

Rotorua Air Quality Problem Analysis

This report looks at the issues of fine particulate matter that contribute to Rotorua's poor air quality, and is an overview that examines the cause of the problem, legislation, and some of the scientific work carried out to help develop policies to solve the problem.

The effect on health of the naturally occurring hydrogen sulphide in Rotorua's air is being investigated by another agency and falls outside the scope of this report.

1 What is the Problem?

In Rotorua:

- An estimated 22 people die each year because of pollution in the air¹
- There is an increase in hospital visits because of air pollution²
- There is an increase in the number of days where people can't enjoy or do things outdoors because of the air pollution.³

What is causing the problem?

Several air pollutants can harm humans. These include carbon monoxide, nitrogen dioxide, ozone, sulphur dioxide and fine particulates. Monitoring in Rotorua shows there are high levels of fine particulates in the air, and these are causing health problems for residents. In 2008 Government standards for air pollution were breached 45 times in Rotorua.

What are fine particulates?

Fine particulates are defined as particles that are 10 micrometres in diameter or less. They are known as PM₁₀ and they are so small that five of them can fit across the width of a human hair. Particles larger than this are not as much of a problem because they are heavy enough to drop out of the air, but PM₁₀ sized particles can remain suspended, floating in the air, for longer periods, behaving more like a gas and making it easier to be inhaled.

What do they affect?

These particulates affect the cardiovascular system, particularly in the elderly, the very young, and people who already have conditions that affect the respiratory system (such as asthma). If someone is exposed to high amounts of PM₁₀ over a long period of time it can cause death. High PM₁₀ levels create poor air quality which can mean people prefer to stay indoors.

At the very least, high concentrations of particulates are unpleasant to look at and could tarnish New Zealand's clean, green image as one of the reasons tourists visit New Zealand is to escape the pollution in their home country. Rotorua is a popular tourist destination which in turn is a major driver of the local economy, so it is essential that the problem of air pollution is addressed.

¹ G Fisher, T Kjellstrom, S Kingham, S Hales, R Shreshta *Health and Air Pollution in New Zealand*, June 2007

² Ibid

³ Ibid

2 National Legislation

In 2004 the Government introduced standards to improve New Zealand's air quality.

The Resource Management (National Environmental Standards Relating to Certain Air Pollutants, Dioxins and Other Toxics) Regulations 2004 (NESAQ) included seven activity standards, five ambient air quality standards, and two design standards.

The standards relevant to Rotorua's Air Quality Action Plan are the ambient standard for fine particulates (PM₁₀) and the design standard for domestic woodburning appliances.

The main purpose of the standards is "to provide a guaranteed level of protection for the health of all New Zealanders."⁴ Despite air quality being a health issue, local government enforces the standards.

Under the Resource Management Act, 1991 (RMA), Environment Bay of Plenty (regional council) has rules to regulate what contaminants may be released into the region's air. The Rotorua District Council is responsible for granting building permits, and issues permits for the installation of woodburners that meet NESAQ requirements.

The deadline for compliance with national air quality standards is 1 September 2013. After that date (if the standards aren't met) the Regional Council will not be able to issue consents to discharge PM₁₀ to air. This will not affect domestic woodburners, but will affect industrial discharges.

If a business discharges pollutants into the air, it will not be allowed to set up within the Rotorua Local Air Management Area (LAMA, see Figure 1). The two sawmills within the Rotorua airshed that have consents to discharge PM₁₀ to air will not be able to renew their consents so it is in everybody's best interest to make sure air quality meets the standard before the deadline.

3 The Rotorua Airshed

3.1 What's an Airshed?

An airshed, as defined in the NESAQ, is a geographic boundary for air quality. Any area can be described as an airshed.

The Bay of Plenty has several airsheds, but the airshed of most concern in our region is Rotorua. The national standards require any airshed that exceeds the limit more than once a year to be notified (gazetted) by the Ministry for the Environment (MfE). Once an airshed is gazetted, certain NESAQ rules come into effect.

Areas that have been gazetted under the NESAQ process are called Local Air Management Areas (LAMAs). As required by the standards, the Rotorua airshed was gazetted by the Ministry on September 1, 2005, making it a LAMA.

3.2 What are the Boundaries of Rotorua's Local Air Management Area?

The Rotorua LAMA includes most of the urban area, up to, but not including, the airport as shown on Figure 1.

⁴ The Ministry for the Environment *The Users' Guide to Resource Management (National Environmental Standards Relating to Certain Air Pollutants, Dioxins and Other Toxics) Regulations 2004*, November 2004.



Figure 1 – The Rotorua Local Air Management Area

3.3 Rotorua LAMA's Breaches

Last year, the national air-quality standard was breached 45 times in Rotorua, the highest breach being measured at $163 \mu\text{g}/\text{m}^3$, more than three times the NESAQ limit of $50 \mu\text{g}/\text{m}^3$. Under NESAQ rules only one breach is allowed a year.

The Ministry for the Environment currently ranks Rotorua as the sixth-worst airshed in the country and is the worst in the North Island.

3.4 Airshed Modelling

Modelling of an airshed is done to better understand the causes of the air pollution and to assist with developing policies to combat it, and NESAQ rules requires monitoring to be carried out in the areas where breaches are most likely to occur.

Modelling of the Rotorua airshed was completed in September 2007, mapping the current PM_{10} concentrations within the airshed (Figure 2).

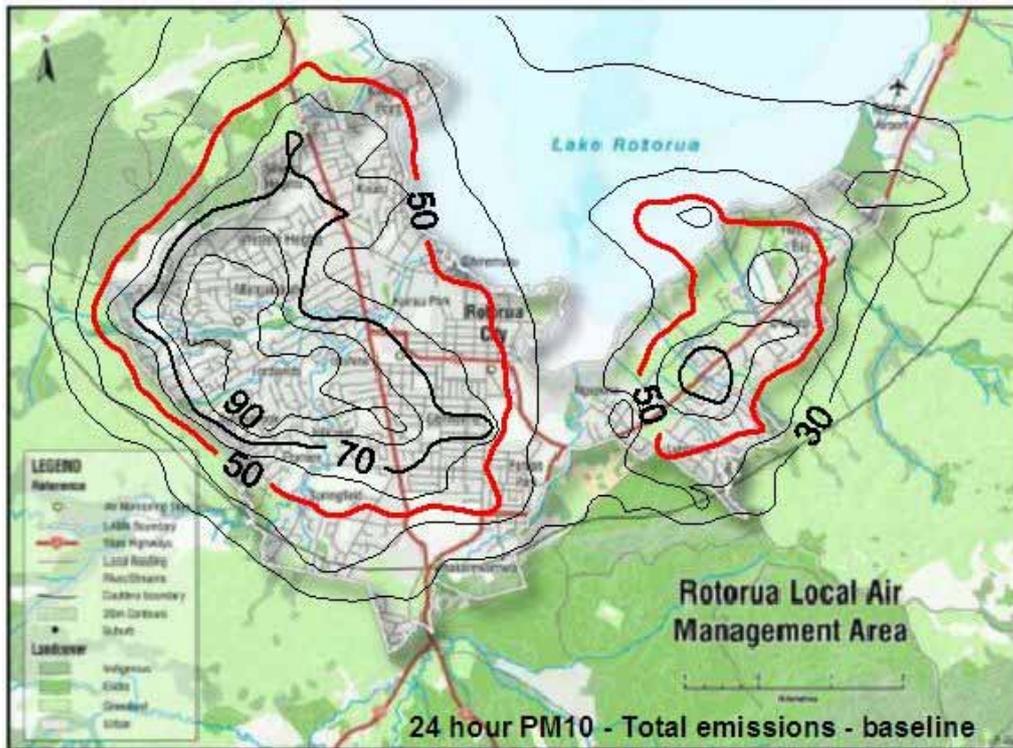


Figure 2 – Baseline Emissions of PM₁₀

Figure 2 is similar to a topographical map. Instead of the lines showing elevation, they show the concentration of PM₁₀. The red line at 50 is the limit permitted by NESAQ rules. Almost all the Rotorua urban area falls inside this line, meaning that almost the whole city is exposed to high levels of particulates.

Initial mapping/monitoring of the airshed set Edmond Road as a good location for a site from which to carry out long-term monitoring. The modelling also indicated that air pollution was likely to occur in the eastern section of the airshed, where no monitors were located at the time. Because of this the monitoring station that had been at Pak N Save (corner of Fenton and Amohau Streets) was shifted to Ngapuna.

The source of emissions was also mapped. An interesting result was that even if all other pollution sources are removed from the airshed, domestic emissions (pollution from woodburning fireplaces) will still cause breaches, even in the industrial areas (Figure 3). This means a large reduction in the amount of particulate air pollution from homes is required to meet NESAQ standards.

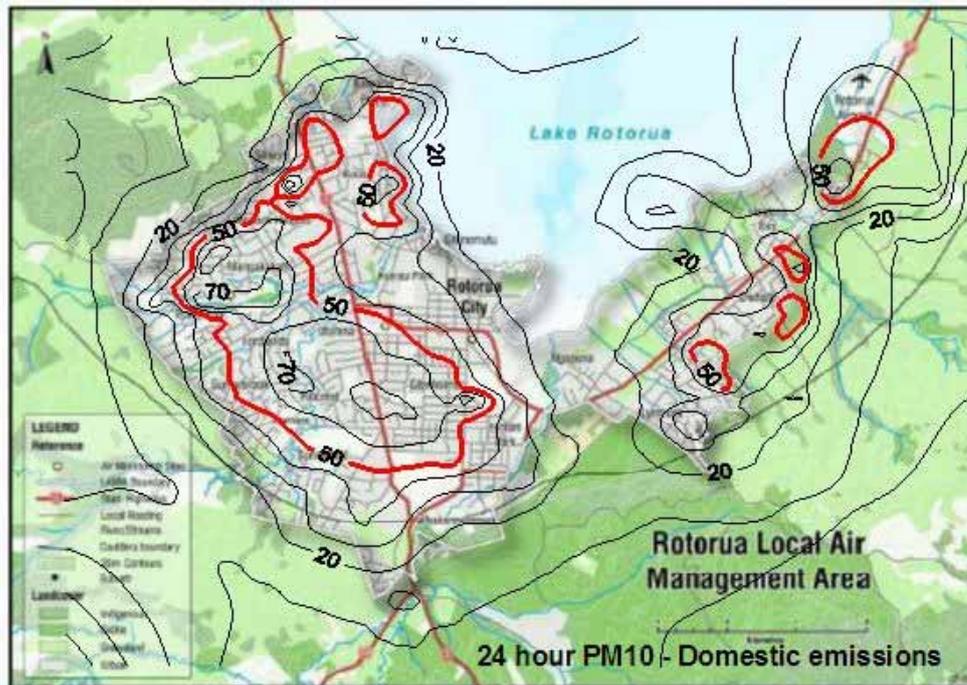


Figure 3 – Baseline Domestic Emissions of PM₁₀

4 Characteristics of the Rotorua Airshed

The Rotorua airshed has many characteristics that combine and interact to cause air pollution and to make it worse. To propose and implement any solutions, these characteristics and the way they interact need to be considered, and examined against wider issues, such as climate change.

What may seem like an ideal solution may result in unintended and undesirable consequences. For example, widespread conversion to heat pumps may increase the electricity bill of a household beyond that which it can afford, and lead to the use of fossil fuels to generate power, contributing to climate change.

4.1 Climate and Topography

The Rotorua airshed is located inland, at the bottom of a sheltered caldera, with less wind than many other parts of New Zealand. Winters are cool, with frosts likely to occur in clear calm conditions and temperature inversion layers (where cold air is held down by warm air above) are more likely to form. In these conditions, householders are also more likely to heat their homes for longer periods. The inversion layer then traps the resulting air pollution down low over the city.⁵

However, the inversion layer breaks up in the morning, and this and a slight increase in wind speeds helps clear the pollution each day so avoiding the problem experienced in other parts of the country where pollution from the previous night remains, and combines with the following night.

Rotorua is a unique city because of the major geothermal area on which it sits. Although the increased ground temperature could affect air patterns, this is not believed to be significant and has not been studied in-depth.⁶

⁵ Shane Iremonger and Bruce Graham *Rotorua Air Emissions Inventory 2005, 2007*.

⁶ G Fisher et al *Rotorua Airshed Modelling Investigation Report*, September 2007.

4.2 Demographics

The 2006 Census showed the Rotorua airshed (Figure 1) as having a total population of 57,840 people living in 17,200 dwellings. The population has increased by 2.7% since 2001 and is projected to increase by a further 2.8% by 2013⁷. In theory any population increase will lead to further emissions.

The deprivation index (measure of household income) shows that Rotorua is polarised, with very few people in the middle levels. The majority of households in the airshed are highly deprived, as shown on Figure 4. Anecdotal evidence suggests that these lower socio-economic households are more likely to use woodburners as their main source of heating, as the wood can be sourced more cheaply than fuels for other methods⁸. This sector of the population is also less able to afford to replace their ageing and inefficient woodburners. Any proposed solutions to Rotorua's air quality problem must take into account the lower income sector to ensure regulations and policies do not force further hardship on to the community.

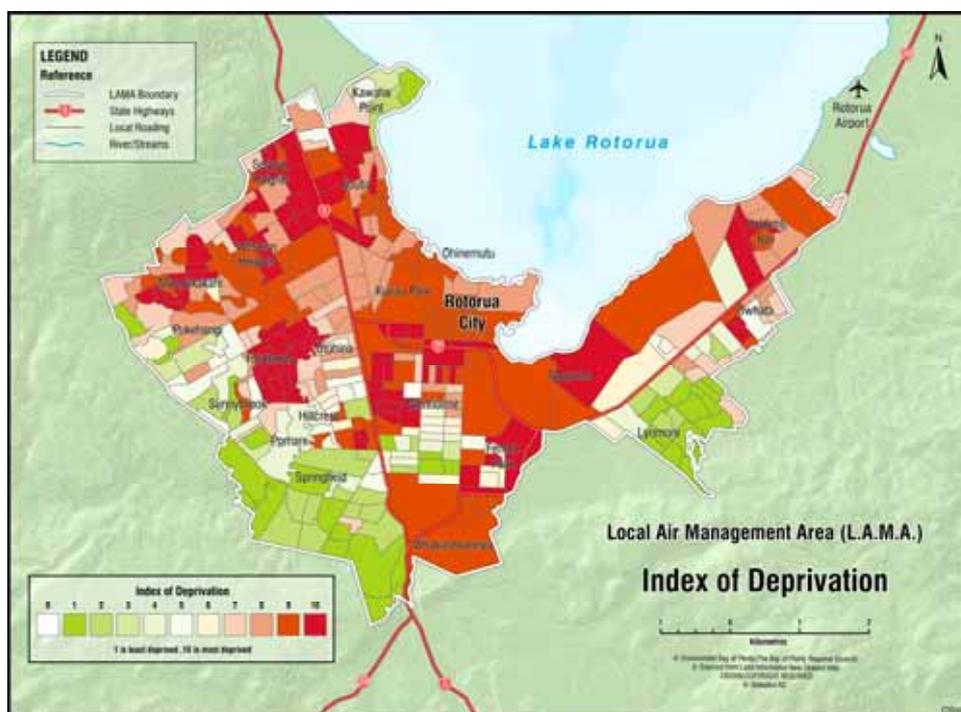


Figure 4 – Index of Deprivation within Rotorua Airshed

A large proportion (37%) of the houses in the Rotorua airshed are rentals (i.e., not owned by the usual residents). This leaves a large number of houses that cannot be upgraded by the occupier, even if they chose to. Tenants also tend to be lower-income households, the group most vulnerable to poorly insulated and heated houses.

4.3 Sources of the Particulates

Homes, industries and transport are the three main sources of particulates in Rotorua's air. Figures 5 to 7 show the pattern of emissions from each of these sources. Most domestic emissions come from the western suburbs, in particular the lower-income areas. Most transport emissions are from State Highways 5 and 30, with some contributions from other main roads. Industrial emissions are from the two main industrial zones in the city, with a minor contribution from the central business district. The eastern industrial zone

⁷ Shane Iremonger and Bruce Graham *Rotorua Air Emissions Inventory 2005, 2007*.

⁸ Ibid.

contains the Tachikawa and McAlpines sawmills, the two biggest industrial contributors to PM₁₀ concentrations.⁹

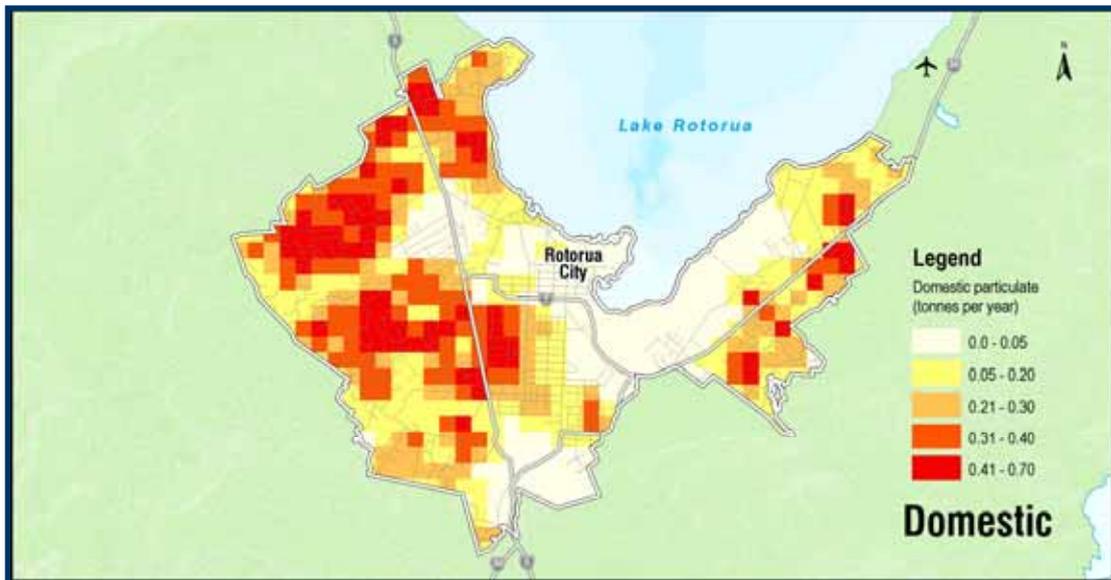


Figure 5 – Particulate Matter: Estimated Emissions from Domestic Sources



Figure 6 – Particulate Matter: Estimated Emissions from Transport

⁹ Shane Iremonger and Bruce Graham *Rotorua Air Emissions Inventory 2005, 2007*.

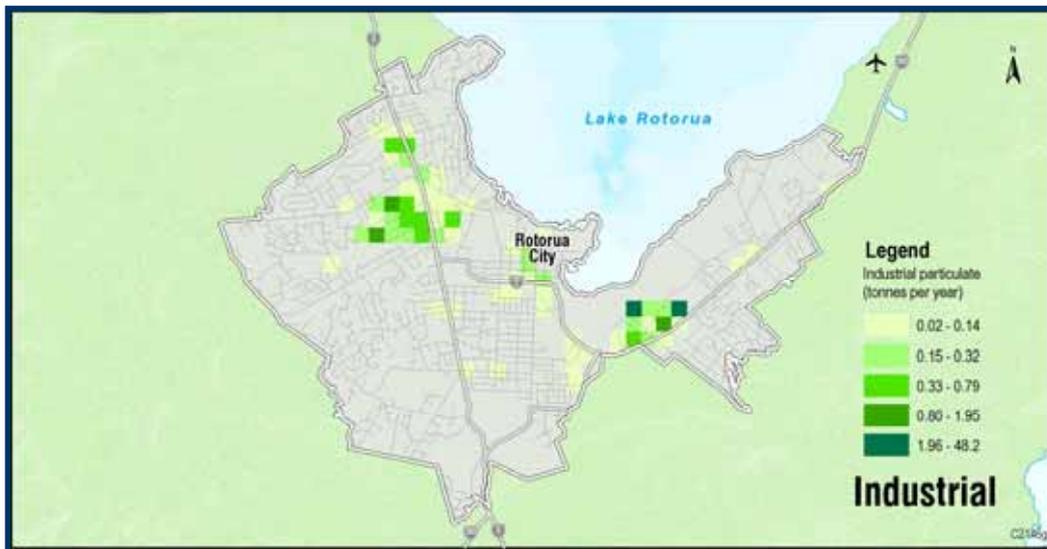


Figure 7 – Particulate Matter: Estimated Emissions from Industrial Sources

During winter, when most air quality breaches are recorded, domestic emissions make up most of the PM₁₀ in the airshed. Figure 8 shows the winter PM₁₀ contribution by source.

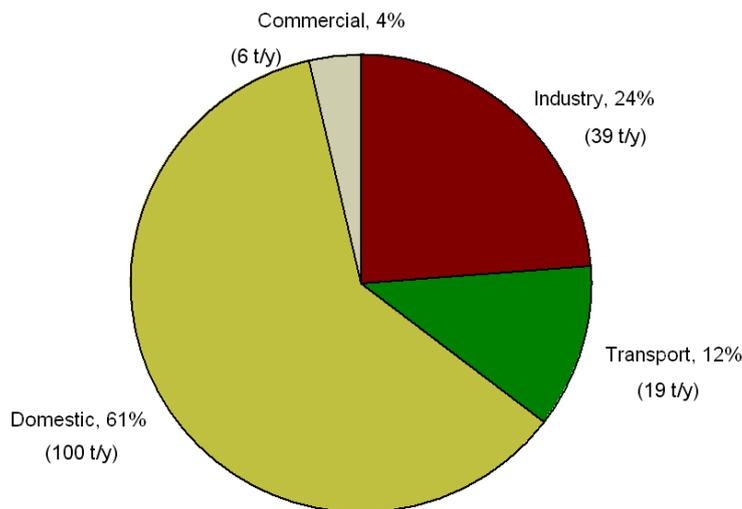


Figure 8 – PM₁₀ Winter Percentage by Source

4.3.1 Domestic Emissions

The domestic contribution to the amount of PM₁₀ in the air is mostly made up from solid-fuel burning, such as wood, for home heating. Backyard burning of rubbish and green waste contributes a small amount. Figure 9 shows that 38% of homes in the Rotorua airshed are heated by burning solid fuel.¹⁰

¹⁰ Shane Iremonger and Bruce Graham *Rotorua Domestic Heating Survey*, September 2006.

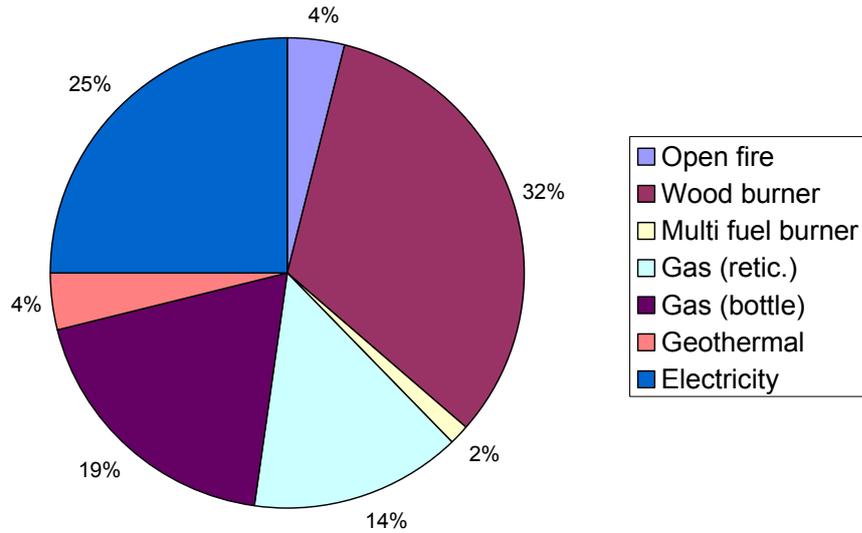


Figure 9 – Home Heating Methods

Figure 10 shows that 42% of all woodburners within the airshed are at least 18 years old,¹¹ with a further 13% at least 13 years old. The lifespan of an effective woodburner is 15 years, thus making the majority of them outdated as old technology generally means reduced efficiency and increased emissions. Many of these old woodburners are most likely owned by lower income households.

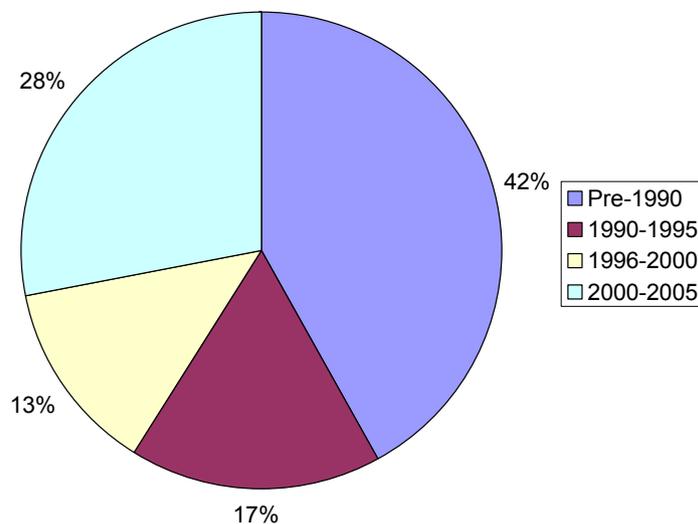


Figure 10 – Woodburner Age

Despite the airshed being surrounded by forestry, two-thirds of those who burn wood buy their firewood. Only one-third collect their own, as shown on Figure 11.

¹¹ Shane Iremonger and Bruce Graham *Rotorua Domestic Heating Survey*, September 2006.

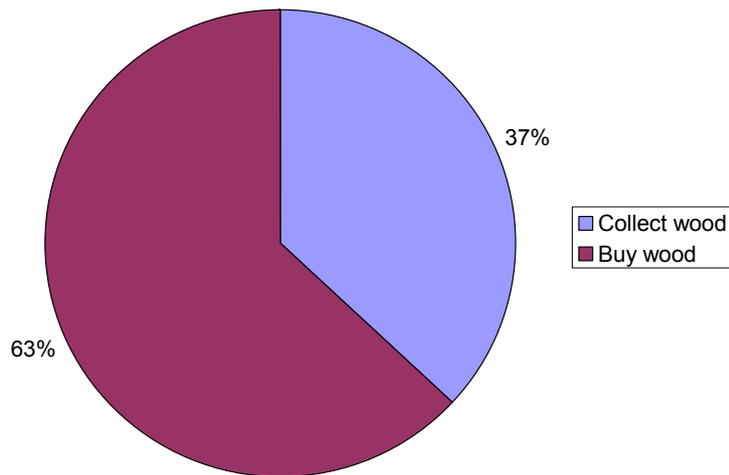


Figure 11 – Source of Firewood

For those that collect their own wood, education about the best types of wood to collect is the best tool the Regional Council has to improve the quality of wood being burned. However, for those that purchase their wood, merchants can be approached and encouraged to sell only seasoned, dry wood.

4.3.2 Industrial Emissions

The two biggest industrial sources of PM₁₀ in Rotorua's air are the sawmills owned by Tachikawa and McAlpines. These mills are located in Ngapuna and both hold current consents to discharge PM₁₀ into the air. The consents have conditions to restrict the amount of pollution discharged, however both plants are at least 20 years old and the technology that removes dust from the waste air stream is inefficient.

Modelling scenarios indicate that if the consent conditions are met, these sawmills will not cause a breach of the standards. However, if their discharge is combined with domestic emissions in this area, breaches are likely. It is not reasonable for Environment Bay of Plenty to ask the residents of Rotorua to upgrade their woodburners while a significant source of PM₁₀ continues to use outdated technology.

In June 2007 a monitoring station was shifted from Pak n Save (corner of Fenton and Amohau Streets) to the Cryovac site along State Highway 30 in Ngapuna to comply with NESAQ rules that require monitoring stations to be placed in areas where breaches are most likely to occur. Airshed modelling indicated that this area was the more likely to exceed the limit.

Since being shifted to the new site, four breaches have been measured. As these events took place during summer, it is highly unlikely that domestic heating was responsible for the elevated particulate concentration and industrial activities are the most likely source.

When the airshed modelling was commissioned (see Section 3.3), this information was not available, so industry was not included in the reduction scenarios. However, with summertime breaches caused solely by industry, reductions will be required by this sector to ensure compliance with NESAQ rules.

4.3.3 Other Emission Sources

Although the contribution from vehicles is still reasonably high (14%), there is very little that can be done at local government level to control these emissions. Fine particulates from this source are expected to decrease up to 15% by 2013 because of better engine technologies and vehicle emission controls from central government. Although no initiatives regarding vehicles are proposed in this Action Plan, however the assumed reduction in PM₁₀ is included in the calculations.

There are also no suggestions to reduce the particulate generated by the commercial sector. With a contribution of only 4%, it would be an inefficient and ineffective use of resources for little gain.