

# QUIXOTE INDUSTRIES

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# Driving Question

What percent of Indiana's electrical grid energy can be displaced by wind energy in the next 20 years?

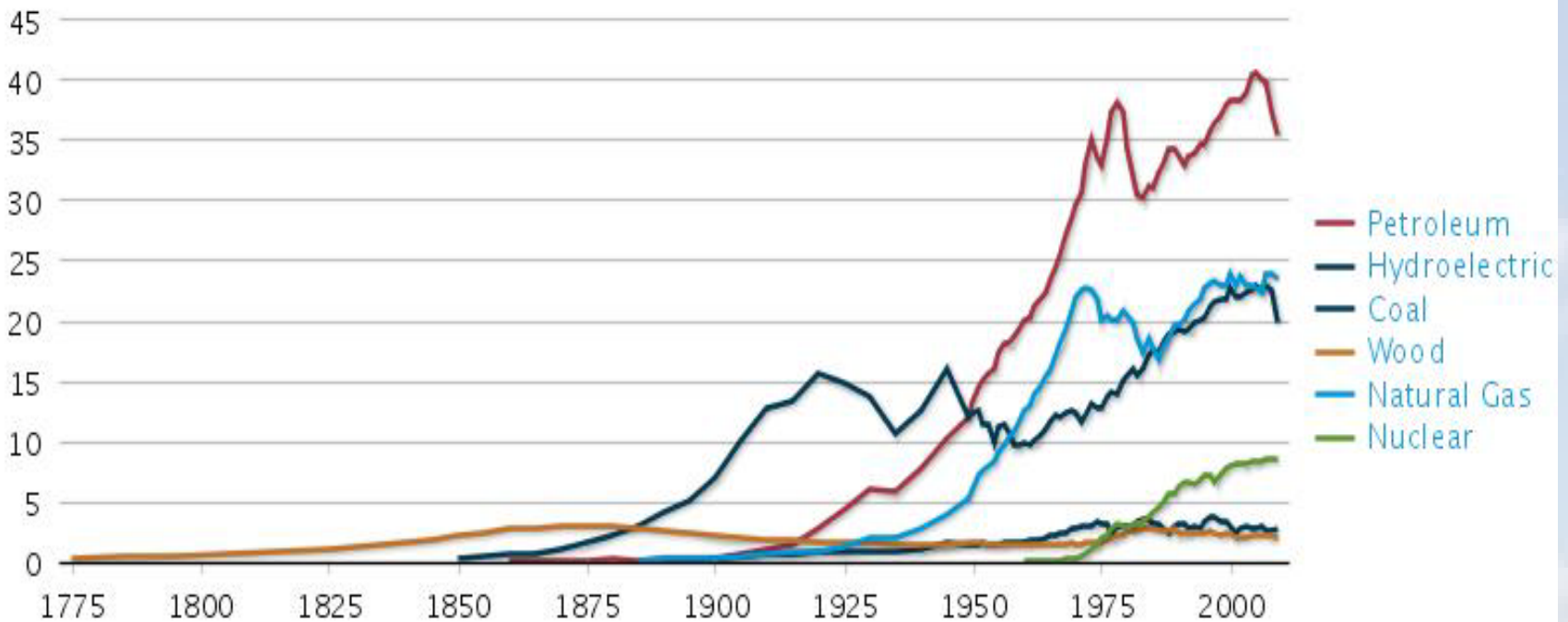
# Project Management

- Developed driving question (DQ)
- Researched wind energy as a group
- Brainstormed research paths to address DQ
- Divided research topics among team members
  - Energy statistics
  - Intro to wind as a renewable energy source
  - Costs – setup and maintenance
  - Pros and Cons of wind energy

# US Energy Consumption

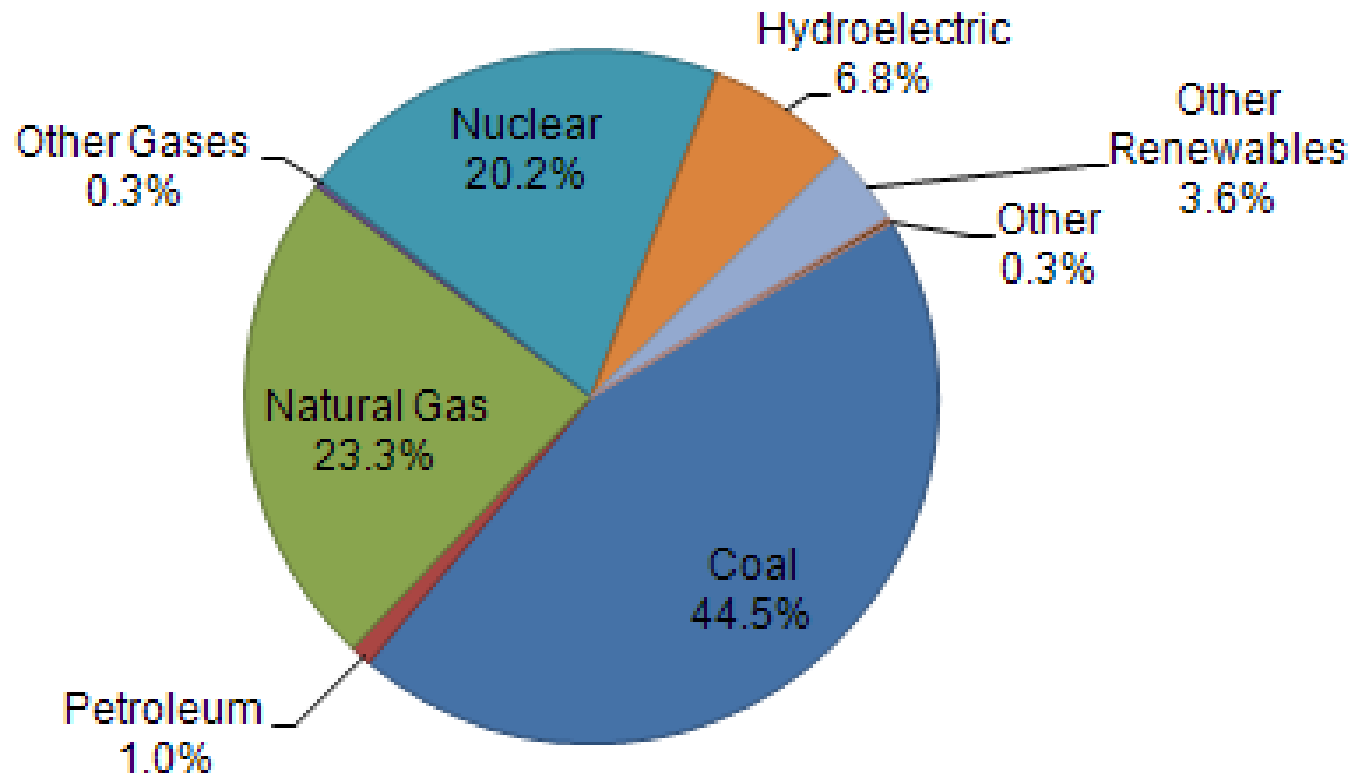
## History of energy consumption in the United States

quadrillion Btu



# US Energy Sources

Total = 3,950 billion kWh



Electric Utility Plants = 60.1%

Independent Power Producers and Combined Heat and Power Plants = 39.9%

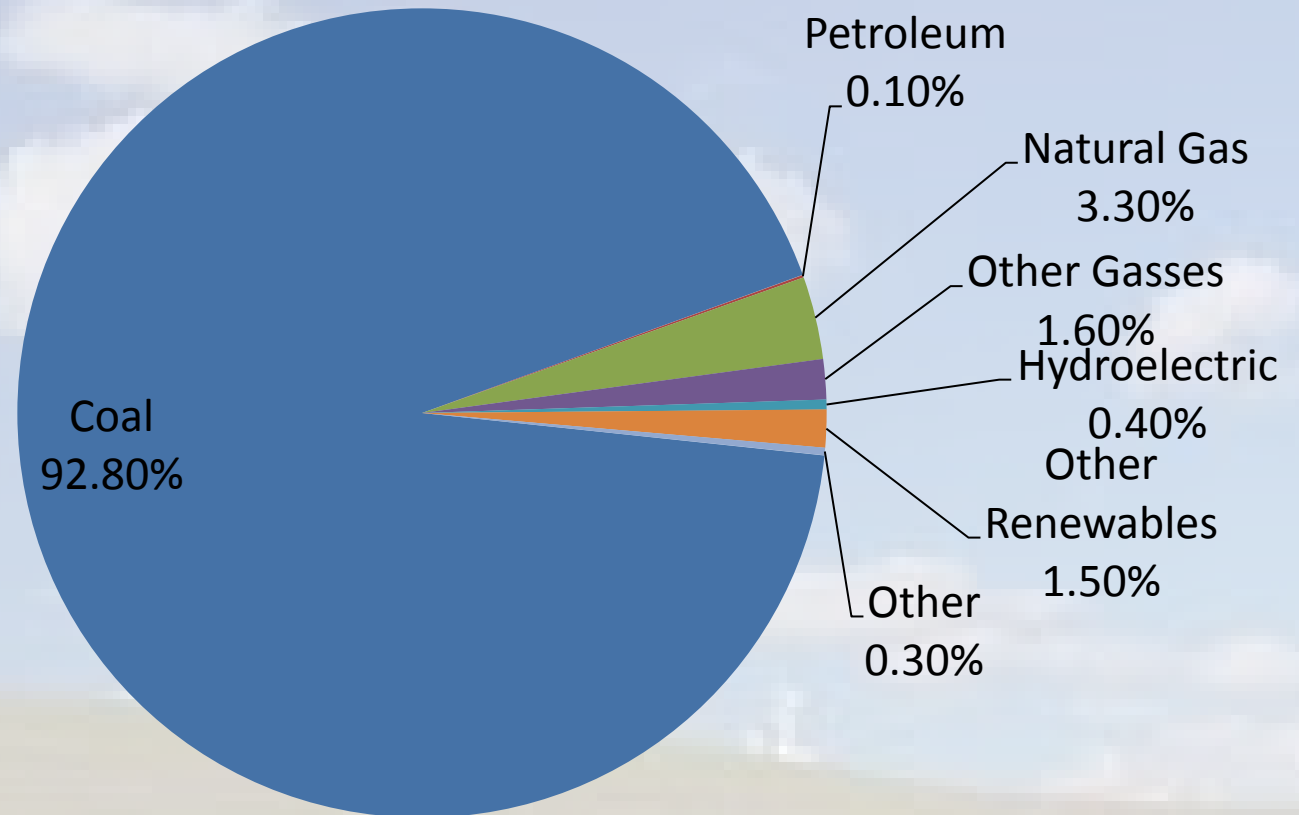
# Indiana Stats

- Indiana is ranked 10 in the total consumption per capita in the nation
  - #2 in coal use (456.6 million MWh)
  - #12 in natural gas use (163.7 million MWh)
  - #14 in petroleum use (245.1 million MWh)

# Indiana Energy Usage

- Current Energy Usage (million MWh)
  - Total 768.7
    - Residential (153.3)
    - Commercial (104.7)
    - Industrial (337.1)
    - Transportation (173.6)

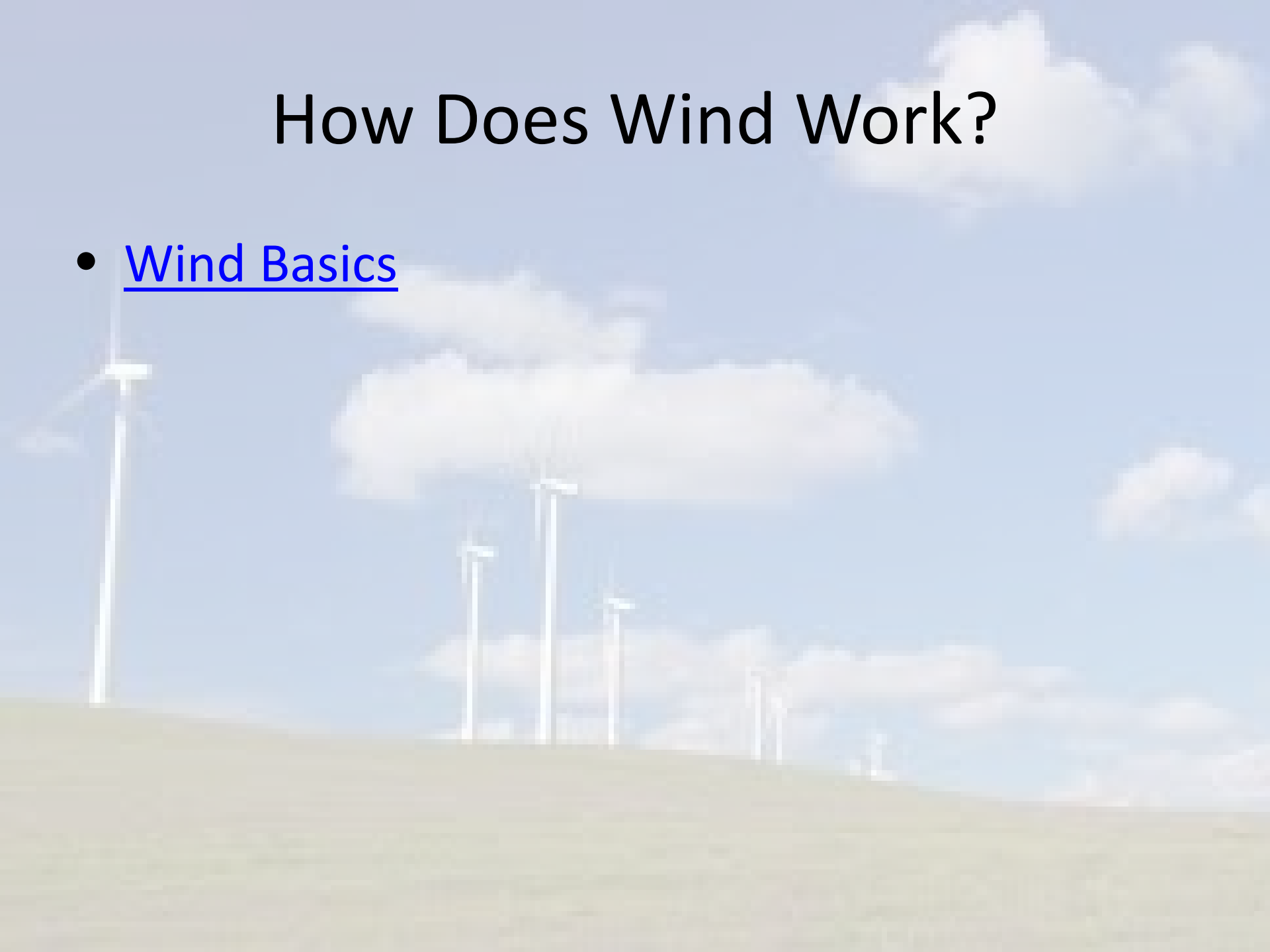
# Current Indiana Energy Sources



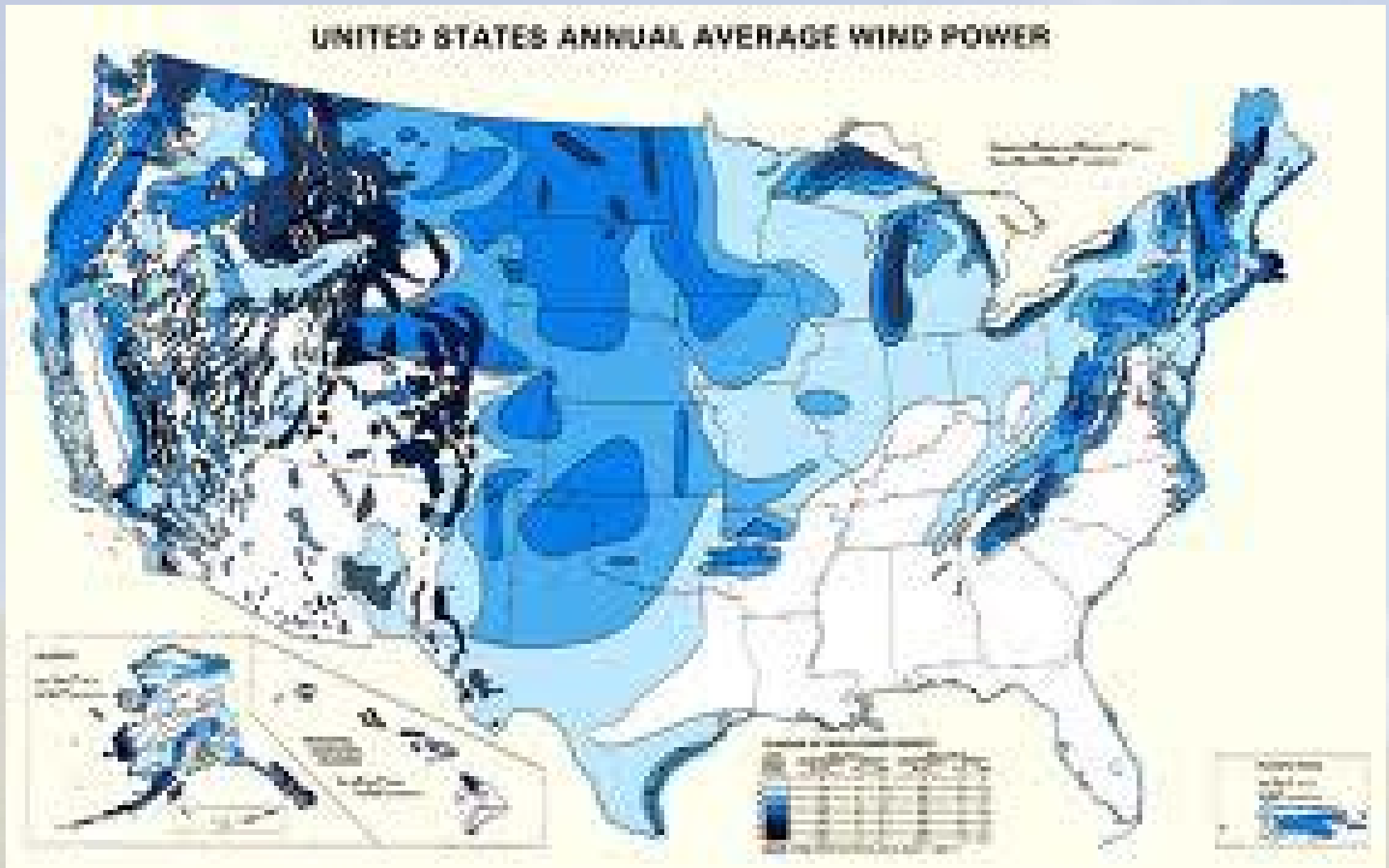


# How Does Wind Work?

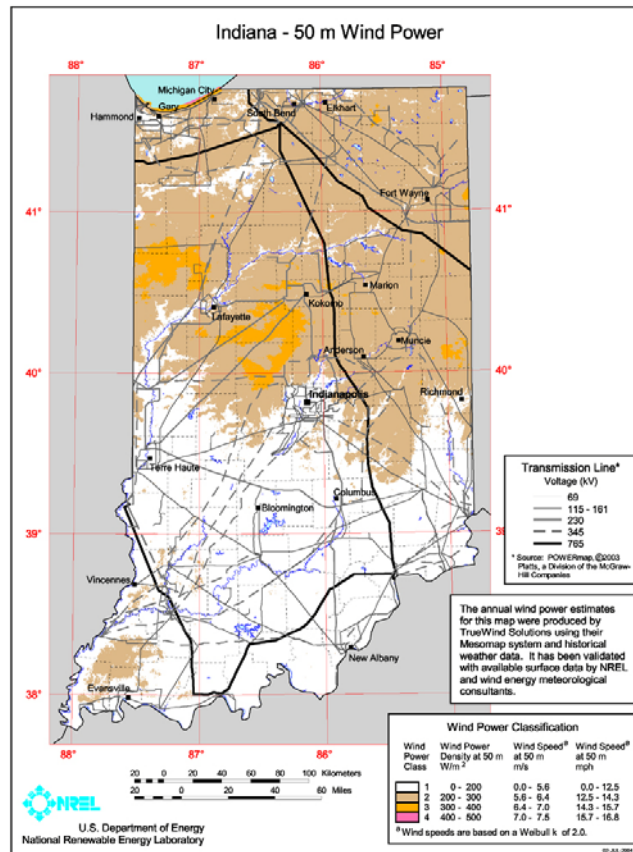
- [Wind Basics](#)



# Wind Distribution



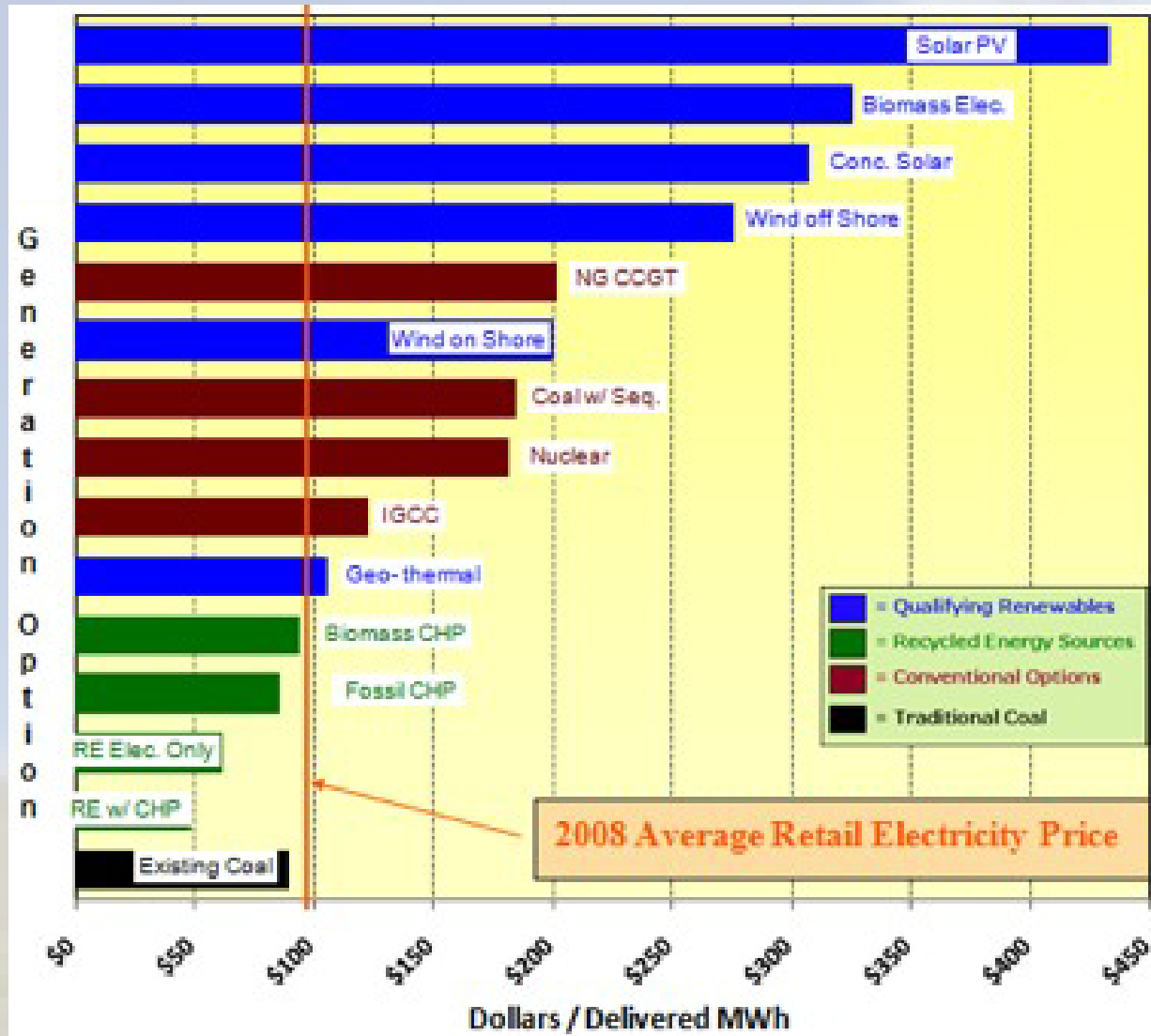
# Indiana Wind Power



# Utilization

- Statewide wind resource for Indiana
  - 1.3 billion MWh (at 80 meters) (200% of current needs)
  - Indiana's wind resource is ranked 15th in the US and according to resource assessment from the National Renewable Energy Lab, Indiana's wind resource could provide over 400 percent of the state's current electricity needs.
- Current Wind Power Utilization
  - 2.4% of Indiana power provided by wind in 2010
  - Current usage is only 0.9% of potential wind energy for Indiana (11.7 million MWh) / (1.3 billion MWh)
- Projects in queue
  - Projects in queue amount to 5.7% of total capacity for Indiana

# Cost per MW/h



# Wind Farm Costs

- Install cost about \$4M per Turbine
- Maintenance cost about 1%/year over 25 years
- Installation, Maintenance, and Operation costs equate to ~\$200/MWh

# Cons of Wind Energy

- Aesthetic, Sound and perceived Health Consequences
- Bird and Bat Kill
  - Endangered Indiana Bat kills in Benton County may affect the local industry or they may be granted a waiver
  - Design improvements and monitoring may reduce this concern
- Back-up power must be available
  - Hydroelectric is the preferred back-up source
  - Denmark – model of wind, relies upon hydroelectric sources of neighboring countries
  - Batteries, hydroelectric and fly-wheel storage of energy is in development

# Cons of Wind Energy (Cont.)

- National Security concerns about supply of Neodymium Magnets used in Wind Turbines
  - China supplies 97% of the Neodymium-Iron-Boron Magnets used in wind turbines and its own wind energy resources are rapidly expanding
  - China supplies 95% of the world's rare earth elements. In 2009, China produced 150,000 tons of the rare earth metals. The Global Wind Energy Council's predict that it will need 160,000 to generate and additional 250.5 GW of wind energy
  - Mining of the Rare Earth Metals is not environmentally friendly



# Pros to Wind Energy

- Wind Energy has Zero Emmissions
- Renewable Energy that is feasible for Indiana
- Wind Turbines will produce 15 to 20 times the energy used to build and install them
- Builds the local economy
  - Jobs
  - Leased farm land
  - Reduced property taxes
  - Increased revenue to the government
  - Local manufacturing

# Pros to Wind Energy (cont.)

- Technical improvements to the design of wind turbines will continue to improve the economic viability of the energy source



# Summary – 20 Year Estimates

- Expected wind energy capability
  - 0.9% of currently available = 11.7 million MWh
  - 5.7% of planned projects = 74.1 million MWh
- Anticipated energy needs for IN
  - Expected to increase by 43% = 1.1 billion MWh
- Projected energy supplied by wind
  - Available and planned = 8%
  - A study found that wind could produce up to 20% of nation's electricity needs by 2030
  - Based upon Indiana's favorable wind energy potential Indiana should be able to produce >20%

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