Conservation of Energy

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Energy can be transferred, stored or dissipated but never created or destroyed.

All energy is never transferred usefully. Some is always wasted (dissipated). For example, energy is transferred electrically to a laptop but some is dissipater to the thermal store of the laptop.

Power

This is the rate of doing work (per second) in watts.
1 watt = 1 joule of energy transferred per second.

$$P = \frac{E}{t}$$ (Energy transferred (J); time (s))

$$P = \frac{W}{t}$$ (Work done (J); time (s))

eg. calculate the power of a motor that uses 6000J of energy to lift an object for 20 seconds.

$$P = \frac{6000}{20} = 300W$$

A more powerful devise can transfer more energy in a given time, or, will transfer the same amount of energy in a faster time.

For example, two identical cars but one with a more powerful engine race. The more powerful one will finish first – it will have transferred the same amount of energy but in a quicker time.

Reducing Wasted Energy

Friction between two moving objects causes energy to be dissipated to the thermal store. It can be reduced by lubrication.

Insulation reduces energy transfer by heating. This is useful in our homes to reduce heating costs:

- **Cavity wall** insulation fills the air gap between the inner and outer wall reducing heat loss by convection.
- **Loft** insulation reduces heat loss by convection.
- **Double glazing** creates an air gap between the two panes of glass to reduce energy loss by conduction.
- **Draught excluders** reduce energy loss by convection when placed around windows and doors.
- Reducing the temperature difference between the inside and outside will also reduce energy transfer.

Conduction

This occurs in solid objects. When an object is heated thermal energy is transferred to the **kinetic store** of the **particles**. This causes them to **vibrate more** and **collide** with other particles, so energy is **transferred** between the kinetic stores.

Convection

When particles are free to move (in a liquid and gas) an increase in their kinetic store causes them to **move faster**.
This means the **space** between the particles **increases**, so the **density** of the area being heated **decreases**.
The warmer less dense region **rises** and the cooler, more dense regions fall.

Efficiency

An efficient device wastes less energy than a less efficient device. It can be calculated as a decimal, or multiplied by 100 to give a percentage.

$$Efficiency = \frac{useful\ energy\ output}{total\ energy\ input}$$

$$Efficiency = \frac{useful\ power\ output}{total\ power\ input}$$

Eg. calculate the efficiency of a motor that has a power of 500W and transfers 300W usefully.

$$Efficiency = \frac{300}{500} = 0.6\ or\ 60\%$$