2009 Indiana Renewable Energy Resources Study

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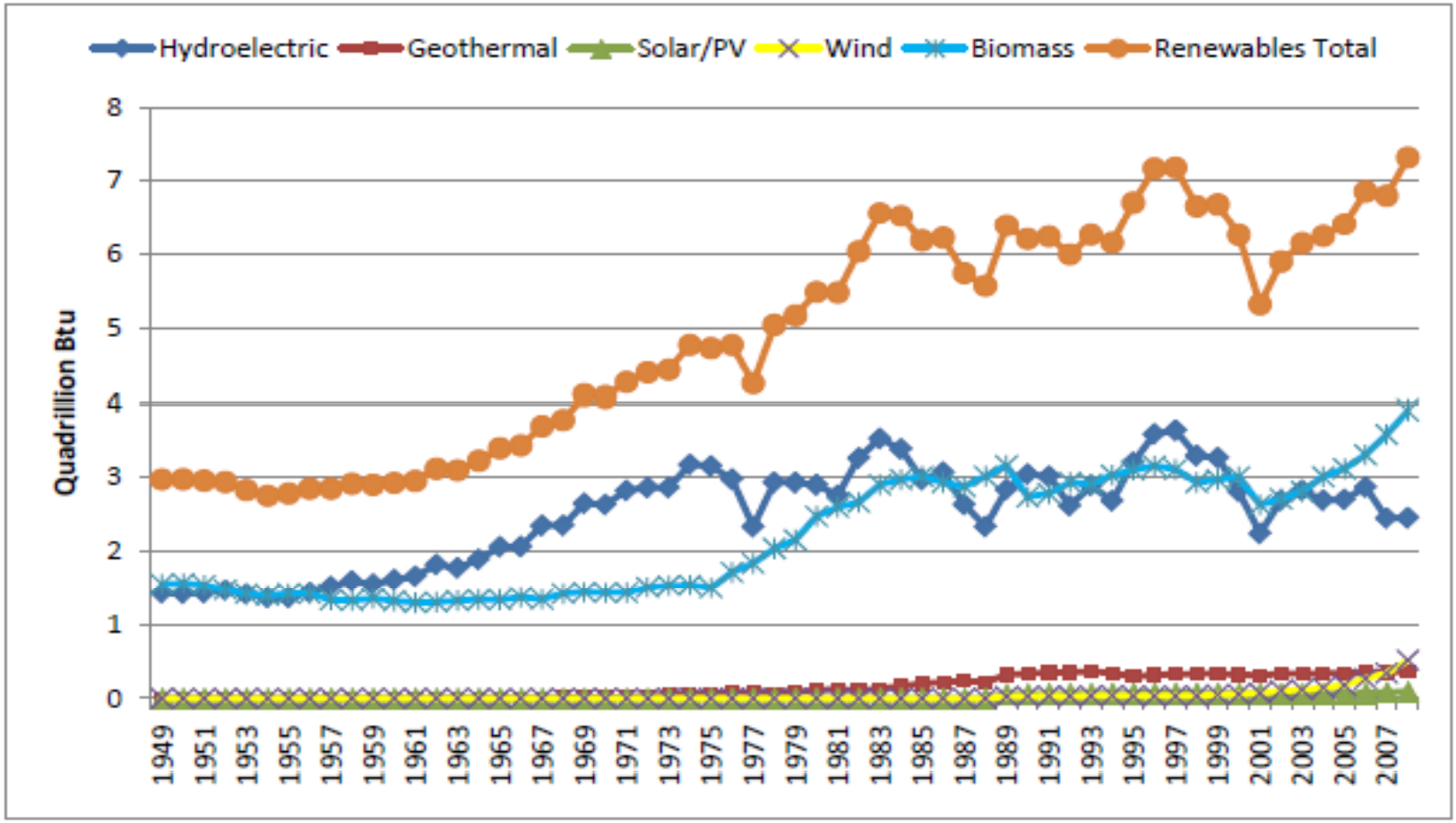
2009 Renewable Resources Study

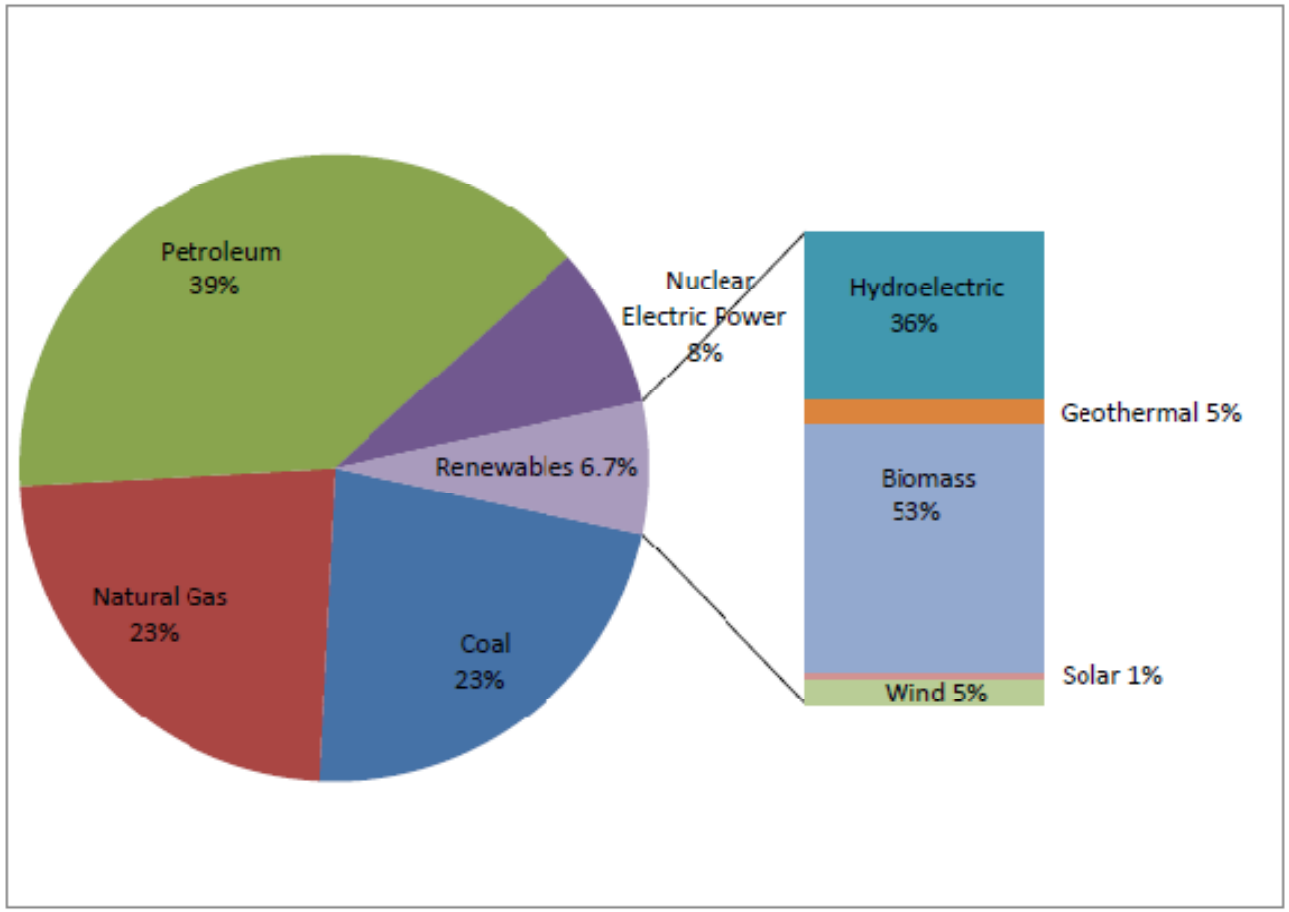
- Renewable energy trends
- Barriers and incentives
- Individual renewable resources
  - Wind
  - Energy crops
  - Organic waste
  - Solar/photovoltaics
  - Fuel cells
  - Hydropower
  - Algae

Historical Renewable Energy in the U.S.



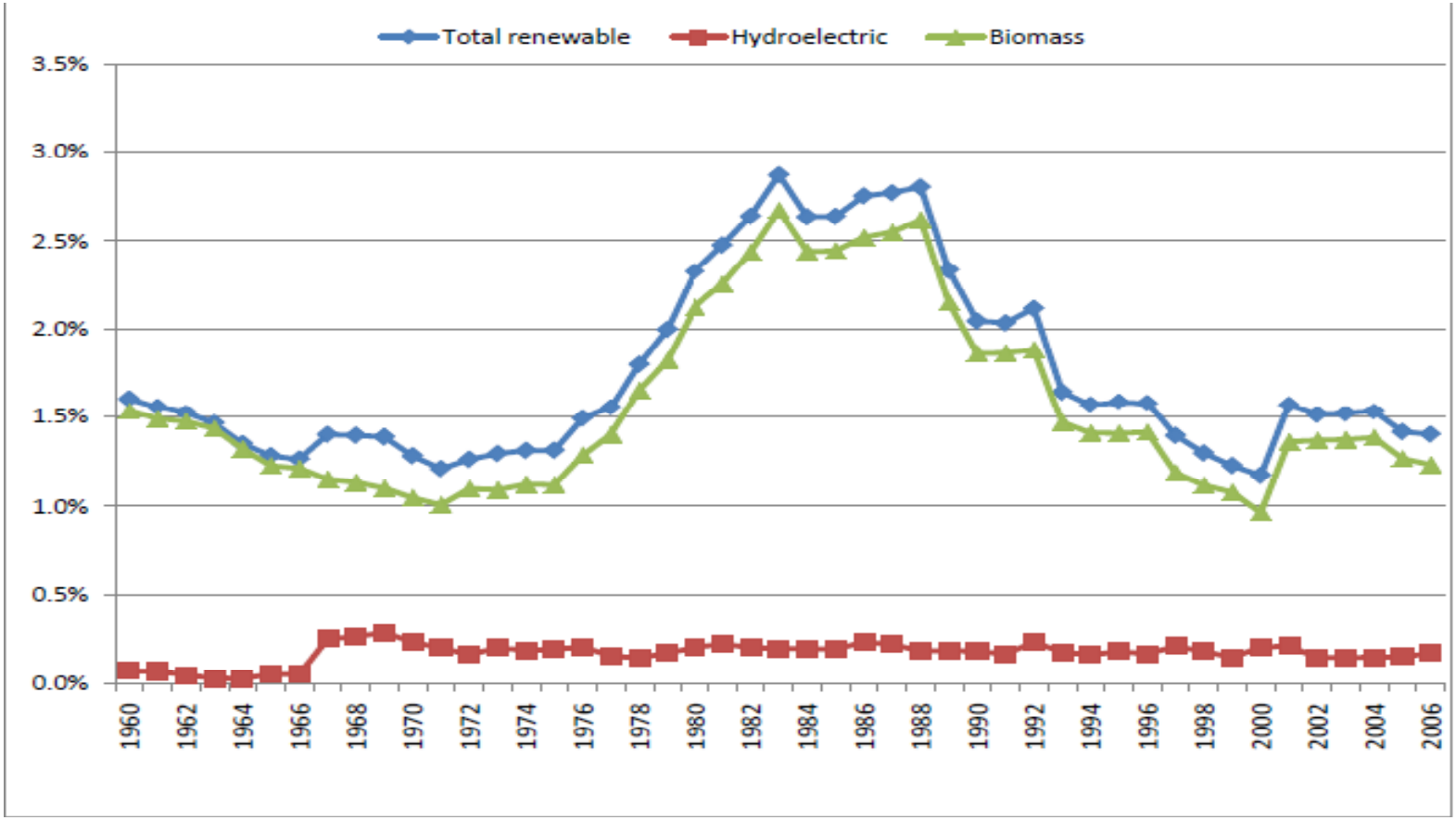
Source: EIA

2007 U.S. Total Energy Consumption by Energy Source



Source: EIA

Renewables Share of Indiana Total Energy Consumption



Source: EIA

Barriers to Renewables

- Major barrier is cost
  - Most renewable technologies have high capital costs
  - Indiana had the 9th lowest electricity rates in the country in 2007, according to the Energy Information Administration (6.50 cents/kWh vs. national average 9.13 cents/kWh)
- Limited availability for some resources
  - Solar/photovoltaics, hydropower, wind
- Intermittency for some resources
  - Solar/photovoltaics, wind

Incentives for Renewables

- Federal
  - Tax credits and exemptions (production tax credit)
  - Grant programs
- State
  - Net metering rule
  - Grant programs
  - Tax credits
  - Emissions credits
- Utilities
  - Green pricing programs

Wind Developments

Project Name	Counties	Developer	Rated Capacity (MW)	Construction Schedule	Status
Benton County Wind Farm	Benton	Orion Energy	130	Completed May 2008	Completed
Fowler Ridge Wind Farm I	Benton	BP Alternative Energy & Dominion	400	Completed March 2009	Completed
Fowler Ridge Wind Farm II	Benton	BP Alternative Energy & Dominion	350	Under Construction	Under Construction
Fowler Ridge Wind Farm III	Benton	BP Alternative Energy & Dominion	350		Pending
Hoosier Wind Project	Benton	enXco	106	Under Construction	Under Construction
Tri-County Wind Energy Center	Tippecanoe, Montgomery, Fountain	Invenergy	300-500	Begin 2010	Proposed
Meadow Lake Wind Farm I	Benton, White	Horizon Energy	200	Under Construction	Under Construction
Meadow Lake Wind Farm II	Benton, White	Horizon Energy	800		Proposed
	Randolph	Horizon Energy	100-200		Proposed
	Howard	Horizon Energy	200		Proposed
	Boone	enXco	200-400		Proposed

Indiana Utility Wind PPAs

Utility	Project	State	MW	Status
Duke Energy	Benton County Wind Farm	Indiana	100	Operational
Vectren	Benton County Wind Farm	Indiana	30	Operational
WVPA	AgriWind	Illinois	8	Operational
Indiana Michigan	Fowler Ridge I	Indiana	100	Operational
Hoosier Energy	Story County Wind Energy Center	Iowa	25	Operational
NIPSCO	Buffalo Ridge	South Dakota	50	Approved
NIPSCO	Barton Windpower	Iowa	50	Approved
IPALCO	Hoosier Wind	Indiana	106	Approved
IPALCO	Lakefield Wind	Minnesota	201	Pending
Indiana Michigan	Fowler Ridge II	Indiana	50	Pending
Vectren	Fowler Ridge II	Indiana	50	Pending

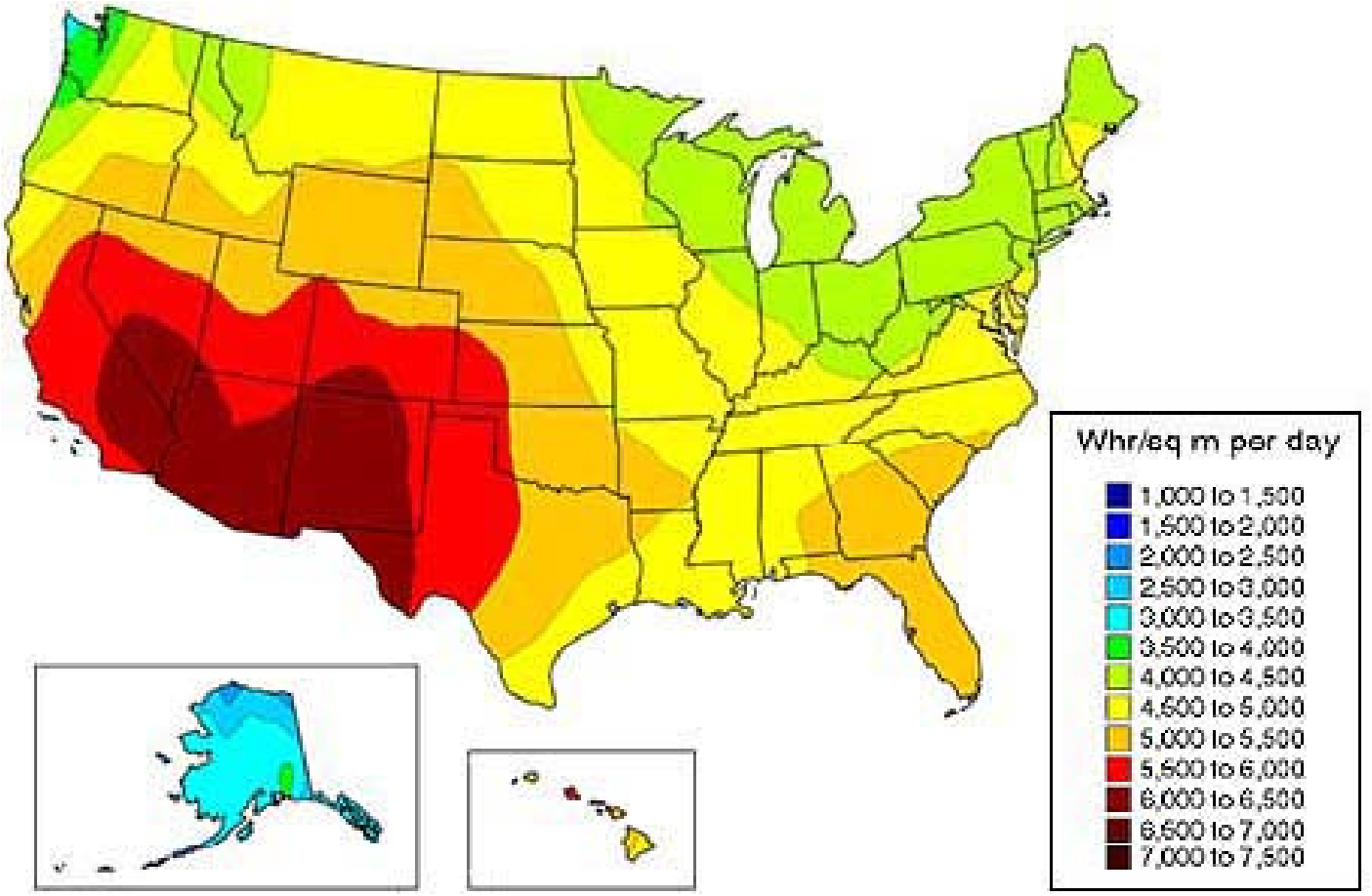
Energy Crops

- Transportation fuels
  - Ethanol
  - Biodiesel
- Other possibilities
  - Fast growing hardwood trees (hybrid poplar/willow)
  - Grasses (switchgrass)
- Barriers to be overcome
  - Other high-value uses for the land
  - Harvesting and transportation costs
  - Price of competing fossil fuels

Organic Waste Biomass

- This resource is the single largest source of renewable energy in Indiana
  - Primarily due to the use of wood waste
- It is the 3rd largest source of renewable electricity generation in the state
  - Landfill gas
  - Municipal solid waste
  - Animal waste biogas
  - Wastewater treatment

Solar Energy / Photovoltaics



Solar resource for a flat-plate collector

Source: DOE

Fuel Cells

- Currently available fuel cells cost about $2500/kW
- This is significantly higher than the cost of a natural gas-fired combustion turbine
- There is a large amount of research being performed to solve some of the problems
  - Cost
  - Efficiency
  - Hydrogen production
  - Hydrogen storage

Hydroelectric Power

- Indiana has about 60 MW of hydroelectric generating capacity.
  - Mostly run-of-the-river (no dam)
  - Largest source of renewable electricity
- The U.S. Department of Energy identified another 66 MW of potential hydropower at existing dams
  - Only about 42 MW was considered viable (spread out over 27 sites)

Energy from Algae

- Rapid growth and efficient conversion of sunlight
- Much higher oil content than other biomass
- Not a food crop
- Can be grown in water and on land that is not usable for other agriculture
- Potential for recycling of CO2 from fossil fueled power plants
- Production of both biofuels and valuable co-products
- But, cost of harvesting and processing is high

Algae Production Systems

- Open pond
  - Less costly than enclosed system
  - Subject to contamination from native algae species
  - Subject to water evaporation
  - Exposure to weather extremes
- Enclosed bioreactor
  - Better control of environment
  - Much more expensive than open system

Further Information

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