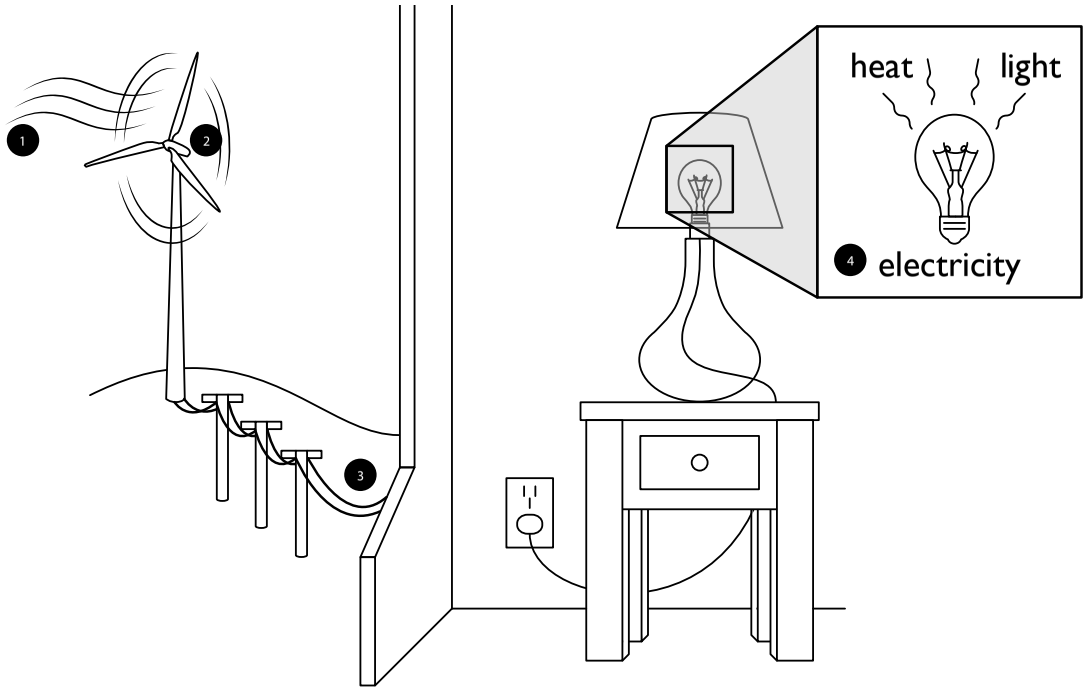
READING PASSAGE 3: UNDERSTANDING LOSSES

As you can see from this image, to light a bulb in your house using wind power takes many steps.

1 Moving air molecules (wind) cause the wind turbine blades to move. It is impossible to convert 100% of the power in the wind to rotational energy. Typical wind turbines convert 40–50% of the moving wind into rotational motion. Maximum theoretical conversion is 59% due to the Betz limit. (Research this to learn more.)

2 Wires moving near magnets generate electricity. Due to friction and design, an electrical generator cannot transform 100% of the spinning motion into electricity. Typical efficiency for a wind turbine generator is 90–95%.



3 Electricity moves down the wires to your house. "Friction" in the wires, caused by resistance, will not allow 100% of the electricity to make it to your house. Typically, this transfer of electricity is about 93% efficient,t but depends on a number of factors like distance and wire sizes.

4 Electricity is converted by the lamp and generates heat and light. An incandescent bulb transforms electricity into heat and light. About 97% of electricity is transformed into heat and 3% into light using an incandescent. If you were using a compact fluorescent bulb (CFL) you would convert 10% to light and 90% to heat. (See note, lighting efficiency gets very complicated!)

READING PASSAGE 3 APPLICATIONS

Start with 100 units of energy.

- Wind to generator: lose 50 units of energy in transformation. 50 units remain.
- Generator to electricity: lose 5 units of energy in conversion. 45 units remain.
- Electricity moving down the wires: lose 3 units in transfer. 42 units remain.
- Electricity converted into light: lose 40 units to heat. 2 units are used to light bulb.

In this example if we started with 100 units of power in the wind. We end up with 2 units of power transformed into light.

How do fossil fuels compare to wind in terms of energy transformation? A typical coal fired plant will convert 35–40% of the energy in the coal to usable thermal energy to heat water. Natural gas plants perform a bit better converting 50–60% of the fuel into usable thermal energy. After that each of these plants will face the same power line and other losses.

Important note on lighting:

Light is measured in "lumens," which correspond to the amount of light produced per watt. For a source of light to be 100 percent efficient, it would need to emit 680 lumens per watt! The luminous efficiency of fluorescent lighting is between 9–11% for most CFLs, while conventional incandescent bulbs stand between 2–3 percent. The luminous efficiency of halogen lamps is between the previous two at 3.5 percent efficiency, while newly developed LEDs are between 8–15%.

Luminous efficiency is one way to determine which bulb to choose. Another element to look at is the watts it takes to produce the same amount of light. For example: It takes an incandescent bulb 60 watts to produce the same amount of light that would take a CFL bulb only 15 watts to produce. An LED could produce the same light with 8 watts.