Centre for Urban Research
School of Global, Urban and Social Studies
RMIT University

Inquiry into health impacts of air pollution in Victoria

Submission on behalf of the Centre for Urban Research

29th March 2021

Dear Environment and Planning Committee Members,

This submission is made by A/Prof Melanie Davern, Dr Nigel Goodman, Prof Lauren Rickards, Prof Sarah Bekessy, Dr Louise Dorignon and Dr Lucy Gunn on behalf of the Centre for Urban Research, RMIT University.

We provide a summary of our key recommendations, followed by background information about the Centre, and present detailed recommendations in response to the Terms of Reference.

1. Summary of our recommendations

Sensing and monitoring of air pollution

- Increased monitoring of ambient air quality for small area geographies across large cities in Victoria (with populations >100,000) with current, dynamic (real-time) and publicly available data for the minimal requirements of $PM_{2.5}$, PM_{10} and NO_2. Other gases for consideration should include O_3, SO_2, NO_x and Non-Methane Volatile Organic Compounds (NMVOCs).
- Projected population rate estimates should be clearly considered in air quality monitoring infrastructure planning, and population data must be integrated with spatial data to target, measure and monitor air quality within local areas. Small geographies of analysis (e.g. Statistical Area Level 1 or 2) should be utilised to minimise the masking of any potential discrepancies, plume dispersion, and identify issues of environmental injustice.
- Roadside CO testing should also be considered with increased traffic volumes during the COVID-19 pandemic and rapid densification of cities and combined with VicRoads road densification measures captured with hourly traffic volumes.
- Invest in technologies that provide real-time measurements of air pollutants. These could be based on low-cost air quality sensor networks to identify trends in air pollutant levels and potential 'hotspots'. Sensors should be used to monitor both outdoor and indoor air quality.
- Use of low-cost sensor networks to collect and communicate real-time data relating to elevated levels of particulate matter during dust storms, pollen events, and during prescribed burns and bushfires. This is needed to inform decision making, communication, and support community awareness about potential public health risks and behavior of the general public to avoid areas of risk especially in vulnerable populations (e.g., asthmatics).

- Subsidised or free access to portable air filters during prescribed burns. This should be accompanied with increased air quality monitoring, public awareness campaigns notifying of expected poor air quality, particularly for vulnerable members of the population including older people, children, or people with respiratory conditions, those living in high pollution areas.
- The number of schools, early learning and childcare centres and aged care facilities located on main roads should be monitored with air quality included in the Planning and Environment Act 1987. Currently, there is no inclusion of public health or air quality within the legislation.
- Improved monitoring and reporting of air pollution around power stations to ensure that they are meeting not only existing emissions standards, but tighter standards that are recommended above and recommended within this submission.

Reducing air pollution

Indoor air pollution

- New policy phasing out wood heaters in urban areas with incentives to switch to gas or electric appliances. In regional areas encourage the adoption of high efficiency wood heaters such as those with dual combustion chambers, particularly in areas heavily impacted by wood smoke from residential heating. Note that the USA Census includes a question about the use of wood heaters in the home.
- Increased awareness of the benefits of creating healthy indoor environments, and strategies to reduce levels of indoor pollutants including using low emission construction materials, furnishings, paints and products. Indoor environments can be important locations of exposure to hazardous air pollutants (e.g., formaldehyde).
- Incentives to create workplaces that have low (or zero) fragrance policies to reduce exposures to primary pollutants (e.g., limonene, acetone) and secondary air pollutants (e.g., formaldehyde, $PM_{2.5}$).
- Incentives to reduce the leakiness of Victorian homes to help reduce smoke intrusion during prescribed burns and bushfires. These incentives could also be coupled with initiatives to improve the thermal performance of buildings (such as increasing insulation).

Outdoor air pollution

- Significant upgrades to existing power stations to reduce emissions of key pollutants (e.g., Hg, SO_2) and introduction of world class emissions standards and regulations, notably on mercury.
- Enhanced efforts to reduce climate change in recognition that it exacerbates both the prevalence and toxicity of air pollution, and people and animals' susceptibility to it, leading to worse health impacts.
- Incentives to support a transition away from using small petrol driven motors (e.g., lawn mowers, line trimmers) in urban areas and incentives to support community-share arrangements for equivalent electric mowers and line trimmers.
- Transport emission reduction strategies including broad use of electric vehicles within the public transport network to reduce diesel particulate matter from buses, trains, trucks and vehicles.
- Urban greening initiatives designed to improve air quality, particularly in identified pollution hot spots.

Integration of air pollution into policy

- Air quality has direct connection to current Victorian policies of Plan Melbourne for transport and land use integration, and the Victorian Public Health and Wellbeing Plan 2020-2023, particularly actions on climate change and active living, Biodiversity 2037 and also relevant to a recent Victorian inquiry into environmental infrastructure. Recommendations for air quality in apartment developments are a key feature of the 2021 draft Apartment Design Guidelines for Victoria. Standards for air flow and natural ventilation are set even in noisy environments, where windows are likely to be kept closed. The 2021 draft states that 'access to fresh air movement in apartment dwellings contributes to thermal comfort, passive cooling opportunities and creates a comfortable and healthy indoor environment' (p.124).
- Regular monitoring and public reporting of incidence of disease in relation to local air quality monitoring, particularly respiratory, cardiovascular, metabolic, neurological and birth-related outcomes with inter-agency cooperation by the Victorian Department of Health and Human Services and the Environmental Protection Authority.
- In 2018 the Minister for Energy, Environment and Climate Change and Minister for Roads and Road Safety established the Inner West Air Quality Community Reference Group and recommended actions to improve air quality in Melbourne's inner west.
- Air quality is directly relevant to the UN Sustainable Development Goals (SDG) and the 2030 Agenda for Sustainable Development. This includes contributing to SDG 3 (good health and well-being), SDG target 7.2 on access to clean energy in the home, SDG target 11.6 on air quality in cities, SDG target 11.2 on access to sustainable transport and SDG 13 (climate action) and the goals of the Paris Agreement on climate change. Goal 17 also requires goals and targets be adopted with measuring and monitoring frameworks that are also necessary for sustainable development.
- Air quality is also directly relevant to the Climate Change Adaptation Action Plans that the Victorian Government is currently preparing for the Health System and for each region of Victoria. As mentioned above, climate change exacerbates air pollution and its health impacts. Combined with its localized effects around coal-fired power stations and petrol stations (see above), air quality is therefore also relevant to greenhouse gas mitigation and could be highlighted as part of the rationale for accelerating Victoria's transition away from coal power to renewable energy.

2. About the Centre for Urban Research

The Centre for Urban Research at RMIT University is a focal point for leading and emerging scholars to deliver conceptual and applied research to create transformative change to cities and regions. We are deeply committed to a research impact culture that scales up and reaches out to develop and apply new ideas, understandings, and practices. The Centre has about 70 researchers, of which approximately 65% are research intensive. Staff expertise spans urban and transport planning, public policy, human geography, economics, environmental sciences, public health, spatial analysis, history, and sociology. The Centre for Urban Research leads numerous research projects primarily delivered under eight programs:

- Climate Change Transformations
- Critical Urban Governance
- Health Place and Society
- Healthy Liveable Cities
- Housing and Urban Economics
- Interdisciplinary Conservation Science (ICON Science)
- People, Environment, Place
- Planning and Transport in City Regions
- Urban Cultures and Technologies

The Centre's membership draws on deep and diverse academic expertise, active and meaningful collaborations, and lessons from the past and present to contribute thoughtfully to major urban and global agendas. Our cross-disciplinary research and new directions programs are gaining global recognition for addressing complex questions that are current and central to the fields of urban and regional planning, and social and environmental science.

3. Additional Information and detailed recommendations

3.1. Indoor air quality

Australians spend more than 90% of their time indoors in locations such as houses, apartments, schools, offices, public buildings, and forms of transport. In these locations, the levels of pollutants can be many times higher than outdoors. However, in contrast to ambient air, indoor air is essentially unregulated and unmonitored. Poor indoor air quality can cause significant impacts to health, environment, and the economy. In Australia, exposure to poor indoor air quality is estimated to cost over $12 billion per year due to lost productivity and illness. Despite the potential adverse health impacts, there are currently no regulations or standards for acceptable levels of indoor pollutants in Victoria (or Australia). The previous advisory indoor air quality guidelines provided by the NHMRC were rescinded in 2002. We propose that a significant investment is made to develop indoor air quality guidelines such as those published by the World Health Organization or by the Canadian Government.

Primary sources of indoor air pollutants are building materials (e.g., laminated timber, carpets, paints) and fragranced consumer products (e.g., air fresheners, cleaning products, laundry supplies). Fragranced consumer products emit a range of volatile organic compounds (VOCs), including hazardous air pollutants. In addition, common fragrance VOCs, such as terpenes, react with ozone to generate secondary pollutants, such as formaldehyde. Moreover, in urban areas, emissions from consumer products (e.g., paints, printing inks, cleaning agents, adhesives, and fragranced products) now constitute a dominant source of fossil fuel derived VOCs. These products now make up 50% of all emitted VOCs in industrialized cities (33 studied globally) and make important contributions to the generation of aerosols (e.g., $PM_{2.5}$) and ozone which are key contributors to urban smog. Therefore, strategies to reduce these emission sources are needed.

Recent research has increased our understanding of sources and concentrations of VOCs within indoor environments in Australia. This research found that discontinuing the use of air fresheners can reduce concentrations of fragrance chemicals (e.g., terpenes) by up to 96% (average 81%) within two weeks. In addition, switching from fragranced to fragrance-free laundry products can reduce dryer-vent emissions of fragrance chemicals by up to 99% (average 79.1%). Increasing community awareness of ways to create healthier indoor environments should be a priority. One strategy that can reduce indoor levels of terpenes (and secondary pollutants) is to implement fragrance-free policies such as those found in the US and Canada. Other strategies could focus the incorporation of low VOC materials (e.g., laminated timber, coatings, furnishings), appropriate ventilation, and air filtration (e.g., high-efficiency particulate air "HEPA" filtration).

3.2. Increasing the number of ambient air quality monitoring stations

In Victoria, the current air quality monitoring networks cannot adequately characterize population exposures. Also, detailed information about the spatial distribution of pollutants may not be available, making it difficult to characterize pollutant concentrations, and identify 'hotspots'. Additional reference grade sensors are essential to understand source apportionment, how pollutants interact with the local environment, and possible pollutant exposure profiles.

A recent review found that governments have the opportunity to act more strategically to manage and improve air quality. The review suggested that there is an opportunity to move beyond compliance with standards towards an approach of reducing population risks. It suggested that monitoring networks be redesigned to represent population exposure on a pollutant-by-pollutant basis. The procedures to determine the location and number of sites should be based on international best practice, similar to those used in Canada, EU, and USA. Essential design criteria include specifications for: the minimum requirement for the network; population thresholds; screening criteria; spatial considerations; specific considerations for roadside monitoring capacity; and the process for network review.

3.3. Deploying low cost sensor networks for monitoring outdoor and indoor air quality.

Real time air quality information that can provide qualitative information (e.g., peaks and trends) of the levels of air pollutants (e.g., $PM_{2.5}$) can help to identify sudden changes in the levels of pollutants and reduce exposures. Low-cost sensors (e.g., for $PM_{2.5}$) are becoming reliable and more widely used to monitor air quality in real time. These sensors provide an opportunity for more data to be collected across larger geographic areas to help identify hot spots and help authorities and communities respond.

In Victoria, air quality sensors that meet international standards are sparsely located and can only provide data for a relatively small local area. Also, due to the small number of sensors, detailed information about the spatial distribution of pollutants may not be available, making it difficult to identify hotspots. Understanding where hotspots are located (e.g. within a city) provides valuable information that could lead to more refined mitigation strategies. Also, some hotspot locations may correspond to vulnerable communities who may require additional support. Low-cost sensors (e.g., $PM_{2.5}$) are becoming more widely used to monitor air quality.

Recent research has highlighted the need to protect populations and individuals from exposure to bushfire smoke. In particular, it highlighted the need for methods to communicate air quality information, and for a reevaluation of the health protection advice that is currently provided so that it can be adapted for longer periods of smoke exposure. There is a need to deploy low-cost air quality sensor networks to provide real-time data that can inform decision makers and help communities reduce exposure to air pollutants. This ideally would include air quality monitoring and community notifications during prescribed burns.

We recommend that low-cost sensors networks be deployed to provide real-time measurements of air pollutants. These could be based on similar networks in other cities that provide data to inform decision makers and help communities reduce exposure to air pollutants. Ideally, sensor networks should be used to monitor both outdoor and indoor levels of pollutants.

3.4. Preventing smoke exposure and infiltration of smoke into buildings

Victoria is one of the most fire prone places on earth. The 2019–2020 bushfires caused significant damage to natural and built environments in many states and exposed millions of people to extreme levels of air pollution. It is estimated that approximately 80% of the Australian population was impacted by bushfire smoke for prolonged periods of time (i.e., weeks). Smoke from bushfires and prescribed burns can substantially increase the levels of pollutants within residential buildings. For instance, a recent study showed that indoor $PM_{2.5}$ levels can reach 500µg/m^3 during bushfire smoke events.

The integrity of the residential building envelope is critical for minimizing the amount of smoke from entering a building. A tighter building envelope will be less leaky and reduce the rate of smoke infiltration through cracks, gaps, and openings. A recent study of Australian homes found that the level of protection offered from peak outdoor $PM_{2.5}$ levels during controlled burning ranged from 12%–76%. In Victoria, the average air change rate per hour (ACH) of new housing is 19.7 ACH, this is slightly higher than the national average of 15.5 ACH. By comparison homes in the USA are typically less leaky (e.g., 3 ACH). Improving the air tightness of homes will help reduce infiltration of outdoor pollutants, it will also help make homes easier to heat and cool. Incentives to improve the building envelop in Victorian housing are needed. These incentives could be coupled with initiatives to improve the thermal performance of buildings such as by increasing building insulation.

Air filtration using portable air filters can reduce indoor levels of $PM_{2.5}$ by between 32–88%. Air filters can improve indoor air quality during bushfires and significantly improve health outcomes (e.g., reduced hospitalisations), especially for vulnerable members of the community such as the elderly, or those suffering from respiratory or cardiovascular diseases. We recommend subsidised or free access to portable air filters during prescribed burns and bushfires, particularly for vulnerable members of the population.

3.5. Air quality, climate change and Municipal Public Health

The Victorian Health and Wellbeing Plan 2020-2023 includes climate change and active living as health planning priorities relevant to air quality, which all local government Municipal Public Health and Wellbeing Plans are responding to in 2021. These legislated plans require the use of available evidence to support and prioritise local government health actions. Detailed evidence is now available through the Australian Urban Observatory (auo.org.au) at RMIT University, where decision-makers can now interrogate social, economic and environmental indicators across local areas using a strong evidence base. The AUO was developed with an understanding that these indicators are strongly related to the concept of liveability which describes the relationship between urban planning and the social determinants of health in an area. Mapping of these indicators enables data visualisation and a deeper understanding of how social, economic, natural and built environments connect to support community health and wellbeing.

Data relating to air quality are currently not accurately measured at a metropolitan level and consequently missing from the AUO. The importance of these data for decision making and accessibility through a user friendly interface such as the AUO, cannot be understated. The benefits of understanding spatial data are described through an example as follows.

Figure 1 below displays an indicator of the proportion of dwellings within 400m distance to public open space and shows that some areas have better access to public open space than others. The detailed neighbourhood level assessment of public open space access in Figure 1 could also be replicated for new air quality measurement with dissemination through the AUO. In turn, this information can be used to identify priority areas and future planning needs that could address unforeseen issues in the quality of our cities where air quality and other environmental factors coincide with populous areas. The relationship between population growth and our environmental quality (including air quality) has implications for the way we plan cities for our current and future populations – residents ideally should not be housed in poor quality environments with poor air quality that could impact their health and wellbeing. Victoria in the Future projected population rates and Australian Bureau of Statistics population estimates also provide important information that needs to be considered in air quality monitoring. Population growth needs to be considered in future planning and take into consideration all the previous recommendations provided in this report relating to outdoor and indoor air quality. Increased traffic volumes, land use planning and public health outcomes are the most obvious implications of population growth currently not being considered in relation to air quality.

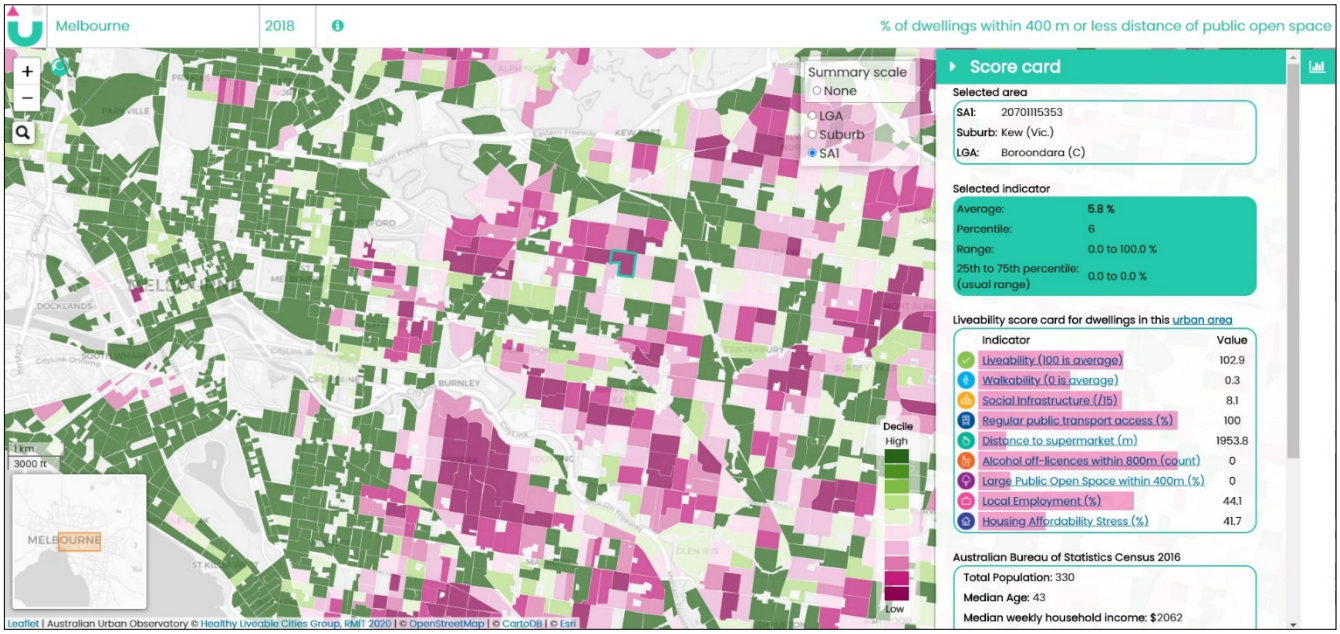

Figure 1: SA1 proportion of dwellings within 400m distance to public open space (neighbourhoods across Melbourne presented) included within the Australian Urban Observatory (auo.org.au)

Indicators currently included in the AUO include: alcohol; food; employment; housing; liveability; public open space; social infrastructure; transport; and walkability. Having air quality indicators based on accurate data from sensors aligned to small geography areas (i.e. SA1-level) would be a welcome addition. Larger aggregated geographies currently being used to estimate air quality does not allow local air quality issues to be detected and hides potential discrepancies and inequities across areas.

Climate change and air pollution are tightly knotted. Climate change worsens the health effects of air pollution in three ways: making existing air pollutants more toxic (e.g. heat increases the production of ozone), introducing more air pollutants (e.g. via more fires), and making people and animals more susceptible to them (by eroding their physical health in other ways). At the same time, the fossil fuel combustion largely causing climate change is also a major source of air pollution, and the effects of climate change on the fossil fuel supply chain is making this air pollution worse (e.g. heat exacerbates the toxicity of vehicle emissions, and extreme heat or bushfire can ignite open cut coal mines, as the deeply impactful and fatal Hazelwood coal mine fire in 2014 illustrated).

Well-designed urban greening strategies have the potential to simultaneously improve air quality (Janhall 2015) and sequester carbon for climate change mitigation (Churkina et al. 2010).

- Churkina, G., Brown, D. G., & Keoleian, G. (2010). Carbon stored in human settlements: the conterminous United States. *Global Change Biology*, *16*(1), 135-143.
- Janhäll, S. (2015). Review on urban vegetation and particle air pollution–Deposition and dispersion. *Atmospheric environment*, *105*, 130-137.

3.8. Air quality and urban agendas

UN Sustainable Development Goals

Globally, there is a major commitment from cities and countries to prioritise health and wellbeing, reduce poverty, and support environmental resilience. This is reflected in the UN's 17 Sustainable Development Goals (SDGs) that were adopted by all member states in 2015, with a vision for achievement by 2030. The focus of the SDG agenda is on collective action, and environmental and social justice, which align closely with environmental infrastructure objectives. Moreover, the SDGs provide an umbrella for bringing together diverse stakeholders, by encouraging both vertical (i.e. multiple levels of government) and horizontal (i.e. intersectoral) collaboration and integration to create more sustainable and liveable cities. Each of the 17 goals is underpinned by numerous targets, which have been designed for relevance and application across low to high income country contexts. Bench-marking neighbourhood, city, and country progress against these goals and targets can provide important information on progress across a range of health, social, and sustainability outcomes. The global momentum and importance of the SDGs presents an opportunity for local and federal governments and stakeholders to align these with air quality and embed varied dimensions of the goals and related targets into relevant measuring and monitoring frameworks.

Relevant Sustainable Development Goals

As mentioned earlier in this submission, air quality is of direct relevance to SDG Goals 3, 7, 11, 13 and 17 and the overarching 2030 Agenda for Sustainable Development.

In conclusion, we thank the Committee for their time and for providing the opportunity to make this submission to the Parliamentary Inquiry on Air Pollution. Please direct any queries related to this submission to A/Prof Melanie Davern [redacted].

Yours sincerely,

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