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Melbourne Energy Institute

Air pollution from fossil fuels: A public health policy gap

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Mitigating the health impacts of air pollution in Australia. From research to policy.

Acknowledgment of the traditional owners

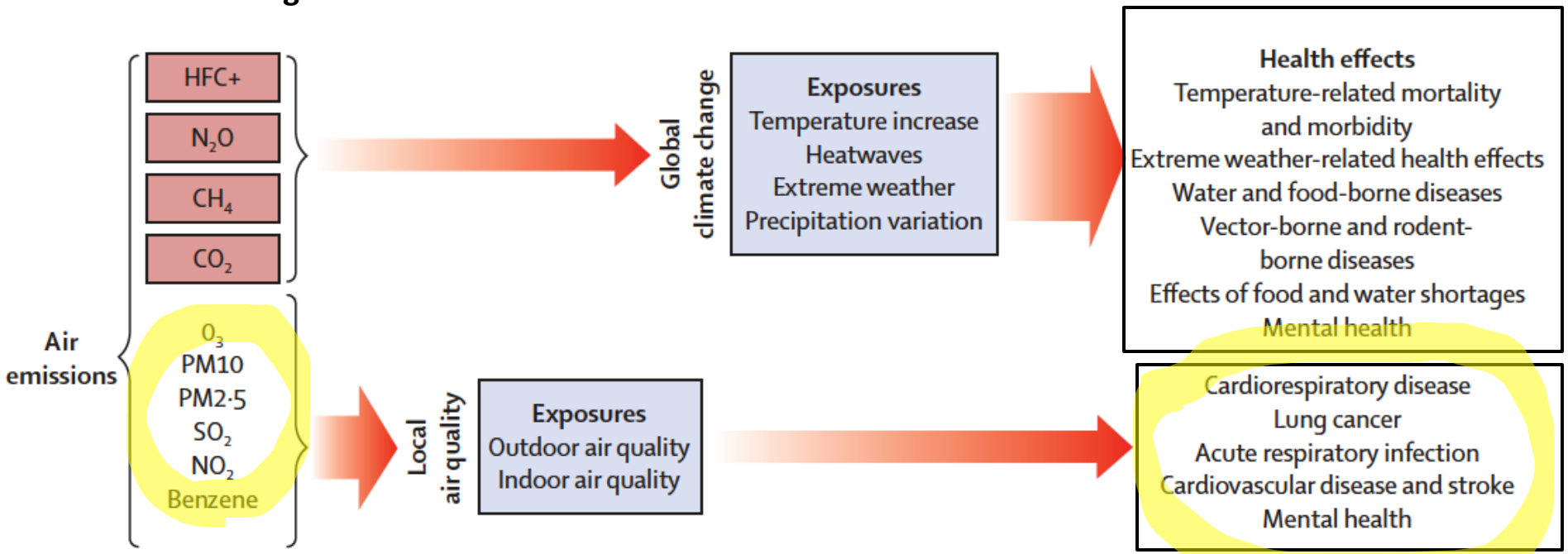
Good health includes

physical, ***social,***
emotional, cultural, spiritual
and ecological wellbeing,
for both the individual and the community.

These factors are **connected**

Air pollution: *the presence in or introduction into the air of a substance which has harmful effects.*

Longer-term, global
"Indirect"; less easily attributable
Structural change measures



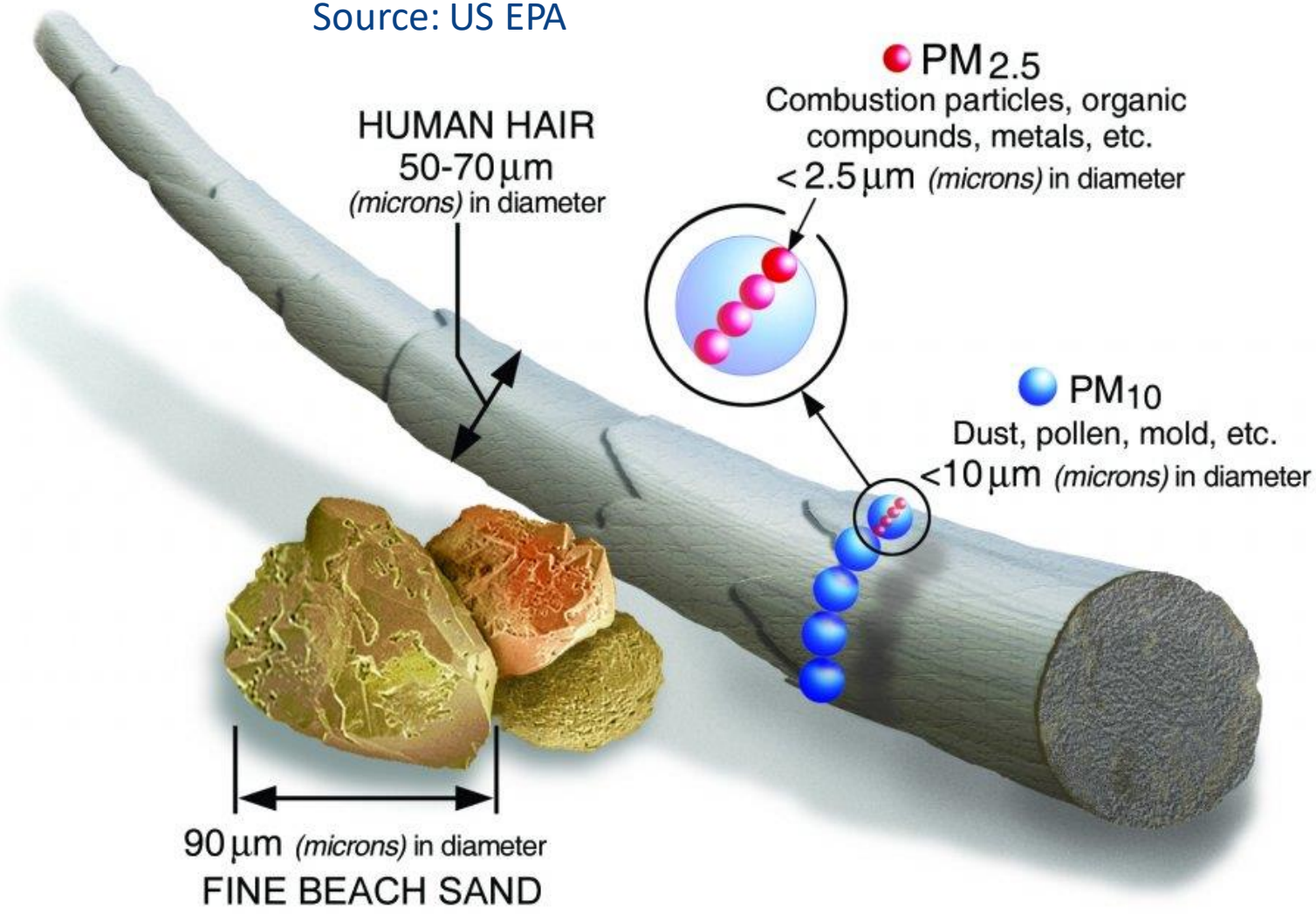
Shorter-term, domestic
Direct; more easily attributable
End-of-pipe measures
(cheaper)

Watts N, et al. (2015), Health and climate change: policy responses to protect public health. *Lancet*, Nov 2; 386(10006): 1861–914

Criteria pollutants

Particulate matter	**(PM_{10})**	*Natural sour*
	($PM_{2.5}$)	***Combustion o***
Nitrogen dioxide	**(NO_2)**	***Vehicle emiss***
Ozone	(O_3)	*Interactions b*
Sulfur dioxide	(SO_2)	*Coal fired pow*
Carbon monoxide	(CO)	*Vehicle emiss*
Lead	(Pb)	*Industry*

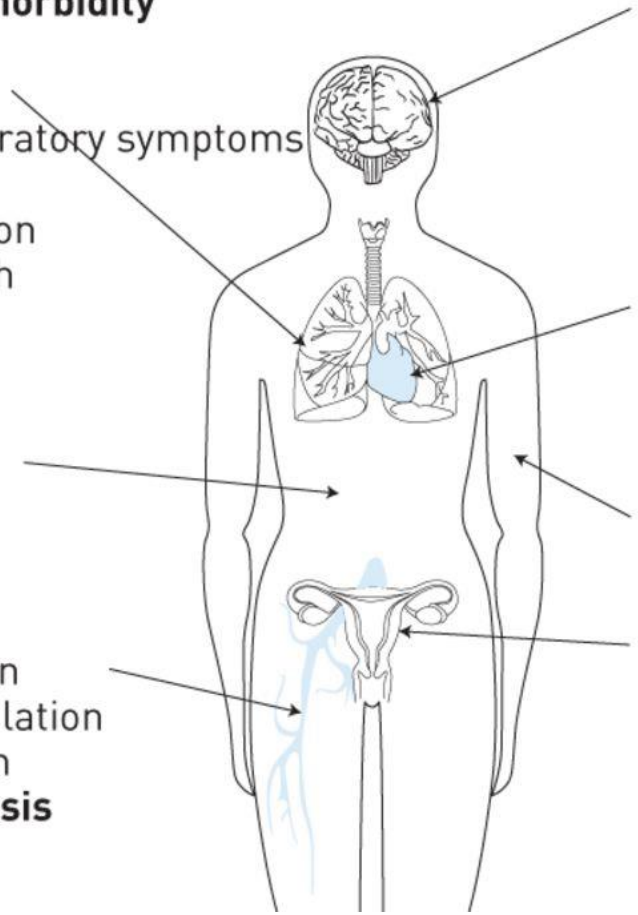
Source: US EPA



Respiratory disease mortality
Respiratory disease morbidity
Lung cancer
Pneumonia
Upper and lower respiratory symptoms
Airway inflammation
Decreased lung function
Decreased lung growth

Insulin resistance
Type 2 diabetes
Type 1 diabetes
Bone metabolism

High blood pressure
Endothelial dysfunction
Increased blood coagulation
Systemic inflammation
Deep venous thrombosis



Stroke
Neurological development
Mental health
Neurodegenerative diseases

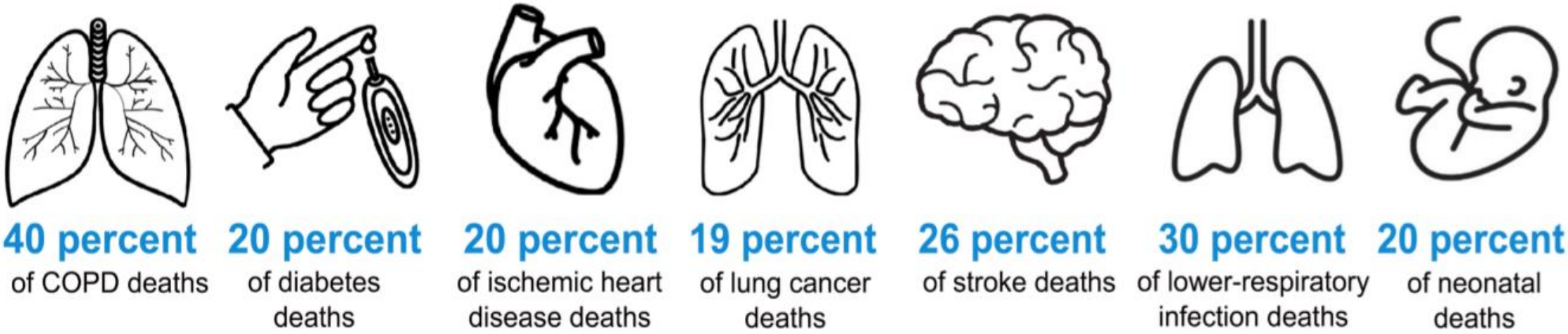
Cardiovascular disease mortality
Cardiovascular disease morbidity
Myocardial infarction
Arrhythmia
Congestive heart failure
Changes in heart rate variability
ST-segment depression

Skin ageing

Premature birth
Decreased birthweight
Decreased fetal growth
Intrauterine growth retardation
Decreased sperm quality
Pre-eclampsia

Thurston et al, *Eur Respir J* 2017

Causal associations



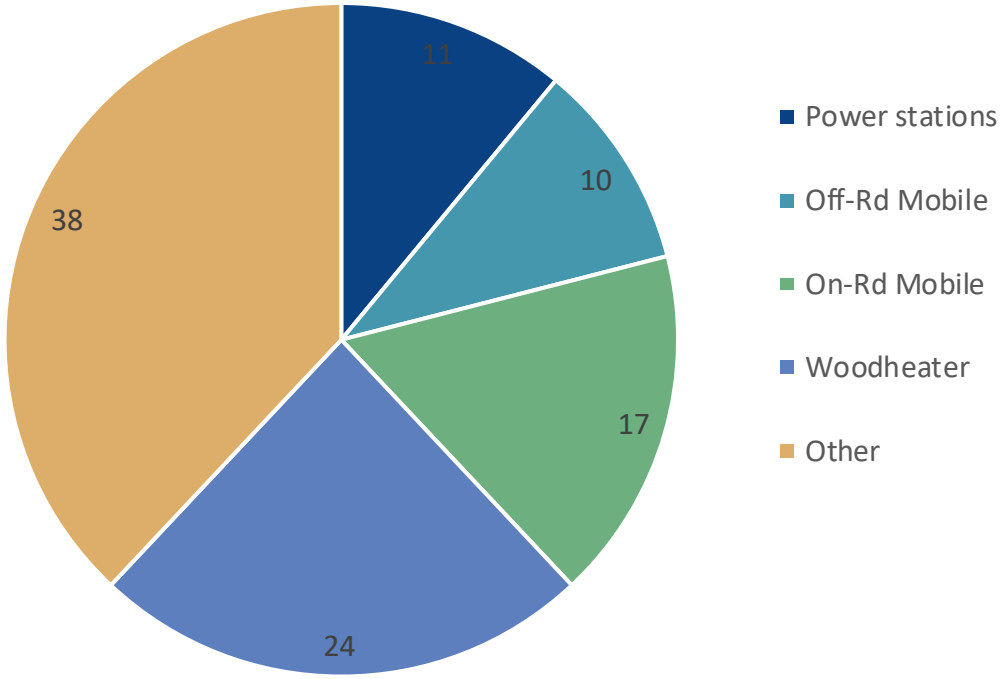
Percentage of Global Deaths (by Cause) attributed to air pollution. Source: soga-global-profile-factsheet.pdf

Ella Kissi-Debrah. Lived 30 metres from south circular road in London
Cause of death: Air pollution

"If this was happening to water and 40,000 deaths were being brought forward due to poisoning in water, we'd be outside Parliament shouting."

Prof Stephen Holgate

$PM_{2.5}$ Health impacts Sydney GMR
Source: Broome et al. Env Int 2020

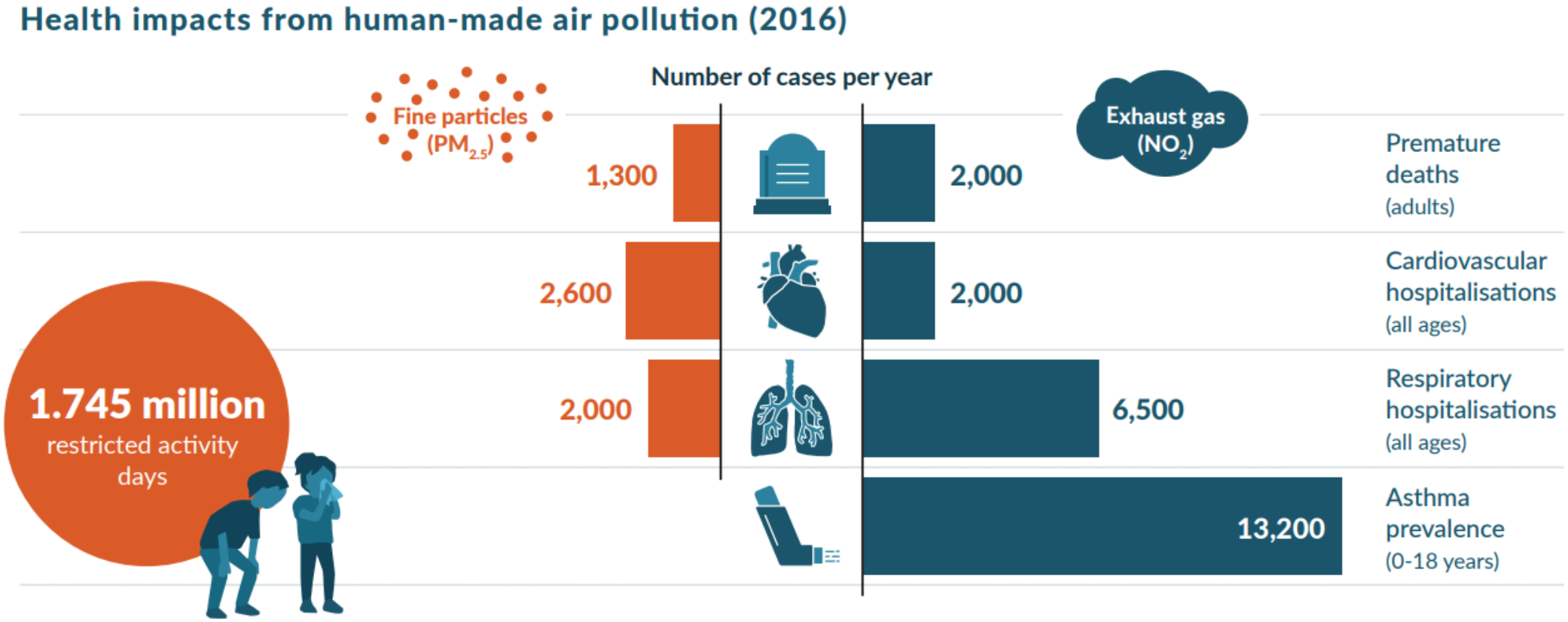


***Annual 2,616 premature deaths from anthropogenic PM2.5* (Hanigan, 2021)**

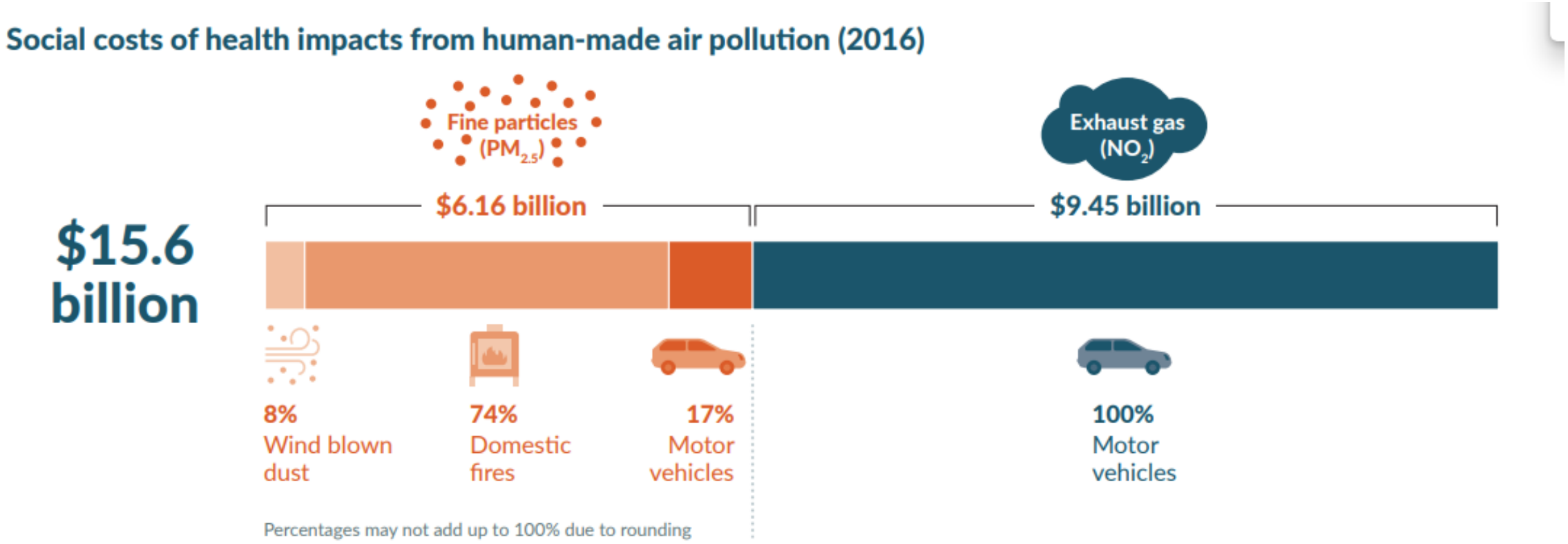
Limitations

-$PM_{2.5}$ – mass measurement. PNC likely to be more reflective of health impacts.
-Size and chemical composition differ according to source.

New Zealand: A tale of two pollutants…



Source: HAPINZ 3.0, 2022



Source: HAPINZ 3.0, 2022

UK estimations

2009: 29,000 attributable deaths from PM2.5 (COMEAP)

2015: 23,500 attributable deaths from NO_2 (DEFRA)

2016: Combined – 40,000 annual deaths (Royal College of Physicians)

In Australia

? ? ?

Source	Publication year	Year data obtained	Pollutants	Morbidity	Mortality	Relevant details
Year Book Australia (EA 2001c)	2001	?	Particles		2.5% of all deaths (2400)	Estimated to be conservative as it failed to take account of long-term effects of air toxics on cancer
AIHW	2007	2003	PM2.5 and Ozone		3056	Accounts for urban air pollution; regional areas excluded.
OECD	2014	2005	PM2.5 and Ozone	YLL 13,048 DALYs 14,342	882	Impacts and costs associated with road transport.
OECD	2014	2010	PM2.5 and Ozone	YLL 20,631 DALYs 22,867	1482	Impacts and costs associated with road transport
AIHW	2016	2011			1.3% of all deaths (1910)	Methodology changed therefore cannot make direct comparison to previous AIHW study
IHME – GDB		2005			3154	
IHME – GDB		2016	PM2.5 and Ozone		3098	
Hanigan	2021	Annual population weighted average from 2006 - 2016	Anthropogenic $PM_{2.5}$		2,616	
Arriagada	2021	Bushfire season 2019/2020	Bushfire PM2.5		429	

If Australia = New Zealand then…

Anthropogenic air pollution causes

16,500 annual premature deaths

10,956 due to motor vehicle emissions

However:

Energy mix different

Underlying population health – maybe?

“Australia has good air quality”

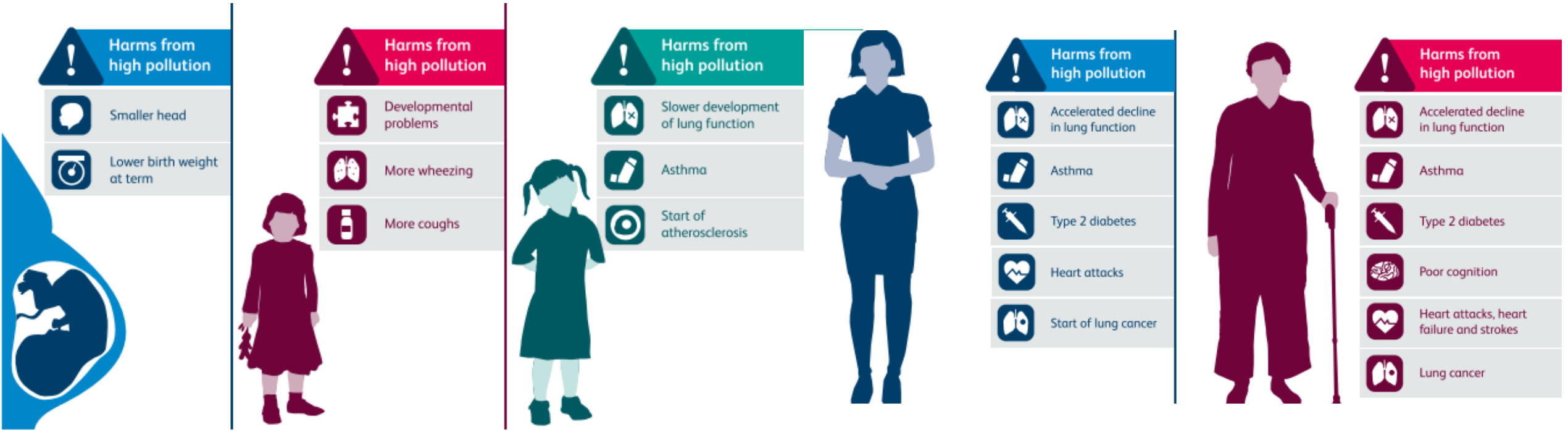
Air quality monitoring network does not capture population exposure

Increasing trajectories:

- Urbanisation
- Population growth
- Uptake of diesel vehicles
- Heat (supra-additive impact)

Thresholds not protective of health

Vulnerable groups (RCP 'Every Breath' report, 2016)



Children Increased dose and susceptibility

RR
Surface area
Height

Immature defence mechanisms
Higher cell turnover

Policies

Federal

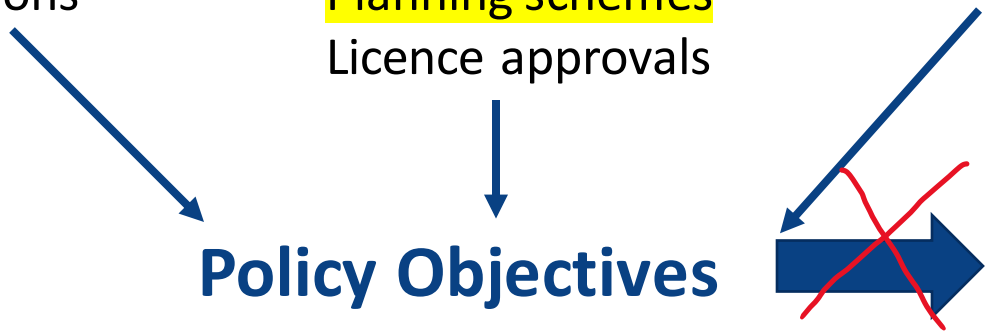
NEPM AAQS
Fuel Content
Vehicle regulations

State

EP Act
EES Act
Planning schemes
Licence approvals

Local Government

Siting of sensitive facilities
Approval processes



Problems

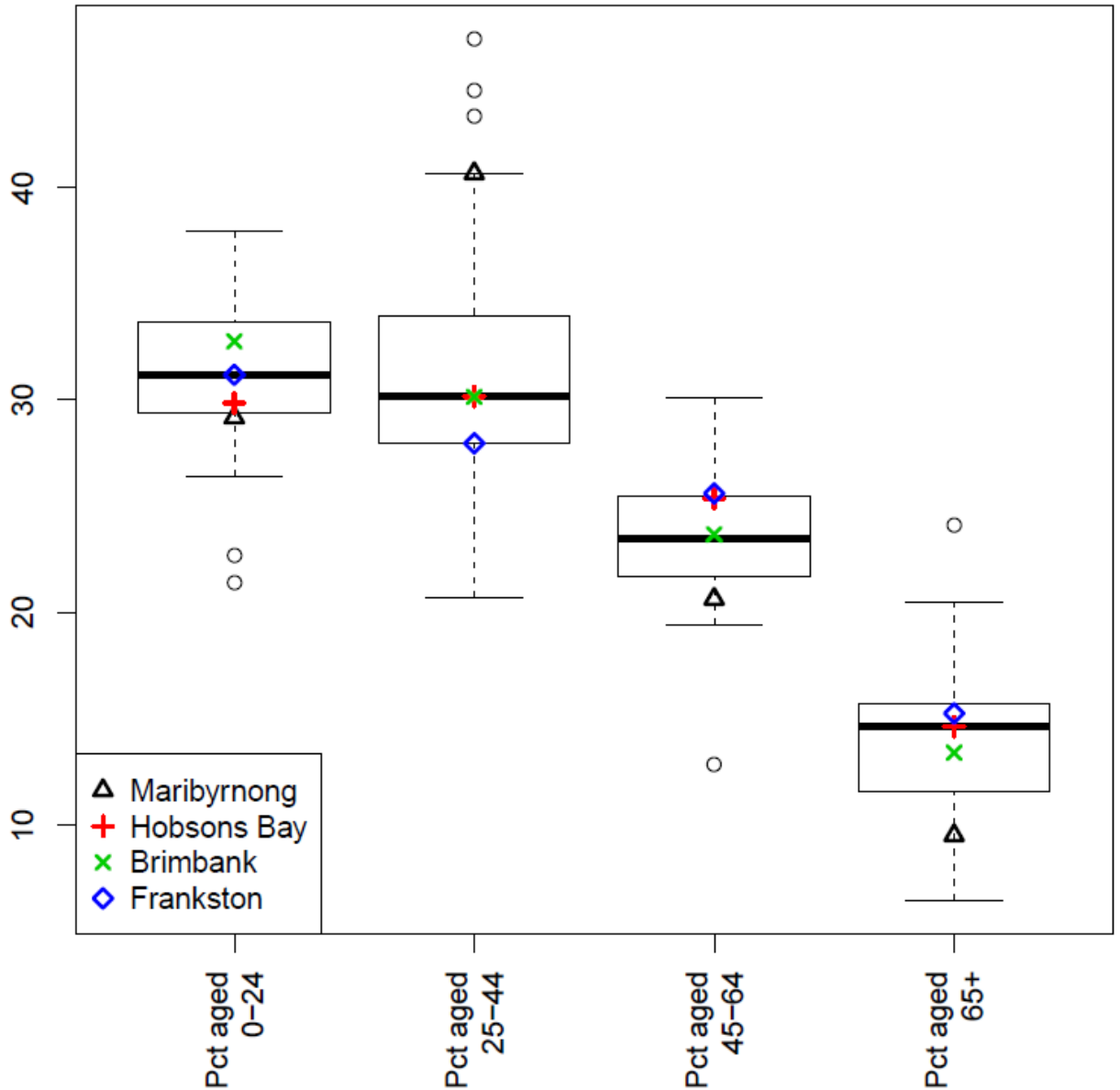
Lagging by global standards
Thresholds not enforceable
Lacking transparency
Cost benefit analyses based on???

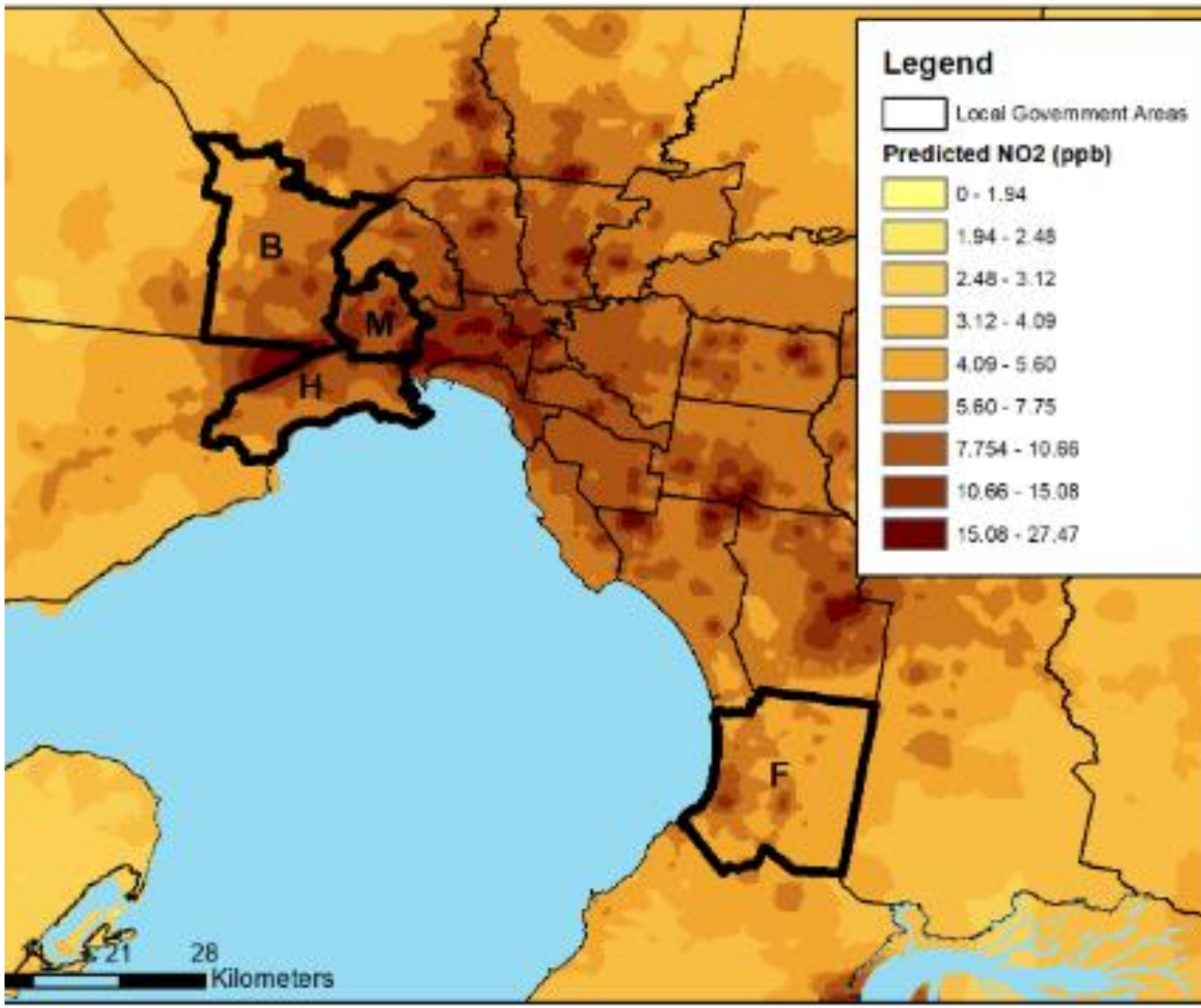
Policy Objectives

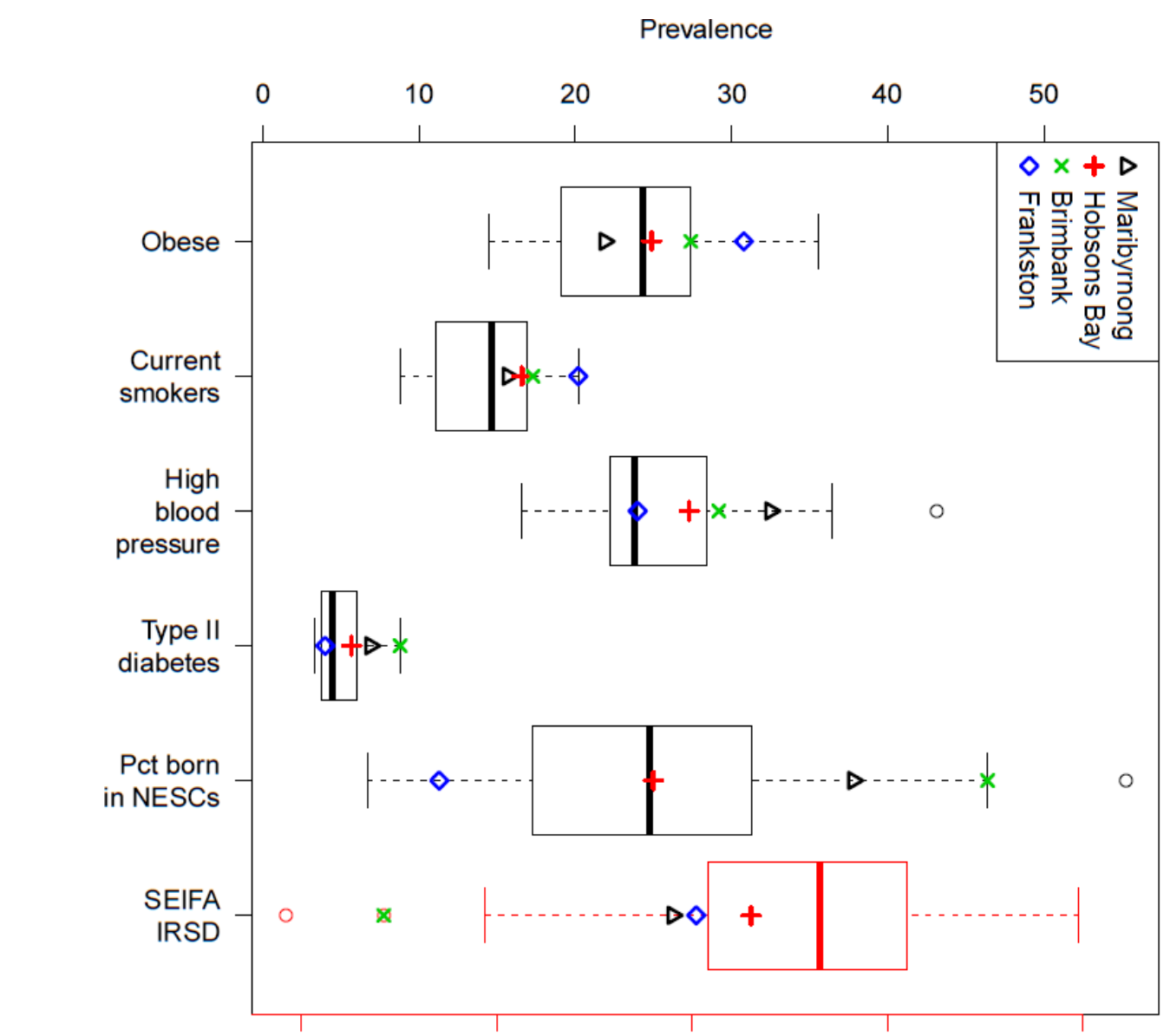
Precautionary principle
Equitable protection
Harm minimisation
Protect vulnerable groups
Intergenerational equity

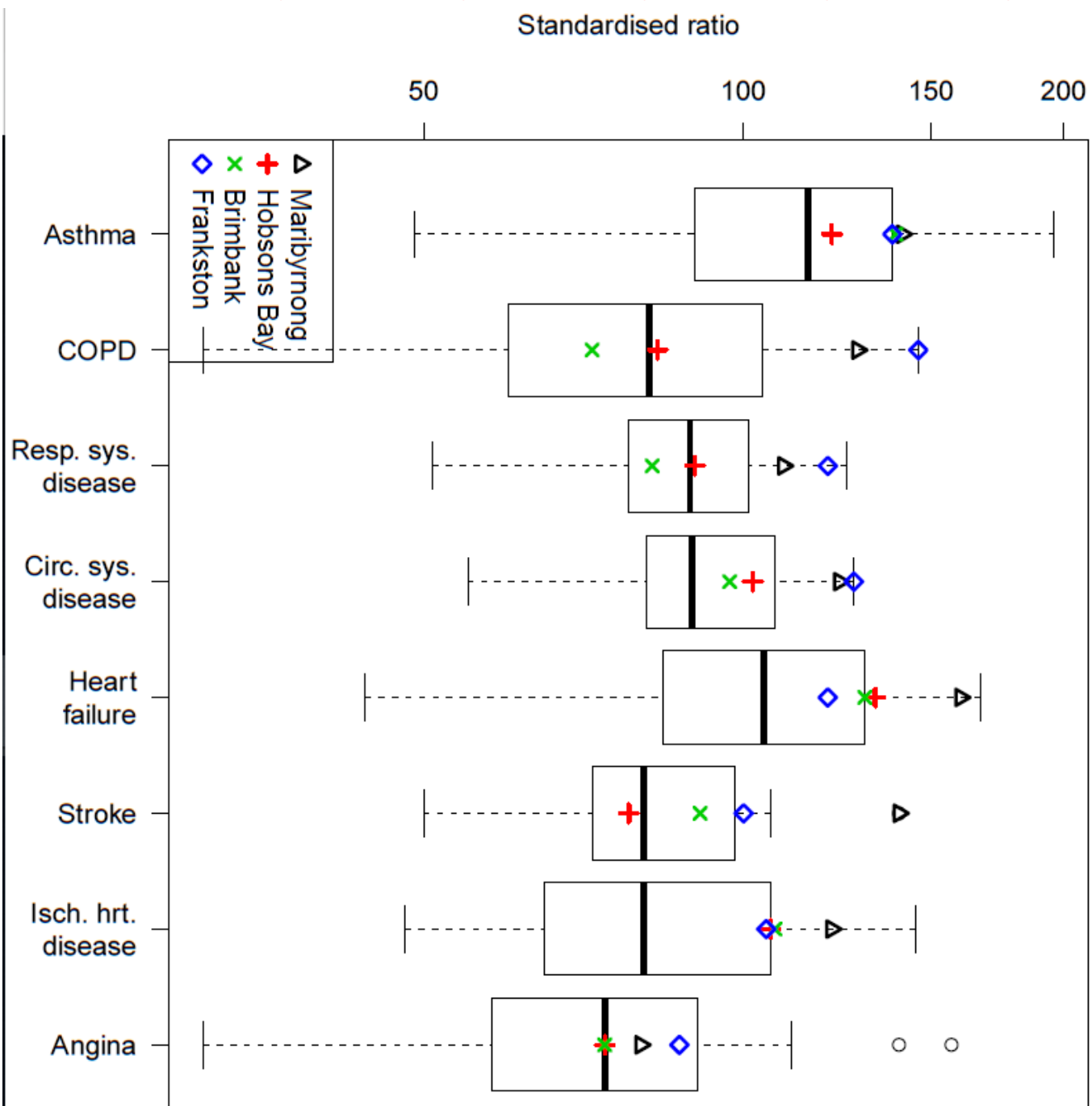
Practices

Children's exposure to traffic pollution

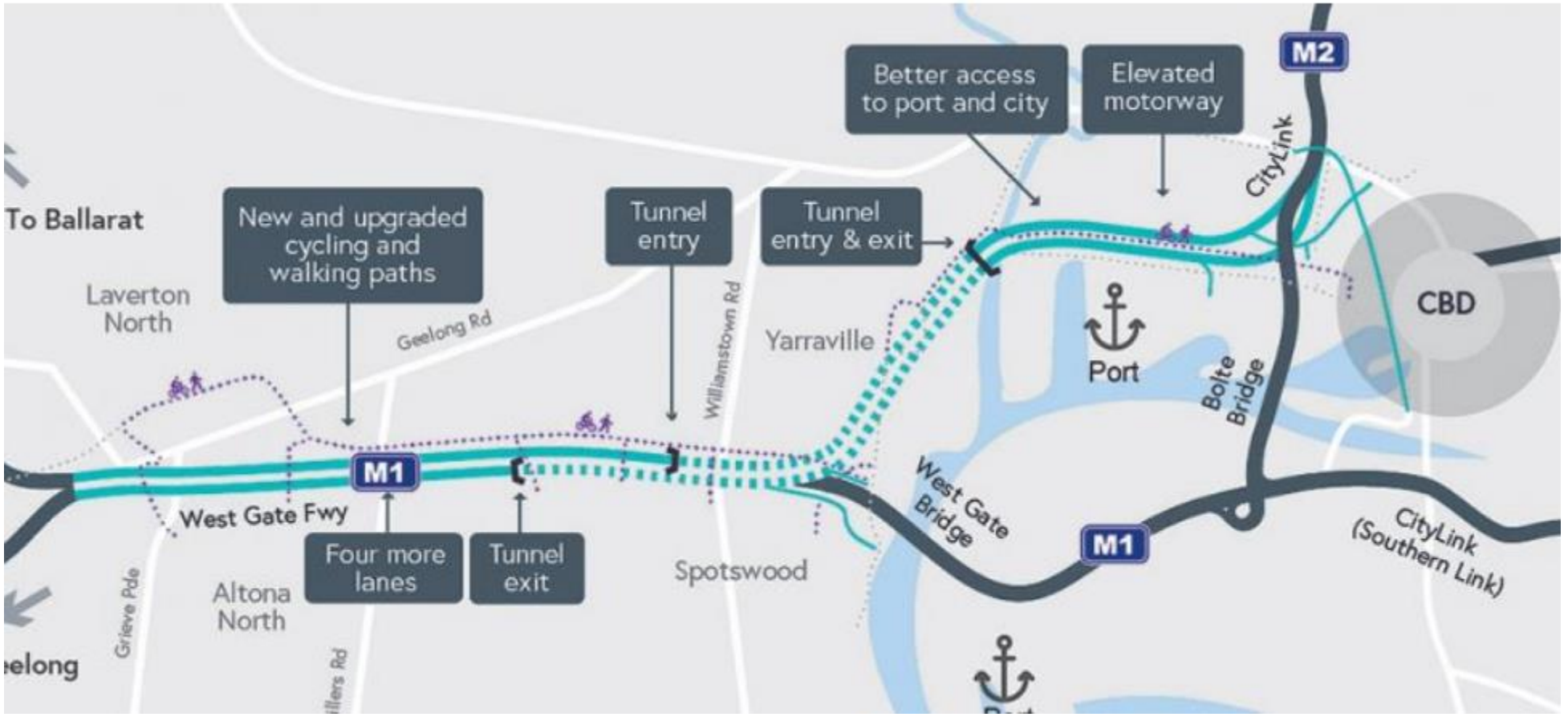

40
30
20
10
Maribyrnong
Hobsons Bay
Brimbank
Frankston
Pct aged 0–24
Pct aged 25–44
Pct aged 45–64
Pct aged 65+


Legend
Local Government Areas
Predicted NO2 (ppb)
0 - 1.94
1.94 - 2.48
2.48 - 3.12
3.12 - 4.09
4.09 - 5.60
5.60 - 7.75
7.754 - 10.66
10.66 - 15.08
15.08 - 27.47
B
M
H
F
21
28
Kilometers


Prevalence
0
10
20
30
40
50
Obese
Current smokers
High blood pressure
Type II diabetes
Pct born in NESCs
SEIFA IRSD
Maribyrnong
Hobsons Bay
Brimbank
Frankston


Standardised ratio
50
100
150
200
Asthma
COPD
Resp. sys. disease
Circ. sys. disease
Heart failure
Stroke
Isch. hrt. disease
Angina
Maribyrnong
Hobsons Bay
Brimbank
Frankston

EES process for Westgate tunnel project



EES concentrations versus roadside

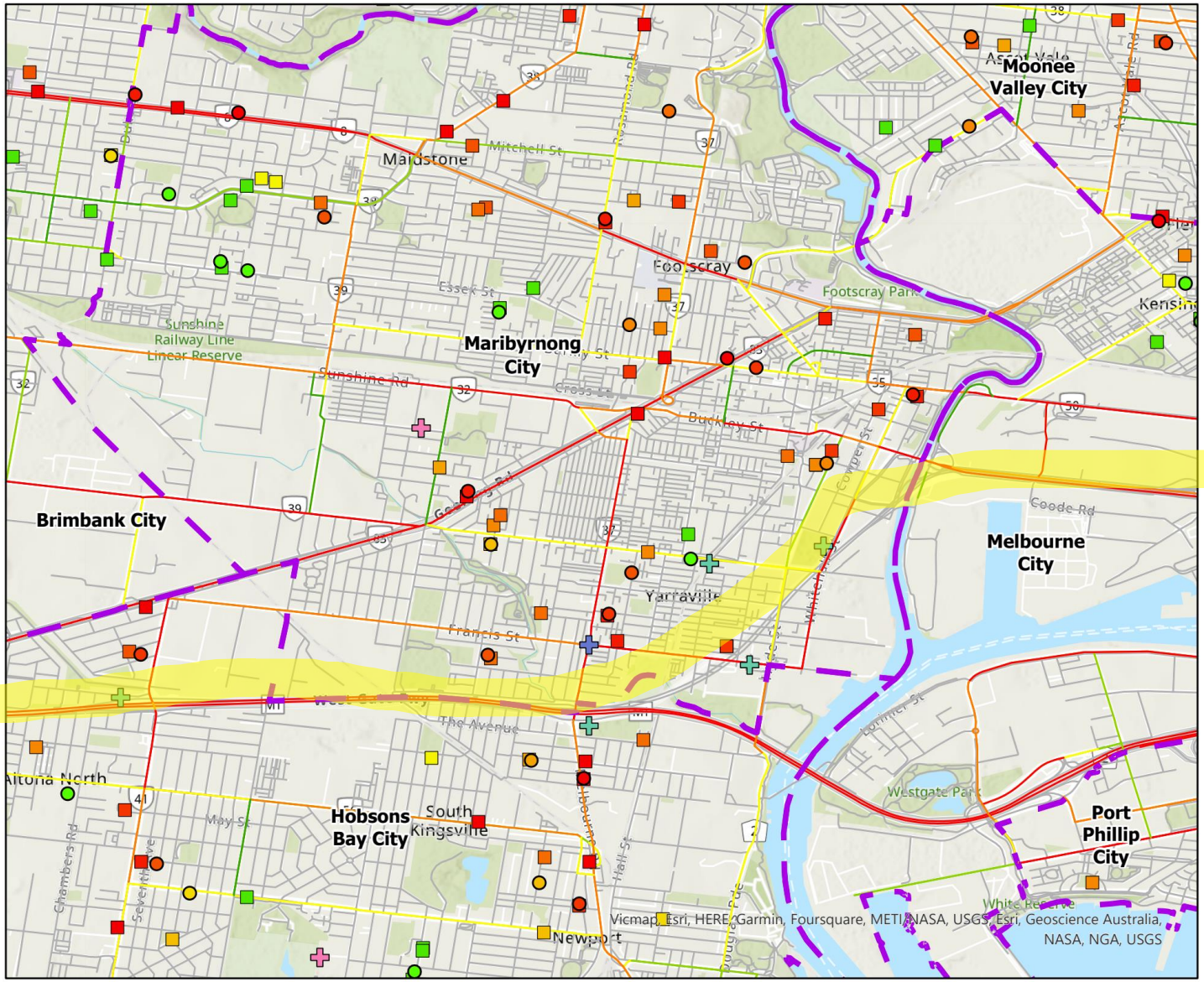
Pollutant	Monitor	2017	2018	2019	Average over 3 years	May 2020 – Apr 2021	Aus standards	WHO Standards
Annual $PM_{2.5}$ concentration ($\mu g/m^3$)	EPA	8.0	7.8	7.7	7.9	6.6	8	5
	WG1	8.8	8.8	9.3	9.0			
	WG2	9.2	8.1	9.7	9.0			
	WG3	9.0	7.1	8.0	8.0			
	WG4	8.8	7.9	10.1	8.9			
	WG5	9.4	7.2	9.1	8.6			
	Community					15.0		
Annual NO_2 concentration (ppb)	EPA	11.5	10.3	10.4	10.7		15	10
	WG4	17.4	15.7	15.0	16.0			

Applying Khreis, 2017 random effects meta-risk estimates for childhood asthma diagnosis:

1.03 (1.01, 1.05) per 1 $\mu g/m^3$ $PM_{2.5}$ for the **28% increase in risk.**

1.05 (1.02, 1.07) per 2.13 ppb NO_2

13% increase in risk



Map Legend

Schools
(Distance to main roads)
- ≤50
- ≤100
- ≤150
- ≤200
- ≤250
- ≤300
- ≤350
- ≤400
- ≤450
- ≤500
- <out of range>

Childcare Centers
(Distance to main roads)
- ≤50
- ≤100
- ≤150
- ≤200
- ≤250
- ≤300
- ≤350
- ≤400
- ≤450
- ≤500
- <out of range>
- EPA Monitoring Site
- Community Monitoring Site
- Westgate Monitors

Road Traffic
(Trucks AADT)
- ≤96
- ≤235
- ≤440
- ≤834
- ≤13000
- Road network
- LGA borders

Californian Policy
150 metre buffer between schools & major roads
300 metre from major truck route

21 (41%) of childcare centres and eight schools (36%) were 150 metres or closer to a high-density route (> 800 trucks per day)

Health Effects Institute. Special Report 23, 2022.

Systematic Review and Meta-analysis of Selected Health Effects of Long-Term Exposure to Traffic-Related Air Pollution

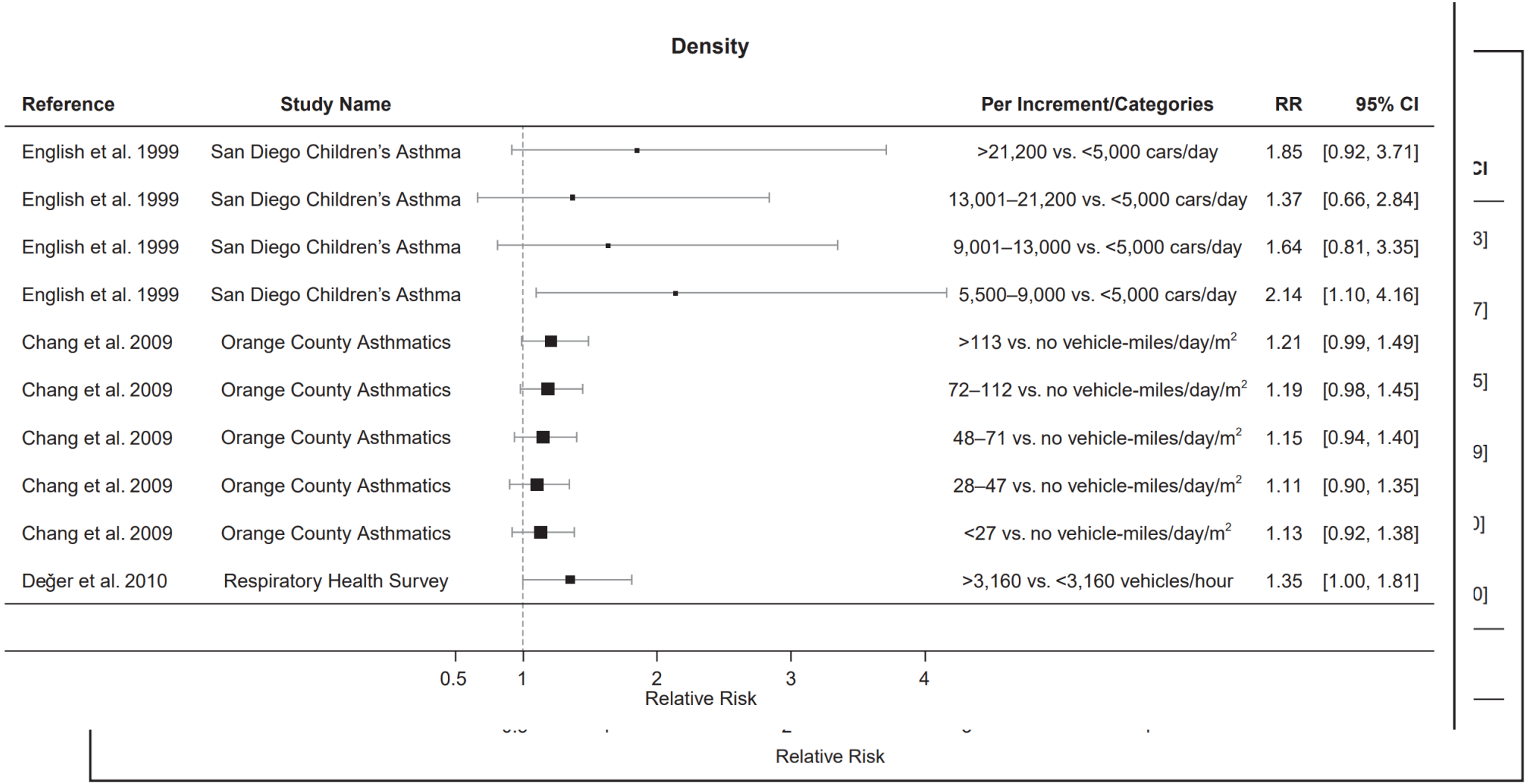
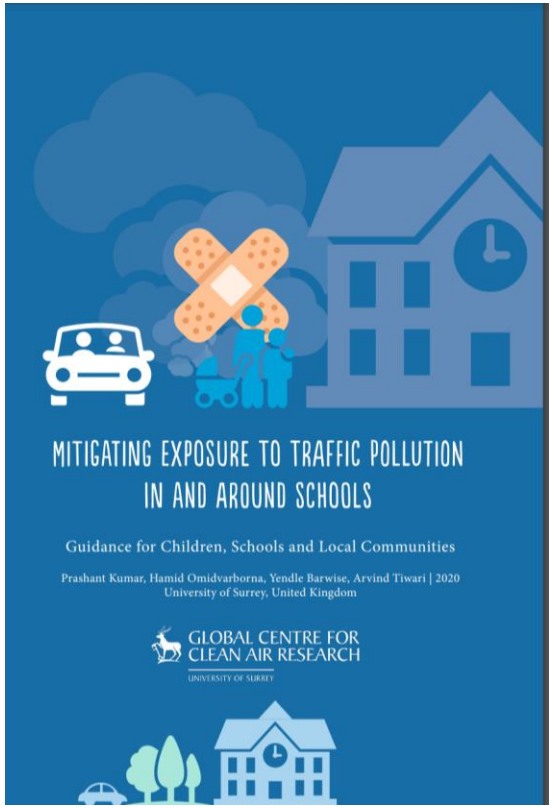
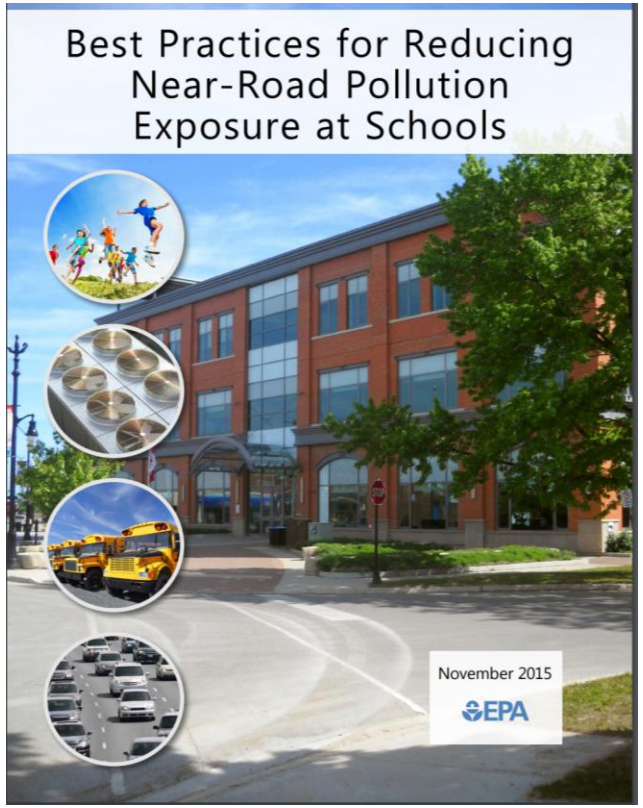


Figure 9.18. Associations between indirect traffic measures and asthma exacerbation in children. Huynh et al. 2010 was stratified by moderate to severe and intermittent mild

Mitigation strategies “harm minimisation”
Wait for improved tailpipe emissions?





Clean air zones
Passive control systems
Classroom air quality
Plan new schools and buildings carefully
Active transport
Consider road surface dust
Removal at point sources

Inserting health into policy

Re-frame the issue. Focus on children's health

Raise public awareness

Connection between health and climate

Quantify health and economic impacts

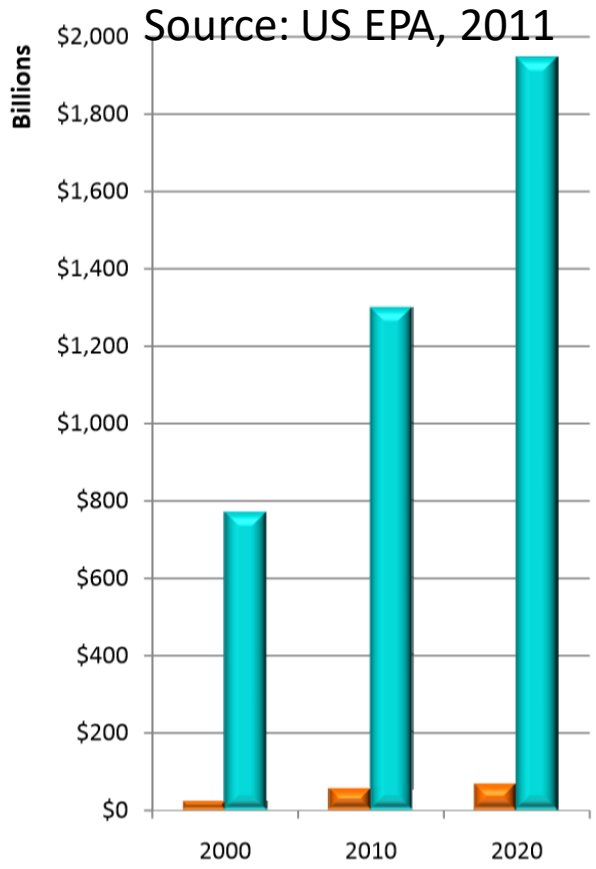
Create a narrative that focuses on the health co-benefits of climate change mitigation

"…the public health community has an important perspective to share about climate change, a perspective that makes the problem more personally relevant, significant, and understandable to members of the public."

Maibach et al (2010), Reframing climate change as a public health issue: an exploratory study of public reactions, *BMC Public Health*, 10, 299.

Direct benefits and costs of the Clean Air Act, USA

Source: US EPA, 2011



Legislated threshold for $PM_{2.5}$

-America 1997 federal and binding

-Australia 2016 not federal or binding

"Crushing blow to the economy"

Implementation costs

Economic benefits (reduced healthcare expenditure)

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