OHM'S LAW

- Ohms are a measure of resistance in an electrical current.

- Ohm's law states that the current through a conductor between two points is directly proportional to the voltage across the two points.
    - Relationship between current, voltage, and resistance

OHM'S LAW

- The relationship between current, voltage, and resistance can be expressed as an equation in three ways:

$$V = I \times R$$

$$I = \frac{V}{R}$$

$$R = \frac{V}{I}$$

Where:

V is the voltage (V)

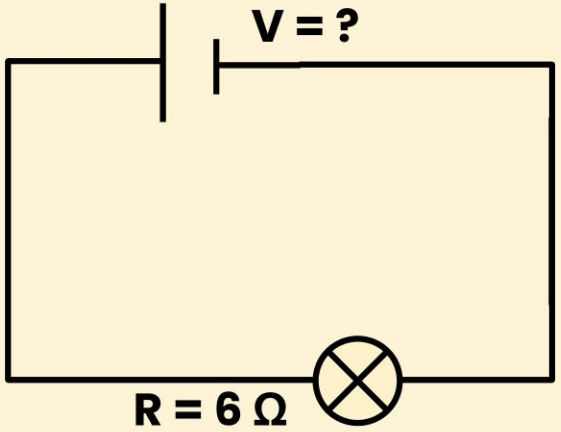
I is current in amps (A)

R is the resistance in ohms (Ω)

Think about it!

Use Ohm's law to solve for the unknown.

1.



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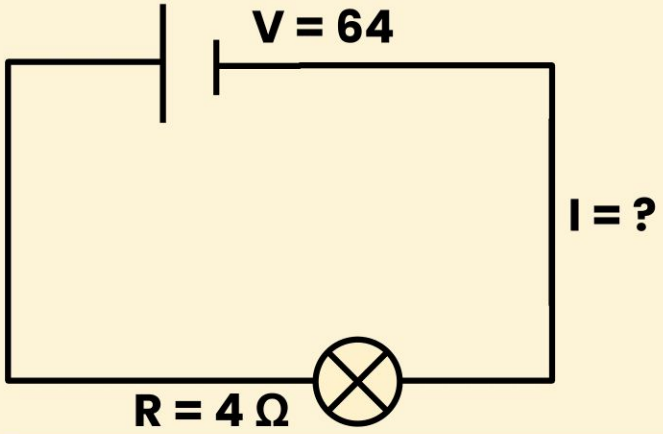


$V = I \times R$

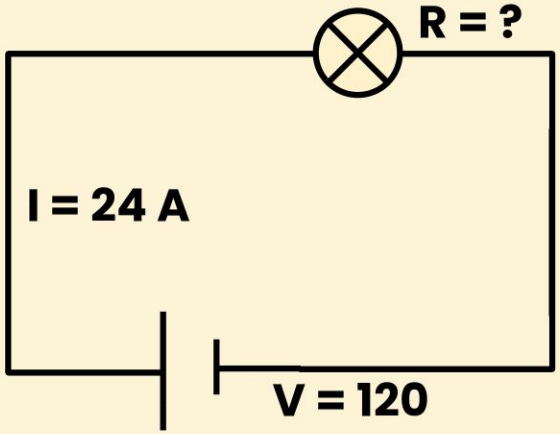
$I = \frac{V}{R}$

$R = \frac{V}{I}$

Think about it!

Use Ohm's law to solve for the unknown.

3.



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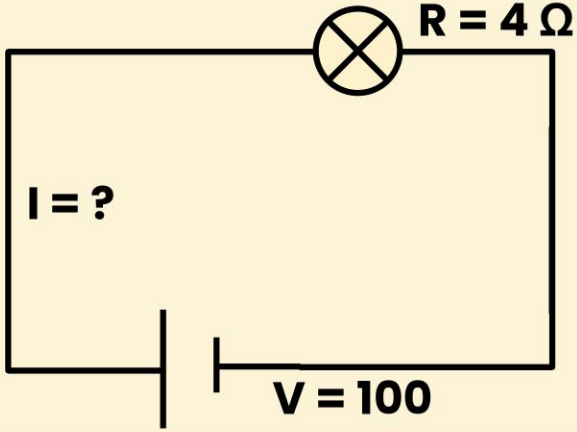


$V = I \times R$

$I = \frac{V}{R}$

$R = \frac{V}{I}$

OHM'S LAW

- Prefixes are used to indicate the quantity of International System of Units (SI) units:

Prefix	Symbol	Multiplier	Power of Ten
Mega	M	1 000 000	10^{6}
kilo	k	1000	10^{3}
none	none	1	10^{0}
milli	m	1/1000	10^{-3}
micro	μ	1/1 000 000	10^{-6}

Think about it!

Solve the problems below.

1. What potential difference is needed to produce a current of 15 A with a resistance of 90 Ω?

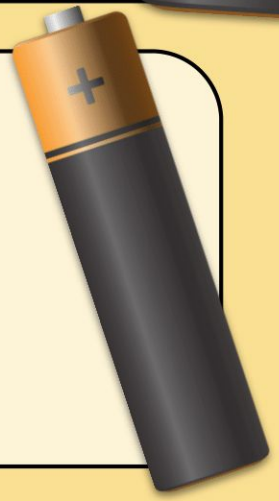
2. Determine the current for a small oven with resistance 18 Ω when the potential difference across it is 196 V.

Think about it!

Solve the problems below.

3. A resistance of 6.2Ω is connected across a 240 V source. Determine the current.

4. Determine the voltage for a circuit with I = 7 A and R = 60.



FACTORS AFFECTING RESISTANCE

- Resistance (measured in ohms) is what determines how much current can flow.

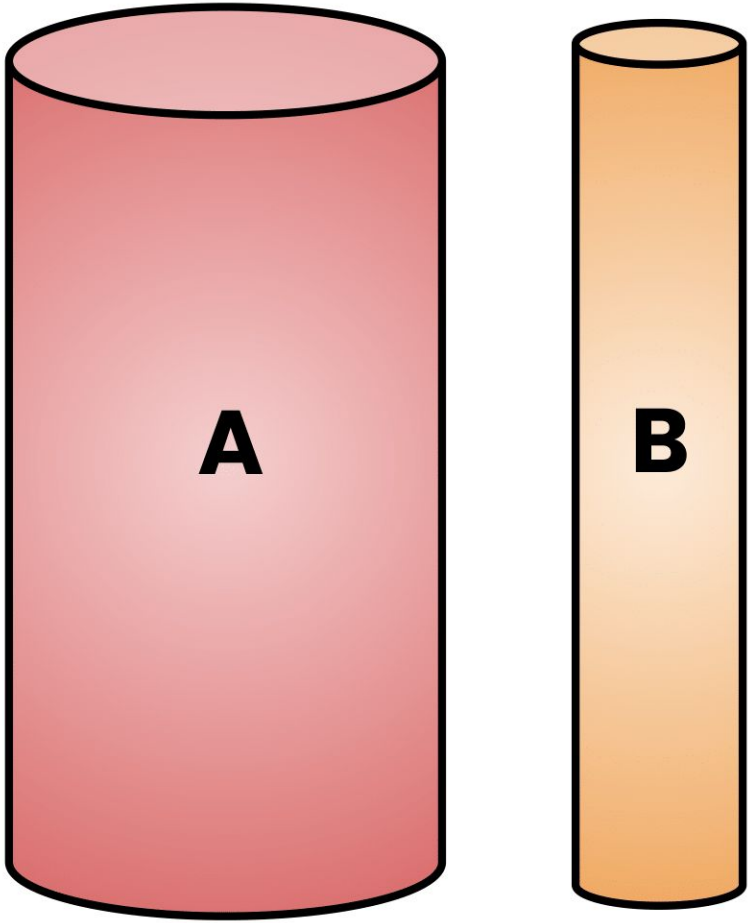
- The **length** of a cable **increases the resistance** of a current.
  - This is because the electrons in the current collide with the atoms of the material.
  - Shorter cables have fewer collisions and less resistance.

FACTORS AFFECTING RESISTANCE

- Resistance is also affected by the **area of the wire**.
- **Wider** cables have more space for electrons to flow.
  - This results in fewer electron collisions and a **greater electrical current**.
  - Narrow cables have less room for electrons to flow and will have more collisions and less of a current.

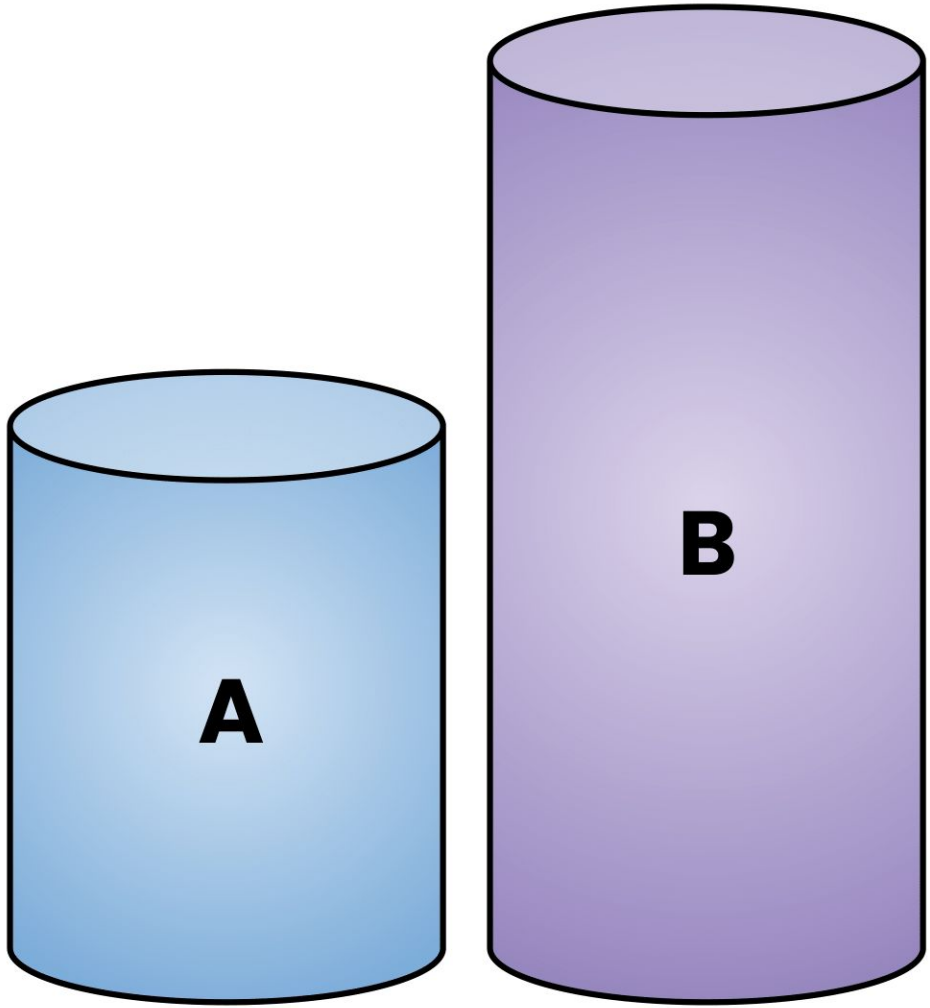
Which wire would have greater resistance?

Why?



Which wire would have greater resistance?

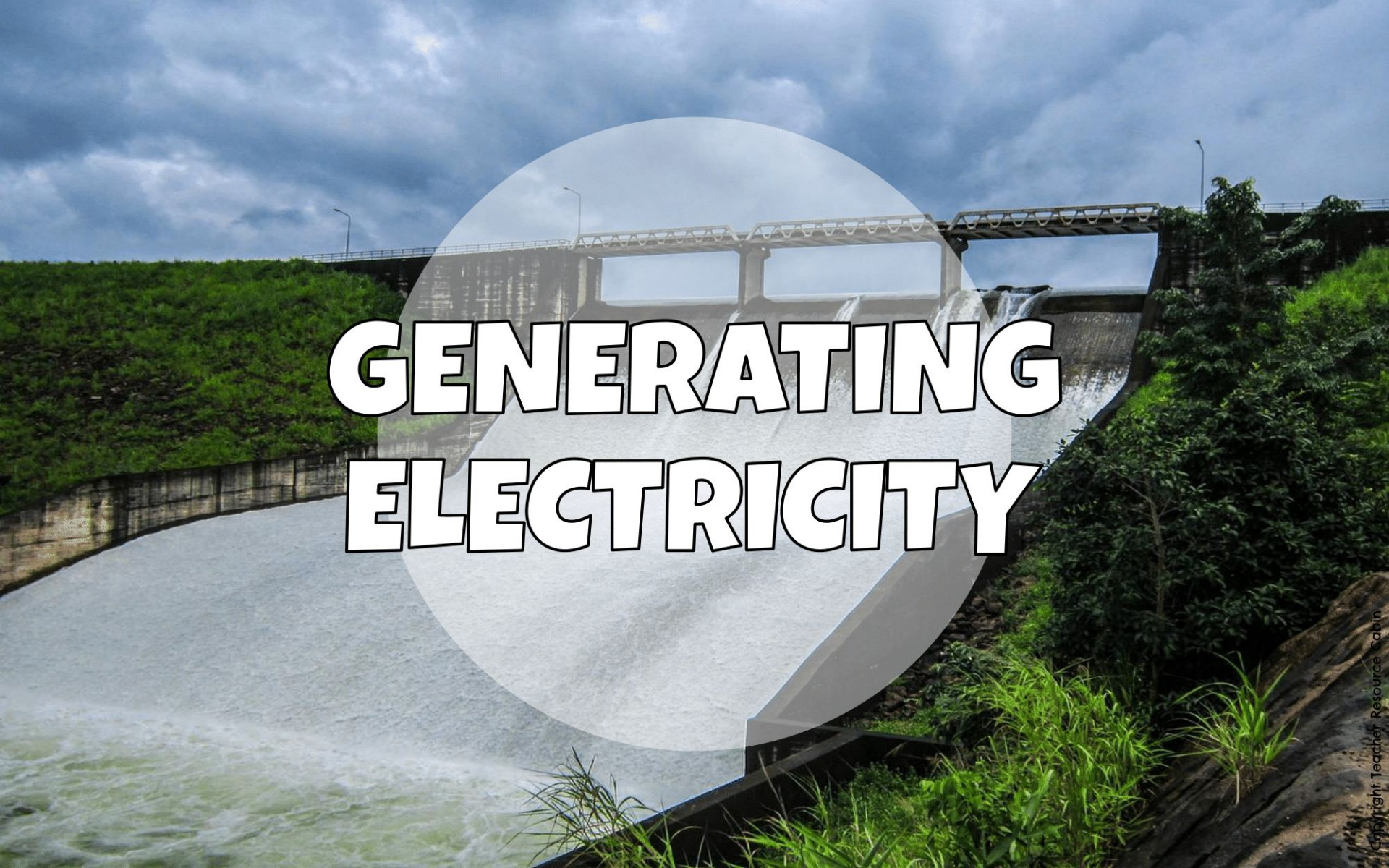
Why?



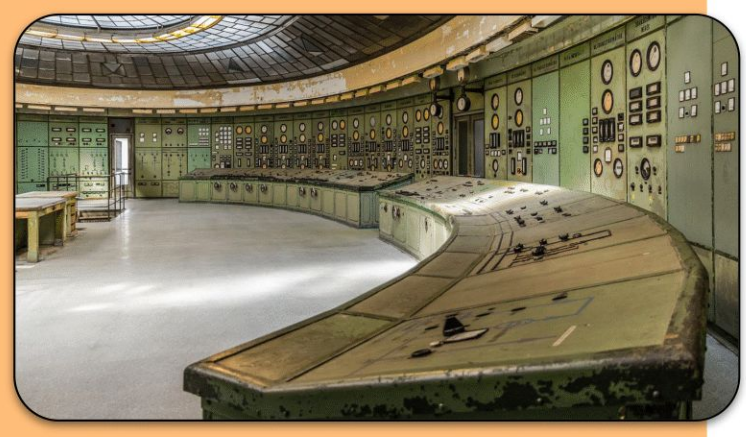
? ? ?

What does this sign mean?

What is voltage?



GENERATING ELECTRICITY



- Electricity generation is the process of generating electric power from sources of primary energy.

- Primary energy is energy that is found in nature that has not been engineered by humans.

GENERATING ELECTRICITY

- Primary energy can be mined, extracted, harvested, or harnessed directly from nature.

- These energy sources are transformed into an electrical current.

GENERATING ELECTRICITY

Hydro:

- Uses the power of flowing water to generate electricity

Nuclear:

- Nuclear fission generates steam, which turns a turbine to generate electricity

GENERATING ELECTRICITY

Coal:

- A black sedimentary rock
- Coal is an inexpensive fossil fuel (takes millions of years to form)

Natural gas:

- An odourless, gaseous mixture
- Emits less carbon dioxide than coal when burned

GENERATING ELECTRICITY

Biomass:

- Burning organic materials to produce steam, which turns a turbine to make electricity

Wind:

- Uses the power of wind to turn a turbine which generates electricity

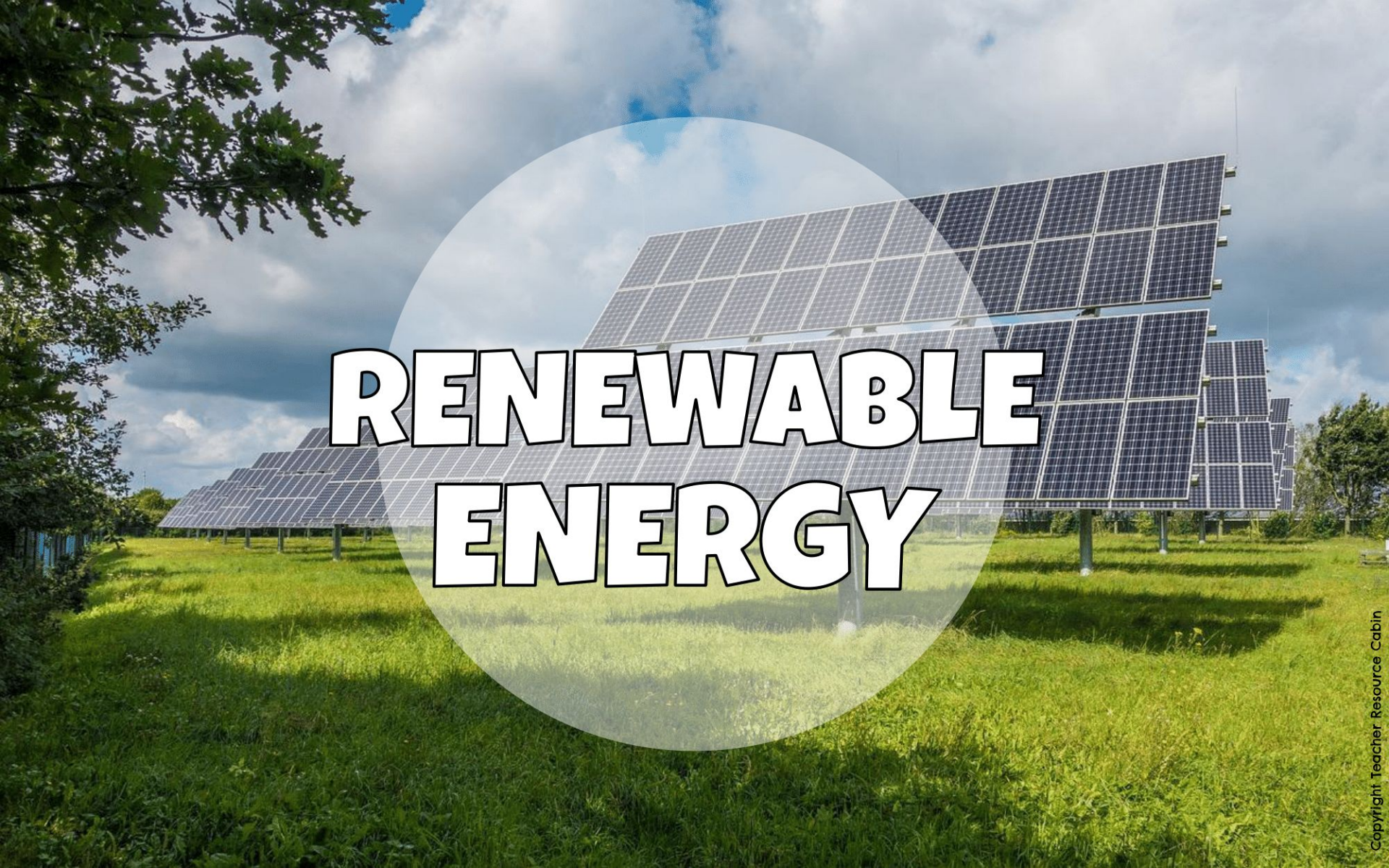
GENERATING ELECTRICITY

Solar:

- Converts the Sun's light and heat into electricity

Geothermal:

- Uses the internal heat from the Earth's crust to produce energy



RENEWABLE ENERGY

- A renewable energy source or renewable resource is something that can be used more than once.
  - Replaced naturally and quickly

- **Examples:** Oxygen, water, the Sun, and wood

RENEWABLE ENERGY

Wind:

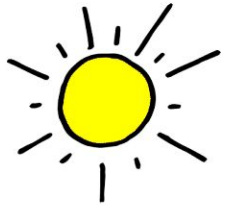
- Flows through wind turbines and electrical generators and is converted to electricity

- Historically, wind energy was used to power windmills.
    - Windmills were used to crush grain and pump water.

RENEWABLE ENERGY

Solar:

- Energy from the Sun, collected by solar panels
- Solar panels convert the Sun's energy into electricity.



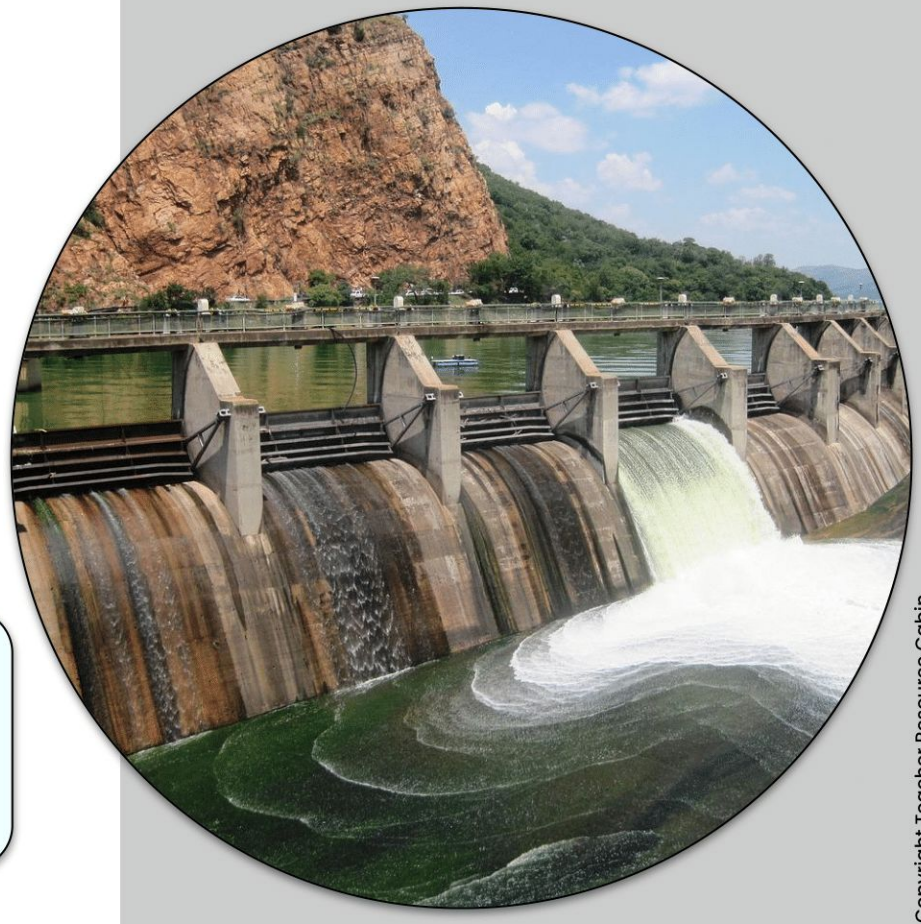
Where have you seen solar panels before?

RENEWABLE ENERGY

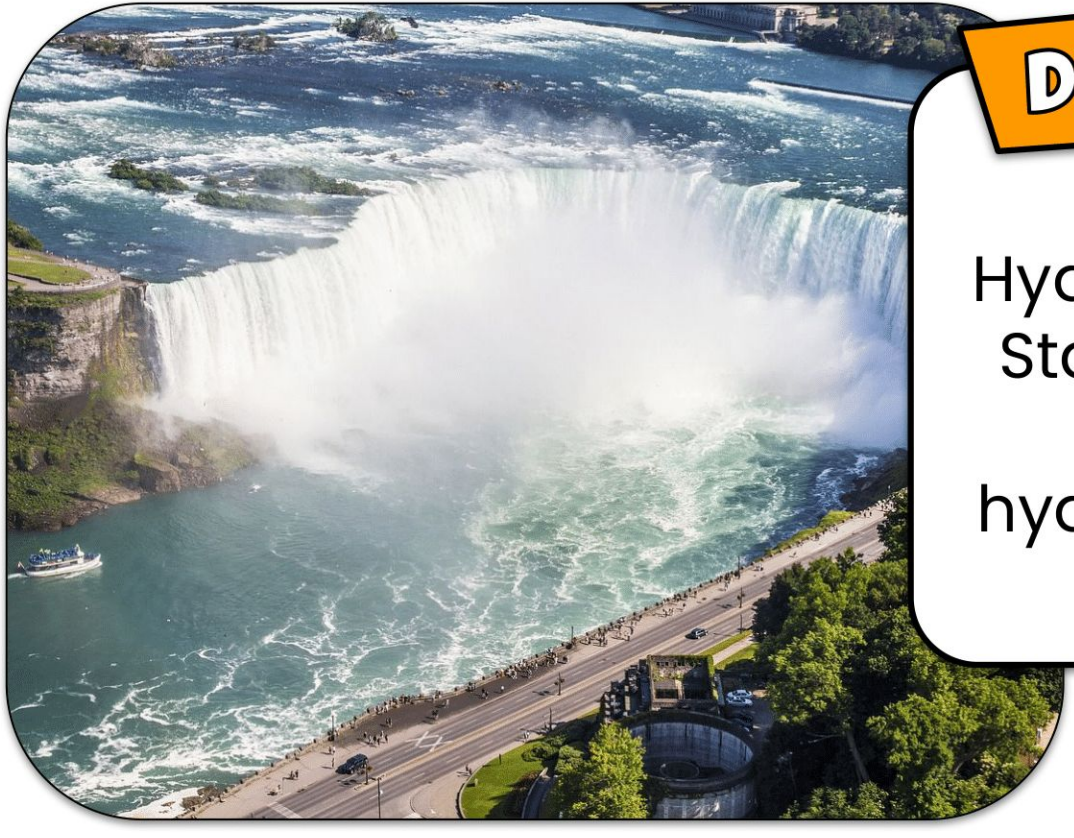
Hydro (Hydropower):

- Converting the flow of water into electricity
- Electricity can be generated from natural waterfalls or built dams.

How is hydro a form of renewable energy?



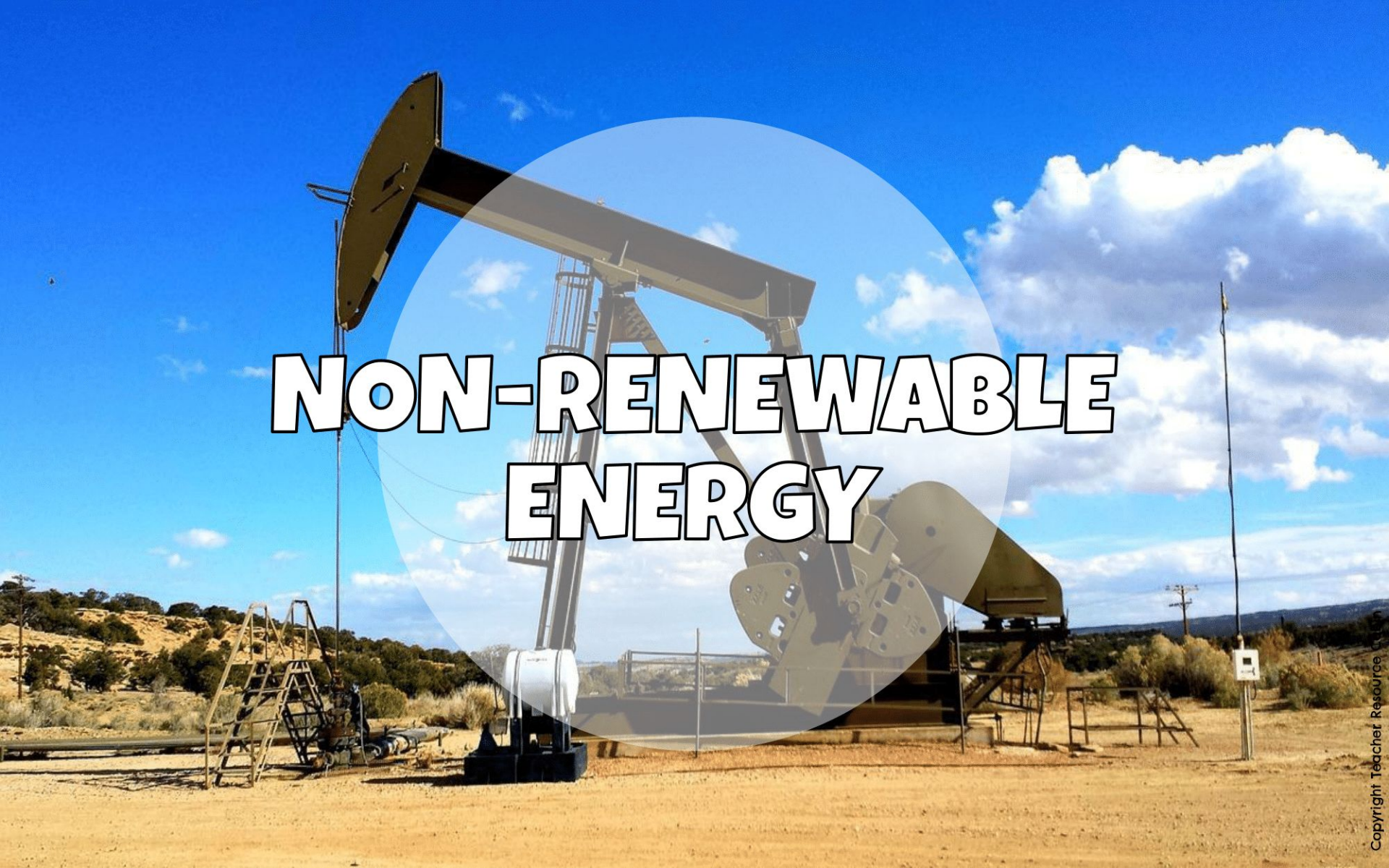
RENEWABLE ENERGY



DID YOU KNOW?

Sir Adam Beck Hydroelectric Generating Stations (Niagara Falls) are the largest hydroelectric generating stations in Ontario.

Adam Beck I was the largest hydroelectric station in the world when it was first built!



NON-RENEWABLE ENERGY

- A non-renewable resource is something that can only be used once.

- **Examples:** Oil, gas, diesel, plastics

What are some concerns associated with non-renewable resources?

NON-RENEWABLE ENERGY

- Although fossil fuels are produced naturally, they can take up to millions of years to form.

- It is important to conserve some fossil fuels in the Earth for future generations.

NON-RENEWABLE ENERGY

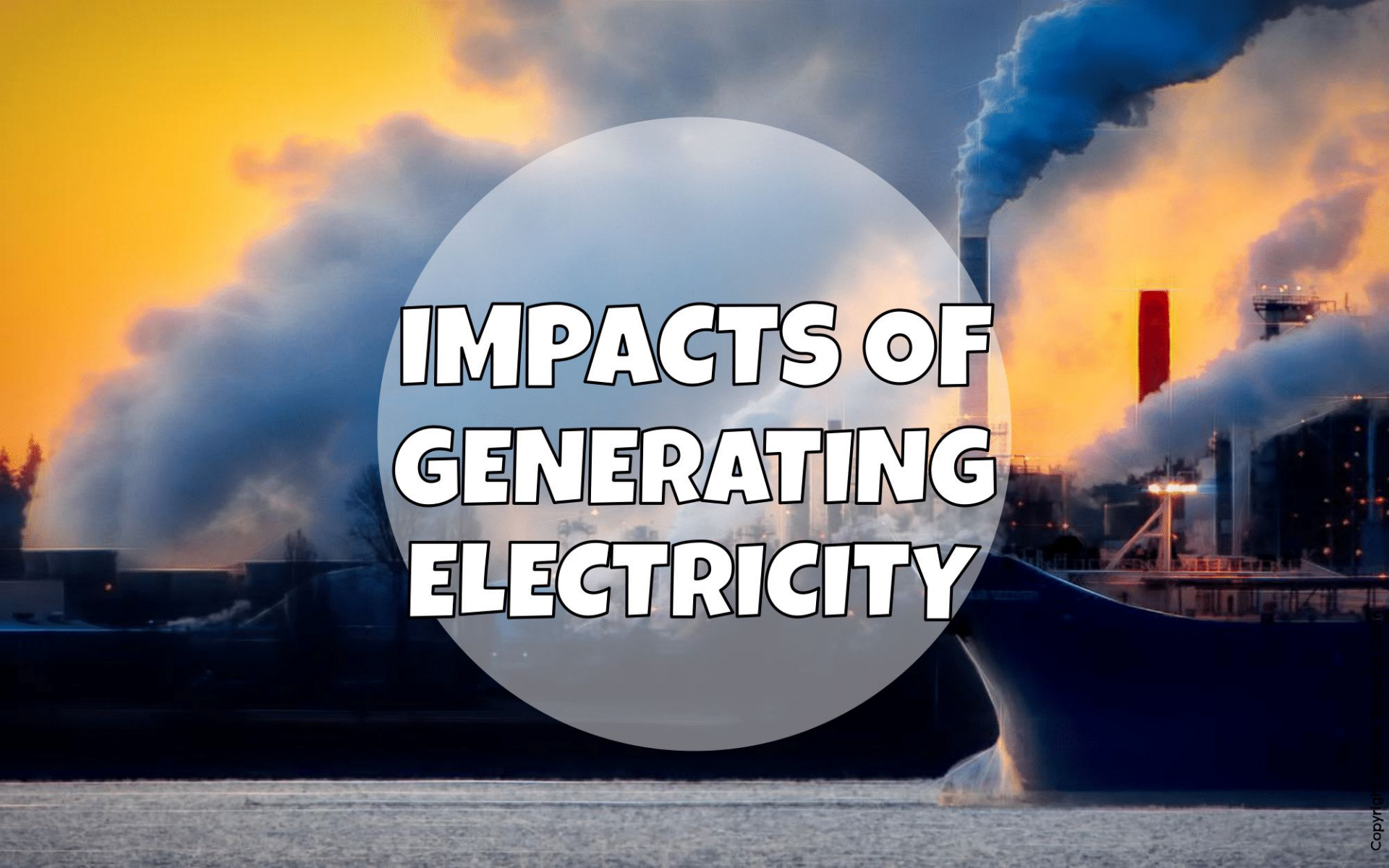
- Fossil fuels contribute to pollution and climate change.
- Fossil fuels release emissions into the atmosphere that are harmful to human health.
- Renewable energy is better for the environment, but often costs more to use.

NON-RENEWABLE ENERGY

- Scientists have worked to make alternatives to fossil fuels to reduce dependence on them.

DID YOU KNOW?

Fuel substitutes can be made from renewable sources like corn, soybeans and canola.


IMPACTS OF
GENERATING
ELECTRICITY

IMPACTS OF ELECTRICITY

- Renewable energy can be naturally replaced in a short amount of time.
- Better for the environment compared to non-renewable sources
- Improved public health (less harmful emissions)

IMPACTS OF ELECTRICITY

- Wind turbines used for electricity generation kill many bird and bat species every day.
  - Birds struggle to see the spinning turbine blades and collide with them.

What are some ways this negative impact could be mitigated?

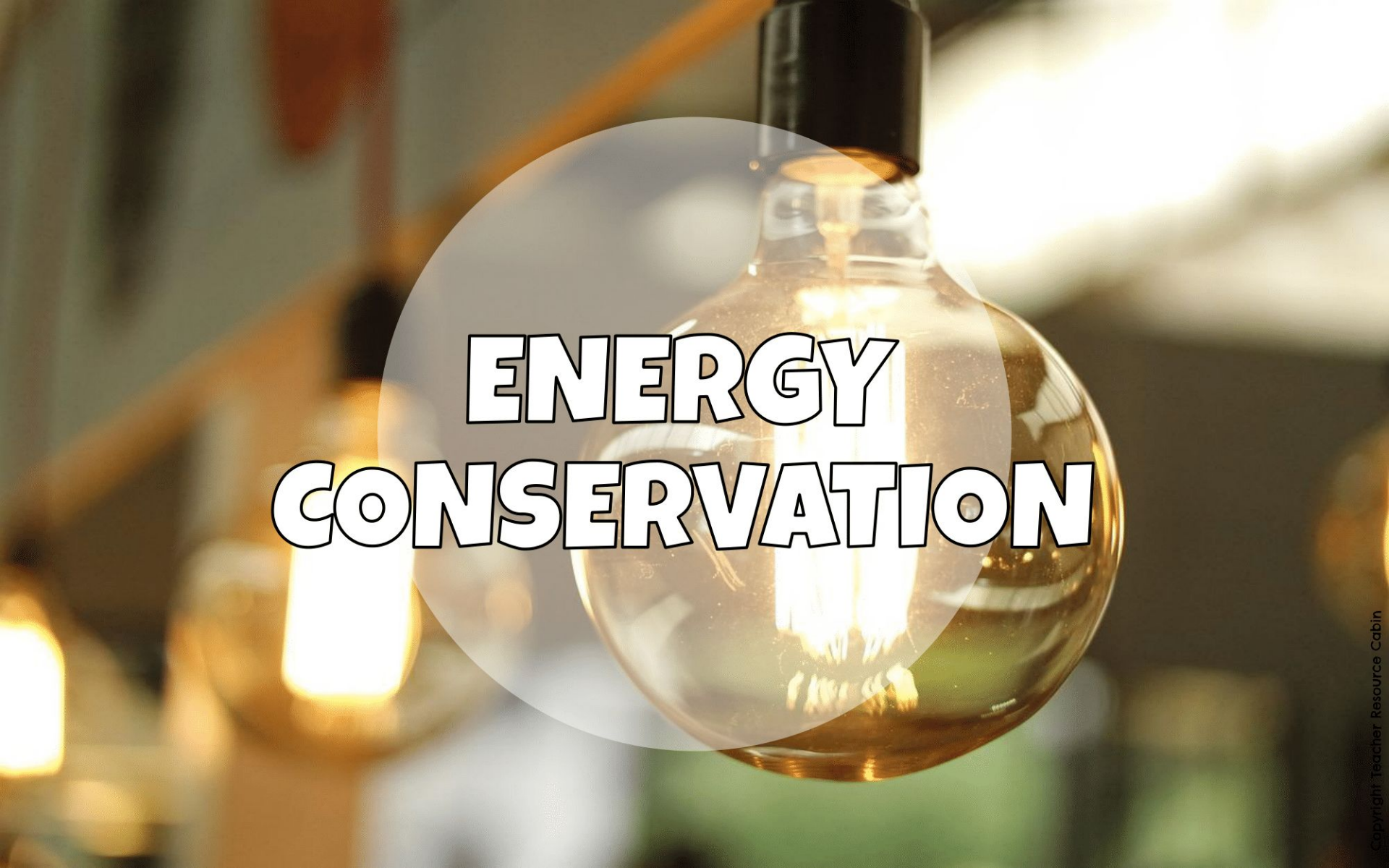
IMPACTS OF ELECTRICITY

- Solar panels are expensive.
  - Require a lot of space
  - Effectiveness is weather-dependent (sunny)
- The construction of dams for hydroelectric energy is destructive to animal habitats.
  - May flood land and kill and displace plant and animal species.

IMPACTS OF ELECTRICITY

- Burning fossil fuels for electricity releases carbon emissions (greenhouse gases) into the atmosphere.

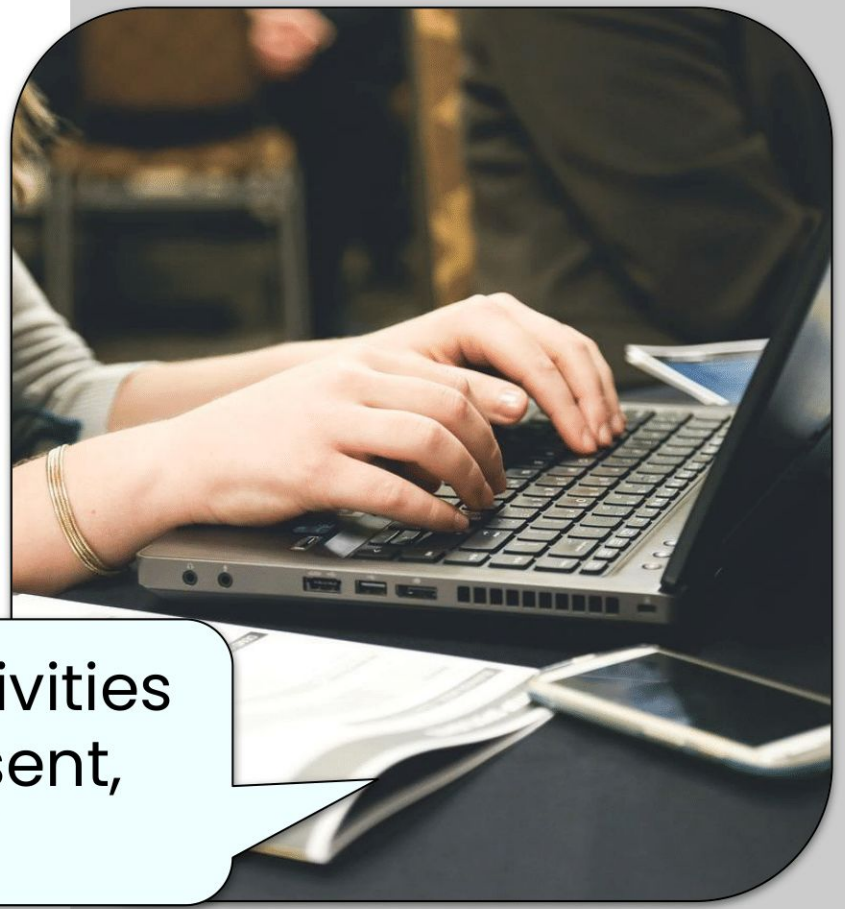
- Greenhouse gases act like a blanket and trap heat in the Earth.



ENERGY CONSERVATION

- The rate that society is consuming energy is increasing.

- Many businesses and industries rely on energy to operate.



How have people's daily activities changed from past to present, regarding energy use?

ENERGY CONSERVATION

- Conserving energy is especially important, as some forms of energy are non-renewable.

What do you think should be done to ensure non-renewable resources are consumed sustainably?

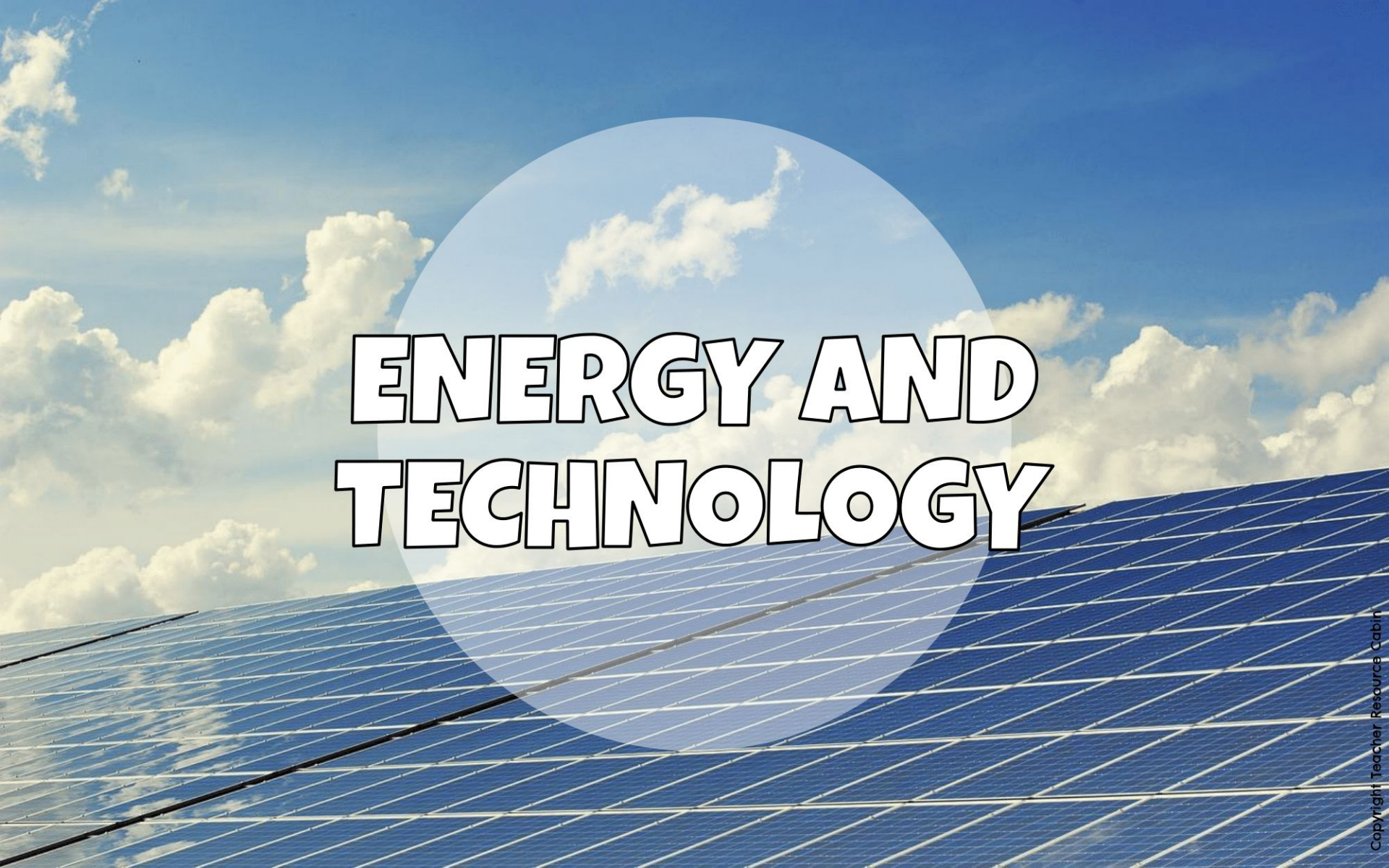
ENERGY CONSERVATION

- Energy conservation means saving energy by not using more energy than what is needed.

- **Examples:** Walking to school, using a clothesline, turning off electronic devices

? ? ?

What efforts has the government taken to conserve energy or limit fossil fuel consumption?



TECHNOLOGY: SOLAR PANELS

- Solar panels absorb energy from sunlight into the PV cells in the panel.
  - Creates electrical charges which move in the internal electrical field in the cell.

✓ **Benefits**: Easy to install, require very minimal maintenance, have a long lifespan

✗ **Downsides**: costly to install, weather dependent, and require a lot of space.

TECHNOLOGY: TRAFFIC LIGHTS

- Traffic lights are designed to be long-lasting, energy-efficient and produce minimal heat.
- They have a critical role in managing transportation and keeping people safe in society.
- A traffic light bulb lasts between 10-15 years before burning out.

TECHNOLOGY: ELECTRIC CARS

- Electric cars were created as an alternative to gas-powered vehicles.
  - Require a charging station where they take electricity from a **power grid**
- Electricity gets stored in a rechargeable battery.

TECHNOLOGY: ELECTRIC CARS

- The batteries are used to power an electric motor, which converts electrical energy into mechanical energy.

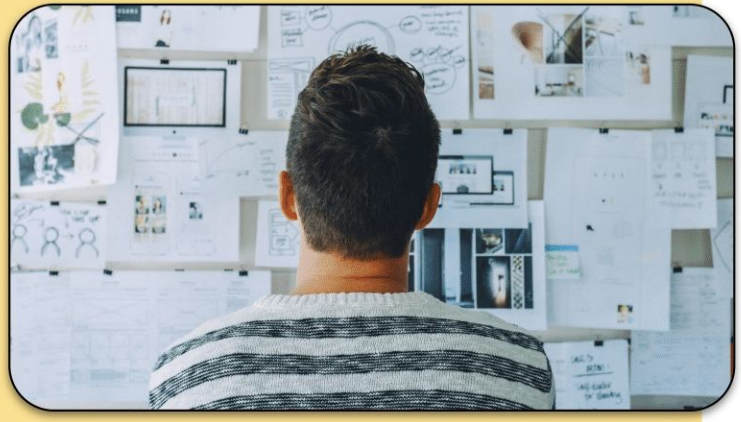
- Hybrid vehicles operate on electricity but have a traditional combustion engine in case the driver runs out of charge.

ENERGY AND TECHNOLOGY

- All electronic devices require electrical energy.
- Some electronics even consume energy when they appear to be turned off.

- Phantom energy is a draw of electricity that electronics consume while not being actively used.

ENERGY AND TECHNOLOGY



- People have designed products to conserve energy.

Example: Smart thermostats can be programmed to avoid heating/cooling the house when nobody is home.

What are some other examples of technology that helps conserve energy?

ENERGY AND TECHNOLOGY

Examples:

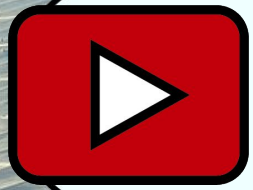
- Fluorescent and LED lightbulbs provide the most light using a small amount of energy.
- Power bars can be shut off to prevent appliances from consuming energy when they are not in use.

? ? ?

What other energy-efficient technologies do you know of?

TEACHER TIPS

- Interactive activities on the “Think about it!” slides in this resource must be completed in “Edit” mode. They will not work in “Present” mode.
- Interactive activities may be assigned to students to complete independently, or they could be completed as a whole class activity with the teacher inputting answers.



Looking for videos to support the topics discussed in this unit? Click the YouTube icon to find our “Grade 9 - “Principles and Applications of Electricity” playlist of recommended videos.

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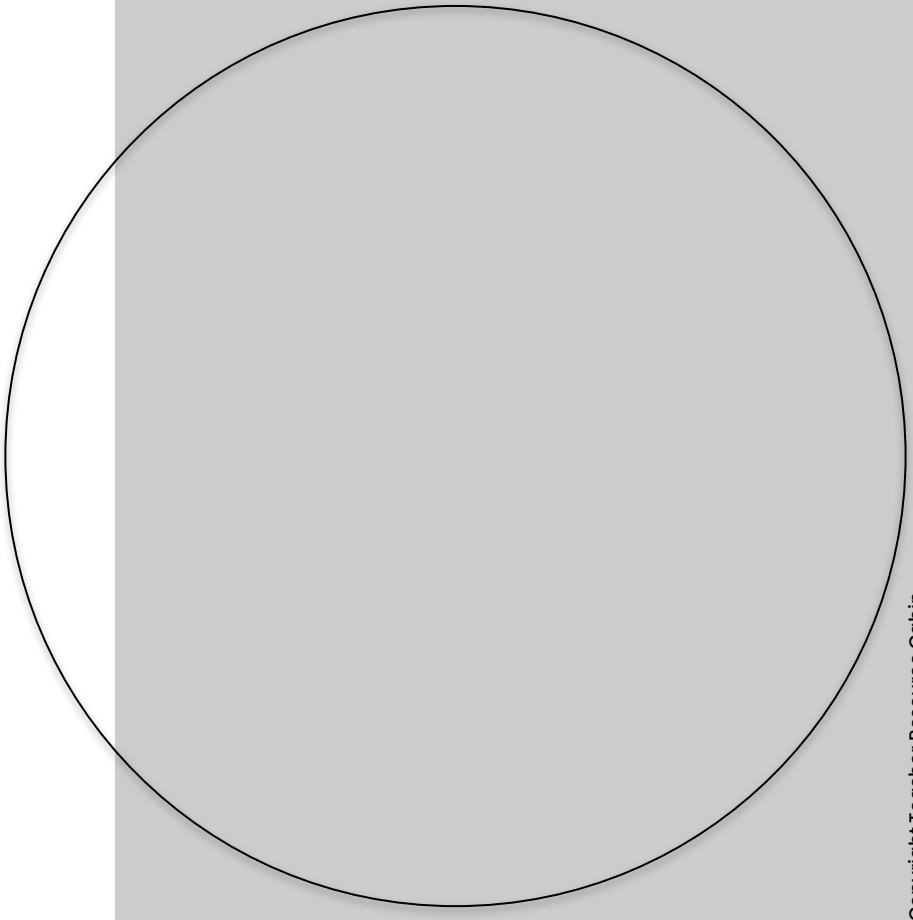

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