P2: Energy
Knowledge organiser

Energy adds up

The **law of conversation of energy** states that energy cannot be created or destroyed, only transferred.

total energy before = total energy after

Transferring energy

Light, sound, and electricity are ways of transferring energy between different stores.

Energy and temperature

- **Thermometers** measure temperature in degrees **Celsius (°C)**.
- Temperature measures the *average* energy.
- **Thermal energy** measures the total energy.

A warm bath has more thermal energy than a heated kettle, even though the kettle has a higher temperature.

Heating solids, liquids, and gases

- As we heat things the particles gain more **kinetic energy**, and vibrate more or faster.
- The energy needed to heat an object depends on the mass, material and temperature rise.

Equilibrium

Equilibrium is when objects have the same thermal energy.

Energy and power

Renewable resources

Renewable resources produce greenhouse gases when built, not when used, and will not run out.

For example, wind, tidal, wave, hydroelectric, geothermal, biomass, and solar powers.

Particles

Thermal energy can be **transferred** by **conduction, convection** or **radiation**.

Conduction

- Particles collide into others when they vibrate.
- Occurs in solids.

thermal store at a high temperature — thermal store at a low temperature

Convection

- Occurs in liquids or gases.
- The part in contact with the heat source gets hotter. The particles move faster, causing them to become further apart, and a decrease in density.
- The hot part then rises, and cooler, denser parts fall and take its place at the bottom.
- They now heat, so the cycle continues. We call this a **convection current**.
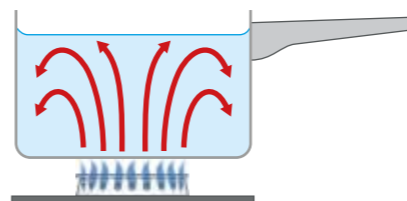
Energy and power

Power is the rate of energy transfer – how much energy is transferred each second.

Energy bills

- Energy bills are measured in 1 **kilowatt** per hour (kWh).
  For example, a 2 kW device uses 4 kWh.
- A bill covers the cost of the fuel used at the power station, the power station, staff, and infrastructure.
- To convert kWh this to joules, convert the time to seconds.
  For example, $2000 J/s \times 7200 s = 14\,400\,000 J$

Reducing bills

- Use fewer appliances or more efficient ones.
- Insulated houses lose less thermal energy so don't need to use as much power.

Work energy and machines

Work done (J) = force (N) × distance (m)

Simple machines like **levers** and **gears** can make it easier to do work but you still get the energy out that you put in.

Radiation

- **Infrared radiation** transfers energy without particles – it is a wave.
- All objects emit radiation.
- The amount depends on their temperature and the surface (colour and rough/smooth).
- Radiation can be **absorbed** or **reflected**.

Non-renewable resources

Non-renewable resources include the **fossil fuels** coal, oil, and gas. These were formed millions of years ago from fossilised remains.
These are non-renewable because you cannot reuse them, and they will eventually run out.
Coal, oil, or gas are used to run **thermal power stations**.

The current created is sent to our offices, factories, and homes down long cables.

Fossil fuels are burned to heat water, which produces steam.

These fossil fuels produce **greenhouse gases**, such as carbon dioxide.

The steam turns a turbine, which spins a generator.

Food and fuels

- There is energy in the **chemical stores** associated with food and fuel.
- Energy is measured in **joules (J)**.
- You need different amounts of energy for different activities.

The energy in food varies.
For example:
- apple – 200 kJ per 100g
- chips – 1000 kJ per 100g

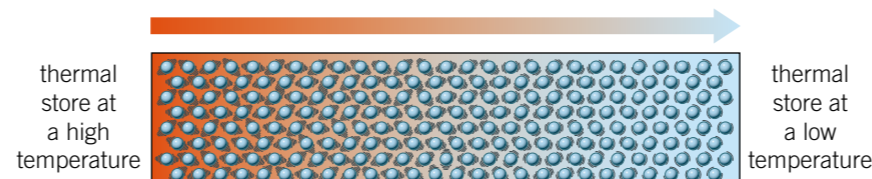The energy used when we do things varies too.
For example:
- sitting – 6 kJ per minute
- running – 60 kJ per minute

Key terms

Make sure you can write definitions for these key terms.

absorb   chemical store   conduction   convection   convection current   equilibrium   fossil fuel   gear   greenhouse gas   infrared radiation   insulator   joule   kilowatt   kinetic energy   law of conservation of energy   lever   non-renewable   power station   radiation   renewable   reflect   thermal energy   thermometer   work