



# WIND ENERGY

## BOHR GROUP

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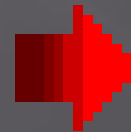
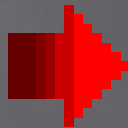
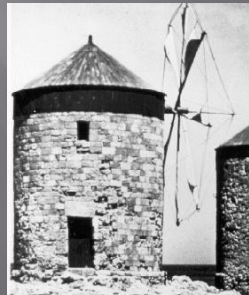
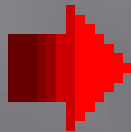
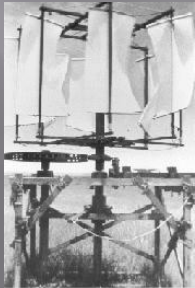
# HOW WIND TURBINES WORK



# WIND TURBINES: THEN

THEN: MAINLY USED FOR PUMPING WATER.

- ▣ Vertical axis wind mill
- ▣ Horizontally oriented turbines
- ▣ Post mill to tower mill.
- ▣ Blades evolved and became more efficient



# WIND TURBINES: NOW

**NOW:** TURBINES WERE FIRST USED TO GENERATE ELECTRICITY IN THE LATE 19<sup>TH</sup> CENTURY.

- ▣ Commercial turbine market evolved
- ▣ Turbine designs



- ▣ Off-shore wind farms



- ▣ 495 turbines have been built in Benton County.

# PROS & CONS

- ▣ ECONOMIC IMPACT
- ▣ JOBS
- ▣ RENEWABLE ENERGY SOURCE
- ▣ REDUCING CARBON EMISSIONS
- ▣ STORING THE ENERGY
- ▣ SUPPLY & DEMAND
- ▣ SURROUNDING WILDLIFE
- ▣ MAINTENANCE

# COST OF WIND TURBINES

Cost factors



Construction,  
infrastructure,  
maintenance,  
transportation



GE 1.5MW → 400 homes  
Vesta 1.65 MW → 400 homes  
Clipper 1.5 MW → 650 homes



\$2,000,000

\$3,000,000 per 100  
turbines



- \$7,000 for 10 Kw home turbine
- Low maintenance cost
- Lasts 20 years

# Comparison to other energy sources

## Wind

\$.07Kwh

## Coal

\$.10 Kwh

## Solar

\$.40Kwh



# Cost benefits

\$86,000,000 per 100 turbines

15 % Annual return from original investment



Pay off investment



Free electricity



pay off investment

Extra 840Kwh = \$7 profit



\$1150 annual American electric bill



# Societal benefits



Farmers paid \$5,000-10,000 yearly per acre with turbine

Income taxes on farmers



Improved local economy



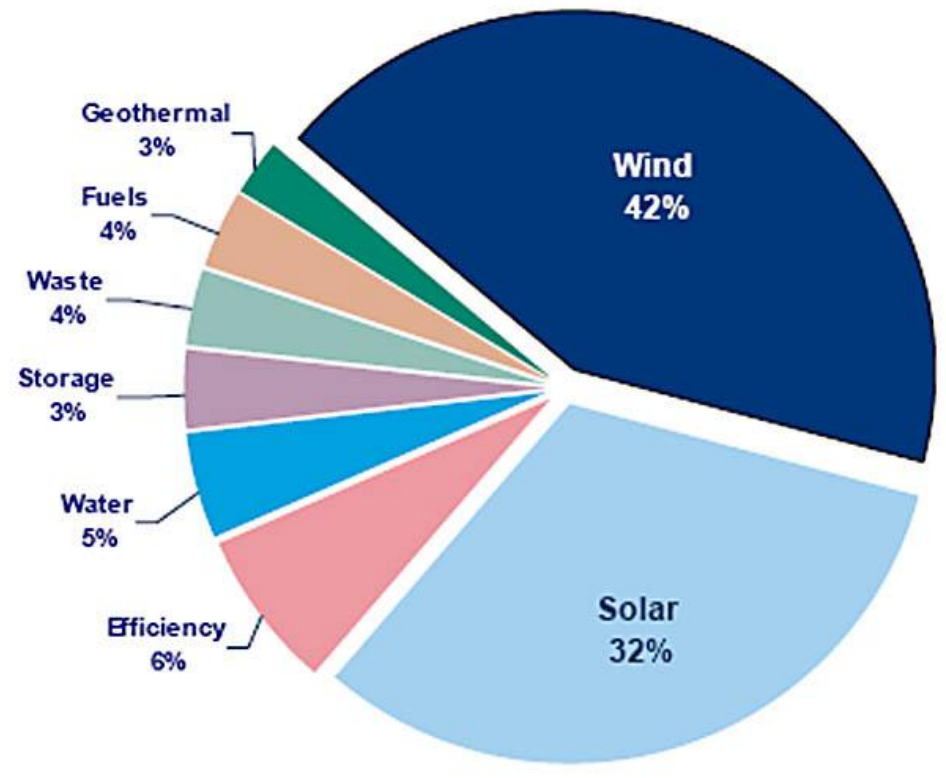
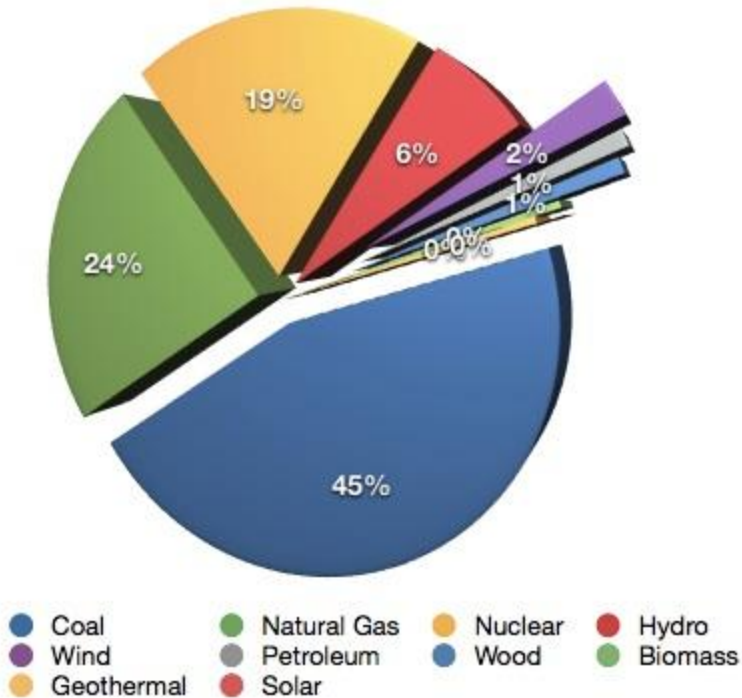
Construction of infrastructure creates job

Commercial tax on business



# MARKET SHARE

U.S. Net Generation by Source - 2010



# Wind Turbine Design

- HAWT= Horizontal Axis Wind Turbine
- Generates, then transfers
- Built high up
- Instruments + Motor = Turn into wind



# Betz Law

- ▣ Discovered by Albert Betz
- ▣ 59.3% max wind power
- ▣ Discovered in 1919



# Placement

## LINEAR

- ▣ Maintenance
- ▣ Land accessibility



## SCATTER

- Max wind power
- Less effect on other turbines



# Wind Turbine Innovations

## WIND LENS

- ▣ Increases wind speed by 40% = triples electricity generated
- ▣ Saves space
- ▣ Quiet



## AIRBORNE TURBINES

- ▣ Goes to where winds are more consistent, stronger
- ▣ Easy to deploy



# Innovations Con't

## VERTICAL TURBINES

- ▣ Closer to ground-> easier to maintain
- ▣ All directions



## HOMEMADE TURBINES

- ▣ Cheap
- ▣ Recycled Materials
- ▣ What you want



# Purdue's Contribution

- Increase accuracy
- Sensors to detect problems
- New computer programs=better farms





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