

# Energy – use, where it comes from and why it is important

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The Goals of this Presentation is two fold:

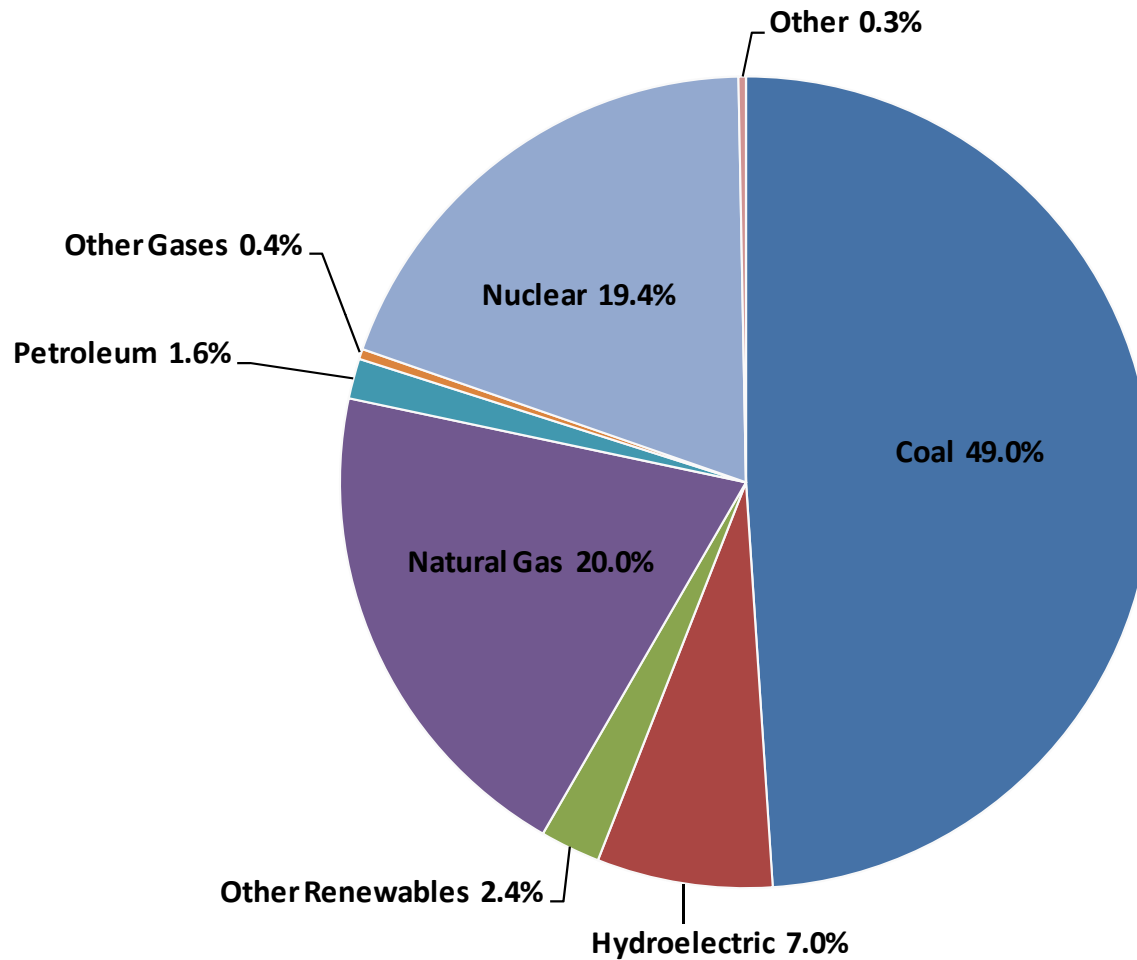
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- Energy – where it comes from
- Economic Prosperity – how it is related to energy



# Sources of Energy

## Fuel Sources for Electric Generation in 2006

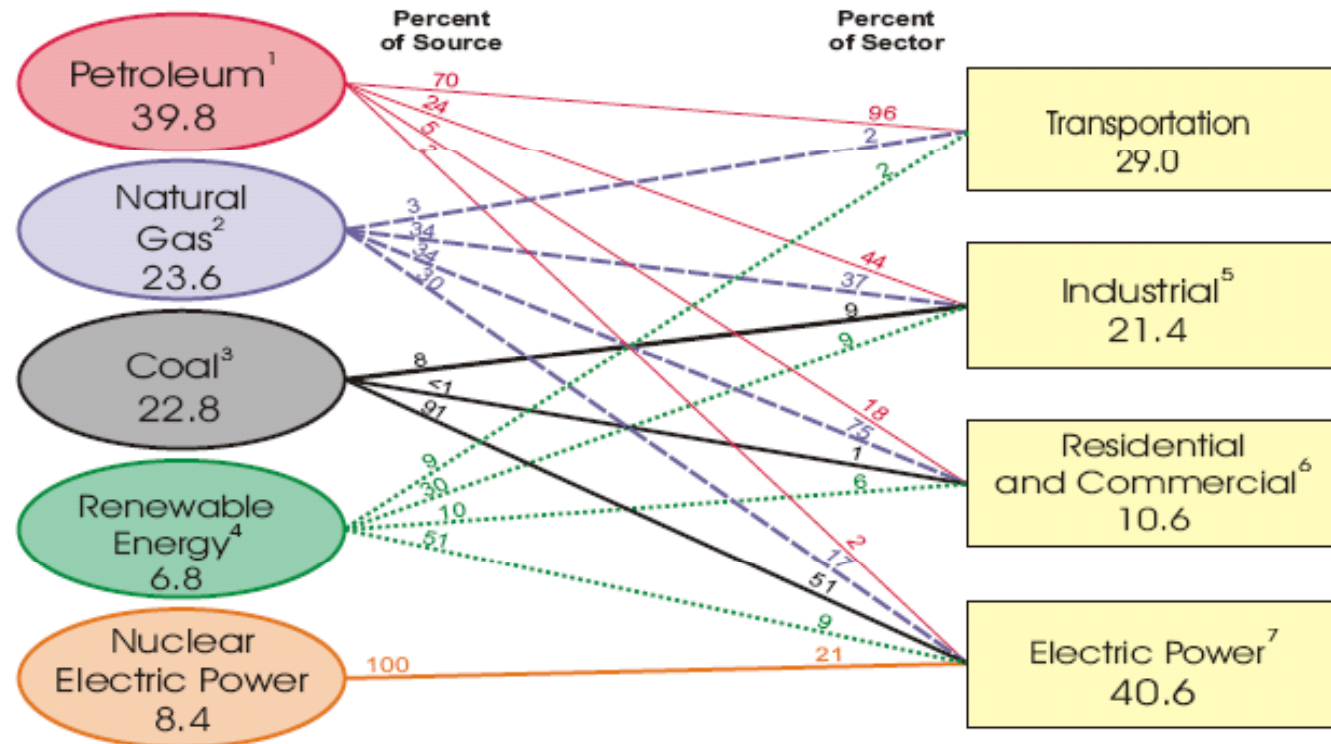


Source US Department of Energy, Energy Information Administration



# Energy Consumption

U.S. Primary Energy Consumption by Source and Sector, 2007  
(Quadrillion Btu)

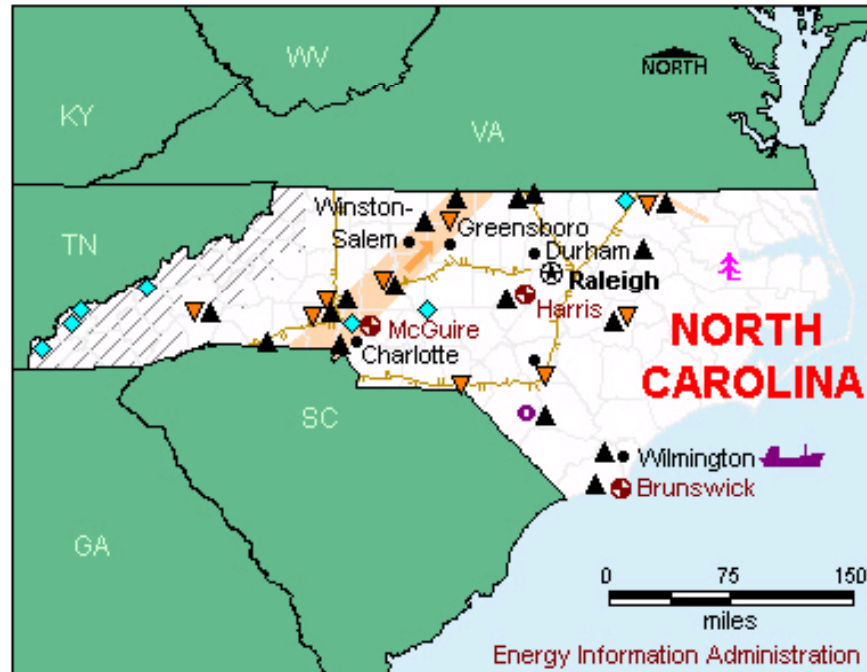


<sup>1</sup>Does not include 0.6 quadrillion Btu of fuel ethanol, which is included in "Renewable Energy."  
<sup>2</sup>Excludes supplemental gaseous fuels.  
<sup>3</sup>Includes less than 0.1 quadrillion Btu of coal coke net imports.  
<sup>4</sup>Conventional hydroelectric power, geothermal, solar PV, wind, and biomass.  
<sup>5</sup>Includes industrial combined-heat-and-power (CHP) and industrial electricity-only plants.

<sup>6</sup>Includes commercial combined-heat-and-power (CHP) and commercial electricity-only plants.  
<sup>7</sup>Electricity-only and combined-heat-and-power (CHP) plants whose primary business is to sell electricity, or electricity and heat, to the public.  
 Note: Sum of components may not equal 100 percent due to independent rounding.  
 Sources: Energy Information Administration, *Annual Energy Review 2007*, Tables 1.3, 2.1b-2.1f and 10.3.

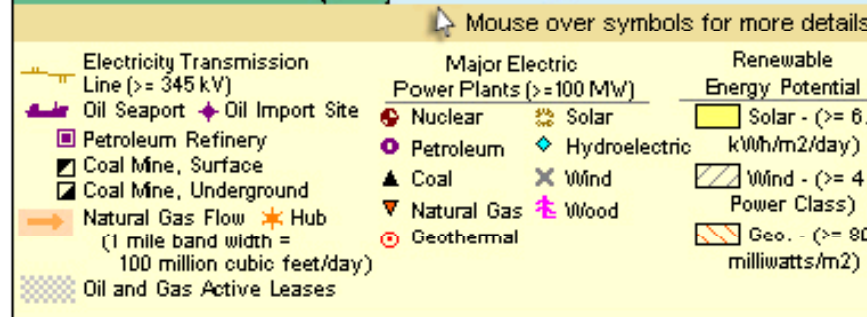


# NC Profile



## North Carolina Quick Facts

- North Carolina is one of the top nuclear power producers in the United States.
- The Dixie Pipeline, a major supplier of propane to the Southeast, terminates in Apex, North Carolina, where a terminal and above-ground storage tanks are located.
- Several rivers in western and central North Carolina provide hydroelectric power, North Carolina's only substantial energy resource.
- North Carolina's electricity consumption is among the highest in the Nation.





# Renewable Energy

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- Biomass
  - Wood and Wood Waste
  - Municipal Solid Waste
  - Landfill gas
- Geothermal
- Hydro
- Solar
  - Thermal
  - Photovoltaic
- Wind
- Ethanol



# Renewable Energy

## Wood and Wood Waste



Truck unloading wood chips that will fuel the Tracy Biomass Plant, Tracy, California.

Biomass energy is derived from three distinct energy sources: wood, waste, and alcohol fuels. Wood energy is derived both from direct use of harvested wood as a fuel and from wood waste streams. The largest source of energy from wood is pulping liquor or “black liquor,” a waste product from processes of the pulp, paper and paperboard industry. Waste energy is the second-largest source of biomass energy. The main contributors of waste energy are municipal solid waste (MSW), manufacturing waste, and landfill gas. Biomass alcohol fuel, or ethanol, is derived almost exclusively from corn. Its principal use is as an oxygenate in gasoline.

Source: National Renewable Energy Laboratory, Photographic Information Exchange



# Renewable Energy

## Municipal Solid Waste



The municipal solid waste industry has four components: recycling, composting, landfilling, and waste-to-energy via incineration. Municipal solid waste is total waste excluding industrial waste, agricultural waste, and sewage sludge. As defined by the U.S. Environmental Protection Agency, it includes durable goods, non-durable goods, containers and packaging, food wastes, yard wastes, and miscellaneous inorganic wastes from residential, commercial, institutional, and industrial sources. Examples from these categories include: appliances, newspapers, clothing, food scrapes, boxes, disposable tableware, office and classroom paper, wood pallets, rubber tires, and cafeteria wastes. Waste-to-energy combustion and landfill gas are byproducts of municipal solid waste.

Source: National Renewable Energy Laboratory, Photographic Information Exchange





# Renewable Energy

## Landfill Gas



Municipal solid waste contains significant portions of organic materials that produce a variety of gaseous products when dumped, compacted, and covered in landfills. Anaerobic bacteria thrives in the oxygen-free environment, resulting in the decomposition of the organic materials and the production of primarily carbon dioxide and methane. Carbon dioxide is likely to leach out of the landfill because it is soluble in water. Methane, on the other hand, which is less soluble in water and lighter than air, is likely to migrate out of the landfill. Landfill gas energy facilities capture the methane (the principal component of natural gas) and combust it for energy.

Source: National Renewable Energy Laboratory, Photographic Information Exchange



# Renewable Energy

## Geothermal



Geothermal energy is contained in underground reservoirs of steam, hot water, and hot dry rocks. As used at electric generating facilities, hot water or steam extracted from geothermal reservoirs in the Earth's crust is supplied to steam turbines at electric utilities that drive generators to produce electricity. Moderate-to-low temperature geothermal resources are used for direct-use applications such as district and space heating. Lower temperature, shallow ground, geothermal resources are used by geothermal heat pumps to heat and cool buildings.

Source: National Renewable Energy Laboratory, Photographic Information Exchange



# Renewable Energy

## Geothermal – Heat Pumps



GHP equipment at Beijing Concordia International Apartment Building.

A geothermal heat pump is an electric heat pump that draws heat from or discharges heat to the ground or ground water, instead of air. This works because the ground temperature which is 10-12 feet below the earth's surface stays relatively constant at 55 degrees Fahrenheit. A turbine is driven either from hot water or by natural steam that derives its energy from the Earth's heat. An "open loop" geothermal heat pump uses heat found in rocks or fluids at various depths beneath the surface of the earth, and receives/discharges fluids from the earth. The fluids are extracted by drilling and/or pumping. A "closed loop" geothermal heat pump pipes a fluid in a closed piping system underground, which receives heat from or discharges heat to the Earth.

**Source: National Renewable Energy Laboratory, Photographic Information Exchange**



# Renewable Energy

## Hydro



Water is currently the leading renewable energy source used by electric utilities to generate electric power. Hydroelectric plants operate where suitable waterways are available; many of the best of these sites have already been developed. Generating electricity using water has several advantages. The major advantage is that water is a source of cheap power. In addition, because there is no fuel combustion, there is little air pollution in comparison with fossil fuel plants and limited thermal pollution compared with nuclear plants. Like other energy sources, the use of water for generation has limitations, including environmental impacts caused by damming rivers and streams, which affects the habitats of the local plant, fish, and animal life.

Source: National Renewable Energy Laboratory, Photographic Information Exchange



# Renewable Energy

## Solar - Thermal



Solar thermal devices use direct heat from the sun, concentrating it in some manner to produce heat at useful temperatures. The modern solar industry began with the oil embargo of 1973-1974 and was strengthened with the second embargo in 1979. The growth of the solar industry during this period of fuel shortages and high prices (1974-1984) soared from 45 solar collector manufacturing firms to 225 firms. The solar market was helped during this period by government assistance, both Federal and State. Currently, solar thermal devices do everything from heating swimming pools to creating steam for electricity generation.

Stirling Energy Systems, Inc. (SES)/Boeing, 25 kW Dish Stirling system at sunset.

Source: National Renewable Energy Laboratory, Photographic Information Exchange



# Renewable Energy

## Solar - Photovoltaic



Photovoltaic devices use semiconducting materials to convert sunlight directly into electricity. Solar radiation, which is nearly constant outside the Earth's atmosphere, varies with changing atmospheric conditions (clouds and dust) and the changing position of the Earth relative to the sun. Nevertheless, almost all U.S. regions have useful solar resources that can be accessed.

Source: National Renewable Energy Laboratory, Photographic Information Exchange



# Renewable Energy

## Wind



Winds are created by uneven heating of the atmosphere by the sun, irregularities of the Earth's surface, and the rotation of the Earth. As a result, winds are strongly influenced and modified by local terrain, bodies of water, weather patterns, vegetative cover, and other factors. The wind flow, or motion of energy when harvested by wind turbines, can be used to generate electricity. Wind-based electricity generating capacity has increased markedly in the United States since 1970, although it remains a small fraction of total electric capacity.

750 kW NEG Micon Turbine in Moorhead Minnesota.

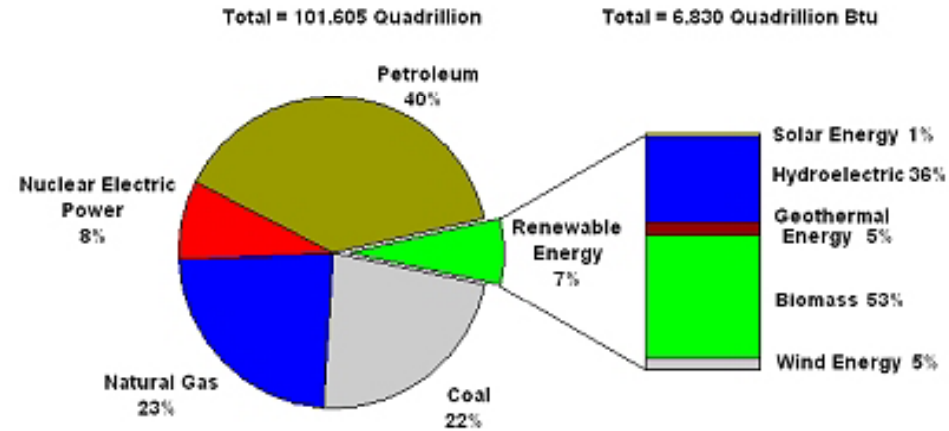
Source: National Renewable Energy Laboratory, Photographic Information Exchange



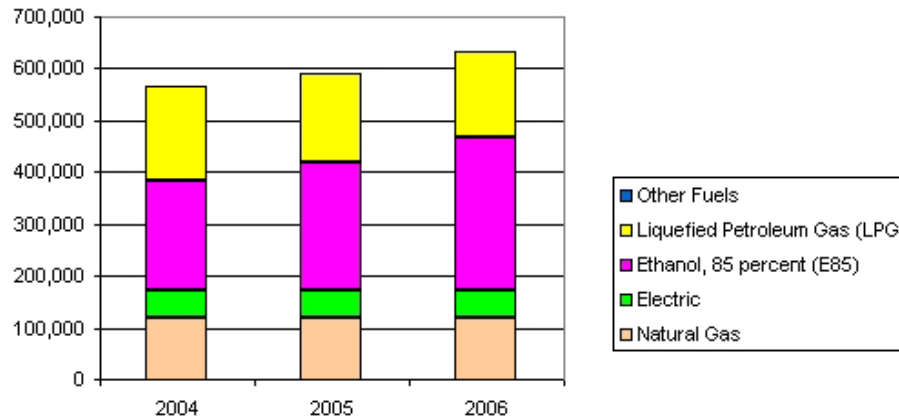
# Renewable Energy

## Ethanol

Alternative fuel produced by fermentation of sugars, in the United States it is most commonly produced from corn and used in gasoline at volume fractions of 10 percent or less.



Estimated Number of Alternative Fueled Vehicles in Use in the U.S., 2004-2006



Source: National Renewable Energy Laboratory, Photographic Information Exchange





# Popular Misconception: Renewable Power CAN Power America

93% of America's energy is used as heat energy for prime movers such as steam turbines, jet engines, diesel locomotives, ship propulsion, buses and automobiles.

Renewable Energy – including old hydropower dams is about 7% now and cannot replace the 93% energy forms that America Depends on now.





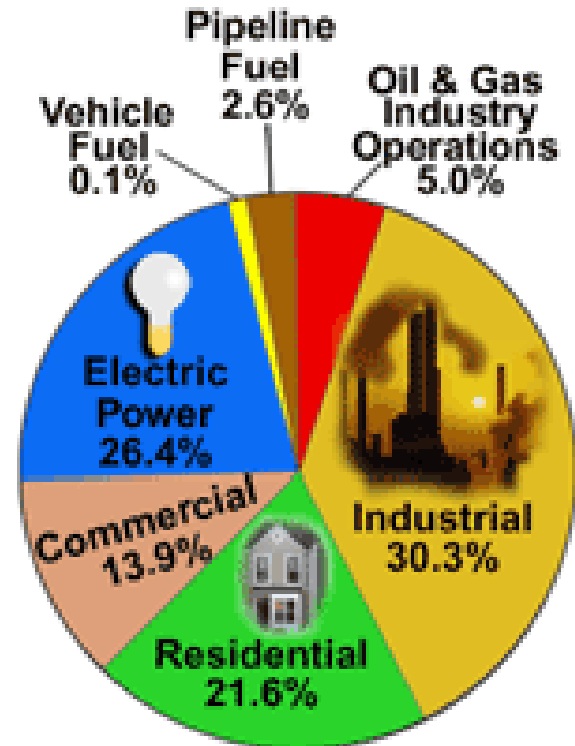
# Non Renewable Energy

## Natural Gas

Natural gas is a nonrenewable source of energy used primarily for heating and generating electricity. The U.S. produces natural gas from wells within the U.S. but also imports natural gas from abroad. The U.S. imports natural gas via pipeline from Canada and Mexico, but to move natural gas from countries that are further away, the natural gas is turned into a liquid (also called "Liquefied Natural Gas" or LNG) by super cooling and transported as a liquid on tankers before being warmed up and turned into a gas upon arrival in the United States.

Natural gas burns more cleanly than other fossil fuels. It has fewer emissions of sulfur, carbon, and nitrogen than coal or oil, and when it is burned, it leaves almost no ash particles. Being a clean fuel is one reason that the use of natural gas, especially for electricity generation, has grown so much and is expected to grow even more in the future.

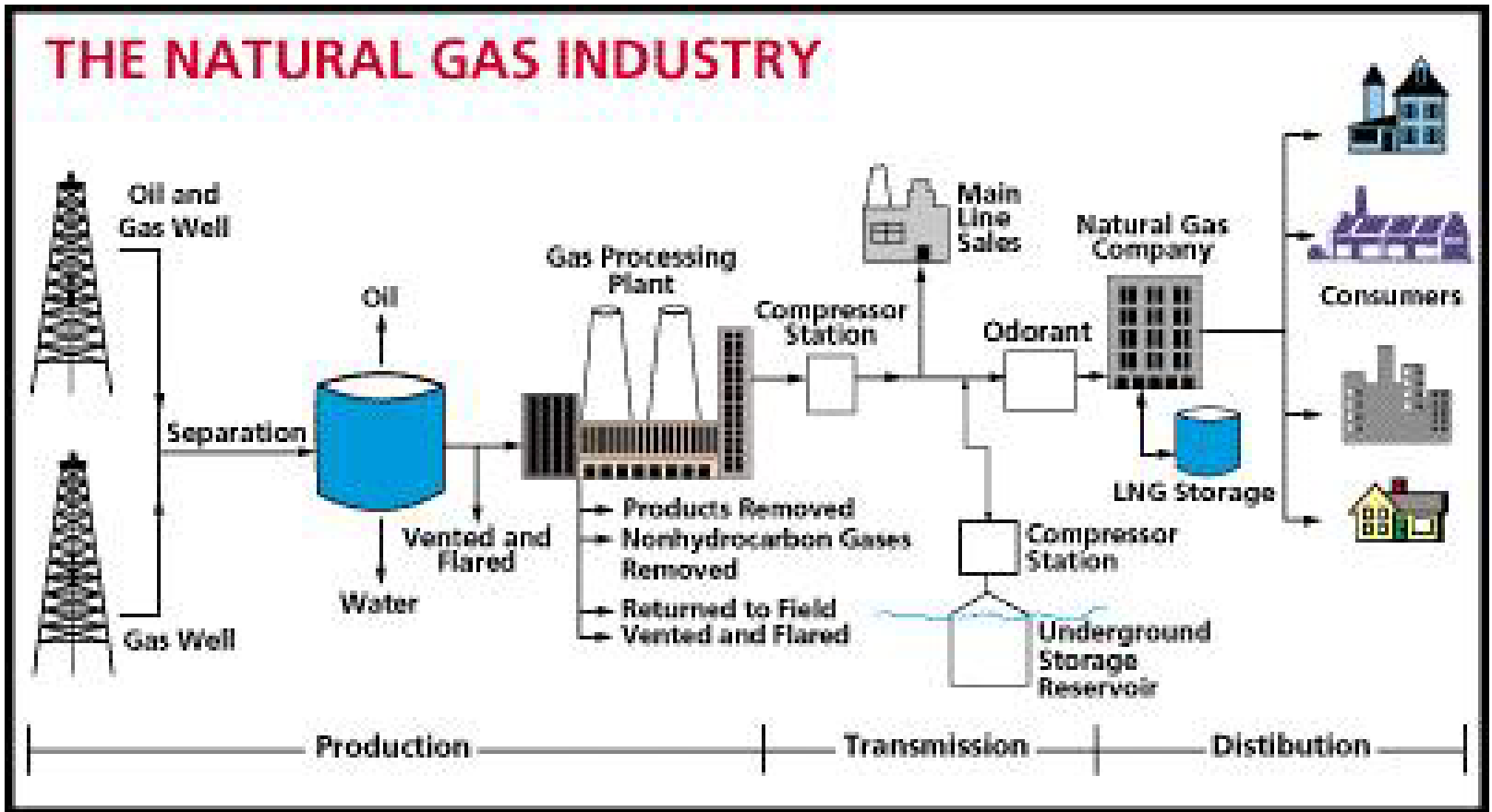
## NATURAL GAS USE



Source: [http://www.eia.doe.gov/basics/naturalgas\\_basics.html](http://www.eia.doe.gov/basics/naturalgas_basics.html)

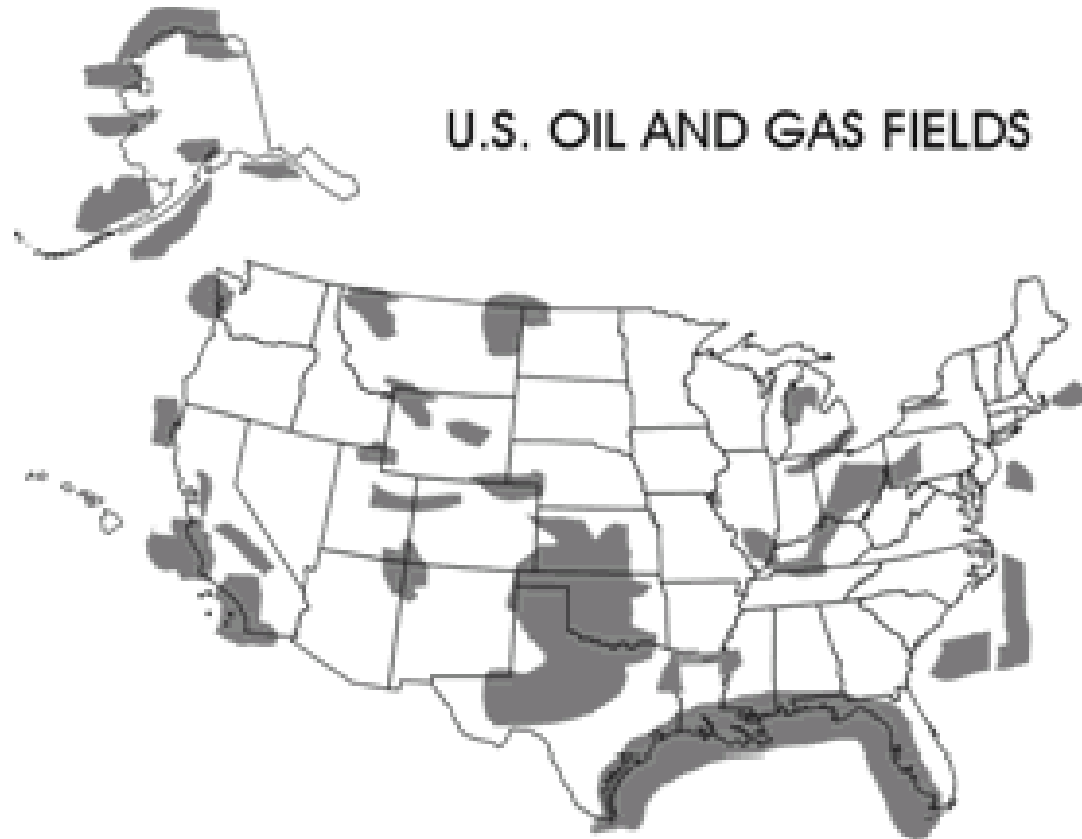


## THE NATURAL GAS INDUSTRY





Source: Sources: National Energy Education Development Project, *Ocean Energy*, 2006-2007.

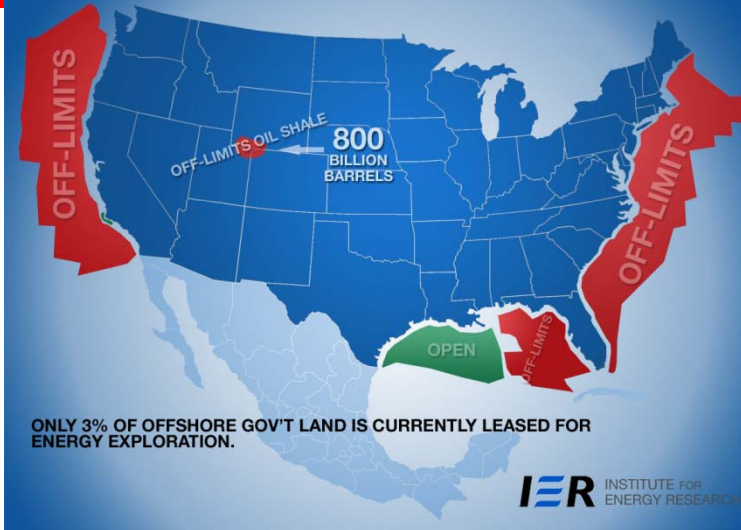


Note: Although it might seem like the ocean is the border of the U.S., the border is actually 200 miles out from the land. This 200 mile wide band around the country is called the Exclusive Economic Zone (EEZ). In 1983, the President claimed the area of the EEZ in the name of the United States, and in 1994, all countries were granted an EEZ of 200 miles from their coastline according to the International Law of the Sea.



## OFFSHORE ENERGY RESOURCES [OCS]

- OFF-LIMITS TO ENERGY EXPLORATION
- ONLY AVAILABLE OFFSHORE AREA OPEN TO EXPLORATION IN THE CONTINENTAL UNITED STATES



Click for details



**10 billion barrels**  
White House estimate of reserves  
Arctic National Wildlife Refuge

Click for details



**18 billion barrels**  
White House estimate of reserves  
Off-shore drilling

Click for details



**800 billion barrels**  
White House estimate of reserves  
Oil shale



# Non Renewable Energy

## Oil

Oil is the lifeblood of America's economy. Currently, it supplies more than 40% of our total energy demands and more than 99% of the fuel we use in our cars and trucks.



At Arab Oil Embargo in 1974 – USA imported 25% of total – now about 60%



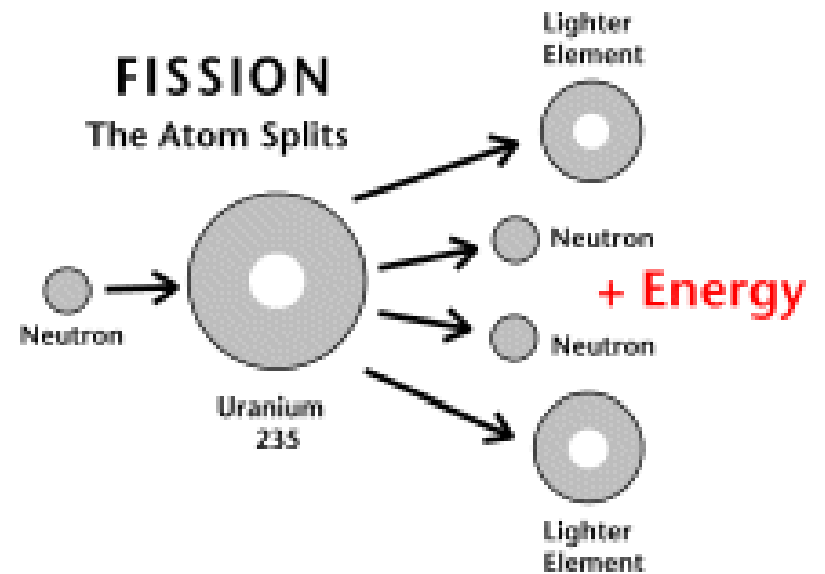
Imagine 22 of these side by side – each 48” in diameter and each passing 1 million barrels/day of oil. This is how much oil we use each day. Most for transportation.



# Non Renewable Energy

## Nuclear - Fission

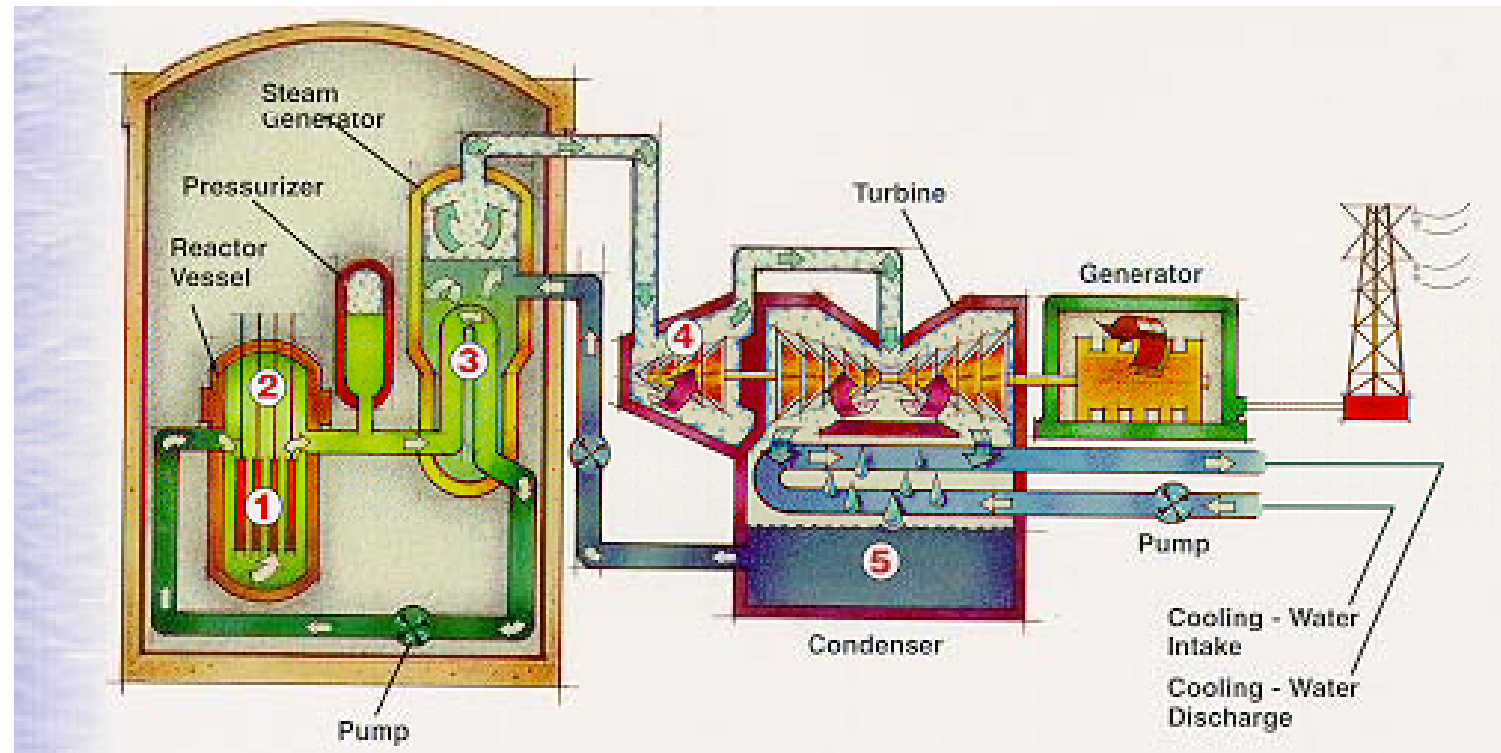
Nuclear power accounts for about 19 percent of the total electricity generated in the United States, an amount comparable to all the electricity used in California, Texas and New York, our three most populous (having the most people) states. A nuclear power plant operates basically the same way as a fossil fuel plant, with one difference: the source of heat. The process that produces the heat in a nuclear plant is the fissioning or splitting of uranium atoms. That heat boils water to make the steam that turns the turbine-generator, just as in a fossil fuel plant. The part of the plant where the heat is produced is called the reactor core.



Source: [http://www.eia.doe.gov/basics/nuclear\\_basics.html](http://www.eia.doe.gov/basics/nuclear_basics.html)



# Non Renewable Energy



Nuclear reactors are basically machines that contain and control chain reactions, while releasing heat at a controlled rate. In electric power plants, the reactors supply the heat to turn water into steam, which drives the turbine-generators. The electricity travels through high voltage transmission lines and low voltage distribution lines to homes, schools, hospitals, factories, office buildings, rail systems and other users.

Source: [http://www.eia.doe.gov/basics/nuclear\\_basics.html](http://www.eia.doe.gov/basics/nuclear_basics.html)





# Non Renewable Energy



Yucca Mountain  
Planned site for the nation's first  
long-term geological repository  
for nuclear waste.

Compared to electricity generated by burning fossil fuels, nuclear energy is clean. Nuclear power plants produce no air pollution or carbon dioxide but a small amount of emissions result from processing the uranium that is used in nuclear reactors.

Like all industrial processes, nuclear power generation has by-product wastes: spent (used) fuels, other radioactive waste, and heat. Spent fuels and other radioactive wastes are the principal environmental concern for nuclear power.

The United States Department of Energy's long range plan is for this spent fuel to be stored deep in the earth in a geologic repository, at Yucca Mountain, Nevada.

Sources: Energy Information Administration, *Annual Energy Review* 2006, August 2007,  
Energy Information Administration, Office of Coal, Nuclear, Electric, and Alternative Fuels, October 2006.



Closer to Home – Where does our Electricity Originate?

## 2 – 832MW Nuclear Units



Source: <http://eyeball-series.org/npp2/npp2-eyeball.htm>

Catawba Nuclear Plant



# North Carolina Municipal Power Authority

There are 19 cities in the North Carolina Municipal Power Agency 1 (NCMPA1) of Electric Cities of NC. This consortium holds ownership of 75% of generation at Unit #2 the Catawba Nuclear Plant. Catawba Nuclear Unit #2 is rated at 832 MW (megawatts).

- Albemarle
- Bostic
- Cherryville
- Cornelius
- Drexel
- Gastonia
- Granite Falls
- High Point
- Huntersville
- Landis
- Lexington
- Lincolnton
- Maiden
- Monroe
- Morganton
- Newton
- Pineville
- Shelby
- Statesville

**Albemarle consumes an average of about 50MW of electric power.  
Peak usage last year was 67MW.**



# Non Renewable Energy

## Coal

Coal is one of the true measures of the energy strength of the United States. One quarter of the world's coal reserves are found within the United States, and the energy content of the nation's coal resources exceeds that of all the world's known recoverable oil. Coal is also the workhorse of the nation's electric power industry, supplying more than half the electricity consumed by Americans.

Coal is a combustible black or brownish-black sedimentary rock composed mostly of carbon and hydrocarbons. It is the most abundant fossil fuel produced in the United States. Over 90 percent of the coal used in the United States is used to generate electricity. It's also used as a basic energy source in many industries, including, steel, cement and paper.





# COAL our most abundant fuel

Coal is the largest single primary source of energy used to generate electricity in the United States (~ 50%) !



Common Power Plants Consume anywhere from 4 – 8 rails cars of coal per hour to produce electrical energy.



# Coal is a National Treasure

## Coal Producing States

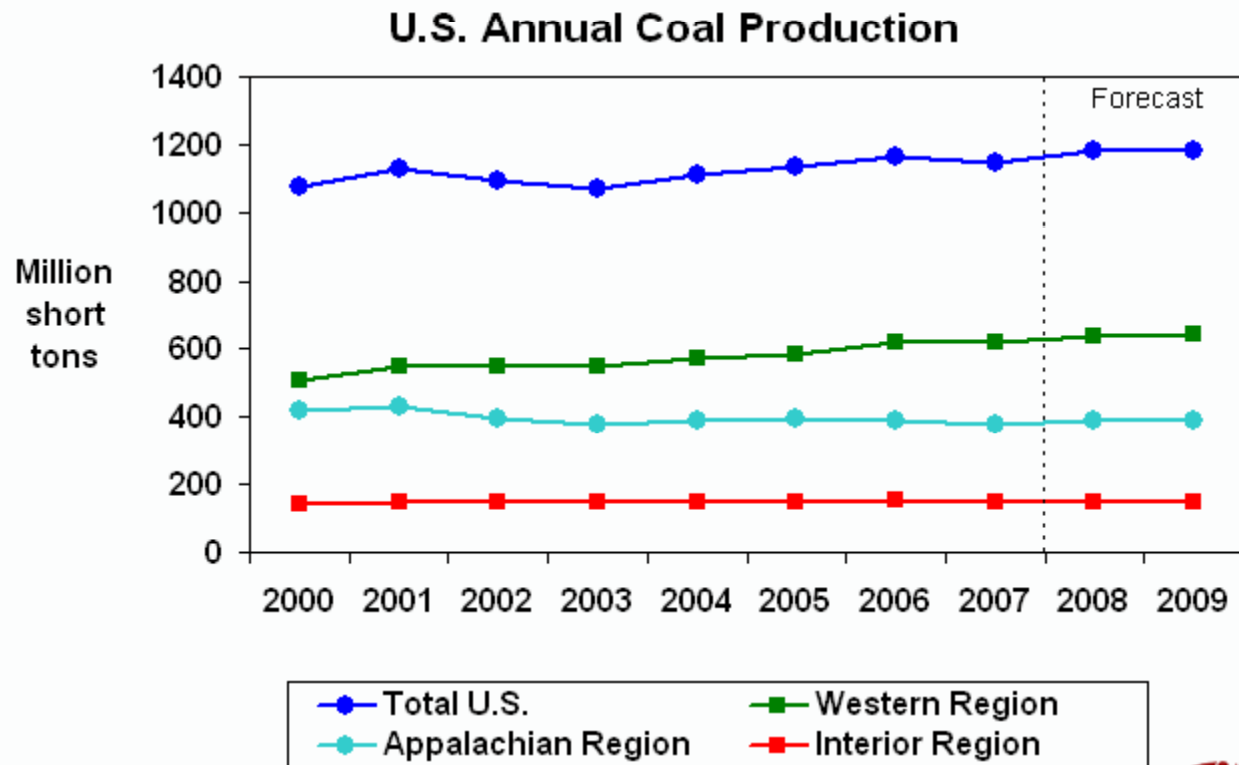
### *Major & Minor*



Coal is a Fossil Fuel sourced from the organic remains of prehistoric organisms.



# Coal Production



Short-Term Energy Outlook, September 2008





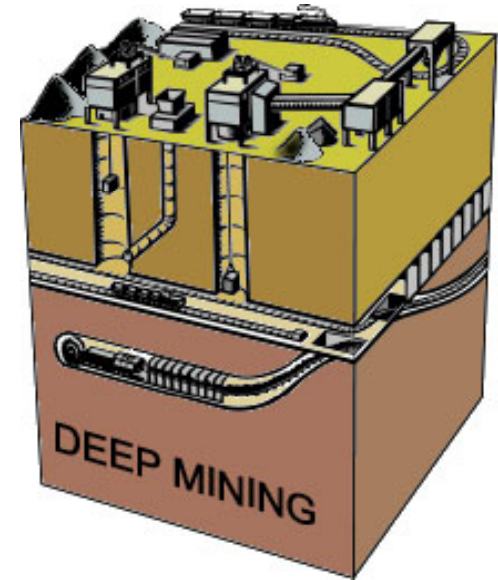
# Mining for COAL

**SURFACE  
MINING**



Top Soil  
Overburden

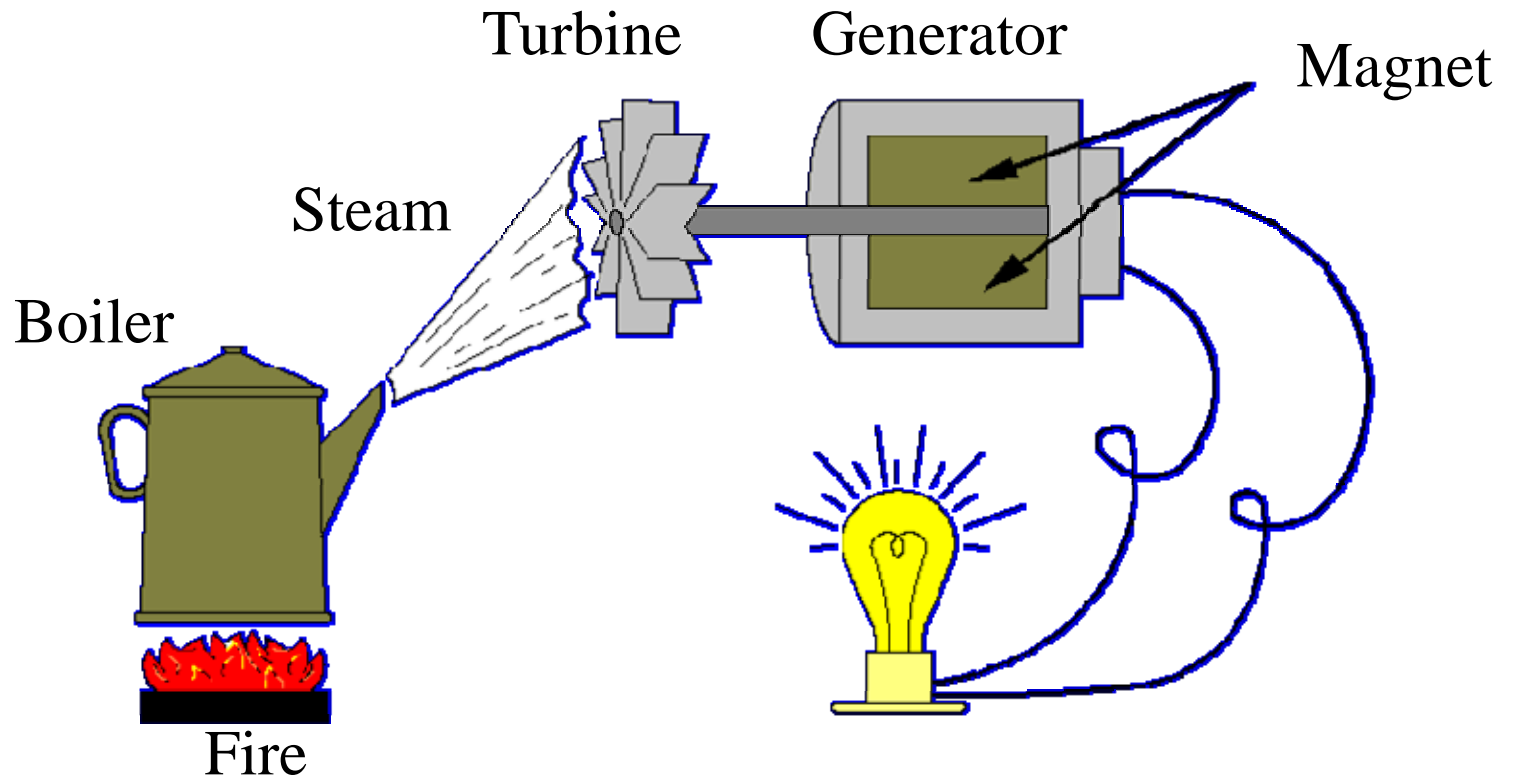
**Shallow Coal Seam**





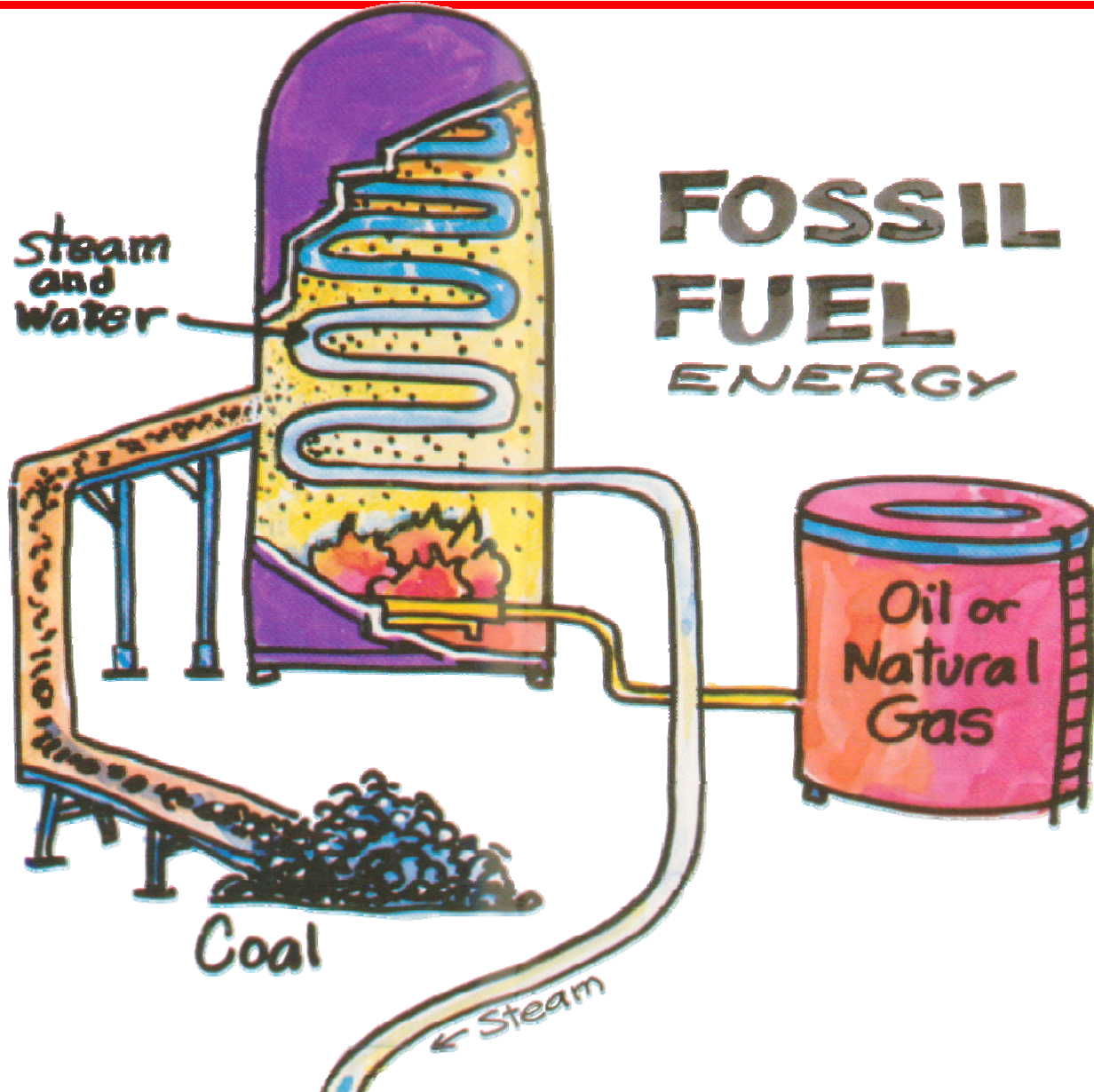


# The Basic Process

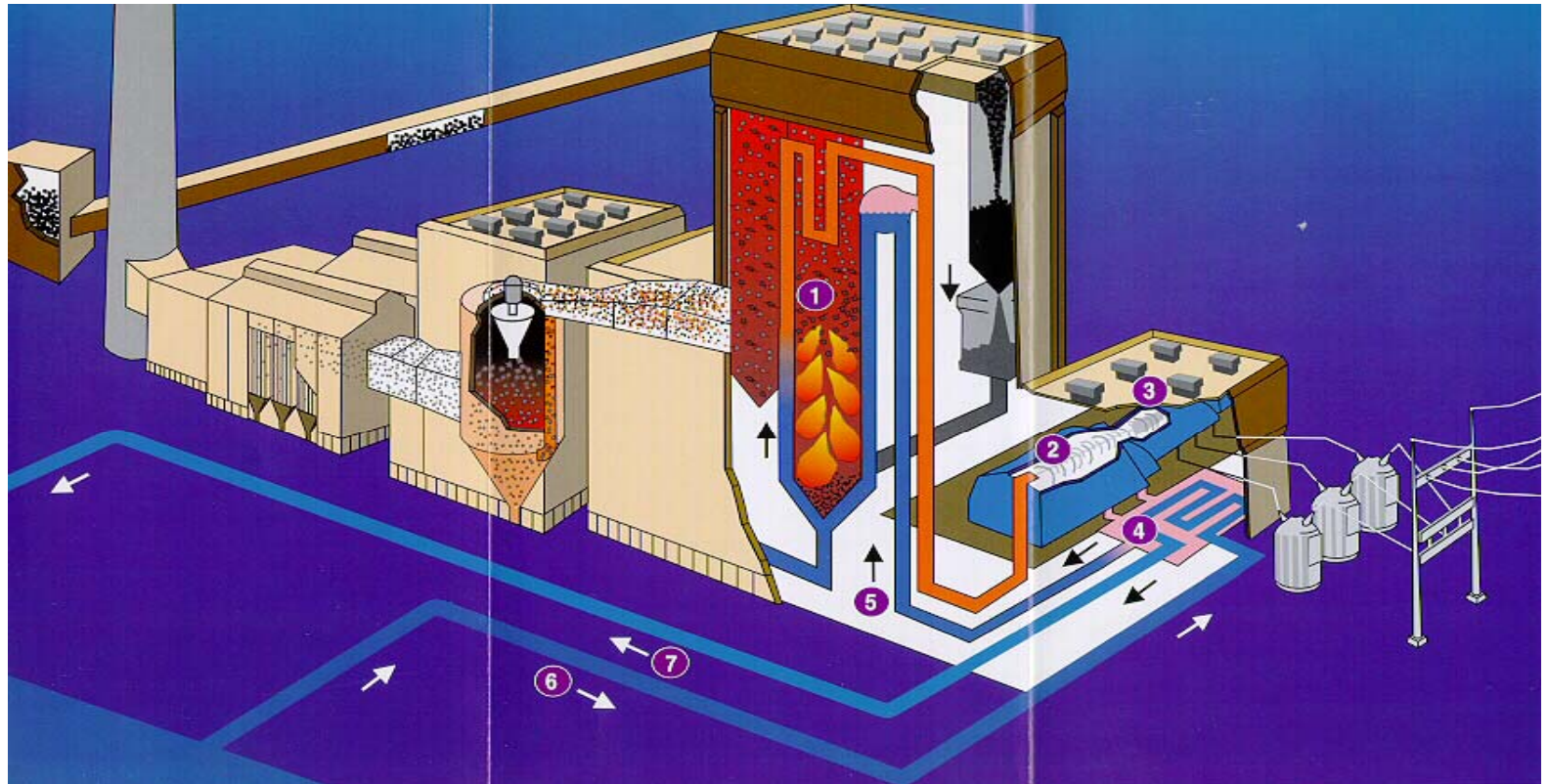


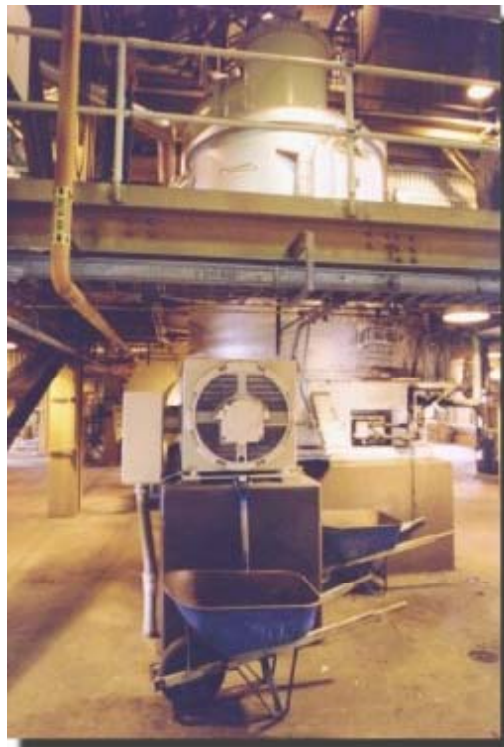
Producing Steam w/ Heat Energy & then Creating Mechanical Energy into Electrical Energy

Combustion of Fossil Fuels produces heat to boil water into steam



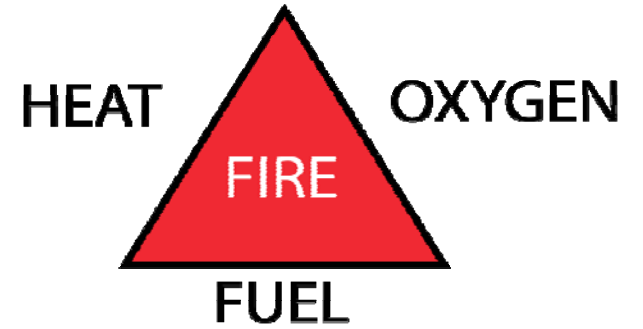
# Typical Coal Fired Boiler Operation





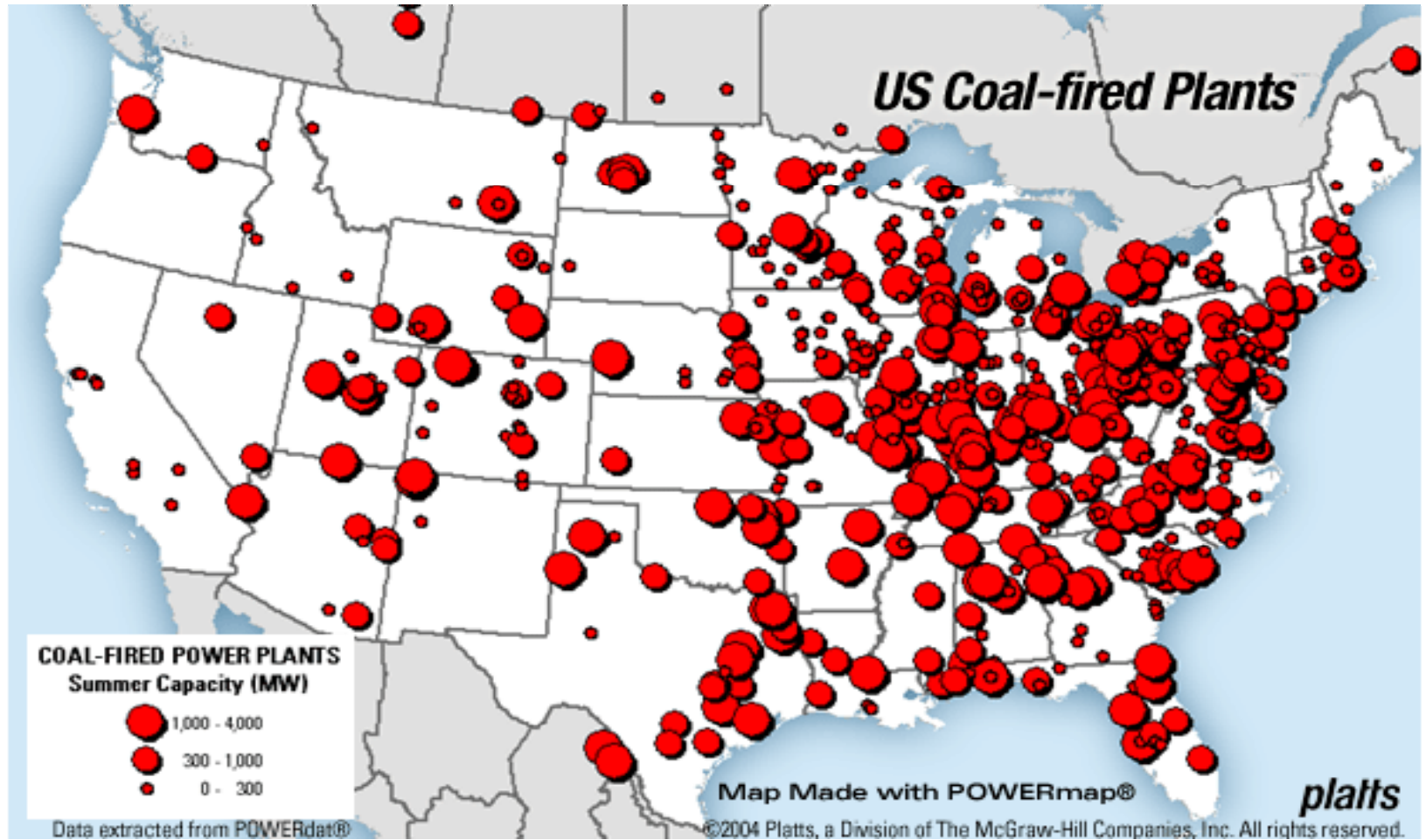
Coal is transported to Power Plants & then most often crushed & pulverized into a baby powder consistency.

# Solid Fuels can fire like a Gas





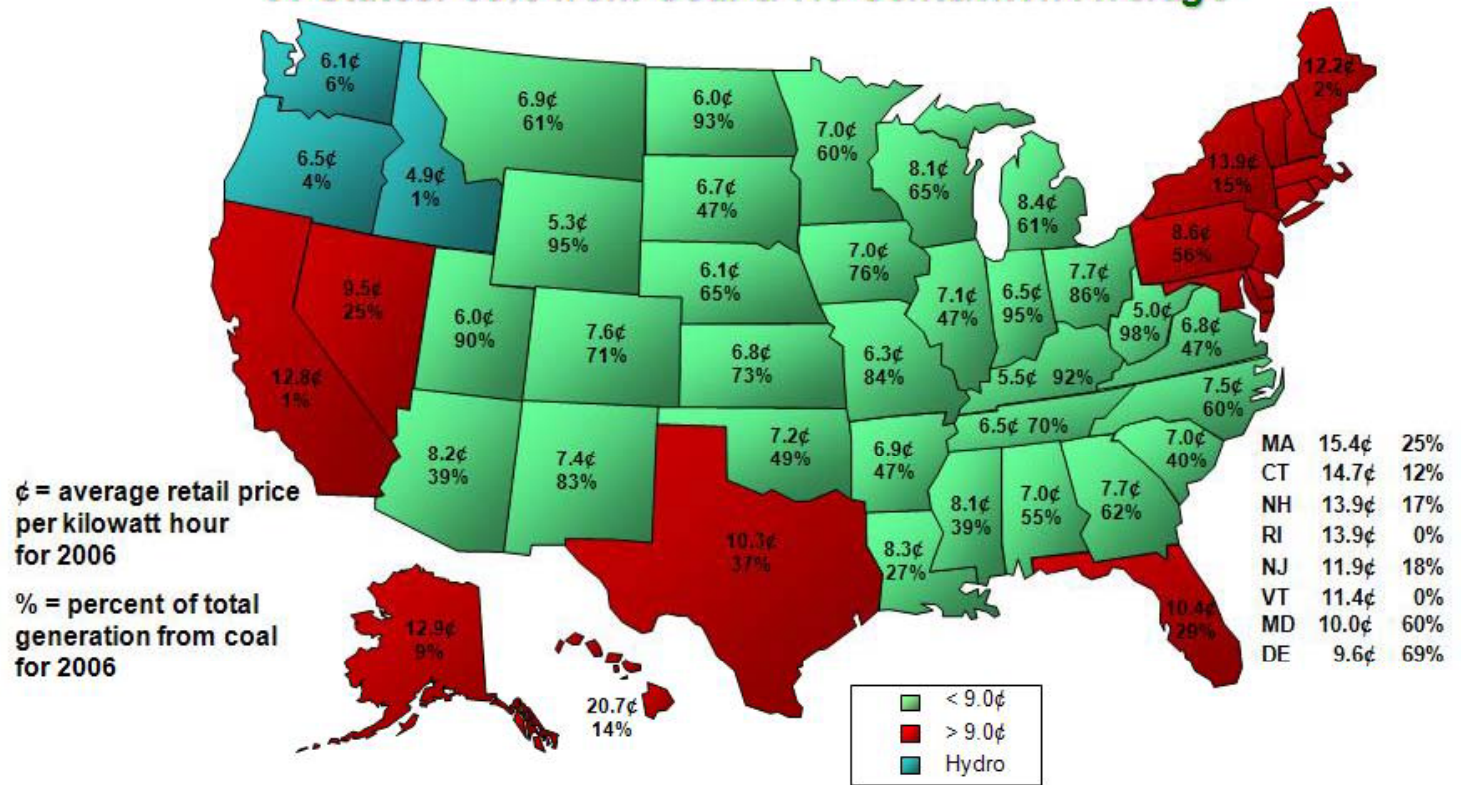
# US Coal Fired Plants





# States that Rely on Coal Have Low-Cost Electricity

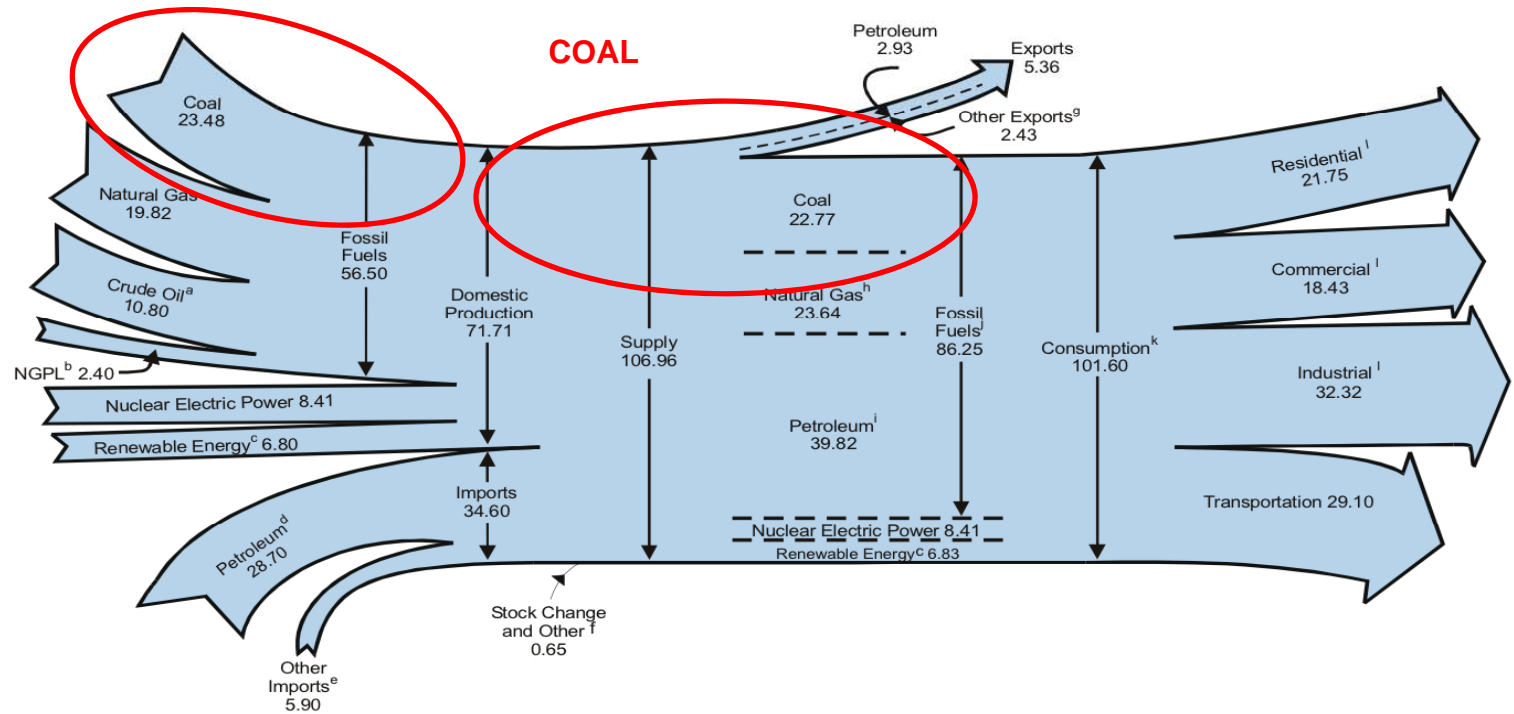
**16 States: 21% from Coal & 12.7 Cents/kWh Average**  
**31 States: 65% from Coal & 7.0 Cents/kWh Average**



Source: Energy Information Administration, March 2007.



# All Forms of Energy are Needed to Power America



**Coal remains an important fuel for America at about 24% of our total energy. Coal is needed for national security and continued economic prosperity.**



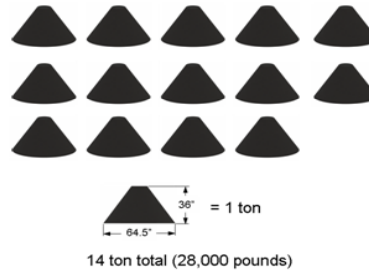


334 million Btu's each for all Americans.

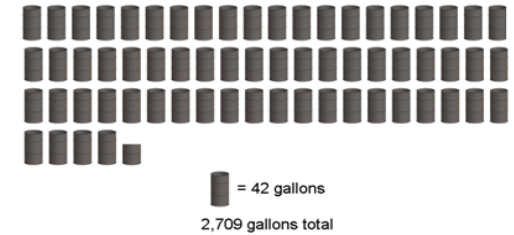
The raw fuel cost at an average of 8.00/million Btu would be \$3,340/yr per capita or a trillion dollars.

- There are over 300 million residents in the United States
- In 2007, the U.S. consumed 101.605 quadrillion Btu's
- That is 334.4 MMBtu/yr per person
- The equivalent of this amount of energy from each resource is shown

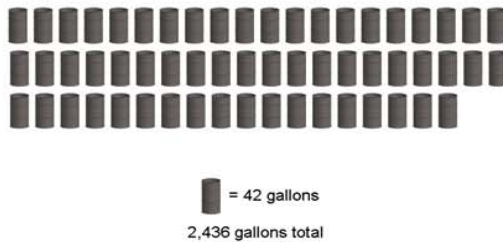
Each US Resident uses an equivalent of 14 Tons of Coal



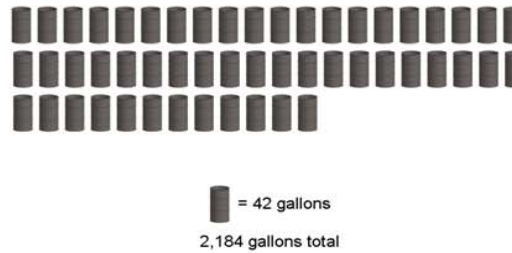
Each US Resident uses an equivalent of 64.5 Barrels of Gasoline



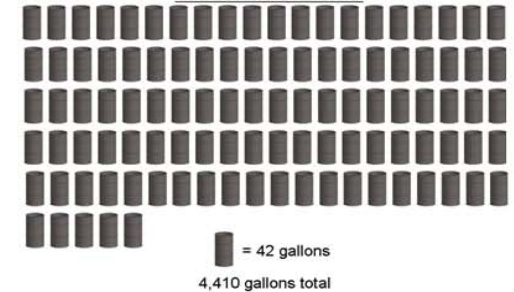
Each US Resident uses an equivalent of 58 Barrels of Diesel Fuel



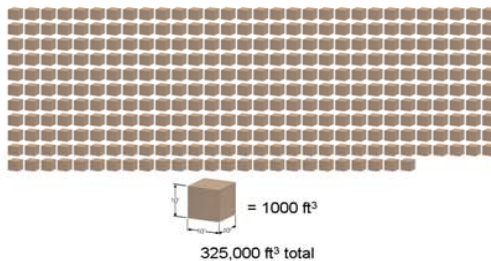
Each US Resident uses an equivalent of 52 Barrels of #6 Oil



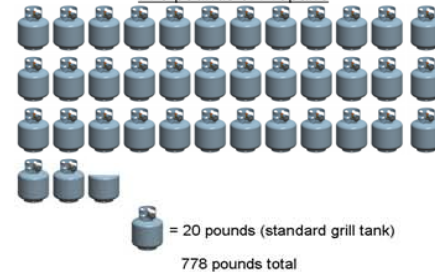
Each US Resident uses an equivalent of 105 Barrels of Ethanol



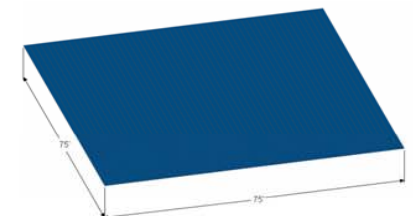
Each US Resident uses an equivalent of 325,000 cubic feet of Natural Gas



Each US Resident uses an equivalent of 778 pounds of Propane



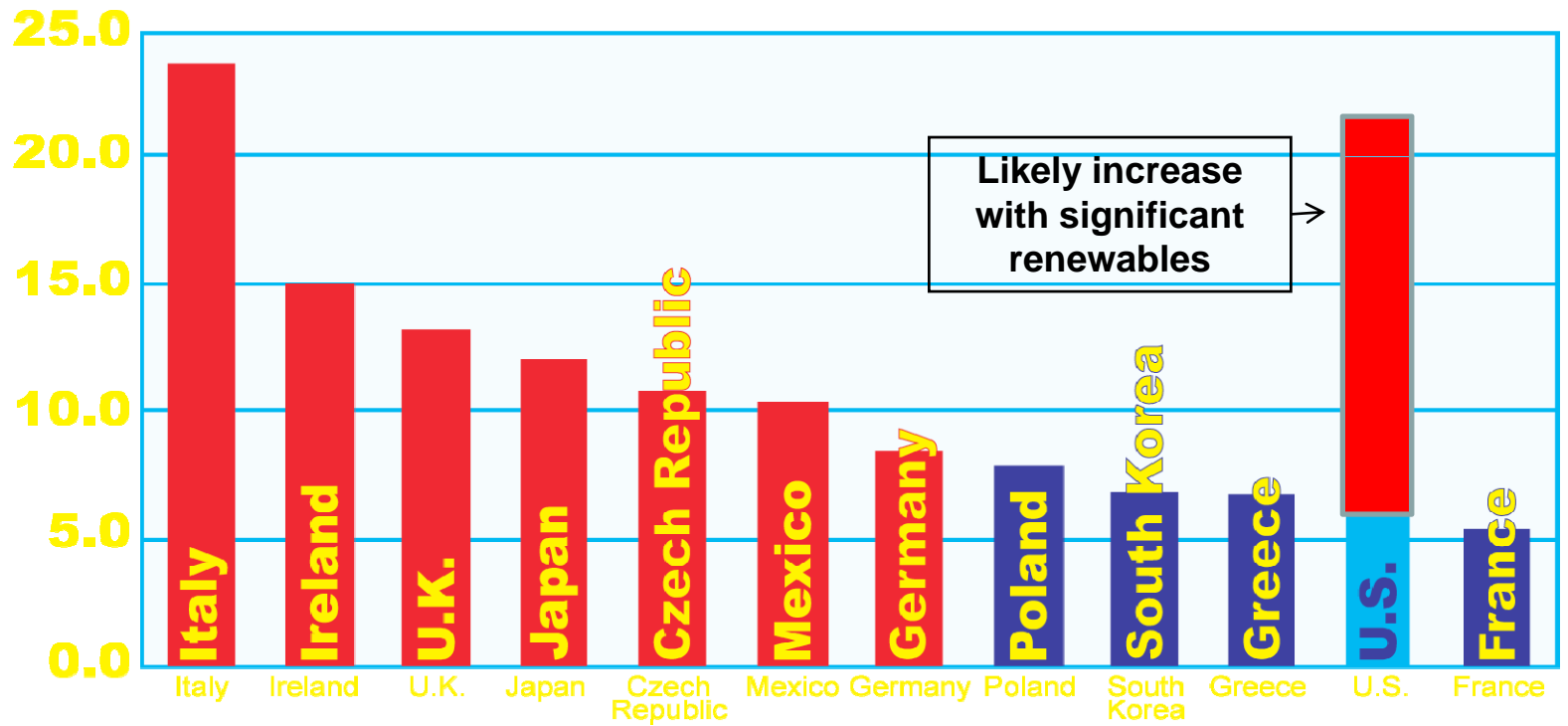
Each US Resident uses an equivalent of a 75'x75' Solar Panel





# Manufacturing In America depends on low cost electricity

Approx. cost per kWh, First quarter 2007

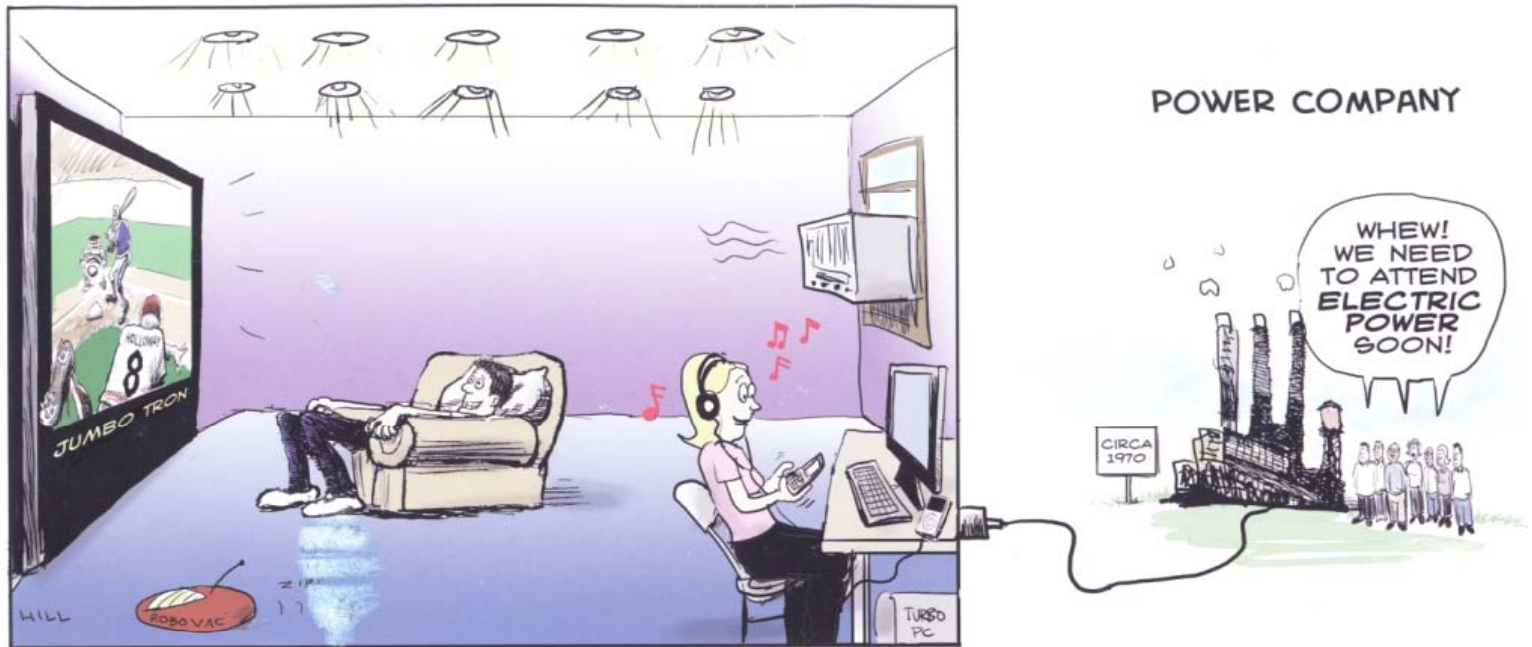


**The politicians do not get it!  
Energy drives economic prosperity.**



## Who Needs new Power Plants Anyway? What about Industry?

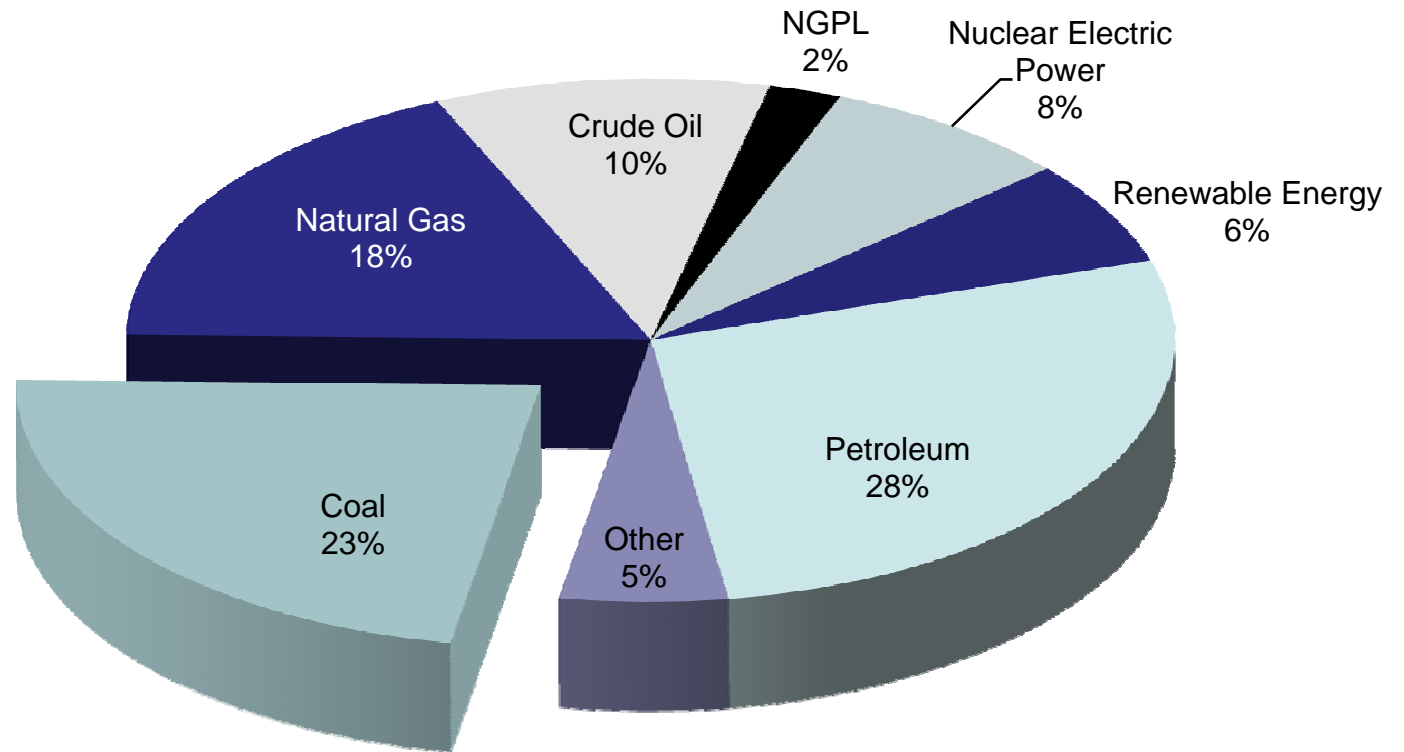
Electric Power demand is growing at 1-2% per year. America still depends on 35+ year-old, average age, power plants for 50% of its power. (Duke's fleet is average age 47 years old.)





# Without Coal America's Energy Future, and Especially American Manufacturing is in Jeopardy

Where America's Energy Comes From

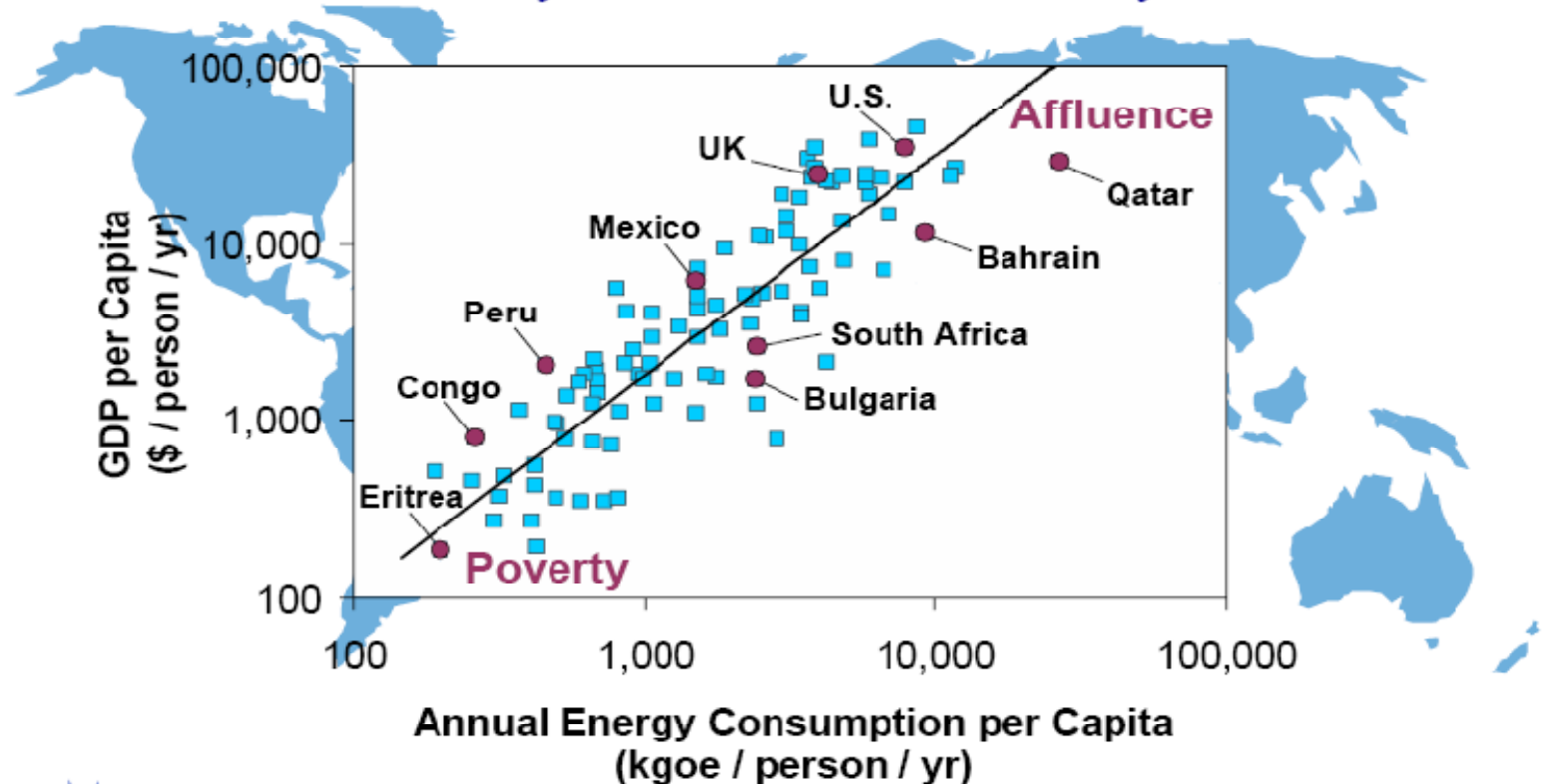


Source: Energy Information Agency



# Does Energy Use and Economic Prosperity Correlate?

## Energy = Quality of Life *Poverty Reduces Global Security*

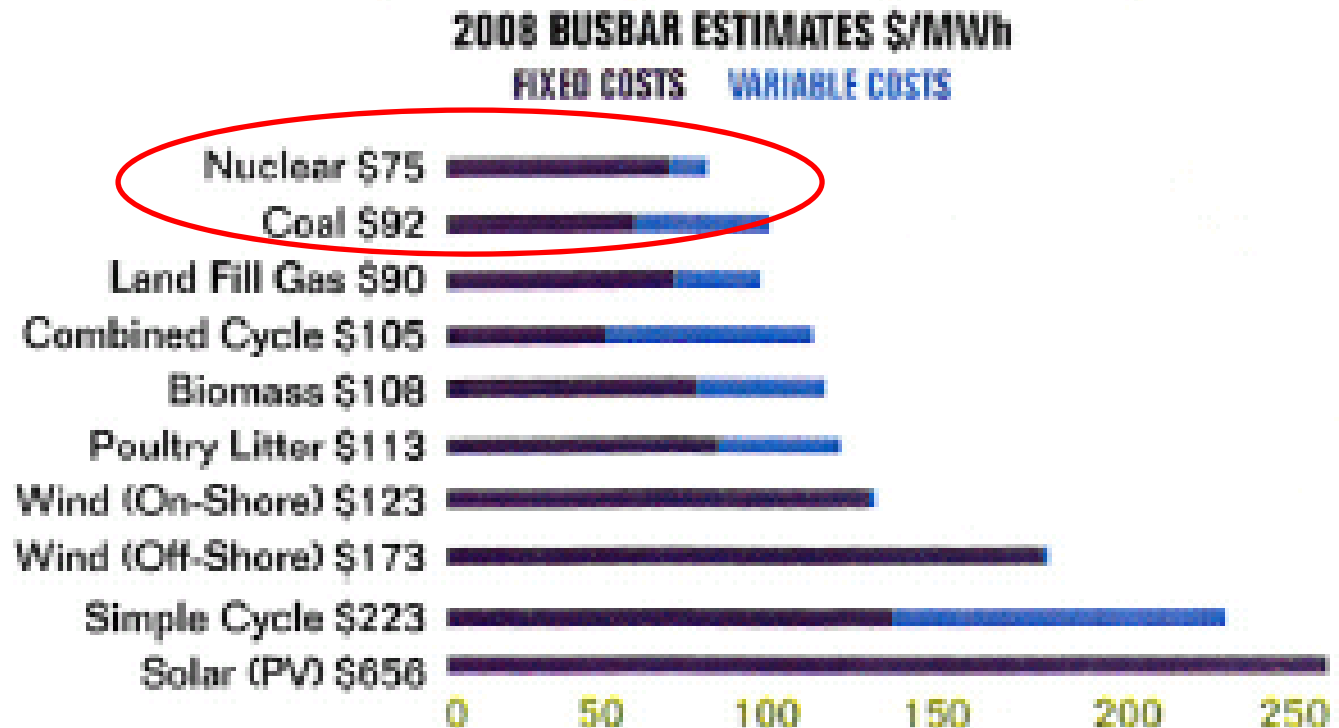


World Resources Institute Database, accessed June 1, 2005  
[http://earthtrends.wri.org/searchable\\_db/](http://earthtrends.wri.org/searchable_db/)

Carl O. Bauer, EPSCor, June 16, 2006



# Cost / MWh



*Busbar costs are the cost per megawatt (MWh) hour of producing electricity; they include the cost of capital, debt service, operation and maintenance, and fuel. As this graph clearly demonstrates, nuclear power has the lowest busbar costs per MWh.*



## Truths & Facts

- Coal is an American Treasure that can replace much of our imported energy
- The American Economy depends on reasonable cost Energy
- Coal Power works in the dark and when the wind not is blowing
- Transmission infrastructure is already set up for citing more coal plants, not for wind turbines or solar, even if they could supply significant power
- Coal is less cost than renewable energy
- American dollars and investment stay at home
- Coal is the most plausible Bulk power supply to build in say 5-10 years until nuke's can be built and started up
- If we got rid of NSR (New Source Review), then old plants could be made more efficient and even updated. With NSR "Uprates or Upgrades" are not allowed.



Coal is good for the USA and if your are for it then you are on the right side of this issue and what is best for America.

