

## Air pollution – how are we tracking it?

### Updating the air emissions inventory for the Greater Metropolitan Region in NSW

#### Why do we update the air emissions inventory?

Air pollution comes from many sources. We need to understand the contribution each source makes in order to develop the best approaches for improving air quality. The last air emissions inventory for NSW was based on activities that took place during 2003 and has been used to inform the best approaches for managing air pollution sources in NSW over the past five years.

To ensure that air quality management approaches are based on the most up-to-date information, the NSW Department of Environment, Climate Change and Water (DECCW) is now updating the inventory for activities that took place in 2008. The results will be available later in 2010 and will be used to shape the way we continue to improve air quality in NSW.

Figure 1 presents the role of the air emissions inventory within the NSW air quality management cycle.



*Figure 1: Air emissions inventory within the NSW air quality management cycle*

#### What is the air emissions inventory?

The air emissions inventory is a detailed listing of the substances discharged into the atmosphere by each emission source over a given time period and at a specific location.

The study area includes the greater Sydney, Newcastle and Wollongong regions, known collectively as the Greater Metropolitan Region (GMR). This region covers an area of 57,330 km<sup>2</sup> housing approximately 75% of the NSW population. Figure 2 shows the population distribution in the GMR.

The inventory includes emissions from the following natural and human-derived sources:

- biogenic sources (e.g. bushfires, marine aerosol and windborne dust)
- commercial businesses (e.g. printers, quarries and service stations)
- domestic activities (e.g. lawn mowing, portable fuel containers and wood heaters)
- industrial premises (e.g. coal mines, oil refineries and power stations)
- off-road mobile sources (e.g. off-road vehicles such as dump trucks and equipment such as bulldozers, aircraft, ships and recreational boats)
- on-road mobile sources (e.g. buses, cars and trucks).

## How have air emissions been estimated?

Activity data has been obtained from industry groups, government departments and other service providers. All Environment Protection Authority-licensed premises as well as a sample of households were surveyed to collect additional activity data. The household survey included questions such as the frequency of lawn mowing and the volume of wood used in heaters.

The inventory includes emission estimates for over 850 substances, including:

- common air pollutants, i.e. carbon monoxide (CO), lead, oxides of nitrogen (NO<sub>x</sub>), fine particles (PM<sub>10</sub> and PM<sub>2.5</sub>), sulfur dioxide (SO<sub>2</sub>) and volatile organic compounds (VOCs)
- metal air toxics, e.g. antimony, arsenic, beryllium, chromium and nickel
- organic air toxics, e.g. benzene, formaldehyde, polycyclic aromatic hydrocarbons (PAHs), toluene and xylenes.

Air emissions have been estimated by combining activity data with emission factors. Where available, emission test data for industrial and commercial sources has been used in preference to emission factors.

For industrial and commercial point sources, emissions have been assigned to map coordinates. For area sources (biogenic, domestic-commercial, off-road mobile and on-road mobile sources), emissions have been assigned to 1-km by 1-km map grid cells. Emissions are then calculated for months, weekdays, weekend days and hours using factors derived from the activity data. Figure 3 shows an example of how emissions from vehicle refuelling change over a day.

Emission estimation techniques for all source types have been based on either published Australian methodologies, i.e. National Pollutant Inventory (NPI) manuals, or overseas methodologies, e.g. those published by the California Air Resources Board (CARB), United States Environmental Protection Agency (USEPA) or European Environment Agency (EEA).

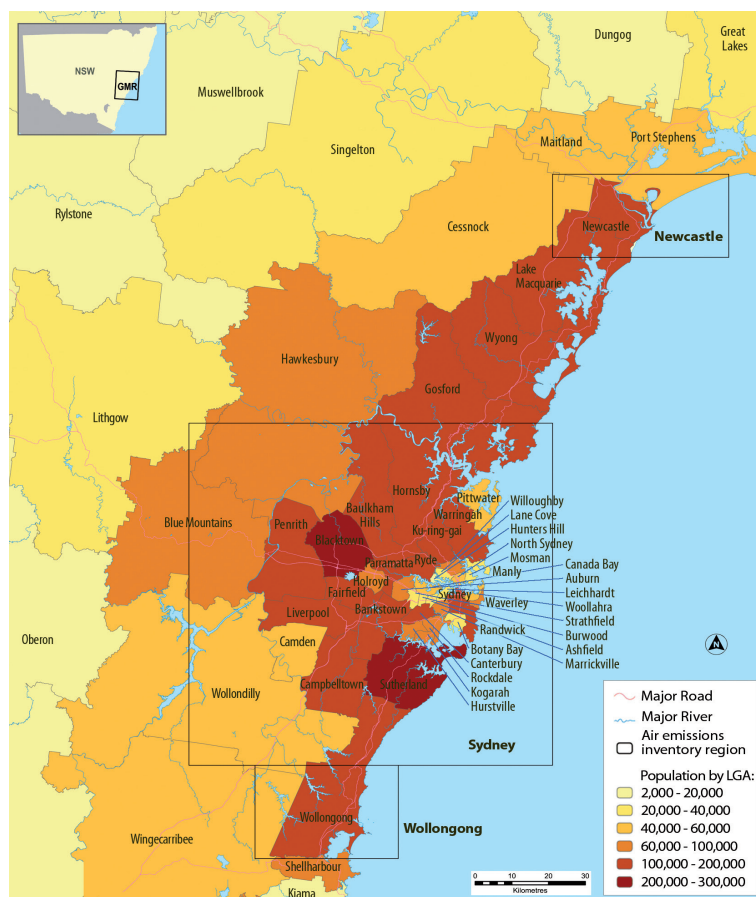


Figure 2: Population distribution in the GMR

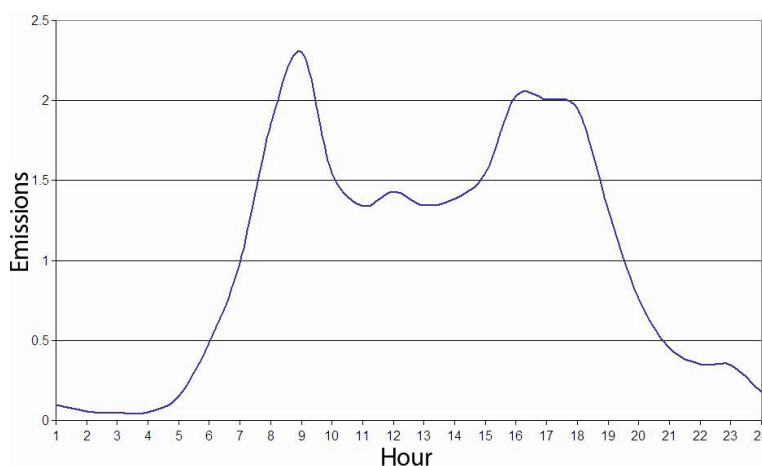


Figure 3: Change in vehicle refuelling emissions over a day

## Where is the air emissions data stored?

The air emissions inventory data is stored in a database.

The database includes features such as:

- air pollution modelling using California Institute of Technology, CSIRO and USEPA models
- charting by substance, source, region and local government area (LGA)
- data visualisation using geographical information systems (GIS)
- forecasting up to the year 2036
- modelling to test policy scenarios
- environmental reporting by substance, source, region and LGA
- pollutant prioritisation using the CARB guidelines for facility prioritisation
- photochemical smog prioritisation using the CARB maximum incremental reactivity methodology.

Figure 4 presents an example of an air pollution model form from the inventory database.

Figure 4: Example air pollution model form

## What's new in the updated emissions inventory?

The updated inventory includes emission estimates based on activities that took place in 2008. Emission projections from 2009 to 2036 are made using forecasts of:

- primary and final energy consumption from the Australian Bureau of Agricultural and Resource Economics (ABARE) E4 Cast Model
- population, dwelling and vehicle kilometres travelled from the Australian Bureau of Statistics (ABS) and NSW Bureau of Transport Statistics.

Figure 5 presents forecast changes in fine particle ( $PM_{10}$ ) emissions from domestic wood heaters in the GMR to 2036, assuming a business-as-usual scenario. The forecasts use ABARE final energy consumption data.

All emission estimation techniques have been updated to reflect the current state of science for all emission sources.

New emission sources previously unaccounted for include:

- biogenic sources – marine aerosol, cut grass and fertiliser application
- domestic activities – evaporative emissions from lawn mowers, garden equipment and portable fuel containers
- new industrial premises – 285 new EPA-licensed premises
- off-road mobile sources – off-road vehicles and evaporative emissions from off-road mobile equipment.

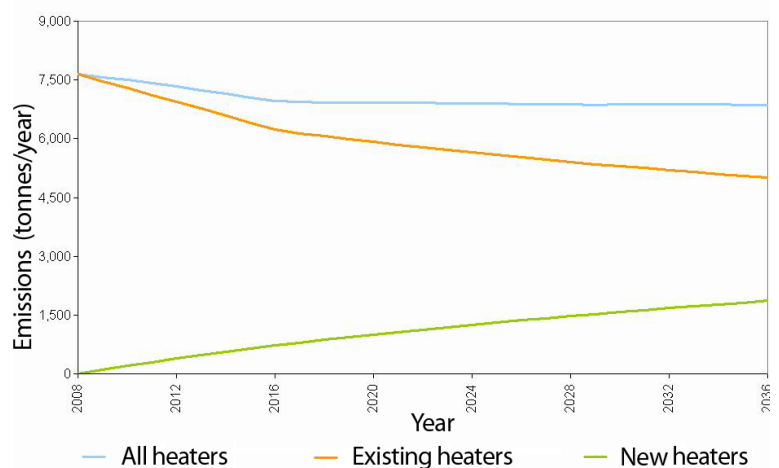


Figure 5: Forecast changes in  $PM_{10}$  emissions from domestic wood heaters



## How is the information being used?

The air emissions inventory is being used to refine existing emission reduction strategies and develop new strategies for all major sectors to further reduce their emissions.

The following case studies demonstrate how strategies targeting some specific sources – service stations, commercial premises, off-road diesel engines and industrial emissions – have used information from the inventory.

### Service stations

The air emissions inventory has been used to investigate the introduction of new laws to capture petrol vapour emissions from service stations. Reducing these emissions will cut smog. The new Regulation, Stage 2 Vapour Recovery (VR2), will capture VOC emissions from vehicle petrol tanks during refuelling at petrol bowwers.

VR2 is being introduced on a staged basis with vapour recovery equipment to be installed at the largest service stations in Sydney, Newcastle, Wollongong and the Central Coast by 2014, and at all but the smallest service stations in Sydney by 2017.

Stage 1 Vapour Recovery (VR1), which captures VOC emissions from underground storage tanks as they are filled by road tankers, has been in place in most parts of Sydney for some time, but is being extended to all parts of Sydney and the metropolitan areas of Wollongong, Newcastle and the Central Coast.

The technical work that underpinned the Regulation was based on information collected for the inventory. Information used the inventory included:

- identification of service station locations and throughputs
- estimation of potential emissions from each source at service stations.

This information was used to estimate the potential emission benefits from introducing VR2 over time.

VR2 technology can reduce refuelling emissions by over 85%. The Regulation covering VR2 and the VR1 extension will reduce VOC emissions in NSW by approximately 5,000 tonnes per year by 2017, making it one of the most significant actions available in NSW to substantially reduce VOCs, and delivering benefits for both regional and local air quality and health.

Estimated VOC emission reductions due to the introduction of the VR2 Regulation are shown in Figure 6.

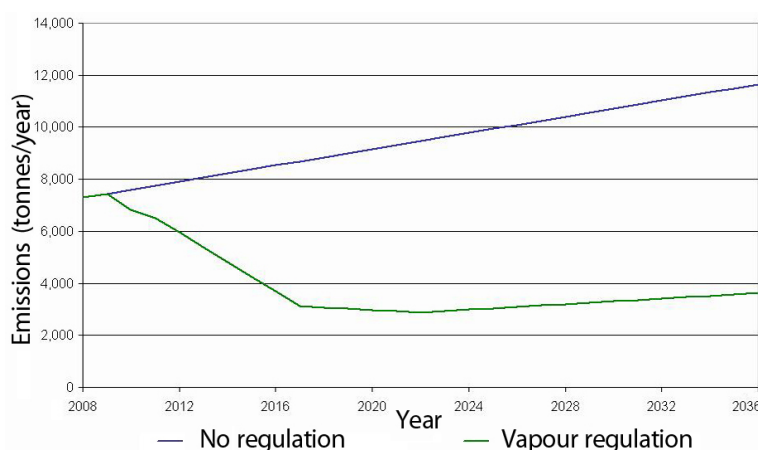


Figure 6: Estimated VOC emission reductions from service stations

### Commercial premises

The air emissions inventory has been used to model the effect of introducing particulate matter emission standards at commercial premises. Data from the inventory shows that the use of particulate matter emission standards for new and replaced plant and equipment at commercial premises has the potential to reduce particulate emissions by over 90 tonnes per year in 2010 and over 200 tonnes per year by 2029. This is equivalent to a reduction of 31% from these sources. This information was used to evaluate the costs and benefits of the proposed Protection of the Environment Operations (Clean Air) Regulation 2010.

Estimates of emissions avoided by introducing particulate matter emission standards for commercial premises are shown in Figure 7.

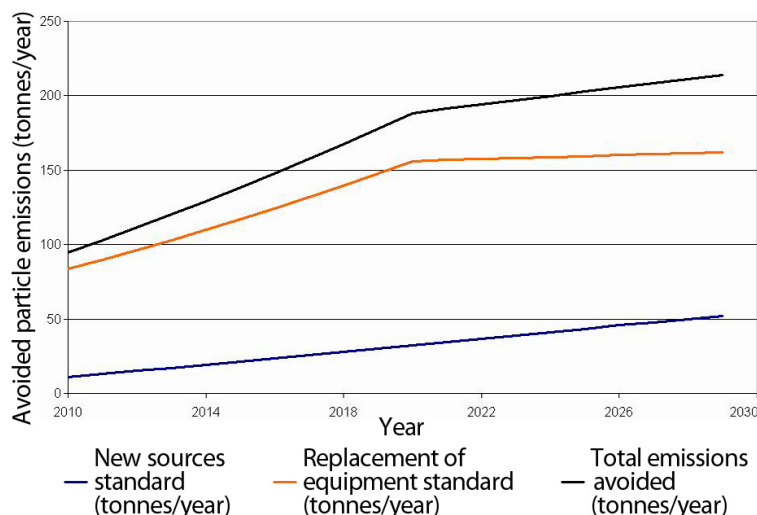


Figure 7: Estimates of particulate matter emission reductions from commercial premises

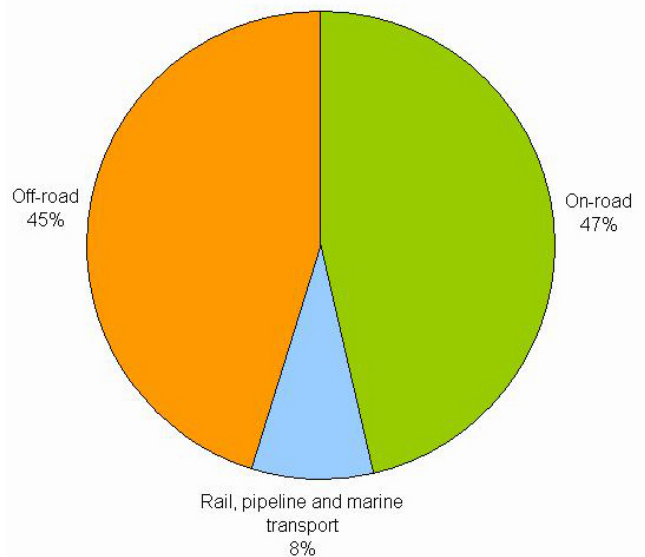
## Off-road diesel engines

The air emissions inventory has been used to show that off-road diesel engines are growing as a source of air pollution. Analysis of the inventory indicates that emissions from off-road diesel engines, such as those used in dump trucks and bulldozers, are a significant source of fine particulate matter in urban areas. At the local level, emissions can create particle concentrations that are significantly higher than background levels, and in densely populated areas this can lead to higher exposures and greater health consequences for workers and residents.

Over the past decade the need to reduce exhaust emissions from on-road diesel trucks and buses has been addressed through the use of cleaner fuel, emission standards and retrofitting old vehicles with pollution control equipment. Analysis shows that the off-road diesel sector consumes approximately 45% of all fuel, as shown in Figure 8, indicating that a similar approach is required for off-road diesel engines.

While the introduction of national exhaust emission standards may take some time, DECCW is undertaking a number of initiatives to promote the uptake and use of cleaner off-road diesel engines, including developing partnerships with local government and private sector organisations.

The evidence base behind developing this policy is supported by data gathered for the inventory.



*Figure 8: Diesel fuel consumption by sector*

## Industrial emissions – VOC reduction programs

Air emissions inventory information has been used to prioritise industrial sources of VOCs in order to reduce the formation of photochemical smog. By using the inventory data, DECCW has been able to target major industry operators that contribute significantly to total VOC emissions. DECCW uses Pollution Reduction Programs (PRPs) to help industry adopt alternative practices and materials that reduce VOC emissions.

The printing industry is one industrial sector being more strongly regulated through VOC reduction programs. Inventory data showed the printing industry was one of the largest sources of industrial VOC emissions in the GMR. DECCW officers inspected the licensed facilities and identified that four of the top ten larger printers were significant emitters of VOCs. Collectively these premises released approximately 1,700 tonnes of VOCs to the atmosphere each year (10% of industrial VOC emissions). Through the use of pollution control equipment and process material substitution (such as replacing solvent-based processes with water-based ones), VOC emission reductions of 1,300 tonnes per year will be achieved as a result of this project (7% of industrial VOC emissions).

A similar campaign was conducted with the metal coating, petroleum refining, plastics, petrochemical and chemical storage industries. This campaign focused more on requiring industry to implement measures that eliminated, substituted or improved the efficiency of VOC processes, materials and systems rather than end-of-pipe pollution control treatment. In doing this, several large industrial sources of VOCs have been reduced and the facilities have benefited in the following ways:

- operational costs associated with raw materials have been reduced
- energy usage and process efficiencies have improved
- maintenance programs have improved
- process yields have improved
- fire and safety risks have been reduced.

## **Where can I find out more?**

If you require more detailed information about the existing 2003 air emissions inventory you can visit the DECCW website at [www.environment.nsw.gov.au/air/airinventory.htm](http://www.environment.nsw.gov.au/air/airinventory.htm).

Also, keep a look out for the new air emissions inventory based on activities that took place in 2008. This will be available on the DECCW website later in 2010.

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