2   Atmosphere

This chapter lists the questions about air pollution and ozone that we would like addressed. We present a summary of the analysis of the official data that addresses those questions. We then outline the initiatives to address our atmospheric information needs.

The effects of air pollution on the health of New Zealanders were first assessed in *Health and air pollution in New Zealand* (Fisher, Kjellstrom, Kingham, Hales, & Shrestha, 2007). This work was updated in 2012 (Kuschel, Metcalfe, Wilton, Guria, Hales, Rolfe, & Woodward). The more recent study showed that the total health impacts associated with anthropogenic air pollution in New Zealand each year included nearly 1,200 premature deaths, over 600 extra hospital admissions for respiratory and cardiac illnesses, and 1.5 million restricted-activity days.

The total social costs associated with anthropogenic air pollution in New Zealand are estimated to be $4.3 billion per year or just over $1,000 per person (Kuschel et al, 2012).

The integrity of the ozone layer has been threatened by the release of long-lived man-made chemicals. These changes have caused concerns around the impacts of UV radiation, as the amount of UV radiation that reaches Earth's surface is controlled by the amount of ozone in the atmosphere. This has an impact on New Zealanders. For example, we have one of the highest rates of skin cancer in the world, partly due to the extreme levels of summertime UV we experience. Changes in ozone concentrations over Antarctica have also resulted in increased winds and rainfall in some parts of the Southern Hemisphere during summer. These changes have also contributed to atmospheric warming and cooling over parts of Antarctica, warming of the Southern Ocean, and a local decrease in the ocean's capacity to absorb carbon dioxide.

Atmosphere questions

This section presents the enduring questions and the supplementary enduring questions on atmosphere.

Enduring questions

What are the levels of air pollution in New Zealand and what is the consequential impact on ecosystems and human health?

To what extent has the stratospheric ozone layer over New Zealand been depleted, and what is the consequential impact on ecosystems and human health?

Supplementary enduring questions

A. What are the levels[1] and sources of air pollution[2] throughout New Zealand and how are they changing over time?

B. Who experiences poor air quality[3] in New Zealand and what is the impact on their health?

C. What and where is the impact of air pollution on Māori and how does the impact compare with that on the general population?

D. To what extent has the stratospheric ozone layer over New Zealand been depleted, and what is the impact on ecosystems and human health?

E. What is being done to reduce, mitigate, and prevent[4] air pollution and stratospheric ozone layer depletion?

Notes

1. Levels cover, but are not limited to, average, peak, and exceeding air quality standards.

2. Includes rural and urban, natural and anthropogenic sources of particulate matter. Odour and visual smoke are included, but indoor air quality and second-hand smoke are outside the scope of this domain plan.

3. Poor air quality can be defined by when air quality standards are exceeded. The definition of poor air quality also includes the impact of highest levels, and averages, for the air pollution sources described in note 2.

4. Includes expenditure on these activities to inform analysis of the costs, benefits, and value of environmental protection effort.

Gap analysis

Table 3 summarises the analysis of how well official information (including Crown research institute data) informs the supplementary enduring questions on atmosphere. See appendix 3 for details of the analysis process.

Table 3

How well official data informs supplementary enduring questions on atmosphere

Supplementary enduring question (SEQ)	Question topic	Level at which official data informs SEQ
A	Levels and source of air pollution	Medium
B	Who experiences poor air quality	Medium
C	What impacts affect Māori	Low
D	Stratospheric ozone	Medium
E	Mitigation of air pollution and stratospheric ozone depletion	Medium

Experts determined two data sources as being highly valued:
- Airshed reporting
- National air quality (nitrogen dioxide) monitoring programme.

Atmosphere initiatives

This section presents the atmosphere initiatives by priority and a discussion of each in detail.

AT1 Identify key non-standard air pollutants

The first of the top-priority initiatives is to identify and understand the concentrations of key air pollutants that are not currently covered by an ambient standard in the National Environmental Standards for Air Quality (NESAQ). These pollutants could include heavy

metals such as arsenic, which is largely emitted from burning treated timber used to heat homes during winter. Another pollutant is benzo[a]pyrene, which is an indicator of exposure to polycyclic aromatic hydrocarbons (PAHs) and is also emitted from burning timber. Many PAHs are human carcinogens. Limited information is known about these and other pollutants, but GNS Science has collected some information on a few of these.

Significant encouragement is needed in this area as monitoring air quality is expensive. Monitoring pollutants outside of the pollutants regulated by the NESAQ is not currently within the resources available for many regional councils and unitary authorities. Internationally, there are increasing concerns about the risks presented by pollutants not covered by New Zealand's NESAQ.

Included in this work could be further measurement and analysis of PM2.5 (particles smaller than 2.5µm which penetrate deep into lungs), which could also support the second initiative (discussed next). These smaller particles have stronger associations with adverse health effects and are more closely linked to anthropogenic (human-generated) sources than PM10, which is covered by the NESAQ. Currently there are a few PM2.5 measurement sites around the country. Data from these locations could be further analysed, and the number of monitoring sites extended to ensure representative coverage across New Zealand.

By doing this initiative, we can use the information on the concentrations of these pollutants to assess the health impacts of key air pollutants on New Zealanders.

AT2 Gather evidence to support future review of the National Environmental Standards for Air Quality

Promote the gathering and use of quality statistical data that informs decision-making around air pollutants such as PM2.5 and health outcomes.

In 2009 and 2010, the National Environmental Standard for Air Quality (NESAQ) technical advisory group (and various submitters) addressed PM10 regulations and requested consideration of setting an ambient standard for PM2.5. This and other potential changes to national air quality guidelines need to be underpinned by research, standard development, and consultation.

This initiative outlines the need to fully consider statistical information about the linkages between health outcomes and air pollutants like PM2.5 when setting new national air quality guidelines.

AT3 Develop a national database of emissions inventories and concentrations

Develop a national open database or portal of emissions inventories and ambient concentrations, including source apportionment data. This will give users access to existing information so that it can be better used and have more value.

Specific objectives of this initiative include:
- provide open access and use of existing data and databases by optimising what we have and making it accessible to all users
- improve existing databases and portals by updating, revising, and rationalising them.

This national database would require custodianship and common data collection and reporting protocols to enable efficient collection and reporting.

AT4 Develop health indicators for air quality

Create more effective (useful) health indicators for air quality. For example, experts in Canada have developed a 'Percent CP Mortality Risk'. This indicator refers to the

proportion of cardiopulmonary mortalities estimated to be due to outdoor ambient ozone or PM2.5 concentrations.

These indicators will show the impact of poor air quality on human health. There may be a need to better link health data and air quality measurements to know the relationship between the two. This initiative is linked to initiative AT18.

AT5 Extend health and air pollution study in New Zealand

Air pollution's effects on health in New Zealand were first comprehensively assessed in the *Health and air pollution in New Zealand* (HAPINZ) study in 2007 (Fisher et al, based on 2001 Census and other data). This study was updated in 2012 to include 2006 Census and other information.

At the workshop, there was a suggestion to run the HAPINZ study more often. This will enable the gathering of trend information, which will show the changing risks, improvements, and costs of air pollution to New Zealand. Repeating the study more frequently will allow the reassessment of some of the underlying assumptions in place regarding air pollution and health.

AT6 Gather information on the state of indoor air-quality

The workshop determined an indoor air-quality baseline as important – despite indoor air quality being initially regarded as out of the scope of this domain plan.

Indoor air quality is an important issue to consider, as it could also have adverse health effects. This baseline can be used to estimate the health effects of indoor air quality in New Zealand and as the basis for on-going measurements. It could be scoped using a pilot study.

AT7 Develop reporting protocols

Like other environment domain plan topic areas, developing protocols for metadata and reporting was identified as an important initiative.

Reporting protocols would help in comparing data from across New Zealand, and would be most useful when gathering information on the national state, trends, and impacts of air pollution.

AT8 Estimate costs of health impacts

One area identified as lacking sufficient information is on the social costs of health impacts of air pollution (eg quantifying the cost to society of an air pollution-related premature death or hospitalisation). This would build on the work already completed under HAPINZ.

This information is fundamental to cost/benefit analyses or similar. Case studies and pilot studies in this area would also be welcome.

AT9 Gather domestic fire-use information

Gather more details on domestic fire use. The census asks about home-heating methods, but the question is general and is asked only every five years. While it is unlikely that we can change the census question, initiating more frequent national surveys in other forums (for example in Statistics NZ's General Social Survey) to more quickly identify domestic fire trends would be useful (eg asking the age of the wood burner).

AT10 Understand susceptible groups

Results from a preliminary cohort study undertaken in New Zealand (Hales, Blakely, & Woodward, 2010) suggest that Māori are more susceptible to the adverse effects of air

pollution than the total New Zealand population. This susceptibility may extend to other ethnic groups.

We need better information to improve our understanding of the susceptibility of Māori and other groups, such as Pacific islanders and Asians.

AT11 Continue remote sensing of vehicles

Remote sensing of the emissions of light vehicles are being done in Auckland (around every two years). The results have been critical for assessing trends and policy effectiveness (eg exhaust emissions standards).

The workshop supported continuing regular remote sensing of vehicle emissions.

AT12 Develop a standard method for assessing exposure

Population exposure to the adverse effects of air pollution can be assessed in a number of ways. Commonly it is based on results from a fixed monitoring site.

There is a need to develop a standard method for assessing exposure in New Zealand to air pollutants. This work would include scoping the options available, and focusing on how these methods can be used to evaluate the impacts of pollution and the effectiveness of policy. This initiative can include assessing aesthetic, economic, tourism, and cultural impacts.

AT13 Expand governance group to coordinate information and research

There was some discussion at the workshop on the governance issues around this topic.

One suggestion was to expand air quality governance. That potentially, a group of stakeholders could provide guidance on coordinating, collaborating, and integrating data gathering, and that might direct collective research. There is already a group that does much of this role, the regional councils' special interest group for air quality. The Ministry for the Environment and the National Institute of Water and Atmospheric Research are already fully engaged with this, with additional support from the Ministry of Health and the New Zealand Transport Agency.

AT14 Estimate off-road emissions

Another gap in air-pollution understanding is quantifying off-road emissions, eg emissions from rural vehicles, lawn mowers, marine pleasure craft, and machinery. Given New Zealand's reliance on the primary industry sector, these emissions are likely to be non-trivial compared with other sources such as domestic fires and road-based transport.

Further work is needed to quantify these off-road emissions to understand their contribution to air pollution. Using Statistics NZ's Energy Use Survey to help quantify these emissions could be explored.

AT15 Estimate rural air quality

The quality of rural air is not well characterised, especially the quantification of sources such as open burning. This information could also provide background levels of pollutants for comparison with urban areas.

Rural air quality and its impacts need to be investigated. One suggestion is to undertake a pilot study to investigate the scale of the problem.

AT16, AT17 Estimate impacts of ozone

Two of the 19 initiatives suggested during the workshop focus on stratospheric ozone.

The first initiative is to investigate the impacts of the changing ozone on New Zealand biodiversity. The second is to undertake further work on sources of ozone-depleting substances.

AT18 Develop better health data

Developing better and more useful health data is also important. Consideration needs to be given to developing a standard methodology for collecting data and setting time periods (hourly, weekly, or daily), to better link the health outcomes to air pollution concentrations.

This would be a relatively complex initiative involving cooperative work across both the science and health sectors. This initiative links to AT4 and AT8.

AT19 Evaluate the effectiveness of air-pollution reduction approaches

Explore and promote effective responses and approaches to improving air quality.

This initiative will promote successes and improve information transfer across a wider range of organisations.

Atmosphere initiatives table

Table 4 lists the atmosphere initiatives by priority, estimates of their complexity, and the supplementary enduring questions they address.

Table 4

Atmosphere initiatives by priority, complexity, and supplementary enduring question (SEQ) addressed

Initiative number	Initiative name	Priority	Complexity	Helps inform which SEQ
AT1	Identify key non-standard air pollutants	1=	Complex	A, B
AT2	Gather evidence to support future review of the National Environmental Standards for Air Quality	1=	Complex	E
AT3	Develop a national database of emissions inventories and concentrations	3	Moderate	A
AT4	Develop health indicators for air quality	4	Complex	B
AT5	Extend HAPINZ	5	Moderate	B

AT6	Develop an indoor air quality baseline	6=	Moderate	A, B

Table continued next page

Table 4 continued

Atmosphere initiatives by priority, complexity, and supplementary enduring question (SEQ) addressed

Initiative number	Initiative name	Priority	Complexity	Helps inform which SEQ
AT7	Develop reporting protocols	6=	Moderate	A
AT8	Estimate costs of health impacts	6=	Complex	B
AT9	Gather domestic fire usage information	9	Moderate	A
AT10	Understand susceptible groups	10=	Complex	C
AT11	Continue remote sensing of vehicles	10=	Moderate	A
AT12	Develop a standard method for assessing exposure	12=	Complex	B
AT13	Expand governance group to coordinate information and research	12=	Moderate	E
AT14	Estimate off-road emissions	12=	Complex	A
AT15	Estimate rural air quality	12=	Moderate	A, B
AT16	Estimate impacts of ozone (biodiversity)	12=	Complex	D
AT17	Estimate impacts of ozone (ozone destruction)	12=	Complex	D
AT18	Develop better health data	12=	Highly complex	B
AT19	Evaluate the effectiveness of air pollution reduction approaches	12=	Complex	E