Science
Grade 9

SNC1W

Unit 3 Lesson 6

Energy Sources and Power

Learning Goals

- I will learn about renewable and non-renewable energy resources
- I will learn about power
- I will learn about energy efficiency
- I will learn to calculate the cost of electricity

Success Criteria

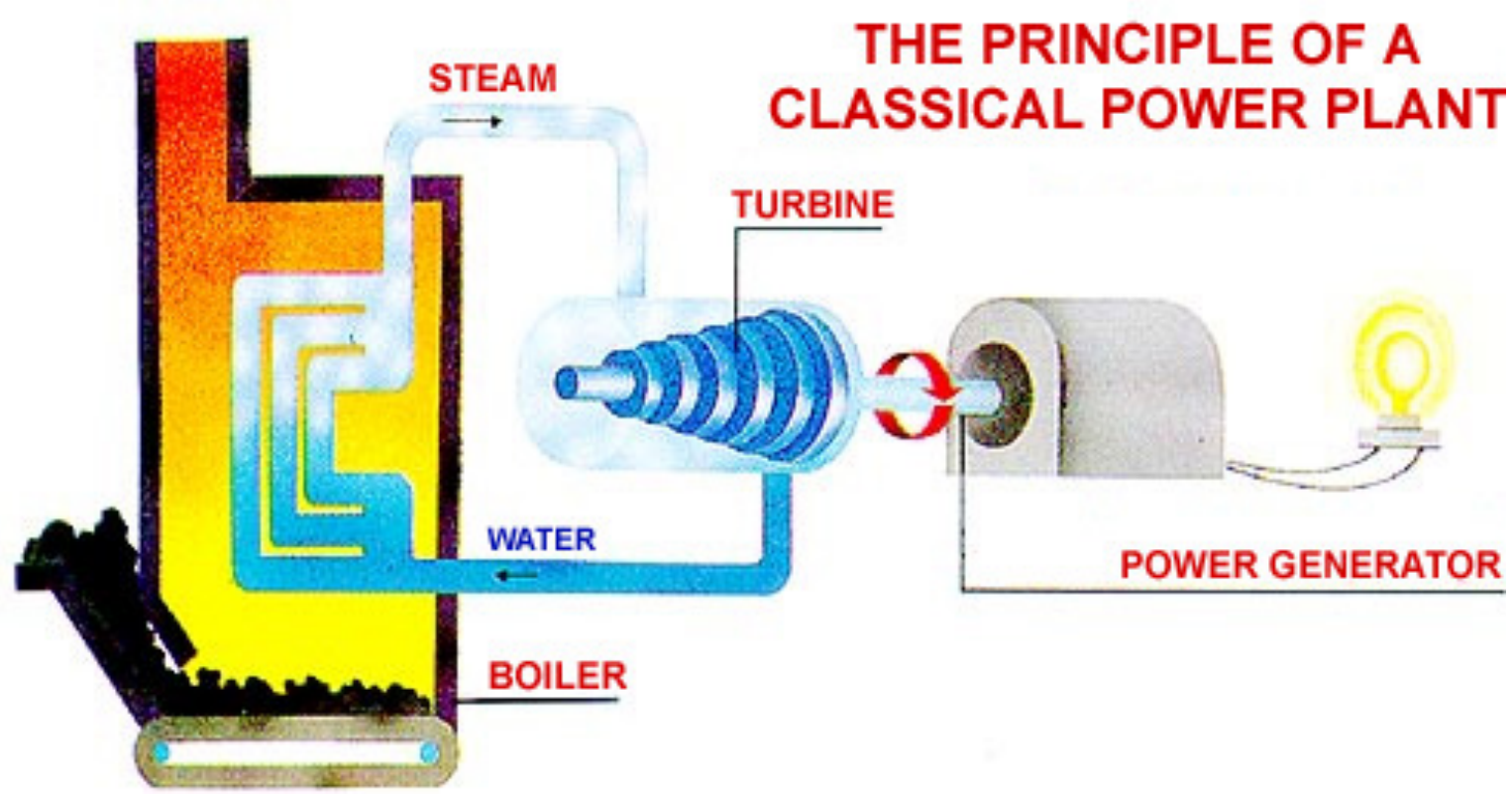
- I can list and classify renewable and non-renewable sourcs of energy
- I can calculate the power from the current and voltage in a circuit
- I can calculate the percent efficiency of electrical devices
- I can calculate the cost of electricity in my community

Energy Sources

Electrical energy is produced from renewable or non-renewable sources.

- Renewable energy sources like wind or solar do not get depleted when they are used.
- Non-renewable energy comes from sources, like fossil fuels, that will run out, or not be replenished for thousands of years.

The energy from these sources is converted into electrical energy by a generator at a power station.



In a power plant, some type of energy is used to boil water, the steam created turns a turbine connected to a generator which converts the energy into electricity. The electricity is transported out power lines to the consumers.

Power

Power is the amount of energy that is converted into heat, light, motion or sound per second.

$$P = \frac{E}{t}$$

where energy is in joules (J)
time is in seconds (s)
power is in Watts (W)

In a circuit, power can be calculated by multiplying current by voltage.

$$P = I \times V$$

Example:

A current of 15A passes through a heater connected to a 110 V wall outlet. What is the power of the heater?

Given: $I = 15A$

$V = 110V$

Required: $P = ?$

$$P = I \times V$$
$$= (15)(110)$$
$$= 1650\ W$$

Efficiency

Electrical devices do not work perfectly so the amount of energy they take in is not completely converted into useful energy.

For example, an incandescent light bulb converts some energy into light, but most is converted into heat.

Halogen and LED lightbulbs are much more efficient, converting more of the input energy into light.

Percent Efficiency

The percent of energy that is converted into useful energy is calculated from the equation:

$$\%\ Efficiency = \frac{useful\ energy\ output}{electrical\ energy\ input} \times 100\%$$

The more input energy a device converts into usable output energy, the more efficient the device is.

Example:

It takes 196 000 J of energy to boil 600mL of water from room temperature to boiling, if the kettle requires 240 000J of energy, what is the percent efficiency of the kettle?

Given: energy input $= 240000J$

energy output $= 196000J$

Required: $\%\ efficiency = ?$

$$\%\ eff = \frac{energy\ output}{energy\ input} \times 100\%$$

$$= \frac{196000}{240000} \times 100\%$$

$$= 82\%$$

Energy Efficiency

It is important to be aware of our energy consumption to reduce costs and conserve natural resources.

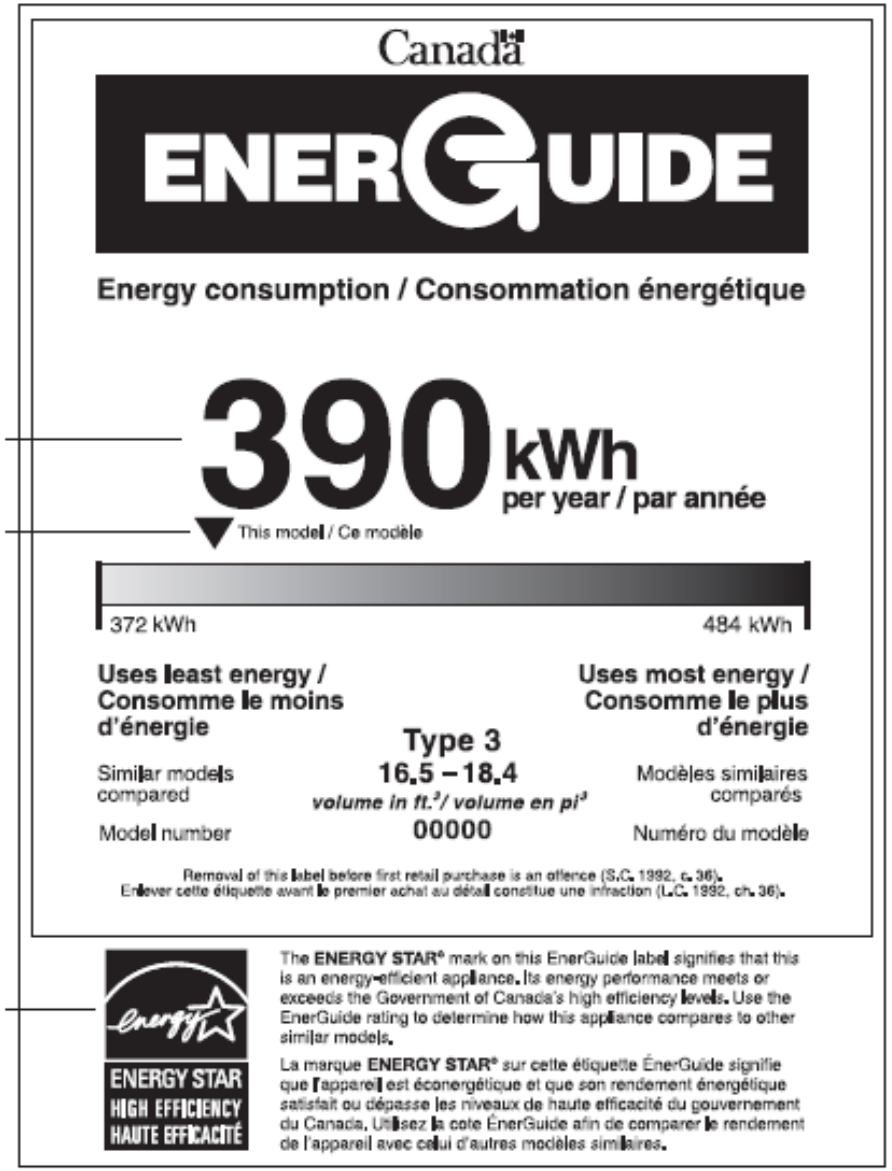
Many countries have implemented programs to promote energy efficient appliances and devices.

For example, LED light bulbs are far more efficient than incandescent bulbs, but they are more expensive to buy. The Canadian government provides rebates to reduce the cost of LED bulbs for consumers.

Comparing Efficiency

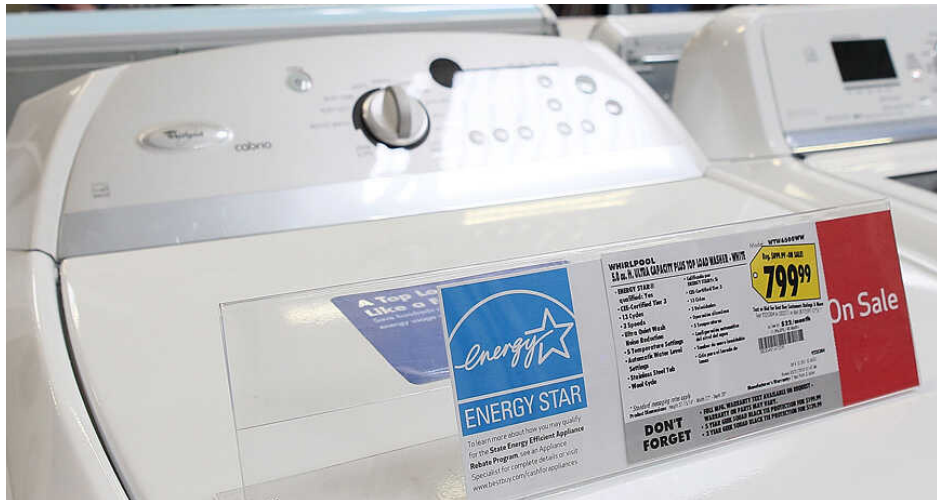
In 1972, the Canadian government started a program that required manufacturers of appliances and electrical devices to provide the energy efficiency information on all products.

a) yearly energy consumption (kWh)
b) comparison to similar appliances
c) indicates if the appliance is high efficiency or not



ENERGY STAR
HIGH EFFICIENCY
HAUTE EFFICACITÉ

Products with the highest efficiency receive the Energy Star rating making it easy for consumers to find and choose high efficiency appliances and electrical devices.



Cost of Electricity

Meters are used in homes and buildings to measure the electricity consumption.

The consumption is measured in kilowatt hours which is 1000W per hour. The cost of electricity is determined by an amount per kWh.

For example if you are charged $0.02 per kWh and you use an average of 6.0 kW every hour in a day, then your cost of electricity per day would be:

$$Cost = (6.0kW)(24hr)(0.02)$$
$$= \$2.44$$

You would pay $2.44 per day for electricity.