



AIRBORNE HAZARD: HOW AIR POLLUTION HARMS OUR KIDS

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Responsibility for the final content of the report remains with the authors.



The Climate Council acknowledges the Traditional Owners of the lands on which we live, meet and work. We wish to pay our respects to Elders, past and present, and recognise the continuous connection of Aboriginal and Torres Strait Islander peoples to land, sea and sky. We acknowledge the ongoing leadership of First Nations people here and worldwide in protecting Country, and securing a safe and liveable climate for us all.



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Key findings

1 Coal, oil and gas is causing most of the air pollution we're breathing in, as well as the climate pollution overheating our planet and driving unnatural disasters.

- › The vast majority of human-caused air pollution is caused by the burning of coal, oil and gas.
- › Researchers found air pollution from fossil fuels was responsible for 8.1 million premature deaths worldwide in 2021 - more than the deaths attributed to tobacco, dietary risks or high body mass index.
- › Using coal, oil or gas to power our cars, power stations, mining operations and factories is the main source of climate pollution that's overheating our planet, and driving more intense weather extremes.
- › Air pollutants are released at every stage of the production and burning of coal, oil and gas. No matter where they're used - whether in power generation, transport or our kitchen stovetop - fossil fuels are bad news for our climate, the air we breathe, costs to taxpayers and our health.

2 It's been found that over three times as many Australians are dying prematurely from air pollution than those in traffic accidents.

- › In 2021, outdoor air pollution in Australia was linked to an estimated 4,250 premature deaths, more than triple the 1,130 deaths that occurred in car accidents that year.
- › Among Australians, 8% of diabetes deaths, 6% of ischemic heart disease deaths and 4% of lung cancer deaths are linked to air pollution.
- › Air pollution is harming the health and wellbeing of Australians to the tune of \$6.2 billion per year.
- › Experts say that exposure to air pollution, even for short periods of time at levels below our national standards, harms the health of Australians.

3 Australian children are losing many more years of good health to disease or illness from air pollution than they are to secondhand tobacco smoke.

- › In 2021, air pollution is estimated to have been responsible for almost seven times as many disability adjusted life years (the number of healthy years lost to poor health) as exposure to secondhand tobacco smoke among Australian children aged 0-14.
- › Children exposed to air pollution face an increased risk of asthma. One study estimated that a 25% reduction in NO₂ concentrations in NSW would lead to at least 2,597 fewer children with asthma.
- › Researchers in Australia and internationally have found that traffic-related air pollution increases the risk of asthma attacks, reduces lung function and puts people at higher risk of respiratory conditions.
- › Coarse particulate matter (PM₁₀) from traffic exhaust was estimated to have prematurely killed between 1,000 and 2,550 Australians in 2018, and contributed to 26,700 other hospitalisations, asthma attacks and disease episodes.
- › Breathing in small particulate matter (PM_{2.5}) from traffic while pregnant has been found to increase the risk of low-birth weight on a similar scale to passively smoking up to 3.8 cigarettes, while living next to a freeway was found to be equivalent to passively smoking up to 10 cigarettes per day.

4 Traffic pollution is harming children, and it's preventable. New analysis shows one in every six schools and childcare centres within our capital cities are close enough to major roads to raise health risks for the children who attend.

- › Children are more vulnerable to the harms of air pollution due to their physiology, size and behaviour. Those who live, learn or play near busy roads, factories or industrial areas are at greater risk.
- › The more time that children spend near busy roads, the greater their exposure to air pollution and the greater their risk of poor health outcomes. One US study showed that the lung-function of eight-year-old children living within 100 metres of a major road was 6% worse than peers who lived at least 400 metres away.
- › Climate Council analysis finds that about one-in-six of all schools and childcare centres across our capital cities are located within 100 metres of a busy main road. Childcare centres are the most likely to be located near a busy road (21% of them are), followed by secondary schools (17%) and primary schools (15%).
- › This is worst in Melbourne, where almost a quarter of all schools (263) and childcare centres (nearly 850) are located on or near a busy road. Boroondara, Whitehorse - West and Port Phillip had the highest concentration of schools and childcare centres on or near busy roads.

5 We can't easily move childcare centres or schools away from busy roads, but we can clean up air pollutants from traffic. This will create immediate health benefits for our kids.

- › Building more clean energy like solar and wind, backed by storage, and phasing out coal, oil and gas is vital. It will clean up the air we breathe and cut climate pollution.
- › We can dramatically and quickly cut climate and air pollution further by providing more people with options to get around in cleaner ways. Only half of the 15 million Australians living in our five biggest cities have access to frequent, all-day public transport today and many communities don't have adequate walking, rolling or bike paths.
- › An overwhelming majority (80%) of Australians want governments to invest more in public transport, and two in three (67%) want more investment in footpaths, bikeways and other active transport infrastructure.

1. Introduction

Ever stepped out of your front door, and taken in a big breath of fresh air? Depending on where you live that air might not be as clean as you think.

Coal, oil and gas is polluting our air and that can be lethal.

Although Australians enjoy air quality that's better than in many parts of the world, three times as many of us are dying prematurely from air pollution than from traffic accidents.

A key culprit? Coal, oil and gas. These fossil fuels emit most of the toxins we're breathing in, as well as the climate pollution that's overheating our planet and driving unnatural disasters. At every stage of their production, and no matter how they are used, fossil fuels are harming us.

This report explores the latest research, from Australia and internationally, on how air pollution is harming Australians today, and explains why children - who are still growing, breathe faster and spend more time outdoors - are particularly vulnerable.

Many researchers have compared the impacts of air pollution - which include more asthma attacks, respiratory disease and poorer lung function - to the poor health outcomes related to passive smoking.

Air pollution is an insidious and serious problem - often we can't see or smell it, and are unaware of the harm it is doing to our bodies. Depending on where people live, work and spend their time, they can be much more exposed to air pollution. In this report, we've analysed schools and childcare centres across all our capital cities to find out how many of them are at greater risk by being located on or near a major road.

Experts have found that many Australians are getting sick when exposed to particulate matter at levels *below* our existing air quality standards. It is clear that air pollution - including from traffic exhaust - is harming our kids' health, and that it is avoidable.

We can be doing so much more to cut air pollution, which will reduce asthma incidence and exacerbations, hospitalisations for respiratory infections and premature deaths.

Building more clean energy like solar and wind, backed by storage, means we can close polluting coal-fired power stations. Providing more people in our cities with cleaner ways of getting around means we can clean up air pollution from traffic that's clogging up our streets. In doing so, we can also cut climate pollution further and faster.

What a breath of fresh air that would be!

Image 1: A mother fitting a mask to her son: Research has shown that traffic-related air pollution is harming kids' health.



2. Clean air is fundamental to our health and wellbeing

All of us, no matter where we live, our income, nor our age, should be able to breathe clean air and enjoy good health as a result. Unfortunately, this isn't the case for many people.

Across the globe air pollution was responsible for 8.1 million additional (or excess) deaths in 2021 - more than other risk factors such as tobacco, dietary risks, high glucose or high body mass index (Health Effects Institute 2024a). More than half of these deaths were attributed to poor outdoor air quality, while burning solid fuels indoors for cooking and heating accounted for the rest (Health Effects Institute 2024a). Alongside climate change, air pollution is one of the biggest environmental threats to human health we face (World Health Organisation 2021; Pillay, Dodd & Cartwright et al. 2023).

While Australians enjoy much better air quality than many other countries, air pollution in the places we live, work and learn is still harming our health. In 2021, small particulate pollution in the form of PM_{2.5} contributed to 4,250 premature deaths, over three times as many deaths from car accidents that year (n=1,130) (Health Effects Institute 2024b; Australian Government 2024a). It is estimated that air pollution has

contributed 8% to deaths due to diabetes, 6% to deaths due to ischemic heart disease and 4% to lung cancer deaths among Australians (Health Effects Institute 2024b). Air pollution also worsens both heart and lung diseases (Shraufnagel et al. 2019).

Air pollution is harming some people and communities more than others. People who live close to busy roads, factories and industrial areas are likely to be exposed to more air pollution (see for instance IWAQCRG 2020). Socio-economically disadvantaged communities are often exposed to poorer air quality and health outcomes (AIHW 2021a). Some of the most vulnerable members of our community, including children, older people and those with chronic health conditions are at greater risk of harm from air pollution (Pillay, Dodd & Cartwright et al. 2023).

No one wants to live, work or learn anywhere with harmful levels of air pollution. By tackling avoidable sources of air pollution, which include vehicle exhaust fumes and pollution from mining and industrial activities - we can cut climate pollution and make sure all Australians are breathing in cleaner air, and enjoying better health as a result.

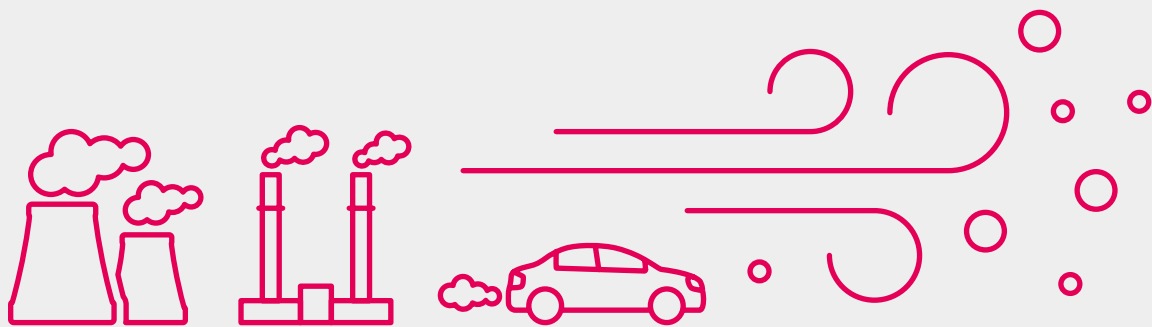
Clean air matters. While air quality in much of Australia is better than in other countries, thousands of lives are cut short each year due to air pollution.

BOX 1: KEY TERMS AND DEFINITIONS

- › **Climate pollution** refers to greenhouse gas emissions, including carbon dioxide and methane, that are predominantly from the burning coal, oil and gas that’s overheating our planet (Environmental Defense Fund 2024a).
- › **Ambient air pollution** refers to concentrations of substances in the air outdoors that are above naturally occurring levels and are potentially harmful to human health (World Health Organisation 2024a). It includes particulate matter (PM) and gases such as nitrogen dioxide (NO₂) that are harmful to people. The main sources of human-caused, outdoor air pollution are from petrol and diesel vehicles, coal and gas-fired power stations, mines, manufacturing facilities and domestic activities such as wood-fired heating (Australian Government 2021). Wood fired heating is a major source of PM_{2.5} in many

Australian towns and cities, often exceeding pollution from other sources such as traffic and industry (Borchers-Arriagada, 2024). Sources of outdoor air pollution also vary across regions, depending on the presence of industry activity, major roads and population density (Australian Government 2021). Another significant source of outdoor air pollution includes the smoke and fumes from bushfires and hazard reduction burns (Australian Government 2021). Ambient, or outdoor air pollution from the burning of coal oil and gas is the main focus of this report.

- › **Traffic-related air pollution** is a mixture of gases and particles including ground level ozone (O₃), nitrogen oxides (NO_x), carbon monoxide (CO), small particulate matter (PM_{2.5}), and Volatile Organic Compounds (VOCs) (Li et al. 2024; NSW Health 2014).



3. Coal, oil and gas are polluting our climate, and our air

The vast majority of human-caused air pollution - including 85% of particulate pollution and almost all sulphur dioxide and nitrogen oxide emissions - is from the burning of fossil fuels, wood and other forms of biomass (Perera 2017).

Using coal, oil or gas to power our cars, power stations, mining operations and factories is also the main source of greenhouse gas emissions - or climate pollution - that blankets and overheats our planet, and is driving dangerous new weather extremes (Environmental Defense Fund 2024b). No matter where they are dug up, transported or used, fossil fuels are bad news for our climate and the air we breathe.

Image 2: The majority of human caused air pollution is from the burning of coal, oil and gas, impacting kids in the places they live, learn and play.



SOURCES OF AIR POLLUTION IN AUSTRALIA

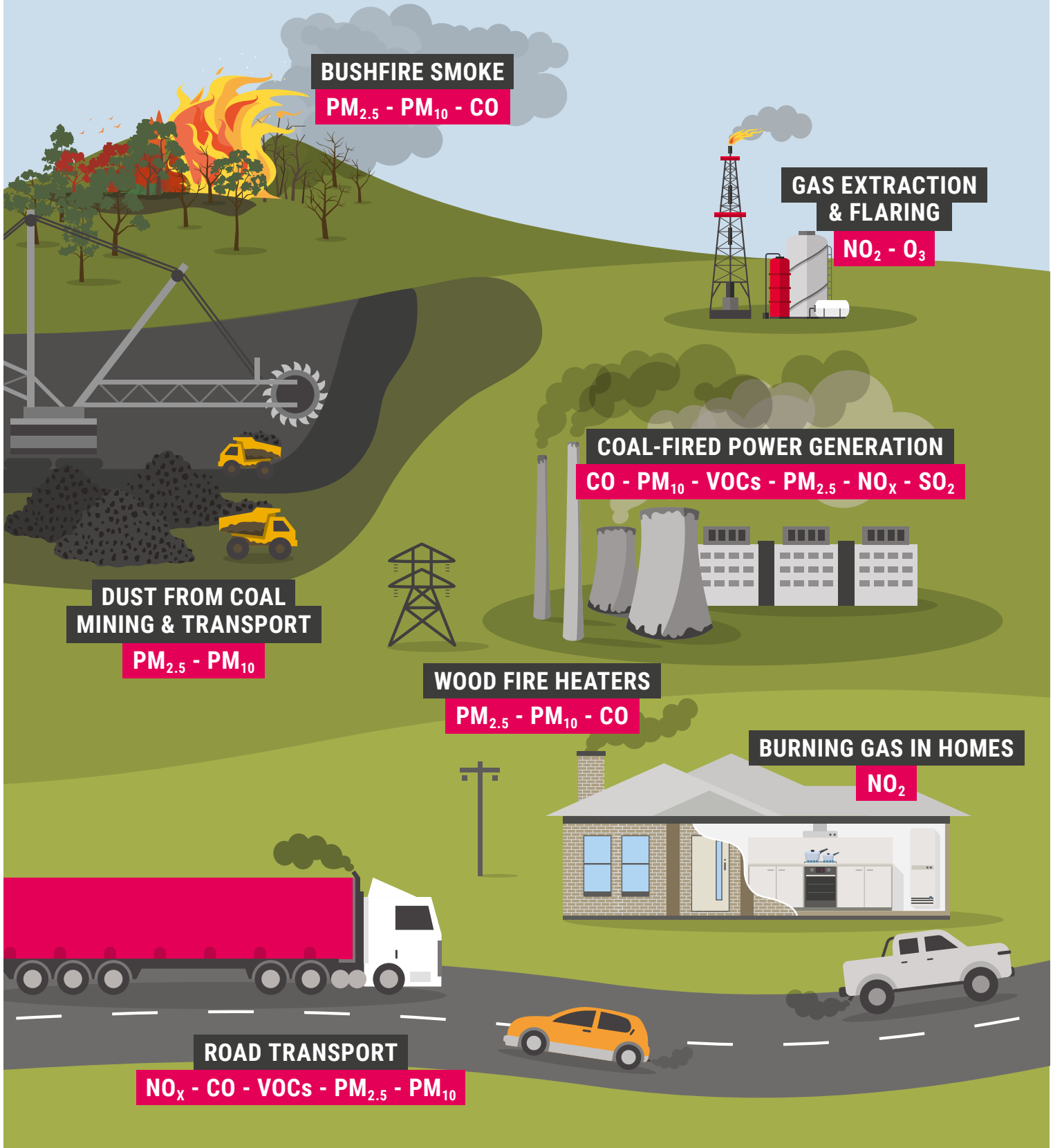
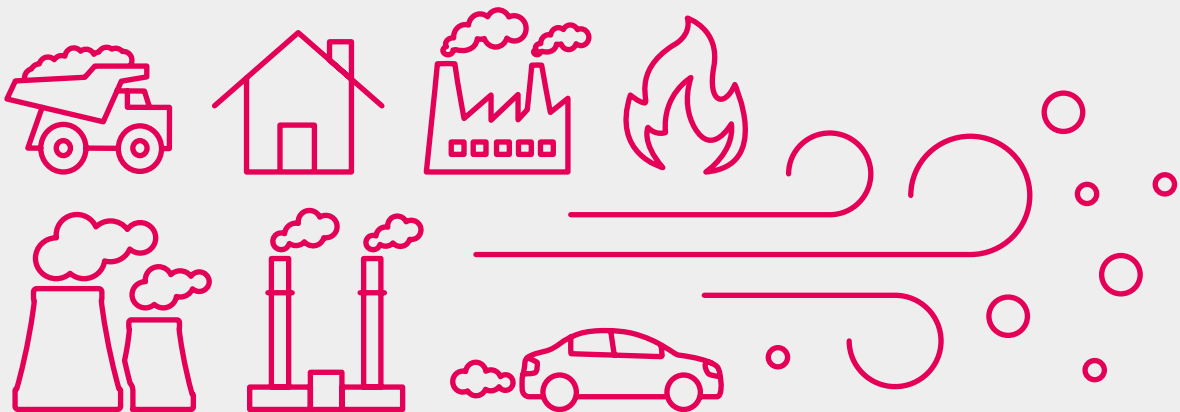


Figure 1: Sources of air pollution in Australia: Air pollution is produced at every stage of the production and burning of fossil fuels, including mining, transportation and wherever they end up being used.

BOX 2: SOURCES OF AIR POLLUTION

- › One of the main sources of air pollutants such as $PM_{2.5}$, NO_x and sulphur dioxide (SO_2) is the fuel combustion used to generate electricity from **coal-fired power stations** (Australian Government 2021; Doctors for the Environment 2024). They are also responsible for other pollutants such as carbon monoxide (CO), PM_{10} and volatile organic compounds (VOCs) (Dean and Green 2017). Power stations are often located in regional areas and some air pollutants can travel long distances impacting air quality in more populated urban areas (Dean and Green 2017).
- › **Vehicle emissions** are a significant source of NO_x and of CO in Australia, with motor vehicle exhaust accounting for an estimated 80% of NO_2 in urban areas (Dean and Green 2017; Australian Government, 2021). Traffic pollution is also a significant source of other pollutants such as VOCs, benzene and $PM_{2.5}$ and PM_{10} (Dean and Green 2017).
- › **Mining activities** also contribute to air pollution nationally, with metal ore and coal mining some of the main contributors to PM_{10} , and NO_x (Dean and Green 2017).
- › **Fires, including bushfires and hazard reduction burns** also cause air pollution. Hazard reduction burns and agricultural burn offs are a significant source of CO, NO_x and PM (Dean and Green 2017; Australian Government 2021). When they occur, both bushfires and hazard reduction burns can cause air pollution levels to spike to dangerous levels.
- › Separate from ambient (outdoor) air pollution, certain activities within **homes** contribute to indoor air pollution like the use of gas for heating and cooking which also produces CO and NO_2 (Climate Council 2021, World Health Organisation 2024b). The smoke from **wood heaters** can also contain particulate matter, carbon monoxide, carbon dioxide and volatile organic gases (OCSE 2023). The use of wood heaters contributes significantly to air pollution in towns and cities across Australia (Vardoulakis et al. 2024).
- › Some harmful air pollutants such as ground level ozone (O_3) arise from chemical reactions between pollutants including VOCs, CO and NO_x warmer temperatures and sunlight (World Health Organisation 2024; EPA Victoria 2022).



4. Climate change is a health hazard

Climate change poses a very significant risk to human health and well being. 2023 was the hottest year on record, and 2024 is on track to surpass it (Copernicus 2024). By burning coal, oil and gas, we are adding to the climate pollution that's driving unnatural disasters, like lethal heatwaves, worsening bushfires, droughts and flooding rains (Climate Council 2024).

According to the latest Lancet Countdown report (Romanello et al. 2023) climate inaction is costing lives and livelihoods today, with new global projections revealing the grave and mounting threat to health resulting from any further delay in cutting climate pollution. Currently it is estimated that 3.6 billion people live in areas highly susceptible to the impacts of climate change. Between 2030 and 2050 it is expected that there will be approximately 250,000 additional deaths per year from causes such as undernutrition, malaria, diarrhoea and heat stress due to climate change (World Health Organisation 2023). A global mean temperature rise of just under 2°C is projected to increase heat-related deaths by 370% by mid century (Romanello et al. 2023).

On the flipside, by cutting climate pollution from coal, oil and gas much further and faster we can provide a health lifeline to many people around the world.

In Australia, heatwaves have killed more people than any other extreme weather event (Coates et al. 2022). Driven predominantly by the combustion of fossil fuels, climate change is worsening extreme heat events and harming human health in many ways (CSIRO, 2024). This also places greater demand on public health and emergency services (AAS 2015).

According to health experts, we need to treat the symptoms of our overheating planet that people are already experiencing, while also addressing their root cause: coal, oil and gas.

Health experts know that prevention is far better than a cure. If we cut pollution from coal, oil and gas as quickly as we can that will be much more effective in protecting the health and wellbeing of Australians than dealing with the consequences: like more severe and frequent bushfires.

Image 3: Climate change is fuelling more intense bushfires, leading to more smoke-related illnesses: A young girl from Junee, NSW Australia using a playground impacted by smoke from nearby fires on 5th of January 2020.



CUTTING CLIMATE POLLUTION WILL IMPROVE AIR QUALITY

Urgently replacing the use of coal, oil and gas with clean energy sources like solar and wind is essential not only to limit the dangerous effects of climate change, but also to avoid direct and harmful impacts of air pollution on our health. This is how we can keep our communities healthier and safer (World Health Organisation 2024c, Clean Air Fund 2024).

Climate change can also worsen air pollution in the following ways:

- › Extreme heat can cause large air masses to stay still for longer, preventing air pollution from clearing (Environmental Defense Fund 2024a).
- › Rainfall plays a role in removing harmful air pollutants including PM from the air (Dean and Green 2018). Climate change is disrupting rainfall patterns, with more rain in the form of heavy downpours, punctuated by prolonged dry periods (Commonwealth of Australia 2022). When there is no rain, air pollution remains at harmful levels for longer.
- › More frequent and severe climate-fuelled disasters increase the likelihood of industrial and manufacturing facilities being damaged and the release of pollutants (Environmental Defense Fund 2024a). This occurred in February 2014 when wildfire embers ignited a coal seam in the Hazelwood open-cut mine which then raged for 45 days, smothering nearby towns in smoke and ash (Xu et al. 2022; Australian Disaster Resilience Hub 2024). People exposed to this smoke were more likely to present to hospital for respiratory conditions and have premature ageing of the lungs compared to residents of a nearby town with no smoke exposure (Xu et al. 2022; Holt et al. 2021).
- › Larger, more frequent and more intense bushfires due to climate change directly worsen air quality by creating vast volumes of smoke containing harmful particles (Pillay, Dodd & Cartwright et al. 2023; Environmental Defense Fund 2024a).

BOX 3: THE BLACK SUMMER BUSHFIRES THAT BLANKETED US IN SMOKE



Image 4: An 11-year-old boy and his family fleeing the Murrumbidgee bushfires in December 2019.

Climate pollution is driving longer bushfire seasons and worsening bushfire conditions, leading to larger, more intense fires (ELCA & Climate Council 2020).

The 2019-20 Black Summer bushfires had a devastating impact on many communities across Australia. More than 3,000 houses were destroyed and many communities were either threatened or displaced due to the fires (AIHW 2021b).

The smoke generated by these fires also blanketed many communities with smoke containing high concentrations of $PM_{2.5}$. This was the case in the Australian Capital Territory (ACT) which, during the fires, recorded some of the worst air quality in the world compared to other cities at that time. In the week beginning January 5, local air quality monitors recorded peak concentrations of $PM_{2.5}$ between 1,526.2 and 2,496.1 micrograms per cubic metre ($\mu\text{g}/\text{m}^3$), which is far in excess of the 25.0 $\mu\text{g}/\text{m}^3$ limit for 'good' air quality (AIHW 2021c).

Sales of inhalers in the ACT for shortness of breath increased by 204.3% compared to the same time a year earlier (AIHW 2021c). There was also a 52% increase in hospital attendances for respiratory conditions among ACT residents compared to the five-year average (AIHW 2021b).

Thirty-three Australians lost their lives due to the fires, and modelling has estimated a further 417 died from the smoke filled air that covered three of Australia's major cities for weeks (Arriagada et al. 2020, Cook et al. 2021). Research has also estimated that the smoke was responsible for a surge in hospitalisations and presentations to emergency departments. It is estimated that an additional 2,027 people attended hospital for respiratory problems, 1,124 for cardiovascular problems and 1,305 people presented to emergency departments with asthma (Borchers Arriagada et al. 2020).

The overall smoke-related health costs from the Black Summer bushfires are estimated to be as high as \$1.95 billion (Johnston et al. 2021).

5. Air pollution is dangerous for our health

Air pollution from coal, oil and gas is placing an unnecessary and avoidable burden on our health, especially children. There is no 'safe' level of exposure to PM (World Health Organisation 2024b, Australian Government 2022). Further, NO₂ related health impacts have been recorded at concentrations five times lower than those prescribed in our national standards (see Box 3 below) (Zosky et al. 2021).

Australian federal, state and territory governments recognise that air pollution in the form of CO, O₃, SO, NO₂, PM₁₀ and PM_{2.5} can have a significant impact on the health of Australians (Australian Government 2024b; NSW Government 2024). The National Environment Protection (Ambient Air Quality) Measure (NEPM AAQ) provides

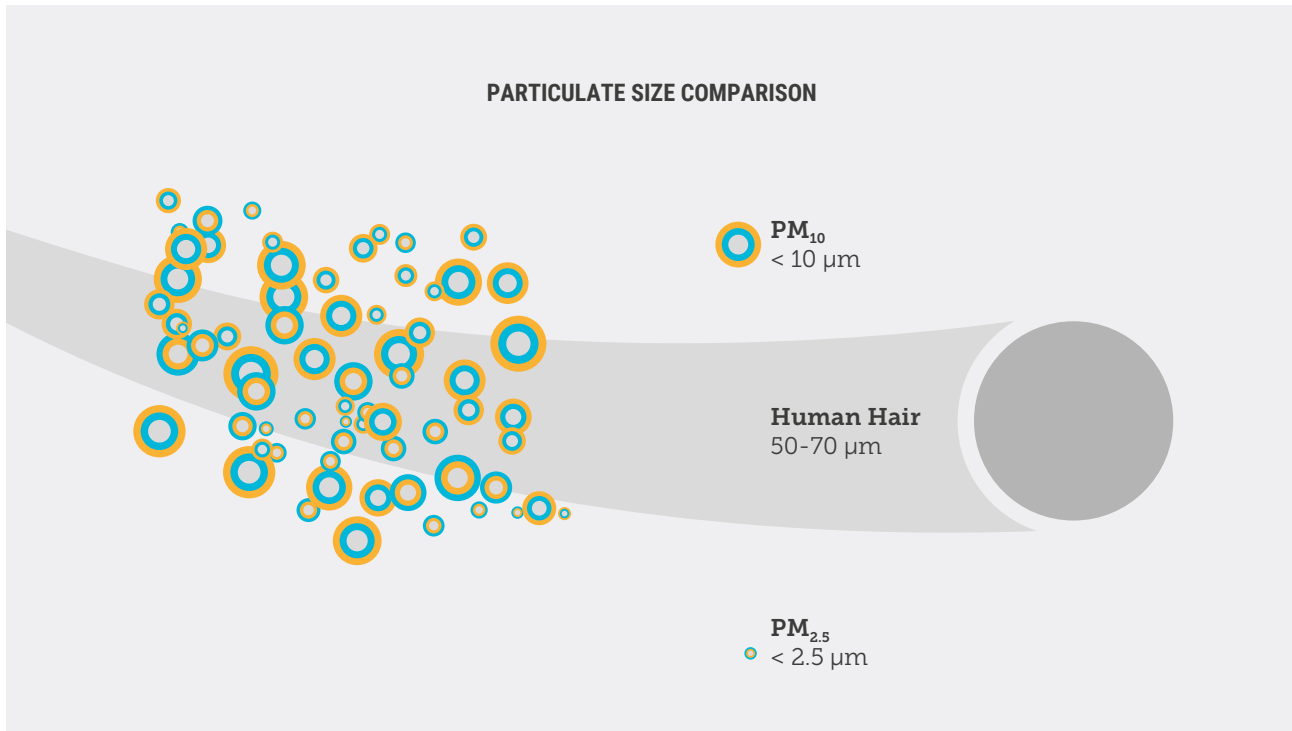
standards on the permissible concentrations for each pollutant that state and territories must monitor and report on (Australian Government 2024b). The intended environmental outcome of the NEPM AAQ is "ambient air quality that minimises the risk of adverse health impacts from exposure to pollution" (Australian Government 2021b).

Under the NEPM AAQ, pollutants are measured in terms of their average concentration over a set period. As an example, the maximum allowable short-term concentration of PM_{2.5} averaged over a day is 25 µg/m³. For NO₂, for the one hour averaging period the maximum allowable concentration is 0.08 ppm (Australian Government 2021b). The NEPM AAQ also sets maximum long term concentrations of PM_{2.5} and NO₂ averaged over a year of 8 µg/m³ and 0.015 parts per million (ppm) respectively (Table 1 below).

Table 1: Australian standards for pollutants under the National Environment Protection Measure (NEPM) for Ambient Air Quality.

Pollutant	Averaging period	Maximum concentration standard
Carbon monoxide	8 hours	9.0 ppm
Nitrogen dioxide	1 hour	0.08 ppm
	1 year	0.015 ppm
Photochemical oxidants (as ozone)	8 hours	0.065 ppm
Sulphur dioxide	1 hour	0.10 ppm
	1 day	0.02 ppm
Lead	1 year	0.50 µg/m ³
PM ₁₀	1 day	50 µg/m ³
	1 year	25 µg/m ³
PM _{2.5}	1 day	25 µg/m ³
	1 year	8 µg/m ³

Figure 2: The comparative sizes of PM_{2.5}, PM₁₀ and human hair (Source: California Air Resources Board).



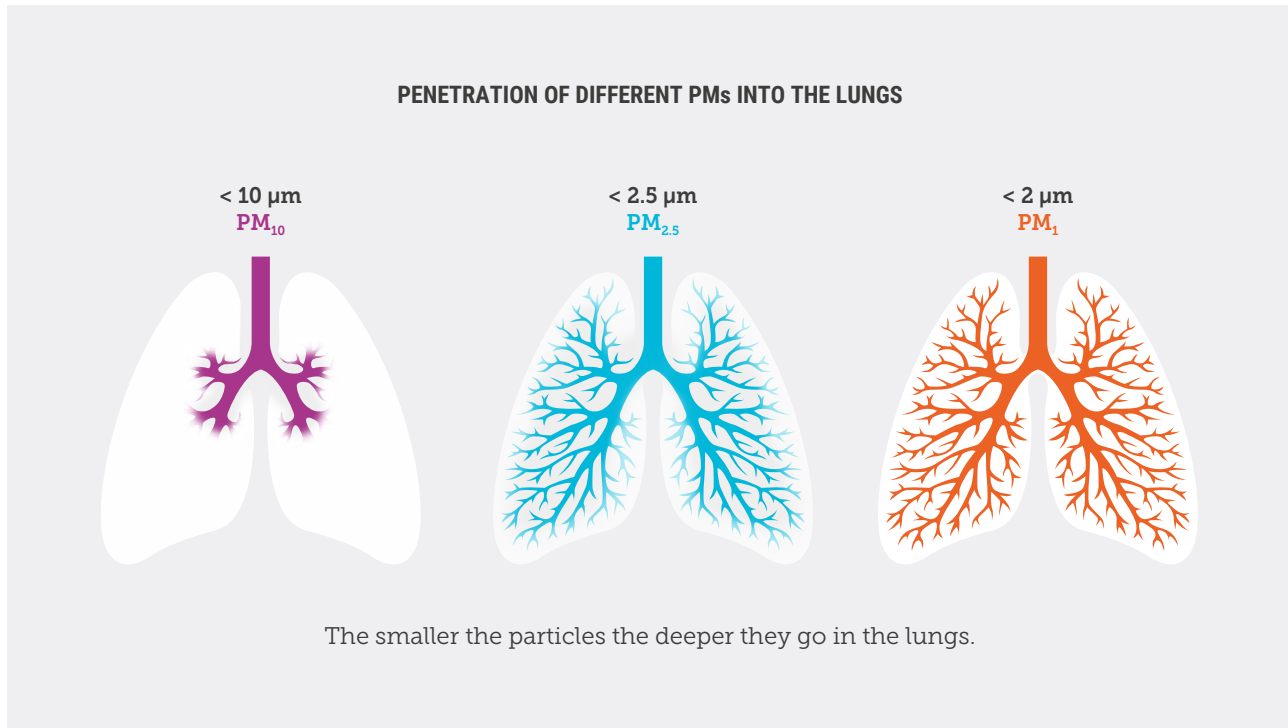
Additionally, in July 2024, the Environmental Health Standing Committee (enHealth) provided new guidance to the government on hourly and 24-hour air quality monitoring based on the latest research (Commonwealth of Australia 2024). The guidance from enHealth states that “much of the burden of disease due to air pollution in Australia arises from exposures *below* the existing national PM_{2.5} standards”, which many Australians are exposed to (Commonwealth of Australia 2024). In turn, enHealth noted that the NEPM AAQ does not make a distinction between ‘safe’ and ‘unsafe’ air pollution, rather it is a means for Australian state and territory governments to assess their air quality performance (Commonwealth of Australia 2024).

Although the NEPM AAQ does not provide hourly standards for PM_{2.5}, enHealth supports hourly reporting of PM_{2.5} levels to guide public health communications about actions people can take to protect themselves. Further, enHealth cites research that identifies harmful impacts from exposures to PM_{2.5} as brief as three hours (Commonwealth of Australia 2024).

Particulate matter is very harmful to health because of its composition, which can include sulphate, nitrates, ammonia, sodium chloride, black carbon, mineral dust or water (World Health Organisation, 2024b). PM₁₀ has a diameter of 10 micrometres or less and can easily pass through the throat and into the lungs (NSW Government 2020). Smaller still, PM_{2.5} can easily move deep into the lungs and into the bloodstream and harm other organs, especially the heart (NSW Government 2020; Pillay, Dodd & Cartwright et al. 2023). To provide an indication of their size - roughly 28 PM_{2.5} particles would span a strand of human hair (California Air Resources Board 2024).

Experts say that exposure to air pollution, even for short periods of time, harms the health of Australians.

Figure 3: Penetration of different PMs into the lungs. The smaller the PMs the further they can spread into the body (Source: Safera 2024).



Short-term exposure to PM_{2.5} - over hours or days - can lead to irritation of the eyes, nose and throat, worsening of asthma and chronic bronchitis and increases in hospital admissions (NSW Government 2020). Over the longer term, exposure to PM_{2.5} increases the risk of cancer, chronic obstructive pulmonary disease, cardiovascular and neurological diseases and stroke (Lu 2023).

In Australia, air pollution worsens diseases and significantly increases the likelihood of dying from heart and lung disease and diabetes (Health Effects Institute 2024b). It was estimated that in 2021, outdoor air pollution in the form of PM_{2.5} contributed to 4,250 premature deaths, over three times as many deaths from car accidents that year

(n=1,130) (Health Effects Institute 2024b; Australian Government 2024a). Further, the economic cost of all air pollution on the health and wellbeing of Australians based on exposure to PM_{2.5} is estimated to be as high as \$6.2 billion a year (Pillay, Dodd & Jalaludin 2023).

In 2021 the contribution of air pollution to deaths in Australia was over three times that of car accidents.

The impact of coarse particulate matter pollution (PM_{10}) is also significant. In 2018, PM_{10} specifically from traffic exhaust is estimated to have contributed to between 1,000 and 2,550 premature deaths in Australia, and was linked to 26,700 cardiovascular hospitalisations, asthma attacks and chronic obstructive pulmonary disease episodes (Li et al. 2024).

Exposure to NO_2 worsens asthma symptoms and attacks, increases the susceptibility of asthma sufferers to lung infections, and among healthy people results in greater risk of airway inflammation (Anenberg et al. 2022; NSW Government 2020). Importantly, NO_2 also contributes to the formation of O_3 , which irritates the eyes, nose, throat and lower airways, reduces lung function and worsens asthma and other respiratory diseases (NSW Government 2013).

Figure 4: The many health impacts of air pollution on adults and children (Pillay, Dodd & Cartwright et al. 2023).

HEALTH IMPACTS OF AIR POLLUTION ON ADULTS AND CHILDREN

NEUROLOGICAL

- Stroke
- Cognitive impairment
- Dementia

RESPIRATORY

- Respiratory mortality
- Respiratory morbidity
- Asthma
- COPD
- Lung cancer
- Lower respiratory tract infections
- Impaired lung function

ENDOCRINE

- Type 2 diabetes
- Insulin resistance
- Metabolic syndrome
- Type 1 diabetes

REPRODUCTIVE

- Pre-term birth
- Low birth weight
- Pregnancy loss
- Gestational diabetes
- Pregnancy-induced hypertension
- Impaired fertility

HAEMATOLOGICAL

- Thrombosis

ALLERGIES

- Allergic rhinitis

CARDIOVASCULAR

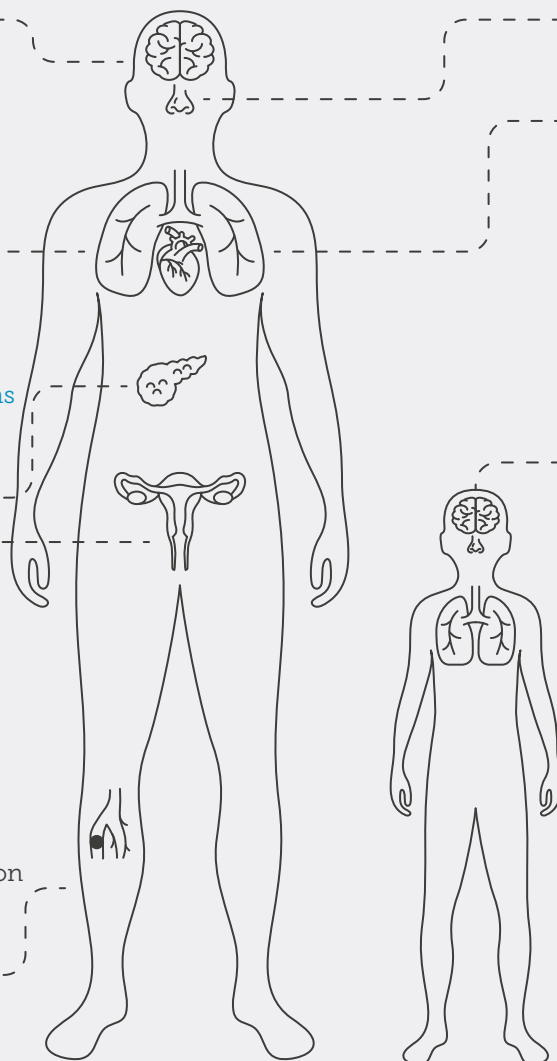
- Cardiovascular mortality
- Cardiovascular morbidity
- Ischaemic heart disease
- Cardiac arrest
- Hypertension
- Congestive heart failure
- Arrhythmia

PAEDIATRIC

- Asthma
- Lower respiratory tract infections
- Impaired lung function
- Cognitive impairment
- Neuropsychological impairment

KEY

- Well-established
- Emerging
- Inadequately characterised



6. Our kids are most vulnerable

Air pollution from the burning of fossil fuels like coal, oil and gas has a significant impact on the health and wellbeing of all Australians. Some of us are more vulnerable than others, including those who are pregnant, infants and children, the elderly, people with pre-existing health conditions and those experiencing social disadvantage (Walter et al. 2021; Australian Institute of Health and Welfare 2021b; Cooper, Green & Knibbs 2019). In fact, the burden of disease due to air pollution is twice as harmful for the most disadvantaged Australians compared to the most advantaged (Australian Institute of Health and Welfare 2021b).

WHY ARE CHILDREN MORE VULNERABLE?

Compared to adults, children experience greater exposure to air pollution. This is because they inhale more air per kilogram of body weight and have faster breathing rates, which means that they are more susceptible to air pollution (Brumberg & Karr 2021, Liu et al. 2018). Due to their shorter height, children are often closer to sources of air pollution and exposed to higher concentrations (World Health Organisation, 2018). For example, they are exposed to car exhaust fumes on their way to and from school, in community playgrounds and other public spaces.

Children spend far more time outdoors than adults, giving them greater potential exposure to air pollution (Bateson and Schwartz, 2007). For much of this outdoor time, children are engaging in physical activity such as sports or play, which means they are breathing more heavily, drawing air deeper into their lungs (California Air Resources Board, 2024b).

However, children are also more vulnerable to the harmful effects of air pollution due to their physiology, size and behaviour (Garcia, Rice and Gold 2021). Because their bodies are still developing, exposure to air pollution can significantly impact their internal organs, including the development and long term functioning of their lungs (Brumberg & Karr 2021; Liu et al. 2018).

THE HEALTH IMPACTS OF AIR POLLUTION ON KIDS

Exposure during gestation

Exposure to air pollution can negatively impact the healthy development of children, from pre-birth through to early, middle and late childhood (Brumberg & Karr 2021).

A recent review by the Health Effects Institute exploring evidence of the impact of traffic-related air pollution on health found that exposure to PM_{2.5} during pregnancy was linked to low-birth weight and smaller gestational age (Boogaard et al. 2022). For every increase of 10 micrograms of PM_{2.5} µg/m³, the increased risk of low-birth weight is equivalent to passively smoking up to 3.8 cigarettes in an indoor setting (van der Zee 2016).

Prenatal exposure to air pollution - particularly PM_{2.5} - also increases the likelihood of children having poor respiratory health and infections later in life (Pillay, Dodd & Cartwright et al. 2023). In one study, mid-gestational exposure to PM_{2.5} was linked to asthma developing among boys by the age of six (Liu et al. 2018).

Exposure during childhood

Children exposed to increased air pollution face an increased risk of both short- and long-term health issues. When exposed to above-average concentrations of PM₁₀, PM_{2.5}, SO₂, NO₂ and O₃, children are more likely to present to hospitals for acute respiratory infections, including tonsillitis and pneumonia (Aithal 2023; Cheng, Su & Xu, 2021).

In 2023, asthma was the leading cause of burden of disease in children under ten in Australia (Australian Institute of Health and Welfare 2024b). Air pollution can contribute to the development and exacerbation of asthma in children (Pillay, Dodd & Cartwright et al. 2023, Lavigne et al. 2021; Yang et al. 2021). A comprehensive Australian study focusing on NO₂ and respiratory health among 2,630 children aged 7-11 found that for every additional 4.0 parts per billion increase in NO₂ there was at least a 24% greater likelihood of reporting asthma (Knibbs et al. 2018).

Children who are exposed to harmful air pollution may also go on to suffer from lifelong health impacts. Children exposed to harmful levels of PM₁₀, PM_{2.5} and O₃ have an increased risk of slowed developmental growth and permanently reduced capacity of their lungs (Aithal 2023; Liu et al. 2018). This in turn can lead to significant health issues in later life (Pillay, Dodd and Cartwright et al. 2023, Aithal, 2023).

Breathing in particulate matter while pregnant increases the risk of low-birth weight, a condition that can have lifelong consequences.

BOX 4: HOW AIR POLLUTION IS HARMING OUR CHILDREN

The latest Global Burden of Disease study shows the impact of air pollution on Australian children.

Based on results from the most recent Global Burden of Disease study it is estimated that in 2021, PM_{2.5} was responsible for almost seven

times as many disability adjusted life years - the number of healthy years lost to poor health - as exposure to secondhand tobacco smoke among Australian children aged 0-14 (Institute for Health Metrics and Evaluation 2024).¹

Image 5: A child using an asthma inhaler. Researchers have found that asthma incidence increases with exposure to air pollution.



Outdoor air pollution is more harmful to Australian children than exposure to secondhand smoke.

¹ The disability adjusted life years for outdoor PM and secondhand smoke among Australian children aged 0-14 were calculated using the Institute for Health Metrics and Evaluation's [GBD Compare](#) tool. In 2021 outdoor PM_{2.5} was responsible for 1,746.02 disability adjusted life years among young Australians aged 0-14, compared to 252.25 disability adjusted life years for secondhand smoke exposure.

HOW MUCH AIR POLLUTION IS TOO MUCH?

Even limited exposure can be harmful

Being exposed to air pollution for even short amounts of time can damage kids' health. Above-average daily concentrations of $PM_{2.5}$ have been found to increase the risk of children presenting to health services for worsening asthma (Lim et al. 2016; Huang et al. 2023).

Another study also found that when average daily concentrations of $PM_{2.5}$, PM_{10} , SO_2 , O_3 , CO_2 and NO_2 increase, children have a greater risk of presenting to health services for pneumonia (Nhung et al. 2017). This highlights that exposure to harmful air pollution for as little as 24 hours can negatively impact children's respiratory health.

There is no 'safe' level

As outlined by the Centre for Safe Air (Zosky et al. 2021), the health effects of air pollution are seen at very low levels and for many pollutants there is no evidence of a 'safe' level of exposure. The evidence is strongest for $PM_{2.5}$ and PM_{10} . Any safe threshold for NO_2 is likely to be five times lower than current national standards allow. This highlights that the health of Australians can be improved with significant reductions in air pollution (Zosky et al. 2021). For example, one recent study estimated that a 25% reduction in NO_2 concentrations in NSW would lead to at least 2,597 fewer children with asthma (Ewald, Knibbs & Marks, 2021).

Image 6: Hurting kids: Traffic exhaust fumes containing harmful pollutants like NO_2 and $PM_{2.5}$ being released into the air.



7. Avoidable traffic pollution is making Australian kids sick

There are multiple sources of air pollution, but there is clear evidence that air pollution from fossil fuel powered vehicles is harming our children.

The onset of asthma, wheeze and acute lower respiratory infections among children has been linked to exposure to traffic-related air pollution which can include NO₂, PM_{2.5}, PM₁₀, benzene and VOCs (Boogaard et al. 2022; Han et al. 2021, Khreis et al. 2017; Gasana et al. 2012). In a study spanning ten European cities, researchers estimated that 14% of asthma cases amongst children aged 0-17 were attributable to traffic related air pollution from busy roads (Perez et al. 2013). Researchers from the Netherlands found that living next to a freeway is equivalent to passively smoking up to 10 cigarettes per day (Van der Zee et al. 2016).

Children living, learning and playing near busy roads have an increased risk of a range of respiratory health problems (Gasana et al. 2012). Research from the United States

demonstrated that the lung function of an eight-year-old child living within 100 metres (m) of a major roadway is 6% lower on average than their peers living 400m away (Rice et al. 2016). A study from the United Kingdom showed the risk of wheeze among primary school aged children was greater for those living within 150m of main roads, with the risk increasing the closer they lived (Venn et al. 2001). In another study, children who lived and attended school in places more than 100m away from major roads were less likely to report asthma symptom days, healthcare use and poor asthma control (Hauptman et al. 2018).

The closer children are to busy roads, the greater the risk of poor health. Whether it's their home, or where they learn and play, if they are spending time outdoors within 100m of a busy road, exposure to air pollution and risk of wheeze and asthma among children is greater (Venn et al. 2001; Hauptman 2020; Freid et al. 2021).

Researchers have found that children living, learning and playing near major roads are more likely to have asthma, wheeze and poorer lung function.

BOX 5: EXPOSED: SCORES OF CITY SCHOOLS AND CHILDCARE CENTRES ARE CLOSE TO MAJOR ROADS

Climate Council analysis suggests that about one-in-six schools and childcare centres across all our capital cities are located within 100 metres of a busy main road. Childcare centres are the most likely to be located near a busy road (21%), followed by secondary schools (17%) and primary schools (15%).

Children appear to be most exposed in Melbourne, where almost a quarter of all schools and childcare centres are located on or near a busy road, closely followed by Perth and Brisbane. Across all capital cities, nearly 850 childcare centres are within 100m of a busy road, alongside 263 schools.

Exposure to major roads differs within each city. In Sydney, Perth, Canberra and Adelaide, schools and childcare centres in the inner city and suburbs are most likely to be located near a major road. However in Melbourne, schools in the eastern suburbs are highly likely to be exposed to more traffic.

In smaller cities like Adelaide and Canberra fewer educational facilities were located within 100m of a major road. This is due in part to both cities having fewer major roads overall.

HARD LESSON: ANALYSIS OF CITY SCHOOLS AND CHILDCARE CENTRES NEAR MAJOR ROADS

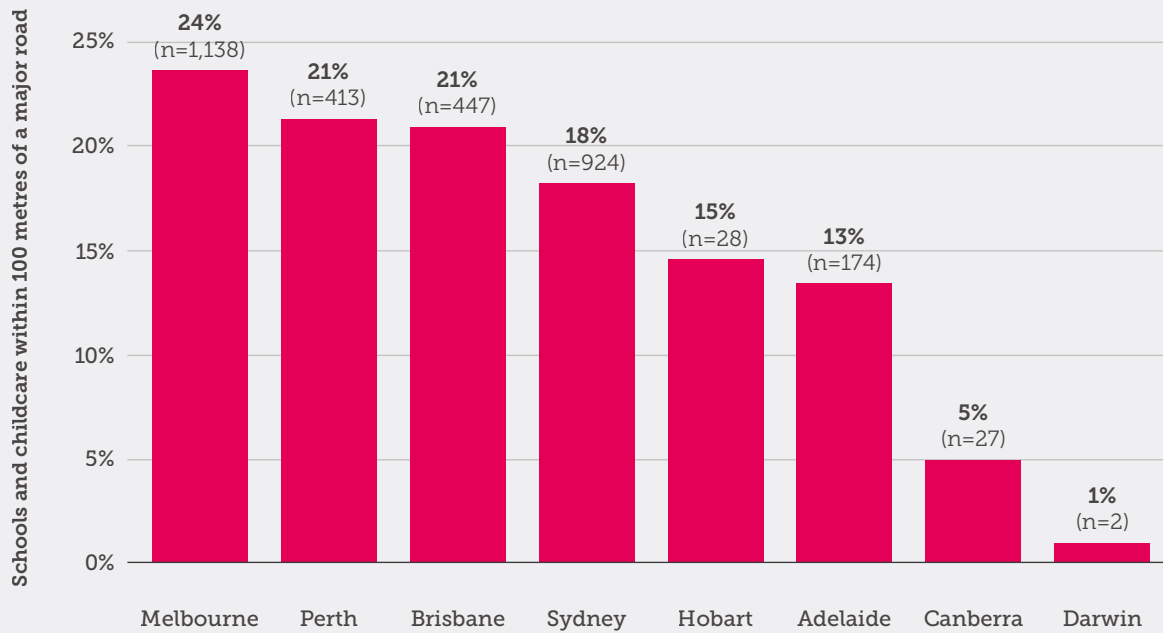


Figure 5: Up to a quarter of schools and childcare centres in our capital cities are near a major road.

Table 2: Australian suburbs with high concentrations of schools and childcare within 100m of a busy road.

City	Traffic pollution danger zones	Percentage of schools and childcare centres within 100m of a busy road
Adelaide	1. Norwood - Payneham - St Peters	39.3% (22 of 56)
	2. Prospect - Walkerville	36.6% (15 of 41)
	3. West Torrens	29.7% (22 of 74)
Brisbane	1. Carindale	36.6% (15 of 41)
	2. Brisbane Inner	35.8% (24 of 67)
	3. Holland Park - Yeronga	32.9% (28 of 85)
Canberra & Queanbeyan	1. Gungahlin	13.3% (10 of 75)
	2. South Canberra	8.6% (5 of 58)
	3. Queanbeyan	8.1% (3 of 37)
Melbourne	1. Boroondara	51.9% (97 of 187)
	2. Whitehorse - West	47.5% (56 of 118)
	3. Port Phillip	42.2% (48 of 83)
Perth	1. Perth City	55.3% (57 of 103)
	2. Cottesloe - Claremont	39.0% (30 of 77)
	3. Gosnells	34.5% (38 of 110)
Sydney	1. Sydney Inner City	43.2% (79 of 183)
	2. Pennant Hills - Epping	42.1% (33 of 57)
	3. Leichhardt	41.6% (45 of 77)

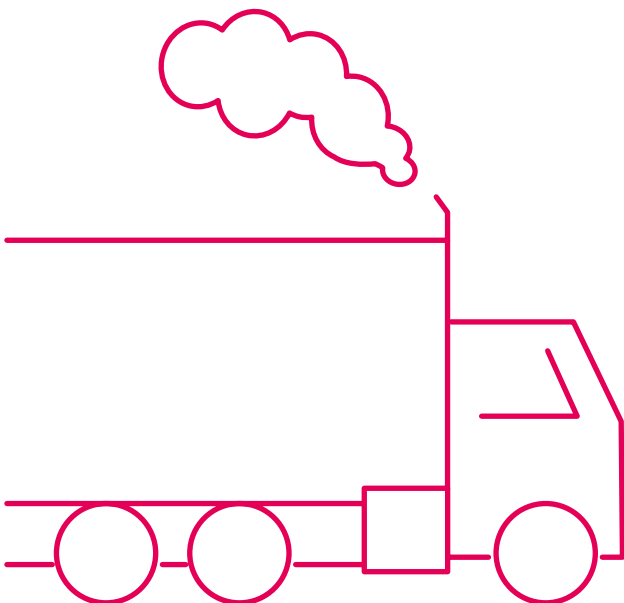
Note: Exposure between different areas is not included for Darwin and Hobart because they have a limited number of suburbs with busy roads compared to other Australian capital cities. Areas are based on ABS Statistical Area 3 boundaries, which represent functional areas within cities.

Up to a quarter of the schools and childcare centres in our capital cities are close enough to major roads to raise health risks for children.

It is also important to note that other local factors - including the types of vehicles using roads in addition to proximity to major roads - may influence health outcomes among children. The City of Maribyrnong, in Melbourne's inner west hosts busy arterial roads used by trucks transporting freight from the nearby Port of Melbourne. Compared to other nations, Australia has an older fleet of trucks, with more than a quarter (27%) manufactured before 2002 (Terril, Burfurd and Fox, 2022). Older trucks are more polluting - those sold between 1996 and 2002 emit 20 times the particulate matter of a truck that meets current pollution standards (Terril, Burfurd and Fox, 2022). Historically, children and young people aged 3 to 19 residing in the City of Maribyrnong have reported higher rates of hospital admissions for asthma and respiratory conditions compared to the rest of the state (ACSQHC, 2015). Due to these factors, children attending the 27% of schools and 29% of childcare centres within 100m of a busy road in the City of Maribyrnong are likely to have a greater risk of poor health compared to their counterparts in other parts of Melbourne (Walter et al. 2024).

Recent research has also shown that there are specific times of the day when children's exposure to air pollution is likely to be greater. An international review of air pollution and children's health found that the highest risk times for air pollution exposure are the journey to school, at the school gate and in playgrounds (Osborne et al. 2021). A study from the United Kingdom showed that concentrations of $PM_{2.5}$ were up to three times higher at a primary school due to cars idling whilst queuing for morning drop-offs (Kumar et al. 2020). For children attending childcare centres in Perth, Western Australia, concentrations of $PM_{2.5}$ peaked at times when they were likely to be playing outside or leaving for the day: 1pm, 2pm and 6pm (Christian et al. 2022).

Childcare centres and schools cannot be easily relocated away from busy roads, but we can clean up the air and better protect our children's health and by implementing strategies to support cleaner forms of transport. We can also take steps to safeguard children's health by ensuring that new schools and childcare centres are built in locations away from air pollution sources such as industrial facilities and high traffic roads (Lee et al. 2023). Introducing clean air zones around schools can also benefit the health of children (Walter et al. 2024, Kumar 2020).



Q CASE STUDY: WHAT ARE THE FUMES DOING TO MY DAUGHTERS' LUNGS

For Melbourne father Ben, watching his kids happily playing outside at their daycare centre brings up a sense of anxiety. The kids are playing just 3m from a busy road where trucks and other vehicles frequently pass by spewing out fumes that can be seen and smelt when you walk along the footpath near the centre. Ben's two daughters aged 21 months and three years both attend the centre. His youngest daughter suffers from infant asthma.

"I can't help but wonder and worry, what are these fumes doing to little lungs? And I feel increasingly frustrated. There is a better way, we have cleaner options available but we are moving too slow to clean up our transport system and protect the health and wellbeing of our kids".

Image 7: Loving family: Ben with his two daughters in Melbourne, Victoria.



8. Cleaning up our transport sector will cut climate and air pollution, with immediate health benefits

The Commonwealth, state and territory governments have taken positive steps to reduce the health impacts of air pollution on Australians. The introduction of the national New Vehicle Fuel Efficiency Standards (NVES), which start on 1 January 2025 will reduce traffic related pollution, with a cut of at least 60% in emissions from new passenger cars by 2030 (DCCEEW 2024).

The Climate Council has also mapped out in detail how we can build a clean economy to power our lives, set up Aussie communities and our kids for success, and cut climate pollution by 75% this decade (Climate Council 2024b). This would have two benefits: we help to prevent avoidable escalations in extreme weather events such as heatwaves, bushfires and floods and also remove the sources of air pollution that harm our kids' health and shorten our lives. A key step is building much more clean energy such as wind and solar, backed by storage, so we can close all coal-fired power stations by 2030) and ditch our gas-powered stoves and heaters for electric ones. (Climate Council 2024b, World Health Organisation 2024d).

We can cut climate and air pollution further by providing more people who live in our cities with more frequent, sustainable and

accessible transport solutions. Only half of the 15 million Australians living in our five biggest cities have access to frequent, all-day public transport today (Climate Council 2024c). An overwhelming majority (80%) of Australians want governments to invest more in public transport, and two in three (67%) want more investment in footpaths, bikeways and other active transport infrastructure (Climate Council 2022).

At the same time, we need to ensure that our national air quality standards reflect the most recent evidence on the health risks of harmful pollutants (Pillay, Dodd and Cartwright et al. 2023). Health impacts have been found for concentrations of PM_{2.5} below the current standards contained in the NEPM (Commonwealth of Australia, 2024). For some pollutants, no safe level of exposure has been established (World Health Organisation 2024b). To better protect the health of Australians, the NEPM should include a focus on continuous air quality improvement, ensuring that harmful pollution is reduced over time (Pillay, Dodd and Cartwright et al. 2023).

With the health of so many children being harmed by the air they breathe, we can and should be doing so much more to cut harmful air and climate pollution from the burning of coal, oil and gas.

BREAKOUT: STEPS THAT PROTECT OUR KIDS

There are steps that schools, childcare providers and parents can take to limit children’s exposure to harmful pollution from nearby traffic.

Schools and childcare facilities can work with local governments to introduce clean air zones around their boundaries, particularly in the spaces where children are most likely to play and congregate (Kumar 2020). This can mean relocating car drop-off and pick-up points away from school entrances and playgrounds. Many communities are already trialling versions of this. Merri-Bek Council has partnered with Bicycle Victoria and nine local schools to trial the Open Streets Program, where car traffic is restricted for a day a week at the front of schools to create

healthier and safer environments for children (Merri-Bek, 2024). Schools and childcare facilities can also work with parents to reduce the amount of cars that are idling by ensuring that car engines are turned off at drop off and pick up times (An et al. 2021). Greening the boundaries of schools and childcare facilities, can also create a barrier of trees, shrubs and vegetation to limit children’s exposure to traffic pollution (Kumar 2020).

Parents and children can also take steps to minimise traffic pollution by using active travel such as walking and riding bikes to and from school, and avoiding routes along major roads in favour of smaller streets away from busy traffic (An et al. 2021).

Image 8: Outdoor fun: Primary school children in the playground.



There is great potential to clean up the air we breathe, cut climate pollution and protect our kids from harm.

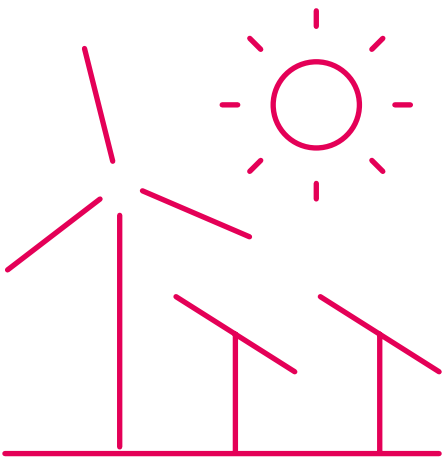
9. Conclusion

Nothing is more important than the health of our children. If there's an opportunity to create a safer and healthier community, we should take it. Especially when that same opportunity promises to lower our travel costs and deliver many additional benefits for our households and society.

Outdoor air pollution linked to the mining and use of fossil fuels is stealing more years from Australian children than exposure to secondhand smoke. There is no 'safe' level of exposure to many pollutants. Every exposure to avoidable particulate pollution from fossil fuels is potentially doing us harm. We cannot easily move children away from these sources of harm - such as through relocating schools and childcare centres away from busy roads - but we can do so much more to eliminate the problem at its source.

The good news is that we have everything we need at our disposal to reduce harmful outdoor air pollution now. By moving away from avoidable sources of air pollution such as petrol and diesel powered cars, and making it easier for more people in our cities to walk, ride or take public transport more often, we can clean up the air in our major centres and reduce the burden of asthma and other diseases. Taking such steps is an important part of reducing climate pollution, and thereby limiting further harm on our children from extreme weather events into the future.

Every time we replace an ageing, polluting coal-fired power station with clean energy like wind and solar backed by storage, or provide more people in our cities with cleaner ways of getting around, we are building a healthier future for all of us, and especially for our children.



By building more clean energy and cleaning up transport pollution we're creating a healthier future for all Australian children.

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Appendix: Schools and childcare centre proximity to major roads methodology

School and childcare centre locations were sourced from the [Australian Curriculum, Assessment and Reporting Authority](#) and [Australian Children's Education & Care Quality Authority](#). Childcare locations were based on address data and were geocoded prior to analysis.

Major roads were sourced from OpenStreetMap, queried using [Overpass Turbo](#). Roads were considered *major* if they were a highway tagged as 'Primary', 'Trunk' or 'Motorway'.

For the purpose of this analysis, city boundaries were based on the Australian Bureau of Statistics' [Urban Centres and Localities](#) classification, which represents major city areas, rather than the larger 'greater' capital cities used in some analyses.

To identify schools and childcare facilities within 100 metres of a major road, point locations for facilities were first buffered to a 10-metre polygon to better represent the typical building footprint. Major roads are then buffered to 100 metres forming a catchment area. Any facilities within this catchment area for at least one road were included in the count of facilities within 100 metres of a major road.

Image credits

Cover: Kid using asthma inhaler, photo by iStock user Solar737.

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Page 9 – Image 3: Junee, NSW Australia, January 05 2020, photo by Shutterstock user Greg Stonham.

Page 11 – Image 4: Photo taken by Mallacoota mother Allison Marion of her son steering a boat on Mallacoota lake trying to stay safe from fire, shared by ABC Gippsland 30 December 2019.

Page 18 – Image 5: Girl Using Inhaler To Treat Asthma Attack, photo by iStock user Highwaystarz-Photography.

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Page 24 – Image 7: Ben and children - Melbourne, Victoria, photo via Ben and Parents for Climate.

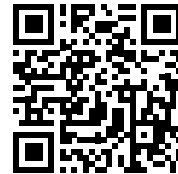
Page 26 – Image 8: Primary school children in the playground, photo by iStock user JohnnyGreig.

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The Climate Council acknowledges the Traditional Owners of the lands on which we live, meet and work. We wish to pay our respects to Elders, past and present, and recognise the continuous connection of Aboriginal and Torres Strait Islander peoples to land, sea and sky. We acknowledge the ongoing leadership of First Nations people here and worldwide in protecting Country, and securing a safe and liveable climate for us all.

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