Submission No 10

INQUIRY INTO CLEAN INDOOR AIR

Organisation: Doctors for the Environment Australia

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Clean indoor air

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About Doctors for the Environment Australia

Doctors for the Environment Australia (DEA) is an independent, non-government organisation of medical doctors in all Australian states and territories.

DEA's work is based on the premise that humans need a future with clean air and water, healthy soils capable of producing nutritious food, a stable climate, and a complex, diverse and interconnected humanity whose needs are met in a sustainable way. We are therefore interested in environmental protection and restoration to promote human health and social stability.

Acknowledgement of Country

Doctors for the Environment Australia's members live and work around Australia. We acknowledge Aboriginal and Torres Strait Islander peoples as the Traditional Owners of these lands, in the spirit of reconciliation.

We recognise that First Nations peoples have cared for Country and lived sustainably for millennia, and that sovereignty of this land was never ceded. We pay our respects to First Nations Elders past and present, and to emerging leaders.

Summary

Poor indoor air quality is caused by pollution from multiple sources within and outside buildings, most of which can be improved or eliminated. Burning carbon in the form of fossil gas, wood, diesel or petrol are particularly important contributors to poor indoor air quality.

The direct and indirect economic costs of poor indoor air quality are considerable.

Health harms from poor indoor air quality disproportionately impact young children, those who are pregnant, older people and those with existing heart, lung or immune system conditions as well as those in lower socioeconomic groups or in workplaces where fossil fuels are burnt. However, measures to improve indoor air quality, such as improved ventilation and eliminating the main sources of pollutants will benefit everyone.

In particular, efficient electric appliances are safer, healthier, more energy efficient and affordable for residential and most commercial uses.

Recommendations

- National and state indoor clean air strategies should be a priority.
- Indoor air quality should be addressed by Australia's building codes, along with ongoing enforceable standards.
- Public awareness campaigns are needed on all aspects of indoor air quality and measures to improve it.

- Burning carbon, such as fossil fuels and wood, should be phased out as energy sources for all buildings and motor vehicles.
- Building design should include:
    - improved ventilation, especially with improved energy efficiency measures, including the ability to turn off external air sources when outdoor air quality is poor
    - no gas connections – fully electrified heating, cooking & hot water systems
    - childcare centres, schools and aged care facilities should not be situated near high traffic areas.
- For buildings with current gas connections or appliances:
    - mandated, externally vented rangehoods for gas cooktops
    - internally vented rangehoods should be banned from sale
    - mandatory implementation of clearly visible health warnings on all new gas appliances at point of sale
    - phasing out of gas appliance use in homes, public buildings and businesses, with financial and organisational assistance to facilitate full electrification.
- Measures to reduce traffic-related air pollution that enters buildings include:
    - promotion and enabling of active transport, such as walking and cycling
    - improved vehicle emission standards, sufficient to discourage the use of internal combustion engine vehicles
    - acceleration of the transition to electric vehicles, especially for large vehicles, including mass transport and prioritising provision of electric buses for schools
    - zero or low emissions areas in cities
    - no-idling zones outside public buildings or in carparks, especially those where children or older people congregate such as childcare centres, schools and aged care facilities
    - better ventilation in enclosed carparks and public transport hubs.

Addressing the terms of reference

Impacts of poor indoor air quality due to airborne pollutants

Health

Air pollution is a significant health issue generally and is now ranked as the second leading risk for death worldwide.[1] For indoor air, there are multiple sources of pollutants in modern buildings, including those from cooking and heating with fossil gas or solid fuels such as wood, off-gassing of volatile organic compounds from furnishings and paint, expired air from building occupants and airborne microorganisms that can cause infection.[2] All of these pollutants can harm health – children, older people, those who have heart or lung conditions, are pregnant or in lower socioeconomic groups are particularly at risk.[1,3]

Indoor pollutants occur in higher concentration when ventilation of buildings is inadequate – an increasingly important issue for modern buildings as we improve their energy efficiency by sealing them tightly against draughts.[4] And concerningly, those who are unable to address the causes of indoor air pollution will continue to be most impacted, particularly renters and those on low incomes.

Australia currently has no indoor air quality standards, but development of such standards would assist efforts to improve health through better indoor air. Much of the evidence base for outdoor ambient standards for nitrogen dioxide is from indoor controlled exposure studies, so it can be argued that indoor and outdoor standards should be set at the same level.

Evidence from the Australian Childhood Air Pollution Study from 2007-08 is instructive. That study of 2630 school children showed that a 4 part per billion (ppb) increase in annual nitrogen dioxide (NO_2) exposure was associated with significant effects on lung function (both FEV_1 and FVC) and the prevalence of current asthma. The average outdoor exposure was 9 ppb.[5] While this does not give us a *no observable effect* level, it does establish that in populations with average annual exposure of 9 ppb there is a gradient in asthma prevalence between more exposed and less exposed children. We suggest that chronic indoor exposure to NO_2 should be no more than 9 ppb.

Burning carbon creates indoor air pollution

The most common sources of carbon pollution in Australian homes is from cooking or heating with fossil gas or wood as well as that from motor vehicles and landscape fires that has infiltrated indoors.[2] Burning carbon from any source creates airborne pollutants – products of combustion such as particulate matter of various sizes, carbon dioxide, carbon monoxide, oxides of nitrogen (especially NO_2) and sulphur as well as volatile organic compounds like formaldehyde and benzene,[6–8] which are known carcinogens.

NO_2 is a known respiratory irritant and is associated with the development and exacerbation of asthma.[9,10] Exposure to NO_2 pollution has also been associated with an increased risk of dementia and cognitive decline.[11–13]

Carbon monoxide is given off when carbon is not burned completely, particularly when an appliance is not functioning perfectly. It is a colourless, odourless gas that is difficult to detect without specific equipment. At low levels it causes non-specific symptoms like headaches, nausea and weakness that can be confused with influenza or food poisoning. Longer term symptoms from lower level exposures include worsening memory as well as changes to mood and behaviour. As levels increase, drowsiness, confusion and eventually death occur. Exposure during pregnancy is risky for both mother and baby.[14,15]

Wood heaters, landscape fires and motor vehicles are especially known for producing particulate pollution. Particulate matter, especially fine particles (less than 2.5 micrometres in size – $PM_{2.5}$) and ultrafine particles (less than 0.1 micrometre in size) are absorbed through the lungs into the bloodstream and travel throughout the body, contributing to ischaemic heart disease, lung cancer, chronic obstructive pulmonary disease, lower respiratory tract infections like pneumonia, stroke, type 2 diabetes and adverse birth outcomes. Again, those particularly affected include older people, children, pregnant women and those with existing heart and lung disease.[3]

Fossil gas – methane

In addition to its role in climate pollution and consequent global heating, fossil gas is one of the most concerning and avoidable sources of indoor air pollution in Australia. The health impacts of home gas appliance use are widely researched and significant.

The harmful air pollution from burning gas indoors lingers inside for hours after a gas appliance has been used,[16] particularly in more airtight modern homes.[4] Particularly concerning pollutants are NO_2, carbon monoxide,[4] formaldehyde and benzene.[7,8,17] This is worrying, given the large amount of time most people spend inside their homes, but it is also avoidable.[7]

The risk of a child being diagnosed with current asthma is 42% greater with gas in the home, mainly due to NO_2 exposure, and is similar to indoor cigarette smoke exposure.[10,18,19] There is an increased risk of worsened asthma symptoms and bronchitis for all occupants.[10,20] Asthma cost Australia $28 billion in 2015 including $1.2 billion in direct healthcare costs,[21] and indoor gas use is estimated to be responsible for 12% of our national childhood asthma burden.[22] Treatment and management of asthma cost the health system approximately $852 million in 2020-21.[23]

Indoor gas use, especially gas heaters, also poses a particular risk of carbon monoxide poisoning[24] which often goes undiagnosed due the vague symptoms of low level exposure. Significant exposure can lead to deaths and near misses, and this continues to occur in Australia.[25] Unflued gas heaters are especially dangerous, as all products of combustion are emitted directly into the room – no one, least of all children, should be exposed to unflued gas heaters. It is a matter of deep concern that, despite the well-known dangers, large numbers of unflued gas heaters are still used in NSW schools.[26]

Open-flued (room vented) heaters are also dangerous under certain 'negative pressure' conditions, which are more likely to occur in tightly draught-sealed buildings. Negative pressure causes the products of combustion to be sucked back into the room, rather than exiting the building through the flue. The risks from gas (or wood) appliances can be reduced (but not eliminated) by regular servicing, remembering to always allow adequate ventilation when using open-flued heaters and correct installation and use of carbon monoxide alarms.[24,27,28] The only way to actually eliminate these risks from buildings is to remove the sources of combustion – gas or wood appliances.

In addition to these physical harms, it is notable that the cost of energy in homes using gas is significantly higher than in fully electric homes. Home electrification, especially when combined with rooftop solar and home batteries, insulates the community from the financial stresses of energy price inflation.[29,30]

Prevention is the best and most effective method for reducing physical and mental harm to our community. When there are equivalent or better electric alternatives to gas or wood appliances that do not carry these health risks, we should be changing our practices to protect the public and move to fully electric homes and businesses as a priority. There are now safer, healthier and more efficient and affordable ways to heat buildings and cook.

Transport related air pollution

Pollutants from motor vehicle and other petrol/diesel combustion sources that contaminate indoor environments similarly include particulate matter, NO_2 and carbon monoxide.

Transport, industry and planning decisions need to consider the importance of minimising exposure to pollutants that can enter indoor environments, particularly where individuals at higher risk of health harms may be exposed.

The best example of this is in schools where there are air pollution hot spots are created by vehicle idling at drop off and pick up times, schools located on busy roads or gardening equipment like blowers and mowers. The resulting air pollution spreads into classrooms where it is often trapped partially or completely.

Other public places where people (especially those at higher risk) are particularly exposed to transport related air pollution, include:

- idling vehicles, including patient transport vehicles, at the front of hospitals
- enclosed shopping centre carparks, as they are underventilated, though this may be difficult to overcome for existing carparks
- partially covered locations such as train stations where idling diesel locomotives can expose people to high levels of diesel particulates. This has been noted especially from locomotives of the NSW XPT trains (see photo).

Diesel particulates clearly visible in exhaust of NSW XPT train at Maitland. The same train also idles at busy Central Station where the particulates are trapped in semi-enclosed areas.

Productivity and economic output

Poor indoor air quality reduces productivity through reduced cognition, along with acute and chronic ill health. Inadequately ventilated workplaces increase transmission of infectious diseases, resulting in reduced

productivity through acute illness (particularly respiratory) which can in turn have long term impacts, such as long COVID.[31] Lower respiratory tract infections alone are thought to have cost Australia $1.6 billion in 2018-19[32] and direct health costs of asthma were estimated at $852 million in 2020-21.[23]

The overall economic impacts of poor indoor air quality are considerable, and certainly much higher than a 2001 prepandemic estimate of $12 billion,[32] and possibly as high as $24 billion in today's money.[31]

Work health and safety

Given the health impacts of gas in homes, it is notable that employees can be subject to these harms at their work, and workers have no choice in this. An obvious example is commercial kitchens, where workers are exposed to the multiple gas burners and ovens are used for cooking. In these circumstances, there is clearly potential for even higher exposure to indoor pollutants than in homes, despite ventilation requirements.

Apart from increasing the risk of kitchen fires, worker health is also impacted by unnecessary heat, as the inefficiency of gas cooking leads to most of the heat generated going directly into the surrounding work environment.

The same can be said for staff exposure to motor vehicle or diesel train pollution at covered public transport hubs, and the associated risk from particulate matter, $NO_{2,}$ carbon monoxide and other air pollutants.[33,34]

Equity of access to public services and spaces

The health impacts of poor indoor air quality are inequitably distributed across the community, particularly affecting the very young, those who are pregnant, older people and those with existing heart, lung or immune system conditions. Consequently, such people (and those caring for them) are likely to avoid public spaces with poor actual or perceived indoor air quality.

In particular, the recent COVID-19 pandemic has drawn attention to airborne transmission of infectious diseases. Those at high risk of airborne infections are likely to remain fearful of accessing public spaces and in-person services, with considerable impact on their social functioning. Measures to reduce the transmission of airborne communicable diseases, like increased ventilation, also reduce the health impacts of other causes of poor indoor air quality.

Improving air quality in public spaces has the potential to improve not only the physical health, but also the mental health of a wide section of the community, along with increased social participation.

Indoor air quality standards and monitoring

Australia;'s building codes, regulations and health strategies do not adequately address indoor air quality.[2,35] Each state or territory decides the extent to which it will follow the National Construction Code for new buildings and compliance is assessed at the design and construction stage.[2] There is a real risk that the current housing crisis will result in hasty construction of yet more housing that does not address either indoor air quality issues nor climate resilience. There are no ongoing assessment requirements of residential

indoor air quality, and schools, hospitals and other indoor public spaces are only covered insofar as they are workplaces.

There are occupational standards for airborne contaminants – from 1 December 2026, the workplace exposure standard (WES list) will be replaced by workplace exposure limits (WEL list) from Safe Work Australia.[36] Relevant pollutants on this list include carbon dioxide, carbon monoxide, nitrogen dioxide, benzene, formaldehyde, diesel particulate matter and sulfur dioxide.[37] It is not clear how effective monitoring, compliance and enforcement with these new standards will be for workers exposed to gas stovetops or transport related air pollution. Even in workplaces with known significant indoor air quality issues from vehicle engines, like public transport hubs, concerted education and enforcement is required to improve ventilation and change ingrained behaviours, such as leaving bus engines idling for long periods of time.[33,34]

Indoor air quality needs to be better addressed by Australia's building codes and health strategies.

Solutions to improve indoor air quality

Australia needs:

- national and state indoor air quality strategies[32,38]
- evidence-based, national indoor air quality standards, along with public awareness and enforcement, with particular emphasis on public places where priority populations congregate, especially children.

Building design

- Australia's building codes should comprehensively address indoor air quality including ongoing enforceable and evidence-based standards for existing buildings.

New homes and commercial premises, especially schools, health services and public buildings:

- should be designed and built **without** gas connections, so people are not locked into using gas indoors
- should be energy efficient, but with provision for regular, sufficient ventilation along with the ability to switch off air intake from outside on high outdoor pollution days, e.g. from landscape fire smoke
- wood heaters should be phased out, especially in urban areas or where local weather conditions make high pollution days more likely.

Schools, childcare centres and aged care facilities:

- should not be built close to high traffic roads
- 'clean air' zones or 'no idling' zones should be specifically factored into developments, including signage, road marking and tree line buffers
- all appliances should be efficient electric, especially heating and gardening equipment
- $PM_{2.5}$ and NO_2 monitoring should be included and HEPA air filters used when levels are above acceptable.

Retrofitted measures

There is a large amount of current housing, public and commercial buildings that are not designed for or used in ways that facilitate clean indoor air. Education, support and incentivisation will be required to facilitate appropriate retrofitting to improve their indoor air quality, including electric instead of gas appliances for heating and cooking as well as ventilation and filtration systems and other emerging technologies.

For buildings with current gas connections or appliances:

- mandated, externally vented rangehoods for gas cooktops
- internally vented rangehoods should be banned from sale, as they are essentially ineffective at removing harmful pollutants
- mandatory implementation of clearly visible health warnings on all new gas appliances at point of sale
- gas appliance use in homes, public buildings and businesses should be phased out, with financial and organisational assistance provided to facilitate full electrification.

Transport related air pollution

Given that transport related air pollution can and does contaminate indoor spaces, addressing its causes is relevant to the current inquiry.

Solutions include:

- promotion and enabling of active transport, such as walking and cycling, which reduce car dependency and improve health outcomes even further
- improved vehicle emission standards, sufficient to discourage the use of internal combustion engine vehicles
- acceleration of the transition to electric vehicles, especially for large vehicles and mass transport, including prioritising provision of electric buses for schools
- zero or low emissions areas in cities
- no-idling zones outside public buildings or in carparks, especially those where children or older people congregate, such as childcare centres, schools and aged care facilities
- better ventilation in enclosed carparks and public transport hubs.

Public awareness

It is important to raise public awareness about all aspects of indoor air quality and measures to improve it, including:

- causes of and risks from air pollutants in the home – fossil gas used in heating, cooking and hot water; off-gassing from furnishings and paint and transmission of infectious diseases
- interim safety measures when using gas or wood appliances, including ventilation, regular servicing, correct use of carbon monoxide alarms and recognition of symptoms of carbon monoxide poisoning
- the importance of sufficient and regular ventilation of buildings more generally
- the risks of retrofitting tight weather-sealing on houses without also ensuring sufficient ventilation

- the risks of transport related air pollution, especially for particular groups of people, and importance of measures to reduce it, such as no idling and low emissions zones and ventilation for enclosed areas
- awareness of the need for evidence-based indoor air quality standards and how to access affordable air quality assessments.

Implications for climate resilience and pandemic preparedness

Effective action to improve indoor air quality is likely to improve human health, including climate resilience and reduction in transmission of airborne diseases.

Effective emissions reduction policies to slow climate pollution and global heating will reduce the use of fossil gas in homes as well as most commercial applications. Reticulated gas network costs will continue to increase as the customer base diminishes, leading to even greater expense for people still using gas appliances with rising economic inequity. As the commercial viability of gas networks becomes uncertain, people are likely to be left with unusable gas appliances (stranded assets) that need to be replaced with electric ones. Preventing new gas connections will reduce the need for such retrofitting with considerable savings for homes and businesses.

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