Overview

- What is air pollution?
- What are the health effects of air pollution?
- What are the health impacts of ship emissions?
- What are we doing to quantify the effects of ships in NSW?
Air pollution

- A complex mixture of particles (PM) and gases
  - PM$_{2.5}$ and PM$_{10}$
  - SO$_2$
  - NO$_2$
  - Ozone
  - Toxics (mainly related to specific sources)

- Important sources include cars, trucks, industrial processes, wood heaters and ships

- Inevitably, urban exposure is to pollutants from multiple sources
London smog
Bell and Davis 2001

Health Effects

Figure 1. Approximate weekly mortality and SO₂ concentrations for Greater London, 1952–1953.
6 Cities Study – Dockery et al. 1993
6 Cities Study – Dockery et al. 1993
ACS study

Pope et al. 2003

51 US cities, ~500,000 participants
Lung function in children in 12 California towns

Gaudermann et al. 2004

Figure 3. Community-Specific Proportion of 18-Year-Olds with a FEV₁ below 80 Percent of the Predicted Value Plotted against the Average Levels of Pollutants from 1994 through 2000.
Health effects

- PM$_{2.5}$ causes cardiopulmonary disease
- Exposure to SO$_2$ and NO$_2$ are also associated with mortality, respiratory and cardiovascular disease
- IARC has recently said outdoor air pollution and diesel exhaust are “Group 1” carcinogens (ie carcinogenic to humans).
Thresholds

- No evidence of a threshold
- Recent studies have demonstrated PM$_{2.5}$ has health effects at levels below those measured in NSW
- Any reduction in exposure will produce benefit

Crouse et al. 2012
Particle size, type and source

- Current evidence supports management of PM on the basis of particle size (e.g. PM$_{2.5}$ and PM$_{10}$) and duration of exposure (i.e. 24hr average levels and annual average).

- There is some evidence that particles of different types (e.g. black carbon, transition metals) have different effects. This evidence is currently insufficient to inform management.

- Any reduction in exposure will produce benefit.
The health impact of ships

~ 83,500 premature deaths from cardiopulmonary causes worldwide (Winebrake et al. 2009)
Quantify emissions from ships

Calculate dispersion

Quantify exposure

Apply concentration response functions to estimate health risks

Change in PM$_{2.5}$ exposure

Population data (size and age)
Questions