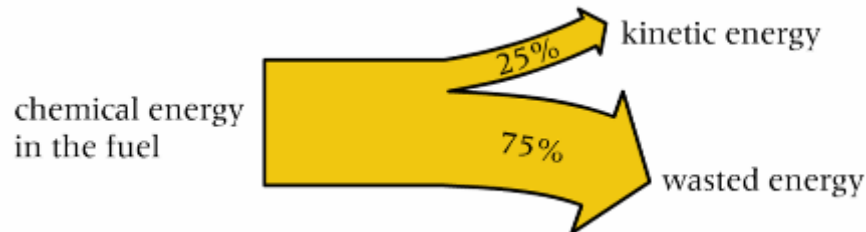A Sankey diagram is used to represent energy transfers in a visual way. The diagram below represents some of the energy transfers in a car.


The width of the arrows is proportional to the amount of energy they represent. In the example above, the arrow representing wasted energy is 3 times as wide as the arrow representing kinetic energy.

Example 1:
A light bulb transfers 100 J of electrical energy each second. It transfers 10 J as light energy, and the rest as heat.
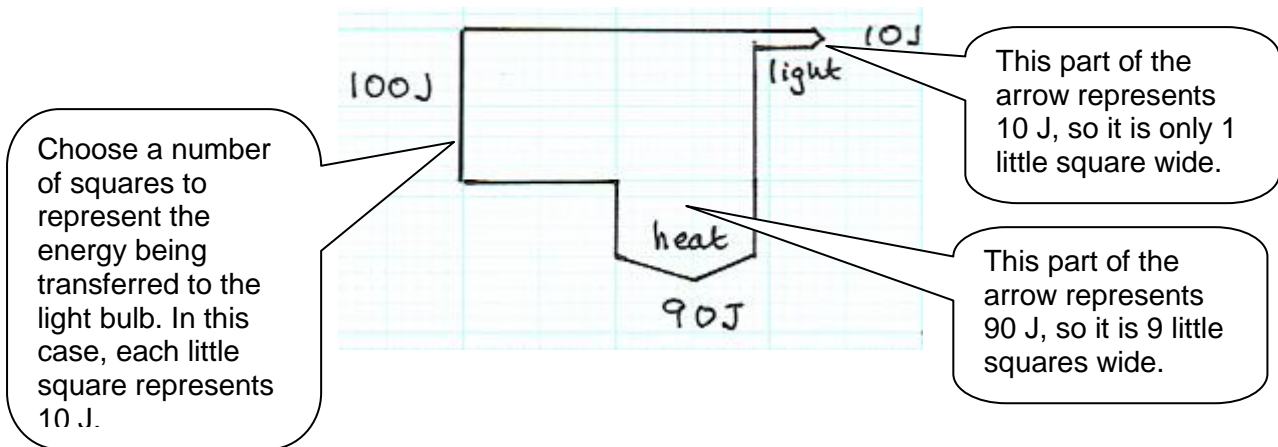
In this example, the useful light energy is 1/10th of the total energy transferred, so the width of the arrow representing the light energy will be 1/10th of the width of the part of the arrow representing the electrical energy. The arrow representing the heat will be 9/10^{ths} of the width
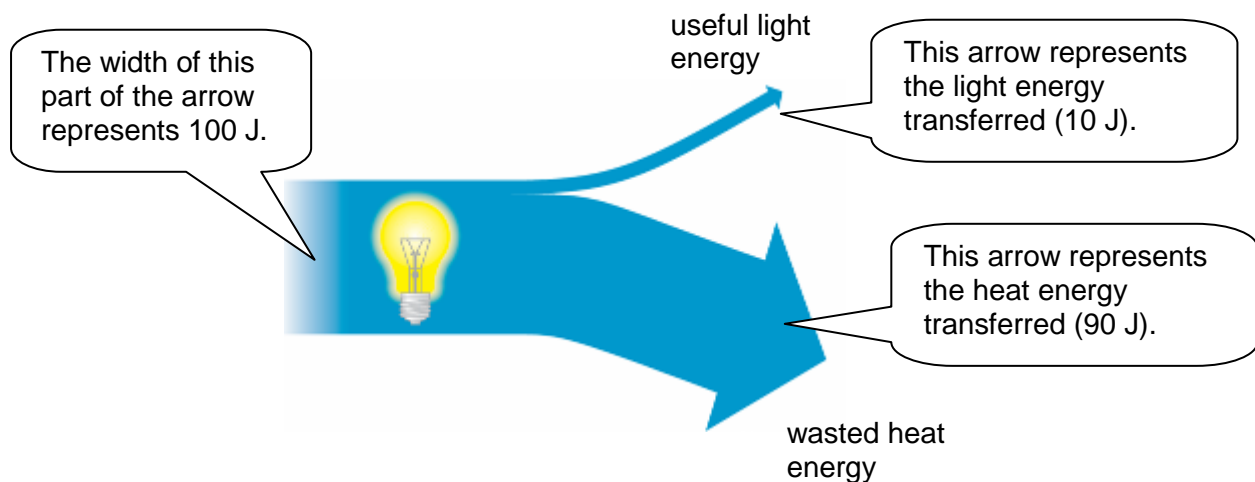
Sometimes it is not easy to draw the arrows neatly to the correct widths. You can also draw Sankey diagrams using graph paper. They do not look exactly the same as the examples above, but the idea is the same. The width of each arrow represents an amount of energy.

The diagram on the next page shows you how to draw a Sankey diagram using graph paper for the light bulb example.
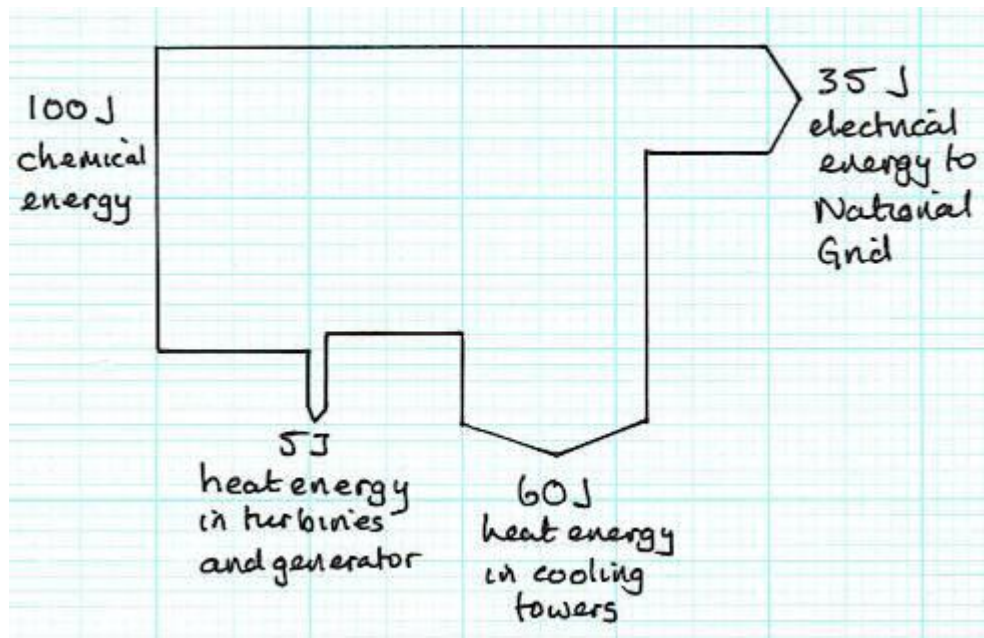
9Ia More on Sankey diagrams (continued)

Choose a number of squares to represent the energy being transferred to the light bulb. In this case, each little square represents 10 J.

100J

light 10 J

This part of the arrow represents 10 J, so it is only 1 little square wide.

heat 90J

This part of the arrow represents 90 J, so it is 9 little squares wide.

Example 2:
For every 100 J of chemical energy stored in the fuel used by a power station, 5 J is wasted as heat in the turbines and generators, 60 J is wasted as heat escaping through the cooling towers, and only 35 J of useful electricity is transferred to the National Grid.

- This diagram is going to be more complicated, so it helps to start it bigger. This time, each little square represents 5 J, so the width of the start of the arrow will be 20 little squares.
- The first arrow to go off will be one little square wide (5 J). The rest of the arrow will be 19 squares wide.
- The next arrow to go off represents 60 J, so this will be 12 squares wide. The width of the arrow that is left will be 7 squares wide, which represents the 35 J of useful energy.

100 J chemical energy

35 J electrical energy to National Grid

5 J heat energy in turbines and generator

60 J heat energy in cooling towers

9Ia More on Sankey diagrams (continued)

1 A 'low-energy' light bulb transfers 80 J of light energy for every 100 J of electricity it uses. Draw a Sankey diagram to represent the light bulb.

2 An electric fire transfers 98% of the energy carried by the electricity into useful heat energy. The rest is wasted as light energy.

    a Draw a Sankey diagram to represent the energy transfers in the electric fire.

    b Draw another Sankey diagram to represent the electric fire, but this time starting with 1000 J of chemical energy stored in the gas used by the power station.

3 On a particular day, the wind passing through the rotor of a wind turbine is storing 1000 kJ of kinetic energy. The wind turbine produces 40 kJ of energy from this wind.

    a Draw a Sankey diagram to represent the energy changes in the wind turbine.

    b Explain why the wasted energy in the wind turbine does not matter as much as wasted energy in a power station.

4 A food chain represents the movement of energy through plants and animals. A gazelle eats grass with a total of 1000 kJ of stored energy in it. Only 100 kJ of this energy ends up stored as chemical energy in the body of the gazelle – the rest is lost as heat following respiration, or in its droppings. A lion eats the gazelle, and only 10 kJ of the original energy ends up stored in the lion's body.

Draw a Sankey diagram to show what happens to the 1000 kJ of energy in the grass that the gazelle ate.