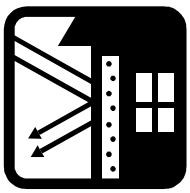
Science Revision Notes

Energy – Heat transfer

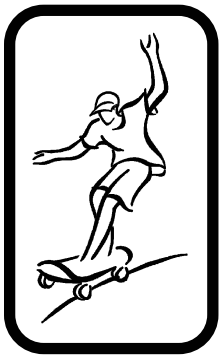
If an object is warmer than its surroundings it will lose heat and cool down. Hot motorcycle engines emit mainly **infra red radiation**. This radiation does not involve any particles. The best insulated glass will not transmit much infra red radiation.
Thermal (heat) energy passes through solids like glass and metal by **conduction**. Copper is a better conductor than concrete which is better than glass.

Air in contact with the outside of a saucepan expands and rises due to decreased density, causing a **convection current**. Heat energy from an immersion heater spreads through the water by convection.
Fibreglass and wool are good **insulators** because they trap air in pockets stopping convection



To **reduce heat loss** from a building you should increase the thickness of the roof insulation and decrease the temperature inside by fitting temperature controls on radiators, decrease the size of the widows and finally, change them to double glazed, instead of single glazed.
Draught proofing a building is the first improvement because it pays for itself in the shortest time. Loft insulation costing £200 and saving £50 per year, gives it a 4 year **pay back time**.

Energy – Using energy

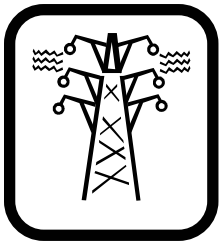


Energy is never lost or destroyed but it can be changed form one form to another. Moving a book to a higher shelf or climbing a ladder increases **gravitational potential energy**. Gravitational potential energy is easily changed into **kinetic energy** e.g. by skateboarding down a hill, or when something is dropped from an open window.
Electrical energy can be transferred into **light** by a bedside lamp, **sound** by a bell, **heat** by a clothes iron, or kinetic by a drill.
All machines **waste** some energy. Total energy input = U**seful** energy output + wasted energy.
No machine is perfectly **efficient** and friction is often the cause of inefficiency. All energy is eventually transferred to the surroundings as heat.

The energy input to a mobile phone is electrical. The useful energy output from the screen is light and from a speaker is sound. The rest of the energy is wasted as heat. Very efficient machines transfer a large percentage of electricity into useful energy.

A lamp converting 10 joules out of every 100 into light has an efficiency of 0.1 and a car wasting 70 joules out of every 100 has an efficiency of 0.3. A kettle transferring 95 joules out of every 100 into heating water has an efficiency of 95%.

Energy – Electrical energy

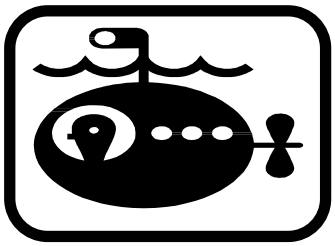


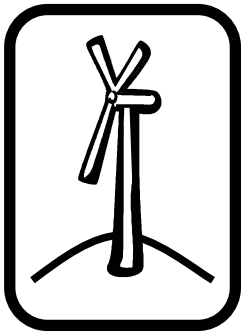
A motor converting 3000 joules per second has a power of 3000W, but a motor converting 3000 joules in 1 minute has a power of 50W. 2400W is equal to 2.4kW and a 4kW electric motor converts 4000 joules per second.
Electricity is transmitted across the country by the **National Grid.** Step-up **transformers** are used to increase the efficiency of the system by increasing the voltage and reducing the current.
The energy transferred by an 8kW immersion heater in 4 hours is 32kWh. If each **kWh** costs 7p, 32 kWh cost £2.24 and a 2kW kettle can be used for half an hour for 7p.

Energy – Generating electricity

The process used to produce energy from **fuel** in a power station is called combustion. This transforms **chemical** energy into heat energy. In a heat producing power station, the heat is used to boil water. A **turbine** in a power station is driven by steam and transfers kinetic energy to the generator. A **generator** transfers energy to homes and factories as electricity. Burning coal or oil to generate electricity produces **Carbon Dioxide** and some **Sulfur Dioxide**. In most power stations in Britain waste heat is released into the surroundings and is rarely used to heat neighbouring buildings.

The fuel costs for nuclear power are low. **Nuclear** Power stations use Plutonium or **Uranium** to produce heat by nuclear **fission**. This generates electricity without producing Carbon Dioxide. Nuclear power stations produce **radioactive waste** which must be contained for a long time. This means they have the highest decommissioning costs. The best energy resource for a submarine which spends months under the water is nuclear fuel. A nuclear power station takes up **less space** than a wind farm because the same amount of energy is much more concentrated in nuclear fuels.



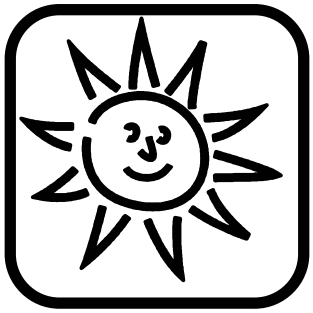


Generators sited on hills in the UK are most likely to use **wind** power. Wind power stations cause **noise** pollution and the supply is **unreliable.** Wind power puts no carbon dioxide or sulfur dioxide into the atmosphere as coal and oil powered stations do. Wind power does not make any dangerous waste, but a disadvantage of a wind power station is that it only works when the wind blows. Large wind turbines may be set up far out at sea because there is more wind than on land and the noise is not a problem.

A **wave** power station does not use fuel, but can be damaged by storms, so requires a lot of **maintenance**. Most likely reasons for objecting to a wave power station are noise and visual pollution and being a danger to shipping.

Hydroelectric power stations have no fuel costs and can be used for **sudden demands** for electricity. In a hydroelectric power station, falling water changes gravitational potential energy into kinetic energy. A disadvantage of a hydroelectric power station is that it only works in wet and hilly areas. If the cost of a power station is £3.4 million and generates £100 000 per year it will take about 35 years to pay for itself.

A power station that includes a barrage across an estuary uses **tidal** power. Tidal energy is free and reliable as tides occur **twice every day**. One disadvantage of a tidal barrage is that it disrupts **wildlife** in estuaries.



A **solar** cell can be used to generate electricity directly from sunlight. It is the best energy source for devices like calculators.

Solar panels can be used to heat water. They absorb energy from the sun as the **black** top surface **absorbs** radiant energy and heats up the water which is then stored in an insulated tank.