

Purpose

I want to figure out how to make electricity using wind and water. I visited Niagara Falls and the Hoover Dam and learned that both use water to make electricity. We see lots of windmills driving to Chicago and they make electricity too.

Fossil fuels make most of our electricity, but they make carbon dioxide, a greenhouse gas. Those fuels help make the Earth warmer. Water and wind are clean energy sources and can help reduce using fossil fuels.

My purpose is to build a water turbine and wind turbine and use the renewable sources, water and wind, to generate electricity. I will measure which source makes more electricity.

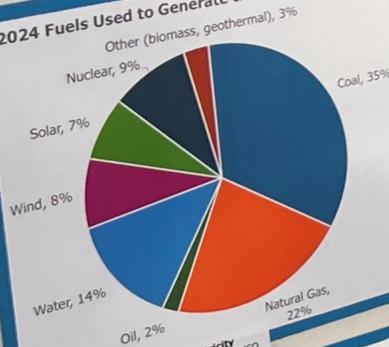


Figure 1. Hoover Dam's Water Turbines, Photograph by A. Johnson, 2025.



Figure 2. Niagara Falls Horseshoe Falls, Photograph by A. Johnson, 2025.

2024 Fuels Used to Generate the World's Electricity



Graph 1. Fuels Used to Generate the World's Electricity, Graph created by Katherine Johnson using Microsoft Excel LTSC MSO

Hypothesis

I believe that the Water Turbine will make more electricity.

Variables

- Independent Variable:**
- Renewable Source
 - Water
 - Wind
- Controlled Variables:**
- Power Input for Water and Wind
 - Turbine Material and Design
 - Generator System

Water vs. Wind

Which Makes More Electricity?

Water Model

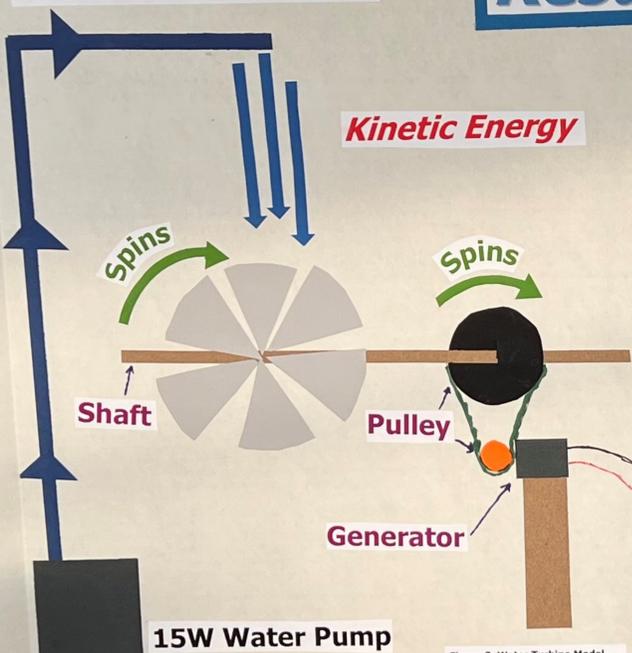


Figure 3. Water Turbine Model, Diagram created by Katherine Johnson

Wind Model

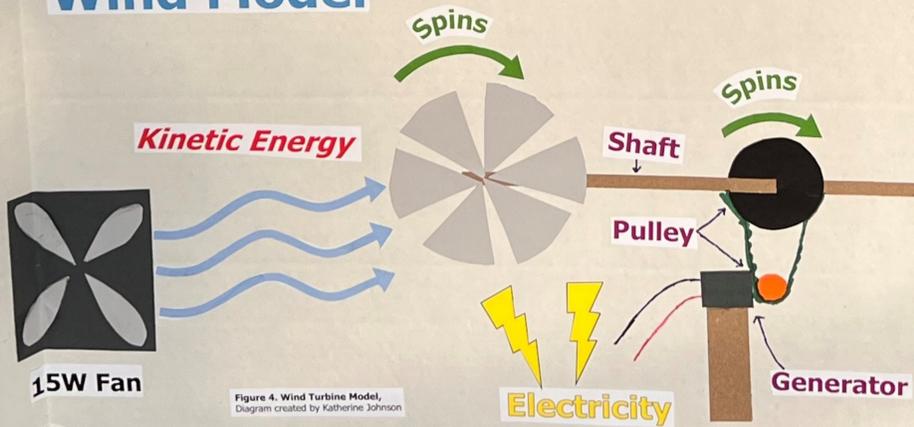
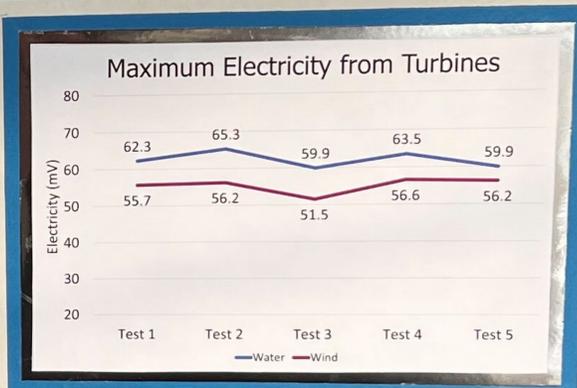


Figure 4. Wind Turbine Model, Diagram created by Katherine Johnson

Results



Graph 2. Maximum Electricity from Water and Wind Turbines, Graph created by Katherine Johnson using Microsoft Excel LTSC MSO



Figure 5. Completed Water Turbine, Photo taken by Katherine Johnson

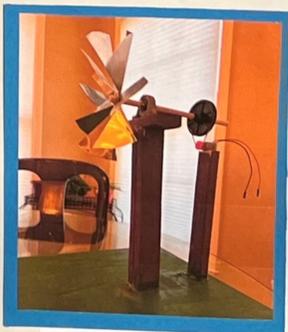


Figure 6. Completed Wind Turbine, Photo taken by Katherine Johnson

Materials

- 1- 15W Submersible Water Pump
- 1- 15W Fan
- 2- Heavy Duty Aluminum Pie Tins
- 4- 3/8 Inch Metal Washers
- 1- 8 Feet Long by 1 1/2 Inches Wide x 1/4 Inch High Piece of Wood
- 2- 3/8 Inch x 17.5 Inches Wooden Dowel Rods
- 3- 10mm Pillow Block Bearings
- 2- Plastic Chain Cable Pulleys 2 Inch O.D.
- 2- 1.5V-6V Type Miniature DC Motors
- 2- 2mm Hole Plastic Belt Pulleys
- 2- Rubber Bands
- 1- 5 Gallon Bucket
- 4- Wood Shims
- 2 feet of 1/2 Inch Clear Plastic Tubing
- 2- PVC 1 Inch 90° Elbows
- 2- 1/2 Inch PVC Couplings
- 1- 1/2 Inch PVC Repair Coupling
- 2- Zip Ties
- 1- Multimeter to Measure DC Volts with Alligator Clips
- 1- 19 Inches x 12 Inches Piece of Wood for Water Turbine Machine
- 1- 18 Inches x 14 Inches Piece of Wood for Wind Turbine Machine
- Drill
- Duct Tape
- Glue- Glue Stick, Hot Glue Gun with Glue Sticks, and Wood Glue
- Hand Saw
- Ruler and Tape Measure
- Scissors
- Timer

Procedure

The detailed procedure for creating the water turbine and wind turbine is in the composition book. It includes the turbine design, as well as the generator system for both machines.

Testing the Water Turbine

1. Connect the multimeter to the water turbine generator's wires using the alligator clips. Connect to the same color as the alligator clip, red to red and black to black.
2. Turn the multimeter on and switch to V for voltage and press the SEL button to switch to DC vs AC since the motor is DC.
3. Plug in the water turbine's pump and let the water flow over the water turbine for 2 minutes.
4. Press the Min/Max button to start collecting the maximum voltage over a 2-minute period.
5. Record the Maximum value on the test sheet.

Testing the Wind Turbine

1. Connect the multimeter to the wind turbine generator's wires using the alligator clips. Connect to the same color as the alligator clip, red to red and black to black.
2. Turn the multimeter on and switch to V for voltage and press the SEL button to switch to DC vs AC since the motor is DC.
3. Plug in the fan and turn the dial to Maximum. Let the wind blow the wind turbine for 2 minutes.
4. Press the Min/Max button to start collecting the maximum voltage over a 2-minute period.
5. Record the Maximum value on the test sheet.

Conclusion

The water turbine made more electricity than the wind turbine. Both turbines captured the kinetic energy from the moving water or wind. They both were able to spin the shaft and the pulleys so the generators made electricity. The water and wind had the same power inputs produced by the water pump and fan, 15W.

The difference was the mass of the source. The water had more kinetic energy since its mass is more than the air's mass. Water weighs more and pushed the turbine to spin faster than the air can spin the wind turbine. The faster the generator shaft spins the more electricity made.