

Introduction to Energy

Energy – what is it? the ability to do work

Law of Conservation of Energy:

energy cannot be created or destroyed – it can only be changed from 1 form to another.

Forms of Energy:

- **Chemical:**

energy stored in the bonds of molecules; e.g. food, fossil fuels, wood, alcohol

- **Kinetic/Motion:**

energy of objects in motion, usually due to the force of gravity; e.g. wind, falling water for hydroelectric power, tides

- **Nuclear:**

energy that comes from joining or splitting atoms; e.g. the Sun - nuclear fusion reactor, nuclear power plant – fission reactor

- **Heat and Light:**

comes primarily from the sun, often “unusable” energy from chemical reactions

- **Sound:**

energy transferred as waves through collision of air particles

All energy on Earth comes directly or indirectly from the Sun.

Example 1: Light energy to heat and motion energy

Sun (light energy) →

plants make sugar molecules through photosynthesis (chemical energy) →

humans and animals eat and digest plants (heat energy, motion energy)

Example 2: Light energy to electricity through wind turbines

Sun (light energy) →

Earth's surface and atmosphere warm and cool (heat energy) →

Air currents move due to convection (wind energy) →

Wind turbines turn generators (electrical energy)

Main Uses of Energy

Three main purposes of energy in industrialized societies:

- ◇ Transportation: oil, gas, diesel for vehicles, trains, planes
- ◇ Heating and cooling of buildings: electricity, gas, oil
- ◇ Providing power for machinery and appliances: electricity

Measuring Energy and Power

Power:

The rate at which work is done (how much work is done every second), measured in watts (W)

Energy:

To find energy used, multiply the power rating (in watts) of an appliance by the number of hours that the appliance is used, to get watt-hours (Wh), or kilowatt-hours (kWh).

Example:

100 W light bulb used for 24 hours uses $100 \times 24 = 2400$ watt-hours (Wh)

Since there are 1000 watt-hours in 1 kilowatt hour, this is $2400 \div 1000 = 2.4$ kilowatt hours (kWh)

The average Canadian household uses **about 35 kilowatt hours (kWh) a day.**

Three Main Ways to Improve Energy Use:

1. Conservation:

- ◇ design systems to use less energy, e.g. electronics without standby power (aka “vampire power” or “phantom load”)
- ◇ e.g. appliances with remote controls, LED displays – standby power accounts for up to 10% of household use

2. Efficiency:

- ◇ make better use of energy (get more from the same amount of energy)
- ◇ e.g. incandescent light bulbs uses 10% of its energy to produce light, 90% to produce heat

3. Renewable Energy Sources:

- ◇ use “green”, sustainable energy instead of non-renewable resources
- ◇ need to “kick our oil addiction”

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Activity: Measuring the Power Rating of Electrical Devices

Measure the power ratings for the following devices when in use, and in standby/sleep mode where appropriate.

Device	Power When in Use (W)	Power When in Standby (W)
Computer, notebook		
Microwave		
Charger, mobile phone		
Game console		
Surge Protector		
Game Console		
TV		

List 2 more items that you or a family member uses.

Device	Power When in Use (W)	Power When in Standby (W)