caring about you & your environment

Report 00.527
10 July 2000
File: ENV/6/3/2
[Report 2000.Env00527.PD:mm]

Report to Environment Committee
from Perry Davy, Air Quality Scientist

Wellington Regional Air Emissions Inventory

1. Purpose

To present a summary of the results of the work undertaken to develop an Air Emissions Inventory for the Wellington Region from 1997-2000.

2. Background

The Wellington Regional Council has developed an air emissions inventory for the Wellington Region as part of the Councils' state of the environment monitoring programme. The inventory was conducted in several stages. The first stage of the project, completed in 1997/98, recorded emissions from the industrial and transport sectors. The second stage, completed in 1998/99, focussed on domestic and area sources. The third stage, which was completed in June 2000, estimated emissions from natural or biogenic sources as well as agricultural activities.

The purpose of this project was to estimate the amount of criteria pollutants being discharged to air throughout the Wellington Region and to determine the relative contribution to ambient pollutant loadings from individual source categories.

The pollutants addressed in the inventory were non-methane volatile organic compounds (NMVOC), nitrogen oxides (NOx), sulphur dioxide (SO_2), carbon monoxide (CO), carbon dioxide (CO_2) and particulate matter less than 10 microns in size (PM_{10}). The inventory of biogenic sources also included methane because of its importance as a greenhouse gas and the large contribution arising from the agricultural sector (cattle and sheep).

During the course of the inventory programme we requested and received the co-operation of a number of organisations, industries and members of the public. We wish to express our gratitude for this co-operation.

3. Collection of Emission Data

3.1 Industrial Emissions

Data was collected from a variety of literature and non-literature sources. Questionnaires were used to collect much of the data pertaining to industries in the Wellington Region, with supplementary information supplied by the Wellington Regional Council (i.e. resource consents). Emissions were estimated using various USEPA guidelines as well as information from other literature sources. Any emission data specific to New Zealand, including actual facility sources test data, were used in preference to published emission factors from overseas sources (i.e. principally the US).

3.2. Mobile Source Emissions

The emission factors used for determining the mobile source component were derived using Australian vehicle fleet data. Some allowances have has been made in its application to reflect the fleet profile in New Zealand and the likely status of emission control equipment on vehicles sold in New Zealand.

Vehicle usage data was obtained from the WRC Transport Division.

3.3 Domestic and Area (Commercial) Emissions

Data about emissions from the domestic sector were collected through a household telephone survey. A total of 949 randomly selected residents from 41 geographical areas within the Wellington Region were surveyed. The results were used in conjunction with 1996 Census information to build a 'typical' usage trend profile (both temporal and spatial) for residential dwellings in the Wellington Region.

Information about discharges from commercial activities was collected from a variety of sources, with preference given to Wellington specific data where possible.

3.4 Biogenic Emissions

A variety of methods were used to develop an inventory of biogenic emissions.

The main objectives of this inventory were:

- To quantify emission rates of pollutants released from the natural emissions sources in the Wellington region including soils, livestock and vegetation.

- To quantify emission rates of pollutants released from controlled rural fires, wildfires and agrichemical spraying in the Wellington region.

- To characterise the spatial distribution of these emissions within the Wellington region and to develop a data-base of these emissions compatible with the Wellington Regional Council Geographical Information System (GIS) for future modelling purposes.

Each methodology used land cover or rural activity to estimate pollutant emission using emission factors. Where possible predicted emissions were extracted into a 3km-by-3km grid covering the Wellington region.

3.5. Uncertainties in Emissions Estimations

It should be noted that there are potentially large uncertainties when developing an emissions inventory. The largest uncertainties occur when population scaling is used to estimate emissions due to the lack of better data. The primary intention of the emissions inventory was to provide 'an order of magnitude' estimation of the predominant contributors to air pollutant loadings within the Region.

As better data becomes available, such as more relevant emission factors or activity data estimates, the emissions presented in the document will be reviewed and updated.

4. Results

4.1 Relative Source Contributions to Pollutant Emissions

A summary of results from the air emissions inventory is presented in Figure 4.1.

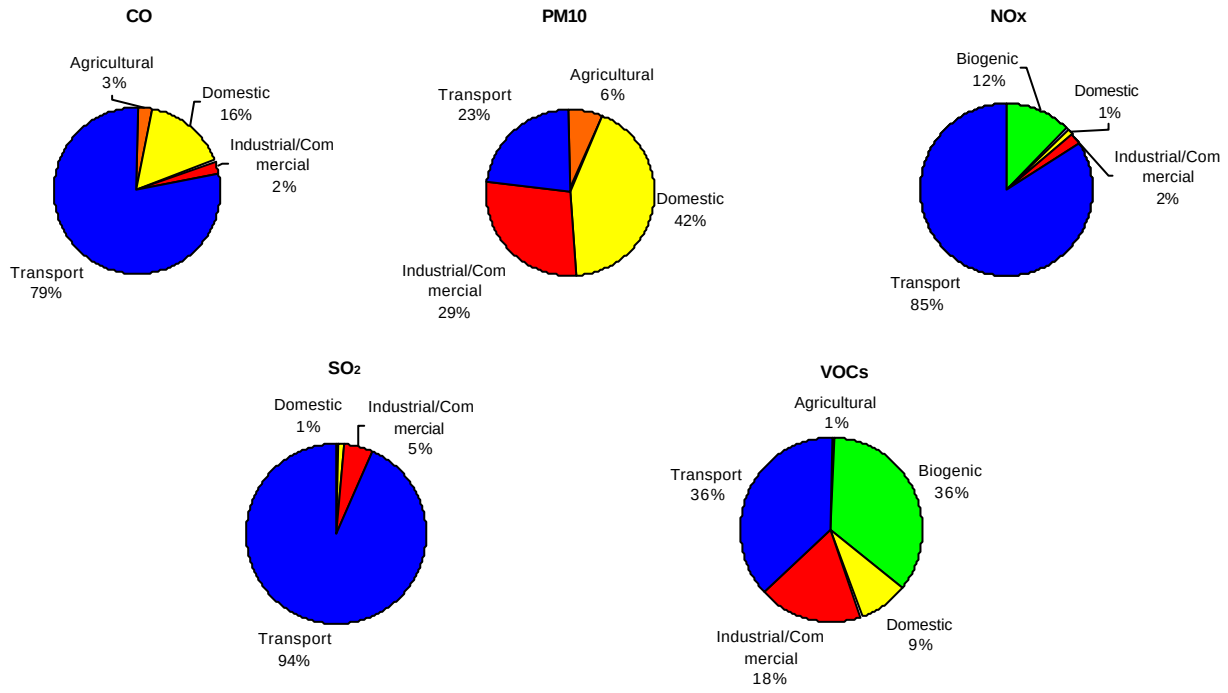

Figure 4.1. Relative Source Contributions to Pollutant Emissions in the Wellington Region.

4.2 Greenhouse Gases

The main anthropogenic sources of carbon dioxide are combustion processes. The predominant sources of methane in the Region are stock (sheep and cattle) through enteric fermentation and manure management processes. The emissions inventory has detailed the relative outputs of methane by territorial authority and indicates that Masterton District has the highest emissions per unit area due to a higher number of stock than other districts. Figure 4.2 shows the relative contributions of each source category to greenhouse gas emissions and the relative proportions of carbon dioxide to methane both in terms of quantity and efficiency. Methane is considered to be 20 times more effective than carbon dioxide as a greenhouse gas.

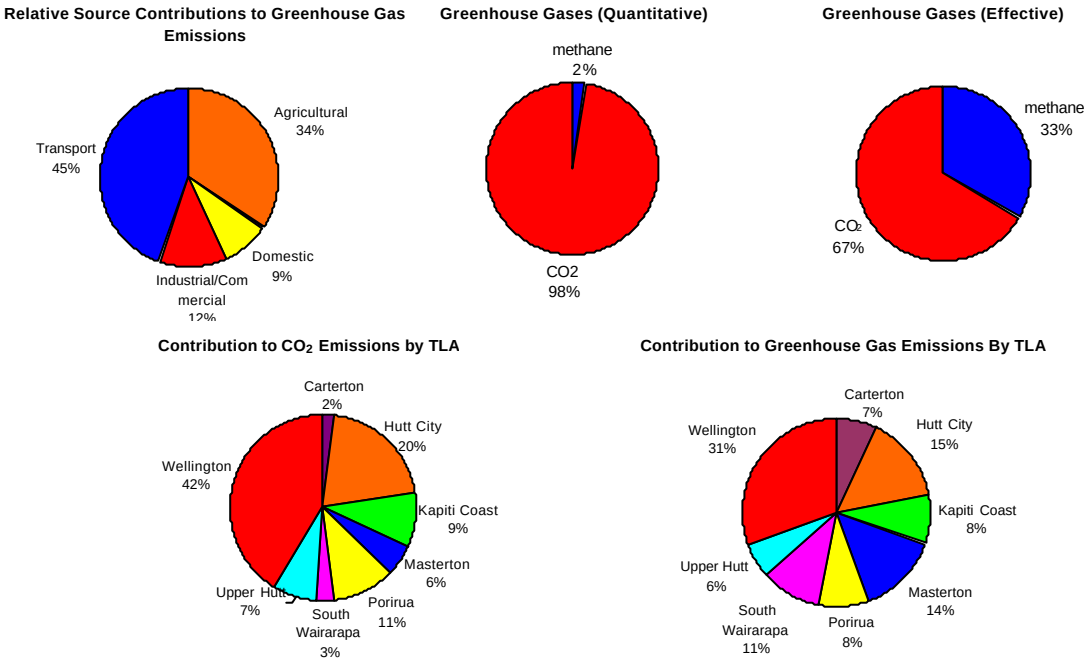

Figure 4.2 Greenhouse Gas Emissions in the Wellington Region

Note that the relative contributions to greenhouse gases represented in Figure 4.2 are provisional at this stage and further research will be undertaken this year to finalise the dataset.

4.3 Pesticide Usage

Pesticide application rates were included in the biogenic emissions inventory to provide an indication of the relative pressures on the environment due to pesticide usage in agriculture.

Herbicides are the predominant pesticides type used in the Wellington Region and account for an estimated 63-69% of the total agrochemical usage for the crop types included in the study.

The main source of herbicides in the Region is associated with pastoral farming and exotic forestry. These combined activities are predicted to account for 92-94% of total

herbicides used in the Region. On an annual basis pastoral farming uses 18-30% of the insecticides and other mineral oils and growth regulators applied in the region, with plantation forestry consuming 49-62%.

Apple production is also a significant consumer of pesticides in the Region, accounting for 9-14% of the total estimated agrochemical application for the Region including 42-48% of all insecticides, 41-51% of all fungicides and 21-31% of all mineral oils, growth regulators and inorganic fungicides.

The greatest concentration of pesticide usage is in the horticulturally intensive areas of the central Wairarapa and Otaki. This may have implications for soil, surface water and groundwater quality in these areas and could warrant further investigation.

5. Key Findings

5.1 Criteria Air Pollutants

The results show that mobile sources are the main source of the air pollutants that were inventoried. The exception was fine particulate matter, for which the greatest contribution comes from domestic combustion sources (mainly solid fuel fires). Approximately 85% of the annual contribution to particulate matter emissions from domestic fires occurs during the winter months. As a consequence, in some areas there are likely to be significant local pollution episodes on cold calm winter nights. Results from the ambient air quality monitoring at Masterton have confirmed this to be the case. The ambient air quality guideline for particulate matter in Masterton was exceeded on several occasions during the winter of 1999.

The emissions inventories provide average summers day and average winters day emissions for each category. During a typical summers day mobile sources are the primary source for most emissions within the Region. However, for PM_{10}, there is an even split between mobile and industrial sources.

During a typical winters day mobile sources are still the major pollution source, but domestic emissions have a much greater impact, especially on PM_{10} where the contribution to air pollution is five times that of any other source.

Within the Wellington Regional airshed, industrial emissions of the criteria pollutants only contribute significantly to CO_2, NMVOC and fine particulate. The most significant emitter of this compound is quarrying operations, releasing over 65 percent of the industrial PM_{10} emissions. Many industrial sources may also discharge hazardous air pollutants that were not inventoried as part of this project.

Biogenic sources only have an impact on NOx and VOCs emissions. Biogenic NOx emissions result from soil microbes involved in the nitrification process. Lowland and pastoral soils produce the most NOx per unit area and therefore agricultural practices impact strongly on rates of NOx production. The contribution of biogenic sources to VOCs emissions is somewhat more significant. However, biogenic emissions are a diffuse source spread over the entire Wellington Region whereas transport related

sources tend to be concentrated in urban areas. Additionally, biogenic VOCs emissions are mainly comprised of isoprenes and monoterpenes but transport emissions of VOCs include carcinogens such as benzene and 1,3-butadiene and therefore have a greater potential impact on human health.

6. Conclusion

The Wellington Regional Emissions Inventory implements Method 3(2) of the Regional Policy Statement and Method 6.1.2 of the Regional Air Quality Management Plan in particular.

The results of the emissions inventory show that motor vehicles and domestic fires are the main sources of criteria air pollutants in the Region. The emissions inventory indicates that the highest pressures on air quality occurs in the urban centres of both the cities and the smaller towns in the Region.

Overall, industrial emissions are a minor contributor. However, they may still have significant localised effects due to the quantity and/or the nature of contaminants discharged.

The information from the emissions inventory will assist with air quality management in the Region as the results are analysed and used in further air quality research. The results have already been considered when locations for long-term air quality monitoring stations were selected as part of the Wellington Regional Ambient Air Quality Monitoring Strategy.

7. Communications

The results of the emissions inventory have been communicated as they have become available to the Regional Council in the form of Committee Reports and to the public via press releases. A summary report of the emissions inventory including the implications for Regional air quality management will be compiled this financial year. The report will be communicated to the Environment Committee and widely distributed to local authorities, tertiary institutions and government agencies.

8. **Recommendation**

That the report be received and its contents noted.

Report prepared by:

PERRY DAVY
Air Quality Scientist

Approved for submission:

JOHN SHERRIFF
Manager, Resource Investigation

JANE BRADBURY
Divisional Manager, Environment