Air pollution –
A summary of our current state of knowledge

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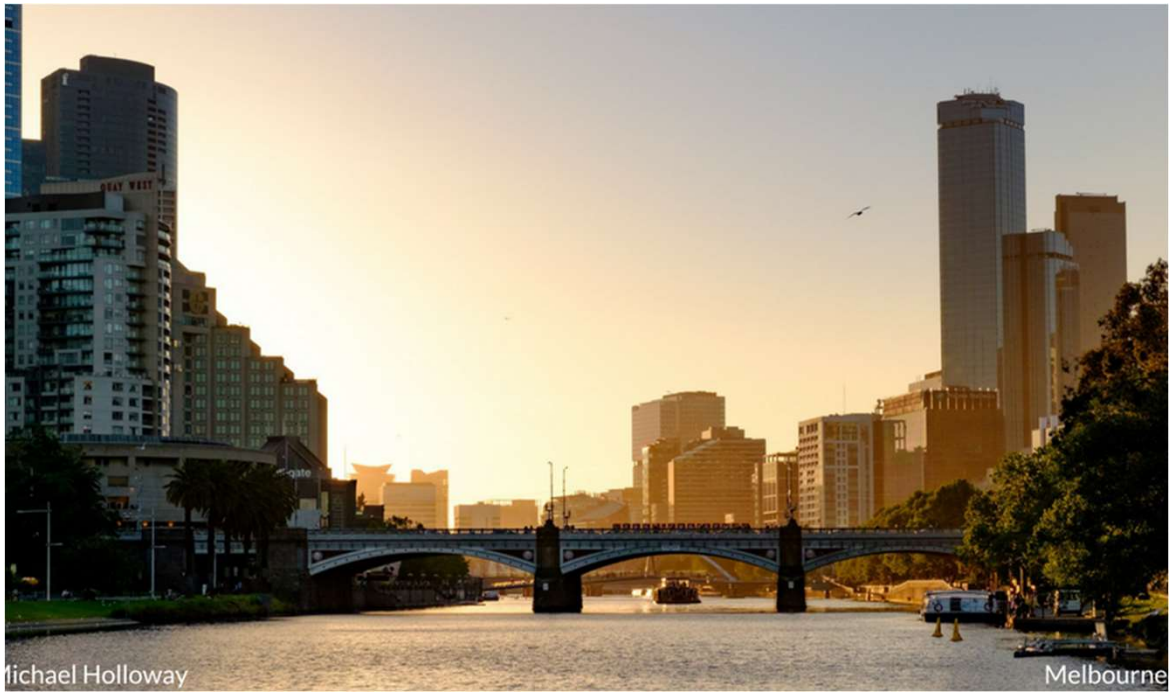
EPA VICTORIA
Environment Protection Authority Victoria

VICTORIA State Government

EPA Victoria: Who we are and why we exist

- EPA is Victoria's environmental regulator
- We exist to protect the environment and people from the harmful effects of pollution and waste
- Our job is to prevent and reduce harm from pollution and waste. We do this by:
  - holding polluters to account
  - supporting people to understand, own and address their harmful impacts on the environment
  - working with others.



Our vision

A healthy environment that supports a liveable and prosperous Victoria, now and always

EPA's role in monitoring and assessment

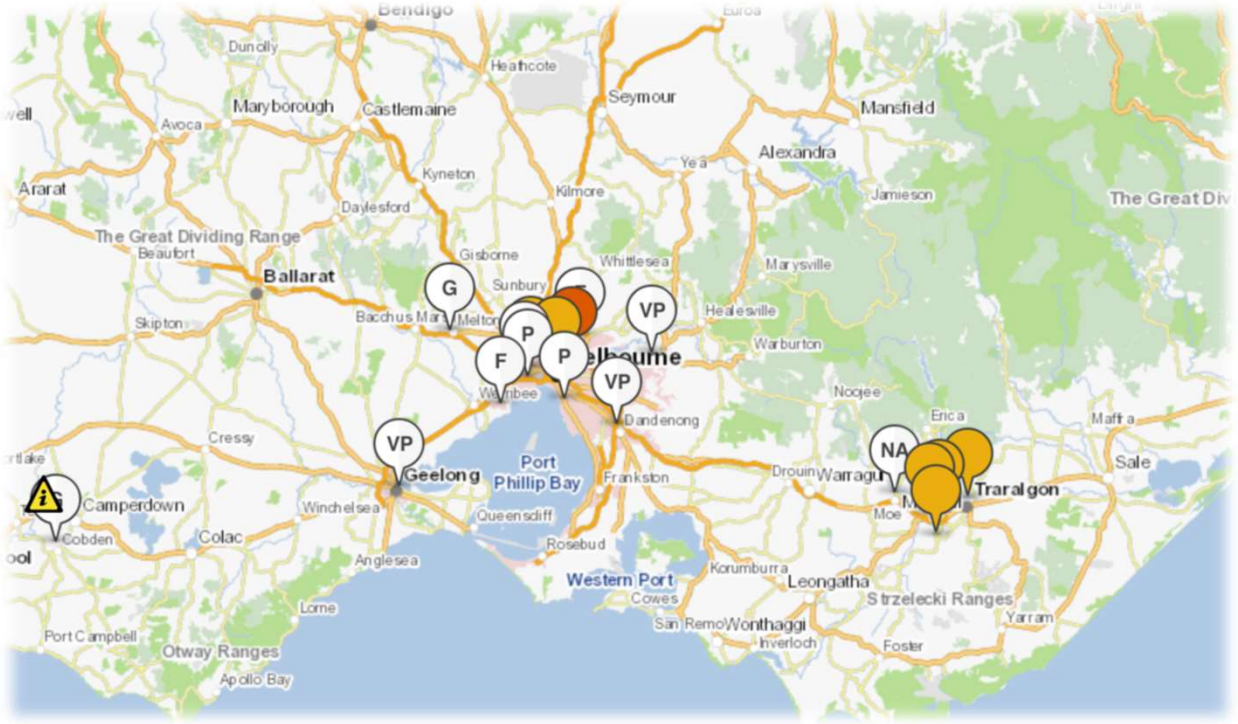
Why Monitor

- Long-term trends
- Investigation/targeting of sources
- Emergency and incident response

EPA has been monitoring air quality since 1979

What we currently monitor via our network

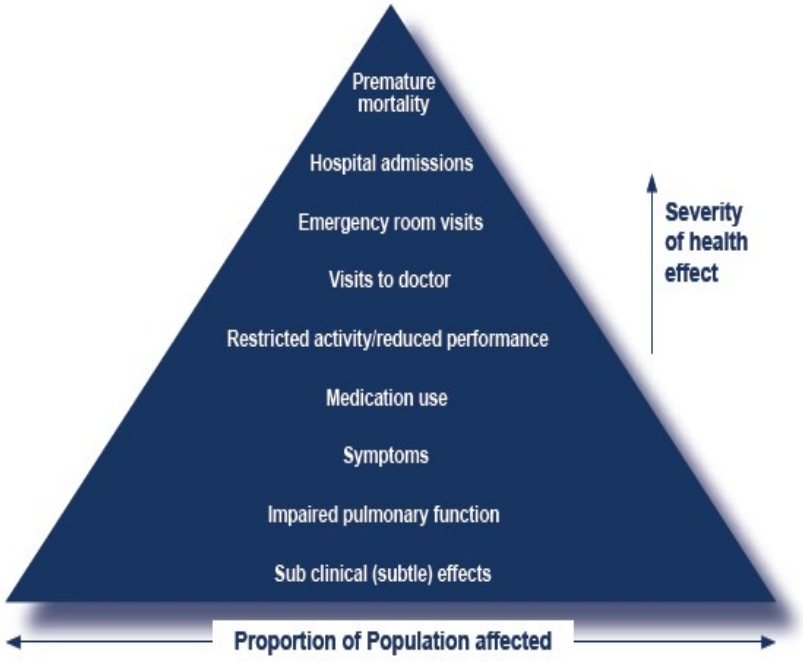
- $PM_{2.5}$ and PM_{10}
- Ozone
- Carbon monoxide
- Sulfur dioxide
- Nitrogen dioxide
- Visibility



http://www.epa.vic.gov.au/our-work/monitoring-the-environment/epa-airwatch

Air pollution and health

- Respiratory and cardiovascular effects
- Premature mortality
- Emerging evidence: Low birth weight, preterm birth, diabetes



Pollutants and their known health effects

Pollutant	Health effects (most consistently reported)
Particulate matter < 10 µm in diameter (PM_{10})	- Decreased lung function - Increased respiratory symptoms - Exacerbation of cardiac conditions, asthma and other respiratory conditions - Premature mortality - Lung cancer
Particulate matter < 2.5 µm in diameter ($PM_{2.5}$)	- Decreased lung function - Increased respiratory symptoms - Exacerbation of cardiac conditions, asthma and other respiratory conditions - Premature mortality - Lung cancer
Ozone (O_3)	- Decreased lung function - Increased respiratory symptoms - Exacerbation of asthma and other respiratory disease
Sulfur dioxide (SO_2)	- Increased respiratory symptoms - Exacerbation of respiratory disease
Nitrogen dioxide (NO_2)	- Increased respiratory symptoms - Exacerbation of asthma and other respiratory disease
Carbon monoxide (CO)	- Exacerbation of ischaemic heart disease - Decreased exercise capacity

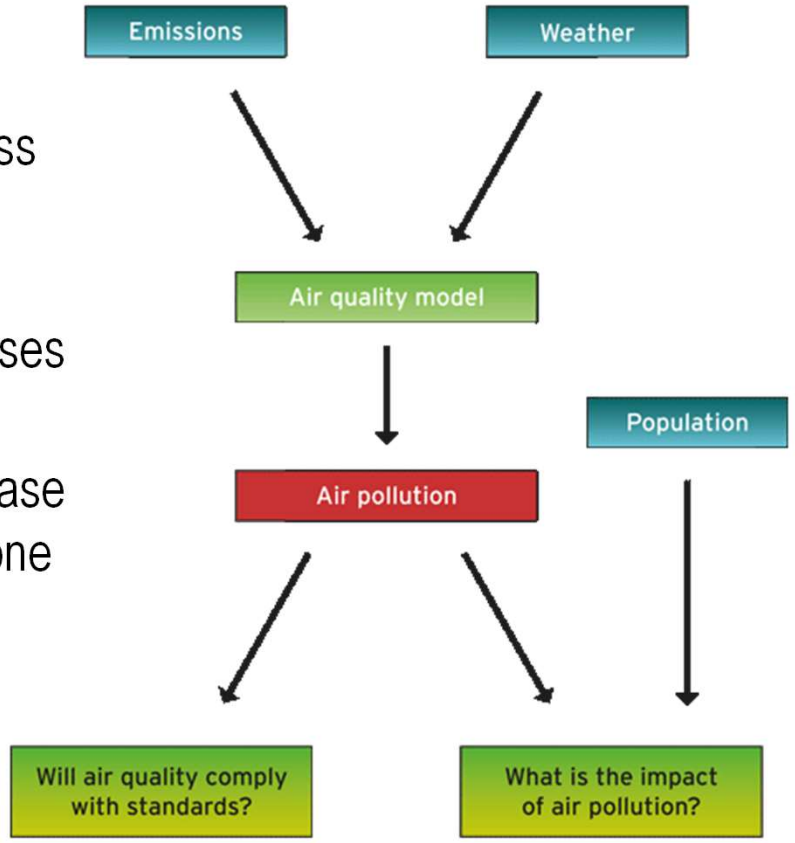
Air pollution in Victoria and Australia

- Globally, diseases caused by outdoor air pollution is estimated to have caused about 4 million premature deaths in 2015
- In Australia, air pollution estimated to account for 3000 premature deaths a year
- Annually this costs Australia approximately $11–24 billion

http://www.thelancet.com/commissions/pollution-and-health

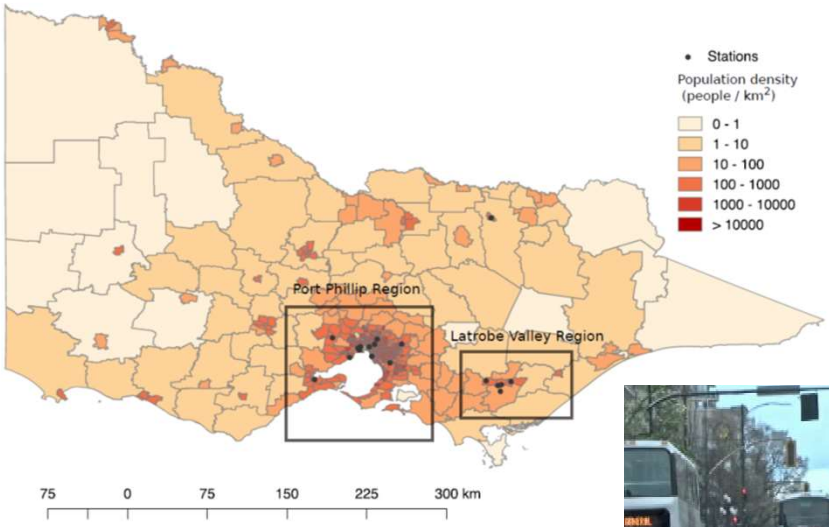
Future scenarios for air quality

- Changes in vehicle technology and population.
- Significant increases expected in domestic and business emissions due to population growth Melbourne and Geelong areas between 2006 and 2030.
- Climate change is predicted to cause significant increases in summer smog (ozone).
- In the most likely future scenario, there will be an increase in population exposure to fine particles ($PM_{2.5}$) and ozone (O_3) between 2006 and 2030.



Challenges for Victoria

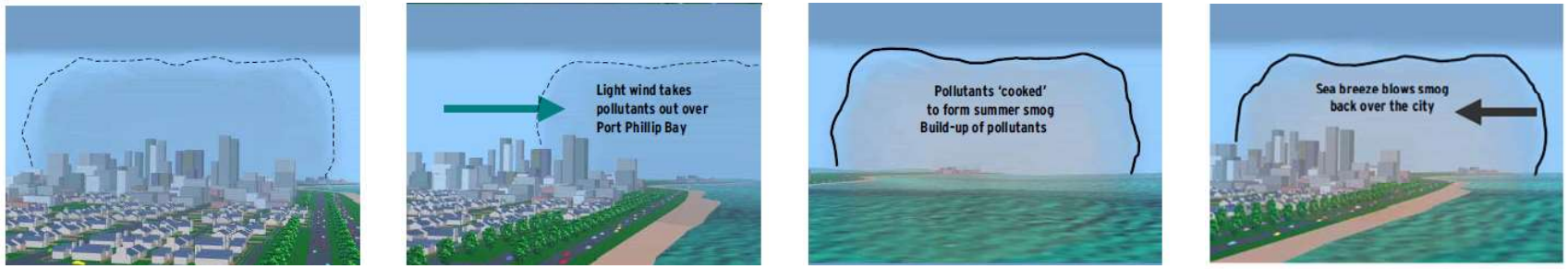
- Changes to the economy and industry
- Increasing population
- Urban densification
- Increasing traffic
- Environmental and climate change
- Increased health impacts



Particulate matter

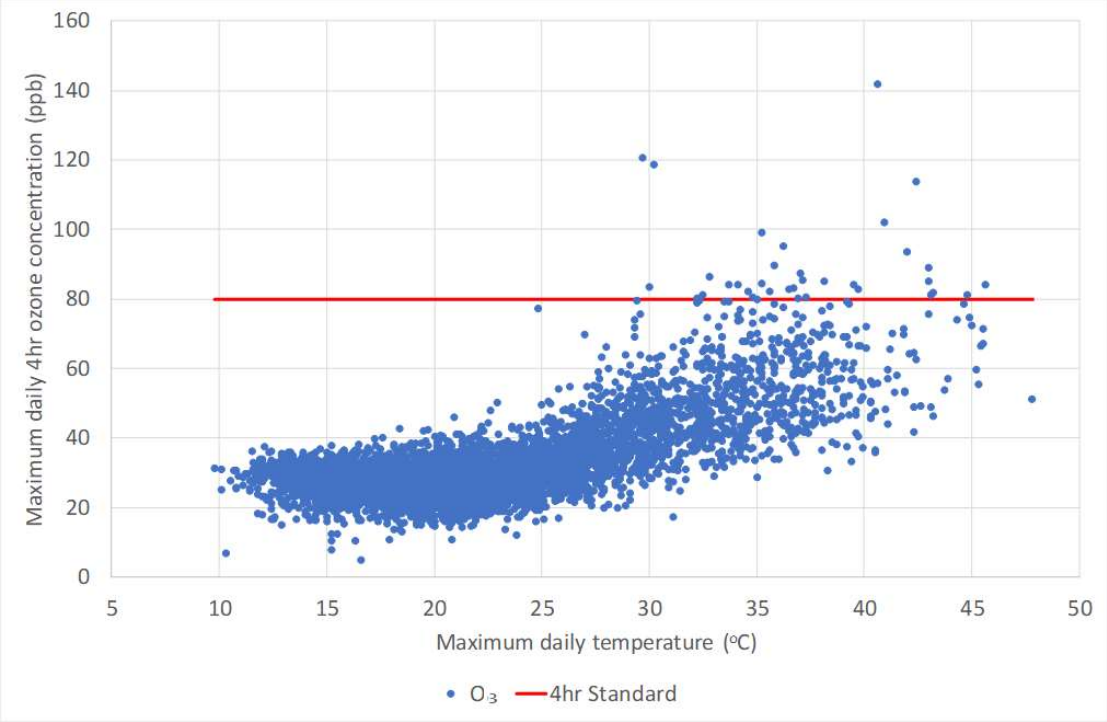
- Particulate matter is a mixture of solid particles and liquid droplets found in the air.
- These particles come in many sizes and shapes and can be made up of hundreds of different chemicals.
- Some are emitted directly from a source, some produced as secondary pollution
- Size fraction ie PM_{10} vs $PM_{2.5}$ and composition will vary depending on the source.

Ozone formation



- Ozone is a secondary pollutant
- Primary constituent of photochemical smog
- Formed by complex reactions between NOx and VOCs in atmosphere in presence of sunlight

Ozone – trends



Sources we know about

$PM_{2.5}$, CO, NOx VOCs	 Wood heaters and other indoor sources
$PM_{2.5}$, CO, NOx VOCs	 Bushfires, planned burns
$PM_{2.5}$, PM_{10} CO, NOx, SO_2 VOCs	 Motor vehicles, tail pipe and raised dust
Dependent on industry	 Industrial sources
Dependent on industry	 Commercial sources

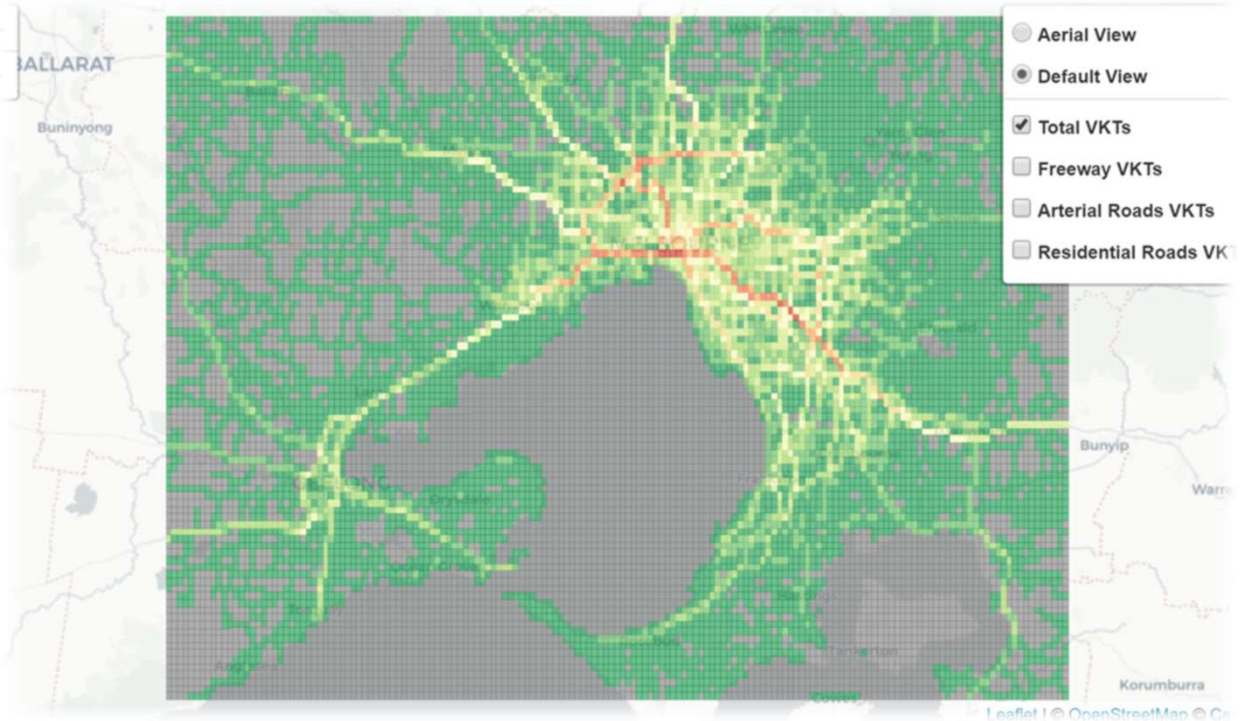
Spatial distribution of wood heaters in Port Phillip Region

Update to EPA's emissions inventory

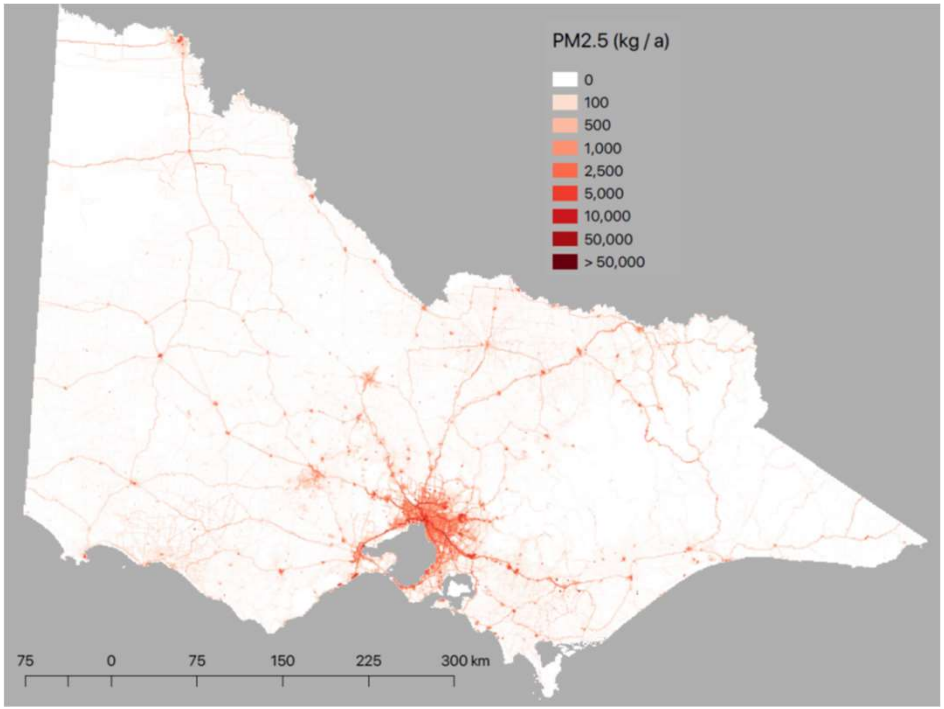
Emissions inventories are a database of where emissions are occurring

Can be used as an input into models of where particles are going

Limitation is that they can only tell us about things we already know about



Emissions inventory – early findings



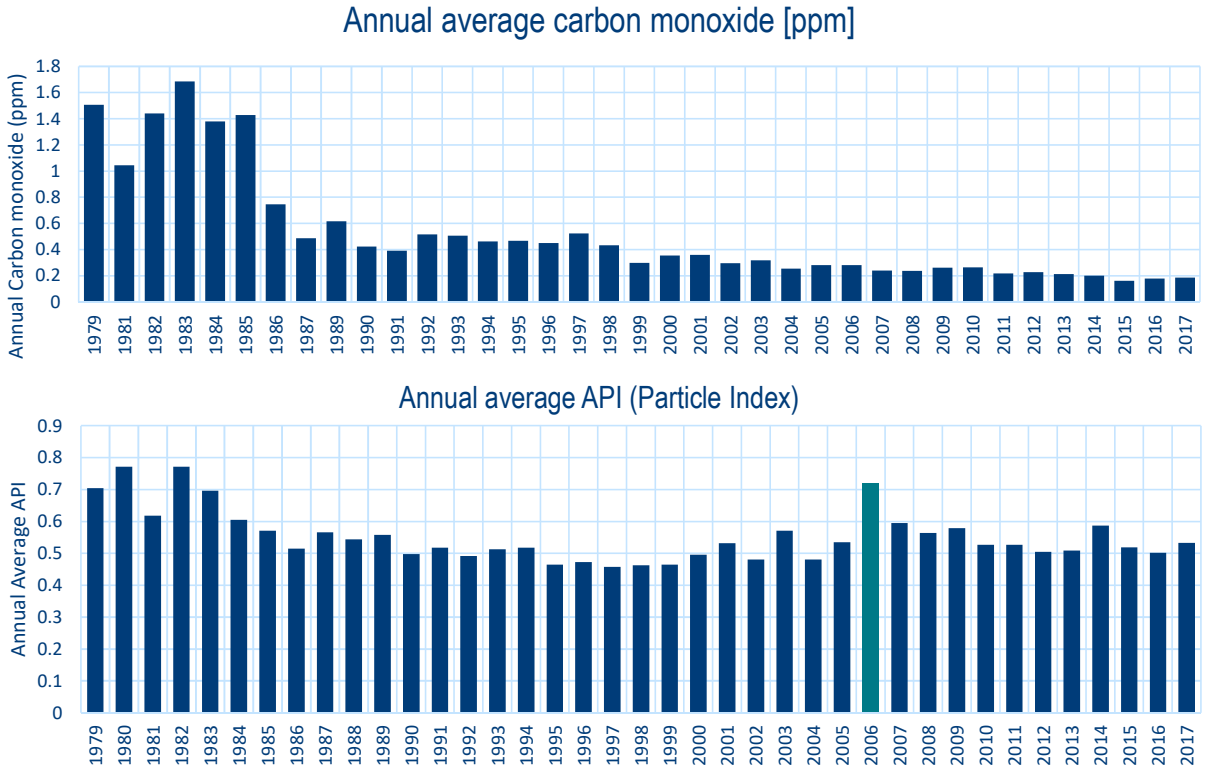
2016 $PM_{2.5}$ kg/m^2/annum

Air quality trends

Some things have improved over time

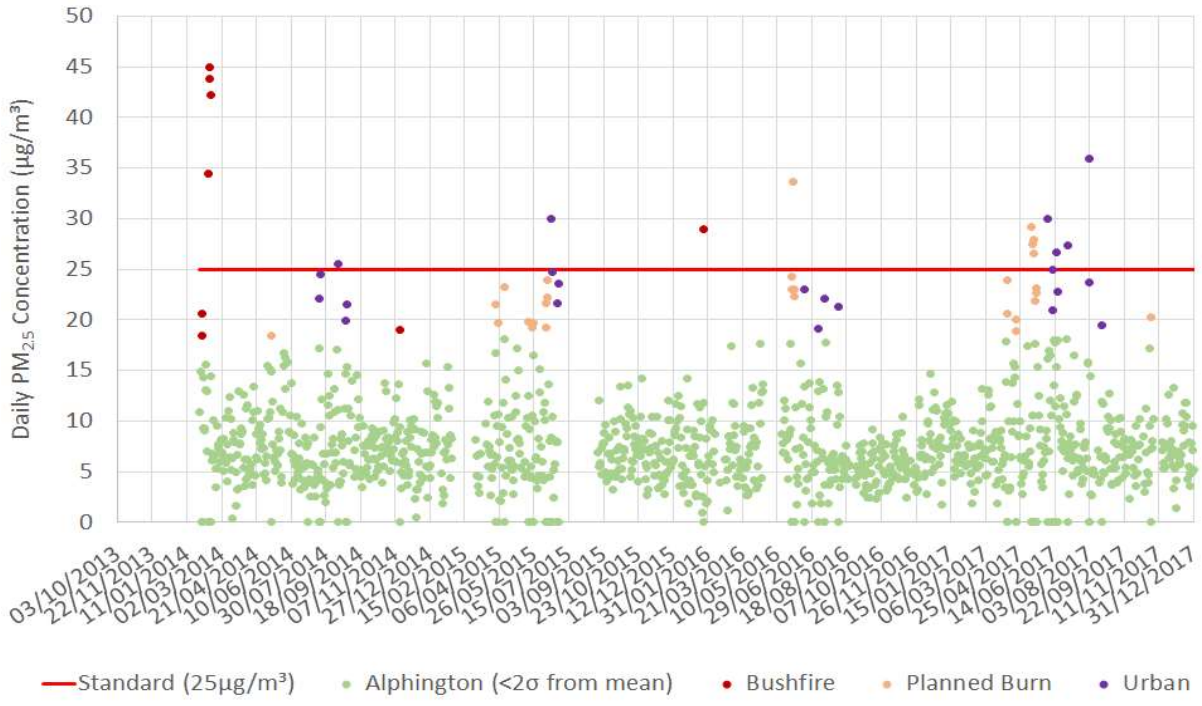
Others have remained similar

Trends can be sensitive to large scale events



$PM_{2.5}$ - trend

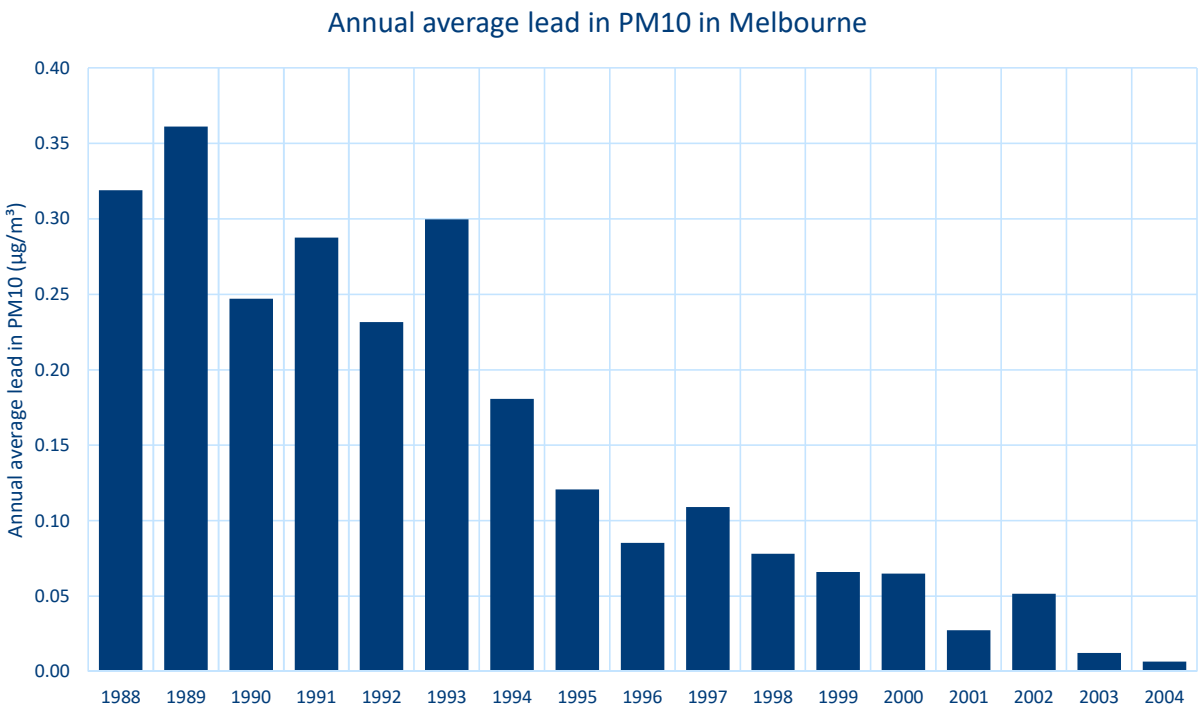
No real trend in $PM_{2.5}$ concentrations over time



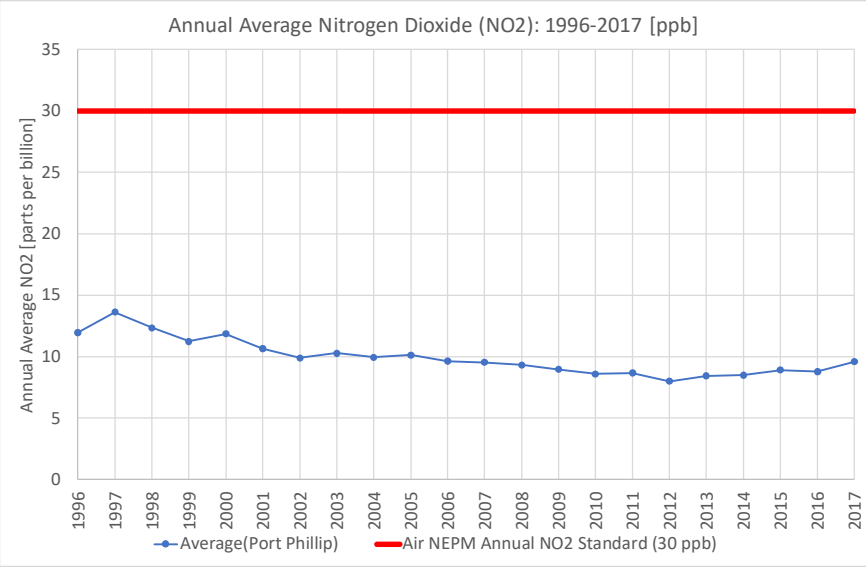
Lead in PM_{10}

Lead in petrol was identified as the primary source of lead in Melbourne.

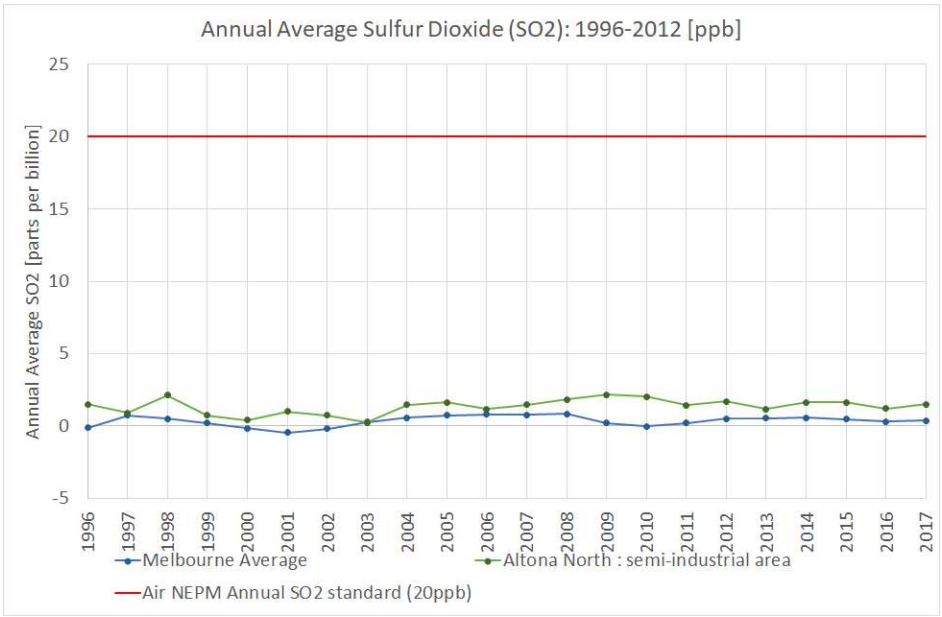
Once leaded petrol was phased out there was no longer a need to monitor for it after 2004



NO_2 and SO_2 - trends

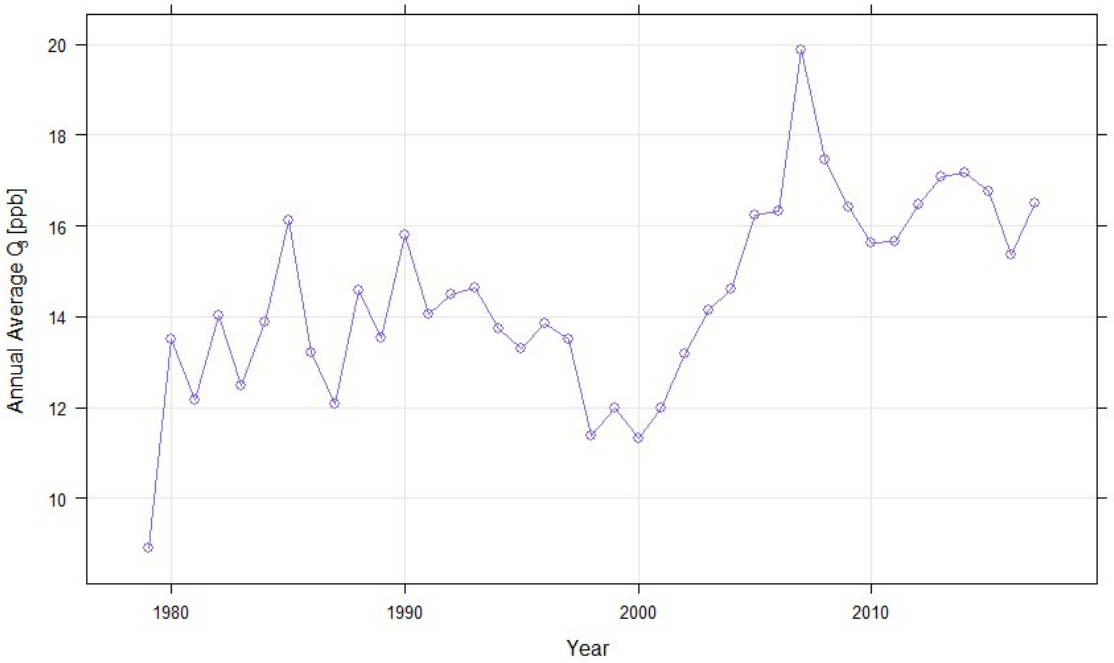


Nitrogen dioxide – average of long-term Melbourne sites



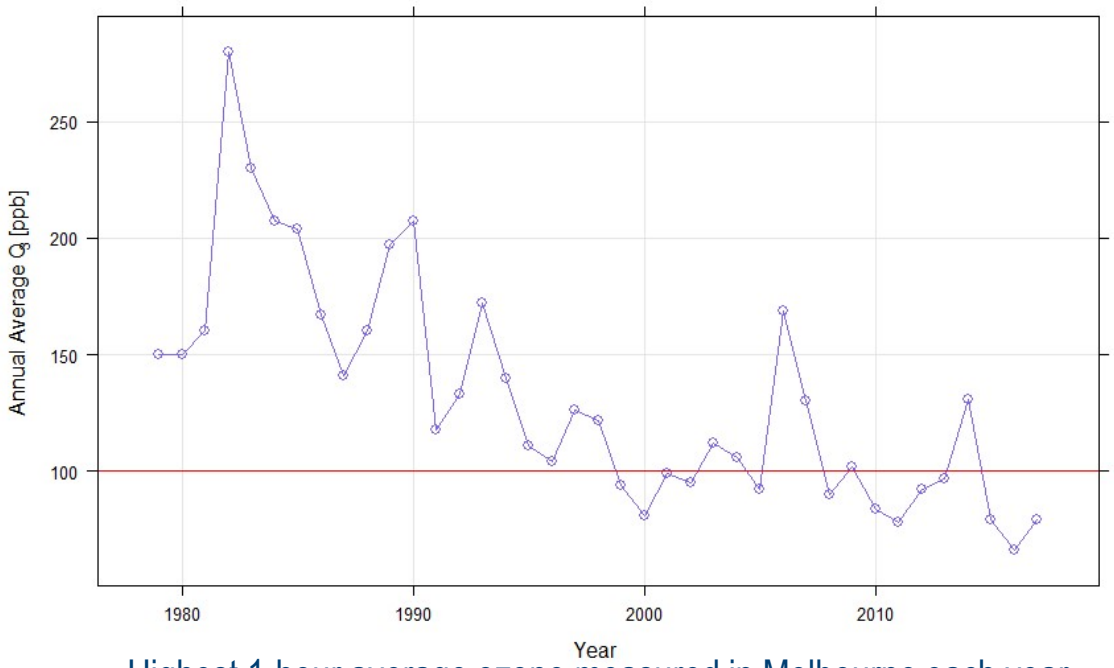
Sulfur dioxide – annual average of long-term Melbourne sites, 1996–2017

Ozone – trends



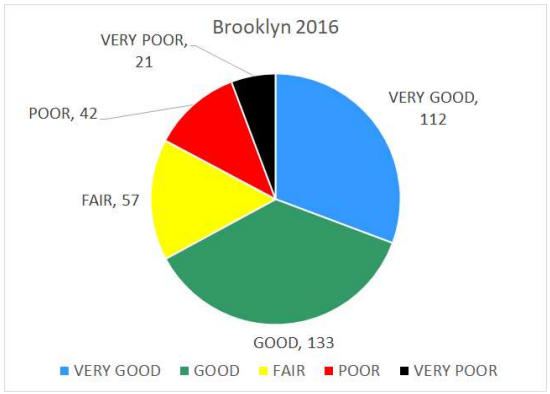
Annual average of long-term Melbourne sites has gradually increased from 1979–2017

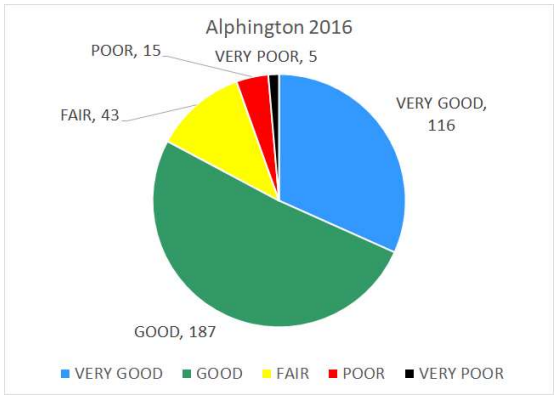
Ozone – trends

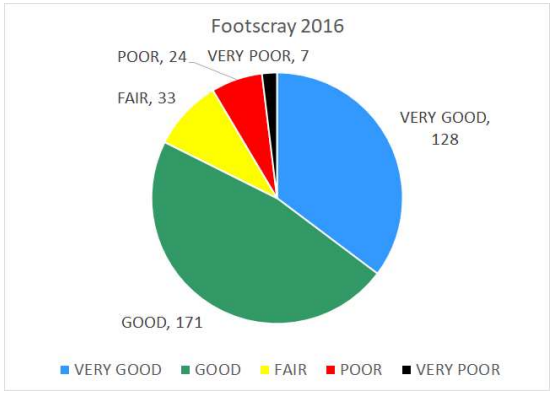


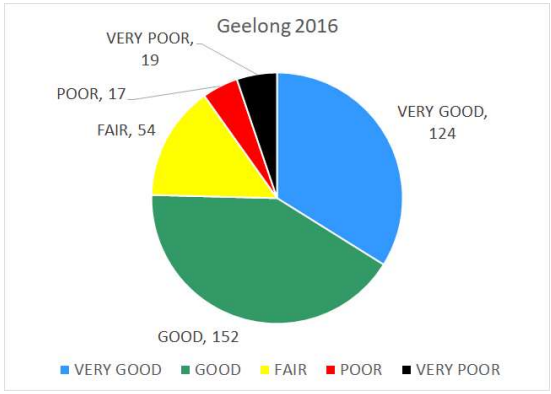
Highest 1-hour average ozone measured in Melbourne each year since 1979

Distribution of days across air quality categories



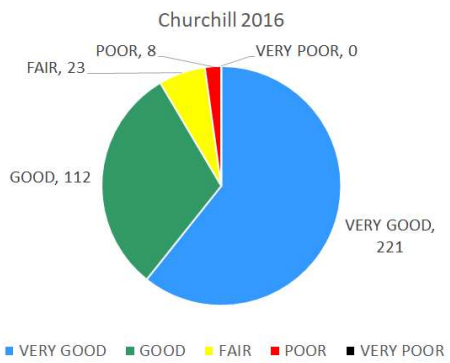


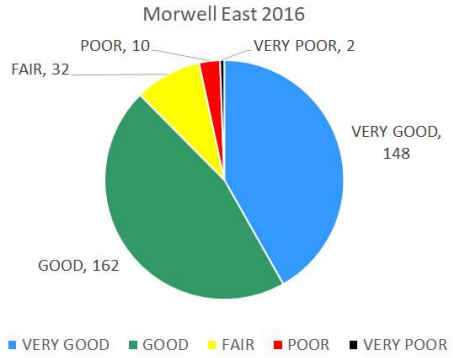


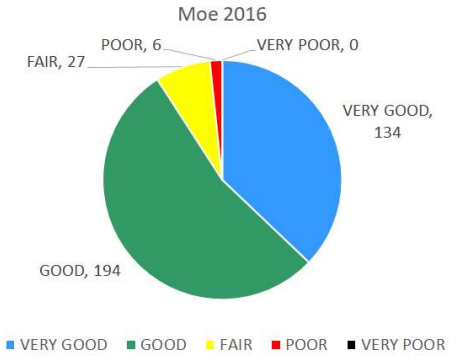


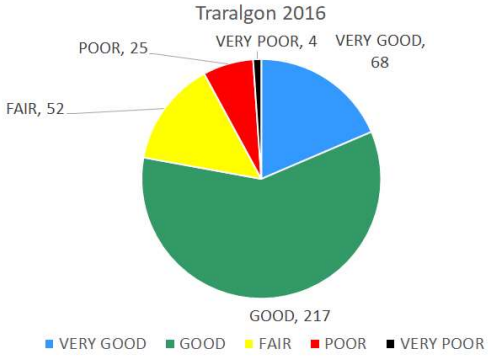
Port Phillip Region

Distribution of days across air quality categories









Latrobe Valley

Sources we need to know more about

Sea salts and other natural sources

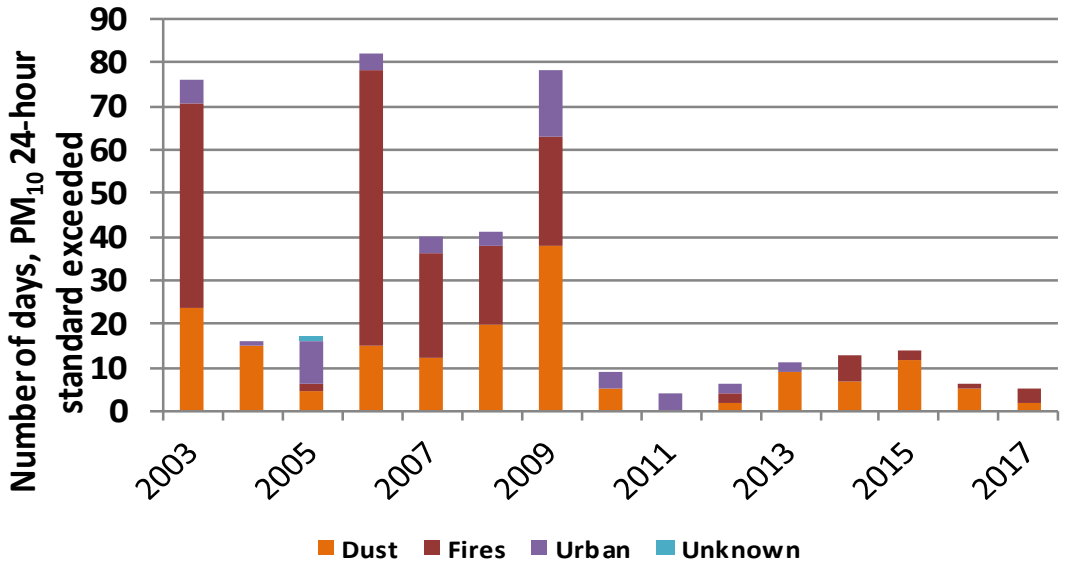
Industrial accidents / major fires

Road emissions from electric vehicles

Indirect formation of particles

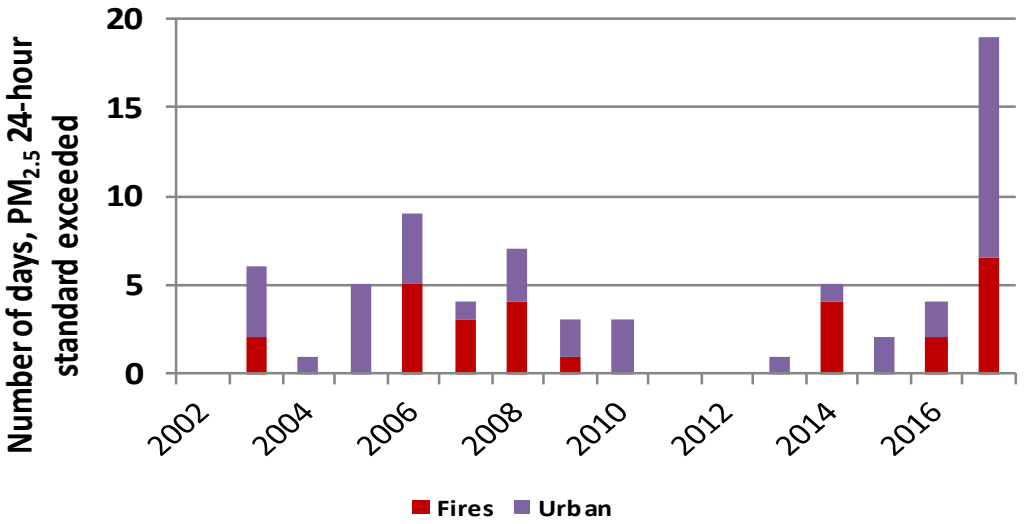
What else?

PM_{10} events at Port Phillip NEPM monitoring sites



Source attribution of PM_{10} events at Port Phillip NEPM monitoring sites (2002–2017)

$PM_{2.5}$ events at NEPM monitoring sites



Source attribution of $PM_{2.5}$ events at NEPM monitoring sites (2002-2017)

Health benefits of reducing air pollution

- Increasing evidence of measurable health benefits from actions to reduce air pollution
- Co-benefits of improving air pollution

Future of air quality science at EPA

- Make our data more accessible
- \+
- Looking at existing data in a different way (Modelling Population Exposure)
- \+
- Developing new knowledge (spatial extent, sources, interventions)
- \+
- New technologies and approaches
- \+
- Citizen science

→ Leads to a better understanding of air quality

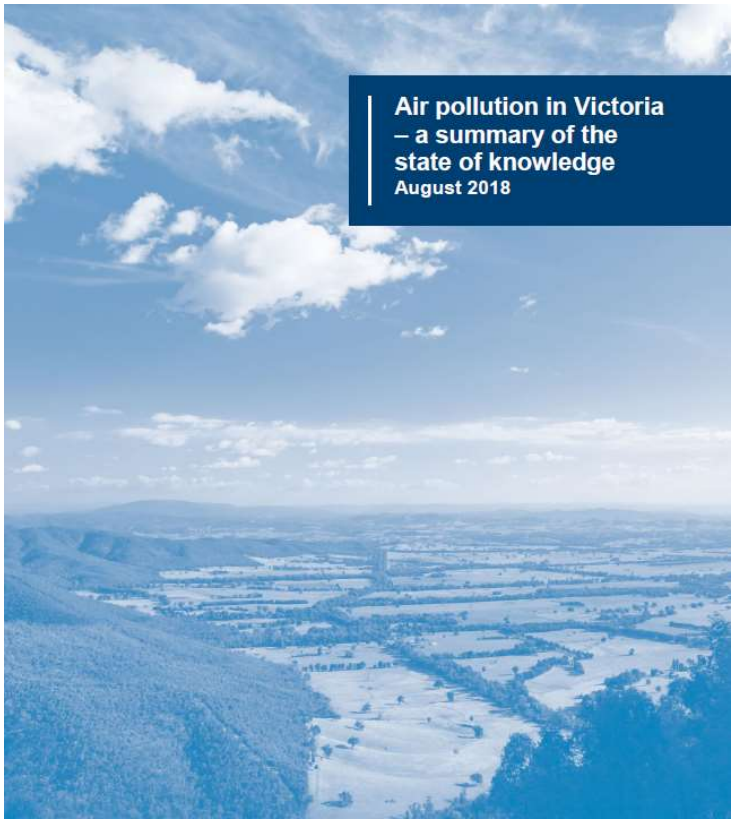
Air pollution in Victoria

Air pollution in Victoria – a summary of our current state of knowledge

Available on EPA's website at:

www.epa.vic.gov.au/AQreport

Publication number: 1709




Questions

Thank you

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