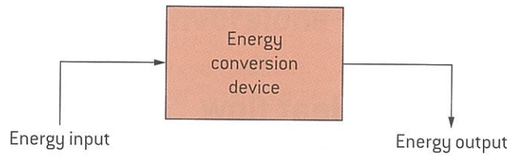
ENERGY EFFICIENCY

Energy conversions produce waste energy. The waste energy is usually heat.

Losing energy

The total amount of energy always stays the same during an energy conversion. This is known as the First Law of Thermodynamics.



The First Law of Thermodynamics states that energy input = energy output.

However, energy conversions are inefficient and produce some waste energy. This means energy conversions occur at less than 100 per cent efficiency.

Think about the conversion of electrical energy into light in a light globe. A light globe that is 100 per cent efficient would convert all of the electricity into light. We know that globes don't do this because they get hot. Some of the electricity is being wasted as heat.

An energy conversion can never be greater than 100 per cent. Energy cannot be created during a conversion. For example, a car engine can never produce more power than the chemical energy contained in the petrol that goes into it.

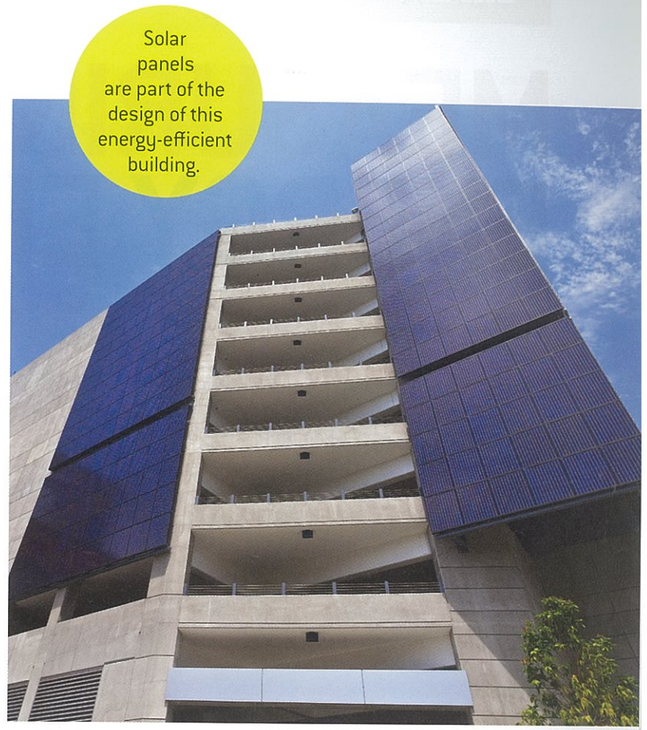
An average car engine operates at only about 25 per cent efficiency. This means that 75 per cent of the chemical energy in the petrol is wasted, mostly as heat. Heat is the most common form of wasted energy. TVs, refrigerators and car engines all get hot when they are being used.

The efficiency of electric light globes has greatly improved. Older incandescent light bulbs passed an electric current through a thin wire filament until it glowed. Approximately 95 per cent of the electrical energy was wasted in this process. Modern globes, such as compact fluorescent lights and light-emitting diodes (LEDs), are more energy efficient.

The energy efficiencies of common devices

ENERGY CONVERSION DEVICE	TYPICAL EFFICIENCY (%)
Hair dryer	Almost 100
Electric heater	Almost 100
Electric generator	95
Battery	90
Steam turbine	45
LED (light-emitting diode) globe	30
Refrigerator	30
Car engine	25
Fluorescent globe	25
Human muscle	20
Incandescent (traditional) globe	5

More stars mean a more energy-efficient appliance, which will be cheaper to operate.



Solar panels are part of the design of this energy-efficient building.

Scientists and engineers are trying to design products that are more **energy efficient**. These are cheaper to run as you are not paying for energy that is being wasted.

Measuring energy efficiency

$$\text{Energy efficiency} = \frac{\text{useful energy output}}{\text{energy input}}$$

Scientists measure power in watts. For example, a battery may consume chemical energy at the rate of 100 watts every second and produce electricity at a rate of 90 watts.

$$\text{Battery energy efficiency percentage} = \frac{90}{100} \times 100 = 90\%$$

From power station to our homes

A lot of energy is lost, usually as heat, in generating power and supplying it to homes and industry.

- When coal burns, 90 per cent of its energy is transferred to making steam – 10 per cent of the coal's energy is lost at this point.
- Just 45 per cent of the steam's energy is converted into spinning the turbine.
- Almost all of the spinning turbine's energy gets turned into electricity.
- Sending electricity long distances via transmission lines can lose 10 per cent of the energy.

Individual appliances, such as TVs, washing machines and ovens, also waste energy. That is, not all of the energy supplied to them is turned into useful output. Traditional incandescent globes are very inefficient and waste lots of energy as heat. An incandescent globe typically turns less than 1 per cent of the original energy stored in the coal into light energy. Australia is phasing out incandescent globes, replacing them with energy-efficient ones.

LOOK IT UP

energy conversion the process of changing one form of energy into another

energy efficiency how much of the energy used by a device is useful

CHECK IT OUT

1. What happens to the total amount of energy during a conversion from one energy form to another?
2. What evidence is there that car engines do not convert all the chemical energy in petrol into motion?
3. A jackhammer wastes 80 per cent of the supplied energy. What is its energy efficiency?
4. What is the energy efficiency of a machine that turns 50 watts per second of electricity into 20 watts of useful work?