



Building a Model of a Wind Farm and Measuring Power Output



Wind energy is clean and renewable. In this experiment, you will build a model wind farm and measure how much electrical power it can produce.

OBJECTIVE

Build a model wind farm and measure the power output under different conditions.

MATERIALS

- 2–4 small DC motors (3–12V) (each will act as a wind turbine generator)
- 2–4 plastic or cardboard turbine blades
- Straws, cardboard, or dowels (for towers)
- Baseboard (cardboard or wood)
- Small fan (to provide wind)
- Digital multimeter (to measure voltage and current)
- Alligator clip leads
- Tape or hot glue
- Ruler or measuring tape
- Optional: resistor or small bulb (for testing load)

BACKGROUND

Wind turbines convert the kinetic energy of moving air (wind) into electrical energy. Larger blades or stronger wind can make more power. When turbines are placed together in a “wind farm,” they can produce more total power than a single turbine.



VARIABLES

- **Independent variables (what you change):** Number of turbines, wind speed (fan setting), blade size or shape, spacing between turbines
- **Dependent variable (what you measure):** Power output (watts)
- **Controlled variables (what you keep the same):** Distance from fan, type of motor, blade material, load (if used), measurement time

PROCEDURE

- 1 Build Your Turbines:** Attach blades to each DC motor shaft. Mount each motor on a tower and secure to the baseboard.
- 2 Wire the Turbines:** Connect the positive (red) lead from each motor together. Connect the negative (black) leads together. These will be your wind farm outputs.
- 3 Set Up the Test:** Place your wind farm on a flat surface. Position the fan at a fixed distance (e.g., 60 cm) directly in front of the turbines.
- 4 Measure Voltage:** Set your multimeter to DC volts. Connect the multimeter across the positive and negative leads of the wind farm. Turn on the fan. Record the voltage.
- 5 Measure Current:** Set your multimeter to DC amps. Connect the multimeter in series with the negative lead (break the connection and insert the meter). Record the current.
- 6 Calculate Power:** Use the formula below to calculate power.

$$\text{Power (watts)} = \text{Voltage (volts)} \times \text{Current (amps)}$$

- 7 Experiment:** Change one variable at a time (e.g., add more turbines, change fan speed, or blade size). Repeat steps 4–6 for each test. Record your data in the table.

DATA TABLE

Test #	Number of Turbines	Fan Speed (setting)	Voltage (volts)	Current (amps)	Power (watts)
1					
2					
3					
5					

ANALYSIS QUESTIONS

1. How did the number of turbines affect the total power output?
2. How did changing the fan speed affect the power output?
3. Which setup produced the most power? Why do you think that happened?
4. How might the spacing between turbines affect performance in a real wind farm?
5. What are some real-world challenges of building wind farms?

CONCLUSION

Write a short paragraph summarizing what you learned from this experiment.

