

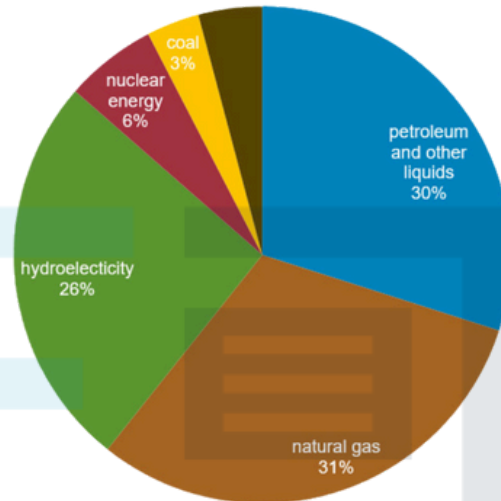
Chapter 7

Energy Resources



7.1 The energy we use

1. Most of the energy we use comes from the Sun, but only a small amount is used directly from the Sun.
2. The diagram below shows the different fuels that contribute to the Canada's energy supplies.



3. Energy resources can be categorized into 2 groups:
 - a. Renewable
 - b. Non-renewable

7.1.1 Renewable Energy

A. Energy direct from the sun

- Solar panels
 - Sunlight strikes a large solar panel on the roof of a house.
 - The solar panel absorbs the energy from the sunlight, heating the water inside the panel.
 - This heated water is then used for washing and central heating.
- Solar cells
 - A photovoltaic cell is an electrical device that converts sunlight directly into electricity by generating a voltage when exposed to light.

Advantage	Disadvantage
Useful in remote locations	It is unreliable because the intensity of sunlight varies.
	A large area of solar panels is necessary to capture enough energy.

B. Wind Power

- Wind power is caused by the effects of the Sun.
 - How: The Sun heats certain parts of the atmosphere more than others. The heated air expands and begins to move, creating a convection current.
 - Application:
 - § Windmill; used for grinding and pumping
 - § Wind turbines; generate electricity

Advantage	Disadvantage
Renewable and does not contribute to global warming	It is unreliable as the speed of wind can vary
	Can be very noisy



C. Hydroelectric power

- Water stored behind a dam is released to turn turbines, which spin generators to produce electricity.
- In some hydroelectric power stations, the turbines can be reversed to pump water back up to the reservoir, storing energy as gravitational potential energy. This water can then be released to generate electricity when demand increases.
- Similar to: Tidal energy

Advantage	Disadvantage
Safe, clean, and reliable way of producing electricity	The construction of these power stations might lead to the replacement of wildlife habitats.
Short start up time	



D. Biomass fuels

- For many people worldwide, wood serves as the primary fuel source for heating homes and cooking.
- Wood, derived from trees and shrubs, stores energy captured from sunlight through photosynthesis.
- Biofuel also encompasses animal dung and biogas produced from decomposing plant matter.

Advantage	Disadvantage
Renewable and does not contribute to global warming	Burning biofuels indoor can lead to respiratory and other health problems



E. Wave Power

- Waves are formed by friction between wind and water.

Advantage	Disadvantage
Renewable	It is unreliable as the height of waves can vary

F. Geothermal energy

- The Earth's interior is hot, presenting a potentially valuable energy source if accessible.
- Geothermal energy is utilized in locations where hot rocks are close to the Earth's surface.
- To harness this energy, water is injected into the rocks where it boils. The high-pressure steam produced returns to the surface to generate electricity.

7.1.2 Non-renewable energy

A. Fossil fuels

- Oil, coal, and gas are all classified as fossil fuels.
- When burned, they combine with oxygen in the air to produce energy, carbon dioxide, and water.
- Fossil fuels are the remains of organisms, such as animals and plants, that lived in the past.
 - When a tree dies and falls onto swampy ground,
 - It does not fully decompose due to insufficient oxygen.
 - As sediment accumulates over these ancient trees, the pressure increases.
 - Over millions of years of compression, these trees transform into underground coal reserves.



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Disadvantages of fossil fuels:
1. Burning fossil fuels releases carbon dioxide into the atmosphere, contributing to global warming.
2. Burning coal and oil generates sulfur dioxide, which can result in the formation of acid rain.

B. Nuclear fuels

- Uranium serves as the fuel for nuclear power stations due to its highly concentrated energy store.
- Within the nuclear reactor, the radioactive decay of uranium and other materials is accelerated, causing their stored energy to be released rapidly.

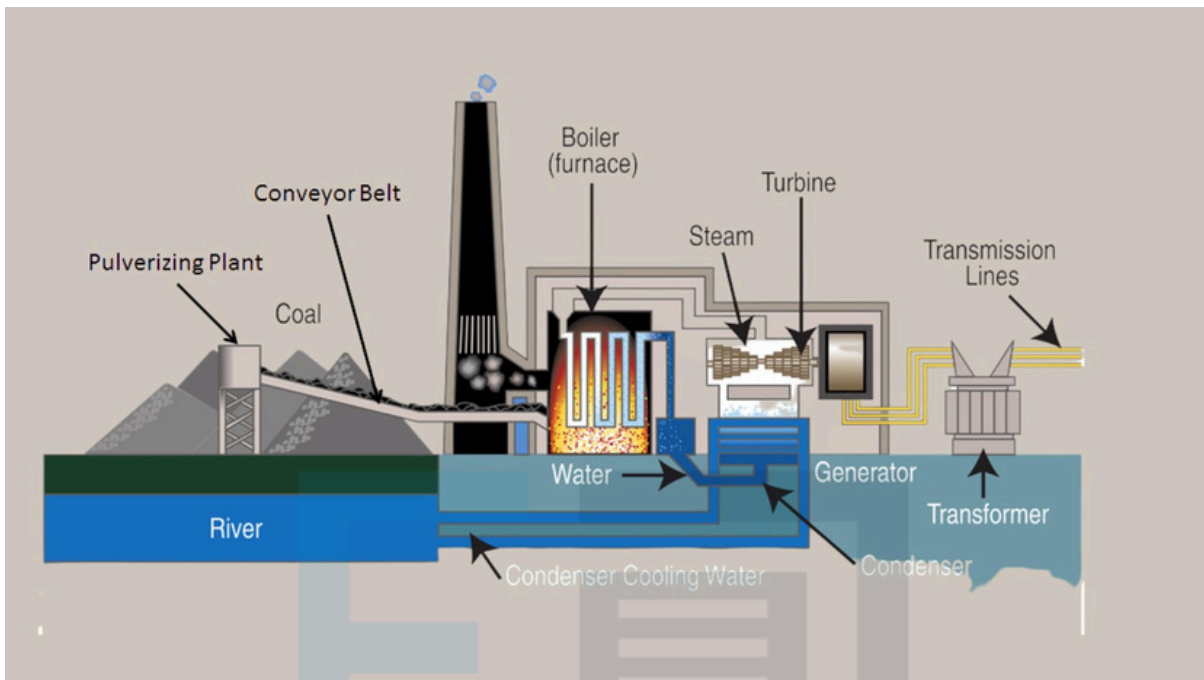
This process is known as nuclear fission.

- Nuclear fission

Nuclear fission is the process in which the nucleus of an atom splits into smaller nuclei, releasing a significant amount of energy.

Advantage	Disadvantage
Nuclear fuel is relatively cheap, concentrated resource.	Nuclear power has been found to be costly primarily due to the high initial expenses associated with constructing the power stations.

7.1.3 Using energy resources to generate electricity



Steps:

1. Thermal energy generated from burning fossil fuels or through nuclear fission is utilized to heat water in a boiler, producing steam.
2. The steam drives the blades of a turbine, converting thermal energy into kinetic energy.
3. The turbine, connected via an axle to a generator, induces voltage in conducting wires as they move through a magnetic field.

7.1.4 Comparing energy resources

1. When deciding which energy resource to use, we need to think about the following factors:

- A. Renewability
- B. Cost
- C. Availability
- D. Reliability
- E. Scale
- F. Environmental impact

7.2 Energy from the Sun

1. Most of the energy we use can be traced back to radiation from the Sun.

Examples:

- Fossil fuels are ancient stores of solar energy.
- Solar panels can absorb radiation from the Sun, converting it into hot water or electricity through arrays of solar cells (photocells) often seen on rooftops in some countries.
- Wind is generated by the Sun heating the air. As warm air rises and cool air replaces it, this movement can be harnessed using wind turbines to generate electricity.
- Most hydroelectric power originates from the Sun. Solar radiation causes water to evaporate from oceans and land surfaces. This evaporated water eventually forms clouds at higher altitudes. Rainfall on elevated terrain can then be captured behind dams, which is part of the water cycle. Without solar energy, there would be no water cycle and no hydroelectric power.

2. Three examples where a small amount of energy does not come from the sun as radiation.

- Both the Moon and the Sun influence ocean tides through their gravitational pull, causing the water level to rise and fall approximately every twelve hours. High tides can be harnessed by trapping water behind dams, which can later be released during lower tides to drive turbines and generators. Tidal power is reliable regardless of the Sun's presence or cloud cover, as it depends on gravity rather than solar heat and light.
- Nuclear power utilizes nuclear fuels, primarily uranium, extracted from underground deposits. Uranium, a mildly radioactive element, has existed in the Earth since its formation 4.5 billion years ago, along with the rest of the Solar System.
- Geothermal energy relies on the presence of radioactive materials within the Earth's interior, which have been present since the planet's formation. These substances continuously release stored energy over time.

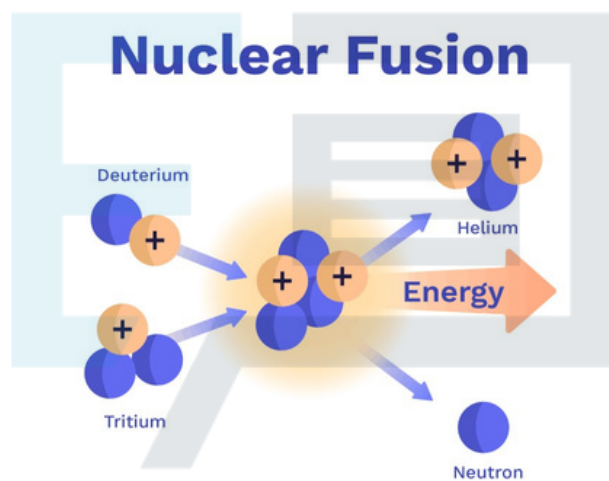
7.2.1 The source of the Sun's energy

1. Energy is released in the Sun by the process of nuclear fusion.

Nuclear fusion:

Nuclear fusion is the process where atomic nuclei combine to form heavier nuclei, releasing a significant amount of energy in the process.

2. In nuclear fusion, four energetic hydrogen atoms collide and fuse to form an atom of helium.



Condition for nuclear fusion to happen:

- a. High temperature
- b. High pressure
 - i. At this temperature, all atoms become ionized.
 - ii. All electrons are stripped from the atoms, resulting in a plasma of positively charged nuclei and negatively charged electrons.
 - iii. Atomic nuclei, all positively charged, repel each other due to like charges. To overcome this electrostatic repulsion and induce fusion, temperatures of around 100 million degrees are necessary.
 - iv. The mass of the resulting nucleus is slightly less than the combined mass of the initial nuclei. The difference in mass is converted into energy.
 - v. The energy released is substantial because it involves multiplying the mass m by the speed of light c squared.

Past Year Questions

No	
1	<p>Which energy resource does not use the Sun as the source of its energy?</p> <p>A Hydroelectric B Wind C Nuclear D Coal</p>
2	<p>Listed below are some energy resources.</p> <p>W wind powering a turbine X water falling through a hydroelectric turbine Y alcohol made from crops which have been grown for burning in a biomass generator Z uranium for nuclear fission reactors</p> <p>Which of the resources are renewable?</p> <p>A W, X and Z B W and X C W, X and Y D W, X, Y and Z</p>
3	<p>Which energy resource involves splitting heavy nuclei?</p> <p>A Nuclear fission B Geothermal C Biomass D Nuclear fusion</p>