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Information Sheet

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Australian Government
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Climate change - causes and impacts

Produced by ForestWorks to inform the forest, wood, paper and timber industry of its role, influence and opportunities in the climate debate.

How global climate and greenhouse gases work

Climate describes the long-term state of the atmosphere across the earth. Climate varies significantly across the earth because of temperature and because the amount of water vapour in the atmosphere in different regions.

The major impact on global climate is radiation from the sun which heats the earth's surface. Reflected heat is trapped in the atmosphere by gases commonly referred to as greenhouse gases. The trapping of this heat is known as the greenhouse effect.

Water vapour is the most abundant greenhouse gas, followed by carbon dioxide (CO₂),

methane, nitrous oxide and a number of minor gases.

Where CO₂ is absent, for example on Mars, the sun's heating effect is not trapped and the planet is cold. Where the atmosphere is mainly CO₂, temperatures are extremely high, for example on Venus.

The natural greenhouse effect makes the earth livable.

In nature, greenhouse gases fluctuate and adjust with the interaction of oceans, forest and animals. Fluctuations in CO₂ occur between the atmosphere and carbon sinks which are natural

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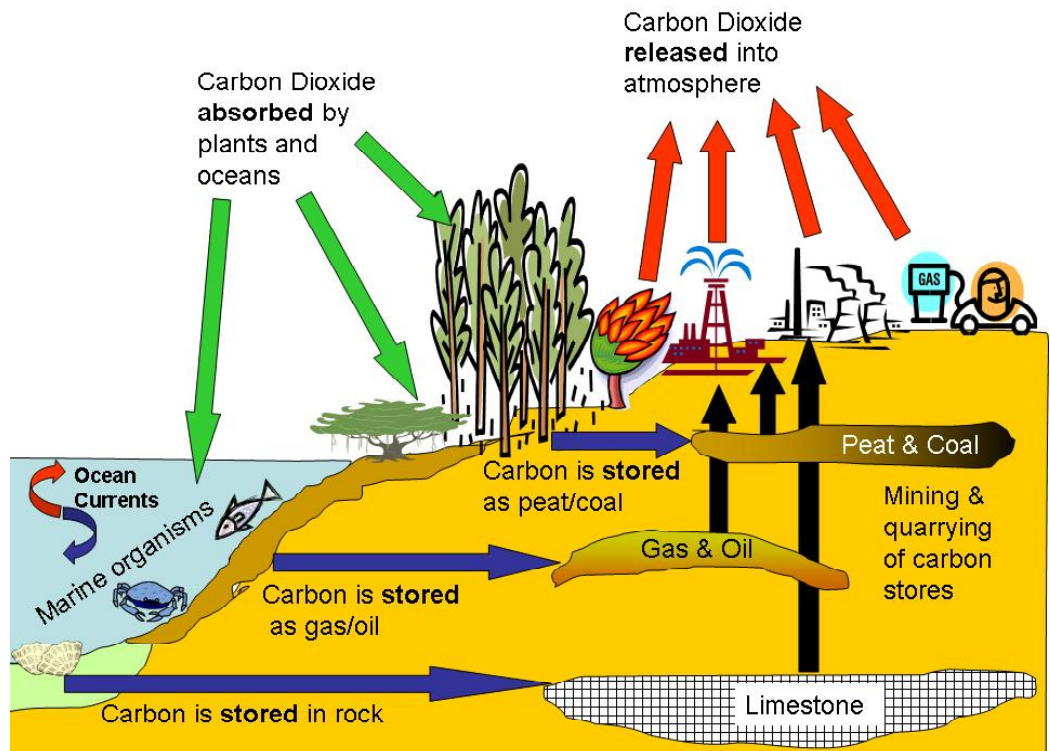


Diagram 1: The natural carbon cycle interacts with human activity. Source: Australian Greenhouse Office, 2008.

stores of CO₂. Carbon sinks include surface waters, deep oceans, trees, plants, soils and rocks.

While carbon sinks have operated to soak up CO₂ for hundreds of millions of years, they may not be able to cope with recent, rapid increases in greenhouse gases.

Through industrialisation over the last 200 years, average global temperatures have increased by 0.6 °C. By 2070, without action to stop global temperatures rising, warming is estimated by the Intergovernmental Panel on Climate Change (IPCC) to increase by between 1 °C and 6 °C over most of Australia.

This is the process known as climate change.

Where carbon comes from and goes to

Carbon is required for all life on earth. The 'carbon cycle' links the living world with the atmosphere and the earth in a continuous exchange of carbon (Diagram 1 outlines the carbon cycle).

Plants absorb CO₂ and store the carbon as fibre. When plants die they return carbon to the atmosphere (as CO₂) or store it in soil sediments that can later form peat, coal and some gases.

It is human use of this carbon store that has created an imbalance and increased CO₂, which in turn has increased the greenhouse effect, causing temperatures to rise. CO₂ is released when vegetation is cleared or soil is disturbed. In Australia, land clearing contributes to around 10 per cent of the nation's total greenhouse gas emissions and around 20 per cent of global greenhouse gas emissions.

In addition to the carbon cycle, forests interact with other natural cycles that effect climate. The carbon cycle is the dominant cycle because CO₂ remains in the atmosphere for an unknown length of time. This process is explored further in Information Sheet 2.

How climate change affects our lives

Rising temperatures is the most obvious impact from an increase in greenhouse gas emissions. However this single impact results in many other 'knock-on' consequences, which can significantly influence all activities on the planet.

The direct effects of rising temperatures are on weather and climate patterns.

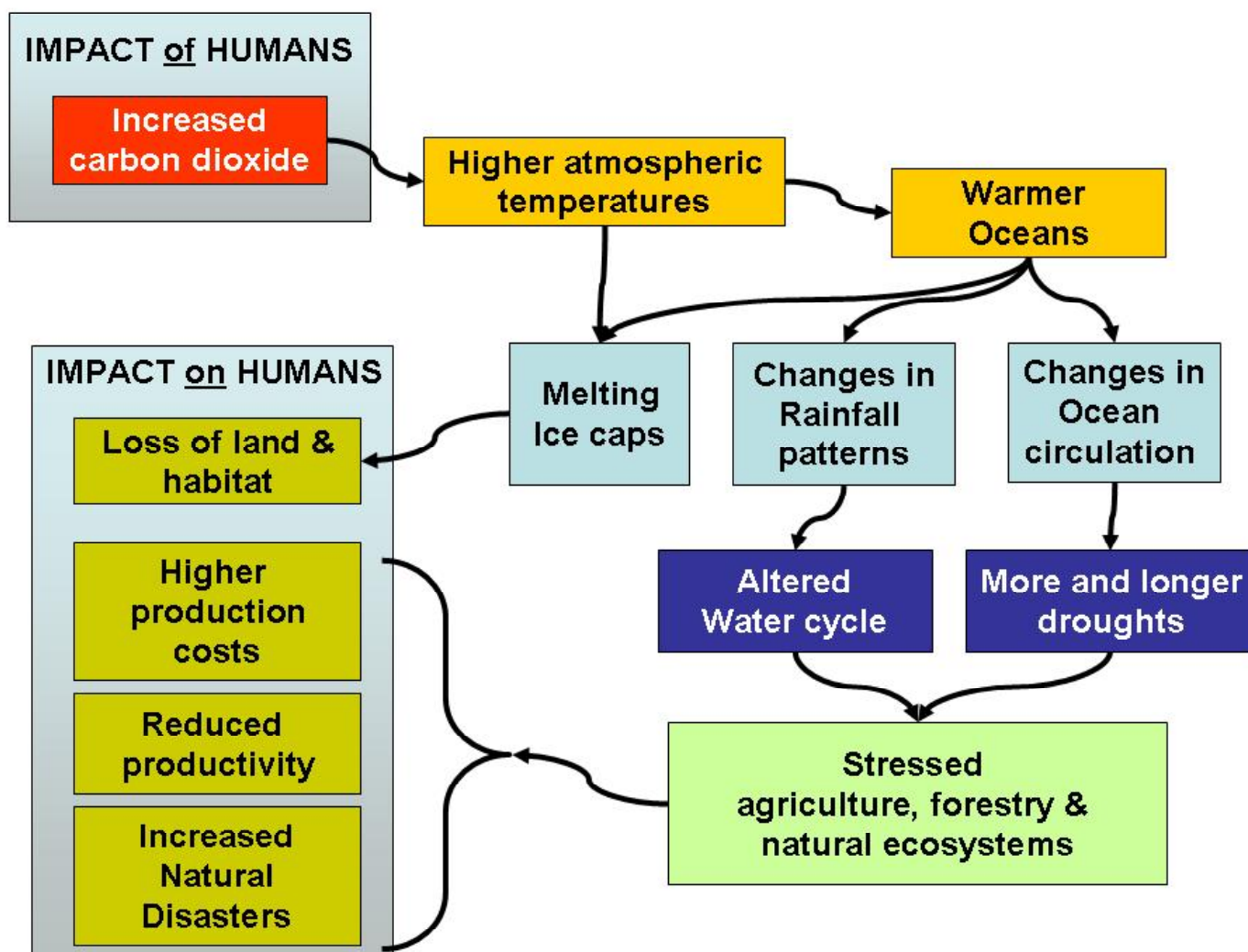


Diagram 2: How people cause climate change

Rainfall distributions are changing, sea levels are rising due to melting icecaps and the intensity of storms is increasing. In addition to the changes in rainfall distribution, the location, intensity and duration of droughts is expected to change significantly.

In Australia, three out of four droughts are related to El Nino (a climatic phenomenon based on interactions between oceans and the atmosphere). El Nino events have in recent years increased in frequency and are often not interrupted by La Nina events (the opposite climatic cycle, which has usually occurred in the past). However, the indirect effects of rising temperatures on weather and climate patterns are potentially far greater.

Droughts reduce agricultural productivity and increase the risk of bush fires, which can dramatically impact forestry production. In addition, the natural ecosystems may be affected. With more extreme weather, plants and animals will become more stressed as habitat and food sources, types and quality are altered by changes in temperature and water availability.

As a result, the bio-diversity of species may decrease. In turn these will have long-

term effects on the sustainability of human societies.

Diagram 2 charts the inter-relationship between humans and climate change.

How humans impact on greenhouse gases and climate change

CO₂ is produced by a range of human activities that use energy such as power stations, car emissions, industry, airplane travel and buildings, which contribute nearly 90 per cent of all greenhouse gas emissions. In contrast, forestry is a carbon sink or remover of CO₂ that is produced by these activities.

While CO₂ is the principal greenhouse gas, methane is the second most important greenhouse gas. According to the Intergovernmental Panel on Climate Change (IPCC), methane is more than 20 times as effective as CO₂ at trapping heat in the atmosphere. Estimated levels of atmospheric methane have risen 145 per cent in the last 100 years.

Since the 1960s the amount of methane in the air has increased by 1 per cent a year – faster than the build up of CO₂.

Further information on climate, climate change and forestry

The following sources provide more detailed information on the topics covered in this Information Sheet. Most are readily available on the internet, from libraries and/or journals:

- Bureau of Meteorology, The Greenhouse Effect and Climate Change, a comprehensive report on the current status of climate change knowledge in Australia. [Click here to view.](#)
- Commonwealth Scientific and Industrial Research Organisation (CSIRO), Climate Adaptation Flagship, introduction to current CSIRO research priorities on climate change. [Click here to view.](#)
- Department of Agriculture, Food and Fisheries (DAFF), forestry website with a particular focus on statistics and management practices. [Click here to view.](#)
- Garnaut Climate Change Review 2008, Issue Paper 1, Climate Change: Land use – Agriculture & Forestry. [Click here to view.](#)
- Intergovernmental Panel on Climate Change (IPCC), Climate Change 2001: The Scientific Basis. [Click here to view.](#)

Australia's greenhouse gas emissions by industry sector

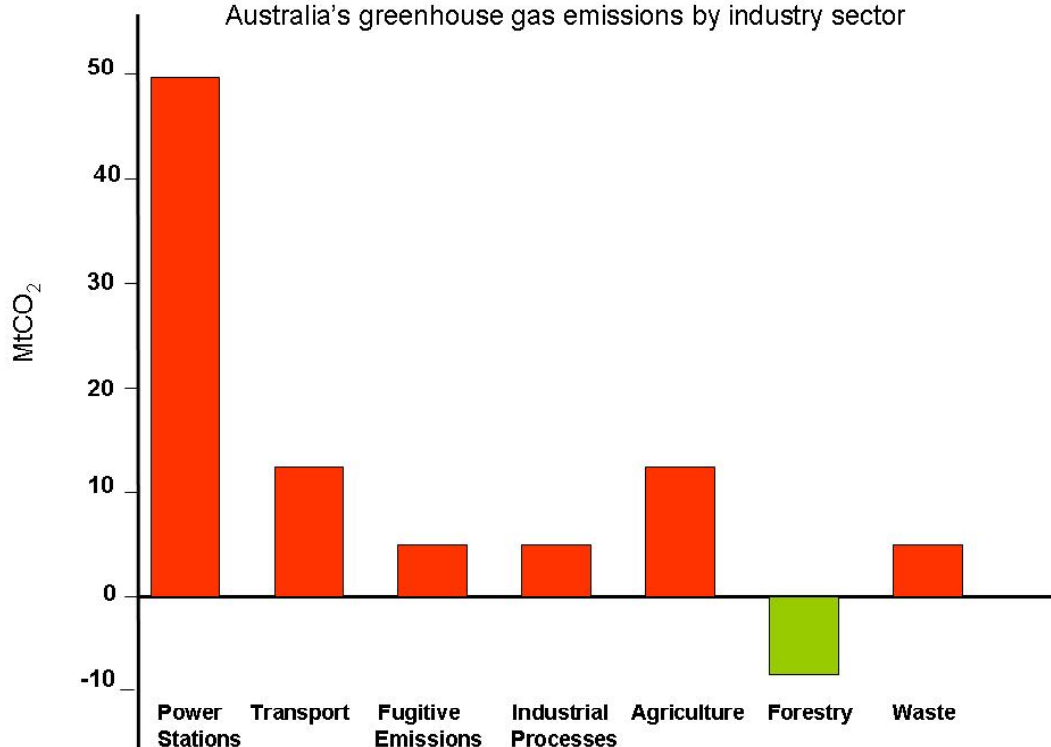


Diagram 3: Australia's greenhouse gas emissions by industry - note that forestry reduces greenhouse gas emissions. Source: Australian Greenhouse Office, 2008.



Water vapour is the most prevalent and most powerful greenhouse agent on the planet, its increasing presence is the result of warming caused by CO₂, methane and other greenhouse gases.

Another greenhouse gas is Nitrous Oxide (N₂O), a colourless, non-flammable gas with a sweetish odour, commonly known as 'laughing gas' and sometimes used as an anaesthetic. N₂O is naturally produced by oceans and rainforests.

Manufactured sources of N₂O include nylon and nitric acid production, the use of fertilisers in agriculture, cars with catalytic converters and the burning of organic matter. N₂O contributes about 6 per cent to the greenhouse effect.

Forests play an important role in managing the world's carbon

Forests 'breathe in' CO₂ as they grow and they store this as carbon molecules in woody stems, branches and roots. Carbon is then released back into the atmosphere as plants decay. As a forest ages, decay increases and growth decreases. Eventually the decay and the growth rates equalise and the forest no longer soaks up carbon as a carbon sink.

However, it does remain a living store of carbon.

Forests around the world store approximately 600,000 million tonnes of carbon. This compares to the around 750,000 million tonnes in the atmosphere and the 1,000,000 million tonnes stored in ocean surface waters.

The amount of carbon stored in forests increases slowly early in life, accelerating as trees increase in size and ultimately reach an equilibrium. Almost half of a forest's 'biomass' is carbon that has been converted from atmospheric CO₂ by photosynthesis.

Where forests are not sustainably managed, carbon can be released into the atmosphere, increasing the greenhouse effect. This is a major issue in developing countries. With the level of carbon stored in forest carbon sinks, the industry has a significant role to play in managing Australia's influence on climate change through carbon storage/sequestration (carbon sequestration is explained further in Information Sheet 2).

While some carbon is released during timber harvesting, carbon remains stored in the harvested forest products used in buildings and wood products. There is potential to increase carbon stored in forests by continually improving forestry practices and by reducing emissions from land clearing and soil disturbance.

About this series

The ForestWorks Climate Change Information Series has been developed to assist Australia's forest, wood, paper and timber industry to make a significant contribution to Australia's efforts to reduce the impact of climate change.

The series includes Information Sheets and other relevant materials.

Information Sheets

Information Sheet 1

Climate change – causes and impacts

Information Sheet 2

Climate change – forestry's influence on greenhouse gases

Information Sheet 3

Climate change – forestry's opportunity to reduce greenhouse gas emissions

Information Sheet 4

Climate change – how the world is responding

Other materials

- Defining Climate Change – a Glossary of Terms
- Education and Training Guidance Notes for Training Providers and Workplace Trainers

The complete ForestWorks Climate Change Information Series is available at:

www.forestworks.com.au