

CARBON FOR THE LAYPERSON

What is Climate Change or Global Warming?

Climate change refers to any change of climatic conditions and can be caused by a variety of factors both natural and human-induced (e.g. temperature, precipitation or wind). Global warming refers to the increased average temperature near the Earth's surface which can contribute to changes in global climate patterns.

What causes it?

The Earth's climate changes in response to various external influences including variations in its orbit around the Sun, changes in solar luminosity, volcanic eruptions, and atmospheric greenhouse gas concentrations. Scientific consensus is that the increase in atmospheric greenhouse gases due to human activity has caused most of the warming observed since the start of the industrial era. This association is clearest for the most recent 50 years.

The greenhouse effect is the process by which absorption and emission of infrared radiation by atmospheric gases warm a planet's lower atmosphere and surface. The major greenhouse gases are water vapor, carbon dioxide, methane and ozone. The issue is how the strength of the greenhouse effect changes when human activity increases the atmospheric concentrations of some greenhouse gases.

Some other hypotheses have been suggested to explain most of the temperature increase. One proposes that warming may be the result of variations in solar activity.

What are its expected effects?

Increased global temperatures may cause broader changes including glacial retreat, Arctic shrinkage and worldwide sea level rise. Changes in the amount and pattern of rainfall may result in flooding and drought. There may also be changes in the frequency and intensity of extreme weather events.

Please note: The information in this document has been sourced from a variety of sites/documents.

Other effects may include changes in agricultural yields, reduced summer streamflows, species extinctions and increases in the range of intermediary hosts which can carry diseases between species.

Greenhouse Gas Emissions

The term greenhouse gas (GHG) refers to a number of gases that contribute to the enhanced greenhouse effect thought to be responsible for climate change. Whilst the most important of these gases is generally carbon dioxide (CO₂), all GHGs must be considered in determining a carbon footprint. This includes the release of methane from landfill which is a significant contributor to GHGs.

Emissions are expressed in terms of their global warming potential (GWP), or specifically as CO₂equivalents (CO₂e). For example, methane is 24 times more potent than CO₂ as a GHG, and so 1 tonne of emitted methane will be expressed as 24 tonnes of CO₂e emitted.

Direct and Indirect Emissions and Scopes

For the purposes of reporting, GHG emissions are broadly divided into Direct and Indirect emissions.

Direct Emissions are produced from sources within the boundary of an organisation and as a result of that organisation's activities.

Indirect Emissions are generated as a consequence of an organisation's activities, but are physically produced by the activities of another organisation. The most important indirect emissions are generally those resulting from electricity use by an organisation.

The GHG Protocol defines three 'scopes' of emission categories.

Scope 1 covers the release of greenhouse gas into the atmosphere as a direct result of an activity, or series of activities (including ancillary activities) that constitute the facility. For example, direct emissions from

- electricity generation
- fuel combustion
- transport in company owned vehicles
- air-conditioning or refrigeration

Scope 2 covers the release of greenhouse gas as a result of one or more activities that generate electricity, heating, cooling or steam that is consumed by the facility but that **do not** form part of the facility. For example, indirect emissions from

- electricity consumption (purchased)

Scope 3 covers emissions that occur outside the boundary of a facility as a result of activities at a facility and are not scope 2 emissions. For example, indirect emissions from

- non-company owned business travel (eg. planes, trains, employee commuting)
- third-party production of resources (eg. equipment, paper, furniture)
- end-use of products sold by the reporting company

When seeking to control carbon emissions, Scope 1 and 2 emissions are most frequently used.

Waste and Climate Change

Landfill and Greenhouse Gases

Organic materials such as food and green vegetation, if left exposed to air, are broken down by bacteria (aerobic bacteria) and other organisms into carbon dioxide (CO₂) and water (H₂O) – both of which contribute to the natural greenhouse effect. When placed in landfills as part of our domestic waste, these same organic materials initially can also break down to CO₂ and H₂O.

However, when other wastes are placed on top and compacted, there is little air left. In the absence of air (specifically the oxygen component), these bacteria are replaced by a different type of bacteria – anaerobic bacteria. These break down the food and much of the green vegetation into a number of products – mainly methane (CH₄), CO₂, and H₂O. The CH₄ and CO₂ come out of the landfill as gases – called Landfill Gas- in approximately equal quantities. If collected and burnt (flared) or used to generate electricity, the methane is a clean fuel (which has the highest hydrogen to carbon ratio) and is converted to CO₂ and H₂O ie the same gases that would be released in a forest. If some of the energy can be collected as electricity on the way this energy could be used instead of energy generated from burning fossil fuels such as coal and oil etc.

If the CH₄ is not collected or burnt it escapes to the atmosphere where it works to keep radiated heat at the earth's surface. As above CH₄ is about 24 times more effective than CO₂ in causing warming and therefore landfill gas makes a significant contribution to 'global warming' – in Australia about 2%. Therefore it is important that even minimal CH₄ is not allowed to escape from the landfill into the atmosphere.

At the same time some of the heavier organic materials such as paper and wood (eg tree branches) are very slow to break down in the landfill. They can keep their carbon content 'fixed' for well over 20 years. In this way they reduce the CO₂ released compared to the release that would occur naturally in a forest or if burnt. This process is called sequestering and provides a positive benefit in reducing greenhouse warming from organic wastes.

Resource Recovery (recycling) and Greenhouse Gases

Currently in Australia, the major ways resources are recovered from solid wastes are through kerbside recycling programs, composting and energy generation. Paper is converted to newsprint and packaging; green organic wastes and sewage sludge are burnt to recover energy or composted; metals and some plastics are converted back into similar or different products. There is also a

growing amount of 're-use' (without reprocessing) of manufactured products where, for example office paper is reused by printing on the other side.

The collection, reprocessing and redistribution of all these goods and materials usually involves transport and some form of mechanical energy obtained from electrical power or petrol, diesel etc. These recovery operations therefore cause the release of additional CO₂ and therefore can increase greenhouse gases in the air.

Fortunately, the use of recovered materials also reduces the amount of 'virgin' resources that have to be extracted from our environment e.g. less alumina, fewer trees etc, have to be used. The transport of these virgin materials is also avoided. This avoidance is the major factor contributing to greenhouse gas reduction during resource recovery.

Most manufactured products contain 'embodied energy' (similar to that contained in steam which when released into your skin, causes worse burning than from the hot water causing the steam). This embodied energy can be usefully released to save new energy during some processes e.g. in aluminium manufacture. Heat energy can also be released by burning some recovered materials e.g. plastics and wood. When collected as electrical energy or hot water for useful human activities, this energy reduces the need to burn coal, petrol, diesel or gas extracted from the earth's limited natural resources.

To find out which is the best option in terms of reducing greenhouse gas generation, wasteful consumption and other environmental impacts a very detailed analysis is required. This is called a Life Cycle Analysis. While difficult, it is really the only way we can reliably find out what is the best thing to do with our waste. The only sure way is to avoid unnecessary 'waste' by reducing consumption of both raw and manufactured materials.

National Greenhouse and Energy Reporting Systems (NGERS)

Overview

NGERS is a framework for the mandatory reporting of greenhouse gas emissions and energy consumption and production by Australian corporations. It is based on *the National Greenhouse and Energy Reporting Act 2007* (NGERA). NGERS will underpin the coming Emissions Trading Scheme.

Further information on reporting requirements can be found at the following site:

www.climatechange.gov.au/reporting

Reporting under NGERS is required by:

- Corporations that control facilities that emit 25 kilotonnes or more of CO₂e or produce or consume 100 terajoules or more of energy or;
- Corporate groups that emits 125 kilotonnes or more of CO₂e, or produces or consumes 500 terajoules or more of energy.

For Corporate groups, the reporting threshold is set to be progressively lowered over the first three years of the scheme to 50 kilotonnes and 200 terajoules. This will effectively capture many smaller corporate groups over time.

Participants in NGERS must document and archive all relevant records that would allow verification of activity data and emissions estimates by an independent verifier.

Participation

The precise participation requirements are as per the Emissions Trading Scheme which is due for release on the 18/12/08.

EMISSIONS TRADING SCHEME

Overview

The Australian Government Emissions Trading Scheme (ETS) will be implemented in 2010.

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The National Greenhouse and Energy Reporting System (NGERS) will be the method of determining and reporting corporate emissions, and the Online System for Comprehensive Activity Reporting (OSCAR) will be the system of reporting for the ETS. OSCAR is a web-based data collection tool for recording of energy, waste and greenhouse data for Government programme reporting including Greenhouse Challenge Plus.

The Australian Government has outlined five tests for an emissions trading scheme (ETS) that give some indication as to how the scheme may be structured:

1. Cap and Trade

An effective emissions trading scheme must be a cap and trade scheme to be internationally consistent. A cap and trade approach is the most widely used scheme design, in which total emissions are 'capped', permits allocated up to the cap, and trading allowed to let the market find the cheapest way to meet any necessary emission reductions.

2. Reduce Emissions

An effective emissions trading scheme must effectively reduce emissions. Such a scheme must stop further growth in Australia's emissions and set Australia on a path to reduce emissions by 60 per cent by 2050.

3. Economically Responsible

An effective emissions trading scheme must be economically responsible. Such a scheme must provide the right incentives to drive investment in low emission technologies and renewable energy while keeping the total cost as low as possible.

4. Fair

An effective emissions trading scheme must be fair. An effective scheme must allow both the costs and the benefits to be shared across the

community. This means additional complimentary policies to make homes, businesses etc more efficient in terms of their energy usage.

5. **Act Now**

An effective emissions trading scheme must recognise the need to act immediately. A scheme needs to commence as soon as possible to minimise the costs of inaction because economic modelling clearly shows that early action is far less costly than delayed action.

Given that the scheme design is still in development, various parameters remain somewhat uncertain, including:

- **Permit Allocation.** Will there be any grandfathering of permits? Will initial permits be auctioned?
- **Baseline Determination.** How will appropriate baselines be determined? Will recent mitigation efforts be allowed for? How will new projects be treated with respect to baselines?
- **Emissions Reduction Targets.** How will targets be allocated across industries?
- **Carbon Sinks.** Will carbon sequestration activities be included in the scheme?

ACRONYMS

AAUs – Assigned Amount Units

AETS – Australian Emissions Trading Scheme

AGO – Australian Greenhouse Office

AWT – Alternative Waste Treatment

CDM – Clean Development Mechanism

CCS – Carbon Capture and Storage

CERS – Certified Emission Reductions

CFCs – Chlorofluorocarbons

CPRS – Carbon Pollution Reduction Scheme

EEO – Energy Efficiency Opportunities

ETS – Emissions Trading Scheme

GECs – Gas Electricity Certificates

GGAS – Greenhouse Gas Abatement Scheme

GHG – Greenhouse Gas Protocol

MRET – Mandatory Renewable Energy Target

NGERS – The National Greenhouse and Energy Reporting System

NETT – National Emissions Trading Taskforce

NGGI – National Greenhouse Gas Inventory

OSCAR – Online System for Comprehensive Activity Reporting

RECs – Renewable Energy Certificates

TEEIs – Trade-exposed, energy-intensive industries

DEFINITIONS

ABATEMENT – Reducing the level of greenhouse gas emissions

ADDITIONALITY – The issue of what qualifies as a bona fide offset. Would the activity have occurred, holding all else constant, if the activity were not implemented as an offset project? If yes, the project is not additional.

AEROBIC ORGANISMS – The decomposition process where oxygen is present.

ANAEROBIC DECAY – The decomposition process because no oxygen is present.

ANTHROPOGENIC – Process derived from human activities as opposed to the process occurring in natural environments.

ATMOSPHERE – The mixture of gases surrounding the Earth

BIOFUELS – Fuels originating from plant matter.

BIOGAS – A gas composed primarily of methane, carbon dioxide and hydrogen sulfide which is used as an alternate source of energy.

BIOMASS – Organic matter that can be burned to produce energy or converted into a gas and used for fuel.

BIOREACTOR LANDFILL – A specially designed landfill which uses a process of water and air circulating to accelerate biological decomposition of the waste material to maximize the generation of biogas for energy production.

CARBON – The basic element in all organic compounds.

CARBON CREDITS – The credit for an action where an individual or

organization undertakes an activity for the purpose of reducing Carbon Dioxide in the atmosphere.

CARBON DIOXIDE (CO₂) – A colourless, odourless, tasteless gas exhaled by humans/animals which is absorbed by plants. It is also released by combustion of fossil fuels. CO₂ is measured in tonnes for emissions trading and accounting.

CARBON FOOTPRINT - The amount of emissions in tonnes of CO₂ equivalent by organizations or individuals through their daily activities.

CARBON MONOXIDE (CO) – A colourless, odourless, non-irritating but highly toxic gas produced by incomplete combustion of fuel, incineration of biomass or solid waste, or partially anaerobic decomposition of organic material.

CARBON NEUTRAL – Offsetting all carbon an individual or organization creates.

CARBON SEQUESTRATION - The capture and long-term storage of carbon dioxide before it is emitted into the atmosphere.

CARBON SINKS – Carbon Sinks are areas that absorb and hold onto lots of carbon dioxide – oceans, soil and forests. A carbon “sink” can become a carbon “source”. For example, a growing forest is a carbon sink as it absorbs more carbon than it releases.

CARBON TRADING – The transfer of Carbon rights (Carbon Credits) from one party to another. They can be traded or sold.

CLIMATE CHANGE – Changes in historical climate patterns sometimes referred to as Global Warming.

COMPOST - Decomposed organic material that is produced when bacteria in

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soil is used to break down biodegradable waste.

ECOLOGICAL FOOTPRINT –

The measure of the amount of land and water required to support/supply resources to sustain current levels of consumption and waste.

EMBODIED ENERGY - The amount of energy used in the construction, production, and transportation of materials.

EMISSIONS – Gases released into the atmosphere.

ENVIRONMENT – The biological, natural and human-made systems that surround us.

ENVIRONMENTAL IMPACT – The impact that human actions have on the environment (air, water, noise, odour, waste, energy).

FIRST ORDER DECAY

MODEL – One of the most widely used methods for quantifying the biodegradation rate of dissolved contaminants. The model is popular due to its simplicity, as it only requires estimation of one parameter, the rate constant or decay co-efficient. It has limitations however, 1) It doesn't account for site specific information; 2) Lab determined decay rates are not readily transferable to field/site operations. 3) It assumes that biodegradation starts immediately.

FOSSIL FUELS – Oil, coal and natural gas that are formed in the ground over millions of years from the remains of ancient plants and animals.

GEOHERMAL ENERGY – Energy generated from the heat inside the earth.

GLOBAL WARMING – A gradual warming of the Earth's atmosphere.

GRANDFATHERING – When a pre-existing situation is exempted from the requirements of a new law.

GREENHOUSE GASES –

Gases in the atmosphere which traps the sun's energy and thereby contributes to rising surface temperatures. These gases include carbon dioxide, methane and nitrous oxide.

HYDRO ENERGY – The energy generated from the moving or falling of water. Moving water has kinetic energy, hence can be used to generate electricity.

KYOTO PROTOCOL – The United Nations regulatory framework for greenhouse gas management. The Protocol was adopted in December 1997 in Kyoto Japan. Officially went into effect in February 2005.

LANDFILL - A large outdoor void where waste is deposited. Engineering methods are employed to ensure environmental impacts are managed. Most landfills are lined and the waste covered so that waste and/or pollutants do not each/escape into groundwater, surrounding surfaces or into the air.

METHANE(CH₄) - A colourless, odourless gas produced by organic matter decomposing in an environment with a lack of oxygen. Methane is the main ingredient in Natural Gas.

MITIGATION – Action taken to lessen the severity of an issue i.e. a plan to reduce the amount of pollutants emitted.

NITROUS OXIDE (N₂O) – A colourless non-flammable gas with a sweetish odour naturally produced in oceans and rainforests.

OZONE – A poisonous gas found in two layers of the atmosphere, the stratosphere and the troposphere.

OZONE LAYER – A collection of ozone gas that shield the earth from the Sun's harmful UV rays. It is approximately 15 – 40 klms above the Earth's surface.

POLLUTION – Contaminated water, air or land from the discharge of harmful substances.

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RENEWABLE ENERGY –

Energy that is generated from resources that are unlimited or naturally renewable i.e. wind, water, sun etc.

WASTE STREAM

COMPOSITION – Waste

composition data is an important element of any waste management study. Primarily it is the collation of data on the various wastes being generated at the site/facility, and is usually broken down by category and weight. It provides information needed to assess potential waste management options including reduction, recycling, energy recovery etc.