
Global Air Pollution - Global Warming

Introduction

The Earth is surrounded by a blanket of gases called the atmosphere, or the air. The air is a mixture of gases. The two main gases in the atmosphere, nitrogen and oxygen, make up 99 per cent of the atmosphere. The oxygen we need to breathe to keep us alive makes up just 21 per cent of the atmosphere.

The air is our most precious resource. We can survive for weeks without food, and for days without water, but only a few minutes without air.

Humans and other animals breathe in oxygen and breathe out carbon dioxide. Trees and other plants take in carbon dioxide and release oxygen back into the air. These processes help to ensure that the air maintains the right balance of gases for all forms of life.

Air pollution is the contamination of the air. It occurs when industries and vehicles release large amounts of harmful and poisonous gases into the air. Some of these gases kill trees and poison the wildlife in rivers and lakes. Other gases cause a gradual warming up of our planet and damage the ozone layer.

In addition to gases, the air is being polluted by dust particles, for example from demolition work or smoke particles resulting from burning fuels.

For most of our time on Earth, we have had clean, healthy air. However, since the industrial age, when the human population began to climb steeply, air pollution has become a serious problem in many big cities. The air over these cities often becomes so filled with pollutants that it harms the health of people.

Sources of air pollution

The two main sources of air pollution are:

- transportation, and
- industrial processes.

Transportation

All types of transport - cars, lorries, trains, ships, and aeroplanes - produce air pollution. Most of them rely on fossil fuels (usually oil) for power, burning petrol or diesel fuel. These fuels release carbon dioxide, sulphur dioxide and nitrogen oxide gases. Car exhausts also produce poisonous carbon monoxide gas, hydrocarbons, and lead. There are estimated to be about 500 million cars in the world today. They emit about 2 trillion cubic metres of exhaust fumes. This is likely to double over the next 30 years.

The principal emissions of aircraft include the greenhouse gases carbon dioxide, water vapour, nitric oxide, nitrogen dioxide, sulphur oxides and soot. These gases and particles are emitted directly into the atmosphere. They increase the concentration of atmospheric greenhouse gases, including carbon dioxide, ozone, and methane.

Sources of air pollution

Industrial processes

Many industries and power stations burn fossil fuels for heat and power. Coal, oil and natural gas are all fossil fuels. They are called fossil fuels because they were formed over millions of years from the remains of prehistoric plants and animals buried in the ground.

Burning fossil fuels causes air pollution. Burning oil produces more pollution than natural gas, but burning coal is the most damaging.

When fossil fuels burn, they release gases including carbon dioxide, sulphur dioxide and nitrogen oxides. Carbon dioxide is the main gas causing the Greenhouse effect. Sulphur dioxide and nitrogen oxides cause acid rain and smog.

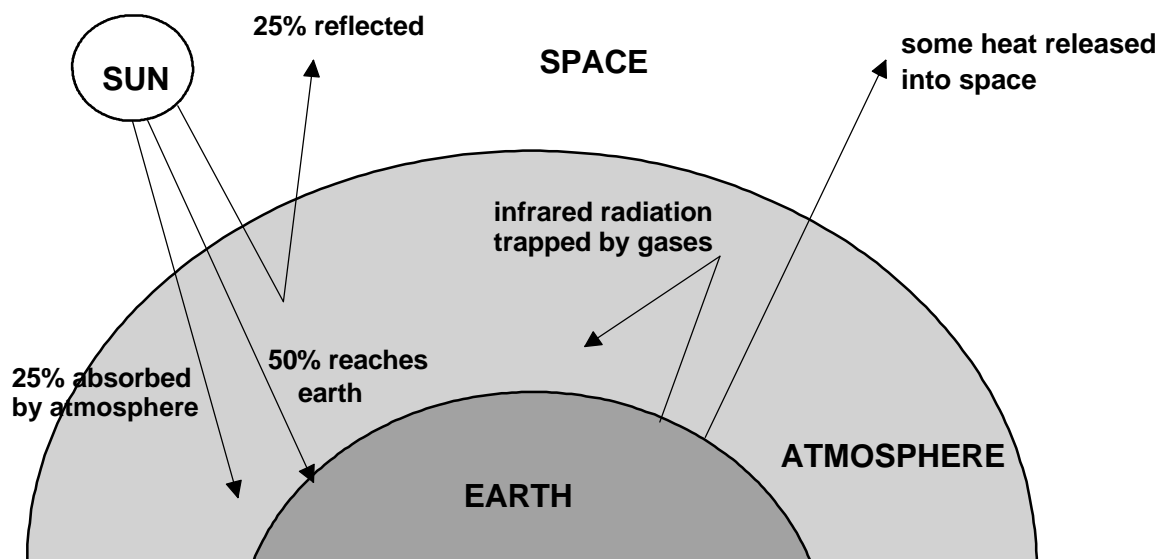
Greenhouse effect

The Earth is kept warm by heat from the Sun. Solar radiation is mainly in the form of short wave visible and ultraviolet energy. As this radiation travels toward the Earth, 25% of it is absorbed by the atmosphere and 25% is reflected by the clouds back into space. The remaining radiation travels directly to the Earth and heats its surface.

The Earth releases a lot of the energy it has received from the Sun back to space. However, the energy re-emitted from the Earth's surface is in the form of invisible long wave infrared radiation.

Greenhouse gases like water vapour, carbon dioxide, methane and nitrous oxide trap the infrared radiation released by the Earth's surface. The atmosphere acts like the glass in a greenhouse, allowing much of the short wave solar radiation to travel through, but trapping a lot of the long wave heat energy trying to escape back to space.

This process makes the temperature rise in the atmosphere just as it does in a greenhouse. This is the Earth's natural greenhouse effect and keeps the Earth 33°C warmer than it would be without an atmosphere.



Greenhouse effect

During the last 200 years human activity has released extra quantities of greenhouse gases which are trapping more heat in the atmosphere. When fossil fuels are burnt, carbon dioxide is given off into the atmosphere. Since about 1800, the amount of carbon dioxide in the air has increased by around 30 per cent. Carbon dioxide accounts for about 50% of global warming. Chlorofluorocarbons (CFCs) contribute another 25%, while methane and nitrous oxide make up most of the remainder.

As the greenhouse gases build up in the atmosphere, they trap more of the heat radiating from the Earth's surface and the Earth gets warmer. Scientists call this the 'enhanced greenhouse effect' or 'global warming'.

- Over the last 100 years the Earth's global mean surface temperature has increased by about 0.5 degrees Celsius
- The six warmest years of the 20th century occurred between 1990 and 2000
- The amount and distribution of precipitation is changing
- Over the last 100 years the average sea level has risen by 15 to 25 mm

Predicted impact of global warming

Scientists predict that the average temperature on the surface of the earth will increase by at least one degree Celsius by the year 2050 and by up to 3.5 degrees Celsius by 2100. If the world warms up, glaciers on mountains, and the ice caps of the North Pole and Antarctica would start melting.

Nobody knows exactly how much the sea levels might rise. Predictions vary between 15 cm and 95 cm rise by the year 2100. Even without melting the ice caps, sea levels would rise due to the increase in temperature of the sea water leading to its expansion.

Much of the land in the Netherlands has been reclaimed from the sea and is very low-lying. A rise in sea level would could put great stretches under water or force the building of expensive sea walls. The Maldives, in the Indian Ocean, is also very low-lying and would almost completely disappear under the waves as would many Pacific islands.

Other effects include:

- displacement of millions of people from low lying islands and coastal areas.
- rapid change in climate will probably be too great to allow many ecosystems to suitably adapt, and the rate of species extinction will most likely increase.
- impacts on wildlife and species biodiversity, human agriculture, forestry and water resources.
- Changes in precipitation (rainfall and snowfall) and the frequency and intensity of extreme weather events.
- adverse effects on human health, E.g. millions more affected by malaria.
- possible reduction in global food production.

Controlling global warming

There are two ways to control global warming:

- make less pollution in the first place, and
- stop the pollution from escaping into the environment.

To avoid the problems of global warming, the first thing we must do is cut back the amount of greenhouse gases getting into the atmosphere.

Power generation

There are several methods of removing the sulphur dioxide from the gases that escape up the chimneys of coal and oil burning power stations. However, all of them make the electricity about 10% more expensive.

There are other ways of generating energy that do not burn any fossil fuel. They include nuclear power, wind power, solar power, wave power, and hydro-electric power.

Energy efficiency

Buildings must be made more energy efficient. This means better insulation and use of natural heating and cooling rather than the use of air conditioning systems which consume large amounts of energy.

Industrial processes must also be made more energy efficient and 'clean'.

Transportation

Transportation systems must be improved to reduce the emissions of green house gases. Catalytic converters can be fitted to the exhaust pipes of cars. These greatly reduce the amounts of carbon monoxide, nitrogen oxides and hydrocarbons given off by the car. However, they increase the price of a car and fuel consumption by about 5%. In the UK, manufacturers have, by law, to fit catalytic converters to all new models.

Another way of reducing pollution from road vehicles is to develop a fuel other than petrol. The electric car has been around for years but is not yet fast or powerful enough to attract many buyers.

Another option is to reduce the number of cars on the road by persuading more people to use of public transport instead of their cars. If public transport is to lure people out of their cars on to buses and trains, the services must go where people want to go and when they want to go. It must be cheaper to use public transport than to run a car. Public transport uses less fuel per passenger than private cars and so causes much less pollution.

The only totally pollution-free way to travel is by bicycle or on foot. But people need to be encouraged to return to pedal-power or to be pedestrians. Cycle lanes must be provided to make travelling much safer. Cities must cater for pedestrians with pedestrian-only zones. To persuade people to walk rather than use cars, it is important to make them feel safe and comfortable.

Reforestation

Another way to reduce the levels of carbon dioxide is to stop cutting down and burning forests. We can also plant trees - they take up carbon dioxide and stop it getting into the atmosphere.

Controlling global warming

Many of the measures to control pollution are expensive and will have to be enforced by laws. Organisations like Greenpeace and Friends of the Earth have been working for many years to open our eyes to the damage pollution does to our planet. They have also pressured Governments into doing something about it.

Increasingly, governments are passing laws and setting requirements designed to control pollution. They issue information on the effects of air pollutants and the techniques available for controlling them. They set goals called air quality standards for achieving clean air. They then must enforce control measures to meet the goals. Governments may act directly against polluters if they fail to obey the regulations.

The control measures include emission standards, which restrict the amount of pollution from factories and other sources of pollution. Governments also set emission standards for motor vehicles. In many countries, to meet these emission standards, new cars must be equipped with catalytic converters.

The Rio Earth Summit

In response to scientific predictions of man-made global warming, the United Nations Framework Convention on Climate Change (FCCC) was adopted and signed by 162 countries in 1992 at the Rio Earth Summit. The ultimate objective of the FCCC was to:

'achieve stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner'

To achieve this objective it was proposed that:

- the global climate be protected for the benefit of present and future generations
- developed nations should take a leading role in combating climate change
- the needs and special circumstances of developing countries, particularly those vulnerable to climate change, should be given full consideration
- the effects of global warming should be reduced by ensuring the greatest possible global benefits at the lowest possible costs

By adopting these objectives and principles, countries were committed to a number of obligations, including the reporting of national greenhouse gas emissions, the development of greenhouse gas emission reduction programmes, the protection of greenhouse gas sinks such as forests, and the provision of education, training and public awareness concerning global warming.

The UK signed the Framework Convention in 1992 and published its first UK Programme of Climate Change in January 1994. This Programme is currently being reviewed.

At the Rio Earth Summit it was agreed that emissions of greenhouse gases, particularly carbon dioxide, should be stabilised at 1990 levels by the year 2000.

Controlling global warming

The Kyoto Protocol

At the Rio Earth Summit, Parties to the Framework Convention on Climate Change (FCCC) agreed to stabilise emissions of greenhouse gases at 1990 levels by the year 2000, in an attempt to mitigate the threat of global warming.

Following this an agreement to cut emissions was agreed in December 1997 in Kyoto, Japan, at the third Conference of Parties to the FCCC. Industrial nations agreed to reduce their collective emissions of greenhouse gases by 5.2% from 1990 levels by the period 2008 to 2012.

The Kyoto Protocol committed developed countries to make legally binding reductions in their greenhouse gas emissions. The six gases that were considered are carbon dioxide, methane, nitrous oxide, and replacements to CFCs, which are to be gradually phased over the next 30 years.

The Kyoto Protocol was endorsed by 160 countries. It will become legally binding provided at least 55 countries sign up to it, including developed nations responsible for at least 55% of greenhouse gas emissions from the industrialised world.

The global cut in emissions of 5.2% is to be achieved by differential reductions for individual countries. The European Union, Switzerland and the majority of Central and Eastern European nations will deliver reductions of 8%; the US will cut emissions by 7%; and Japan, Hungary, Canada and Poland by 6%.

New Zealand, Russia and the Ukraine are required to stabilise their emissions, whilst Australia, Iceland and Norway are permitted to increase slightly, although at a reduced rate to current trends.

Within the European Union, further differential reduction rates apply. The UK has committed itself to a 12.5% reduction, although it has also set its own domestic target of a 20% reduction in carbon dioxide by 2010.

What can we do as individuals?

We all contribute to global emissions of greenhouse gases by using energy for heating our homes, running electrical appliances, cooking food and driving our cars. Most of this energy comes from the burning of fossil fuels, such as oil, coal and gas, which release carbon dioxide, the main greenhouse gas, into the atmosphere. Energy use is responsible for about 75% of man-made carbon dioxide emissions.

Energy used in the home can be saved by a number of measures, including draught proofing, insulation, and using energy efficient lighting and other household appliances.

We can also help to reduce the consumption of energy used in manufacturing, by reducing the amount of waste; re-using products and recycling them where possible. By burying less waste materials in the ground, we can reduce the amount of methane, another greenhouse gas, given off at landfill sites.

Cars produce about 20% of worldwide man-made carbon dioxide emissions. The average car user is responsible each year for a weight of carbon dioxide roughly equivalent to the weight of the car. We can all help by choosing alternative modes of travel, including public transport, walking and cycling.

Assessment

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Questions 1 to 5 - Select the correct response for the following questions :

1. Which of the following is not a 'greenhouse gas' ?

A carbon dioxide
B nitric oxide
C oxygen
D sulphur dioxide

2. Which form of radiation is trapped by greenhouse gases ?

A ultra violet
B microwave
C visible light
D infra red

3. Carbon dioxide accounts for what percentage of global warming ?

A 50%
B 40%
C 20%
D 10%

4. By how much has sea level risen during the last 100 years?

A 0 to 10 mm
B 15 to 25 mm
C 30 to 40 mm
D 50 to 65 mm

5. By 2100 scientists predict that the maximum rise in sea level could be ?

A 10 cm
B 20 cm
C 45 cm
D 95 cm

Questions 6 to 10 - Decide whether each of these statements is True (T) or False (F).

6. i) Over the last 100 years the Earth's global mean surface temperature has increased by about 5 degrees Celsius.
 ii) Global warming may lead to changes in precipitation and the frequency and intensity of extreme weather events.

Which option best describes the two statements?

- A i) T ii) T
 B i) T ii) F
 C ii) F ii) T
 D ii) F ii) F

7. i) Global warming can be controlled by reducing the amount of air pollution.
 ii) Global warming could be reduced by burning more fossil fuels for power generation.

Which option best describes the two statements?

- A i) T ii) T
 B i) T ii) F
 C i) F ii) T
 D i) F ii) F

8. i) Public transport uses less fuel per passenger than private cars so causes less pollution.
 ii) Levels of carbon dioxide can be reduced by planting more trees.

Which option best describes the two statements?

- A i) T ii) T
 B i) T ii) F
 C i) F ii) T
 D i) F ii) F

9. i) The Rio Earth Summit proposed that developing nations should take the leading role in combating climate change.
 ii) At the Rio Earth Summit it was agreed that emissions of greenhouse gases should be stabilised at 1990 levels by the year 2000.

Which option best describes the two statements?

- A i) T ii) T
 B i) T ii) F
 C i) F ii) T
 D i) F ii) F

10. i) The Kyoto Protocol committed developed countries to make legally binding reductions in greenhouse gas emissions.
 ii) The average car user is responsible each year for a weight of carbon dioxide roughly equal to the weight of the car.

Which option best describes the two statements?

- A i) T ii) T
 B i) T ii) F
 C i) F ii) T
 D i) F ii) F