



20/20 **All** Actuaries

Virtual Summit

Through the consumer lens

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When the air becomes toxic: The health costs of air pollution and bushfire smoke

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Overview

- Australia has had good air quality compared to OECD
- Some poor air quality 'hotspots'
 - **Upper Hunter** - global sulphur dioxide hotspot due to power stations and industries burning coal and oil^{1,2}
 - **Liverpool, Sydney** - exceeded annual national air quality standards in 2010-11 for exposure to particulate pollution by 25%³
- Air pollution adversely affects respiratory, immune and cardiovascular health
- There is no 'safe' level of air pollution
- Climate change will worsen air quality and health risks

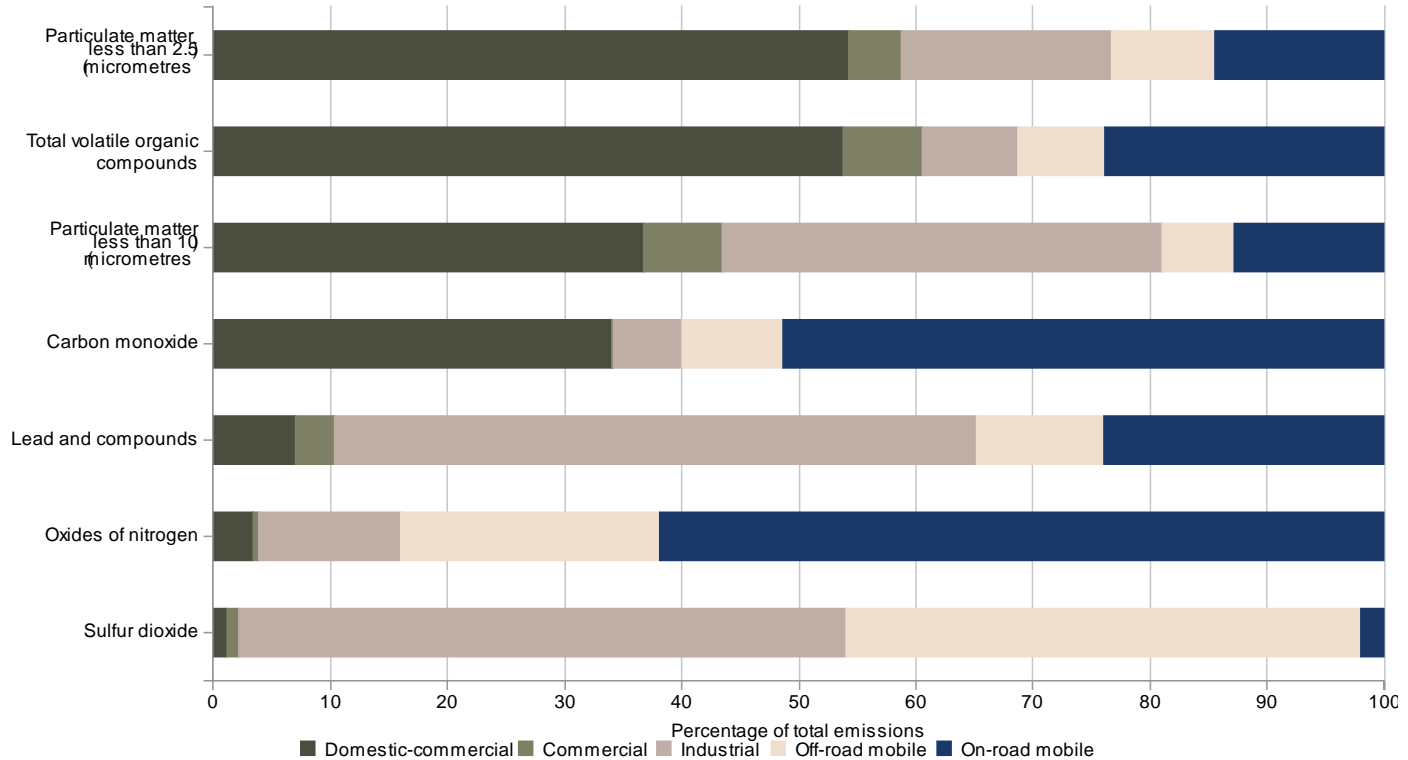
This presentation

1. Air quality in Sydney before and during the 2019-20 "Black Summer" fires.
2. Where do those most vulnerable live?
3. The health costs of poor air quality
4. Policy implications

Section 1

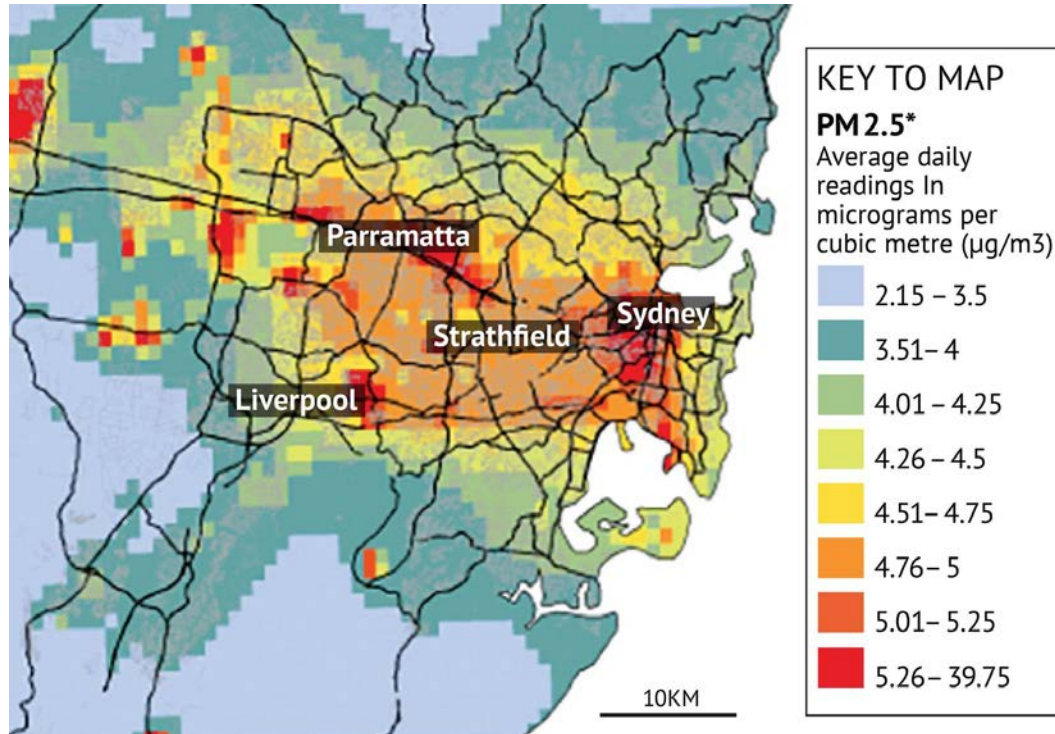
Air pollution & Black Summer

Sources of Air Pollution



Source: 2016 State of the Environment report <https://soe.environment.gov.au/theme/ambient-air-quality/topic/2016/pollution-sources>

Average daily PM2.5 in Sydney



- Worst inland - due to sea breezes, topology of Sydney, industrial activity & higher density living⁶
- Pollutants from traffic and industrial facilities can impact large areas and cause adverse health risks⁷
- Average daily PM2.5 Liverpool 2010-11 $10.1 \mu\text{g}/\text{m}^3$
National standard $8 \mu\text{g}/\text{m}^3$ ³

Quiz Time

Q1

Main sources of PM2.5 emissions

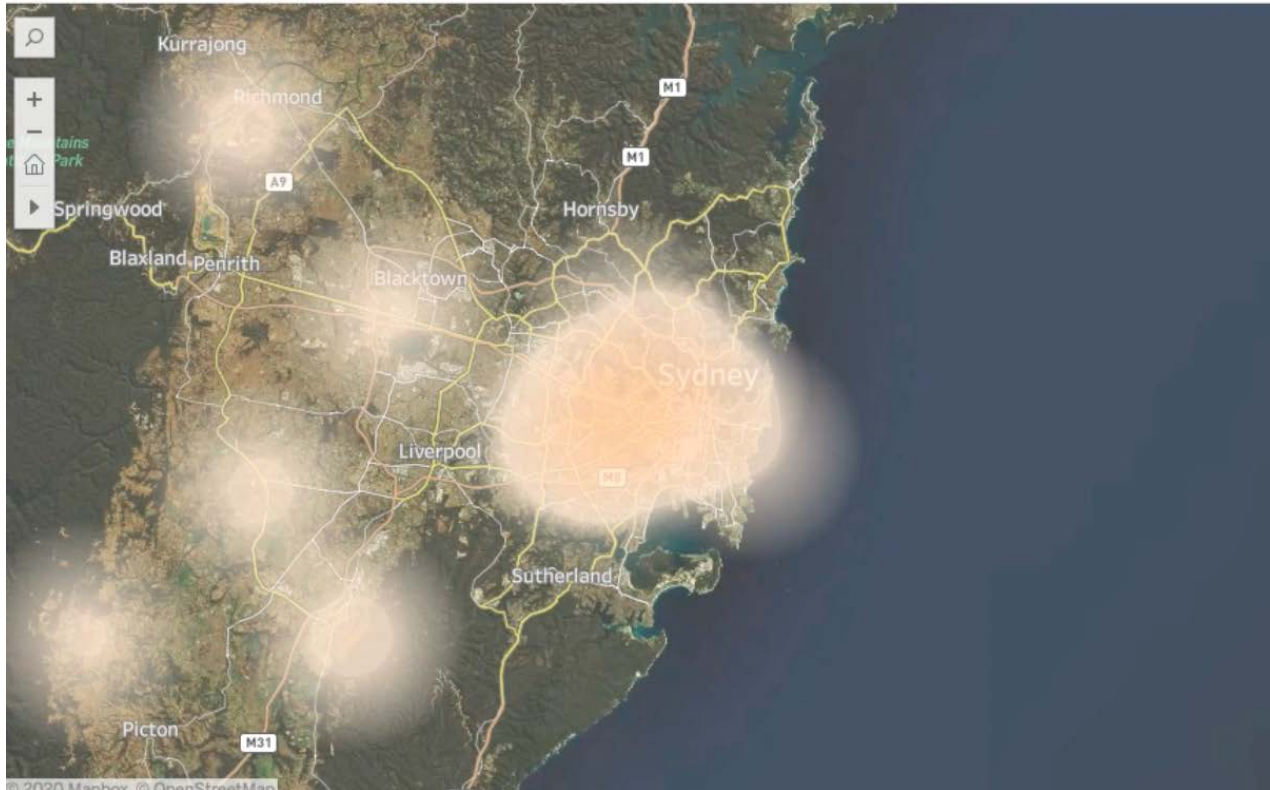
Activity	% PM2.5 Emissions Sydney 2013
Residential Wood Heating	36%
Prescribed Burning and Bushfires	26%
Shipping	5%
Road, Brake & Tyre Wear	4.5%
Diesel Vehicle Exhaust	4.5%



Worse 'daily peaks', but 2nd overall in 2013.
 Significantly higher in 2019-20 Black Summer bushfires

Concentration of PM2.5 in Sydney

Weekly Maximum PM2.5 levels for Sydney Monitoring Stations - January 7, 2019



- Changes in weekly maximum levels of PM2.5 in Sydney from 2019 – February 2020
- Seasonal fluctuation in PM2.5 concentration
- Spikes in high PM2.5 shown to start in October 2019
- PM2.5 slower to disperse in Western Sydney

Source: Authors' compilation of NSW Department of Planning, Industry, and Environment data

Black Summer vs Air pollution guidance

- WHO Air quality guideline values for PM2.5
 - 10 $\mu\text{g}/\text{m}^3$ annual mean
 - 25 $\mu\text{g}/\text{m}^3$ 24-hour mean (daily average)
- Canberra daily average 1 January 2020: 855.6 $\mu\text{g}/\text{m}^3$ - **34x** guideline
- Sydney November 2019: 790 $\mu\text{g}/\text{m}^3$ - **31x** guideline
- Black Summer 2019-20 Sydney:
 - Hazardous on 28 days (PM2.5 \geq 200 $\mu\text{g}/\text{m}^3$ or **8x** guideline)
 - Very poor on 21 days (PM2.5 \geq 37.5 $\mu\text{g}/\text{m}^3$ or **1.5x** guideline)
 - Poor on 32 days (PM2.5 \geq 25 $\mu\text{g}/\text{m}^3$ or over the WHO guideline)

Section 2

Air pollution & Health

Air pollution and health

PM2.5 can penetrate lung barrier and enter blood system

Short-term exposure to low levels of PM2.5 increases risk

- Risk of cardiac arrest increases 4% per 10-unit increase in PM2.5 levels
- Over 90% of cardiac arrests occurred at levels $<25 \mu\text{g}/\text{m}^3$ ¹⁰

Chronic exposure increases risk of

- Cardiovascular disease, respiratory disease and lung cancer
- Affects reproductive, urological and neurological systems^{10,11,12}
e.g. decreased birth weight of babies exposed in utero^{13,14}
- **COVID-19** infection and serious illness¹⁵. 1 $\mu\text{g}/\text{m}^3$ extra PM2.5 associated with 15% higher death rate¹⁵.

Air pollution and health

Extreme exposures are less well understood.

- 2014 Hazelwood power station fire
- Covered surrounding areas in smoke for 6 weeks.
- Victorian DHHS longitudinal study (see <https://hazelwoodhealthstudy.org.au/>) found:
 - respiratory symptoms more than a year after exposure in **adults**
 - respiratory tract infections and small increases in lung stiffness among **children** exposed to smoke either in utero or in their first two years of life

Who is vulnerable to air pollution?

Research identifies risk factors that increase vulnerability to air pollution.

Eg:

- living in a walkable local area means lower risk of chronic diseases, such as obesity, diabetes, heart disease²².
- High road density is inversely correlated with walkability²³.

Risk Factor	References
Pregnant women	16,17,19,20
Children	16,17,19,20
Elderly people	10,16,17,19
Socioeconomic status	16, 18,
Comorbidities	16,17,19,20
Gender	19
Neighborhood walkability and road density	22,23,24,25

Air Pollution Vulnerability Index

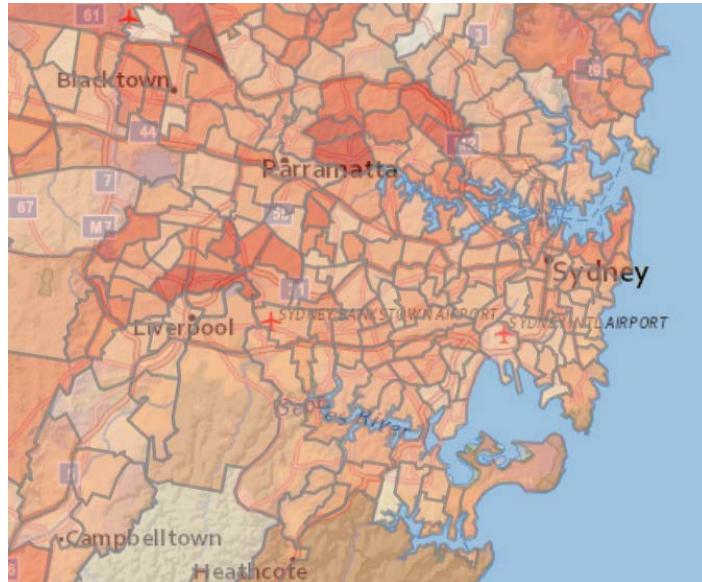
- Risk factors (SA2 geographic level, 2016)
 - Comorbidity (proxy: age standardised diabetes rate)
 - Socio-Economic Index for Areas (SEIFA)
 - Proportion of residents aged over 65
 - Proportion of residents aged 4 or under
 - Road density (km/km²)

Air Pollution Vulnerability in Sydney

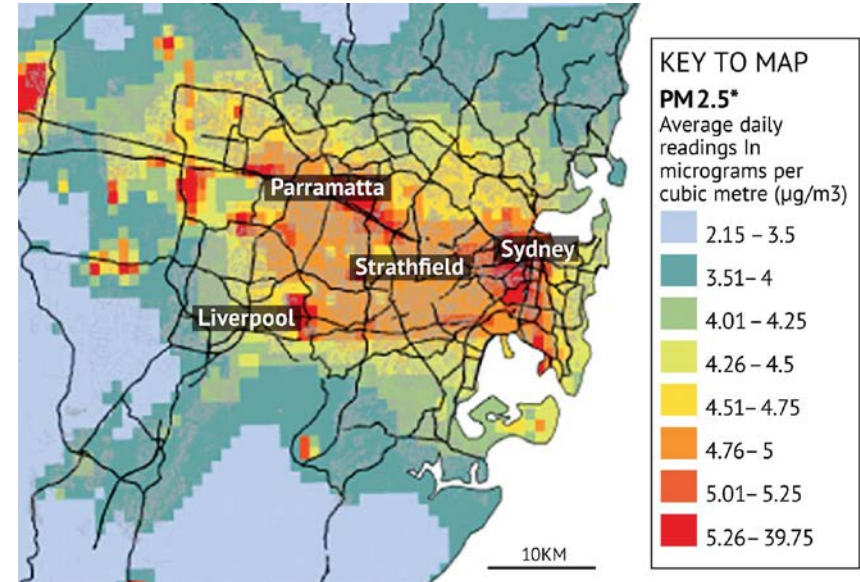


Vulnerability vs Exposure

Vulnerability



PM2.5 Levels



Vulnerability vs Exposure

- Greater Western Sydney contains many vulnerable areas.
 - Air pollution is also worse west of the CBD
 - Population of Western Sydney will be 3 million by 2036²⁶.
 - This will increase emissions and further impact future air quality across the Sydney basin²⁶
- Adaptive capacity of Greater Western Sydney already challenged. eg: urban heat island challenges²⁷

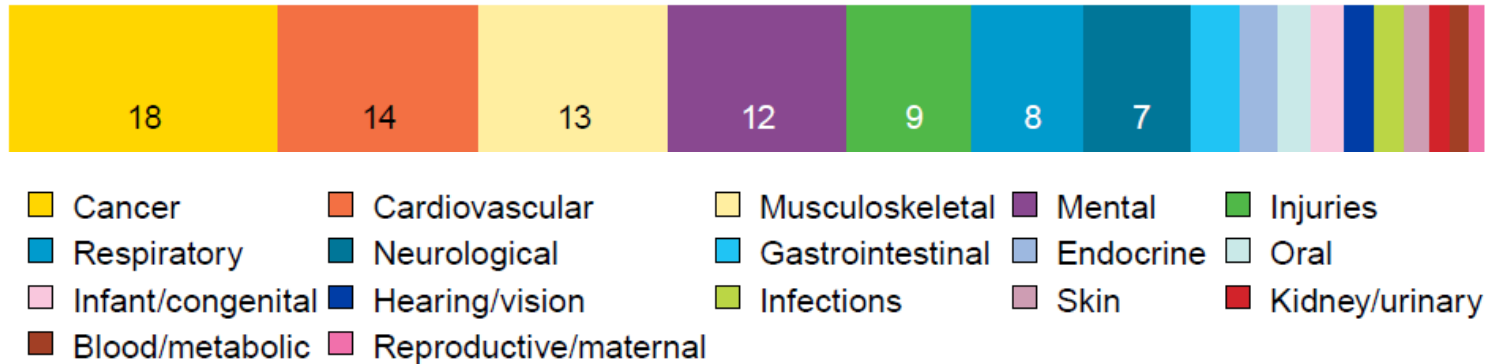
Section 3

Health costs of air pollution

AIHW Burden of Disease Study

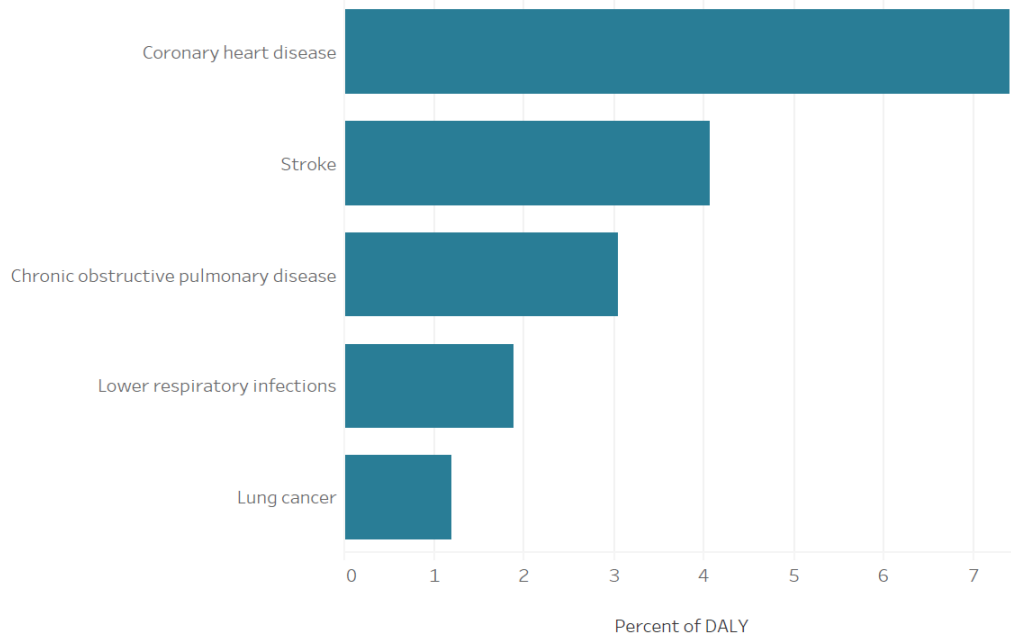
- Estimates for each Disease: Deaths, Years of Life Lost, Years Lived with a Disability, Disability Adjusted Life Years (DALYs)

% of total burden by disease group, 2015



Health Burden of Air Pollution 2015

Percent of DALY due to Air pollution in Persons, 2015



Air pollution included as a Risk Factor for first time in 2015

Links to 5 diseases + asthma

0.8% disease burden ~ 40,000 DALYs

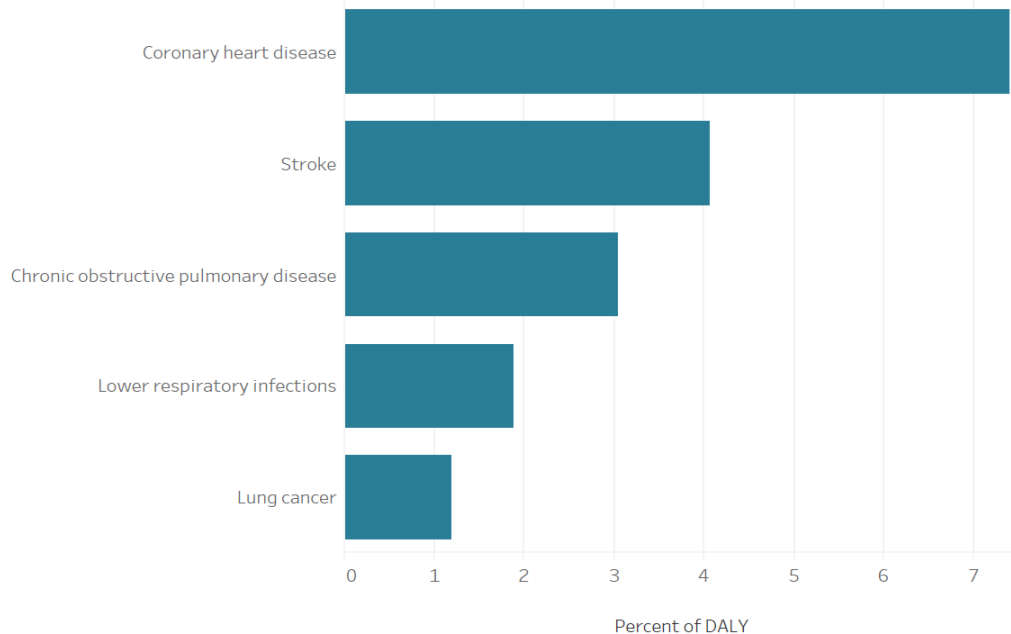
1.6% of deaths ~ 2,700 deaths

Quiz Time

Q2

Health Burden of Air Pollution 2015

Percent of DALY due to Air pollution in Persons, 2015



Air pollution included as a Risk Factor for first time in 2015

Links to 5 diseases + asthma

0.8% disease burden ~ 40,000 DALYs

1.6% of deaths ~ 2,700 deaths

Comparable to

- sun exposure
- intimate partner violence
- opioid use
- amphetamines

Additional health impacts 2019-20

Immediate effects of bushfire smoke 2019-20 estimated as ³⁰



- an **excess 400 deaths**
- over **3,000 hospital admissions** for cardiovascular and respiratory conditions
- over **1,300 emergency presentations** for asthma

Estimated impact in 2019-20

	'Typical' air pollution levels	Extra cost of bushfire smoke
Hospitalisations	~25,000 hospital admissions	3,151 hospital admissions 1,305 asthma presentations
Deaths	~2,700	416
DALYs	40,347	6,213
Health Expenditure \$m	\$283 million	\$37 million
Burden of Disease \$b	\$8.1 billion	\$1.2 billion

Data Sources:

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2. AIHW Australian Burden of Disease Study 2015
3. AIHW Australian Hospital Statistics 2018-19
4. AIHW Disease Expenditure in Australia 2015-16
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Section 4

Policy implications

Will air pollution be better or worse?

Worse

- ↑ Population growth
- ↑ Bushfires & Burn-off
 - Extreme fires 30-80% more likely than a century ago
 - 5x more likely avg temp rise 2°C⁵
- ↑ Heat waves
 - stagnant air, surface ozone

Better

- ↓ Car emission
- ↓ Renewable energy

? Wood fires ?

Policy implications



Tackle Climate Change

- Include future healthcare costs in decision-making
- Switch to renewable can also address air pollution



Reduce air pollution near populations

- Can we better manage burn-offs?
- Emissions management
 - wood smoke
 - vehicles
 - industrial



Manage health risks

- Advice: high pollution days
- Preventative health eg: asthma plans
- Transparency: high pollution zones

Questions

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