Environmental Defenders Office

Toxic Transport:

How Our Pollution Laws Are Failing to Protect Our Health

About EDO

Environmental Defenders Office Ltd (**EDO**) is a community legal centre specialising in public interest environmental law. We help people who want to protect the environment through law. Our reputation is built on:

Successful environmental outcomes using the law. With over 30 years' experience in environmental law, EDO has a proven track record in achieving positive environmental outcomes for the community.

Broad environmental expertise. EDO is the acknowledged expert when it comes to the law and how it applies to the environment. We help the community to solve environmental issues by providing legal and scientific advice, community legal education and proposals for better laws.

Independent and accessible services. As a non-government and not-for-profit legal centre, our services are provided without fear or favour. Anyone can contact us to get free initial legal advice about an environmental problem, with many of our services targeted at rural and regional communities.

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About Healthy Environment & Justice Program

EDO's Healthy Environment & Justice Program (**HEJ** Program) is underpinned by an environmental human rights framework. The goal of the HEJ Program is to empower overburdened people and communities to fight for environmental justice.

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Acknowledgment of Country

The EDO recognises and pays respect to the First Nations Peoples of the lands, seas and rivers of Australia. We pay our respects to the First Nations Elders past, present and emerging, and aspire to learn from traditional knowledges and customs that exist from and within First Laws so that together, we can protect our environment and First Nations cultural heritage through both First and Western laws. We recognise that First Nations Countries were never ceded and express our remorse for the injustices and inequities that have been and continue to be endured by the First Nations of Australia and the Torres Strait Islands since the beginning of colonisation.

EDO recognises self-determination as a person's right to freely determine their own political status and freely pursue their economic, social and cultural development. EDO respects all First Nations' right to be self-determined, which extends to recognising the many different First Nations within Australia and the Torres Strait Islands, as well as the multitude of languages, cultures, protocols and First Laws.

First Laws are the laws that existed prior to colonisation and continue to exist today within all First Nations. It refers to the learning and transmission of customs, traditions, kinship and heritage. First Laws are a way of living and interacting with Country that balances human needs and environmental needs to ensure the environment and ecosystems that nurture, support, and sustain human life are also nurtured, supported, and sustained. Country is sacred and spiritual, with culture, First Laws, spirituality, social obligations and kinship all stemming from relationships to and with the Land.

A note on Language concerning First Nations

We acknowledge that there is a legacy of writing about First Nations without seeking guidance about terminology. We also acknowledge that where possible, specificity is more respectful. In the domestic context, where possible, we have used specific references. Further, when referring to First Nations in the context of a particular Country we have used the term 'Traditional Owners'. More generally, we have chosen to use the term 'First Nations'. We acknowledge that not all Aboriginal and Torres Strait Island Peoples will identify with that term and that they may instead identify using other terms or with their immediate community or language group.

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Foreword

Our health and wellbeing are directly influenced by our environment. It is universally recognised that we each depend on a healthy environment for life and dignity, including clean air and a toxic free environment.

Air pollution increases our chances of developing heart disease, chronic respiratory diseases, lung infections, and cancer. Poor air quality causes people to die younger and exacerbates chronic diseases such as asthma. There is no safe level of exposure to particulate matter, one of the most prolific forms of air pollution in our communities.

And yet, we do not live in a toxic free environment. Worldwide, air pollution is the single greatest environmental cause of preventable disease and premature death.

In Australia, researchers estimate that air pollution from transport alone is linked to 11,000 premature deaths every year. Unlike lifestyle factors, over which people have some control, exposure to air pollution is out of our hands. It is here that governments have a crucial role to play in ensuring everyone has equal access to clean air and a healthy environment.

Transport connects us to everything: our communities, workplaces, friends and family, education, healthcare, and the essential services we need. Transport makes our cities liveable, connects our supply chains and takes our children to school. For most of us, owning a car is not a luxury but a necessity, without which we could not work, stay mobile or access the basic necessities of life. For those of us living with disability, reliance on single use transport may be even more profound. Where public transport is inaccessible or inadequate, and active modes of transport like riding or walking not an option, a car may be a lifeline.

And yet, in Australia, our transport systems are largely reliant on petrol and diesel, which emit toxic air pollution – particulates, nitrous oxides and other harmful pollutants. Transport also produces a large and rising share of Australia's carbon pollution (19 per cent), fuelling climate change and harming people's health. Climate change is predicted to increase ozone in our cities through heat effects, which again increases the risks of air pollutants. Australia is on a path to rising emissions and worsening air quality unless governments step in with coordinated and effective action.

Tackling our transport pollution problem is an opportunity to reduce health inequality in Australia. Not all people have the same exposure to transport pollution, with heavy vehicle routes, main roads, idling vehicles and geography playing a part. And some people are at a heightened risk, usually those that we often call the most 'vulnerable'. This includes older people, people with disability and living with chronic health conditions, pregnant women, and shockingly, children and babies. Our children are especially vulnerable to the toxic effects of air pollution.

The recommendations within this report provide a clear path forward for Australian governments and policymakers to better monitor and regulate transport pollution for safer, cleaner, more liveable cities and communities. This includes adopting a comprehensive "exposure reduction framework" that meets Global

Air Quality Guidelines set by the World Health Organisation, legislating fuel efficiency standards to drive safer vehicle fleets, and setting a target date for phasing out sales of new petrol and diesel cars.

We must also fundamentally change the way we move. This is nuanced and requires a considered planning response. It will require a plan to rapidly transition from petrol and diesel vehicles to cleaner, electric and zero-emission options, and shifting to accessible active and public transport as our primary modes of travel, for better health, and to fulfil our global climate commitments. This planning must be informed by those most affected by transport mode-shifts, namely people with disability, and people at socio-economic disadvantage impacted by change to transport systems.

The pandemic has shown us how governments and experts can work together on addressing complex challenges. We can do the same here and we need to act quickly. Reducing transport pollution is one of the best investments for Australians' health, the environment and social equity. And it will take a step toward our human right to clean air, a toxic free and healthy environment for all.

Nicole Sommer
Director, Healthy Environment & Justice

Environmental Defenders Office

Executive Summary

People living in Australia's largest cities, Sydney and Melbourne, are exposed to transport air pollution at levels that are harmful to health, particularly the health of children, pregnant people, people living with disability, the elderly and those living with chronic disease. Residents are regularly exposed to air pollution that exceeds national standards. To further exacerbate the issue, national standards themselves do not meet international standards set by the World Health Organisation (**WHO**) Global Air Quality Guidelines (**WHO Guidelines**) and need urgent revision. Researchers estimate that air pollution from transport is responsible for approximately 11,000 deaths annually in Australia - that's almost 10 times higher than the 1,194 people killed in road crash accidents in 2022.

Australian governments are failing to properly monitor air pollution. Testing regimes only measure ambient air pollution levels, and testing sites do not all measure the same pollutants and are poorly positioned. These testing systems fail to capture the concentration of transport pollution, and Australian residents' exposure to it, in areas next to busy roads and traffic corridors. These areas are frequently used by diesel-powered heavy vehicles, which are known to be the worst polluters. In fact, diesel exhaust pollution is a Group 1 carcinogen, making it on a par with tobacco smoke. Importantly, current monitoring standards do not adequately measure or report Australian residents' actual exposure to cumulative or localised transport pollution. Consequently, Australian governments are failing to implement measures that accurately evaluate and respond to the impacts of exposure to transport pollution on Australian residents' health.

In our cities most polluted suburbs, people are effectively residing in 'sacrifice zones' where health outcomes are measurably worse than that of the general population. For example, an average of 11,000 trucks pass by residents living near the Port of Melbourne in the city's inner-west each day. The adolescent asthma rate in this area is 50% higher than the state average and the hospital admission rate for people aged 3 to 19 is 70% higher than the Australian average. Across Victoria, a 2019 study determined that one quarter of all childcare centres were located within 150 metres of a major road, exposing young children to unnecessary levels of transport pollution and associated health impacts.

To address these current inadequacies, Australian governments must urgently move away from current ambient air pollution targets and monitoring standards, and instead implement a coordinated and effective '**exposure reduction framework**' that seeks to mitigate Australian residents' exposure to transport pollution and its associated impacts on health. This report makes several recommendations for Australian governments and policy makers to enable the implementation of an exposure reduction framework. These recommendations include revisions to the National Environment Protection (Ambient Air Quality) Measure to significantly improve air pollution targets and monitoring standards, that at a minimum, meet the thresholds contained in the WHO Guidelines. In addition to these revisions, Australian governments must implement an exposure reduction framework by legislating and developing policies to mitigate the population's exposure to current and future transport pollution. Most importantly, fuel efficiency standards and a target date banning the sale of internal combustion engine vehicles must be legislated as soon as possible. Further measures include state or territory expanding enhanced monitoring to support transport pollution related public health warnings, city- or suburb-wide policies such as low-emission zones or traffic calming measures or banning heavy vehicles on residential roads.

Finally, the success of an exposure reduction framework is dependent on all Australian governments implementing measures, strategies and policies that seek the long-term reduction of transport pollution that are consistent and coordinated. To ensure consistency and coordination, Australian governments must adopt 'whole-of-government' and 'health-in-all policies' approaches to the development and implementation of legislation and policies that seek to mitigate Australian residents' exposure to transport pollution reducing its impacts and burdens on health, and longer-term reduce overall sources of transport pollution.


George St
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Summary of Recommendations

Set out in the table below is a summary of the recommendations for Australian Governments and policymakers to enable the implementation of an '**exposure reduction framework**' that focuses on protecting the health of the Australian population by mitigating exposure to harmful transport pollution. These recommendations are designed to facilitate the necessary shift in focus of transport pollution regulation away from current ambient air pollution targets and monitoring standards, to a coordinated and effective exposure reduction framework.

Recommendation 1: Revise the National Environment Protection (Ambient Air Quality) Measure to set ambient air pollution threshold targets that:

a. At a minimum, are consistent with the air pollution threshold targets recommended by the WHO Guidelines; and

b. Implement the principle of 'continuous improvement' that progressively sets new threshold targets for air pollutants, with all thresholds being periodically revised from the new WHO Guidelines consistent targets towards zero.

Recommendation 2: In addition to revising ambient air quality targets, to set targets for an exposure reduction framework, the National Environment Protection (Ambient Air Quality) Measure must:

a. **Establish population exposure threshold targets** for air pollutants; and

b. Set population exposure reduction targets for *cumulative* and *localised* exposure to all air pollutants, incorporating the principle of 'continuous improvement'.

Recommendation 3: To ensure the revised ambient threshold targets and new population exposure threshold targets are effective, the National Environment (Ambient Air Quality) Measure, must set new monitoring standards for air pollutants that require:

a. The significant expansion of the number of ambient air monitoring stations, particularly in metropolitan areas;

b. The monitoring of population exposure to air pollution in areas or hotspots of heightened risks of exposure to air pollution. For transport pollution, this includes monitoring on roadsides in locations where there are high traffic volume roads and in areas of high pedestrian activity, and monitoring cumulative population exposure to transport pollution; and

c. Enable monitoring data to be publicly accessible, available as real time and historical data.

Recommendation 4: To ensure that the new threshold targets and monitoring standards set in a revised National Environment Protection (Ambient Air Quality) Measure are implemented and enforced:

a. Amend the *National Environment Protection Council Act 1994* (Cth) so that thresholds and standards set under a reformed National Environment (Ambient Air Quality) Measure are mandatory;

b. Examine how a new national Environmental Protection Authority (once established) can have a role in enforcing the mandatory threshold targets and monitoring standards in the revised National Environment Protection (Ambient Air Quality) Measure; and

c. Provide for third party review and enforcement mechanisms for breaches.

Recommendation 5: **State and territory governments and regulators must legislate and develop objectives, guidelines, and policies to support an exposure reduction framework, and to meet the mandatory threshold targets and monitoring standards set by the revised National Environment (Ambient Air Quality) Measure.**

Recommendation 6: **In legislating and developing objectives, guidelines, and policies to support an exposure reduction framework, Australian governments must:**

a. Implement Australian Fuel Efficiency Standards by no later than 1 July 2024;

b. Legislate a target of all new vehicles sold by 2035 to be electric or zero emissions; and

c. Implement and coordinate strategies from all levels of government that seek to implement a 'mode shift' away from private vehicles to active and public transport.

Recommendation 7: **To ensure all Australian governments implement measures, strategies and policies that seek the long-term reduction of transport pollution that are consistent and coordinated, Australian governments must adopt:**

a. A **whole-of-government approach** to the adoption and implementation of an exposure reduction framework;

b. A **health-in-all policies approach** when making decisions or developing policies that relate to or could affect the regulation of population exposure to transport pollution; and

c. In developing and implementing regulation and policies to implement an exposure reduction framework, Australian Governments must adopt a **multistakeholder engagement approach** in which all levels of governments engage with the scientific community, the private sector, civil society and with communities and individuals (particularly overburdened communities and physiologically vulnerable groups) who are empowered to participate in decision making processes regarding the regulation of transport pollution.

Glossary of Terms

Aarhus Convention	*Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environment Matters*
Air Quality NEPM	National Environment Protection (Ambient Air Quality) Measure
Air Toxics NEPM	National Environment Protection (Air Toxics) Measure
Ambient air	Ambient air is all external air in the environment but does not include the air environment inside buildings or structures.
CO	carbon monoxide
CEDAW	*Convention on the Elimination of All Forms of Discrimination Against Women*
CRC	*Convention on the Rights of the Child*
CRPD	*Convention on the Rights of Persons with Disabilities*
Diesel Vehicle NEPM	National Environment Protection (Diesel Vehicle Emissions) Measure
EVs	electric vehicles
GHG	greenhouse gas
Heavy vehicle	Any vehicle over 4.5 tonnes in gross vehicle mass (as defined by the *Heavy Vehicle National Law*)
ICCPR	*International Covenant on Civil and Political Rights*
ICE	internal combustion engine
ICESCR	*International Covenant on Economic, Social and Cultural Rights*
LEZ	*Low emission zone*
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure

NO	nitric oxide
NO_2	nitrogen dioxide
NOx	nitrogen oxides
NDC	Nationally Determined Contribution to the Paris Agreement
Non-tailpipe	emissions that are produced from non-exhaust sources such as tyres and a vehicle's brake pads
Pb	lead
PM0.1	airborne ultra fine particulate (≤ 0.1 µm)
PM2.5	airborne fine particulate (≤ 2.5 µm)
PM10	airborne fine particulate (≤ 10 µm)
O_3	ozone
SO_2	sulfur dioxide
SUVs	Sport utility vehicle
Tailpipe emissions	emissions produced from the exhausts of internal combustion engine vehicles
Transport pollution	all pollution caused by road transport emissions, which includes dust, non-tailpipe and tailpipe emissions
ULEZ	ultra-low emission zone
VOC	volatile organic compounds
WHO	World Health Organisation
WHO Guidelines	WHO Air Quality Guidelines 2021

Part One:

What are the Impacts of Transport Pollution on Human Health

Introduction

Transport is essential for our economic and social activities. Transport helps us navigate cities, our regions, stay connected with communities and family, access employment and services, and participate in civic life. Transportation enables our society and economy to function and communities to thrive.

However, in Australia our transport systems are built on unsustainable and harmful pollutants, contributing to significant global and local environmental and social harm in two key ways. First, the transport sector is a key driver of the climate emergency contributing significantly to global greenhouse gas (**GHG**) emissions. Second, the transport sector is a significant producer of particle and chemical pollution. The World Bank reports that it is estimated that the transport sector causes 7.8 million years of lost life annually and is responsible for $1 trillion of health-related costs and damages.[1]

In this report, we have assessed the impact of Australia's road transport pollution and found that the health of people living in Australia is at risk from transport pollution, that our road transport contributes to a global environmental and health crisis, and that there are simple solutions that we recommend governments take to mitigate and manage this health burden to provide a clean and healthy environment for all.

In this section, we explain:

- **the definition of transport pollution examined in this report;**
- **the health impacts of transport pollution on human health;**
- **impacts on particular physiologically vulnerable groups and overburdened communities; and**
- **impacts of transport exacerbated by climate change.**

Defining Transport Pollution

In this report 'transport pollution' is defined as the pollution caused by road transport emissions, which includes dust, non-tailpipe and tailpipe emissions.[2] These types of emissions are the most widespread source of human-made air pollution that the Australian public are the most chronically exposed to.[3]

Tailpipe emissions are produced from the exhaust of vehicles powered by internal combustion engines (**ICE**) that run on fossil fuels, predominantly petrol and diesel (a very small percentage of ICE vehicles run on liquid propane gas). These vehicles include petrol or diesel passenger cars, light commercial vehicles (such as SUVs, utility vehicles and vans) and heavy vehicles (such as buses, trucks and semi-trailers).

Non-tailpipe emissions are produced from non-exhaust sources and can include sources such as tyres and a vehicle's brake pads. Of all road vehicles, heavy vehicles (of which more than 90% have diesel engines) are the single greatest contributors to transport pollution.[4]

Transport emissions from road vehicles include breathable airborne ultra fine (**$PM_{0.1}$**) and fine (**$PM_{2.5}$** or **PM_{10}**) particulates and toxic gases, particularly nitrogen dioxide (**NO_2**), carbon monoxide (**CO**) and ozone (**O_3**). Each of these substances and corresponding effects on human health are discussed in greater detail below.

The Health Impacts of Transport Pollution

Transport pollution, especially the pollutants $PM_{2.5}$, O_3 and NO_2, have been found to have a significant negative impact on the health of people living in areas of heightened exposure, such as the inner west of Melbourne and in Western Sydney. Some researchers have estimated that transport pollution is responsible for more than 11,000 deaths annually in Australia,[5] significantly more than official government estimates. In contrast, the NSW Government estimates that there were an estimated 110 premature deaths per annum caused by transport pollution in the NSW Greater Metropolitan Area.[6] As will be discussed further in this report, these discrepancies can be explained by the way Australian governments monitor both air pollution and population exposure to sources of transport pollution, which in turn affects the estimates produced by health impact modelling. To put the researchers' higher estimates of mortality in perspective, Australia's annual national road toll in 2022 was 1,194 road crash deaths.[7]

Researchers have estimated that a further 85,000 people in Australia are likely to be burdened with a range of health conditions caused or worsened by transport pollution, including hospitalisations for cardiovascular and respiratory emergencies and the prevalence of asthma. These statistics are supported by numerous studies that have examined the components of transport emissions, notably from the exhaust of ICEs. The detrimental impacts of transport emissions on health are widely reported on and accepted by the medical profession.[9]

Overall health threats from transport pollutants in combination can be much greater than any individual pollutant alone. When combined, the pollutants create potential synergies and antagonisms.[10] This means that transport pollution should be considered not just as a grouping of pollutants, but as a single combined toxic pollutant. For instance, diesel tailpipe emissions, which are a combination of various constituent gases and particulates, have been reclassified as a 'Group 1 carcinogen' (the same class as tobacco smoke) which is a confirmed cause of lung cancer.[11] Notably, lung cancer is the fifth most diagnosed cancer in Australia and the leading cause of cancer-related deaths in Australia.[12]

Individual effects of the key pollutants produced by transport pollution are discussed below. The effects on human health are numerous. These are summarised in Table 1 below and discussed in greater detail in the sections below.

Pollutant	Sources	Known health effects	Vulnerable populations
Particulate matter (PM_{10} and $PM_{2.5}$)	Motor vehicle emissions (particularly diesel engines), industry emissions, mining activity, agricultural practices, wood-burning; unflued gas heating and cooking, bushfires, wind-blown dust, cigarette smoke	Upper respiratory tract irritation and infection; exacerbation of asthma; decreased lung function; exacerbation of, and increased mortality from, cardiorespiratory diseases; myocardial infarction; premature mortality; atherosclerosis; adverse birth and neurodevelopment outcomes	Elderly people with respiratory and cardiovascular conditions; children with asthma
Ozone (O_3)	Reaction of sunlight and vehicle or industrial emissions; hydrocarbons and oxides of nitrogen	Decreased lung and pulmonary function; upper respiratory tract infection (especially in children); exacerbation of chronic respiratory conditions, including asthma, emphysema and chronic bronchitis; increased airway reactivity	People with chronic respiratory conditions (especially children with asthma
Oxides of nitrogen (NO_x)	Motor vehicle emissions; energy generation; mining and other industrial emissions; unflued gas appliances	Upper respiratory tract infection (especially in children); exacerbation of chronic respiratory conditions, including asthma; eye irritation; reduced immunity to lung infection;	People with respiratory conditions (especially children with asthma)
Sulfur dioxide	Fossil fuel combustion; metal smelting or photochemical industries	Throat irritation; exacerbation of cardiovascular diseases, including asthma	People with respiratory conditions (esp. children with asthma); elderly people with respiratory and/or cardiovascular diseases
Carbon monoxide	Biomass and fossil fuel combustion; vehicle exhaust emissions; cigarette smoke	Reduction of oxygen-carrying capacity of the blood, resulting in headache, nausea, dizziness, breathlessness, fatigue, visual disturbance; angina, coma; death; low birth weight (after maternal exposure during pregnancy	People with ischaemic heart disease; pregnant women
Lead	Smelting	In children, neuropsychological & cognitive effects; in adults, hypertension & classic lead poisoning.	Children and pregnant women
Air toxics (hydrocarbons, aldehydes, volatile organic compounds, asbestos)	Motor vehicle and industry emissions; biomass; occupational exposures; smoking	Increase in the incidence of cancer; reproductive and developmental effects; eye irritation; genetic damage; central nervous system defects; immunodeficiency; and disorders of the respiratory and nervous systems.	Smokers; people with respiratory conditions (especially children with asthma);

Table 1: *Health effects of Criteria Air pollutants (National Environment Protection (Ambient Air Quality) Measure) and representative air toxicants. [Source: Australian Medical Association]*[13]

Airborne particulates ($PM_{0.1}$, $PM_{2.5}$ and PM_{10})

Transport pollution is one of the key sources of airborne fine particulates. Other sources include woodstove smoke, bushfires and industrial processes, such as coal powerplants and steel smelters.[14]

In Sydney, the NSW Environment Protection Authority (**NSW EPA**) estimated during its last 'Air Emissions Inventory' undertaken in 2013 that road traffic produces approximately 10% of $PM_{2.5}$ and 9% of PM_{10} in NSW, with diesel vehicles and heavy vehicles such as trucks and buses being key emitters.[15] Particulates formed in the combustion process inside an ICE are particularly small. The smaller the particle size, the more likely the particle can transfer into the bloodsteam when it is inhaled into our lungs. From the bloodstream these particles can transfer to organs throughout the body.[16] This can have significant health consequences. Since very small particles can enter the bloodstream and be translocated to all organs, the health effects of such particulates are diverse. Associated health effects include:

- premature birth;
- decreased birthweight of babies;
- systemic inflammation;
- heart diseases including arrhythmia, congestive heart failure, and ischaemic heart disease in adults;
- decline in lung function;
- respiratory disease for all ages including pneumonia;
- type 1 and 2 diabetes;
- high blood pressure;
- stroke;
- impaired neurological development in children;
- neurogenerative diseases including dementia;
- an overall decline in cognitive function in middle-aged and older adults living in urban environments;
- a significant increase in 30-day mortality rate or patients in intensive-care-units in hospitals have been observed, even in the event of short-term exposure to $PM_{2.5}$; and
- increased premature mortality.

Nitrogen dioxide (NO_2)

Nitrogen oxides, NOx, are products of the combustion of fuel in the ICE in the presence of nitrogen in the atmosphere.[18] NOx comprise a mixture of mostly nitric oxide (**NO**) and NO_2. Catalytic converters can increase the proportion of NO_2 and create different forms of nitrogen. NO is benign at typical concentrations in the atmosphere. NO_2, in contrast, **is toxic and harmful to human health and the environment**. Crucially, **there is no safe threshold for NO_2 exposure**. Health impacts occur even at low levels of exposure and when overall transport pollution levels are considered 'low'.[19]

Where NO_2 is used as an indicator for overall monitoring of air pollution produced by road transport, studies have shown that petrol and diesel vehicles are a major source of NO_2 in cities, with Australian and New Zealand studies showing that 70% to 90% of NO_2 is emitted by petrol and diesel vehicles.[20] The health impacts of NO_2 exposure vary but are most attributed to:

- respiratory diseases including lung cancer; and
- the development of childhood asthma.[21]

These health effects of NO_2 are well known to governments and health professionals, and have been reviewed broadly by the United States' Environmental Protection Agency and by Health Canada.[22] Although a global health and economic assessment for NO_2 is not yet available,[23] a New Zealand study evaluated that this toxic pollutant caused 60% of New Zealand's national social cost (i.e. $NZD 9.5 billion) from human-caused air pollution in 2016.[17]

Carbon monoxide (CO)

Although vehicle emissions of CO have fallen since 1990, petrol and diesel vehicles continue to be a major source of CO in Australian cities.[24] CO causes health impacts because once it has been inhaled and transferred into the bloodstream, it reacts with the haemoglobin in blood to form a substance called carboxyhaemoglobin. Carboxyhaemoglobin reduces the effective transportation and transfer of oxygen and carbon dioxide in the bloodstream. This can result in sublethal hypoxia which can aggravate pre-existing health conditions. Prolonged exposure to even low levels of CO can cause:[25]

- neurogenerative diseases;
- low birth weights; and
- cardiovascular diseases, particularly in older people.

Ozone (O_3)

O_3 is a secondary atmospheric pollutant formed by pollutants emitted by transport, such as NO_x, reacting in the air in urban environments with volatile organic compounds (**VOC**). When peak concentrations of other transport pollutions occur, peak concentrations of O_3 typically follow . That is, they are usually found downstream from where exposure to other transport pollution occurs. Disturbingly, peak O_3 levels are increasing in Australian cities and regional centres.[8] Crucially, if sources of NO_x produced by transport pollution were reduced in cities, this would curtail O_3 production and its impact on populations. Like NO_2, **there is no safe threshold for O_3 exposure.**[26]

The health effects of exposure to O_3 are well known and can:[27]

- contribute to the development of respiratory diseases;
- aggravate existing respiratory conditions, such as asthma; and
- damage human skin.

Exposure to O_3 has also been associated with increased summertime cardiovascular and respiratory deaths.

Health Impacts on Physiologically Vulnerable Groups and Overburdened Communities

The impacts of transport pollution do not affect all segments of the population equally. Various factors, including a person's physiology and external factors, contribute to increased risks of harm. For example, physiologically vulnerable groups such as children in utero, children, older people, individuals with underlying health conditions, and overburdened communities such as First Nations Peoples and people experiencing financial disadvantage will likely be at greater risk of harm from transport pollution.[28]

Among these groups, children (including children in utero) experience the most significant consequences from prolonged exposure to transport pollution, particularly those children who are also part of an overburdened community.[29]

Children In Utero

Unborn children are particularly vulnerable to the impact of transport pollution as their organs, hormone systems, and immune systems are in a critical stage of development. Exposure to transport pollution during pregnancy can lead to serious consequences such as stillbirth, low birth weight, premature birth, and organ damage.[30] Recent research suggests that this exposure can also have long-term effects on respiratory and immune development, as well as neurodevelopment, potentially resulting in reduced IQ.[31] Particles as small as $PM_{2.5}$ can pass from the birthing parent via the placenta and cause DNA damage in the unborn child, leading to adverse effects that may persist throughout their lifetime. Worryingly, these effects can be passed on to future generations through epigenetic changes that can begin to occur even before a child is born.[32]

Children

Children have unique physiological characteristics that make them more susceptible to the effects of air pollutants. They have a higher respiratory rate and a larger surface area of lungs relative to their body size. Additionally, their respiratory defence systems are not fully developed, allowing pollutants to penetrate more easily into their bodies via their lungs.[33] External factors also contribute to a child's increased vulnerability to transport pollution. For example, children tend to spend more time engaging in physical activities outdoors, and they are also closer to vehicle tailpipes due to their shorter stature.[34]

Studies have found a direct link between exposure to transport pollution and the occurrence and prevalence of asthma and respiratory infections in children. Prolonged exposure to these pollutants can lead to reduced lung development that persists into adulthood.[35] Exposure has been associated with systemic inflammation, impaired cognitive development, and behavioural problems in school children.[36] These findings emphasise the importance of mitigating exposure to transport pollution near schools and childcare centres in order to protect the health and wellbeing of our children.

Case study: Clare Walter, CAHA Policy and Advocacy Specialist

Emma, my second daughter, was born in 2012. We loved our inner-city home in Collingwood, which was a convenient commute to my job as a pharmacist at a lung cancer clinic. When I returned to work in 2013, a scarcity of childcare centres meant the only available place for Emma was located ten metres from a busy 8 lane road. Given the limited options, I ignored the slight concern I felt about the location. During this time, I started to become aware of a seemingly increasing proportion of lung adenocarcinoma patients that were 'never smokers'. Diesel exhaust was classified as a class 1 carcinogen for lung cancer at the same time I began to suspect Emma's incessant coughing at night may be asthma related. The same year the ESCAPE studies - long-term cohort studies of traffic pollution across Europe released data demonstrating a significant association between proximity to traffic and increased risks for a number of health impacts, including lung adenocarcinoma and asthma.

My concern escalated, but when I reached out to the Victoria Environment Protection Authority (**EPA Victoria**), I was reassured the air quality was 'good'. I raised the issue at a parent meeting run by the local council who agreed to conduct air quality monitoring outside Emma's childcare centre. However, they did not release the results of this monitoring until I applied using a Freedom of Information request. The results were deeply concerning – there were multiple exceedances of 'intervention levels' of air pollution and the average $PM_{2.5}$ concentration (11.4 µg/m3) was well over the national standard contained in the Air Quality NEPM. Compared against the reported levels from the nearest EPA Victoria monitor located 3 kilometres away, there was a 35% increase in the risk of childhood asthma.

My husband and I offered to pay for planting a tree break outside the centre, which was refused based on potentially toxic soil. We then spent the next six months trying (and failing) to secure a position in one of the other local childcare centres. Eventually we made the decision to move to another suburb with better air quality and more childcare availability. This was not an easy decision. We had no family to help with our young children in Melbourne, and our community was our support base, additionally the move added an hour of commuting to my day and came at substantial financial cost. Within a few weeks it was apparent it was the right decision, Emma's asthma seemed to completely resolve almost immediately, and over the long-term her asthma attacks have gone from a weekly occurrence to once – twice a year at most.

Our difficult year was over, but as we went about trying to adjust to and connect with our new community, and I continued to work with lung cancer patients I felt I could not let the issue rest. I now had to drive to work, and as I passed through several different Melbourne suburbs, I couldn't help but notice how many other childcare centres were located on busy roads. I wondered how many of the children in these centres had asthma and whether their parents were aware of the risks from traffic pollution. I also wondered how many parents would be able to move like my husband and I were lucky enough to do. When my workplace moved into Parkville with no car park option for me, we could no longer manage childcare, and school drop off and pick-ups within our working hours and I gave up my job. Before leaving work, I looked up the proportion of 'never smokers' with lung adenocarcinoma – 17% of men and 37% of women. Lung cancer is the leading cause of cancer related death in Australia, and yet there had been

no studies analysing the link between diesel and lung cancer in Australia, and no obvious advocacy initiatives from health organisations.

At three, Emma started in a beautiful local kindergarten on a quiet local street backing onto a park. The 'sun smart' policy meant parents would occasionally be applying sunscreen outside their vehicles close to idling diesel SUVs in the drop off zone. The incongruity struck me. Despite the odd idling vehicle, I was cognisant that Emma was in a beautiful environment and many other children in Melbourne were not so lucky. I began advocacy work aimed at reducing children's exposure to transport pollution and eventually began a PhD researching traffic pollution, children's asthma, and related policies in Australia.

None of this has lessened my guilt at placing Emma in harm's way for a year that was critical for her lung and respiratory system development. Emma is eleven now, but still has the occasional bout of asthma and is allergic to a range of aeroallergens (another health impact linked to transport pollution). The steroid nasal sprays used to treat her allergies have affected her nasal mucosa and there's a rare week when she doesn't have a nosebleed. Is this because of where we placed her in her first childcare centre? As a scientist, I acknowledge there may be compounding factors and there is no way to know for sure. As a Mum, I think about our lack of family history related to asthma and atopy and can't help but compare her to my older daughter who did not attend that centre and does not suffer these conditions. Whilst I can't directly link one child's exposure to health outcomes, on a larger population scale, we can link these outcomes and there is strong evidence that many Australian children are adversely affected by traffic pollution. The trajectory of evidence is alarming, the health impacts are continually expanding and now include cognitive impacts, adverse birth outcomes and diabetes and the strength of associations are increasing. I believe there's a strong possibility Emma's health was adversely affected by her year in her first childcare centre, but I also know Emma is fortunate that we were able to move. For many Australians this is not the case.

Transport pollution, environmental injustice and human rights

Exposure to transport pollution, and the impacts from this exposure on people's health and wellbeing, does not occur evenly across our society. Overburdened people and communities – including people who are experiencing financial disadvantage, culturally and racially marginalised communities, people living with a chronic illness or who are physiologically vulnerable to transport pollution, including people with disability, pregnant people, children and older people – are the most at risk of the impacts of transport pollution.[37] Many people in these groups are already experiencing poverty, marginalisation, and systemic discrimination. The disproportionate impact of pollution is, therefore, a form of environmental injustice. The term 'sacrifice zones' has been used to describe locations where commercial interests are valued at the expense of local communities who are then exposed to particularly heightened levels of pollution and who suffer severe impacts as a result.[38] In Australia this includes communities who live alongside heavily polluting transport corridors. For example, in suburbs close to the Port of Melbourne in the inner west of Melbourne, local communities are exposed to significant heavy truck movements where local roads have become freight corridors. In this case, the interests of commercial freight companies using these roads have been prioritised at the expense of the health of local residents.[39]

As described above, exposure to transport pollution poses a significant risk to human health and wellbeing, leading to a range of detrimental health effects including cancer, reproductive abnormalities, lung diseases, diabetes, and learning disabilities.[40] When exposure to transport pollution causes significant impacts to health or even causes premature death, particularly for people who are physiologically vulnerable and/or living in overburdened communities, it becomes a human rights issue. Human rights that are impacted by transport pollution can include the right to life,[41] health,[42] a healthy environment,[43] and a life of dignity,[44] amongst others. Other than the right to a healthy environment these rights are enshrined in key international human rights treaties including the *International Covenant on Civil and Political Rights* (**ICCPR**) and *International Covenant on Economic, Social and Cultural Rights* (**ICESCR**), both of which Australia has ratified.

The solutions to reducing the impacts of transport pollution are multifaceted. However, the United Nations Special Rapporteur on Toxics and Human Rights, upon completing an official visit to Australia in September 2023, commented on the effects of pollution on human rights in Australia and stated that *"the most immediate and momentous opportunity for Australia is to incorporate the right to a healthy environment in its domestic legal order."* EDO has previously produced a report on the right to a healthy environment, which makes a number of recommendations including legislating a national Act or Charter of human rights and freedoms that includes the right to a healthy environment. These recommendations are essential to address environmental injustice and human rights violations caused by the impacts of pollution, including transport pollution.

Case study: Ella Kissi-Debrah, United Kingdom

"My daughter Ella was a playful, happy child growing up in South East London. Healthy at birth, with a lust for life, she didn't develop asthma until just before her seventh birthday. A few weeks after her ninth birthday, she suffered a fatal asthma attack. Ella is the first person in the world to have air pollution listed as a cause of death on her death certificate."[45]

Air pollution is a major environmental concern in the United Kingdom (**UK**), with a 2018 Progress Report highlighting that 44 out of 51 UK cities have pollution levels exceeding the targets in the WHO Guidelines.[46] It is also estimated that between 28,000 and 36,000 air pollution-related deaths occur annually in the UK.[47] The death of nine-year-old Ella Kissi-Debrah provides a tragic human story to these statistics. Ella, a nine-year-old girl who grew up in Lewisham, in south-east London, suffered from asthma and related health complications. She was first admitted to hospital in 2010 due to an intense coughing fit. After a three-year period of multiple seizures and a total of 27 trips to hospital, Ella died in February 2013.[48] An initial inquest in 2014 found that her death was due to acute respiratory failure from severe asthma.[49]

However, facts uncovered in the years following her death led to a secondary inquest five years later, which highlighted air pollution as a contributing factor to Ella's death.[50] This included the extremely high pollution levels at the time of Ella's death detected at a monitoring station near her home,[51] as well as the seasonal pattern of Ella's asthma matching with the winter air pollution spikes.[52] A second inquest undertaken in 2020 in the London Inner South Coroner's Court found air pollution was a contributory cause of death, the first case in the UK to explicitly link air pollution to fatality.[53] The Record of Inquest detailed that Ella had been exposed to high levels of NO_2 and particulate matter exceeding the WHO Guidelines.[54] It was also noted that traffic emissions were the primary source of this life-threatening pollution.[55] The Record of Inquest highlighted that there had been a failure to reduce these pollution levels to within the European Union (**EU**) and the UK's own national limits, as well as a failure to inform Ella's mother of the risks the transport pollution posed to Ella's health. This halted preventative action to protect Ella, with Ella's mother declaring she would have immediately moved her family if she had known the impact transport pollution was having on Ella's health conditions.[56] The *Report to Prevent Future Deaths*, which was published following the inquest, echoed these concerns and directed various UK Government departments and the Mayor of London's office to take action.[57]

The statistical and personal impact of transport pollution is not simply an issue of environmental harm. It can be characterised as a breach of fundamental human rights contained in international human rights treaties,[58] as well as rights contained in the *European Convention on Human Rights*.[59] This characterisation was explicitly noted by Baroness Jones of Moulsecoomb during the second reading speech of the *Clean Air (Human Rights) Bill*.[60] The Bill was introduced partly in response to the findings into Ellas's death and, if enacted, will require the UK Government to take action to improve air quality and bring standards in line with the pollution limits in the WHO Guidelines.[61] The link between transport pollution and human rights is also exacerbated for those living in poverty, with low- and middle-income countries highlighted as those most at risk of exposure to air pollution.[62] While some areas in London have successfully lobbied for the creation of 'Low Traffic Neighbourhoods' to reduce pollution, this strategy only exacerbates the issue for surrounding (and often lower socio-economic) locations.[63]

Air Pollution from Transport Will Worsen Under Climate Change

While the health impacts of transport pollution are the major focus of this report, it is essential to also understand that pollution from the transport sector is both a major contributor to climate change, and that climate change in turn will worsen the impacts of this pollution on Australia's air quality.

To begin with, transport pollution is a major source of Australia's domestic GHG emissions that contribute to climate change. Globally, the transport sector is responsible for 25% of GHG emissions.[64] In 2022, the transport sector made up 19% of Australia's GHG emissions and is predicted to be the leading source of Australia's GHG emissions by 2030.[65] Petrol and diesel passenger cars and light commercial vehicles alone contribute to 60% of Australia's transport emissions and 10% of Australia's total GHG emissions.[66] Currently Australia has set itself a Nationally Determined Contribution (**NDC**) to the Paris Agreement to reduce its GHG emissions by 43% below 2005 levels by 2030 and a target of net zero by 2050.[67] As EDO has previously reported these targets do not align with the Paris Agreement, and Australia must reduce its GHG emissions by 74% below 2005 levels by 2030 and achieve net zero by 2035.[68] It is therefore essential that, in order to mitigate climate change, Australian governments reduce GHG emissions produced by the Australian transport sector.

Reducing transport pollution is essential for Australia to meet its obligations under the Paris Agreement. Further, reducing transport pollution is essential for protecting Australian residents against the impacts of climate change, as air pollution is expected to worsen as global temperatures increase. As was discussed in Australia's 2021 *State of the Environment* report:[69]

> *"Climate change is expected to exacerbate natural emissions from dust and biogenic sources, through increased prevalence of widespread droughts and rising temperatures. Temperature-driven chemical reactions in the atmosphere are likely to cause more summertime smogs in urban areas. The predicted increase in extreme heatwave events will lead to increased summer bushfire activity, meaning that extremely poor air quality due to smoke may be a recurrent feature of future Australian summers."*

The 2019-2020 Black Summer bushfires, which were exacerbated by climate change, resulted in dangerous levels of smoke. Bushfire smoke was estimated to have affected about 80% of the Australian population at some point during the season and an estimated 417 deaths were attributed to the smoke.[70] While governments can't prevent the spread of smoke from bushfires once they have started, it is essential that governments take steps to reduce transport pollution as much as possible so that it does not compound the effects of other sources of air pollution like bushfires and to reduce the overall health burden caused by air pollution.

Part Two:

Why Current Air Pollution Laws are Failing to Address the Impacts of Transport Pollution

In this section, we explain:

- the background to the legislative and policy frameworks in place in Australia for regulating transport pollution;
- examine Australia's nationally agreed air pollution thresholds and monitoring standards in regulating transport pollution, and identify key failings of the national Air Quality NEPM;
- examine the current approach of states and territories in monitoring and regulating transport pollution, discuss the inadequacies of the 'point source' regulation approach.

Background to Australia's Transport Pollution Laws, Regulations and Policies

As a federated Commonwealth of states and territories, the primary responsibility for environmental protection and the regulation and reduction of pollution rests with Australian state and territories.[71] Despite this, in some key areas the Commonwealth, states and territories have collectively agreed to set national pollution standards to monitor and set threshold targets for identified pollutants. In other cases, the Commonwealth pursuant to its powers under the Australian Constitution can legislate and make regulations that address issues affecting pollution including transport pollution.

Nationally, Australia 'regulates' transport pollution via the following frameworks:

1. The National Environment Protection (**Ambient Air Quality**) Measure (Air Quality NEPM) agreed under the *National Environment Protection Act 1994* (Cth) (**NEPC Act**);
2. In June 2001 the National Environment Protection Council (**NEPC**) enacted a National Environment Protection (Diesel Vehicle Emissions) Measure (**Diesel Vehicle NEPM**), with the goal of reducing tailpipe emissions from diesel vehicles;[72] and
3. The Australian Design Rules, Australia's national standards for road vehicle emissions that are set pursuant to the *Road Vehicles Standards Act 2018* (Cth).[73]

At a state and territory level, transport pollution is generally regulated in the same manner as other sources of air pollution. It is primarily undertaken by implementing and enforcing standards and prohibitions on individual road vehicles and their emissions. Vehicle emissions are treated like other 'point-sources' types of air pollution, such as powerplant or factory emissions.[74]

Rather than seeking to implement legislation and regulation to address cumulative impacts and mitigate exposure to transport pollution, state governments have instead sought to address the impacts of transport pollution by developing strategies and policies that include initiatives such as increasing the uptake of electric vehicles (**EVs**), zero emission vehicles (**ZEVs**) or encouraging people to walk or ride a bicycle instead of using private passenger vehicles.[75] These strategies and policies are further supplemented by local government efforts, such as introducing traffic calming measures and improving local cycling infrastructure.

Taken together, neither national threshold standards nor state legislation or regulation efforts currently address the *cumulative* impacts of transport exposure or seek to *mitigate* population exposure to transport pollution to minimise its impacts on Australian residents' health. Without urgent reform to these laws, Australian residents, particularly those who are members of physiologically vulnerable groups or overburdened communities, will continue to suffer the impacts of transport pollution on their health and wellbeing.

The national Air Quality NEPM

Under the Intergovernmental Agreement on the Environment, the Commonwealth and state and territory governments agreed to enact joint legislation to establish the National Environment Protection Council. The National Environment Protection Council was established to ensure people enjoy the benefits of equivalent protection from pollution wherever they live in Australia.[76] The Council does so by determining national environment protection measures (**NEPMs**).[77] NEPMs set nation-wide threshold targets for pollutants and standards for how to monitor/measure them in the environment. In turn these threshold targets and standards are incorporated into various pieces of state and territory legislation, regulation and policy.

Like other NEPMs, the Air Quality NEPM is implemented by a variety of state and territory legislation and regulation.[78] The Air Quality NEPM has two main functions:

1. To set national ambient air quality thresholds targets for air pollutants including for some key transport pollution substances. These threshold targets are set in relation to the following air pollutants: SO_2, NO_2, O3, CO, airborne particles ($PM_{2.5}$ and PM_{10}) and lead (**Pb**).[79] There is a separate NEPM that sets standards for air toxics including benzene, toluene, xylene, formaldehyde, and polycyclic aromatic hydrocarbons, which have not been considered in this report due to a lack of available data.[80]
2. To set national standards for methods for monitoring Air Quality NEPM criteria pollutants.[81]

What are the problems with the Air Quality NEPM?

There are three major issues with the Air Quality NEPM: a lack of enforceability, inadequate threshold targets, and inadequate monitoring standards. Without reform, the measure will continue to be an ineffective mechanism for monitoring and reducing transport pollution and its impacts on Australian residents.

Problem 1: Non-enforceability of Air Quality NEPM thresholds and standards

As noted above, the Air Quality NEPM is intended to be implemented by states and territories via the incorporation of state legislation, regulation, policies and regulators such as Environmental Protection Agencies.

However, the thresholds and standards are not adequately translated into enforceable laws or regulations by states or territories. Instead, these thresholds and standards are implemented via policy or guidance-type documents. This gives decision-makers and regulators significant discretion to develop policy, grant approvals and undertake their statutory functions even where such decisions may be contrary to the goals set under the Air Quality NEPM. Consequently, Australian states and territories have experienced exceedances of the Air Quality NEPM's thresholds and have also failed to implement the monitoring standards it prescribes.[82] A key reason for this is that neither the Air Quality NEPM nor the NEPC Act (under which the Air Quality NEPM was established) contains provisions to require states and territories to:

- appropriately implement the Air Quality NEPM (or any other NEPM established under the NEPC Act) within their jurisdictions; or
- abide by the monitoring standards or threshold targets when a criteria pollutant is exceeded.

Problem 2: Inadequate Threshold Targets

Another key issue with the Air Quality NEPM is that its threshold targets are inadequate and outdated.

Most significantly, the thresholds set under the Air Quality NEPM **do not meet the threshold limits recommended by the WHO Guidelines**. A comparison of the thresholds in the Air Quality NEPM and WHO Guidelines are set out in the following table:[83]

Item	Pollutant	Averaging period	NEPM Maximum concentration standard	WHO Global Air Quality Guidelines99	Dose threshold for health effects
1	**Carbon monoxide (CO**	8 hours	9.0 ppm/**11.1 mg/m3**	**10 mg/m3**	Unknown
2	**Nitrogen dioxide (NO_2)**	1 hour 1 year	0.08 ppm/**162 µg/m3** 0.015 ppm/**30.4 µg/m3**	**200 µg/m3** **10 µg/m3**	Unknown
3	**Photochemical oxidants (as ozone) (O_3)**	8 hours	**0.065 ppm/137 µg/m3**	**100 µg/m3**	~6–11 ppb/12.16 – 22.28 µg/m3
4	**Sulfur dioxide (SO_2)**	1 hour 1 day	0.10 ppm/282 µg/m3 (0.075 ppm/212 µg/m3 from 1 January 2025) 0.02 ppm/**56.4 µg/m3**	N/A **40 µg/m3**	0.2–0.4 ppm/ 564 – 1130 µg/m3 Unknown
5	**Lead (Pb)**	1 year	**0.50 µg/m3**	No safe limit	None (no safe threshold)
6	**Particles as PM_{10}**	1 day 1 year	**50 µg/m3** **25 µg/m3**	**45 µg/m3** **15 µg/m3**	None (no safe threshold)
7	**Particles as $PM_{2.5}$**	1 day 1 year	**25 µg/m3** (**20 µg/m3** from 1 January 2025) 8 µg/m3 (**7 µg/m3** from 1 January 2025)	**15 µg/m3** **5 µg/m3**	None (no safe threshold)

Scientific understanding of the impacts of these pollutants on human health has improved significantly since these standards were first adopted in 1998. While the thresholds for NO_2, O_3, and SO_2 in the Air Quality NEPM were last varied in 2021,[89] international and Australian studies show that NO_2, O_3, and SO_2 are non-threshold pollutants, meaning **there is no safe level or threshold of exposure below which no health effects are observed.**[90]

Further, the Air Quality NEPM generally only sets a single threshold target for pollutants rather than establishing a framework for staged and continuous improvement (known as the 'principle of continuous improvement') for air pollution via progressively-set interim thresholds.

Though the Air Quality NEPM has incorporated a goal to provide "a framework for continuous improvement and facilitate a review of the $PM_{2.5}$ threshold",[91] this remains inadequate as:

- the 'framework for continuous improvement' only applies to $PM_{2.5}$ and not the other pollutants targeted in the Air Quality NEPM;
- the proposed framework only provides for one review of threshold set for $PM_{2.5}$, to occur once the framework is intended to take effect;
- the new threshold applying to $PM_{2.5}$ will only commence in 1 January 2025; and
- the new threshold will still exceed the WHO Guideline threshold for $PM_{2.5}$.

Commenting on the threshold for $PM_{2.5}$, leading air pollution expert Dr Gabriel da Silva stated:[92]

> *"The national $PM_{2.5}$ standards…do not correspond to levels at which exposure to this pollutant is safe; instead, they represent a level of risk that is at present deemed acceptable."*

Finally, while the Air Quality NEPM contains a requirement for states and jurisdictions to evaluate and report population exposures to particles $PM_{2.5}$, NO_2, and O_3,[93] these requirements do not establish a framework for a reducing exposure to pollutants. Instead, these requirements only establish that a state or territory must evaluate and report on the population of a whole region or sub-region that is at risk of being harmed by air pollution. While evaluating population exposure is certainly important, these requirements are limited as they:[94]

- only apply to the pollutants $PM_{2.5}$, NO_2, and O_3;
- only require evaluation and reporting using data obtained via the Air Quality NEPM's prescribed methodologies for monitoring air pollution (which as discussed below are inadequate); and
- otherwise do not require an exposure reduction threshold target to be set in response to these evaluations.

Problem 3: Inadequate Monitoring Standards

An important function of the Air Quality NEPM is to set nationally consistent methods for monitoring air pollution, which are to be used to determine whether the thresholds set by the Air Quality NEPM are being met.[95] Despite these requirements, the prescribed monitoring methods are failing to capture the extent to which Australian residents are exposed to transport pollution. They are therefore failing to provide an accurate picture of the impacts this exposure is estimated to have on health.

The main reason for this failure is that the Air Quality NEPM requires measurement of ambient air quality and does not account for locations of heightened exposure or 'hot spots' such as areas along main roads, on heavy trucking routes or other areas with high traffic volume. Instead, monitoring stations are generally located away from areas of heightened localised transport pollution and are often situated in sites such as suburban parks. Finally, the monitoring standards prescribed under the Air Quality NEPM do not consider or measure cumulative levels of transport pollution. Instead, monitoring only provides a 'snap shot' of a pollutant measured at a single point in-time, which is then averaged over a certain period.

This means that the actual amount of transport pollution that Australian residents are exposed to in precise locations and over a period of time is poorly understood. So even where states and territories comply with the Air Quality NEPM by implementing its population exposure reporting requirements,[96] it is unlikely that they will be able to provide accurate evaluations.

To explain the issues with ambient air pollution monitoring under the Air Quality NEPM in further detail, we provide the following summary of a 'scoping study' undertaken by the EDO's Science & Expert Advisory Program into the current state of transport pollution monitoring and modelling in Melbourne and Sydney, which examined several studies and research into transport pollution in these cities. This research demonstrated that people in Sydney and Melbourne are being exposed to transport pollution at levels that regularly exceed threshold targets set by the Air Quality NEPM.

Transport Pollution Monitoring, Modelling and Exposure Scoping Study: Environmental Defenders Office, 2023

Australia's two largest cities, Sydney and Melbourne, are among the most 100 populous cities in the world, with each containing roughly five million inhabitants.[97] Each city's design has placed a heavy emphasis on road transport. The prevailing national paradigm in urban transport policy of increasing road capacity to accommodate growth, particularly at each city's edge, has been demonstrated to be seriously flawed.[98] Infrastructure costs have risen sharply, with traffic congestion worsening (despite massive motorway construction projects) and transport emissions have swelled. As a result of these planning failures, transport pollution is worse in South Western Sydney than other parts of Sydney and is particularly problematic in the inner west of Melbourne and is often associated with heavy vehicle freight routes.[99] Despite this, monitoring and modelling of transport pollution is ad hoc and patchy in both cities, limiting the ability of government agencies and health services to provide accurate and crucial health warnings to the public about where transport pollution exposure is occurring.[100]

Both Melbourne and Sydney have air quality monitoring networks, comprised of a diverse array of monitoring stations, that track air quality.[101] These monitoring stations track air pollution following the guidelines set by the Air Quality NEPM, as well as the National Environment Protection (Air Toxics) Measure (**Air Toxics NEPM**). The Air Quality NEPM also specifies where monitoring equipment must be situated to obtain 'a representative measure of the air quality likely to be experienced by the general population in the region or sub-region'.[102] The intended purpose of these monitoring stations is to provide data that is publicly accessible and can be used to evaluate the air quality of the cities in which they are located.

Evaluation of performance against the Air Quality NEPM thresholds is done annually. Both cities regularly record exceedances of the thresholds of $PM_{2.5}$ and PM_{10}, and O_3.[103]

The Air Quality NEPM prevents ambient air quality monitoring stations from being located at 'hot spots' of air pollution, such as roadsides. For example, current 'neighbourhood stations' must be more than 50 metres from a road. This means these monitoring sites are not recording the actual levels of pollution that a person may be exposed to at a particular site. A further problem with this monitoring is that it is limited and not evenly distributed. In Melbourne for instance, there are only two stations that have instruments to measure CO and NO_2 (located at Alphington and Footscray), and two that measure SO_2 (located at Alphington and Altona North).[104] By comparison, Sydney monitoring sites report all six Air Quality NEPM criteria pollutants, although they are still hindered by their location required by the Air Quality NEPM.

To gain a better understanding of air quality across the cities, researchers have used air quality models to assess transport pollution. These models help predict and map pollutant levels based on data from existing ambient air monitoring stations,[105] in addition to inputs such as pollutant sources, meteorological data, and topographic information, to simulate micro-environments near roadways and buildings. These models can estimate pollutant levels in different areas and provide valuable information for authorities to address air pollution concerns. Modelling of transport pollution has proved a valuable counterpoint to standard ambient air quality monitoring, particularly in distinguishing transport pollution from other sources of urban air pollution.[106] This modelling is adept at portraying the composition of transport pollution within cities,[107] and predicting where raised areas of

exposure to transport pollution is occurring to within 100 metres of its source.[108] Models have been used to estimate several of the Air Quality NEPM criteria pollutants over Melbourne (NO_2, O_3, $PM_{2.5}$, PM_{10}),[109] and all six criteria pollutants in Sydney,[110] predicting regular exceedances of existing limits in both cities.[111]

In addition to modelling, studies relying on air quality roadside monitoring have consistently shown poorer results than nearby ambient air monitoring sites. These studies demonstrate the impact of transport emissions from ICE vehicles, particularly heavy diesel vehicles.[112] These studies have been furthered by the development of low-cost air pollution sensors, which have allowed for more diverse and targeted air pollution monitoring and can assist with monitoring perceived transport pollution exposure hotspots.[113]

Arising from both these roadside monitoring and modelling studies, communities living near major roads, particularly those used by heavy vehicles, face dangerous levels of pollution. Worryingly, it is physiologically vulnerable groups, including infants, young children, and older people, who are disproportionately exposed to transport pollutants because childcare centres,[114] schools,[115] and aged-care homes[116] are regularly located near or on main roads where transport pollution levels are higher. Further, it is overwhelmingly the overburdened communities in Australia who are exposed to higher levels of transport pollution.[117] Suburbs with higher levels of socio-economic disadvantage, often with poor housing conditions, are regularly exposed to high levels of transport pollution, with the western suburbs of Melbourne (Maribyrnong, Brimbank, and Hobsons Bay)[118] and in Sydney (Liverpool)[119] being prime examples.

How States and Territories Regulate Transport Pollution

As the primary legislative mechanism for setting air pollution (including transport pollution) targets and monitoring standards, the Air Quality NEPM is intended to be implemented by Australian states and territories in their respective jurisdictions. Australian states and territories have enacted their own NEPC legislation.[120]

Though state and territory governments and regulators have implemented legislation and regulation that is intended to control and limit air pollution (including from transport pollution), the current approach to regulating transport pollution has failed to protect Australian residents from the impacts of transport pollution on their health. There are two primary reasons for this.

First, air pollution (including transport pollution) is generally monitored at ambient levels in accordance with the standards set by the Air Quality NEPM which, as already discussed, are inadequate and require revision. The Air Quality NEPM should act as *baseline* for air pollution criteria thresholds and monitoring standards. However, it has instead been conceived of as an aspirational set of targets around which states and territories have developed air quality strategies and policies. Further, as discussed earlier in this report, this *baseline* both in setting threshold targets and monitoring standards is itself inadequate.

Second, transport pollution is regulated like other sources of air pollution, where tailpipe emissions from individual vehicles are regulated like other 'point-source' emissions. This is discussed in greater detail below.

Why Transport Pollution Cannot be Effectively Regulated as 'Point-Source' Emissions

Regulating 'point-source' emissions involves the imposition of certain regulation, limitation, standards, or prohibitions on individual or 'point' sources of emissions. These sources commonly include industrial activities undertaken at locations or sites such as smelters, factories or powerplants.

States and territories regulate the tailpipe emissions of road vehicles as point sources of transport pollution by incorporating the Australian Design Rules into state and territory legislation that set corresponding standards and prohibitions, which are in turn enforced by the state or territory.[121]

These standards and prohibitions include:

- limiting amounts tailpipe emissions for particular pollutants from vehicles;
- banning the sale of certain petrol and diesel vehicles;
- banning the sale of vehicles without anti-pollution devices;
- prohibiting the adjustment of or tampering with anti-pollution devices;
- requirements related to service and repair of vehicles to limit tailpipe emissions; and
- controlling excessive air impurities or visible smoke from being emitted from vehicles.

However, these regulatory efforts have a limited effect in addressing cumulative levels of transport pollution or mitigating population exposure to transport pollution and its impacts on health. To put it simply, it is not the transport pollution from one dirty or high-emitting petrol or diesel vehicle that impacts Australian residents' health, but exposure to the **cumulative transport pollution** produced by all petrol and diesel vehicles in a particular location and period.

The closest that state and territory jurisdictions come to regulating the cumulative transport pollution caused by multiple vehicles is by imposing conditions on certain 'Environmental Planning Licences' granted under state regulation for road transport developments. In NSW for instance, the NSW EPA has the power to set conditions and emissions standards on emissions from road-tunnel ventilation stacks that are located on several major underground motorway tunnels.[122] While it is certainly important that emissions from road-tunnels are regulated, the application of these kind of conditions are limited and notably still allow for the emission of transport pollution. Further, while transport pollution emitted from road-tunnel ventilation stacks is from multiple petrol and diesel vehicles, these kinds of licence conditions still treat the aggregated emissions from road-tunnel ventilation stacks as a point source of transport pollution. They do not consider the contribution of these road-tunnel ventilation stacks to overall cumulated amounts of transport pollution in an area nor do they prevent population exposure to the transport pollution generated from within them.

As a result of the current way states and state regulators legislate and regulate transport pollution, and air pollution more broadly, Australian residents, particularly in areas of heightened exposure to transport pollution, are suffering the impacts of transport pollution on their health. We have included the below case study to illustrate the current limitations of the interrelationship between the Air Quality NEPM and state efforts to regulate transport pollution. This case study examines the impacts that regulatory gaps have caused for communities in Melbourne's inner west, that have been exposed to heightened levels of transport pollution, particularly from dirty heavy vehicles. This has had a demonstrable and negative impact on the health of people living in these communities.

Inner West Melbourne in Focus: Heavy Freight in Inner West Melbourne

Victoria indirectly implements the Air Quality NEPM's thresholds and monitoring standards via enabling state legislation.[123] Though, like other Australian state and territory jurisdictions, these are not directly incorporated into Victoria's legislation. Instead, air pollution is regulated primarily under the *Environmental Protection Act 2017* (VIC) (**EP Act**) and subordinate regulations such as the *Environment Protection Regulations 2021* (Vic) (**EP Regulation**). The Victoria EP Act sets environmental reference standards that can specify targets for emissions of pollutants, including those set by the Air Quality NEPM.[124]

The responsible regulatory authority for administering and enforcing the EP Act and EP Regulation is EPA Victoria. In exercising its powers and functions, the EPA Victoria is required to enforce the 'General Environmental Duty' under the EP Act, in which 'a person who is engaging in an activity that may give rise to risks of harm to human health or the environment from pollution or waste must minimise those risks, so far as reasonably practicable'.[125] In addition to environmental legislation such as the EP Act, Victoria has enacted various other pieces of legislation and regulations addressing matters such as air pollution, GHG emissions and vehicle standards.[126]

Despite the national Air Quality NEPM, Victorian state legislation and the EPA Victoria's functions to protect human health from pollution, communities in Victoria are experiencing significant and observable impacts to their health caused by exposure to dangerous levels of transport pollution. In a 2020 report commissioned by the Victorian Government, it was found that on an average day 11,000 trucks pass through the largely residential areas in inner western suburbs located near the Port of Melbourne.[127] Heavy vehicles are particularly dangerous as they consume diesel fuel and produce emissions comprising of 80% to 95% ultrafine particulates.[128] There is no safe level of exposure to these ultrafine particulates. Notably, these particulates are not regulated under the Air Quality NEPM or any subnational legislation, including in Victoria.[129]

As a result of this exposure, residents living in these suburbs are disproportionately affected by respiratory health conditions much higher than national averages. For instance, in the local government area of the City of Maribyrnong, which incorporates many of these suburbs, the observable health impacts include:

- a 50% higher adolescent asthma rate than the state average;[130] and
- a 70% higher hospital admission rate for people aged 3 to 19 than the Australian average.[131]

To date, under the current legislative framework for regulating transport pollution in Victoria, affected communities and community organisations such as the Maribyrnong Truck Action Group have been unable to protect themselves against the heavy vehicle fleet operating on local roads, the predominant source of dangerous transport pollution in their community.[132] Despite this, there have been no immediate legislative reforms or regulatory actions undertaken by the EPA Victoria to reduce the current impacts exposure to transport pollution is having on these communities' health. Actions which have been identified by the local government for the City of Maribyrnong as implementable in the immediate to short-term include: banning heavy vehicles on certain streets in the City of Maribyrnong local government area; reinstating smoky vehicle reporting for heavy vehicles to the EPA Victoria; undertaking enhanced monitoring in the area to determine hot-spots of heightened transport pollution exposure; and developing an air quality map using this data to implement strategies to reduce population exposure to transport pollution, that is regularly updated.[133]

As has been demonstrated by the inner west Melbourne case study, state legislation is failing to limit the impacts and burden transport pollution places on Australian residents' health, particularly for people living in identified areas of heightened transport pollution. The current treatment of transport pollution – as a category of air pollution to be regulated as a source of emissions from 'point-sources' and that is monitored at ambient 'air-shed' levels – fails to address the cumulative effects of transport pollution and mitigate population exposure to transport pollution.

Limitations of Australian governments' measures to reduce transport pollution

While current government measures, strategies and policies that address transport pollution are important, their effectiveness has been limited. This is because:

- their development and implementation has been ad hoc, vague and in some jurisdictions are limited in their ambition; and
- they lack measures for coordination with other governments' measures, strategies and policies.

The NSW Government's *Clean Air Strategy 2021-2030* is arguably the most comprehensive state government strategy that addresses and aims to reduce air pollution (including from transport pollution). It identifies 'cleaner transport, engines and fuels' as a priority area to reduce air emissions and impacts from vehicles, fuels and no-road diesel sources.[134] The *Clean Air Strategy* is ultimately a summary of aspirational goals to reduce transport emissions in NSW through several policies, such as reducing transport emissions by rolling out zero exhaust emission electric buses in the NSW bus fleet and 'encouraging people to walk or ride a bike as part of their everyday travel'.[135] While these goals should reduce transport pollution over time if successfully implemented, the Strategy fails to address the present even medium-term risk of exposure to transport pollution and its impacts on health. Further, the Strategy does not place any obligations on the NSW EPA or other regulatory body to monitor or address transport pollution.[136] These features are similarly shared by other jurisdictions' air pollution strategies.[137]

In addition to addressing problems with air pollution strategies, for government measures to be effective in reducing the impacts of transport pollution on health and reducing and, eventually, eliminating emissions from transport pollution, governments must develop measures in conjunction with, and consideration of, other aspects of government policy that influence transport pollution. These matters can include obvious policy goals like vehicle emission standards and policies to increase the uptake of EVs and ZEVs. However, they could also include matters of environment regulations, urban design, planning, transport and include consideration of how Australian cities should be planned to accommodate anticipated population growth.

Part Three:

A New Way Forward: Implementing an 'Exposure Reduction Framework' to Reduce the Impacts of Transport Pollution on Australian Residents' Health

In this section, we explain:

- **why a shift from monitoring ambient air quality to establishing a coordinated 'exposure reduction framework' is necessary; and**
- **identify actions national, state and territory governments and regulators can take to support and implement an 'exposure reduction framework';**
- **identify the benefits of implementing 'whole-of-government' and 'health-in-all policies' approaches to long-term measures to reduce transport pollution emissions and mitigate exposure.**

Implementing an 'exposure reduction framework'

The underlying principle guiding an 'exposure reduction framework' is the scientific recognition that there is no safe threshold for exposure to many transport pollutants. It is therefore crucial that, in order to reduce the impacts of transport pollution on health, a population's exposure to transport pollution must be mitigated.[138]

The primary purpose of an exposure reduction framework is to limit and seek to reduce exposure to transport pollution to mitigate its impacts on Australian residents' health. A key reason for why an exposure reduction framework is necessary is that it responds to the practical barriers to limit, reduce and eventually eliminate petrol and diesel vehicles from operating on Australian roads. In particular:

- the immediate or even long-term elimination of transport pollution will be difficult to achieve, due to the primacy of petrol and diesel vehicles for transport and freight in Australia and lack of alternative transport options; and
- it will take multiple decades to phase out and replace all existing petrol and diesel vehicles (private, public and commercial) with higher fuel efficiency standard vehicles and ultimately with EVs and ZEV vehicles.

By implementing measures to address exposure to current levels of transport pollution, an exposure reduction framework is a short-term solution that can address and mitigate the health impacts of transport pollution in these circumstances. An exposure reduction framework must be accompanied by the development and implementation of legislation, strategies and policies that seek to reduce, and eventually limit, the emission of transport pollution to the greatest extent possible. In many cases these strategies will take many decades to implement, but they are nonetheless crucial for reducing transport pollution in the long-term.

This part identifies a number of recommendations and key elements for establishing an exposure reduction framework for transport pollution.

Reforming the Air Quality NEPM

Establishing an exposure reduction framework requires a coordinated effort by national, state and territory governments. At a national level, this framework requires strengthening the Air Quality NEPM by:

1. establishing exposure threshold targets; and
2. implementing new monitoring standards that measure and monitor criteria pollutants in areas and hotspots of heightened transport pollution in addition to ambient levels.

In order to strengthen the Air Quality NEPM to ensure that it effectively monitors air pollution and is consistent with WHO Guidelines or otherwise international best practice, and to mitigate and reduce the cumulative impacts of exposure to transport pollution on Australian residents' health, we recommend that the National Environment Protection Council urgently reforms the Air Quality NEPM criteria pollutant thresholds.[139]

Noting there are no safe levels or thresholds for exposure to many air pollutants, the Air Quality NEPM must incorporate the principle of 'continuous improvement'. This is considered best practice and is similar to the approach that has been adopted in the EU to regulate air pollution. The principle of 'continuous improvement' works by establishing a framework for staged and continuous reductions in permissible thresholds of ambient air pollution over a

certain period.[140] This would encourage governments to adopt better practice in air quality management and to implement strategies that progressively improve ambient air pollution levels and reduce associated health impacts.[141]

To support reformed threshold targets, a revised Air Quality NEPM requires significant improvement in public accessibility of monitoring data. This data must be available in real time and set out historical levels. For monitoring data to be used to accurately evaluate population exposure to transport pollution and its impacts on health, monitoring must not only measure ambient air pollution levels. It must also monitor and evaluate all air pollution including transport pollution in 'hot spots' where there are heightened risks of exposure such as high-traffic volume roads and in areas with high pedestrian activity, such as high streets.

As noted, a key failing of the NEPM has been its lack of enforceability or regulatory "teeth". It is essential for an effective exposure reduction framework that targets are meaningful, implemented and enforceable. This includes government oversight and accountability for meeting targets and monitoring standards – for example, a role that could be undertaken by a new national EPA once established. In addition, it is important that there be review and enforcement mechanisms available to third parties to report and commence actions on breaches for failing to abide by the targets and standards set under a revised Air Quality NEPM.

Recommendations

1. **Revise the National Environment Protection (Ambient Air Quality) Measure to set ambient air pollution threshold targets that:**

    a. At a minimum, are consistent with the air pollution threshold targets recommended by the WHO Guidelines; and

    b. Implement the principle of 'continuous improvement' that progressively sets new threshold targets for air pollutants, with all thresholds being periodically revised from the new WHO Guidelines consistent targets towards zero.

2. **In addition to revising ambient air quality targets, to set targets for an exposure reduction framework, the National Environment Protection (Ambient Air Quality) Measure must:**

    a. **Establish population exposure threshold targets** for air pollutants; and

    b. Set population exposure reduction targets for *cumulative* and *localised* exposure to all air pollutants, incorporating the principle of 'continuous improvement'.

3. **To ensure the revised ambient threshold targets and new population exposure threshold targets are effective, the National Environment (Ambient Air Quality) Measure, must set new monitoring standards for air pollutants that require:**

    a. The significant expansion of the number of ambient air monitoring stations, particularly in metropolitan areas;

    b. The monitoring of population exposure to air pollution in areas or hotspots of heightened risks of exposure to air pollution. For transport pollution, this includes monitoring on roadsides in locations where there are high traffic volume roads and in areas of high pedestrian activity, and monitoring cumulative population exposure to transport pollution; and

    c. Enable monitoring data to be publicly accessible, available as real time and historical data.

4. **To ensure that the new threshold targets and monitoring standards set in a revised National Environment Protection (Ambient Air Quality) Measure are implemented and enforced:**

    b. Amend the *National Environment Protection Council Act 1994* (Cth) so that thresholds and standards set under a reformed National Environment (Ambient Air Quality) Measure are mandatory;

    d. Examine how a new national Environmental Protection Authority (once established) can have a role in enforcing the mandatory threshold targets and monitoring standards in the revised National Environment Protection (Ambient Air Quality) Measure; and

    e. Provide for third party review and enforcement mechanisms for breaches.

State and territory measures

State and territory governments and their environmental regulators will have a critical role to play in implementing new exposure thresholds and monitoring standards into legislation and in taking regulatory action to address causes of environmental harm. State and territory governments must move away from monitoring air pollution, particularly transport pollution, as an ambient air pollution, and instead implement an 'exposure reduction framework' that incorporates new exposure reduction thresholds included in a revised Air Quality NEPM.

Three examples of immediate measures that state and territory governments and regulators could implement in support of an 'exposure reduction framework' are examined below.

Example 1: Low Emission Zones

Clean air zones or Low Emissions Zones (**LEZs**) are implemented in cities with the primary purpose of reducing exposure to transport pollution in areas of high pedestrian activity, population and heavy urban traffic.

A LEZ aims to reduce tailpipe emissions and at the same time encourage use of lower emission vehicles or active forms of transport. They are introduced at a local government level and in an area designated as an LEZ, access restrictions or charges are applied to vehicles that exceed specific exhaust emission standards.[142]

The intention is to decrease the emission of transport pollutants like NO_2 and particulate matter such as $PM_{2.5}$ and PM_{10}, which have major impacts on health, particularly for physiologically vulnerable groups and overburdened communities. Studies on the efficacy of LEZs across Europe have shown that LEZs work to reduce transport pollution if they are sufficiently ambitious.[143] Further, available evidence suggests observable health benefits from LEZs, particularly for cardiovascular disease.[144]

An ultra-low emission zone (**ULEZ**) was introduced in central London in 2017 and is the largest LEZ in Europe. It introduced a daily fee of £12.50 to drivers whose vehicles did not meet certain emissions standards.[145] By October 2022, the ULEZ had decreased NO_2 levels from transport pollution by 46% within the ULEZ and also benefited the wider area of inner London, where NO_2 levels decreased by 21%.[146] These figures bust myths that LEZs increased air pollution in surrounding areas - to the contrary, the evidence indicates that cleaner vehicles are increasingly being used in suburbs surrounding the ULEZ.[147] The ULEZ is due to expand across all London boroughs from late August 2023.[148]

Example 2: Idling Free Zones (UK, US, and Canada)

Across the UK, USA and Canada, governments have introduced idling offences and 'idle-free zones', where drivers can be fined for idling (leaving the engine running while parked). The purpose of these zones is to reduce spikes in localised emissions particularly during peak periods of traffic. Specific focus has been placed on idle-free zones around schools, due to the specific impacts of transport pollution on physiologically vulnerable children.

In the UK, the *Road Traffic Act 1998* (UK) and its regulations make it an offence to leave a vehicle's engine running when stationary.[149] In March 2023, the *Environment (Air Quality and Soundscapes) (Wales) Bill*[150] was introduced to the Senedd in Wales, which allowed Welsh Ministers to set heavier penalties for vehicle idling offences, with the possibility of heavier penalties for idling offences outside schools and hospitals.[151]

Example 3: Enhanced Monitoring and Safer Active Transport Routes

Enhanced roadside monitoring is essential for measuring and understanding transport pollution in order to determine and mitigate its impacts on the health of pedestrians and cyclists who share roads with ICE vehicles. The Victorian Department of Transport, through the VicRoads 'Smarter Roads Phase 1' program, implemented an innovative, multi-sensor network to monitor roadside traffic emissions (Work Stream 7 – 'Emissions Monitoring') to study this issue.[152] The study comprises seven fixed sites in suburbs of Melbourne, with dual in-bound / out-bound traffic monitoring systems, which are generally in the vicinity of Victoria's Air Quality NEPM monitoring stations. The network has been augmented by several mobile monitoring stations. Measurements include standard Air Quality NEPM pollutants pollutants (see Table 1) (except for lead and air toxics), which have been supplemented by:

- monitoring and analysis of black carbon and ultrafine $PM_{0.1}$ particles;
- extensive site meteorology monitoring; and
- vehicle-characterisation devices (these determine what type of vehicle is using the monitored road, i.e., a heavy vehicle).

Early results from the Victorian Department of Transport emissions monitoring network have enabled an objective comparison of Melbourne air quality along roads (including black carbon and $PM_{0.1}$ particles) with similar international studies undertaken in large cities worldwide. $PM_{0.1}$ were highly correlated with ICE vehicles; these particles are of serious health concern as they can readily pass into the bloodstream and ultimately all organs, including the central nervous system.[153] Black carbon is important to measure as it has proven to be an excellent signature of diesel exhausts, especially those of heavy vehicles which emissions have the greatest impact on health.

The data and insights from the Smarter Roads Phase 1 program are now being incorporated into other inner West Melbourne-based studies that could be used to improve circumstances for inner West Melbourne communities. A prime example of how monitoring can be used to mitigate exposure to transport pollution and associated health impacts is an initiative to identify safer routes for children to use to walk and ride to schools.[154] As was discussed, children are most vulnerable to transport pollution. When walking or riding to school, children can be exposed to harmful localised transport pollution. Using information from the Victorian Department of Transport's enhanced emissions monitoring network under the Smarter Roads Phase 1 program and by backpack sensor monitors for detailed observations along walking routes (direct and alternative), low-exposure routes to schools for children have been identified. These routes avoid transport pollution hotspots, reducing exposure to transport pollution.

Recommendation

5. **State and territory governments and regulators must legislate and develop objectives, guidelines, and policies to support an exposure reduction framework, and to meet the mandatory threshold targets and monitoring standards set by the revised National Environment (Ambient Air Quality) Measure.**

Fuel Efficiency Standards, incentivising EVs and ZEVs and facilitating the mode shift to public and active transport

Complementary elements of establishing an exposure reduction framework include measures to phase out petrol and diesel vehicles and incentivise EVs, ZEVs and a 'mode shift' to public and active transport.

One of the most important and cited set of government measures that can be undertaken to reduce overall transport pollution and support reductions in population exposure is the introduction of national and state legislation and policies that improve the fuel efficiency standards of petrol and diesel vehicles and drive the uptake of EVs and ZEVs for both private and public vehicles.

Case Study: The case for implementing Fuel Efficiency Standards and electrification targets in coordination with active and public transport targets

This case study examines how all Australian jurisdictions should introduce complimentary legislative measures and policies (national and subnational) to drive Australia-wide reductions in the emission of transport pollution, and that if we do not adopt a coordinated approach, it will hinder the achievement of other measures' goals.

Australian Fuel Efficiency Standards and Electrification Targets

The Australian Government's historical reticence to introduce a Fuel Efficiency Standard (**FES**) means that Australia has fallen behind comparable countries in attracting low- and zero-emissions vehicles.[155] Positively, Australian Government has announced it will introduce a FES by the end of 2023.[156] Assuming the design of the new FES is comprehensive and at least meets minimum standards of countries with similar markets such as New Zealand, the United States and EU, once introduced, a FES will immediately begin working to improve the emission standards (and therefore limit transport pollution) from ICE vehicles that are added to Australia's road-transport fleet. In the absence of a comprehensive FES, the total number of dirtier and greater emitting ICE vehicles added to Australia's road-transport fleet will increase. This would undermine and work against measures implemented under an exposure reduction framework.

While the FES is an important step, for Australian governments to reduce the health impacts of exposure to transport pollution (and for Australia to meet its own NDC of a 43% reduction of GHG emissions by 2030 and net-zero by 2050) Australian governments must ensure that Australia is on a trajectory for all new vehicles sold by 2035 to be EVs or ZEVs.[157] Crucially, this electrification of Australian vehicles cannot be limited to private passenger vehicles, given the disproportionate contribution of heavy vehicles (including public buses) to transport pollution. Though national goals can be set to drive the uptake of EVs and ZEVs for both passenger vehicles and commercial heavy vehicle fleets,[158] states and territories governments must also implement measures to increase the uptake of EVs and ZEVs in their jurisdictions. In particular, State and territories are the major operators or funders of public bus fleets – which, being heavy vehicles usually operating in urban areas, disproportionately contribute to overall transport pollution. Fortunately, state and territory governments have set targets for the electrification of their bus fleets.[159]

While implementing the FES, and more importantly, electrifying road transport are essential measures for removing and replacing ICE vehicles on Australia roads, the replacement of ICE vehicles alone will not be able sustainably address transport pollution or allow Australia to meet its NDC targets of net zero.[160] Instead, these efforts must be undertaken in conjunction with a 'mode-shift' away from private vehicle trips to active and public transport. To meet both GHG emissions targets and to reduce transport pollution, this 'mode-shift' will require a halving of the proportion of journeys by private vehicles, quadrupling the number of (electrified) public transport journeys from 14% to 49% of trips.[161] To undertake the mode shift required to reach these targets, transformational and coordinated strategies at national, state and territory levels of government will be required to meet these targets. Presently however, only Victoria has a partial mode shift target, with no targets set nationally or by other state or territory governments.[162] Strategies and policies to increase active public transport must be prioritised and implemented in coordination with a new FES and new electrification targets being set.

Recommendation

6. In legislating develop objectives, guidelines, and policies to support an exposure reduction framework, Australian governments must:

b. Implement Australian Fuel Efficiency Standards by no later than 1 July 2024;

c. Legislate a target of all new vehicles sold by 2035 to be electric or zero emissions; and

d. Implement and coordinate strategies from all levels of government that seek to implement a 'mode shift' away from private vehicles to active and public transport.

Implementing 'whole-of-government' and 'health-in-all policies' approaches to long-term measures to reduce transport pollution emissions and mitigate exposure

When developing strategies to address transport pollution and its impacts on health, the WHO recommends governments must adopt a 'whole-of-government' approach, which requires all levels of government to coordinate efforts to reduce community exposure to transport pollution.[163]

Further, for these strategies to address health impacts, the WHO recommends a 'health-in-all-policies' approach must be adopted by all levels of government. This ensures the health impacts of transport pollution are considered by government departments and agencies responsible for a variety of sectors and areas of government responsibility, and not just the healthcare sector. Again, relevant areas of government responsibility include matters of environment regulations, urban design, planning and transport as well as matters related to social equity.[164] Regarding matters related to social equity, this is especially important given the disproportionate effect the impacts of transport pollution have on physiologically vulnerable groups and overburdened communities.

Finally, the WHO identifies that, in order for effective transport pollution control to be successful, it requires an inclusive multi-stakeholder approach, which contributes to building trust and legitimacy in the policy process and results in more equitable and context-specific policies.[165] This requires not only governments, the scientific community, the private sector and civil society to work together, but importantly also requires the participation of empowered communities and citizens in decision-making processes regarding transport pollution.

Case Study: Applying 'whole-of-government' and 'health-in-all policies' approaches to mitigating and reducing exposure to transport pollution via urban planning policies

As has been discussed in the EDO monitoring and modelling scoping study above, transport pollution does not dissipate evenly and can occur at significantly higher levels in certain areas with high traffic despite ambient monitoring stations recording overall low ambient levels of pollution.[166]

Australian state, territory and local government planning legislation and regulations and urban planning policies have important roles in determining population exposure to transport pollution. WHO considers urban planning a crucial tool in reducing population exposure to transport pollution.[167] Currently, local and state planning regulations across Australia rarely recognise or mandate consideration of the connection between planning decisions and the health impacts of exposure to transport pollution.[168] In NSW for example, health impacts are considered in very limited circumstances. These circumstances are confined to advice given regarding major infrastructure projects such as motorways, and to specific issues and determinations such as the potential health impacts of transport pollution emitted from tunnel ventilation outlets and health impacts of in-tunnel air quality.[169] Because exposure to transport pollution has not been considered in most planning decisions, this has led to poor planning outcomes where the development and operation of essential services have been permitted in areas with high levels of transport pollution. People, particularly people who are physiologically vulnerable to transport pollution, who need to regularly access essential services in these areas – including, for example, children attending school or elderly people accessing a healthcare service – will experience greater health impacts from exposure to transport pollution in these locations.[170]

In Victoria, a study published in 2019 determined that one quarter of all childcare centres were located within 150 metres of a major road, exposing young children to unnecessary levels of transport pollution and associated health impacts.[171] Positively, Victoria is currently in the process of reviewing and updating its planning legislation and policies in Melbourne. The *Plan Melbourne 2017-2050* strategy provides that the location of 'sensitive uses' services such as education, childcare and aged care facilities requires careful consideration and that buffer distances between sensitive uses and emissions sources must be implemented and managed.[172] Further, the plan endeavours to minimise exposure to transport pollution at sensitive use services, through building design responses.[173] While the plan is yet to be fully implemented and the directions on air quality are currently only recommendations, Victoria's focus on tackling exposure to air pollution via a number of propose planning measures, including on its specific focus on sensitive use services like childcare centres, is a welcome example of applying 'whole-of-government' and 'health-in-all-policies' approaches to developing air pollution in conjunction with other areas of government regulation and policy.

Recommendation

7. To ensure all Australian governments implement measures, strategies and policies that seek the long-term reduction of transport pollution that are consistent and coordinated, Australian governments must adopt:

b. A whole-of-government approach to the adoption and implementation of an exposure reduction framework;

c. A health-in-all policies approach when making decisions or developing policies that relate to or could affect the regulation of population exposure to transport pollution; and

d. In developing and implementing regulation and policies to implement an exposure reduction framework, Australian Governments must adopt a multistakeholder engagement approach in which all levels of governments engage with the scientific community, the private sector, civil society and with communities and individuals (particularly overburdened communities and physiologically vulnerable groups) who are empowered to participate in decision making processes regarding the regulation of transport pollution.

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