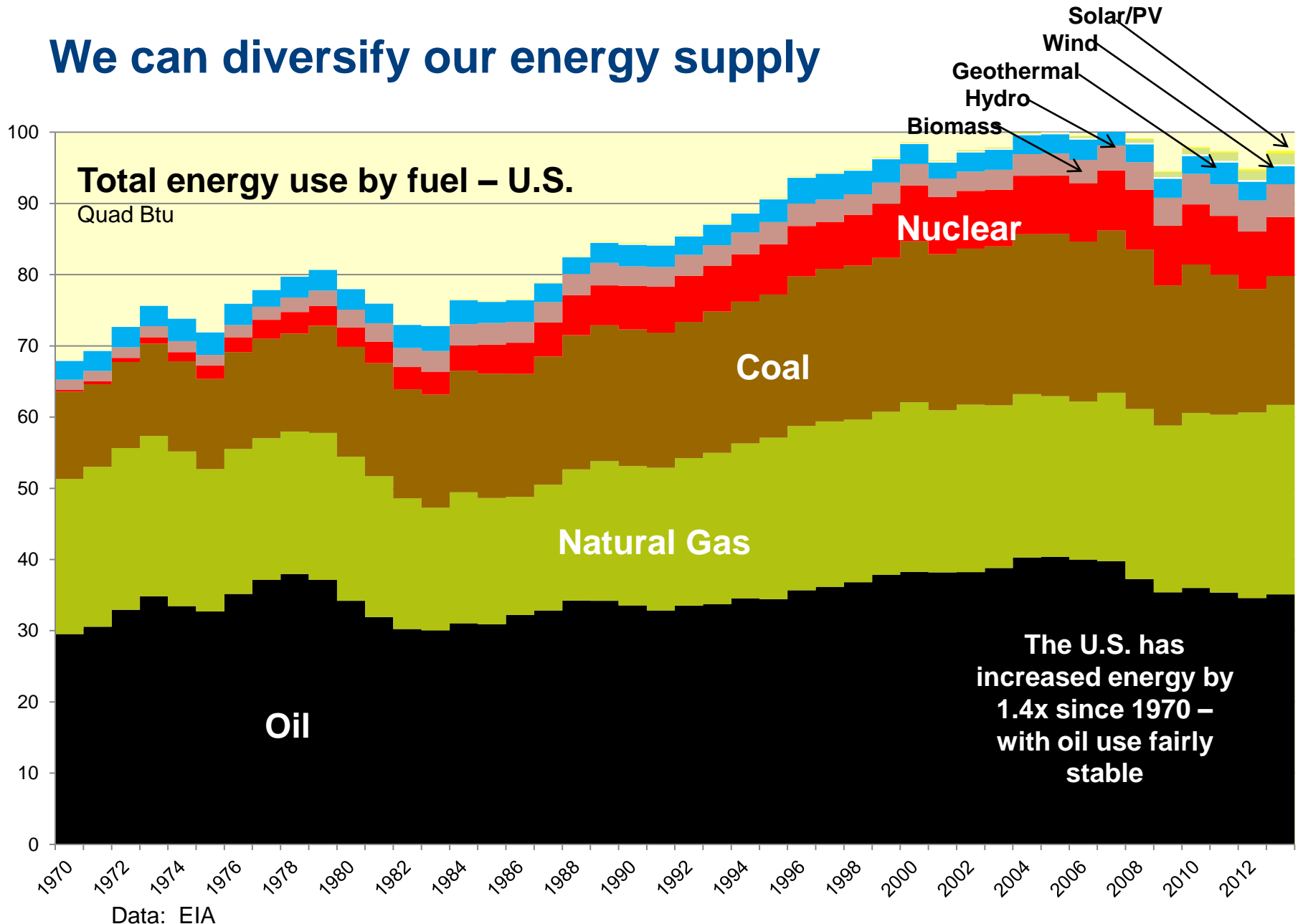
**Pollution and air quality were very bad in many parts of the U.S.**



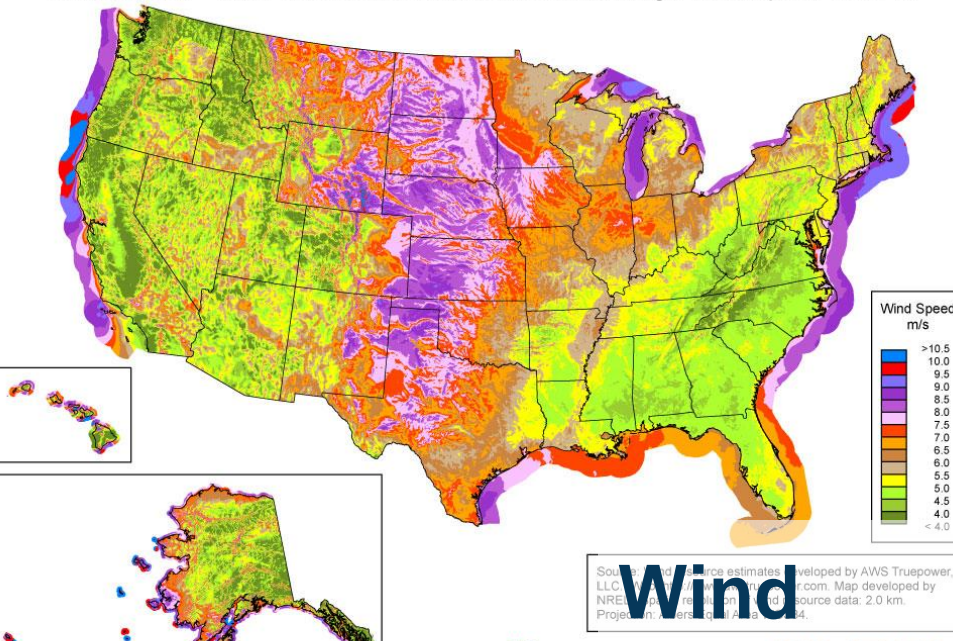
**What have we learned since 1970 that's relevant to help prepare for what's ahead in the electric industry?**



# We can diversify our energy supply



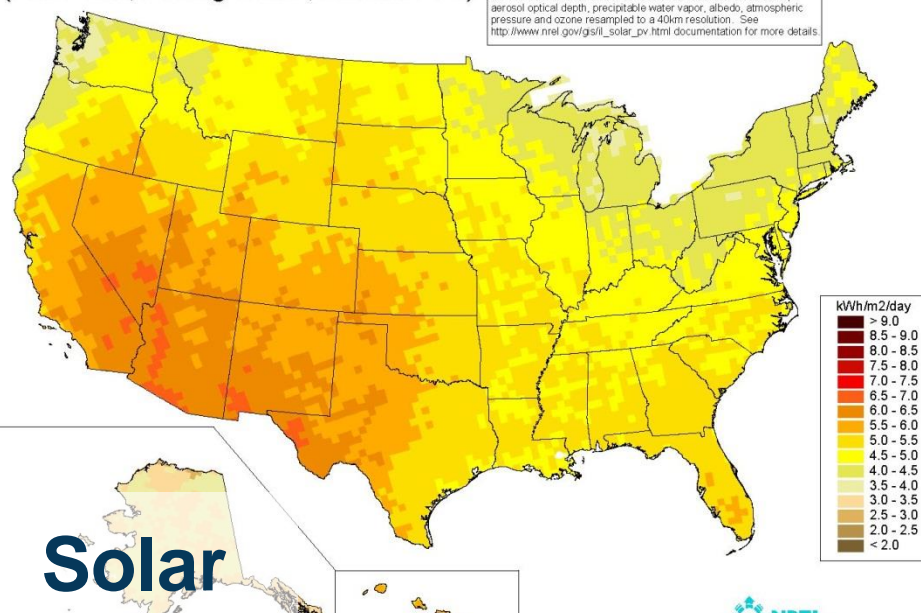
United States - Land-Based and Offshore Annual Average Wind Speed at 80 m



**Wind**

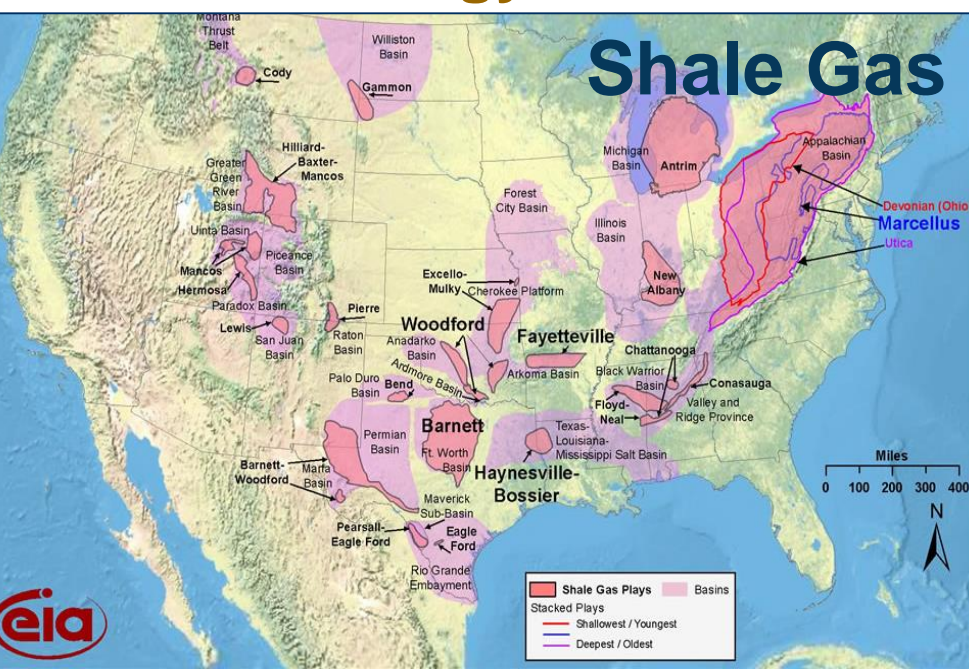
PV Solar Radiation (Flat Plate, Facing South, Latitude Tilt)

Model estimates of monthly average daily total radiation using inputs derived from satellite and/or surface observations of cloud cover, aerosol optical depth, precipitable water vapor, albedo, atmospheric pressure and ozone resampled to a 40km resolution. See [http://www.nrel.gov/gis/solar\\_pv.html](http://www.nrel.gov/gis/solar_pv.html) documentation for more details.

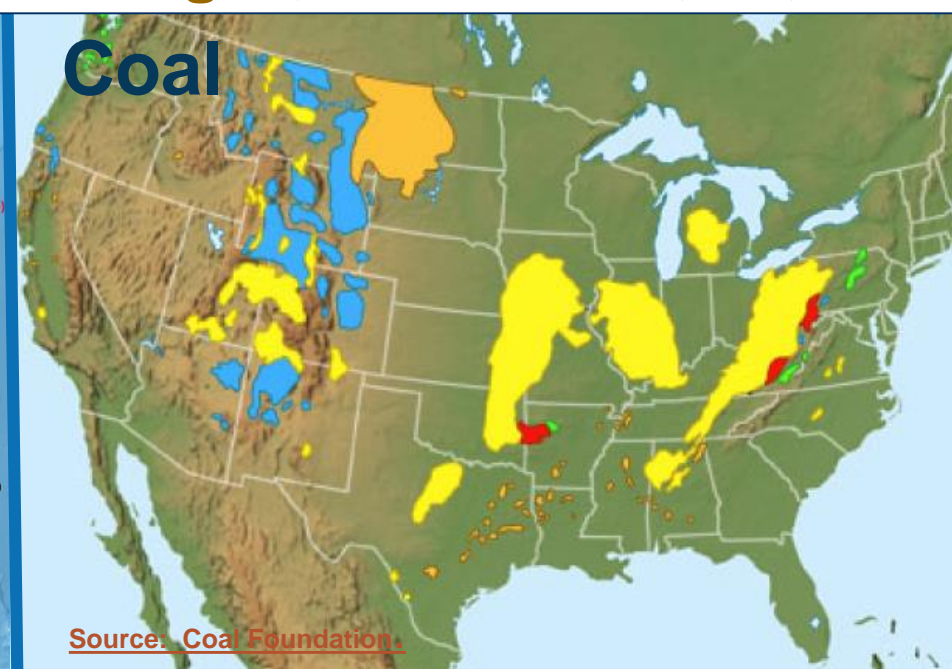


**Solar**

**We are an energy-rich nation: natural gas, renewables, oil, coal**



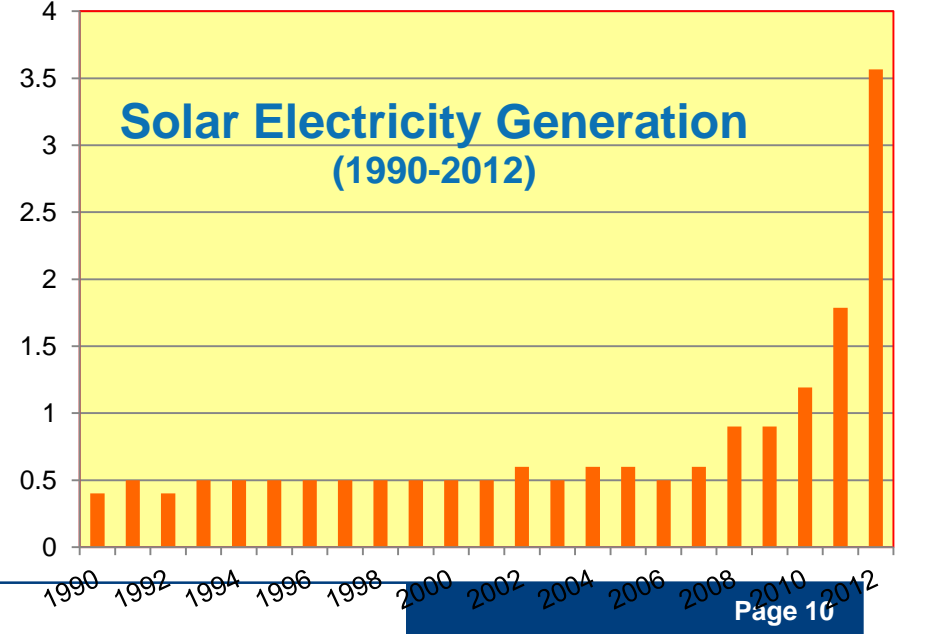
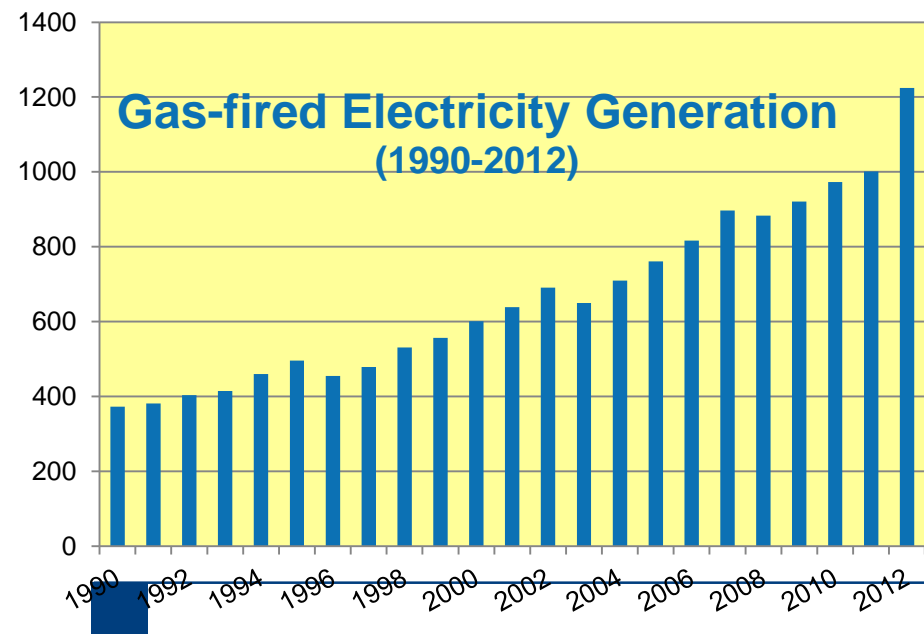
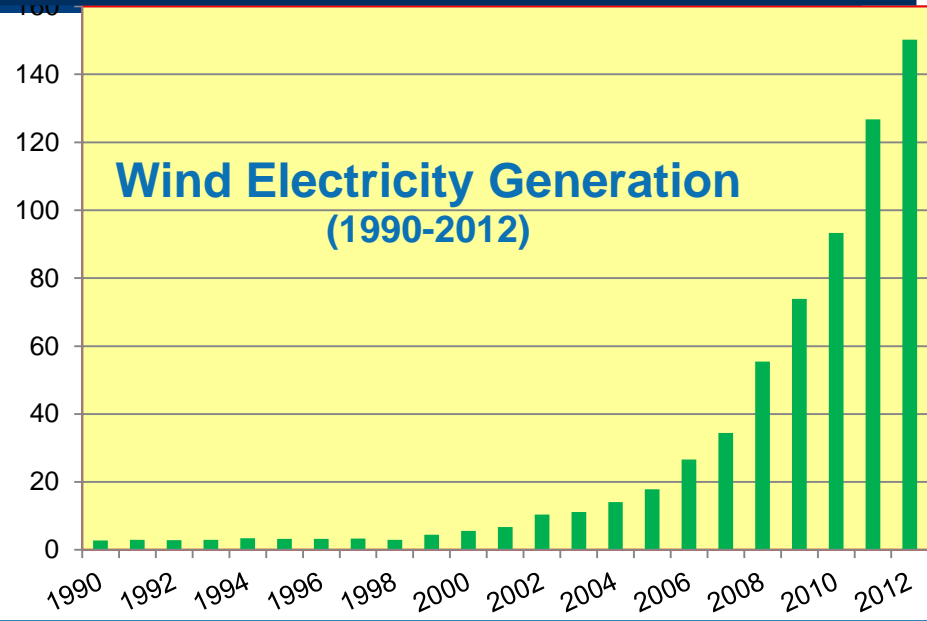
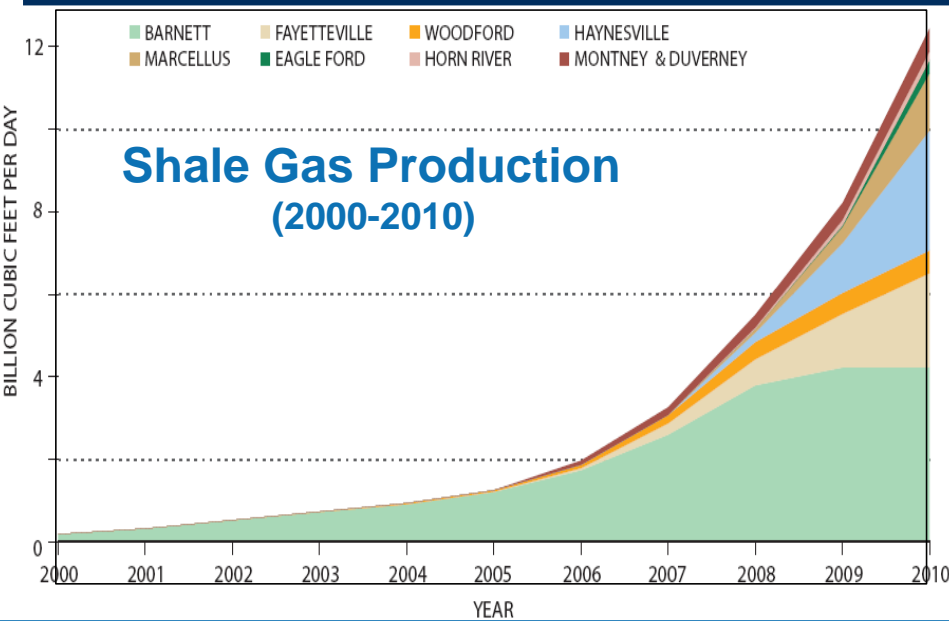
**Shale Gas**



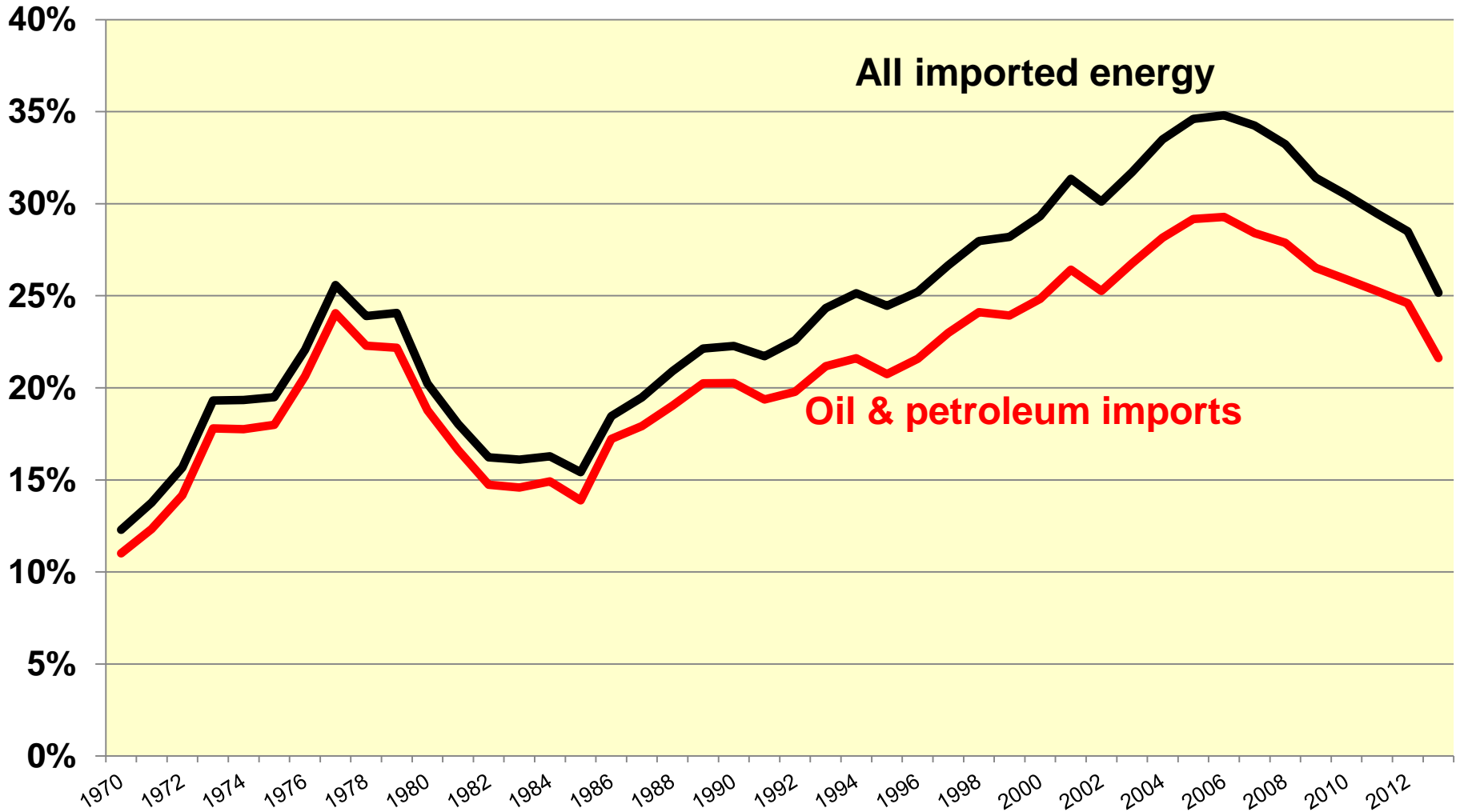
**Coal**

Source: Coal Foundation, www.coal.org

# We can develop domestic resources for power supply

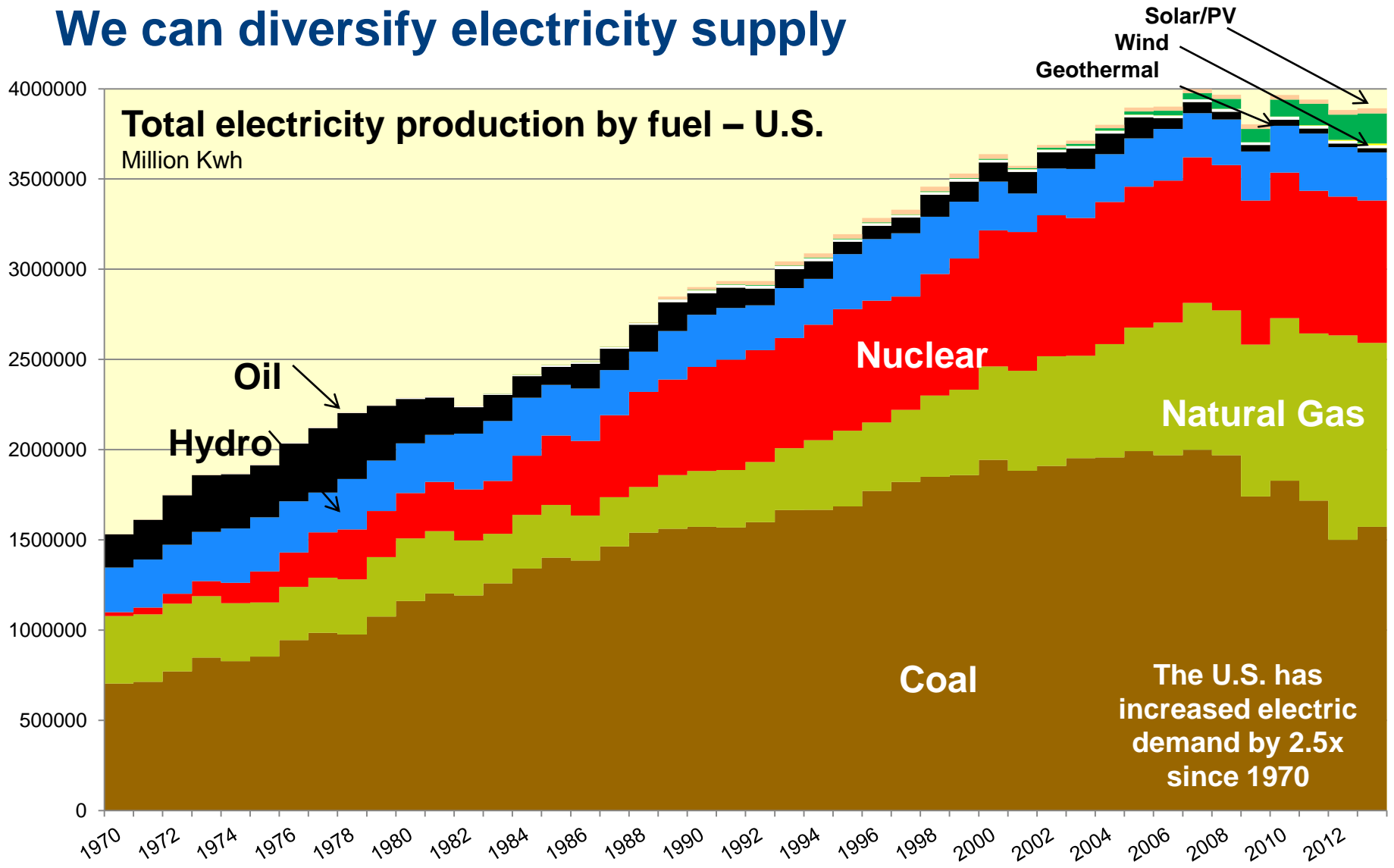


## We can turn the corner on energy imports



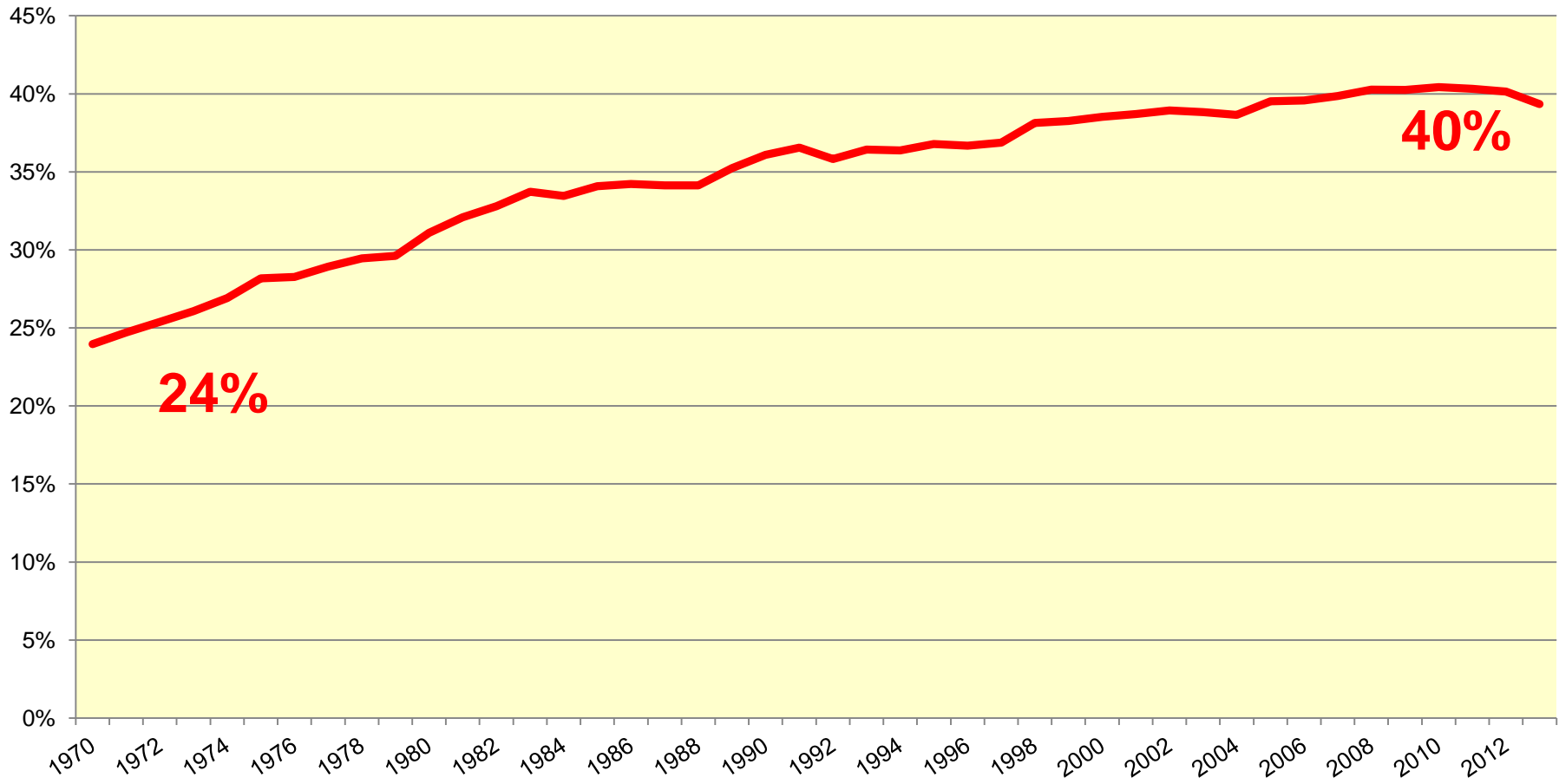


# We can diversify electricity supply

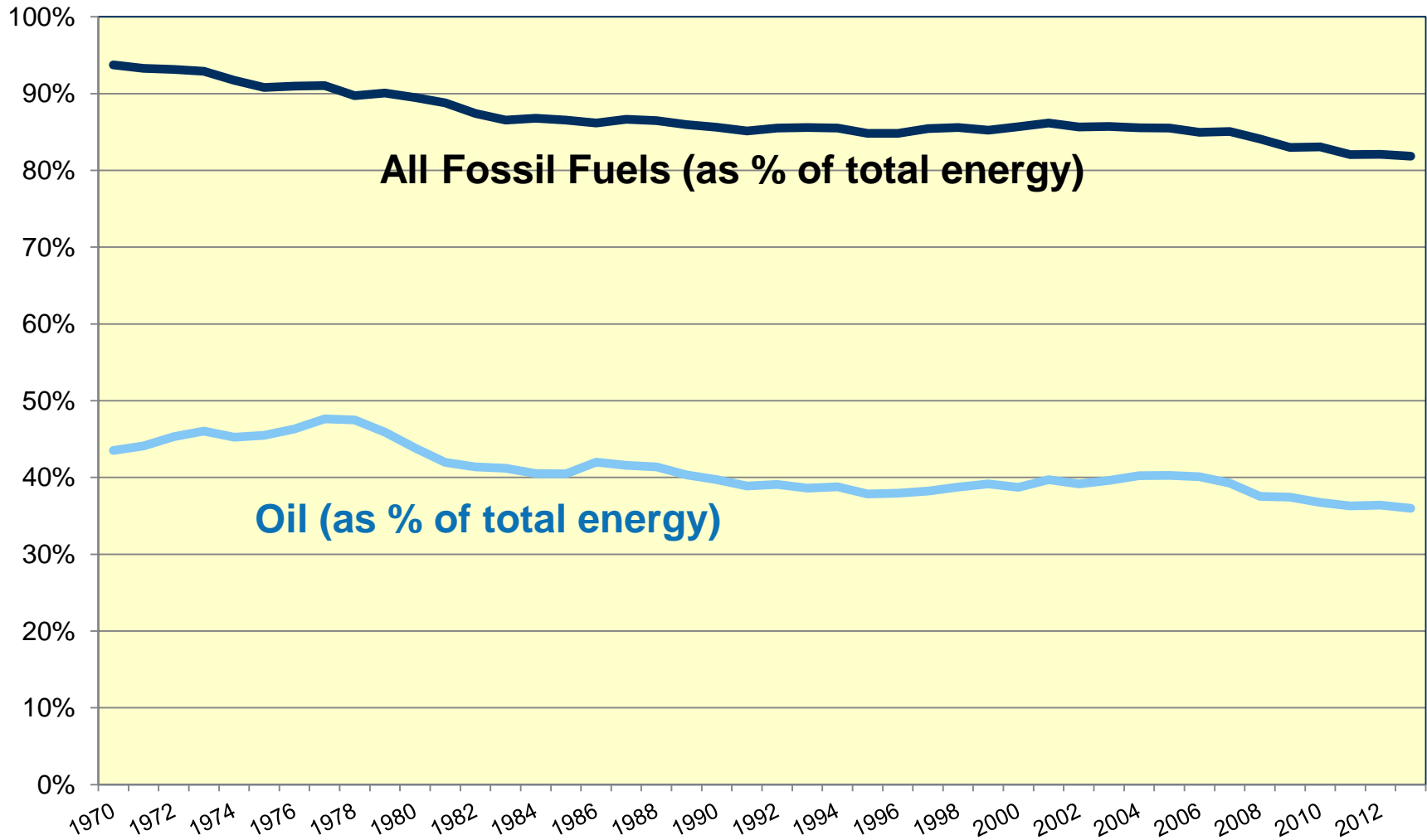


# We can increase the “electricity intensity” of the economy

## Electric Sector as Percent of Total Primary Energy Use

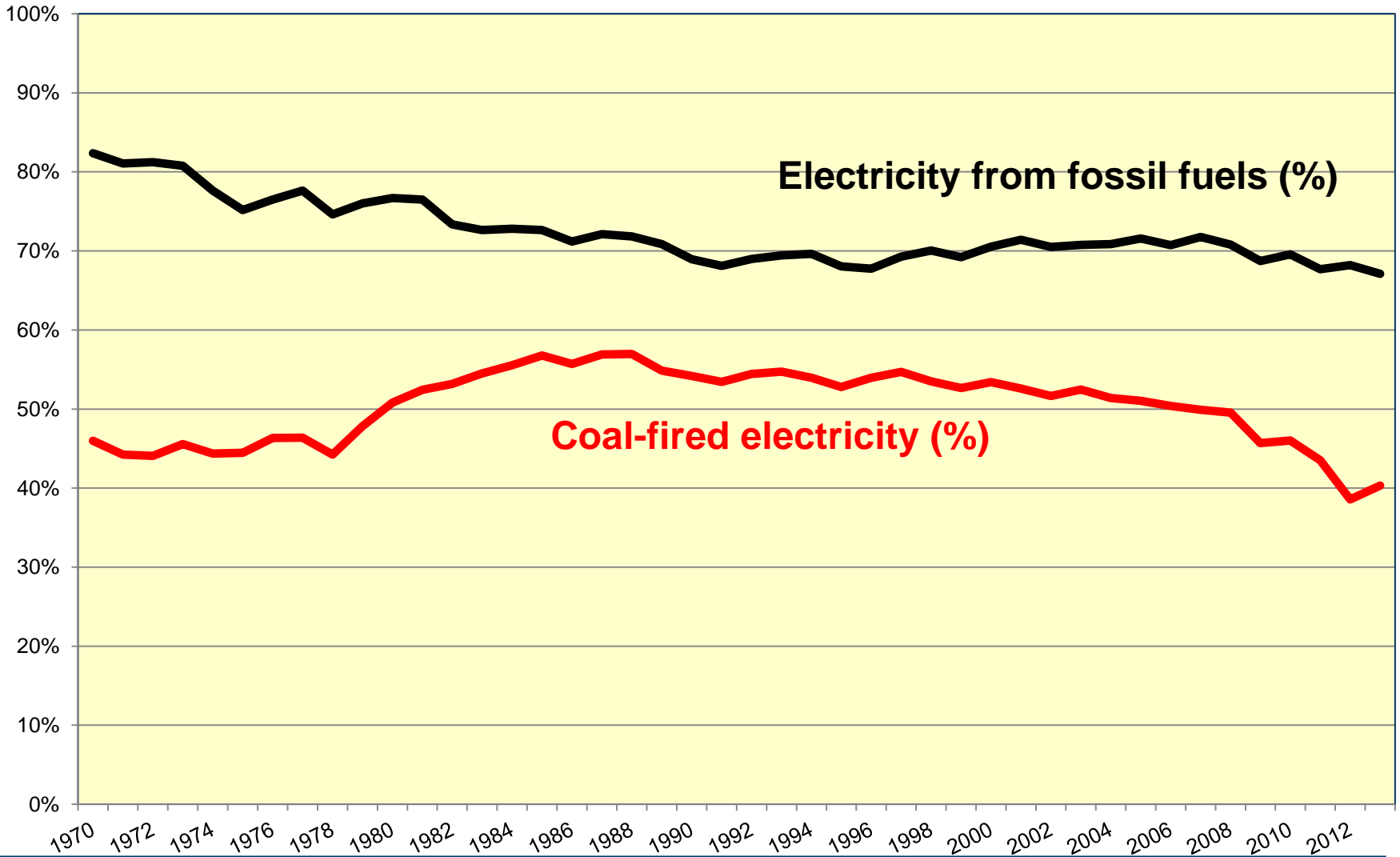


# We can reduce our reliance on fossil fuels....(all energy)

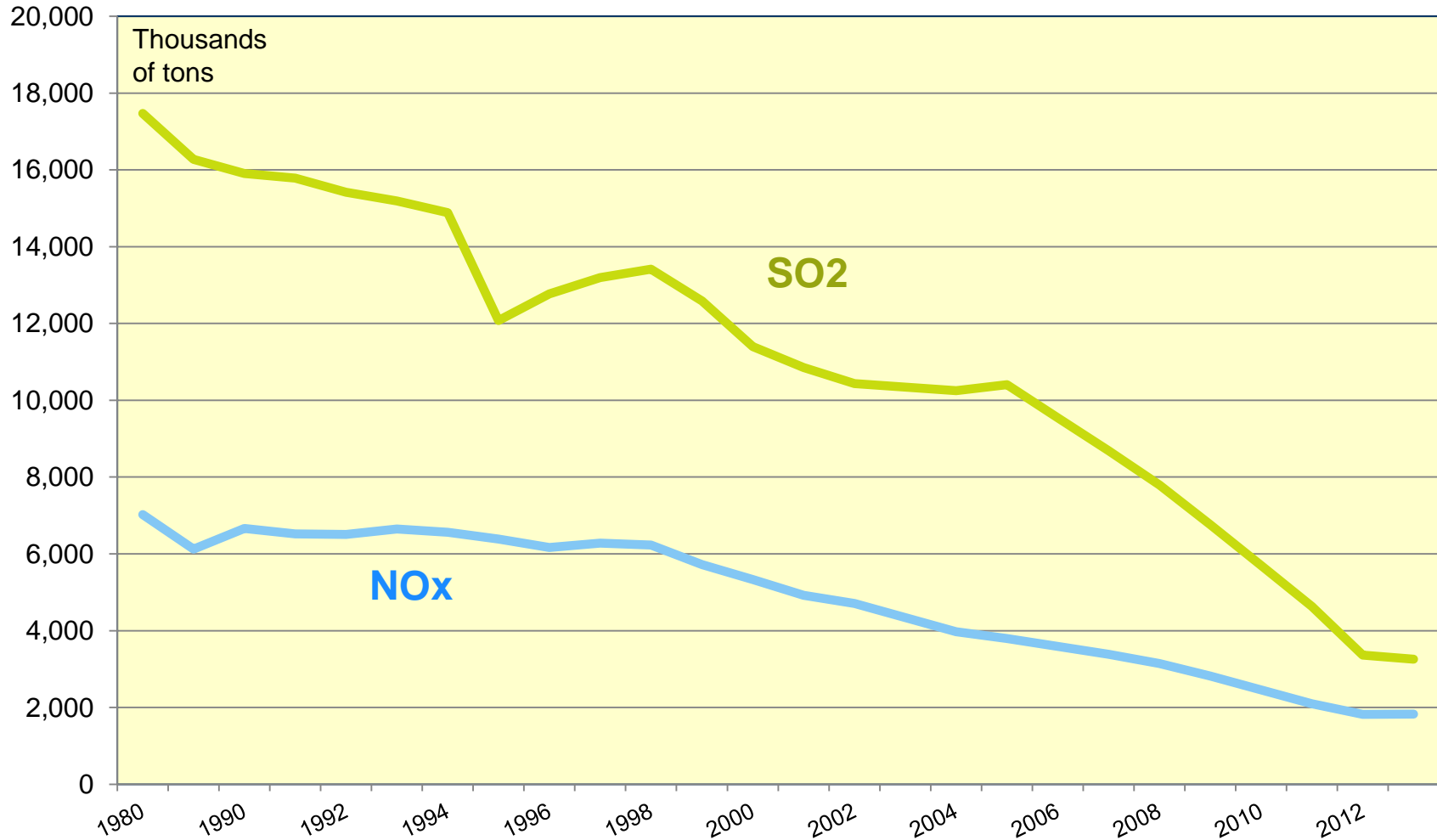




# We can reduce our reliance on fossil fuels....(power)

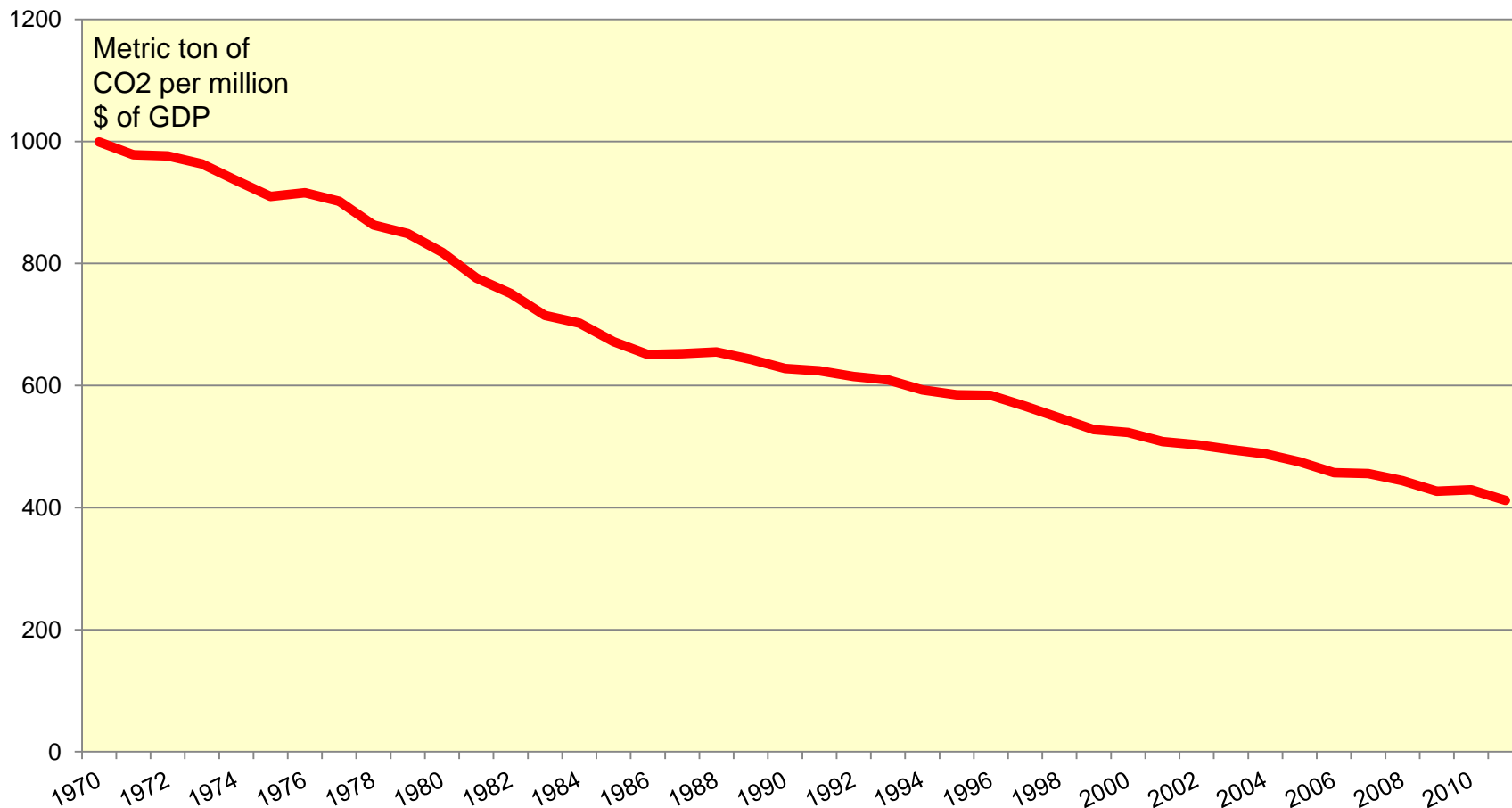


# We can decrease air emissions from power production

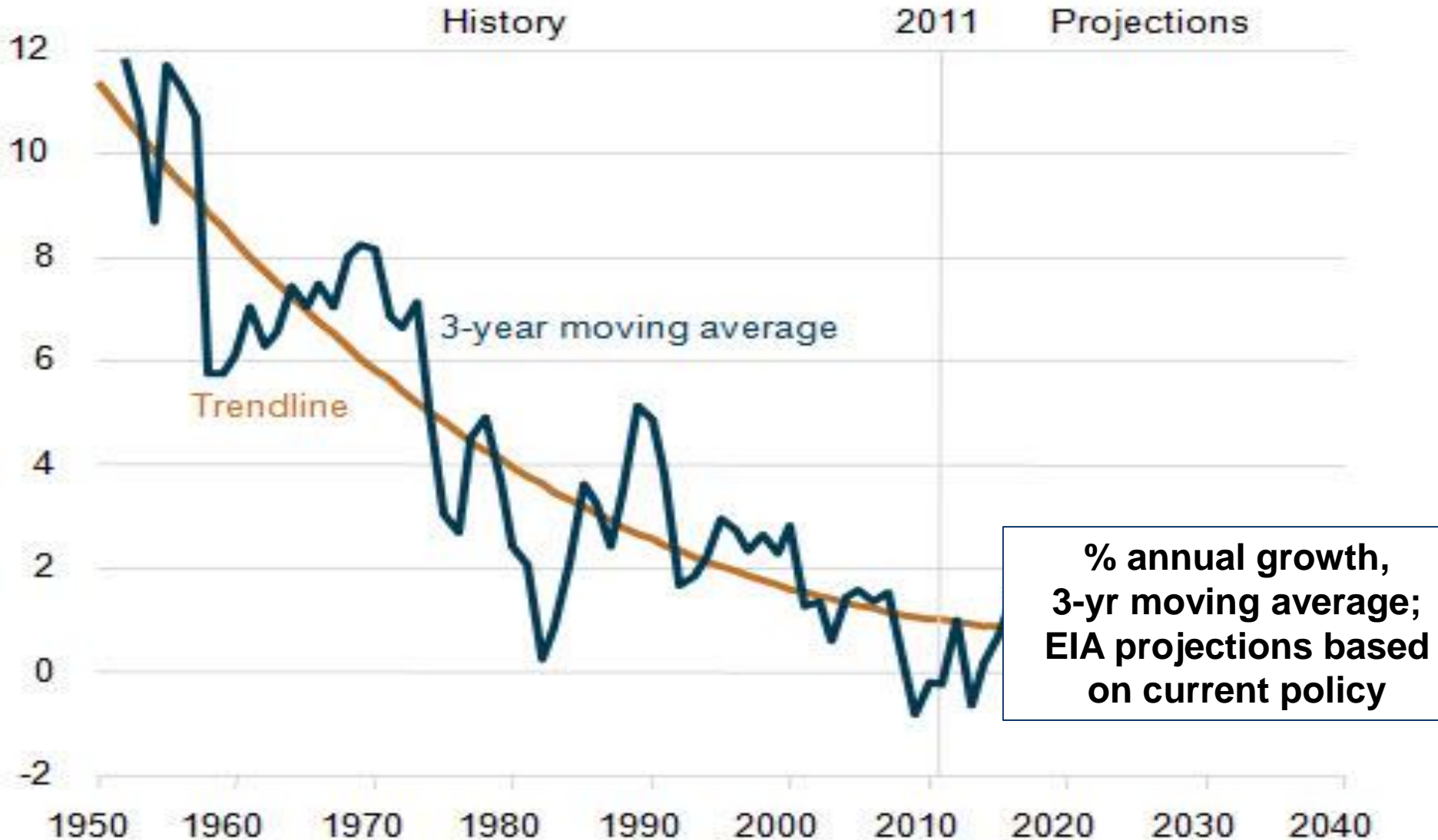


# We can reduce the carbon intensity of the economy

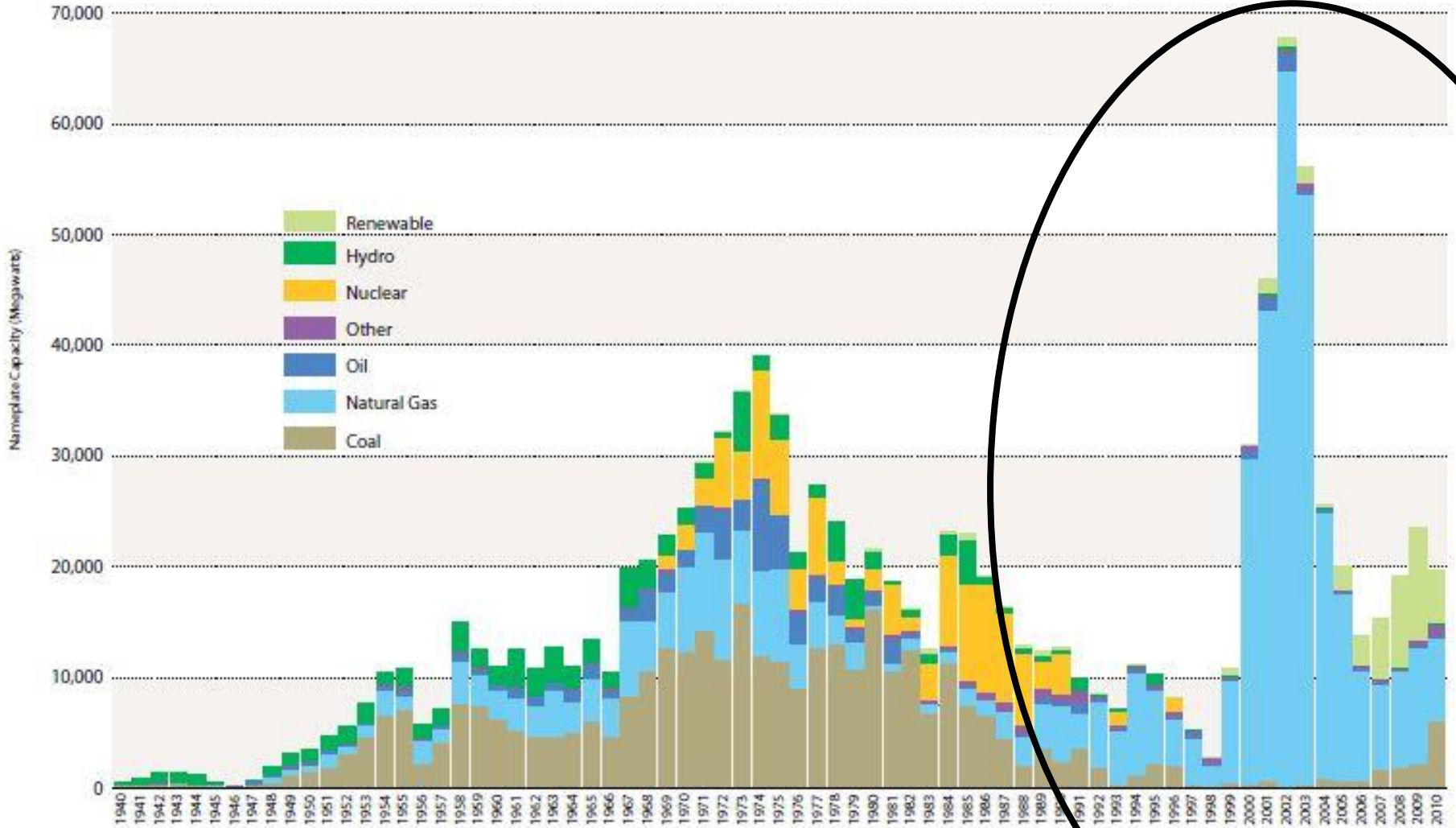
## Carbon Dioxide Emissions per Real \$ of GDP



## We've slowed growth in electricity demand



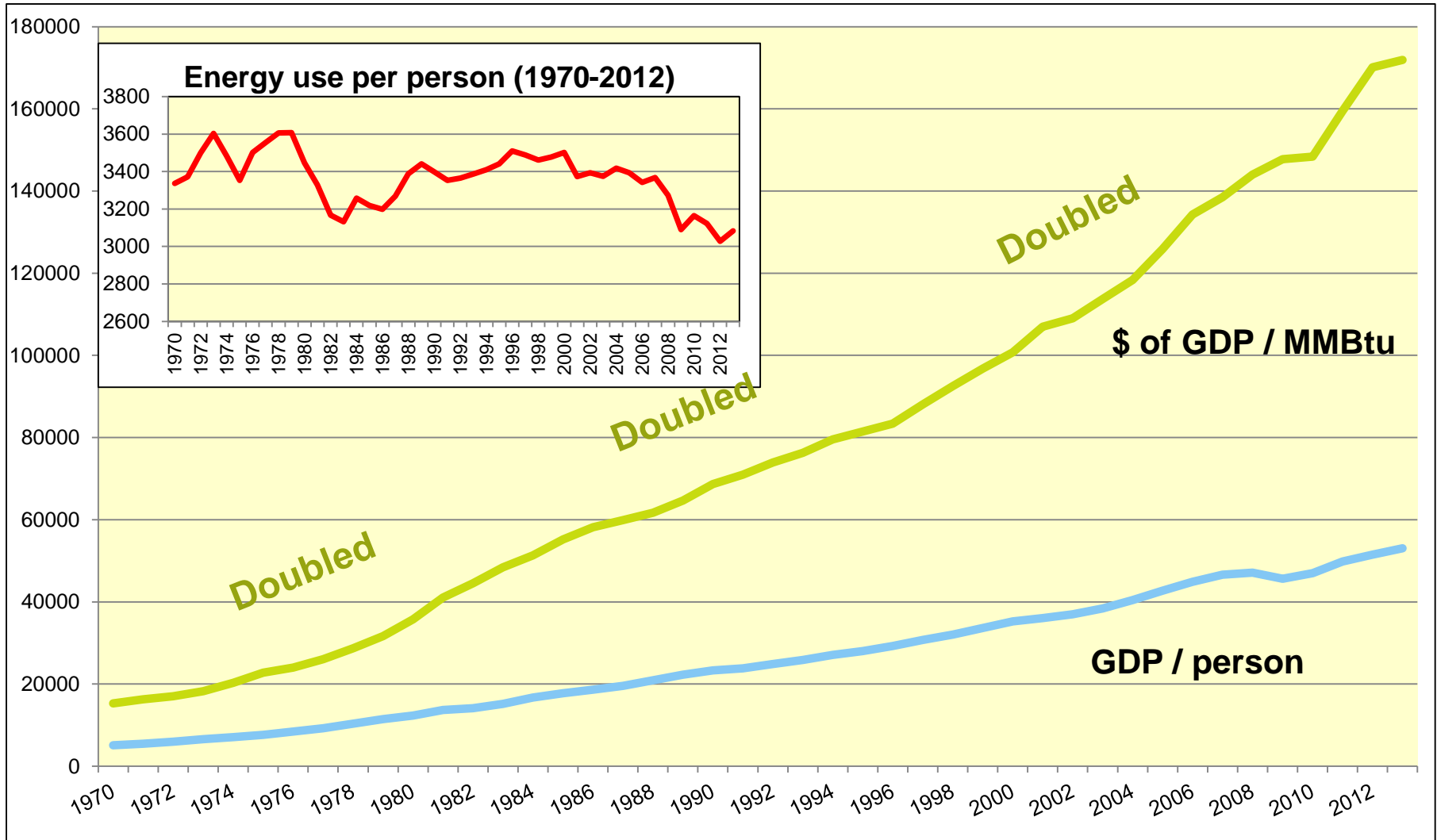
# We've been able to add new resources relatively quickly



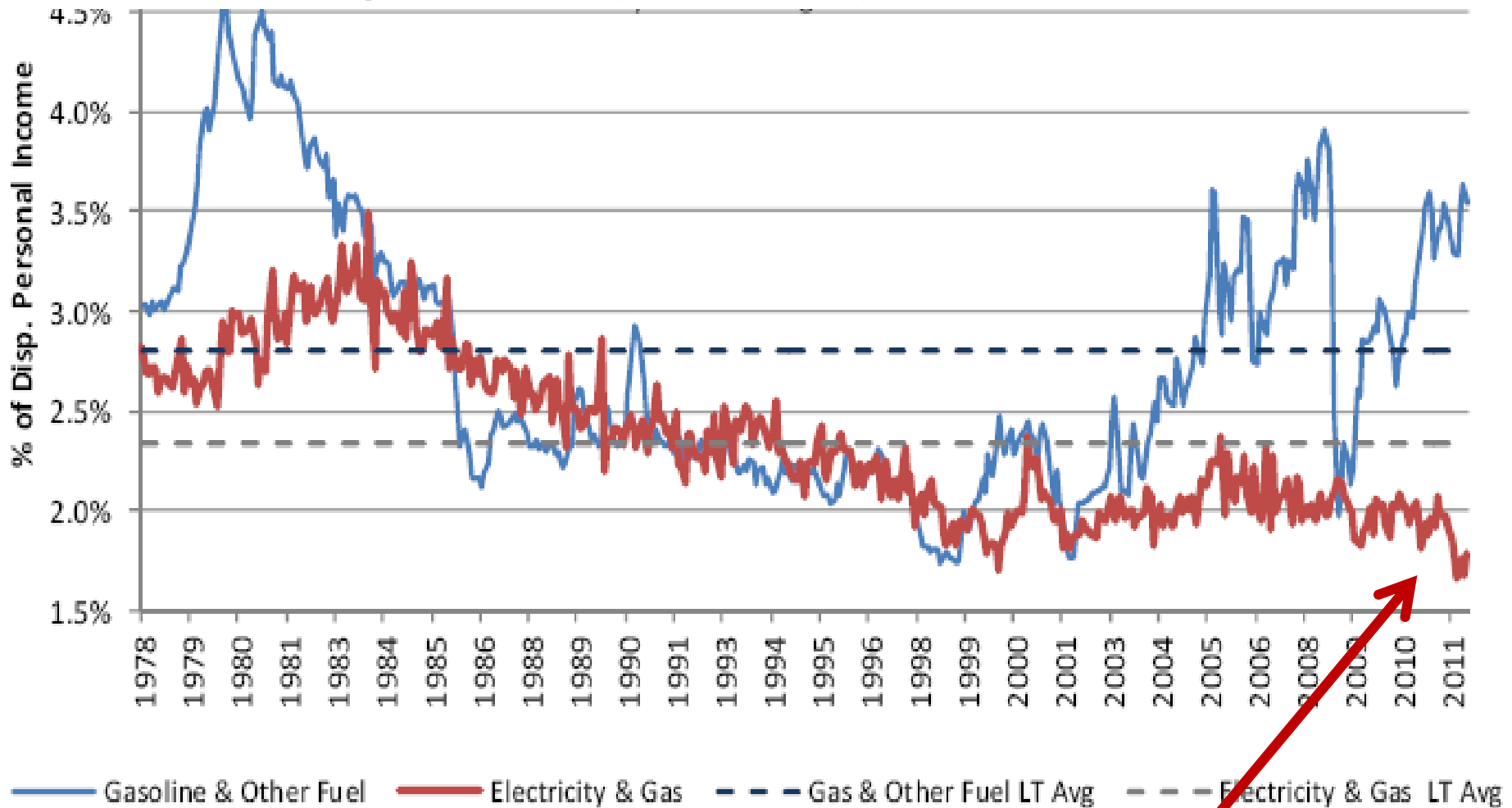
SOURCE: U.S. ENERGY INFORMATION ADMINISTRATION, ANNUAL ELECTRIC GENERATOR REPORT: FORM EIA-860 (2010).

Data: EIA

# And – all the while – the economy can grow



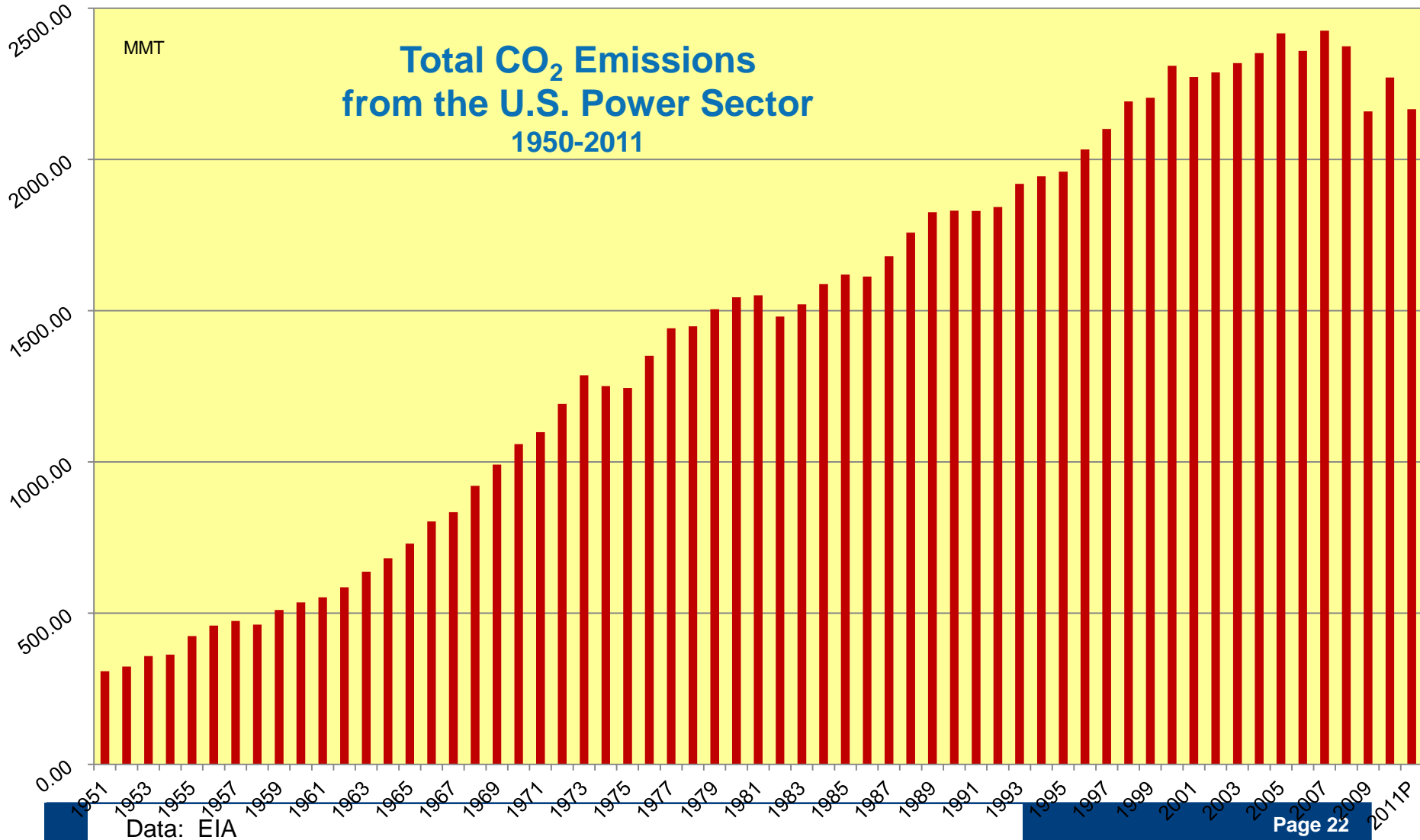
# While keeping electricity relatively affordable. . .



**Electricity and Gas as Percent of Disposable Personal Income  
(1978-2011)**



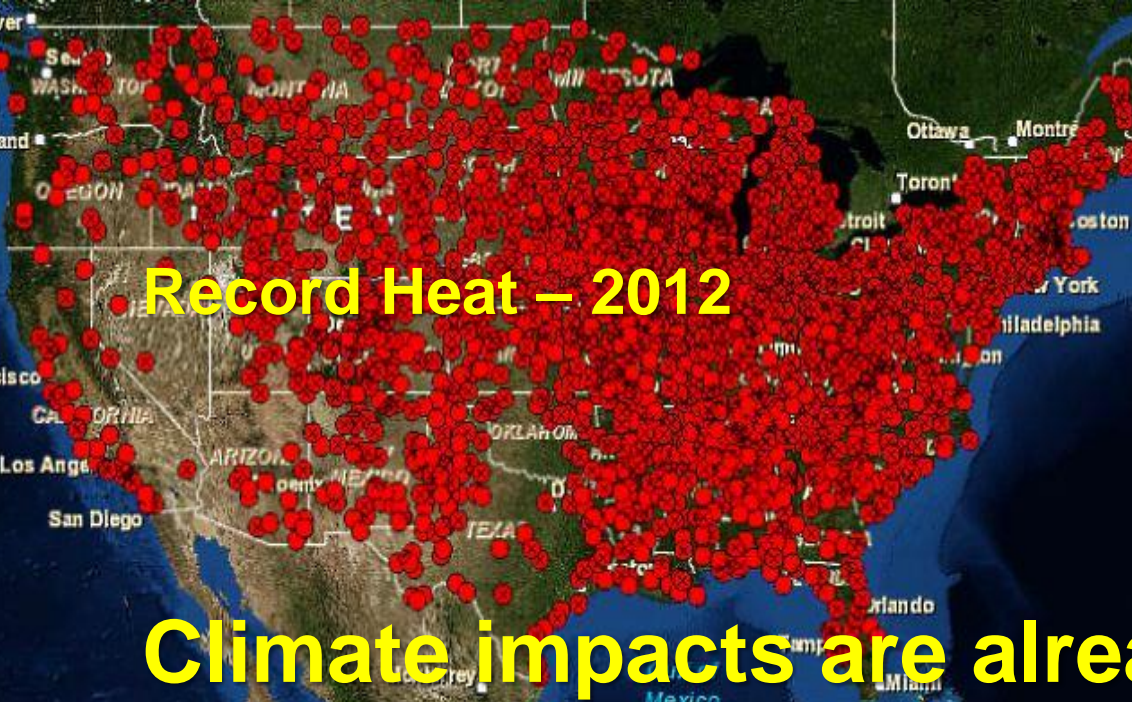
# But we have yet to tackle CO<sub>2</sub> emissions from electricity



A world map where the United States is highlighted in a bright yellow color, representing its CO2 emissions from power production. The rest of the world is shown in a dark blue color. The map is centered on the Atlantic Ocean, showing the Americas on the left and Europe, Africa, and Asia on the right.

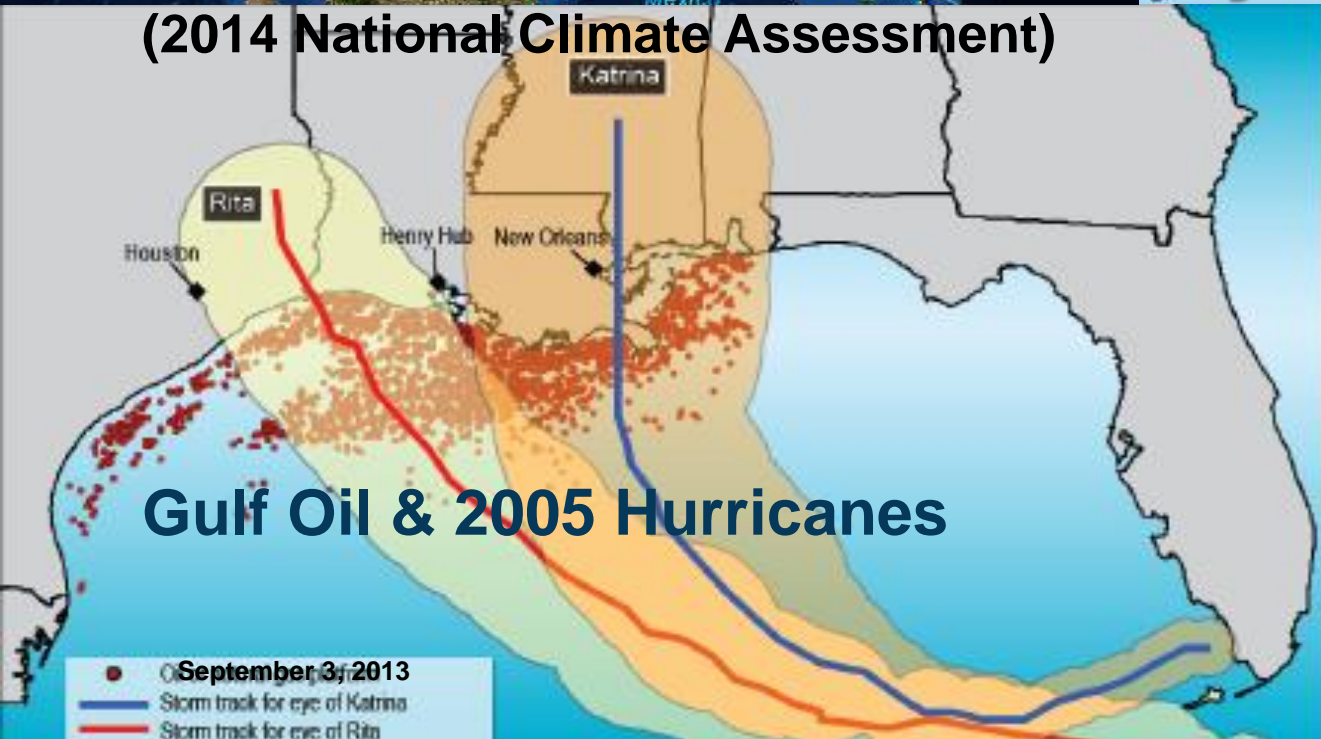
**CO<sub>2</sub> emissions from U.S. power production:  
1 out of every 15 tons of CO<sub>2</sub> produced  
anywhere in the globe.**





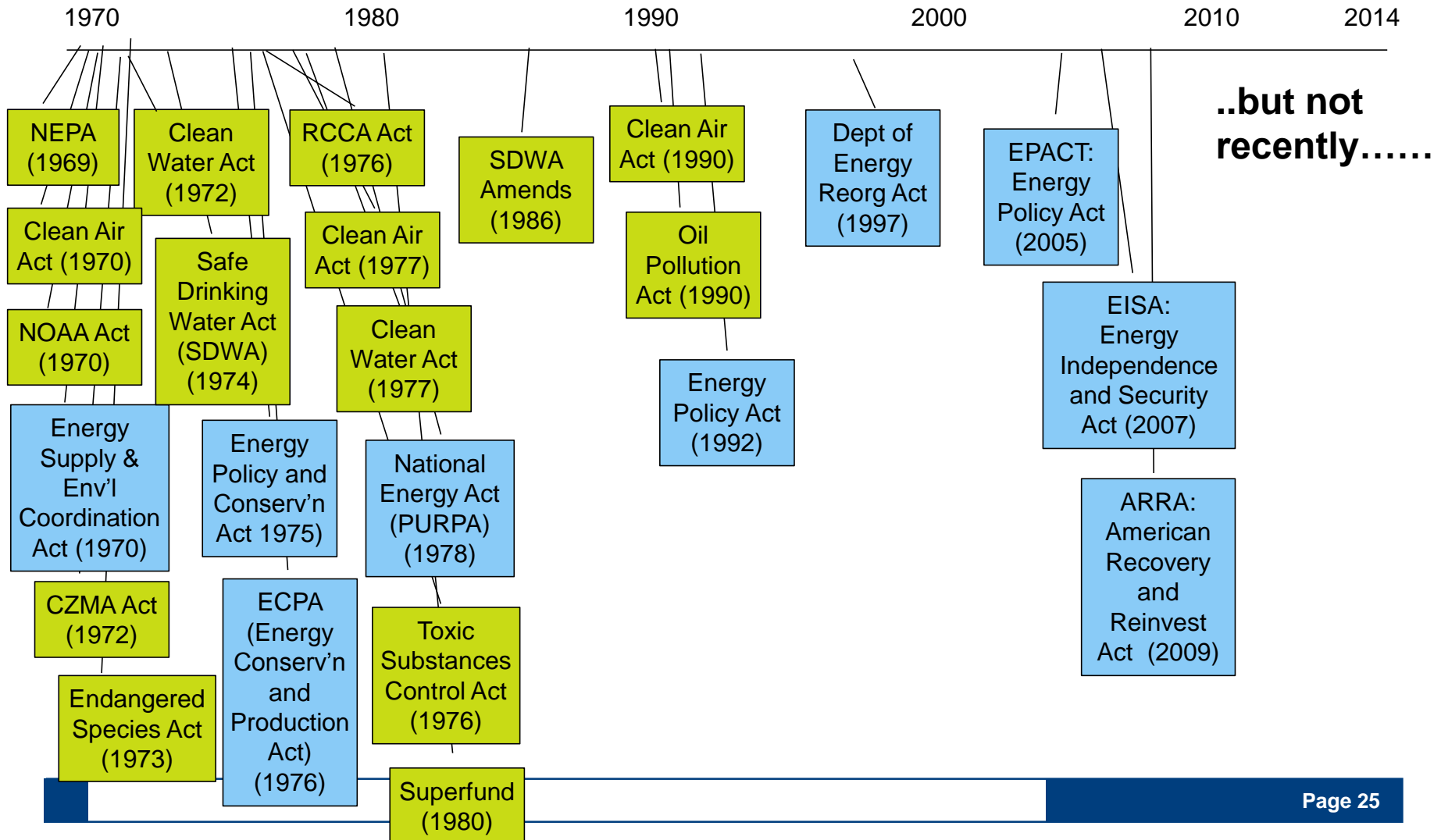
**Climate impacts are already happening**

(2014 National Climate Assessment)



New York Stock Exchange underwater after Hurricane Sandy

# We've been able to enact energy & env'l legislation . . .



**So..... what's needed, looking ahead?**

## A big moment of opportunity for the States:

### Current investment drivers in the power sector

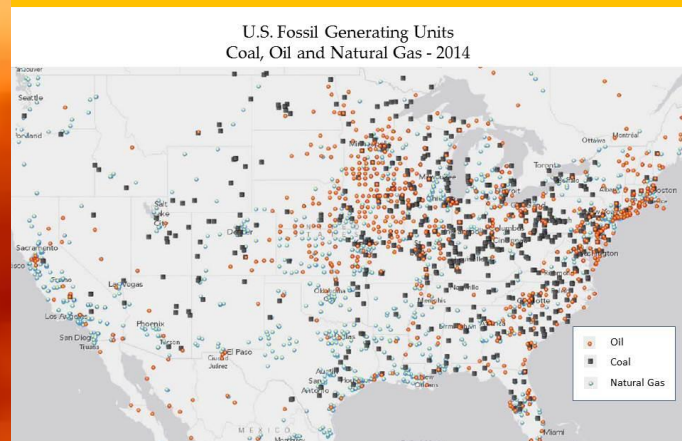
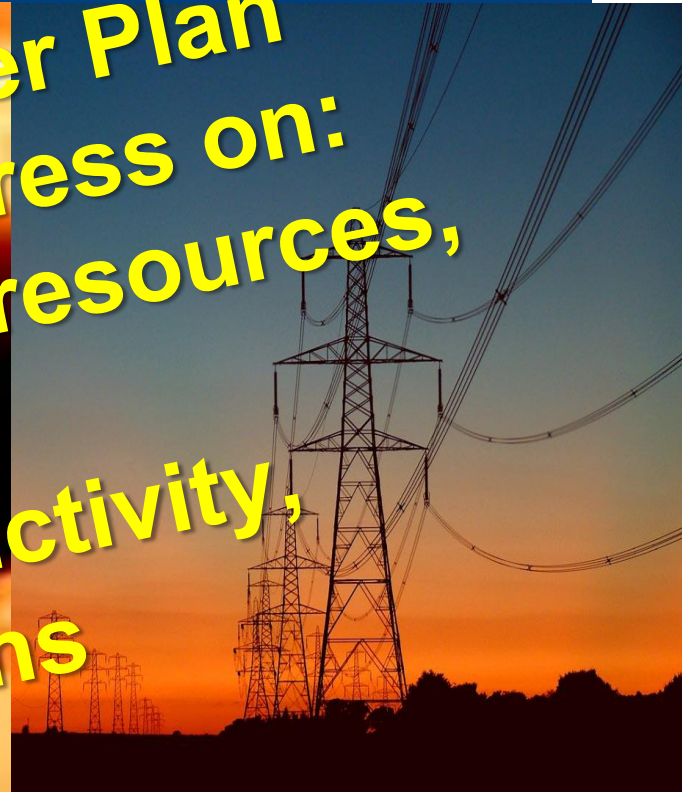
- **Shale gas:** utilizing ‘cheap’ new domestic supply for power generation
- **Customer demand and preferences:** ~flat growth, more on-site options, managing their own energy patterns and bills
- **Technology advancements:** lowering costs of renewables, storage, grid controls
- **Power plant emissions:** controlling mercury/air toxics emissions; reducing CO2 emissions from existing and new plants
- **Infrastructure and electric-resources needs:** making the system more resilient, flexible, and responsive; valuing attributes besides MW and MWh

**\$1-\$2 trillion investment, in the face of ~flat demand**



**Use the EPA's Clean Power Plan process to continue progress on:**

- using domestic energy resources,
- modernizing the grid,
- doubling energy productivity,
- reducing CO<sub>2</sub> emissions



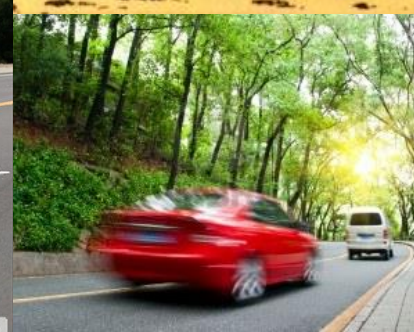
Data source: ESRI



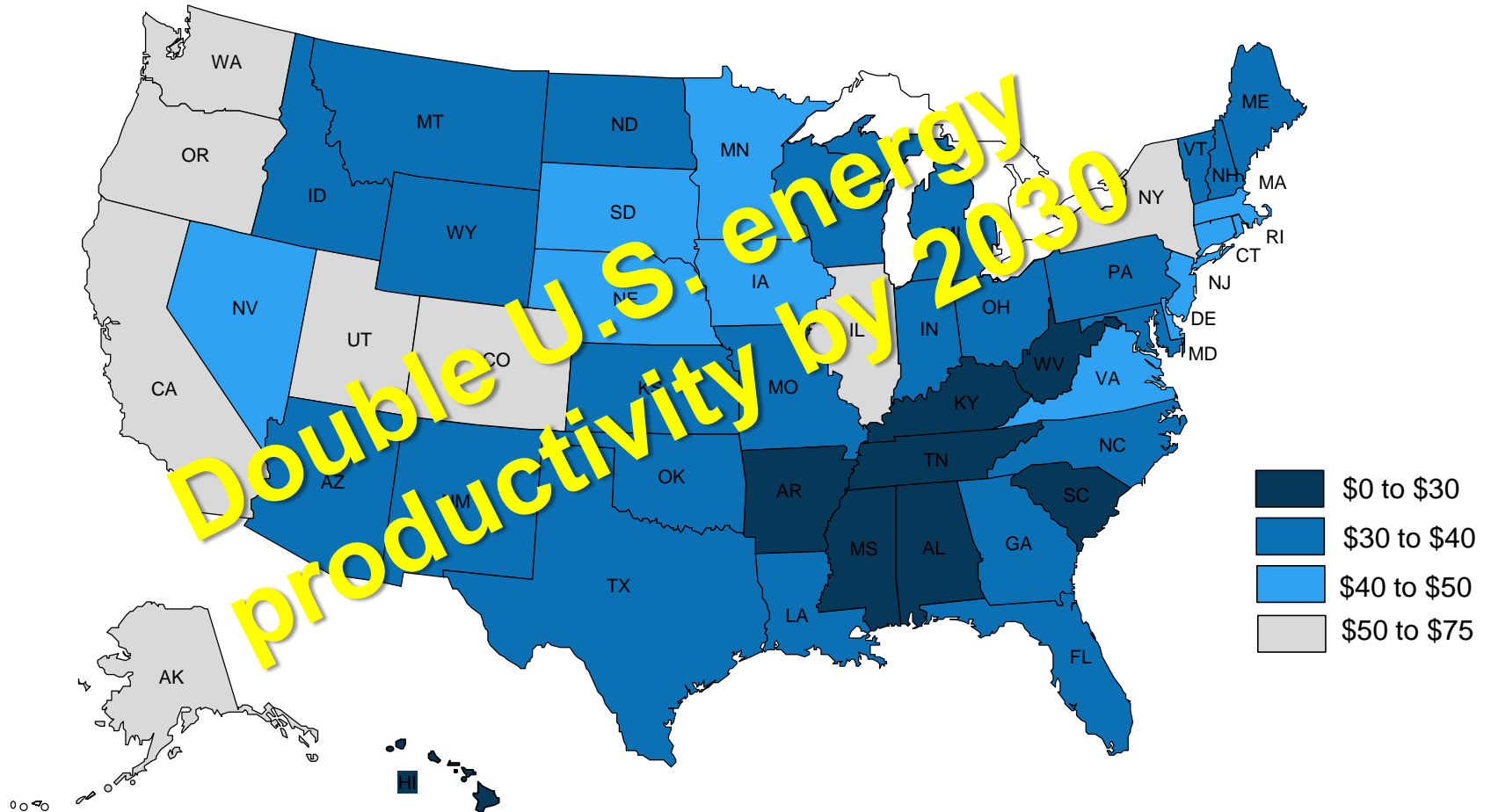
# EPA's Clean Power Plan: Where to go



States:  
What model and routes  
to take



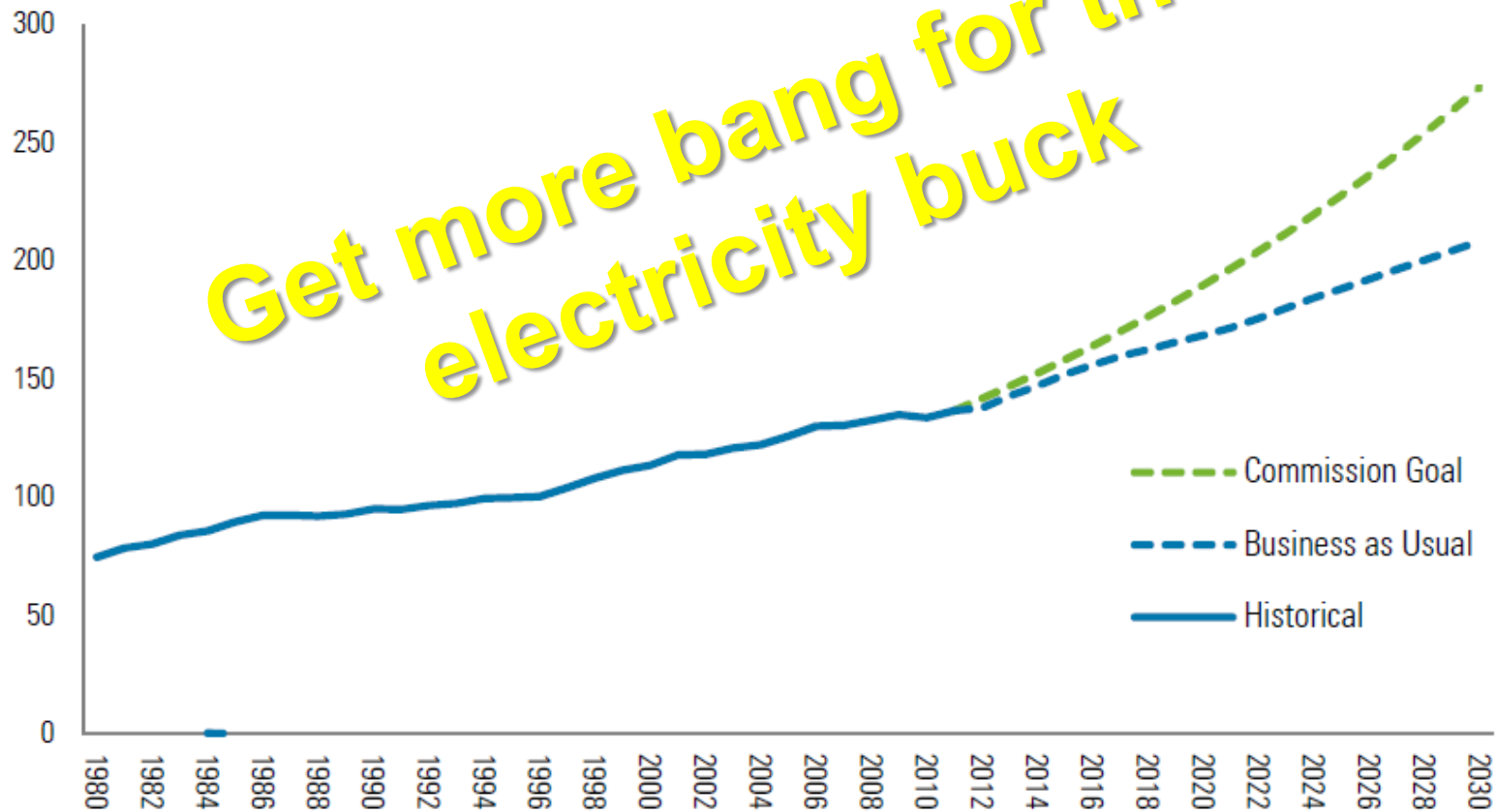
## \$ of Gross State Product Per \$ Spent on Electricity (2011)



\* Target for recommendations of the Alliance Commission on National Energy Efficiency Policy

# Double energy productivity

Real 2005 chained USD of GDP per million BTU of energy demand



Source: EIA and Rhodium Group estimates

Rhodium Group, "American Energy Productivity: The Economic, Environmental and Security Benefits of Unlocking Energy Efficiency," prepared for the Alliance Commission on National Energy Efficiency Policy, February 2013





**Reduce GHG emissions**

**SPECIAL REPORT GLOBAL WARMING**

# TIME

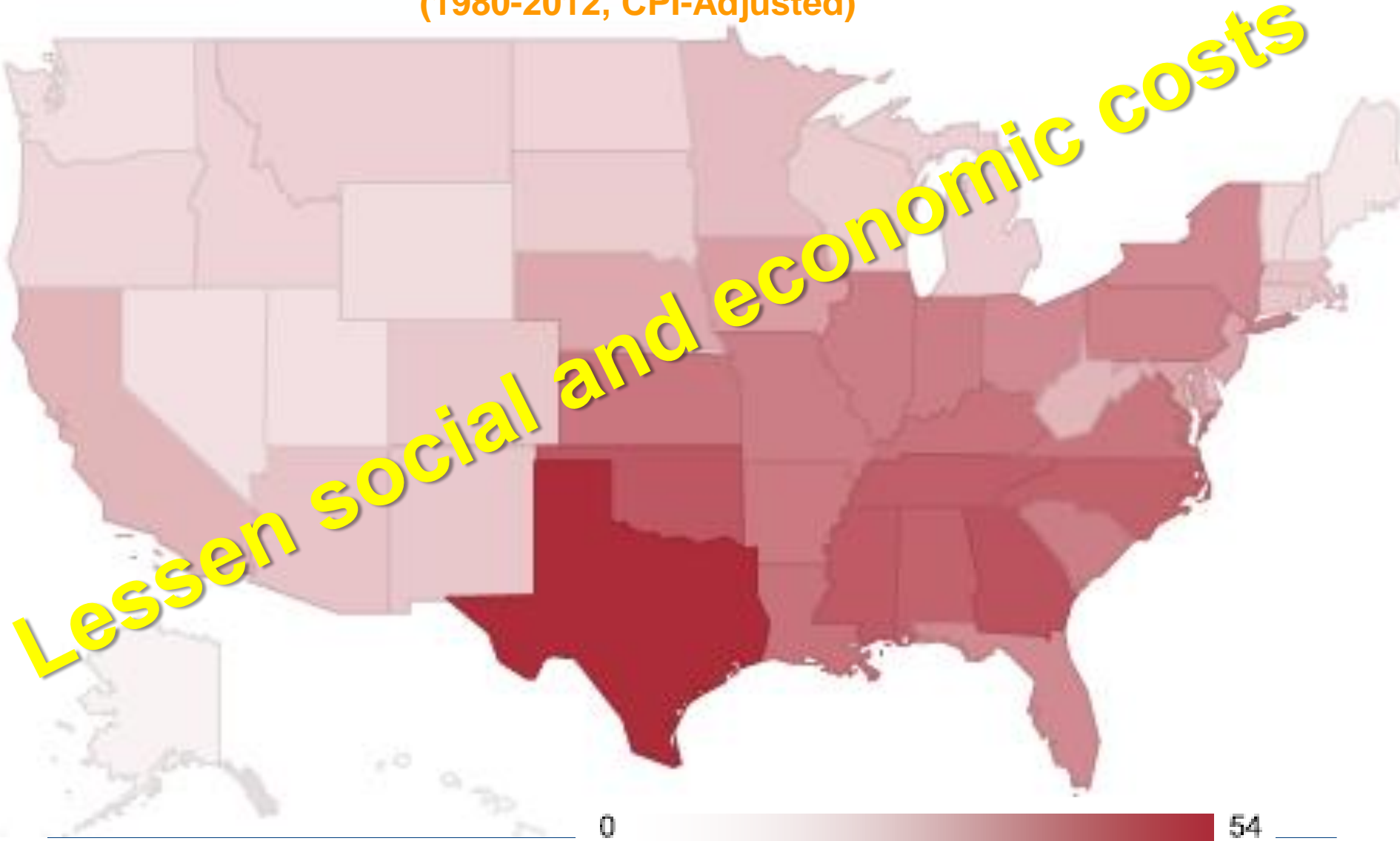
**BE WORRIED.  
BE **VERY** WORRIED.**

Climate change isn't some vague future problem—it's already damaging the planet at an alarming pace. Here's how it affects you, your kids and their kids as well.

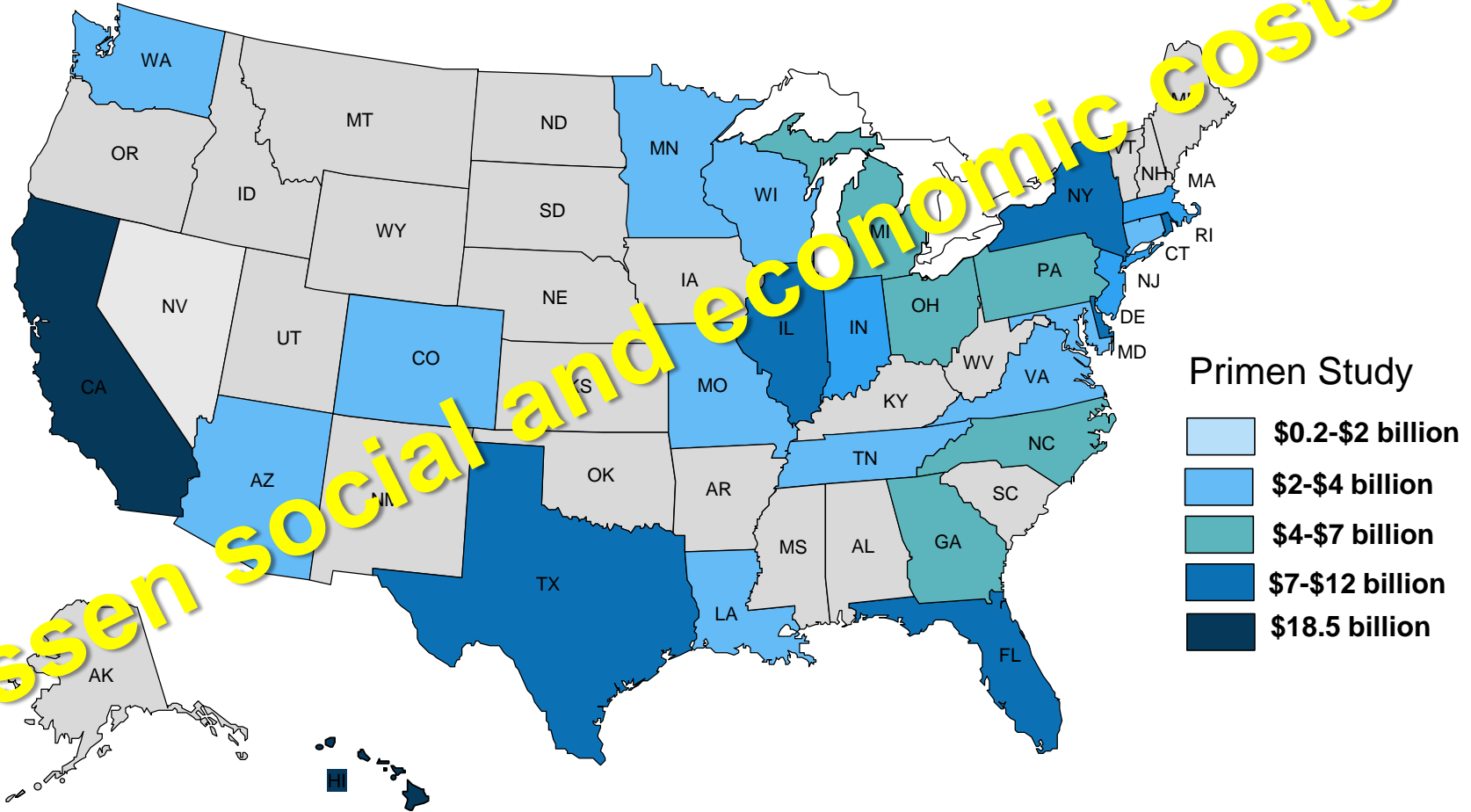
**EARTH AT THE TIPPING POINT**  
**HOW IT THREATENS YOUR HEALTH**  
**HOW CHINA & INDIA CAN HELP SAVE THE WORLD—OR DESTROY IT**  
**THE CLIMATE OUTSPOKES**



## Billion-Dollar Weather/Climate Disasters (1980-2012, CPI-Adjusted)



# Annual Business Losses from Grid Problems: \$150billion per year (2011) (note: pre-Sandy, pre-Colorado)



<http://blogs-images.forbes.com/williampentland/files/2011/04/Power-Outages-Map-of-Estimated-Costs-web.jpg>





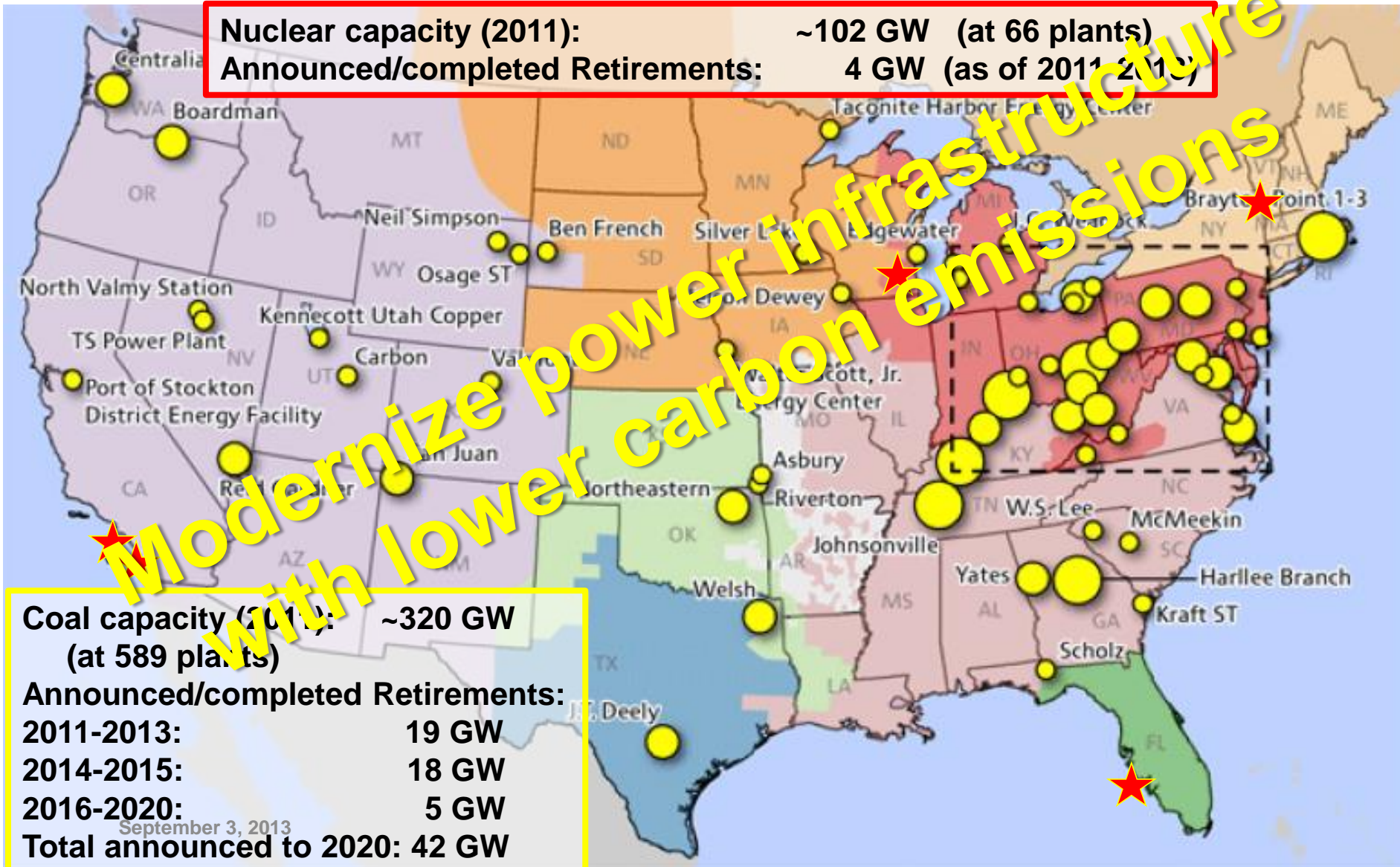
**Empower customers**





# Announced coal and nuclear retirements as of 3-2014

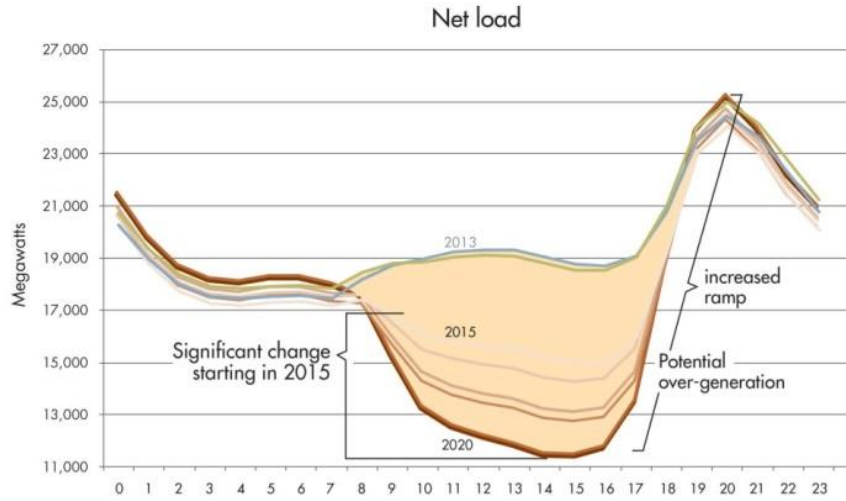
**Nuclear capacity (2011):** ~102 GW (at 66 plants)  
**Announced/completed Retirements:** 4 GW (as of 2011-2013)



**Coal capacity (2011):** ~320 GW (at 589 plants)  
**Announced/completed Retirements:**  
 2011-2013: 19 GW  
 2014-2015: 18 GW  
 2016-2020: 5 GW  
**Total announced to 2020: 42 GW**

September 3, 2013

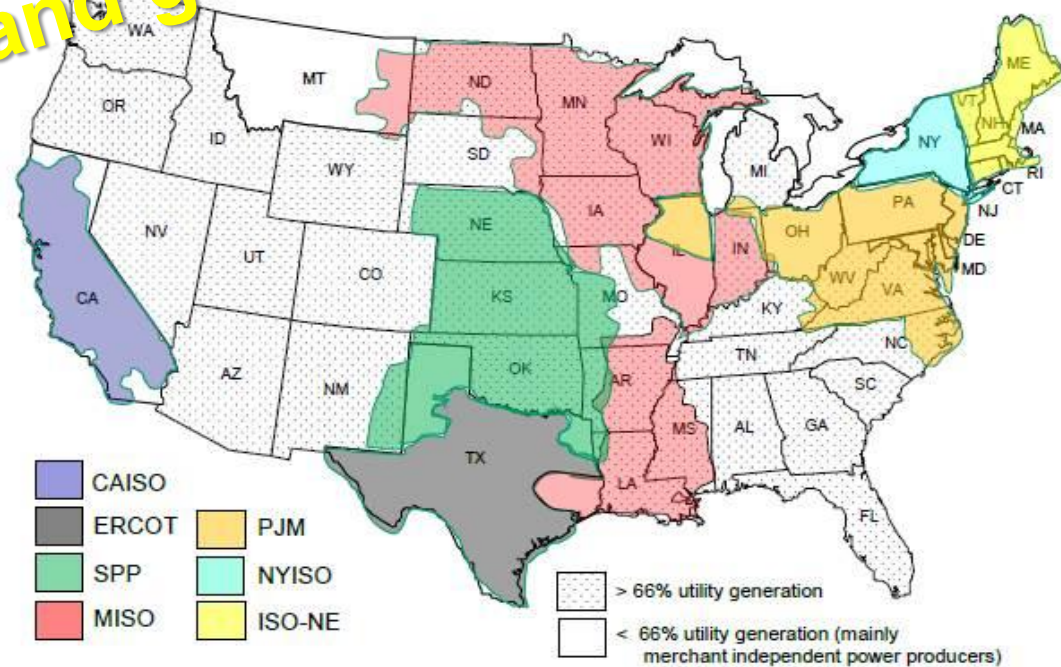
# Growing need for flexibility starting 2015



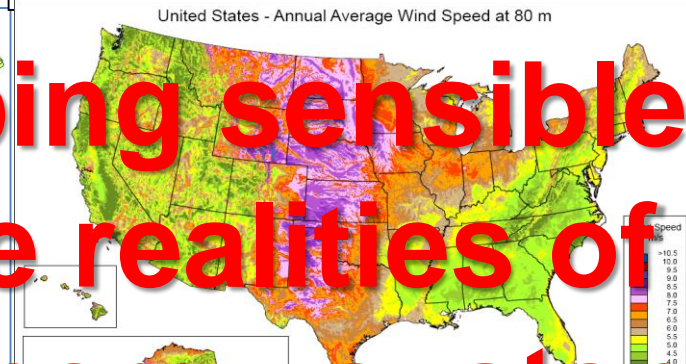
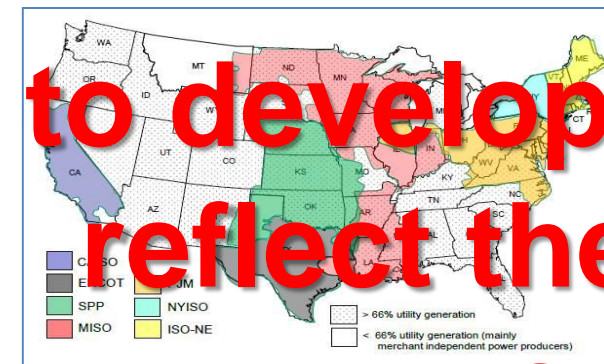
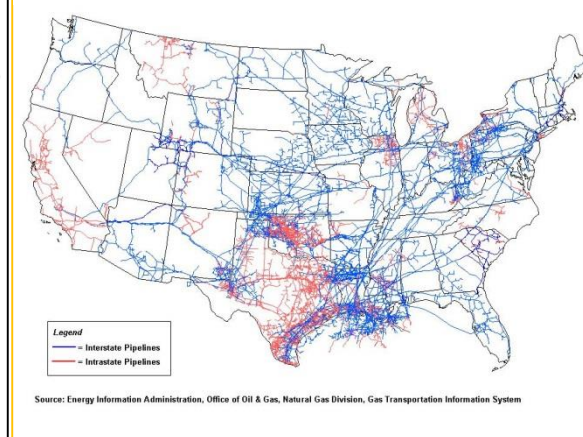
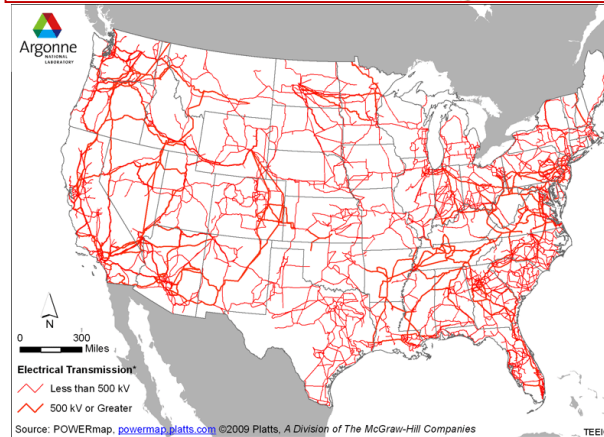
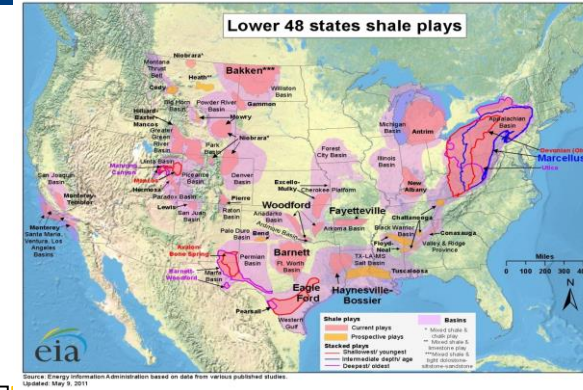
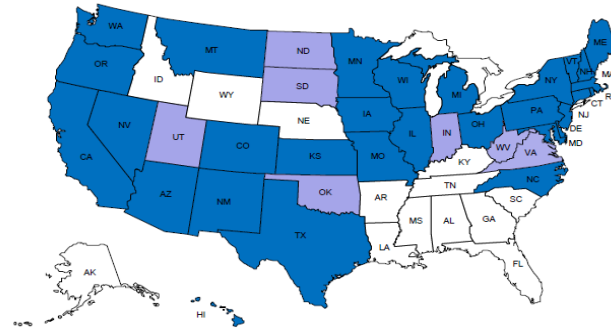
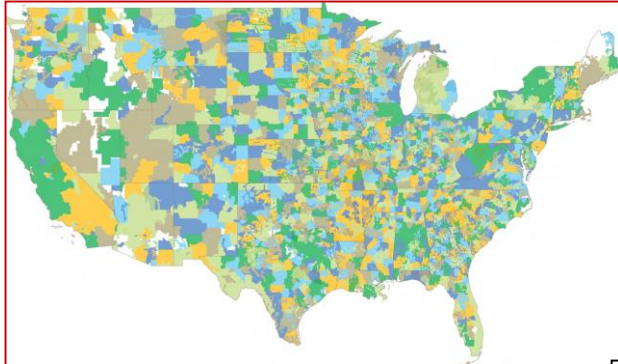
California ISO  
Energy Research Center



**Harmonize electricity and natural gas markets;  
Make renewables and gas friends, not foes**







to developing sensible plans that reflect the realities of interstate energy systems

**UNLOCKING DEMAND:**  
AN ANALYSIS OF STATE ENERGY EFFICIENCY AND RENEWABLE ENERGY FINANCING PROGRAMS IN THE BUILDINGS AND INDUSTRIAL SECTORS

National Association of State Energy Officials  
2107 Wilson Boulevard, Suite 850  
Arlington, Virginia 22201  
www.naseo.org

**STATE ENERGY PLANNING GUIDELINES**  
A Guide to Develop a Comprehensive State Energy Plan Plus Supplemental Policy and Program Options

NASEO

Make good use of NASEO services

Carbon pollution from existing power plants

**NASEO**

Environmental Protection Agency, under President Obama's Climate Action Plan the Clean Power Plan will maintain an affordable, reliable energy system now and for future generations.

**Facilities Covered by the Rule**

Power plants are the largest source of carbon pollution in the United States, accounting for roughly one-third of all domestic green-house gas emissions.

Nationwide, the Clean Power Plan will help cut carbon emissions from the power sector by 30 percent below 2005 levels.

The interactive map to the right shows the location of

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