Air quality

Objectives

1. High quality air in the region is maintained and protected, and there is no significant deterioration in air quality in any part of the region.

2. Air quality is enhanced in those areas with degraded air quality.

3. The adverse effects of the discharge of contaminants into air on human health, local or global environmental systems and public amenity are avoided, remedied or mitigated.

4. The output of gases which potentially promote climate change is at a level which is consistent with central government climate change policy.

Doing well

- Carbon monoxide levels have been "excellent" (less than 10 per cent of the limit set in the National Environmental Standard) in suburban areas for more than 90 per cent of the time and "good" (between 10 per cent and 33 per cent of the Standard) for the rest of the time since 2002.
- Nitrogen oxide and nitrogen dioxide levels have been "excellent" in suburban areas more than half the time and "good" for the rest of the time since 2002.
- Fine particulate levels have been "good" in suburban areas more than 70 per cent of the time since 2002.

Must improve

- Fine particulate levels have failed the limit set in the National Environmental Standard several times each winter in Wainuiomata, Upper Hutt and Masterton since monitoring began.
- Fine particulate levels have been "good" for 55 per cent of the time in inner city Wellington, and only "acceptable" (between 33 per cent and 66 per cent of the limit set in the National Environmental Standard) the rest of the time since March 2004.
- New Zealand's greenhouse gas emissions are increasing, with carbon dioxide emissions in 2003 about 37 per cent higher than they were in 1990.
- About 40 per cent of our carbon dioxide emissions come from transport - mostly private cars. Transport is one of the biggest growth areas of New Zealand's greenhouse gas emissions.

"All I need is the air that I breathe …"

Consider for a moment the immense improbability of your existence. Of all the planets we know, ours is the only one with an atmosphere that can support life like us. And even that could be called a stroke of luck, because for a vast time, the earth's atmosphere was mostly methane and ammonia – a very toxic brew indeed.

The methane and ammonia eventually broke down into nitrogen, hydrogen, and carbon dioxide, and water vapour broke down to hydrogen and oxygen.

Considering this immense good fortune, we treat our precious atmosphere rather shabbily. Around the world, industry pours out tonnes of pollutants, but even the most mundane actions – driving cars, lighting the fire, taking the kids to school, burning rubbish in the backyard – come at a cost to the air and our health. According to the US Environmental Protection Agency, more people die in that country from air pollution than in car accidents – specifically from agitated asthma, bronchitis, emphysema, lung and heart diseases.

On top of this, we're changing the outer skin of the atmosphere. The vital ozone layer is thinning because of chemical reactions with waste gases. The planet is warming, at least in part because we've filled it with carbon dioxide, methane and other greenhouse gases.

Where does our pollution come from?

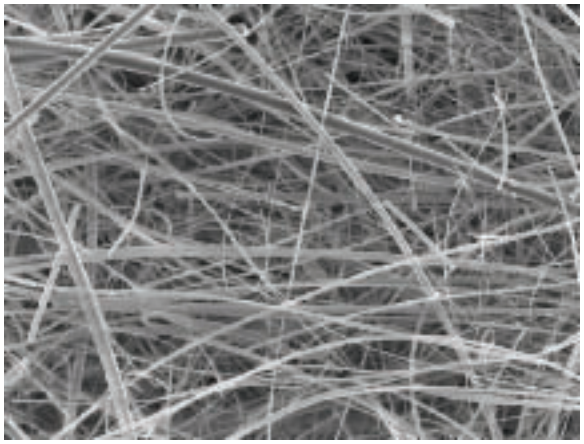
"Clean" air is a mixture of about 78 per cent nitrogen and 21 per cent oxygen. The remaining one per cent is made up of gases such as argon, carbon dioxide, methane, hydrogen and carbon monoxide.

In 1998, Greater Wellington worked out how much pollution was getting into the air and where it was coming from. This is known as an "emissions inventory". Emission inventories are used to predict how changes in particular activities, such as traffic flows, will affect total volumes of pollutants discharged by that activity. We can then work out whether the changes will threaten air quality, and if it will, develop programmes to manage these changes.

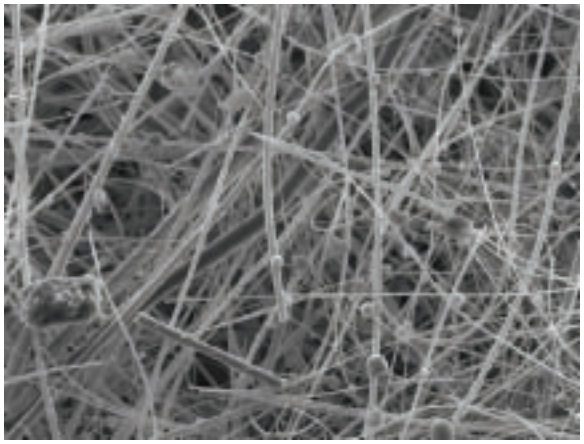
There are less than 150 discharges to air from industry in the region. These are controlled by conditions on discharge permits and most only affect the immediate area of the discharge. We wanted to know the extent of air pollution generally, from the sources that don't require discharge permits.

We checked for sources of non-methane volatile organic compounds (NMVOC), nitrogen oxides (NOx), sulphur dioxide (SO2), carbon monoxide (CO), carbon dioxide (CO2) and what we call particulate matter – a mixture of liquid droplets and solid particles. Coarse bits of particulate matter come from windblown dust and seasalt, while fine particles (smaller than 2.5 micrometers) mostly come from home fires and motor vehicle exhaust fumes. These fine particles are so small that many thousands of them would fit on the full stop at the end of this sentence.

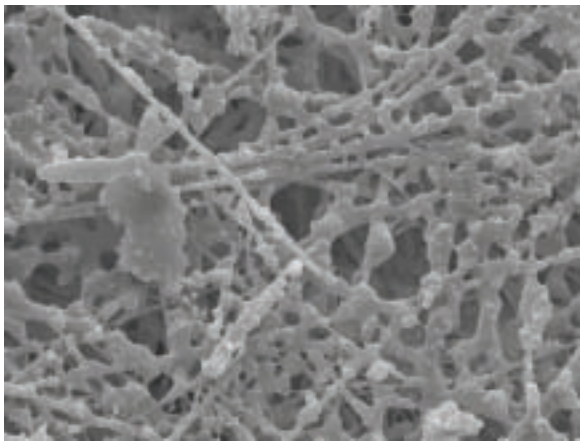
A scanning electron microscope shows us what we are dealing with.



A clean, unused filter, composed of closely matted glass fibres that collect particles from the air.



A filter we used to collect particles during summer – you can see a few particles here and there, mainly from wind blown soil, dust, seasalt and pollen.



A filter we used to collect particles in winter at Masterton on 12 August 2004. Fine particle concentrations that day were measured at 77 micrograms/m^3 , exceeding the limit of 50 micrograms/m^3 set in the National Environmental Standard. The filter is completely coated – and your lungs would have trapped the same fine particles if you'd breathed in Masterton's air that winter morning.

From our inventory, we found that, with the exception of fine particulate matter, exhaust fumes from motor vehicles are to blame for most (over 80 per cent) of the polluting chemicals in the air. Most fine particulate matter comes from home fires, which release nearly 85 per cent of the annual load of these particulates every winter.

Permanent air quality monitoring stations like this one in inner city Wellington are continuously sampling the air for pollutants. This station also monitors air temperature, relative humidity, and wind speed and direction to help us interpret the results.

Where we are now

Air quality monitoring

In the Wellington region, we test for particulate matter (PM_{10}), carbon monoxide (CO) and nitrogen oxides (NOx) because they are harmful to human health and the environment.

PM_{10} is particulate matter that's smaller than 10 micrometers across – small enough to enter the tiniest passages of our respiratory systems. In our region, PM_{10} has been linked to poor health, winter smog and dust nuisance.

Carbon monoxide can replace oxygen molecules in the blood, and so is a major health threat. Carbon monoxide is in vehicle exhaust fumes, and smoke from domestic fires and industry.

Nitrogen oxides – discharging from vehicles, domestic fires and industry – contribute to the smog that clouds our city air, and combine with other compounds to make acid rain. They can attack the body's mucous membranes and respiratory system.

Carbon monoxide and nitrogen dioxide typically concentrate around busy roads, rising to dangerous levels when confined by tall city buildings.

In 1997, the Ministry for the Environment (MfE) set up Environmental Performance Indicators and air quality categories to help us interpret the results of air testing. The categories (see Table 5.1) show whether the air is approaching guideline levels or is within safe limits.

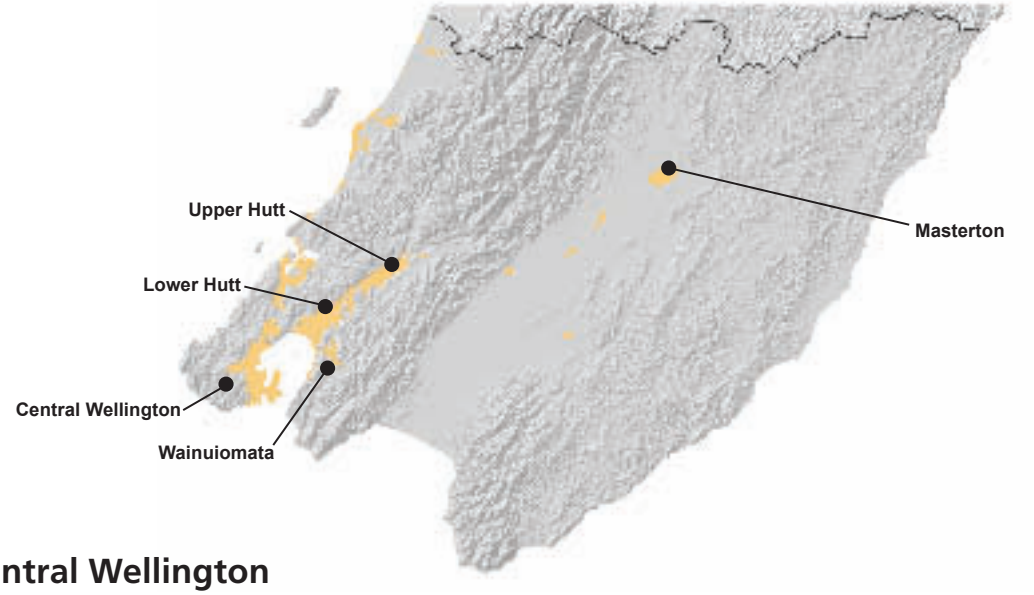
Category	Maximum Measured Value	Comment
Action	Exceeds guideline	Completely unacceptable by national and international standards.
Alert	Between 66 per cent and 100 per cent of the guideline	A warning level which can lead to guidelines being exceeded if trends are not curbed.
Acceptable	Between 33 per cent and 66 per cent of the guideline	A broad category, where maximum values might be of concern in some sensitive locations, but are generally at a level that does not warrant dramatic action.
Good	Between 10 per cent and 33 per cent of the guideline	Peak measurements in this range are unlikely to affect air quality.
Excellent	Less than 10 per cent of the guideline	Of little concern.

Table 5.1:
Air quality categories.

Air quality monitoring results

Air tested on still winter nights in Masterton, Wainuiomata and Upper Hutt is more likely to fail the National Environmental Standards than at other times. This is because on still winter nights, the earth rapidly cools, and cold air is trapped at ground level beneath a warmer layer.

Cool air under a layer of warm air is called a 'temperature inversion'. Temperature inversions seal in air pollutants at ground level. On cold nights home fires and vehicles add more pollutants, which sometimes accumulate until they pose a health risk. Temperature inversions most commonly happen in valleys where the surrounding hills help concentrate the pollution. Areas like Wainuiomata are particularly vulnerable to trapped air pollution.



Central Wellington

In 2004, Greater Wellington set up an air quality monitoring station on the corner of Vivian and Victoria Streets in downtown Wellington. We chose this major traffic intersection to gauge the impact of vehicle emissions on local air quality. Our other stations are in quieter suburban settings so we can find out what the air quality is like around people's homes.

The Victoria Street station recorded the highest concentrations, on average, of carbon monoxide and particulate matter in the region, but peak levels have stayed within the National Environmental Standards and air quality guidelines. We will need a few more years of monitoring before we have a full picture of central city air quality.

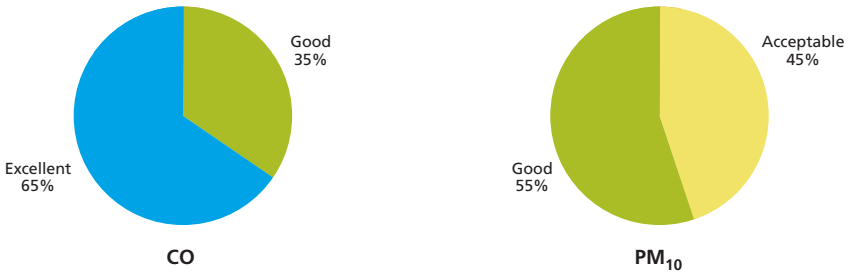


Figure 5.1:
Victoria Street, Wellington during 2004. Carbon monoxide 8 hour average. PM_{10} 24 hour average.

Wainuiomata

Greater Wellington has been monitoring PM_{10} at Wainuiomata Bowling Club since September 2000. Fine particulate concentrations have exceeded the National Environmental Standard several times each winter. Peaks came during cold, calm weather when pollutants were slow to disperse. Home fires are the likely source of most of Wainuiomata's air pollution.

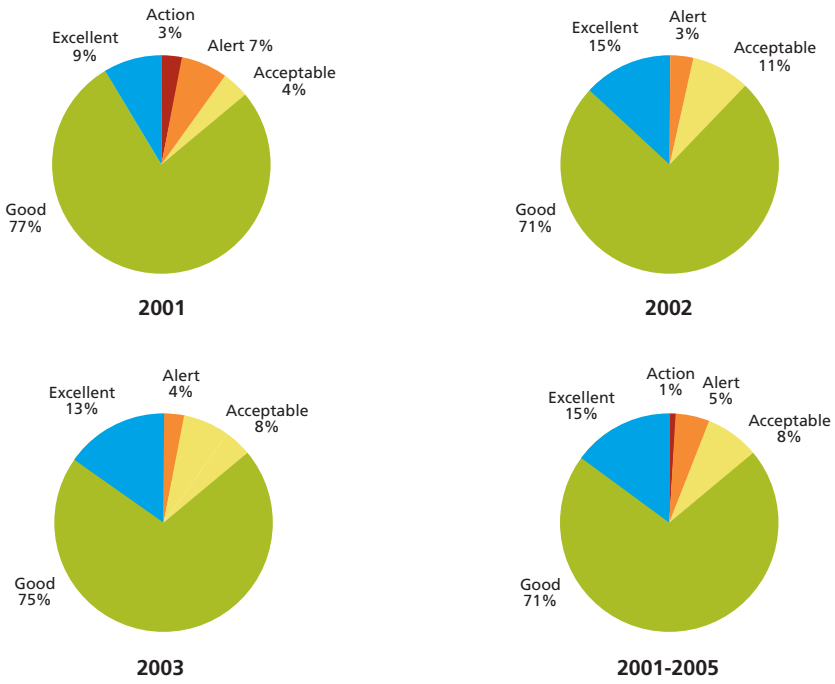


Figure 5.2: Wainuiomata bowling club 2001-2005. PM_{10} 24 hour average. The action level (red) happened in winter 2001. The alert level (orange) has been reached each winter since we started monitoring.

Hutt City

A permanent monitoring station has been operating at Birch Lane in Hutt City since February 2001. It shows us that while nitrogen dioxide and carbon monoxide levels jump in winter, they stay within safe health limits. The peaks coincide with similar recordings at Upper Hutt, confirming the influence of still, cold weather on pollution from cars and home fires.

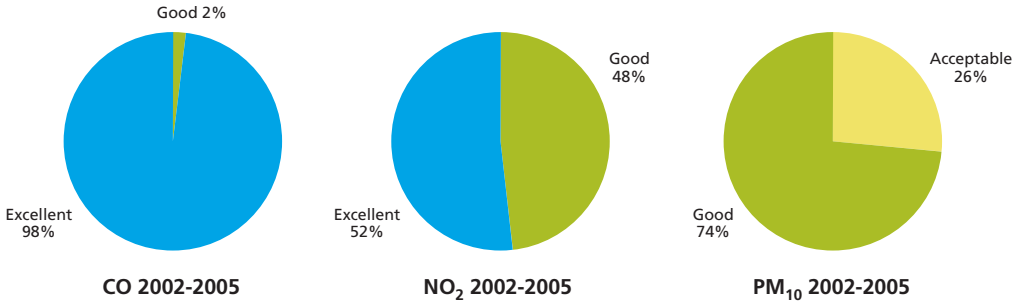


Figure 5.3: Birch Lane, Hutt City 2002-2005. Carbon monoxide 8 hour average. Nitrogen dioxide 24 hour average. PM_{10} 24 hour average.

Upper Hutt

Since June 2000, a mobile station at Trentham Fire Station has been showing the Hutt Valley's susceptibility to winter pollution from particulate matter, carbon monoxide and nitrogen dioxide.

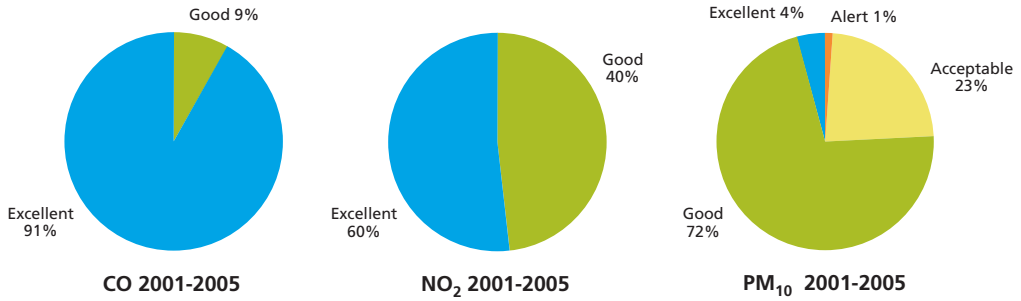


Figure 5.4:
Trentham Fire Station, Upper Hutt 2001-2005. Carbon monoxide 8 hour average. Nitrogen dioxide 24 hour average. PM_{10} 24 hour average.

Masterton

A permanent monitoring station installed at Wairarapa College in Masterton in October 2002 has revealed that fine particulate pollution from home fires causes levels set in the National Environmental Standard to be breached several times each winter.

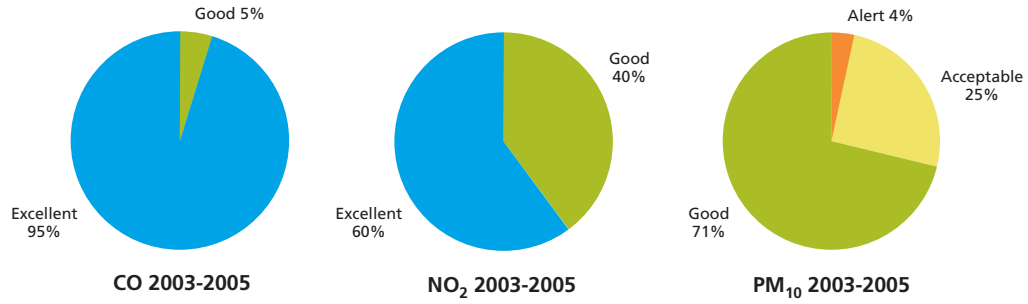


Figure 5.5:
Wairarapa College, Masterton 2003-2005. Carbon monoxide 8 hour average. Nitrogen dioxide 24 hour average. PM_{10} 24 hour average.

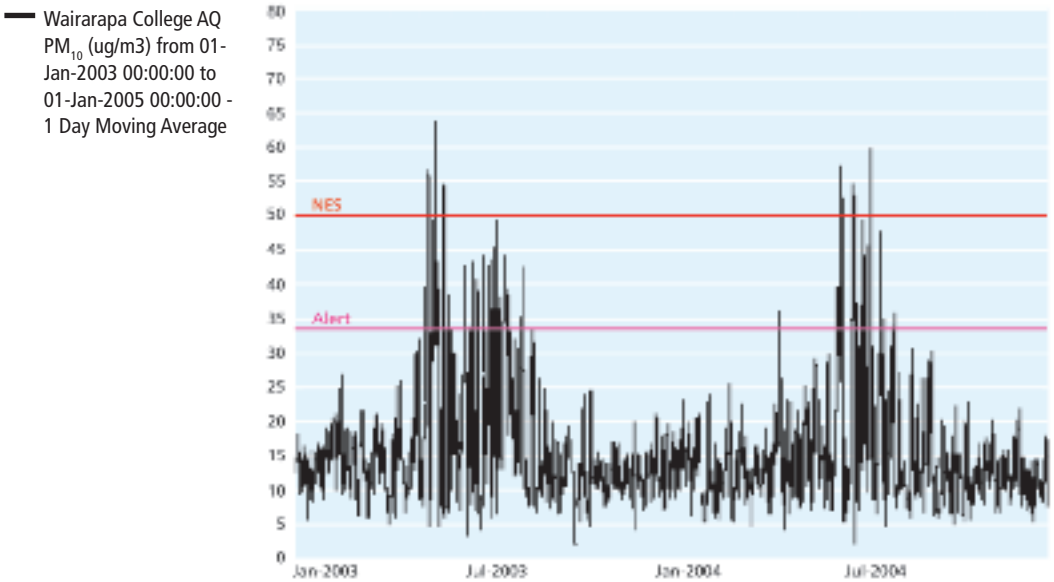


Figure 5.6:
Low summer recordings rise in winter to breach the National Environmental Standard (shown as a red line). Pollution from home fires trapped under temperature inversions is the culprit.

It might make for a dramatic sunrise, but the pall of smoke over Masterton on many winter mornings conceals tiny particles that people breathe into their lungs, causing respiratory diseases and other illnesses – worst affected are children and the elderly.

Air pollution complaints

People expect clean fresh air to breathe. Over half the complaints to Greater Wellington's Pollution Hotline are about air, and most of those are about unpleasant odours. Sometimes, odours can travel considerable distances, channelled by prevailing wind and topography. For example, certain conditions routinely trigger complaints of odour from Wellington's Southern Landfill near Brooklyn.

While unpleasant odours can be hard to live with, it is the more insidious low level pollution from fires and cars that can actually harm people's health.

What's being done

The Regional Policy Statement identified that lack of data about air quality was a significant resource management issue in the region. Ways to address this included setting up an ambient air quality monitoring programme, and preparing a Regional Air Quality Management Plan.

Since 1995, we have identified the sources, scale and distribution of air contaminants and looked at how the region's meteorology and topography influence its air quality. We have also developed a meteorological database.

We set up a pilot air quality testing programme with a mobile monitoring station in 1998 and tested the air in Otaki, Hutt City and Masterton. The results indicated that fine particles could be a problem in winter, and that permanent monitoring was needed to assess the actual extent of the pollution and whether national guidelines were being exceeded. We now have monitoring stations at five sites around the region (Upper Hutt, Hutt City, Wainuiomata, Masterton, and inner city Wellington).

In 2004, the Ministry for the Environment (MfE) released National Environmental Standards to manage air quality. The Standards set down maximum allowable levels of carbon monoxide (CO), fine particles (PM_{10}), nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and ozone (O_3) and ban any practice that exceeds those limits. There is also an emission standard for home wood burners.

The National Environmental Standards require regular testing for pollutants wherever they might threaten public health, and require regional councils to publicly notify all exceedences of the Standard. Greater Wellington is required to develop strategies to improve air quality in areas that do not comply.

In 2004 and again the following year, Greater Wellington's social marketing campaign *Be the Difference* ran advertising and information campaigns about motor vehicle emissions and home fires.

Rules in the Regional Air Quality Management Plan, adopted in 2000, have largely addressed industrial emissions. Most discharges from industrial and trade premises require discharge permits.

Climate change

In 1997, delegates of 150 countries met in Kyoto, Japan to discuss climate change and to agree on binding reductions for greenhouse gases. The outcome was that developing countries would continue with voluntary reduction targets, and that 39 industrial countries would aim, by 2008-2012, to meet specific targets upon ratification of the Kyoto Protocol. New Zealand ratified the Kyoto Protocol in December 2002. It came into force on 16 February 2005.

New Zealand's target is to reduce its greenhouse gas emissions to what they were in 1990, or take responsibility for excess emissions. In 2005, the New Zealand Climate Change Office released the *New Zealand Greenhouse Gas Inventory 1990-2003*. This showed that New Zealand's emissions are increasing, with carbon dioxide emissions in 2003 about 37 per cent higher than they were in 1990.

Carbon dioxide is released into the atmosphere when we burn fossil fuels, such as oil and coal. About 40 per cent of our carbon dioxide emissions come from transport - mostly private cars - and transport is one of the biggest growth areas of New Zealand's greenhouse gas emissions. Agriculture is responsible for nearly 50 per cent of all greenhouse gas emissions, but is not growing so fast.

Central government is responsible for developing policies to reduce greenhouse gas emissions nationwide. Some of the ways it is planning to achieve this are to introduce a carbon tax, help energy-intensive businesses to become more energy efficient, and provide training for company directors to influence a conservation culture.

The clean clear air of Wellington – an asset for tourists and locals alike.

Where to from here?

The National Environmental Standards for air quality set emission standards and efficiency criteria for new wood burners. Over time, as old burners are replaced, the amount of pollution from home fires on cold winter nights should decrease.

With transport responsible for the national growth in greenhouse gas emissions and for most of the polluting chemicals discharged to air regionally, this is where a change is needed if we are to meet the objectives in the Regional Policy Statement.

More information

Davy, Perry. *Air quality monitoring technical report*, 2005. Greater Wellington.

Davy, Perry. *Air Quality – background report*, 2005. Greater Wellington.