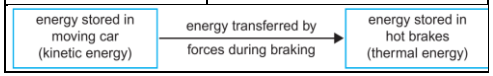
SP3 Conservation of Energy

Lesson sequence

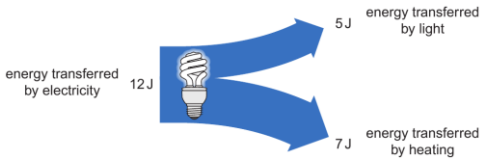
1. Energy stores and transfers
2. Energy efficiency
3. Keeping warm
4. Stored energies
5. Non-renewable energy resources
6. Renewable energy resources

1. Energy stores and transfers

Energy	The capacity to do work.
Joules	The units of energy, symbol = J
Kilojoules	1000 J, symbol = kJ
Thermal energy	Energy stored in hot objects.
Kinetic energy	Energy stored in moving objects.
Chemical energy	Energy stored in chemicals such as fuels.
Nuclear energy	Energy stored in the nucleus of atoms. Also called atomic energy.
Gravitational potential energy	Energy stored in objects based on how high they are.
Elastic potential energy	Also called strain energy. Energy stored in bent or stretched objects.
Energy stores examples	Light, thermal(heat), sound, electrical, kinetic (movement)
Law of conservation of energy	Energy cannot be created or destroyed, just transferred from one energy store to another.
Energy transfers	Say from what store the energy starts as *and* what its new store is.

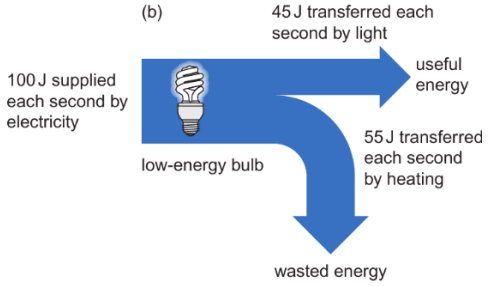


Sankey diagram	Shows energy transfers. The thickness of the arrow relates to the amount of energy.



2. Energy efficiency

Dissipation	The way energy spreads out into the surroundings, becoming less useful as it does.
Wasted energy	Energy that is transferred into stores that aren't useful.
Friction	Causes thermal energy loss as heat when two surfaces rub together.
Lubrication	Allows surfaces to move smoothly, reduces energy loss from friction.
Electrical resistance	Causes wires to heat up, wasting electrical energy.
Calculating efficiency	$\text{efficiency} = \frac{\text{(useful energy transferred by the device)}}{\text{(total energy supplied to the device)}}$ Efficiency is expressed as a decimal.
Energy efficiency numbers	Efficiency is between 0 and 1. 1 = no energy wasted 0 = all energy wasted



3. Keeping warm

Convection	Heat transfer caused when hot fluids (gas or liquid) rise because they are less dense.
Conduction	Heat transfer through solids caused by vibrating particles bumping into each other.
Radiation	Heat transfer by infrared radiation which heats objects up when they absorb it.
Radiation and surfaces	Infrared radiation is absorbed (taken in) and emitted (given out) easily by dull, dark surfaces. Radiation is absorbed and emitted poorly by shiny, light surfaces.
Insulation	Materials that contain lots of tiny air pockets that prevent heat loss by conduction.
Thermal conductivity	A measure of how well a material conducts heat.
Reducing the rate of energy transfer	Increase thickness of material Decrease thermal conductivity Decrease temperature difference

4. Stored energies

Gravitational field strength g	The strength of gravity. Different on different planets. On Earth g = 10 N/kg.
Calculating gravitational potential energy	$GPE = mg\Delta h$ ΔGPE $m \times g \times \Delta h$ GPE is gravitational potential energy (J) m is mass (kg) g is gravitational field strength (N/kg) Δh is height change (m)

Calculating kinetic energy	$KE = \frac{1}{2}mv^2$ KE $\frac{1}{2} \times m \times v^2$ KE is kinetic energy (J) m is mass (kg) v is velocity (m/s)
Calculating v from KE	$v = \sqrt{\frac{2KE}{m}}$

5. Non-renewable energy resources

Non-renewable resource	A resource that will one day run out because it is being used faster than it is being made.
Fossil fuels	Coal, oil, natural gas. All are non-renewable.
Harm from burning fossil fuels	Carbon dioxide gas is released which causes global warming. Sulfur dioxide is released which causes acid rain.
Nuclear power	Electricity generated from non-renewable nuclear fuels such as uranium.
Nuclear power pros and cons	😊 Lasts a long time, releases no carbon dioxide ☹ Produces very harmful waste, expensive to decommission, although rare, accidents are very dangerous.
Climate change	Changes that happen to global weather patterns as a result of global warming.

6. Renewable energy resources	
Renewable resource	A resource will not run out.
Wind power	Large turbines spun by the wind turn kinetic energy into electrical energy. 😊 No CO_2 ☹ Lots needed, ugly?, no wind no power
Solar power	Solar cells turn light energy from the Sun into electrical energy. 😊 No CO_2 ☹ No sun no power, need lots of space, not suitable for all countries
Tidal power	Uses kinetic energy from water movement from tides to spin turbines and produce electrical energy.
Tidal barrage	A damn built across an estuary that fills up when tide goes in. When stored water is released its kinetic energy produces electrical energy. 😊 Huge amounts of energy, no CO_2 ☹ Destroys important mudflat habitats
Hydroelectricity	A damn is built across a river valley, water released from the damn spins turbine and its kinetic energy produces electrical energy. 😊 Lots of energy, no CO_2 ☹ Destroys habitat by flooding
Biofuels	Fuels made from recently plant or animal matter, often waste, are a store of chemical energy. 😊 Carbon neutral ☹ Needs a lot of land, increases food prices

Carbon neutral	When burning a fuel releases the same CO_2 it absorbed when it was growing, so there is no CO_2 increase.

7. Reducing energy losses (HIGHER ONLY)	
Reducing energy losses	Increases the efficiency of a device or process, e.g. engines. This can be by reducing friction; by making sure all fuel is burned; or by using energy that would otherwise be wasted.

Lesson	Memorised?
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7. Reducing energy losses (HIGHER ONLY)	