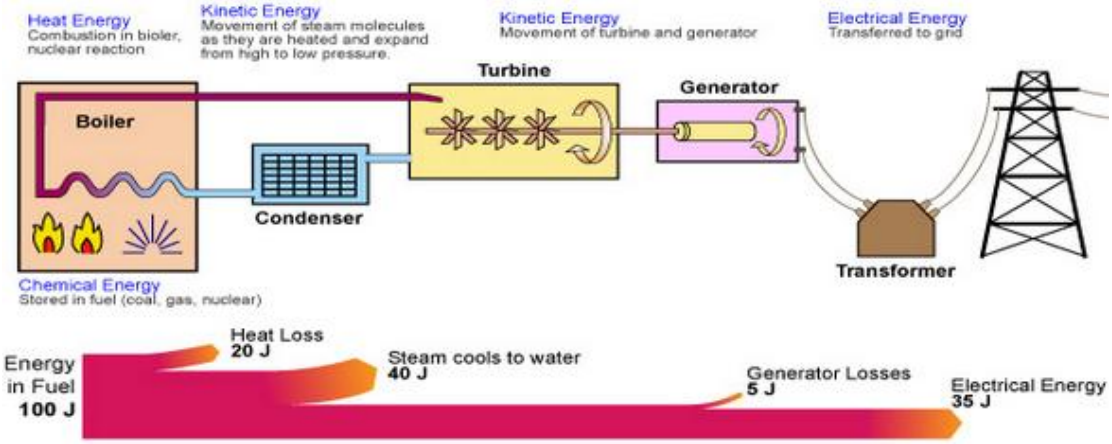
Topic 6 – Energy and the Future

- **ENERGY TRANSFERS**
- There are 9 forms of energy:
    - Thermal (heat energy)
    - Light
    - Electrical
    - Kinetic (movement energy)
    - Sound
    - Chemical potential (e.g energy stored in batteries, muscles and fuels)
    - Nuclear potential (energy stored in nuclei of atoms)
    - Elastic potential (energy stored by things that have been stretched or squashed and can spring back)
    - Gravitational potential (energy stored in things that can fall)
- Energy can move from one place to another and from one form to another – this is called 'energy transfer'
- E.g a battery-powered torch: chemical energy→electrical energy→light and heat energy
- **Conservation of energy:**
- If you add up all the energy that has been transferred by a system (the output energy) and compare it with the energy put into the system (the input energy), the amounts are the same…→output energy = input energy
- I.e energy can't be created or destroyed (it's 'conserved')…it can only be transformed from one form to another – this is the law of conservation of energy
- Although energy is conserved, it's not always transferred into forms that can be used:
    - E.g after a bouncy ball has bounced it gains thermal energy and loses kinetic energy
    - →On the second bounce the ball doesn't reach the height it was initially dropped from
- **Energy conservation diagrams ('Sankey diagrams'):**
- These show the amount of energy converted or transferred
- The width of the arrows represents the amount of energy in joules
- E.g energy conservation diagram for a power station…:



- **EFFICIENCY**
- The efficiency of a device is the proportion (%) of energy transferred into useful forms

- E.g when a light bulb is switched on, most of the electrical energy supplied to it is converted into wasted thermal energy that spreads to the surroundings…:
    - Old-style 100 J light bulbs: 9 J useful light energy, 91 J wasted thermal energy
    - New 100 J light bulbs: 45 J useful light energy, 55 J wasted heat energy
    - →New light bulbs transform more of the input electrical energy into light energy than older-style bulbs→they are more efficient
- Equation to calculate the efficiency of a device:
    - Efficiency (%) = (useful energy transferred by the device / total energy supplied to the device) x 100
    - E.g for 200 J input energy, a jet pack produces 80 J of kinetic energy, 10 J of sound and 110 J of thermal energy. Calculate its efficiency:
        - Wasted energy = sound and thermal energy = 120 J
        - →useful energy transferred into kinetic energy = 80 J
        - →Efficiency = 80/200 x 100 = 40%
- **HEAT RADIATION**
- Black absorbs the most heat energy, radiates the least heat energy
- White absorbs the least heat energy, radiates the most heat energy
- →when wearing black clothes you feel hotter than when you wear white clothes
- Car radiators are designed to remove heat from the engine→have to be good at absorbing thermal energy…→car radiators are always black
- **THE EARTH'S TEMPERATURE**
- For a system to stay at a constant temperature it must absorb the same amount of power as it radiates (i.e it must take in the same amount of energy as it gives out)
- E.g if a pool at 27°C radiates 1200W, the heating system must transfer 1200W to the pool for its temperature to remain at 27°C (if less energy is transferred, then pool temperature will drop…if more is transferred, pool's temperature will rise)
- **Earth's energy balance:**
- The Sun radiates energy
- This energy is either reflected back into space (by clouds, atmosphere and Earth's surface) or absorbed (by clouds, greenhouse gases in the atmosphere and Earth's surface)…:
    - The energy that is absorbed by the Earth's surface is re-radiated as infrared radiation, which can heat up the atmosphere
    - For the Earth's temperature to stay the same, the power absorbed by the Earth and its atmosphere must equal the power radiated
- **Effects of greenhouse gases on the Earth's energy balance:**
- Greenhouse gases trap heat energy→more is absorbed in the atmosphere and less is radiated back into space
- This causes the temperature of the Earth to increase (global warming)
- →To decrease the temperature of the Earth we would have to actively *remove* greenhouse gases from the atmosphere
- **Strategies to stop the Earth's temperature rising:**
- To reduce the Earth's temperature, we must reduce the amount of Sunlight that is absorbed by the Earth and its atmosphere
- We can do this by increasing the amount of Sunlight that is reflected
- →possible strategies:
    - Place huge white screens in space, about 2000km along each side
    - Float millions of white ping pong balls on ocean surfaces