WIND TURBINE GENERATOR PROJECT

• ESSENTIAL QUESTION: How can Energy be transformed into useful forms?

We will look at different types of energy and how they are related, how energy can be changed from one form into other forms, and we will look at energy “losses” and efficiency.
Learning Goals

• Energy can be converted
• Energy can be measured
• Where do “losses” go?
• Efficiency
• The role of energy conversion in our society
• Testing of options, using scientific method
• Mapping the performance of your generator
• Communication of results
Early Windmills

- These are used to power sawmills
Waterwheel, 1900, Yorkshire
This is the inside of a 50 foot diameter waterwheel in Wales
Midwestern Waterpump
Wind Turbine Generator
In the US, 50% of our Electricity is generated by burning coal, to boil water, to make steam, to turn a turbine, to turn a generator, to generate electricity.

Petroleum, Natural Gas, and Nuclear supply the majority of the remaining Electricity.
Efficiencies of Generating Electricity

Coal: 32.8%
Petroleum: 31.0%
Natural Gas: 41.1%
Nuclear: 32.6%
Where Do Losses Go?

Burning of Fuel: lost heat in exhaust
Boiling Water: lost heat from boiler
Steam Turbine: condensation of steam
All Turbines: mechanical friction, bearing heat vibrations, noise, exhaust
Generators: electric field losses, friction, heat, vibrations, noise
Distribution of Electricity

National Power Grid connects all Electricity Generators to all Electricity consumers

The wire in the Powerlines is copper. Copper has a small resistance to the flow of electricity.

This resistance causes a 6.5% average loss
Maine Statistics

Maine ranks 13th in the US on electricity usage per person.

Maine ranks 9th in the US on the average cost per KWH.
Overall Efficiency

Generating Electricity: 32%
Distribution Loss: 6.5%

At your house: (32% * 93.5%): 30%

Typical <4HP Motor: 75%

Useful Work (30% * 75%): 22.5%

In other words, we waste 4 times as much energy as we use!
Your turbines were about 10% efficient when generating then using electricity.

19th century waterwheels were 90% efficient!
Your Generation

What would change if electricity was generated locally?
What would change if factories could use direct drive power from waterwheels?
What would change if we burned less coal and crude oil?

Are you part of the problem or part of the solution?
Wind Turbine Generator