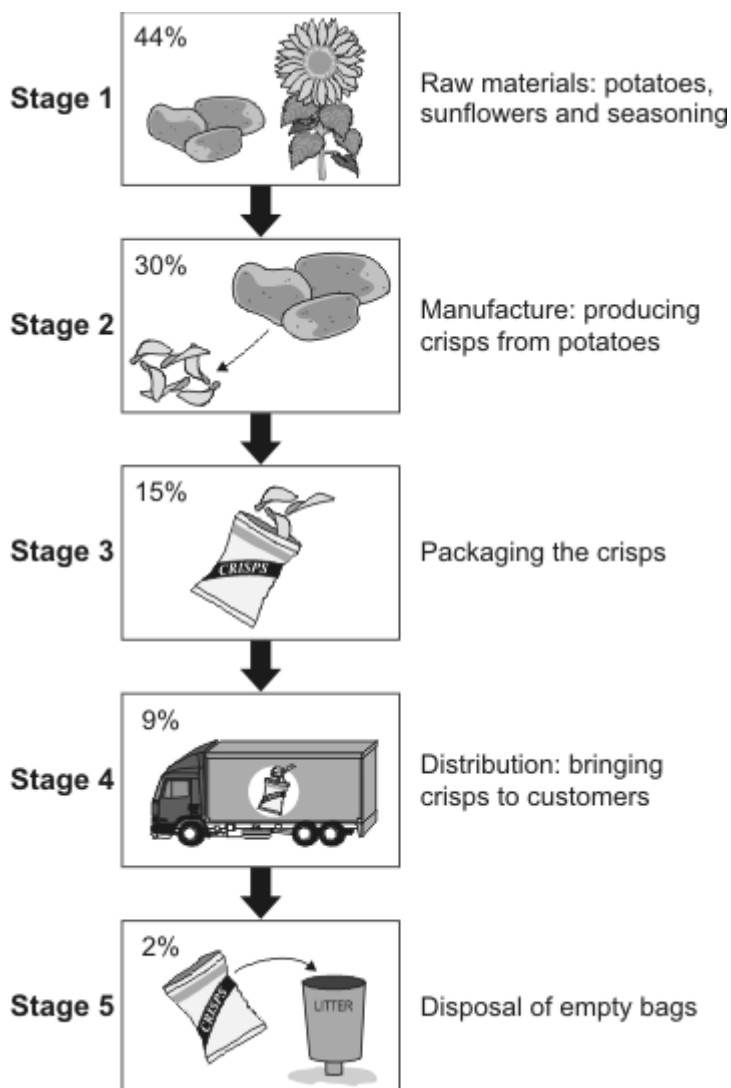


Hydrocarbon fuels

- The carbon footprint of a food product is the amount of carbon dioxide that is produced in its preparation, distribution and disposal.

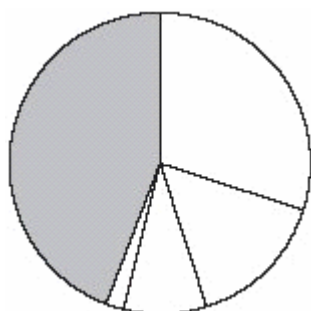
The diagram shows the percentage (%) of the carbon footprint for each stage for a bag of crisps.



- (a) How is most of the carbon dioxide produced in **Stage 4**?

- It is produced when the lorries use fuel.
- It is breathed out by the driver.
- It escapes from the crisp bags.
- It escapes from the tyres of the lorries.

(b) Which stage on the diagram corresponds to the shaded area on the pie chart?



Percentage (%) of carbon footprint for a bag of crisps

- 1 Stage 1
- 2 Stage 2
- 3 Stage 3
- 4 Stage 4

(c) If the company reduces the carbon footprint for a bag of crisps, this will help to . . .

- 1 reduce the acid rain that it causes.
- 2 meet government targets on global warming.
- 3 reduce the sale of crisps which contribute to obesity.
- 4 reduce the use of sunflower oil.

(d) Which of the following changes would reduce the carbon footprint for the bag of crisps?

- 1 increase the sales of the crisps
- 2 change the colour of the crisp bags
- 3 pack many more bags of crisps into each lorry
- 4 increase the size of the lorry fleet

2. Hydrocarbon fuels, **K**, **L**, **M** and **N**, were burned and the products were collected and identified.

The results are shown in the table below.

Products of burning	Hydrocarbon fuels			
	K	L	M	N
Carbon monoxide	✓	✓	✓	✗
Carbon dioxide	✓	✓	✓	✓
Water vapour	✓	✓	✓	✓
Soot	✓	✓	✗	✗
Sulfur dioxide	✗	✗	✓	✓

Key:

- ✓ indicates that the substance is one of the products
- ✗ indicates that the substance is **not** one of the products.

- (a) The results show that combustion was **only** complete for . . .
- 1 hydrocarbon fuel **K**.
 - 2 hydrocarbon fuel **L**.
 - 3 hydrocarbon fuel **M**.
 - 4 hydrocarbon fuel **N**.
- (b) The table of results shows that the hydrocarbon fuels that do **not** contain sulfur are . . .
- 1 **M** and **N**.
 - 2 **K** and **L**.
 - 3 **L** and **M**.
 - 4 **K** and **M**.
- (c) When hydrocarbon fuels are burned, some of the products cause problems.
- Which one of the following **K** statements correctly describes a problem that is caused by the products of burning?
- 1 Sulfur dioxide in the air causes heavier rainfall.
 - 2 Releasing large amounts of carbon dioxide into the atmosphere produces 'acid rain'.
 - 3 A build-up of particles in the air causes 'global dimming'.
 - 4 Releasing large amounts of carbon dioxide into the atmosphere causes 'global dimming'.
- (d) Ethanol is a compound of carbon, hydrogen and oxygen.
Ethanol can be used as a fuel in vehicles together with, or in place of, hydrocarbon fuels.
- An advantage of ethanol as a fuel is that when it burns . . .
- 1 no carbon dioxide is produced.
 - 2 carbon dioxide and water are produced.
 - 3 no sulfur dioxide is produced.
 - 4 only water is produced.

3. Environmentalists say that the introduction of low-sulfur fuels is essential because it gives cleaner emissions from vehicles.

Scientists disagree about the emissions of carbon dioxide from low-sulfur fuels.
Some claim that low-sulfur fuels give higher emissions of carbon dioxide.
Other scientists suggest that the improved fuel consumption from these fuels means that less carbon dioxide is released.

- (a) Vehicle emissions would be cleaner using low-sulfur fuels because they would **definitely** produce less . . .
- 1 carbon dioxide.
 - 2 carbon monoxide.
 - 3 nitrogen oxides.
 - 4 sulfur dioxide.

Unit C1, C1.4.3

(b) Scientists disagree about the emissions of carbon dioxide from low-sulfur fuels because . . .

- 1 they **cannot** repeat the results of their investigation.
- 2 simple experiments do **not** give accurate results.
- 3 there are **not** enough variables in their investigations.
- 4 the data they are using is too simple for a complex problem.

Oil companies are concerned about the cost of removing more sulfur from fuels. They claim that more dinitrogen oxide (N_2O) is produced by these fuels when catalytic converters are running at low temperatures. Dinitrogen oxide is 310 times more powerful than carbon dioxide as a greenhouse gas.

(c) Oil companies do **not** want to remove more sulfur from fuels because . . .

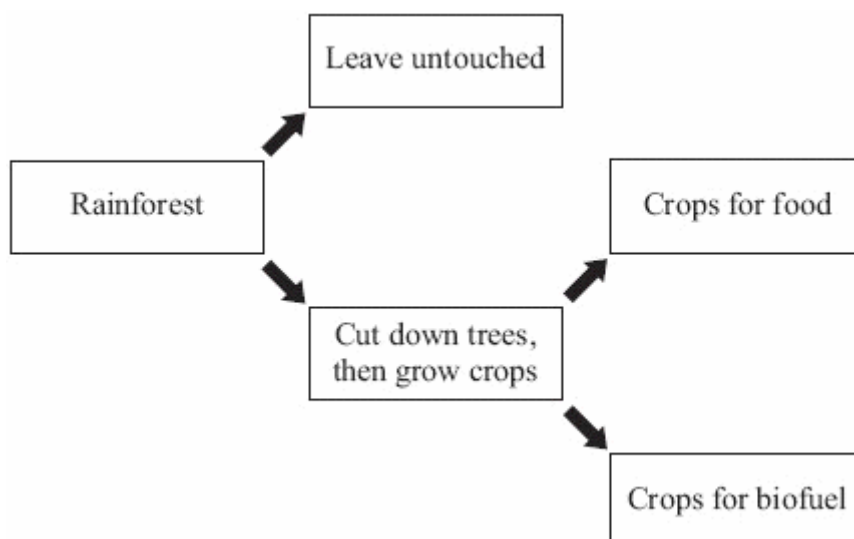
- 1 increased production costs would put up the price of their fuels.
- 2 they would sell less fuel because of improved fuel consumption.
- 3 they do **not** agree that the emissions from low-sulfur fuels are cleaner.
- 4 customers do **not** believe that the fuels are any better for the environment.

(d) The oil companies claim that more dinitrogen oxide is produced when low-sulfur fuels are used. How could this be verified?

- 1 The oil companies should repeat their investigations.
- 2 Independent scientists should carry out further investigations.
- 3 Government scientists should measure the levels of dinitrogen oxide near motorways.
- 4 University students should research the effects of dinitrogen oxide when it is released into the atmosphere.

4. Rainforests have an important global role in absorbing carbon dioxide. They are also a habitat for many endangered species.

Many countries have to make difficult decisions about the use of land. This is summarised in the flow chart. Biofuels that are produced include biodiesel and bioethanol. The trees that are cut down are not always replaced.



Unit C1, C1.4.3

- (a) Why is there a large worldwide demand for biofuels?
- 1 The carbon dioxide produced by the use of the fuel is completely matched by the carbon dioxide taken in when the fuel is grown.
 - 2 They are a renewable source of energy.
 - 3 Their use is always sustained.
 - 4 No greenhouse gases are produced.
- (b) Which row in the table correctly shows two likely consequences of a long-term increase in the demand for biofuel?

1	fewer crops will be grown for food	more species will be endangered
2	fewer trees in rainforests will be cut down	more land will be used for crops
3	less carbon dioxide will be absorbed by the rainforests	more crops will be grown for food
4	land will not be used and will be returned to rainforest	fossil fuel reserves will run out sooner

- (c) Scientists have been asked to carry out research to produce evidence about the consequences of developing the use of biofuels.

Which row in the table gives the correct description of an issue and its impact?

	Issue	Impact
1	ethical	effect on endangered species
2	social	effect on price of fossil fuels
3	environmental	effect on price of wood
4	economic	effect on levels of oxygen in the atmosphere

- (d) Some of the vegetable oils grown as a food crop are reacted with hydrogen at 60 °C using a nickel catalyst.

The purpose of this process is to . . .

- 1 remove single carbon carbon bonds in the oil.
- 2 add double carbon carbon bonds to the oil.
- 3 change the oil so that its melting point is higher than room temperature.
- 4 make the chemicals in the oil detectable with bromine.