

due to its very exposed location) to a rate of 0.74 per 1,000 people in central Christchurch (due to its sheltered meteorology and high rate of wood burner use). Nationally, one in 20 people (4.8%) die earlier than they would have because of air pollution compared to one in 30 people (2.9%) in New Plymouth or one in 9 people (11.8%) in Christchurch.

Of the 67 urban centres studied, Hāwera also made the top 10 in terms of low air pollution-related mortality, behind New Plymouth with the lowest.

Nationally, the greatest single cause of premature mortality is fine particulate levels (sourced from combustion). It is estimated that each year an average of 1,100 people die prematurely due to exposure to air pollution across New Zealand.

Under the national environmental standards, regional councils are obliged to establish air management areas or airsheds for areas that do not meet the ambient air quality criteria stipulated in the standards. Forty-two such airsheds have been created around New Zealand. Along with Gisborne, the Taranaki region is one of only two in New Zealand that have not had to gazette an airshed. The region is in this position because of its high air quality.

Nationally, about 53% of New Zealanders live in areas that from time to time do not meet ambient air quality standards, primarily because of emissions from vehicles and from coal and wood used for home heating¹³. Main centres such as Auckland, Hamilton, Christchurch and Dunedin all have poor air quality. The main pollutant of concern is inhalable particulate materials. As noted above, in Taranaki the main source of such particles is sea spray, and Taranaki's air is rated good to excellent with respect to this pollutant.

Nationwide, 44% of homes burn solid fuels (wood and coal) for home heating. This is the same level as in Taranaki.

6.2 GREENHOUSE GASES AND CLIMATE CHANGE

6.2.1 WHAT IS THE STATE OF GREENHOUSE GASES IN TARANAKI?

Greenhouse gases include carbon dioxide, methane and nitrous oxide, which have the ability to trap infra-red energy that would otherwise be radiated off the Earth's surface into the atmosphere. These gases originate from industry, wastes, farming and fuel.

(A) CHANGES IN EMISSIONS

Industry

The level of emissions from industry varies year by year, especially in the energy sector in those years when gas-fired power stations are used to make up the shortfall in generation from other generators, such as hydropower stations.

The New Plymouth power station was a 600 MW capacity station operating on gas. When operating at a capacity of 75-80%, the station would have emitted 2.4 million tonnes of carbon dioxide annually. In 2007, Contact Energy announced the permanent closure of the station, although in 2008 parts of the station were temporarily used for emergency electricity generation.

A 200 MW gas turbine station at Stratford was closed in August 2001 and subsequently dismantled. In 2007 Contact Energy announced that it would build a new high efficiency open cycle gas turbine peaking station of 200 MW generation capacity on the site. Peaking stations are not generally intended for continuous operation but rather only for short-duration operation to satisfy demand at peak periods or to provide cover for the country's hydropower stations during periods of low hydro storage. Assuming a 40% load factor for the 200 MW power stations (i.e. recognising that they were/are not baseload stations), the old power station would have emitted 560,000 tonnes of carbon dioxide per year, and for the same load factor, the new station will emit 350,000 tonnes per year, a reduction of 210,000 tonnes per year (38%).

Methanex owns two methanol plants in Taranaki, located in the Waitara Valley and at Motunui. The two sites would have emitted 0.5 and 1.6 million tonnes of carbon dioxide per year, respectively. The Motunui site was closed in 2004, with limited production continuing at Waitara Valley. In 2007 Methanex announced its intention to refurbish and re-open half the capacity of the Motunui site during 2008. The intention is that the Waitara Valley site will be closed. The net change in combined maximum annual emissions will be a reduction from 2.1 million tonnes to 0.64 million tonnes.

Hydrocarbon production stations use natural gas as a fuel for on-site energy requirements, and as a purge gas burnt from flares as a plant safety procedure. Gas may also be discharged during plant trip-outs or if unsaleable (e.g. LPG from time to time). Over the past 15 years, the hydrocarbon production and treatment plants in Taranaki have reduced carbon dioxide emissions by reducing everyday flaring, recovering more hydrocarbon fractions as sales stock, and improving plant stability. For example, at one production station annual CO₂ emissions have been reduced 85% since 1996, and at another, 55% since 2001.



Methanex methanol plant and the Pohokura production station in foreground, Motunui.

Wastes

The decomposition of organic wastes in landfill releases methane, a potent greenhouse gas. While composting leads to some release of carbon dioxide, the volume of gas and its warming potential are far less than if the material is landfilled. The volumes of waste being disposed of to landfill in the region has risen over the past six years (refer to Chapter 9: Waste). Increasingly, green and other organic wastes are composted instead of going to a landfill.

Farming

Methane, a potent greenhouse gas, is produced by animals such as cows, sheep, deer and possums through their digestive processes. The highest rate of methane generation is from dairy cows, and animals are responsible for about 87% of all New Zealand's methane emissions. Animals also produce urea in their urine which turns into ammonia, nitrous oxide and nitrates. While the actual volumes of nitrous oxide are quite small, it is a very potent gas (over 300 times as potent as carbon dioxide).

In terms of trends in emissions from farm animals over the past 10 years, the number of dairy cattle, beef cattle and sheep numbers has decreased (see section on livestock emissions earlier in this chapter). Thus it can be reasonably assumed that the overall greenhouse emissions from animals will also have decreased.

Fonterra has advised the Council that milk production in Taranaki fell to 1,576 million litres in 2007-08 from 1,696 million litres the previous year, due in part to the drought of summer-autumn 2008. The Ministry for the Environment¹⁴ considers that in the period 1990-2005, methane emissions per head of dairy cattle rose 11%, per beef 12%, and per sheep 19%.

Thus overall, methane and nitrous oxide emissions from animals may have fallen in Taranaki (based on the numbers of animals) but more robust measurement and monitoring techniques are required for calculating regional greenhouse gas inventories (given possible changes in methane emissions per animal).

Nitrogenous fertiliser such as urea also decomposes to ammonia, releasing nitrous oxide. While the quantity of nitrogen applied to pasture from urine is much higher on intensively grazed pasture than the quantity



The highest rate of methane generation is from dairy cows.

from fertiliser, the latter is generally applied in two single applications rather than all year round, and so can result in proportionally greater amounts of nitrous oxide gas.

The Ministry for Agriculture and Forestry¹⁵ suggests that the ratio of animal wastes to fertiliser as comparative sources is 6:1. Data obtained from MAF and Statistics New Zealand show that quantities of nitrogenous fertiliser applied in the region have risen substantially over the past two decades and are still increasing. Twenty-six times more urea was applied than in the mid-1980s, and five times more di-ammonium phosphate (after peaking at 10 times more in the mid-1990s) (refer Table 6.5).

Table 6.5: Trends in nitrogenous fertiliser use in Taranaki (units: tonnes annually).

	Di-ammonium phosphate	Urea	Ammonium sulphate
Mid 1980s	1,700	900	2,250
Mid 1990s	17,000	12,100	3,600
2004	8,830	26,400	1,000

Research is showing that the rate of methane generation per animal and of nitrous oxide per hectare of soil is hugely variable, both for the same animal day by day and comparing one animal with another (and similarly for land use). Research is underway into measuring differences and understanding the reasons behind variability. The Government's intention is that by 2011 the emissions from individual farms will be able to be calculated accurately.

Motor vehicles emissions

The burning of petrol, diesel, and natural gas (CNG and LPG) as fuel in vehicles releases carbon dioxide. Over the past 10 years, the number of motor vehicles used on the road in the region has increased from 51,300 to 60,900. Over the same period, the volume of petrol used annually in the region has remained constant, at around 77 million litres resulting in 177,000 tonnes of carbon dioxide. However, the volume of diesel



The number of vehicles in New Plymouth continues to increase.

¹⁴ Ministry for the Environment, 2007. *Projected Balance of Emissions Units During the First Commitment Period of the Kyoto Protocol*.

¹⁵ Ministry of Agriculture and Forestry, 2003. *Abatement of Agricultural Non-Carbon Dioxide Greenhouse Gas Emissions*.

fuel used has increased 25% in the same period, from an average of 56.4 million litres to 73.2 million litres used in the 2006-07 period, now resulting in 191,583 tonnes of carbon dioxide. Thus, over the past 10 years, emissions of carbon dioxide from transport fuels have increased by 48,000 tonnes annually in the region, due exclusively to increased use of diesel fuel.

Summary

Table 6.6 summarises the general trends in greenhouse gas emissions by sector based on the above discussion.

Table 6.6: Summary of overall trends in greenhouse gas emissions by sector, 1998-2008.

Industry	Wastes	Livestock	Soil	Fuel
😊	😐	😊	😞	😞

(B) CONSEQUENCES OF CLIMATE CHANGE

The international picture

The Intergovernmental Panel on Climate Change has released its *Fourth Assessment Report*, covering the scientific evidence for climate change manifestation, impacts, vulnerability and adaptation, mitigation options, and a synthesis report¹⁶. The report states that scientists consider 'with

high confidence' (i.e. certainty) that impacts of climate change are now being seen around the world, in phenomena such as changes to natural ecosystems, increasing stresses upon water supply, reduced seasonal snow cover, and glacier shrinkage.

The national picture

Across New Zealand as a whole since 1950 there has been a warming of 0.3-0.7° C with more frequent heat waves, fewer frosts (10-20 fewer per year), more rain in the south-west and less in the north-east of the country, and a rise in sea level of about 70 mm. One quarter of the alpine ice mass has vanished, and beech forests are showing increased seed production. NIWA state that it is virtually certain (more than 99% probability) that New Zealand will continue warming, with heat waves and fire risk increasing in intensity and frequency, more frequent and intense floods, landslides, droughts, and sea storm surges, and increasing rain in western regions and increasingly dry in the east¹⁷.

Over the next few decades, climate change may benefit New Zealand in some ways – enhanced pastoral production due to higher carbon dioxide in the atmosphere, longer growing seasons, and less frost risk, opportunities for horticultural diversification, reduced energy demand and better public health in winter, and greater water flows benefitting hydro-electricity and irrigation supply. However, even by 2020, natural ecosystems are likely to become stressed, with more invasive species, habitat change and loss, and species extinctions (e.g. in alpine areas), as the rate of climate change will outstrip the rates at which ecosystems can adapt. Sea level rise and coastal storm surges will affect coastal development and infrastructure.

The regional picture

A single drought or extreme weather event (such as the summer drought of 2008 or the tornado swarm of July 2007) do not of themselves 'prove' or necessarily arise from climate change (nor would a severe cold spell 'disprove' it). It is the overall pattern observed over several years or decades that is significant. The NIWA report found that climate change is predicted to lead to a number of changes in Taranaki.



Rob Tucker

Taranaki may become windier with climate change.



Rob Tucker

Storm surges may be more frequent as Taranaki's climate changes.

16 IPCC. 2007. *Fourth Assessment Report on Climate Change*.

17 NIWA. 2007. *Climate change IPCC Fourth Assessment Report*. Leaflet produced by the NIWA National Climate Centre, in collaboration with the Royal Society of New Zealand.



Wind Wand, New Plymouth.

A temperature increase will push species south. The bush-clad eastern hill country allows easy migration of flora and fauna along corridors north to south, while riparian planting will do likewise. Alpine species on Mount Taranaki will come under pressure, but given that there is no permanent snow cover in any case, they may well have some degree of robustness already. Freshwater wetlands might well be enhanced.

In terms of weather and climate, Taranaki is expected to become marginally wetter overall. The greatest pressure may come from an increasing frequency of extreme weather events. Westerly winds will increase in frequency and possibly strength.

A study into the region's rainfall between 1930 and 2004 found that there has indeed been an increase in westerly winds over this period, as predicted¹⁸. In the eastern hill country, the number of rain days, the number of days when heavy rain fell, the total amount of rain falling on those days, and the amount of rain falling on the days of heaviest rain, have all increased. The only decrease noted was in the number of consecutive dry days each year. For northern Taranaki the same, although weaker, pattern emerges with an increase in the number of days of heavy rainfall at New Plymouth, and an increase in the amount of rain falling on the days of heaviest rain. The number of consecutive dry days each year has decreased (i.e. the dry spells are generally becoming shorter).

South of the mountain, there is no evidence of a trend in any index that is statistically strong enough to be deemed significant, but all indications are moving towards dryness, with reductions in the number of wet days and the amount of rain falling on those days. While the number of days experiencing heavy rain is not changing, the amount of rain falling on these days appears to be reducing.

In terms of pastoral farming, productivity is expected to increase by 10-20% over the next two decades due to warmer weather, a longer growing season, and increased CO₂ in the atmosphere. However, warmer and wetter weather may mean an increase in fungal diseases, and pastoral species such as paspalum and kikuyu may become a bigger problem in pasture. In horticulture, increased vegetative growth may



Cropping may increase in Taranaki as the weather becomes warmer.

adversely affect fruit quality and yield. Warmer weather may allow an increase in cropping in the region.

On the coast, more regular and more vigorous swells are expected. With few low-lying centres of population and development, Taranaki is not highly vulnerable in this regard. Coastal erosion rates will increase.

In terms of the infrastructure and the built environment, oil and gas production and electricity transmission utilities will have to take into account the possibility of more severe weather. The increased westerly winds will very likely enhance wind generation potential and local hydro generation, especially in winter. Increased storm severity and frequency may lead to increased insurance premiums and increased storm damage being more widespread and severe. This Council may need to review the degree of protection afforded by its flood protection works. Increased natural erosion could lead to more sediment and sand movement deposited into the coast (including into the Port).

Plantation forestry productivity is expected to increase (warmer and wetter, and increased CO₂ in the atmosphere).

Taranaki is not expected to be an area where tropical and sub-tropical diseases or disease vectors might become established. Diseases (human and animal) spread by bacteria may increase due to warmer, wetter weather. On the other hand, warmer winters are expected to lead to a reduction in mortality rates.

6.2.2 WHAT STEPS ARE WE TAKING TOWARDS MANAGING CLIMATE CHANGE?

Climate change is being addressed by the Government and other members of the international community through the Kyoto Protocol, which sets targets for the reduction of greenhouse gas emissions. The target for New Zealand is that greenhouse gas emissions during the years 2008-2012 should on average be the same as they were in 1990.

18 Griffiths, G.M. 2007. Changes in New Zealand daily rainfall extremes 1930-2004. *Weather and Climate* 27:47-66. Published by the NZ Meteorological Society.

(A) REGIONAL POLICY STATEMENT AND PLANS

The *Proposed Regional Policy Statement for Taranaki* includes recognition of the effects of climate change as a significant issue for the region, and has policies relating to adaptation and mitigation of the effects of climate change and methods for both the regional council and district councils to implement.

The *Regional Air Quality Plan* is also in the process of being reviewed. The plan could include measures that produce overall reduction of emissions from various sources of products of combustion since these measures have air quality benefits in any case, other than solely reductions of greenhouse gas emissions. This will also provide some incentive to reduce greenhouse gases. The plan could include provisions to improve energy efficiency, favour processes that emit fewer greenhouse gases, the promotion of vehicle efficiency, restrictions on activities such as flaring at hydrocarbon exploration and production sites, and controls on emissions from landfills.

The Council is a signatory to the Communities for Climate Protection Programme. This voluntary programme aims to empower local government to reduce greenhouse gas emissions from councils' operations and from their communities. The programme has five



The petrochemical industry is a significant activity in Taranaki.

milestones to achieve. The first two of these milestones (an inventory of greenhouse gas emissions and setting a reduction target and timeframe) have been adopted. The Council is currently in the process of preparing a local action plan towards the third milestone which will outline specific measures to meet greenhouse gas reduction targets.

(B) RESOURCE CONSENT MANAGEMENT

Over the years there has been uncertainty in some quarters about the role of regional councils with regard to greenhouse gas emissions. However, the Government has confirmed that because climate change is an international issue, it should be dealt with at a national level. In 2004 the Government amended the Resource Management Act to essentially remove consideration of greenhouse gases and climate change effects from resource consent assessments¹⁹, other than when considering applications relating to activities involving renewable energy.

That said, consent holders of air discharge consents for industrial sites are required to report on emission reduction and energy efficiency options they have investigated and implemented.

(C) SUSTAINABLE LAND MANAGEMENT

The Council works with farmers to encourage the provision of riparian vegetation along stream banks, and on hill country to identify sustainable land use practices. On steeper or more unstable country this means plantation forestry or allowing reversion to native bush. The Council's sustainable land management programme outlined in Chapter 3 will, over time, mean more trees in the ground which will ultimately help absorb carbon dioxide emissions.

(D) INFORMATION, ADVOCACY, EDUCATION, RESEARCH, AND ADVICE PROGRAMMES

In terms of emissions from soils, nitrous oxide emissions can be reduced by measures such as nutrient modelling and budgeting, the use of nitrification inhibitors, better herd management especially when soils are saturated and appropriate choice of supplementary feeds with low nitrogen content. These are measures the Council is investigating and supporting through channels such as the Clean Streams Accord with the dairy industry, and trials on research farms. The Council is also supporting research into control of the clover root weevil, a pest that reduces nitrogen fixation by clover, and hence forces farmers to use nitrogen fertiliser as an alternative (see case study in Chapter 3 on the clover root weevil). It is also anticipated that purchases of nitrogenous fertilisers will reduce given that prices are rising sharply.

During the past six years, the Council has advocated on eight occasions for what it considers to be regionally effective and efficient statutory, policy, and economic measures in connection with options for emissions trading schemes or other economic measures such as carbon taxes,

amendments to the RMA, the role of forestry, and emissions reduction options. It has also submitted in relation to renewable energy policies and options.

(E) REGIONAL TRANSPORT

The Council contracts a public passenger transport service in the wider North Taranaki urban areas (New Plymouth, Waitara, Bell Block and Ōākura). In the 2006-07 year, over 320,000 trips were made. Patronage on almost all services for almost all types of passenger category has increased over previous levels. Once-a-week bus services have been established between Waverley and Hāwera, Opunake and Hāwera, Opunake and New Plymouth and Inglewood and New Plymouth.

(F) SUMMARY OF PROGRESS

Table 6.7 summarises the progress with measures to mitigate greenhouse gases and adopt to climate change as a region.



Climate change may have implications for wildlife.

Table 6.7: Summary of progress: implementing regional objectives and policies on greenhouse gases.

Issue	What do we want to achieve?	What are we doing about it?	Where are we at?
Greenhouse gas emissions	<ul style="list-style-type: none"> Reduction or minimisation of emissions of greenhouse gases, in a manner consistent with national policies and statutes Minimisation of adverse effects of greenhouse gases 	<ul style="list-style-type: none"> Preparing and implementing the <i>Regional Air Quality Plan for Taranaki</i> (1997) Preparing and implementing a new Air Plan (2008-09) Addressing climate change in the new <i>Proposed Regional Policy Statement</i> Advocating actions on climate change, with a particular focus on encouraging central government to prepare and implement national strategies and/or policies to manage emissions. Providing advice and information. Encouraging reforestation. 	<ul style="list-style-type: none"> <i>Regional Air Quality Plan</i> currently being reviewed. Decrease in regional greenhouse gas emission potential over the past five years. Central Government ratified the Kyoto Protocol. Economy-wide Emissions Trading Scheme, other government initiatives (Sustainable Land Use, Afforestation Grants Scheme, Permanent Forests Scheme) in effect from 2008 All major emitters in the region hold consents requiring reporting of energy efficiency measures, and emission reduction investigations. No local effects of greenhouse gas emissions in vicinity of major sources. Council promotion and regional uptake of riparian and hillcountry farm plans.

6.2.3 HOW DOES TARANAKI COMPARE?

On a per capita basis, Taranaki emits about four to four and a half times the national average of methane, and three to five times the national average of carbon dioxide. This is because of Taranaki's relatively small population, significant pastoral industry, and the location of national/international energy and petrochemical facilities within the region. Compared with other regions, Taranaki's contribution from the transport sector is very small but its contribution from its farming sector is very large.

Over the past five years, the regional greenhouse gas emissions inventory has probably reduced overall, because of the closure of some large energy and industrial sources and the declining or static size of livestock herds.

Nationally, emissions from the transport and energy sectors continue to grow rapidly, and the Government expects that by 2012 the country will be emitting 70% more than in 1990²⁰. From 1990 to 2005, nationwide agricultural emissions rose 15%, energy and transport 42%, and industry 32%, for a net overall increase of 25%, with a 10% increase in the five years 2000-2005.

20 Ministry for the Environment, 2007. *Projected Balance of Emissions Units During the First Commitment Period of the Kyoto Protocol*.



Hill country farmers gather at the Douglas seminar.

SOMETHING NEW IN THE AIR

Greenhouse gases may be the ultimate ill wind, but they are resulting in remedial actions that promise to be good for earth and water as well as air. And even good for the wallets of landowners.

New environmental and economic opportunities are presented by climate change initiatives – and they have been explored at seminars organised by the Taranaki Regional Council.

The carbon farming seminars were held in all four corners of the region between November 2007 and March 2008. Hillcountry farmers were the main target, with turn-outs of 60 at Urutī, 80 at Douglas and 40 at Waverley.

Some background: trees play a big role in new climate change initiatives. Simply put, forests reduce the level of greenhouse gases by removing carbon from the atmosphere and turning it into wood.

A major aim of the new approach is to keep land in trees and to promote the growth of new trees. So harvesting incurs a new cost

(the surrender or repayment of the new carbon credits) unless the felled trees are replaced.

Speakers from the Taranaki Regional Council, MAF, the forestry industry and carbon brokers took part in the carbon farming seminars, and their major emphasis was on the business opportunities that exist for landowners in climate change initiatives such as the Forestry Emissions Trading Scheme, the Permanent Forest Sink Initiative and the Afforestation Grants Scheme.

The Permanent Forest Sink Initiative in particular offers hillcountry landowners new scope for developing useful new income streams off steep, highly erosion-prone, infertile land – while at the same time meeting the sorts of soil conservation objectives pursued by the Council. There is flexibility, too, so the landowner can decide which land pockets might be best for reversion to scrub and which would be best for planting trees.

No matter what the option, such vegetation in this steep country will help to prevent sediment run-off into streams and so enhance water quality throughout the entire catchment.

The Council may be able to assist in a variety of ways – for example by supplying historical photos that may be needed by those thinking of taking up one of the climate change initiatives and who need to prove that their forest did not exist prior to 1990, which is the nominal starting point for these initiatives.

Private companies are positioning themselves to work with landowners to take advantage of the new initiatives, and representatives of some of them were among speakers at the Council's carbon farming seminars, although this did not imply Council endorsement of any particular company, and landowners were encouraged to seek independent advice.