MMPA

Minnesota Municipal Power Agency

ENERGY EDUCATION WORKBOOK

ELEMENTARY SCHOOL EDITION

MMPA Member Communities

Anoka | Arlington | Brownton | Buffalo | Chaska | East Grand Forks
Elk River | Le Sueur | North St. Paul | Olivia | Shakopee | Winthrop

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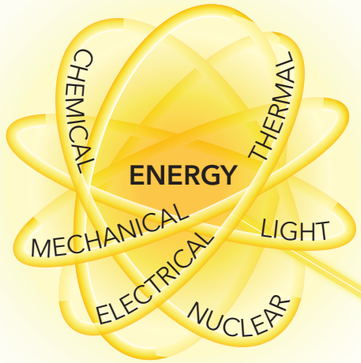
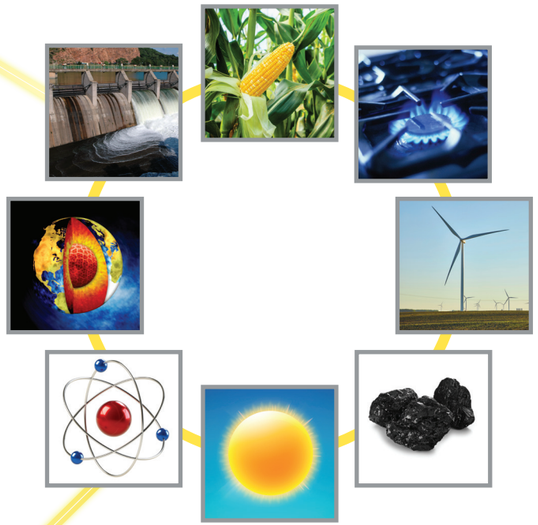
Overview: Energy and Electricity



Energy is the ability to do work and can take a number of forms including: electrical, chemical, mechanical, thermal, light, and nuclear.

Energy cannot be created or destroyed; it can only be transformed from one form of energy to another.



Primary energy sources such as: natural gas, wind, coal, solar, nuclear, geothermal, hydropower, and biomass can be used to create electricity. Electricity is a secondary energy source because it is produced from primary energy sources.

Once electricity is produced, it is delivered over electric power lines to homes and businesses.

ENERGY WHIZ Word Search

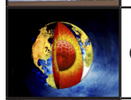
Biomass	Nuclear
Wind	Renewable
Coal	Solar
Electricity	Oil
Energy	Natural Gas
Hydropower	Geothermal

O I L P S D Z N G M E N E R G Y
D P S A O V B H E N W P A R L C
E Y L A L Q R C O K Q R C M K N
B I O M A S S L T L M H R P L A
H I T L R W S E H G E K E O G T
Y A B P T E Q P E O W D N C O U
D L E C R E B R R K Y R E Q K R
R L E O E C K L M J E O W E J A
O R E A T T E E A N N R A M T L
P H C L R W R E L D E T B G S G
O S T F T R O N P I W N L U X A
W L A M L U S N G D Y E E W O S
E L E C T R I C I T Y B K P A R
R T N U C L E A R C L A W I N D

Renewable and Nonrenewable Energy Sources

Primary energy sources are divided into two categories: renewable and nonrenewable. These energy sources can be used to produce electricity, a secondary energy source.

Renewable energy sources are naturally replenished which means they build up again so they won't run out.

	**Solar** energy uses heat and light from the sun collected by panels to produce electricity.
	**Wind** energy uses blowing wind that turns large blades to produce electricity.
	**Geothermal** energy uses heat from deep inside Earth to produce electricity.
	**Hydropower** uses energy from moving water to produce electricity.
	**Biomass** is organic material from plants and animals used to produce electricity.

Nonrenewable energy sources cannot be easily replenished and will eventually run out because it takes millions of years for them to form.

	**Natural Gas** contains methane and is removed from Earth by drilling wells and burned to produce electricity.
	**Coal** is a black or brownish-black sedimentary rock that is removed from Earth by mining and then burned to produce electricity.
	**Oil** exists in liquid form and is removed from Earth by drilling, refined, and burned to produce electricity.
	**Nuclear** energy uses nuclear fission to split uranium atoms to produce electricity.

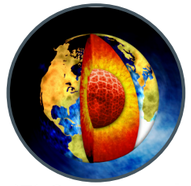
Natural gas, coal, and oil are fossil fuels formed millions of years ago. Heat from Earth's core and pressure from rock and soil turned the remains of dead organisms (fossils) into fuel.

ENERGY WHIZ
Match It

Match the energy source on the left with its description on the right by entering the letter.

(A) Solar

(C) Natural Gas



(E) Geothermal

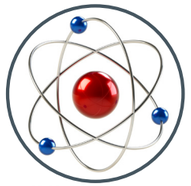
(G) Coal

(I) Hydropower

(B) Wind

(D) Biomass

(F) Oil



(H) Nuclear

_____ Energy from wind turns large blades.

_____ This fossil fuel is a black or brownish-black rock removed from Earth by mining.

_____ Organic material that comes from plants and animals.

_____ This fossil fuel contains methane and is removed from Earth by drilling wells.

_____ Energy from the sun is collected using panels.

_____ Uranium atoms are split in a process called fission.

_____ Energy from moving water.

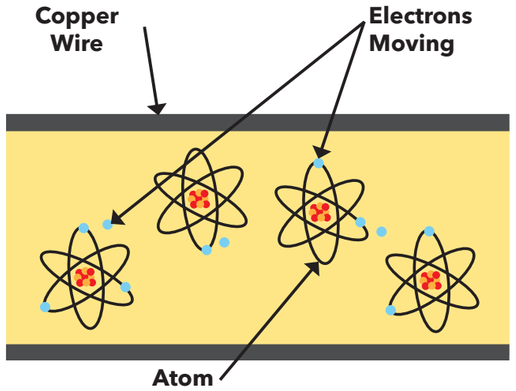
_____ Energy from heat deep inside Earth.

_____ This fossil fuel exists in liquid form and is removed from Earth by drilling.

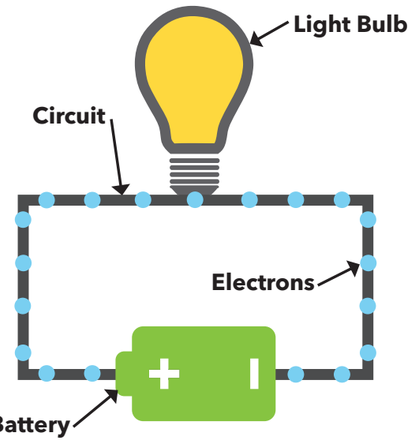
What is Electricity?

Electricity is one of the most common forms of energy we use. It is a secondary source of energy and is neither renewable nor nonrenewable.

Everything in the universe is made up of atoms which are made up of small particles called protons, neutrons, and electrons. Electricity is defined as the movement of electrons between atoms.



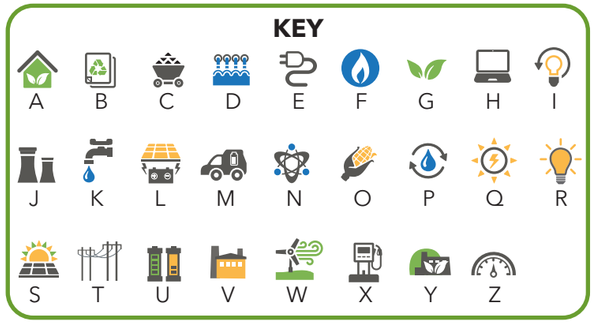
For electrons to move, they need a complete path known as a circuit. A switch like an on-off button closes (turns on) or opens (turns off) an electrical circuit. Turning on a light closes a circuit. This allows electricity to flow from one electric wire, through the light bulb, and then through another wire. Turning off a light opens a circuit, preventing electrons from flowing through the light. Electrical energy in a circuit can be measured by current and voltage. Current is the rate at which charge flows through a circuit. Voltage measures how strong that charge is at a given point.

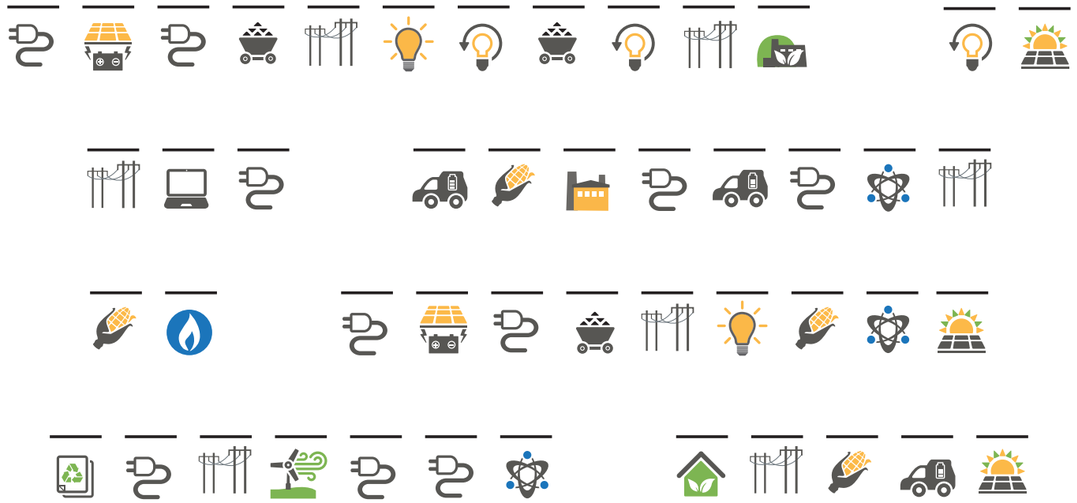


Electricity is measured in watts, a unit of power named after James Watt (the inventor of the steam engine).

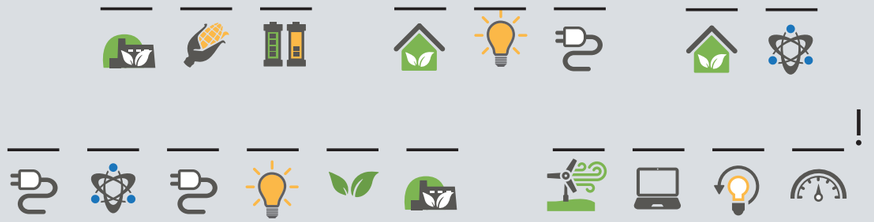
ENERGY WHIZ Code Breaker

Use the key to crack the code.





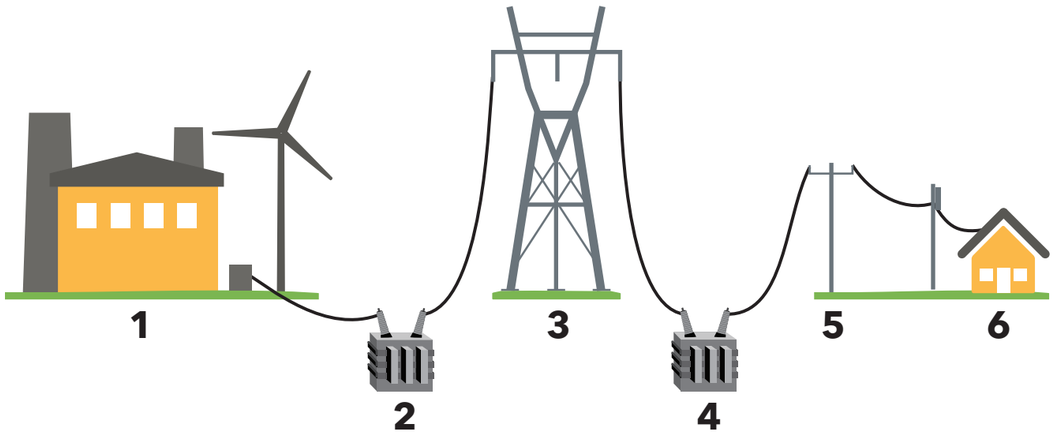
Bonus Code!



How Electricity Gets to You

We use electricity to power things such as lights, refrigerators, televisions, computers, and air-conditioning. Did you ever wonder how electricity gets to our homes and schools?

Electricity is made at a power plant and then travels through a complex system called "the grid". The grid consists of substations, transformers, and power lines that connect where electricity is made to where it can be used.

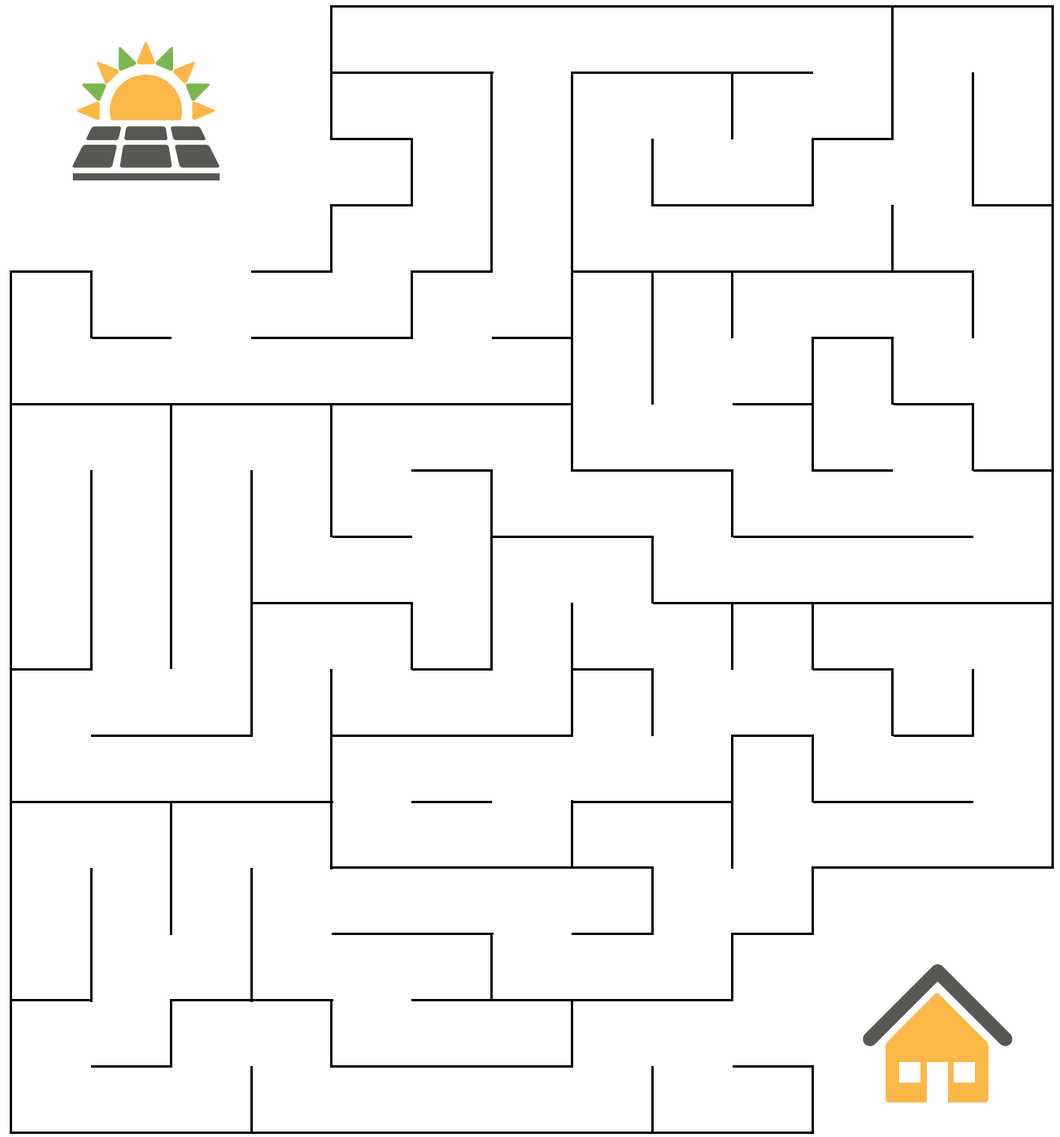


1. Electricity is made at a **power plant.** Power plants use different energy sources like solar, wind, natural gas, water, nuclear, or coal to make electricity.
2. Electricity is sent through a **step up transformer** located near a power plant that increases voltage so it can travel long distances.
3. **Transmission lines** are high voltage power lines that carry electricity over long distances.
4. At a **substation**, electricity goes through a **step down transformer** that decreases voltage so it can travel on smaller power lines.
5. **Distribution lines** are low voltage power lines that carry electricity to homes and businesses.
6. Electricity connects to your house and passes through a **meter** that measures the electricity that you use. Electricity then travels through wires inside walls to outlets and light switches.

In the United States, there are thousands of miles of transmission lines and millions of miles of distribution lines.

ENERGY WHIZ Maze

Get electricity from the solar farm to your home by drawing power lines.



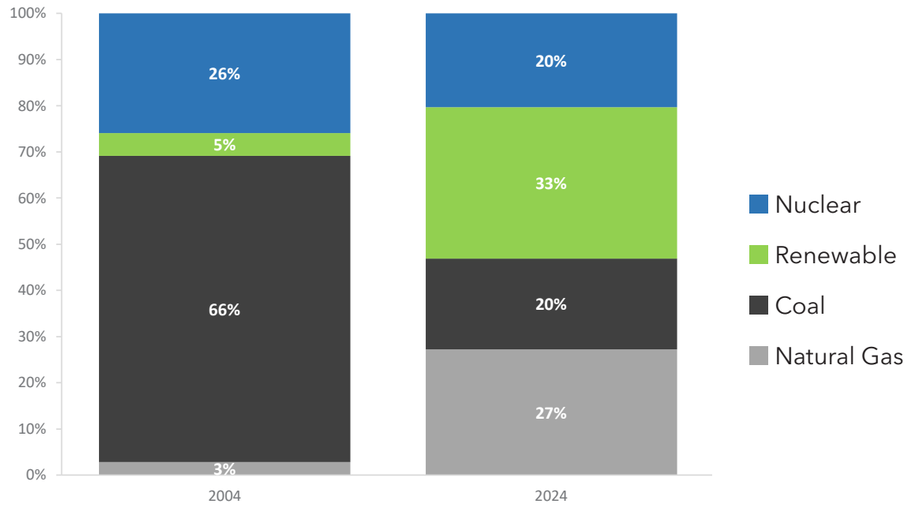
Electricity Generation in Minnesota

What about the electricity generated in Minnesota? Let's take a look at how energy sources used to generate electricity in Minnesota have changed over the years.

Where Electricity Generated in Minnesota Comes From

Electricity generated in Minnesota comes from a variety of sources. The bar chart below compares the percentage of energy sources used to generate electricity in Minnesota in 2004 and 2024. Notice how the percentages have changed.

MN Net Electricity Generation by Source (2004 and 2024)



	ENERGY WHIZ QUIZ
	1. Which energy source generated the largest share of Minnesota's electricity in 2004?
	☐ Nuclear ☐ Renewable ☐ Coal ☐ Natural Gas
	2. Which energy source generated the largest share of Minnesota's electricity in 2024?
	☐ Nuclear ☐ Renewable ☐ Coal ☐ Natural Gas

While 33% of Minnesota's electricity was generated from renewable energy in 2024, 67% came from nonrenewable sources. This means we have work to do if we want most of our electricity to come from renewable energy.

Source: U.S. Energy Information Administration

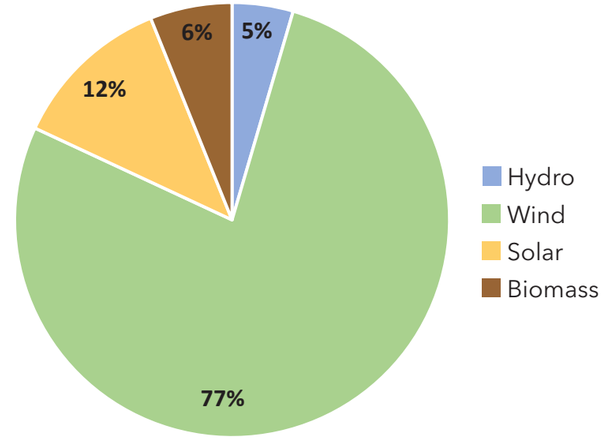
Renewable Energy in Minnesota

Let's take a look at the renewable energy sources used to generate electricity in Minnesota.

Renewable Energy Sources in Minnesota

The pie chart below shows the percentages of different renewable energy sources used to generate electricity in Minnesota in 2024.

MN Renewable Electricity Generation in 2024



Renewable resources (wind, solar, hydropower, and biomass) generate the largest share of Minnesota's electricity.

Wind: Open prairies in the western and southern part of Minnesota are ideal for wind power.

Solar: While you may think of snow before you think of sunshine, solar power provides the second largest share of Minnesota's electricity generation from renewable resources.

Biomass: Rolling plains, farmland, and 18 million acres of forest provide Minnesota with many sources of biomass.

Hydropower: Minnesota has nearly 70,000 miles of natural streams and rivers which are a source of hydropower.

	ENERGY WHIZ QUIZ
	1. Which renewable energy source generated the largest share of Minnesota's electricity in 2024?
	☐ Solar ☐ Biomass ☐ Hydro ☐ Wind
	2. Which renewable energy source generated the second largest share of Minnesota's electricity in 2024?
	☐ Solar ☐ Biomass ☐ Hydro ☐ Wind

Source: U.S. Energy Information Administration

MMPA and You

On these two pages, you can see the types of energy sources Minnesota Municipal Power Agency (MMPA) uses to produce electricity and how electricity gets from MMPA to your local utility and then to you.

MMPA's Power Supply

Faribault Energy Park
300 MW, Natural Gas/Steam

Black Oak Getty Wind Farm
78 MW, Wind

Minnesota River Station
49 MW, Natural Gas

Shakopee Energy Park
46 MW, Natural Gas

Oak Glen Wind Farm
44 MW, Wind

Hometown BioEnergy
8 MW, Biomass

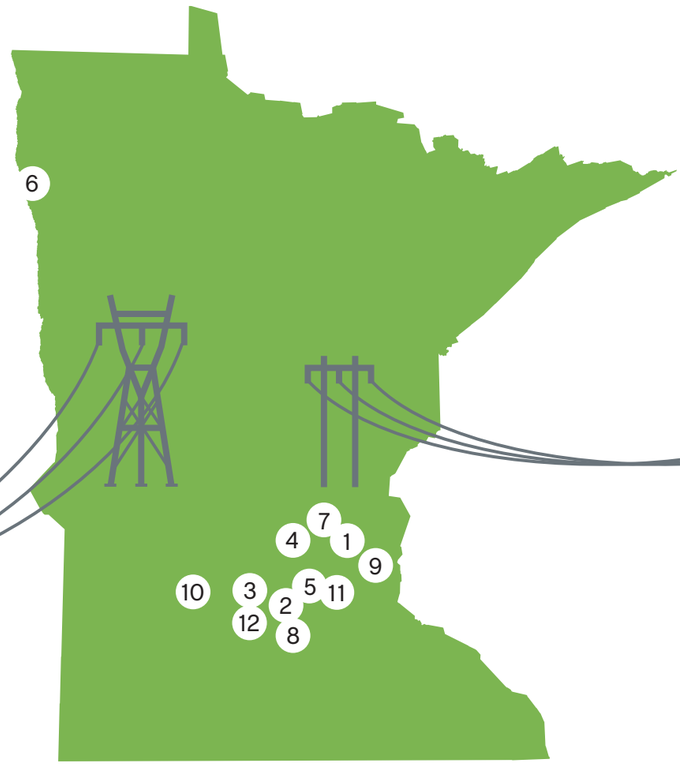
Buffalo Solar
7 MW, Solar

Hometown WindPower
1.9 MW, Wind

Walleye Wind Farm
110 MW, Wind

Twelve Member Utilities

MMPA provides electricity to its 12 member utilities.



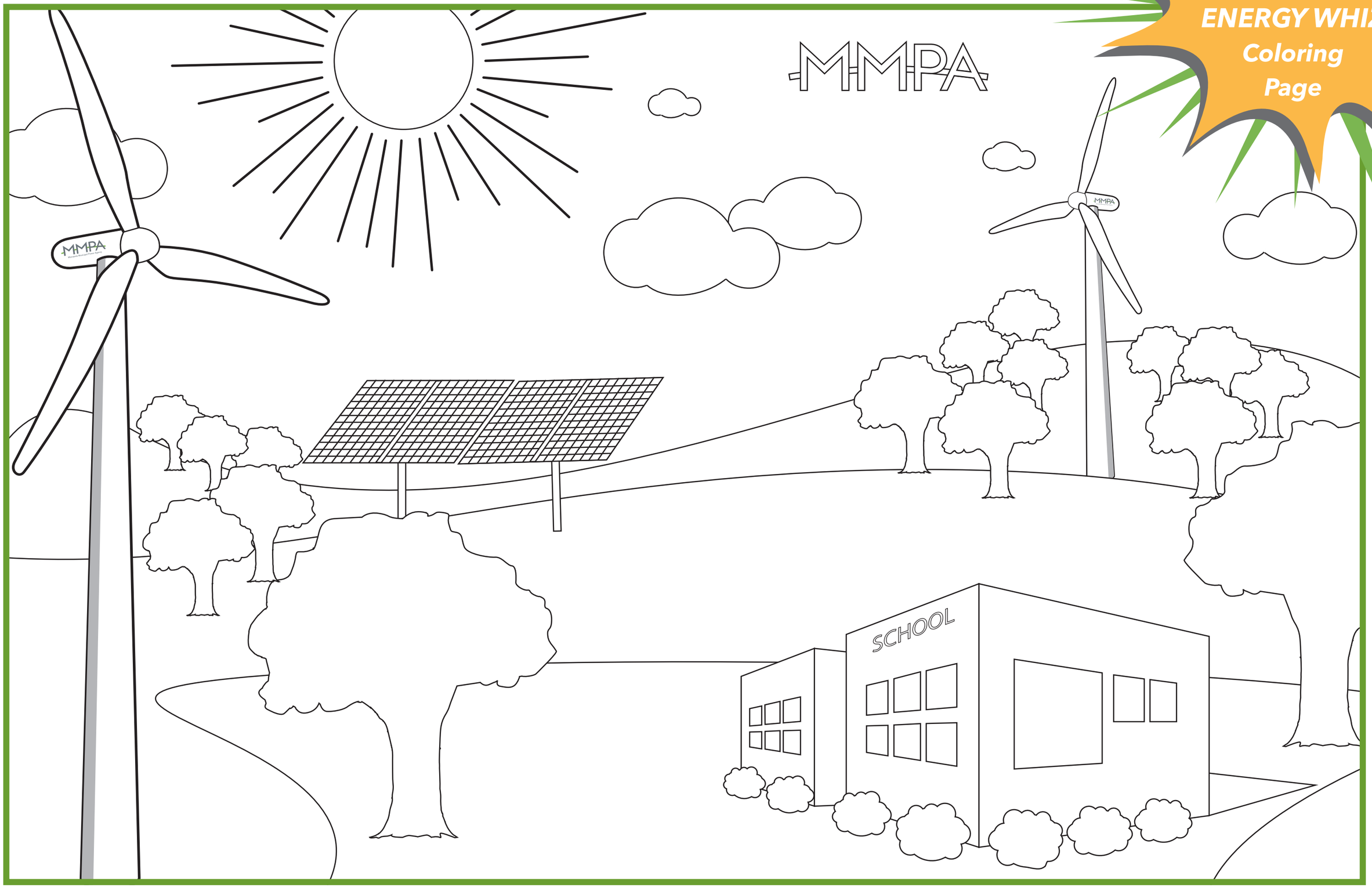
1. Anoka
2. Arlington
3. Brownton
4. Buffalo
5. Chaska
6. East Grand Forks
7. Elk River
8. Le Sueur
9. North St. Paul
10. Olivia
11. Shakopee
12. Winthrop

Your Hometown

Your local utility delivers and sells the electricity it buys from MMPA to your hometown.

The Power of Your Hometown

ENERGY WHIZ Coloring Page



Spotlight: Faribault Energy Park

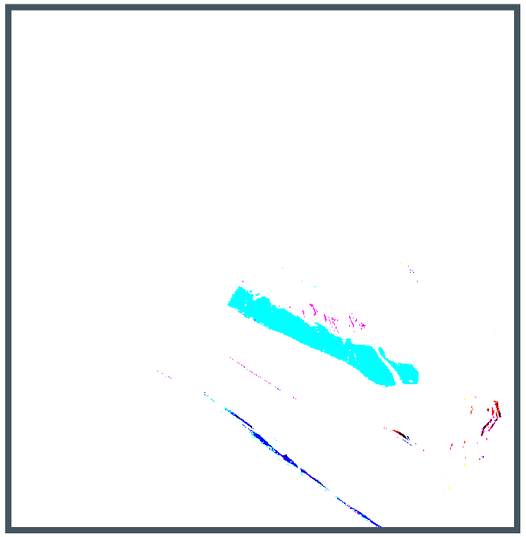
Faribault Energy Park (FEP) is MMPA's largest power plant. FEP runs during periods of higher demand for electricity, when other sources of energy are more expensive.

FEP Features and Facts

- 300 MW combined-cycle power plant using natural gas and steam to produce electricity.
- 185 MW is generated from the gas turbine, 115 MW is generated from the steam turbine.
- In a combined-cycle power plant, steam produced by the gas turbine is used to power a steam turbine. This means more electricity is produced using the same amount of natural gas.

Not Just a Plant but a Park

FEP began operation in 2007, but it's not just a power plant. People are welcome to visit the facility's 35 acres and explore walking trails where you'll see a wind turbine and solar array. You can even drop a fishing line into one of the ponds! Scheduled tours are also available and provide views of the control room and steam turbine.



Spotlight: Wind Energy

Wind turbines turn wind energy into electricity. On this page, you will learn about the different parts of a wind turbine and how electricity is generated from wind.

Parts of a Wind Turbine

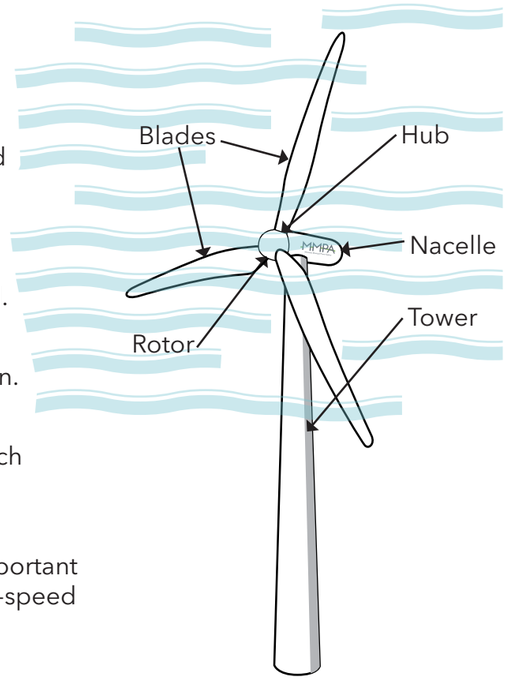
Tower:
Made from tubular steel, the tower supports the wind turbine. The taller the tower is, the more electricity can be generated because wind speed increases with height.

Blade:
Most turbines have three blades. The longer the blade, the more electricity that can be generated.

Hub:
The hub holds the blades and allows them to spin.

Rotor:
Together, the blades and hub form the rotor which connects to the generator.

Nacelle:
The nacelle contains the generator and other important equipment including the gear box, low and high-speed shafts, controller, and brake.



Generating Electricity from Wind

1. **Uneven heating of Earth by the sun causes wind.**
   Earth's surface is made up of land and water which absorb the sun's heat differently. This uneven heating causes wind.
2. **Turbine blades rotate to create energy.**
   When wind blows across the blades of a wind turbine, it makes them spin. The blades are part of the rotor, which is connected to the main shaft that spins a generator.
3. **A generator creates electricity.**
   The gear box inside the nacelle uses a large and small gear. The larger gear powers the smaller gear to turn at a faster pace, which rotates the generator to create electricity.
4. **Electricity is sent over electric power lines and delivered to homes and businesses.**
   Power lines deliver electricity from the wind turbine to customers.

Wind turbines are not large fans. Fans use electricity to make wind. Wind turbines use wind to make electricity.

Spotlight: Solar Energy

Solar cells turn energy from the sun into electricity. On this page, you will learn about the different parts of a solar power system and how electricity is generated from the sun.

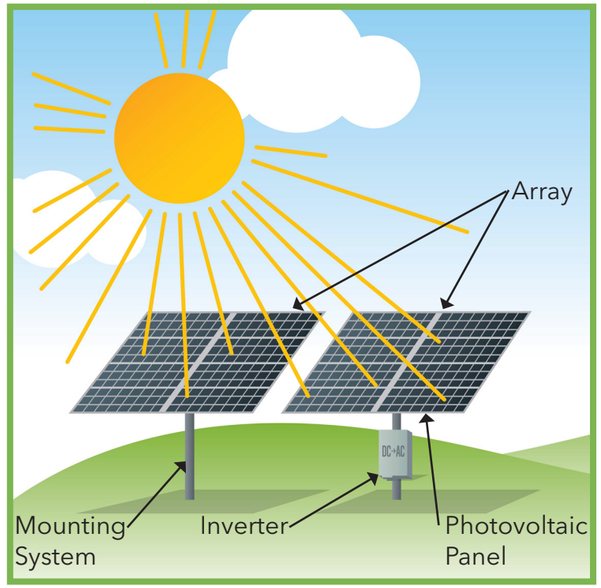
Parts of a Solar PV System

Photovoltaic (PV) Panels:
PV panels are also called solar panels. These panels are made up of PV cells (also called solar cells) that convert sunlight directly into electricity.

Solar Array:
Multiple solar panels connected together are called a solar array. The size of the array determines how much electricity can be generated.

Inverter:
The inverter converts electricity from direct current (DC) to alternating current (AC).

Mounting System:
Solar arrays are mounted on a stable base. Some mounting systems allow PV panels to tilt and turn so they're always pointed toward the sun during the day.



Generating Electricity from the Sun

1. **The sun produces solar energy.**
   Heat and light from the sun produce solar energy.
2. **Solar panels convert solar energy into electricity.**
   PV panels collect light from the sun and convert it into electricity. The type of electricity produced is DC which only flows in one direction.
3. **An inverter converts the electricity from DC to AC.**
   Most buildings use AC which is electricity that changes direction. An inverter takes the DC electricity generated by the solar panels and converts it into AC so that it can be used.
4. **Electricity is sent over electric power lines and delivered to homes and businesses.**
   Power lines deliver electricity from solar power systems to customers.

The sun has produced energy for billions of years. It is essential for all of the energy sources and fuels that we use today.

Climate Change

Climate change is happening and affects us all. To understand climate change, we first need to understand the difference between climate and weather.

Climate and Weather Are Not the Same Thing

The main difference between climate and weather is time. Weather is temporary, a specific event or condition that occurs over a period of hours or days. Climate is more than a few hot or cold days. Climate describes average weather conditions for a specific area over a long time, usually 30 years.

***Weather** is temporary. "It was hot outside today and there was a thunderstorm."*

***Climate** describes average weather conditions. "Minnesota is cold and snowy in the winter."*

Climate Change Is a Change in Average Weather Conditions Over a Long Period of Time

While Earth's climate has changed throughout its history, it's currently warming at a rate not seen over the past 10,000 years and human activity is the main cause. Global air temperatures near Earth's surface have risen around 2 degrees Fahrenheit (2° F) in the past 100 years.[1] That may not seem like a big number; however, a change this size can have big impacts on plants and animals. Examples of global climate change that can be measured are melting glaciers, rising sea levels, intense heat waves, extreme weather events (hurricanes, flooding, drought), and the time it takes flowers and plants to bloom.

Greenhouse gases absorb energy from sunlight and heat Earth's atmosphere. They let sunlight pass through but keep heat from leaving. While it's normal to have greenhouse gases, high levels cause too much warming. The main human activity that increases carbon dioxide is burning fossil fuels for transportation (cars, trucks, trains, airplanes) and to make electricity. This is why it's important to use renewable energy sources to produce electricity.

2024 was the world's warmest year on record since 1850 when global weather records began. The 10 warmest years since 1850 have all occurred during the last decade (2015-2024).[2]

Source: [1] NASA.gov, [2] National Centers for Environmental Information, Annual 2024 Global Climate Report

ENERGY WHIZ Word Scramble

Unscramble the letters below to reveal words from the word bank.

HTAERWE _____

ILTMECA _____

RLGCIEA _____

AEPHMRETSO _____

HERTA _____

ARMPTETRUEE _____

ARMPTETRUEE _____

SOFSIL ELUFS _____

WERBLEANE GEYENR _____

CIRTCLEETIY _____

ASE VELEL _____

MXETREE HTAERWE _____

HGEEROUESN SGAES _____

Word Bank

RENEWABLE ENERGY	EXTREME WEATHER	FOSSIL FUELS
CLIMATE	GLACIER	GREENHOUSE GASES
ELECTRICITY	SEA LEVEL	WEATHER
EARTH	TEMPERATURE	ATMOSPHERE

Climate Change in Minnesota

We don't have oceans and glaciers in Minnesota, but that doesn't mean we don't have climate change.

It's Getting Warmer and Wetter in Minnesota

Between 1895 and 2024, the average annual temperature in Minnesota increased by 3.2°F. Colder months are warming even faster, with the state's average winter temperature increasing by 5.4°F. And it's not just about temperature! During this same period, Minnesota also experienced an average increase of 3.5 inches of precipitation per year.

Changes in Temperature and Precipitation Affect Our Daily Lives

It's getting warmer and wetter, but what does that mean for us in Minnesota? Longer growing seasons for plants can make asthma and allergies worse. Shorter, warmer winters result in more insects (ticks, mosquitoes) that carry disease. Increasing lake temperatures make it easier for algae to grow which is unsafe for swimming. Heavy rains followed by drought can lead to crop damage, higher fire risk, and over time less food to eat.

ENERGY WHIZ QUIZ

Finish the sentences below to show what you've learned about climate change.

1. Longer growing seasons for plants can make

☐ air quality better ☐ asthma and allergies worse ☐ clouds whiter

2. Shorter, warmer winters can cause

☐ more insects like ticks and mosquitoes ☐ thicker ice on lakes ☐ more snow in April

3. Increasing lake temperatures make it

☐ healthier for dogs to swim ☐ easier to ice fish ☐ easier for algae to grow

4. Heavy rains followed by drought can lead to

☐ higher fire risk ☐ crop damage ☐ less food to eat ☐ all three are true

Climate change is scary. What can you do to help?

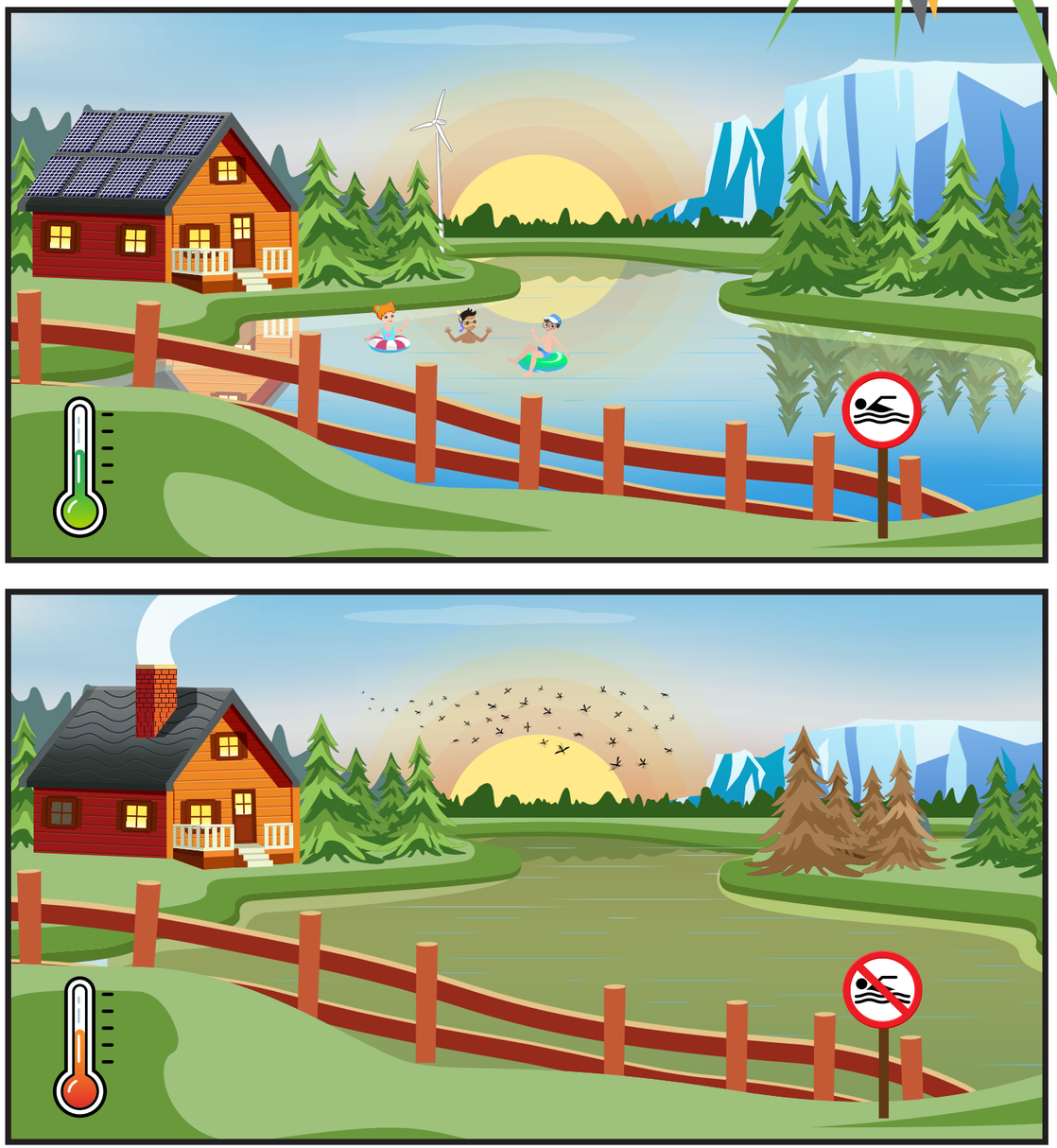
1. **Think like a scientist!** Observe the world around you and pay attention to changes.
2. **Don't waste resources.** Only use as much electricity and water as you need. Recycle!
3. **Talk to family and friends.** Have a contest to see who can save the most electricity.

Source: University of Minnesota Climate Adaptation Partnership, 2025. Climate Change in Minnesota. Version 2. www.climate.umn.edu/climate-change-in-minnesota

ENERGY WHIZ Spot the Differences

Find the differences between the two scenes below.

5 = Good
7 = Great
10 or more = Expert Level!



How You Use Electricity at Home

Energy conservation means taking actions to reduce your energy use. To understand how to conserve (not waste) energy, you must first pay attention to how you use electricity.

Below is a list of some common household items that use electricity. Place a check next to the 3 items you think use the most electricity.

- ☐ lighting
- ☐ air conditioner
- ☐ microwave
- ☐ space heater
- ☐ toaster
- ☐ video game console
- ☐ television
- ☐ fan
- ☐ refrigerator

Devices Use Electricity Differently

Anything plugged in uses electricity. However, devices use electricity differently. Think about a toaster and a refrigerator.

	A toaster uses electricity while you're using it. Most toasters are used less than 15 minutes a day.		A refrigerator uses electricity when it runs. Most refrigerators actively run about 8 hours a day.

What uses more electricity over time - a refrigerator or a toaster?

a refrigerator

Is It Really Off?

What if a device is plugged in, but turned off? Even if they're turned off, devices with an illuminated display (digital clock, small light that stays on) continuously use electricity if they're plugged in. Electricity used by devices that are turned off but still plugged in is called phantom load and it's estimated to account for 5 to 10% of the electricity we use!

	ENERGY WHIZ QUIZ
	What are 3 items you can think of in your home that use electricity even when
	they're turned off? Hint, think of things that have a digital clock display or
	small light that stays on.
	1.
	2.
	3.

Source: U.S. Department of Energy

How You Can Save Energy at Home

In this section, you'll look at things you can do to save energy at home.

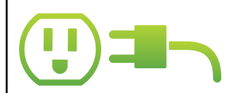
Energy Conservation and Energy Efficiency

Energy conservation and energy efficiency are both ways you can reduce your energy use. Energy conservation involves people and the actions you take to reduce the amount of energy you use. Energy efficiency involves devices and how they work.

By conserving energy, you help the environment by reducing greenhouse gas emissions and eliminating the need to build additional power plants. Saving energy also saves money. By using less electricity, your monthly electric bill will be less.

Tips for Saving Energy

You save energy by not wasting energy. Here are some ways you can save energy.

	**Unplug It**	• Unplug cell phones, gaming systems, and tablets after they are charged. • Unplug charging cables not being used. • Unplug devices that you don't regularly use.
	**Turn It Off**	• Turn off fans and lights in unoccupied rooms. • Plug things like TVs and gaming systems into power strips and switch them off when you're not using them.
	**Turn It On**	• Use energy efficient LED light bulbs. • Set the thermostat to 78 degrees or higher in the summer. • Purchase ENERGY STAR® appliances that use less energy. • Install smart, programmable thermostats.
	**Cool It Down**	• Run ovens, dishwashers, and clothes dryers during the cooler part of the day since they give off heat. • Use fans to help make rooms feel cooler. • Close window blinds and curtains during hot days.

Wherever energy is used, we have an opportunity to improve efficiency.

Home Energy Audit

By conducting a home energy audit, you learn how you use energy now and find ways to save energy in the future. This exercise is to be completed with a grown up.

INSTRUCTIONS: Read the questions below and enter the number that best matches your answer in the box on the right. Then calculate your score by adding up the numbers.

	How often are lights left on in rooms that aren't being used? Rarely: enter 1 Sometimes: enter 2 Almost Always: enter 3	
	How often is the TV left on when no one is watching it? Rarely: enter 1 Sometimes: enter 2 Almost Always: enter 3	
	Are most of the light bulbs used in your home LED? Yes: enter 1 Unsure: enter 2 No: enter 3	
	How often are devices left plugged in overnight to charge? Rarely: enter 1 Sometimes: enter 2 Almost Always: enter 3	
	Count the number of chargers plugged into an outlet but not being used. How many are there? None: enter 1 One or Two: enter 2 Three or More: enter 3	
	Count the refrigerators in your home. How many are there? One: enter 1 Two: enter 2 Three or More: enter 3	
	Add Up Your Score Here →	

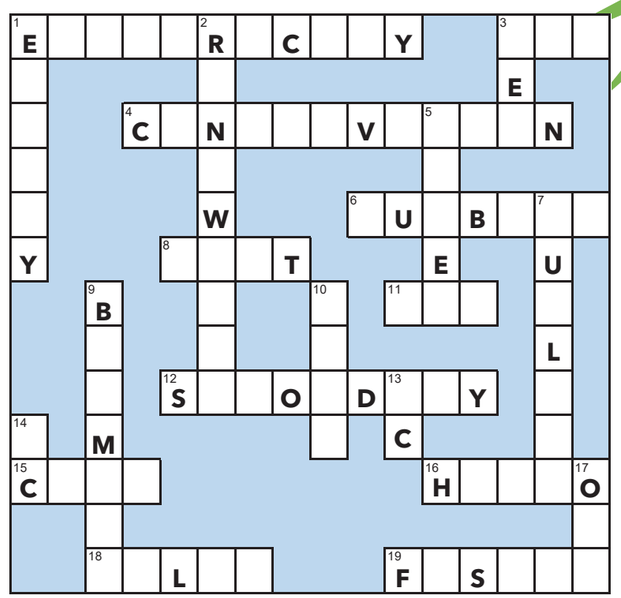
If your total was 12–18 Points, you're an **ENERGY USER**

Now that you've learned ways to save energy, you can start changing the way you use it.

If your total was 6–11 Points, you're an **ENERGY SAVER**

Great job saving energy! Continue to look for new ways to save energy.

ENERGY WHIZ Crossword Puzzle



ACROSS:

1. _____ is the movement of electrons between atoms and one of the most common forms of energy that we use.

3. Natural ____ is a nonrenewable energy source that contains methane and is removed from Earth by drilling wells and burned to produce electricity.

4. Energy _____ involves doing things to reduce the amount of energy we use.

6. At FEP, excess heat from the gas _____ is used to power a steam turbine.

8. A _____ is a unit used to measure electricity that is abbreviated with the letter W.

11. ____ is the abbreviation for light-emitting diode. These light bulbs use less electricity than incandescent light bulbs.

12. Primary energy sources can be converted into electricity which is a _____ energy source.

15. ____ is a nonrenewable energy source that is a black or brownish-black sedimentary rock extracted from Earth and burned to produce electricity.

16. _____ power is a renewable energy source using energy from moving water to produce electricity.

18. _____ energy is a renewable energy source that uses heat and light from the sun to produce electricity.

19. _____ fuels were formed millions of years ago. Examples include natural gas, coal, and oil.

DOWN:

1. _____ cannot be created or destroyed and can only be transformed from one form to another.

2. _____ energy sources are naturally replenished which means they build up again so they won't run out.

3. ____ thermal energy is a renewable energy source that uses heat from deep inside Earth to produce electricity.

5. Number of blades most wind turbines have.

7. _____ energy is a nonrenewable energy source that uses uranium to produce electricity by splitting atoms (a process called fission).

9. _____ is an organic material that comes from plants and animals that is used to produce electricity.

10. _____ energy is a renewable energy source that uses blowing wind that turns large blades to produce electricity.

13. The abbreviation for alternating current.

14. The abbreviation for direct current.

17. ____ is a nonrenewable energy source that exists in liquid form and is removed from Earth by drilling, refined, and burned to produce electricity.

Glossary of Terms

A

Alternating Current (AC): an electric current that reverses its direction again and again

Atom: the smallest particle of an element that can exist either alone or in combination

B

Biomass: organic material that comes from plants and animals and is renewable

Blade: part of a wind turbine that spins when the wind blows

C

Circuit: a closed path for the transmission of electric current

Climate: the average weather conditions of a particular place or region over a period of years

Combined-Cycle Power Plant: a power plant that generates additional electricity from waste heat (steam) from a gas turbine

Coal: a fossil fuel in the form of a black or brownish-black sedimentary rock that is removed from Earth by mining and is nonrenewable

Current: the rate at which charge flows through a circuit (measured in amps)

D

Direct Current (DC): an electric current flowing in one direction only

Distribution Lines: low voltage power lines that carry electricity to homes and businesses

E

Electricity: the movement of electrons between atoms (measured in watts)

Electron: negatively charged particle that forms part of an atom and moves around its nucleus

Energy: the ability to do work, it cannot be created or destroyed and can only be transformed from one form to another

Energy Conservation: any behavior that results in using less energy

Energy Efficiency: using less energy to perform the same task

F

Fossil Fuels: fuels such as coal, oil, and natural gas that formed millions of years ago from the remains of organisms and are nonrenewable energy sources

G

Gas Turbine: an engine that burns natural gas and uses the hot gases to spin blades connected to a generator

Generator: a machine that turns mechanical energy into electrical energy

Geothermal Energy: heat energy that is produced from deep inside Earth and is renewable

Greenhouse Gases: various gases that absorb energy from sunlight, trap heat in the atmosphere, and contribute to the greenhouse effect

Grid: a complex system of substations, transformers, and power lines that connect electricity from where it is generated to homes and business who use it

H

Hub: part of a wind turbine that holds the blades and allows them to spin

Hydropower: energy that comes from moving water and is renewable

I

Inverter: part of a solar power system that converts electricity from direct to alternating current

J

K

L

LED Bulb: an energy efficient light bulb (LED stands for Light Emitting Diode)

M

Meter: a device that measures the amount of electricity used by a house or business

MMPA: Minnesota Municipal Power Agency

Mounting System: the structural base of a solar power system

N

Nacelle: part of a wind turbine that contains the generator and other equipment including the gear box, low and high-speed shafts, controller, and brake

Natural Gas: a fossil fuel formed deep beneath the Earth's surface that contains methane and many other compounds and is nonrenewable

Neutron: uncharged particle found inside the nucleus of atoms

Nonrenewable Energy: energy sources that cannot be easily replenished and will eventually run out because it takes millions of years to form

Nuclear Energy: energy that comes from splitting atoms of radioactive materials (such as uranium) and is nonrenewable

Nucleus: the center of an atom made up of protons and neutrons

O

Oil: a black liquid fossil fuel found deep in Earth that is removed by drilling and is nonrenewable

P

Photovoltaic (PV) Panels: solar panels made up of PV (solar) cells that convert sunlight directly into electricity

Power Plant: a facility where power (especially electricity) is generated

Power Lines: cables that allow electricity to travel from one place to another and can be overhead or underground

Primary Energy Source: an energy source that can be used to produce electricity (includes renewable energy, fossil fuels, and nuclear energy)

Proton: positively charged particle found inside the nucleus of atoms

Q

R

Renewable Energy: energy sources that are naturally replenished and can be used repeatedly without running out

Rotor: part of a wind turbine that consists of blades and a hub which connects to the generator

S

Secondary Energy Source: an energy source produced from primary energy sources (includes electricity)

Solar Array: multiple solar panels connected together

Solar Energy: radiant energy that comes from the sun and is renewable

Steam Turbine: an engine that uses pressurized steam to spin blades connected to a generator

Substation: a facility that allows electricity to be transmitted at different voltages

T

Tower: the structural base of a wind turbine typically made from tubular steel

Transformer: a device that changes the voltage of electricity, it can increase (step up) or decrease (step down) voltages as electricity moves from power plants to homes and businesses

Transmission Lines: high voltage power lines that carry electricity over long distances

Turbine: an engine with blades that are turned by a force such as water, steam, or air

U

V

Voltage: a measure of how strong the current is in a circuit (measured in volts)

W

Watt (W): a unit of power used to measure electricity named after James Watt, the inventor of the steam engine

Weather: the daily state of the atmosphere (hot or cold, wet or dry, calm or stormy, clear or cloudy)

Wind Energy: energy from moving air that is renewable

Wind Turbine: a turbine that uses the wind to spin blades connected to a generator

X

Y

Z

Glossary of Terms

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