CAR

Centre for Air pollution, energy and health Research

Position paper

There is no ‘safe’ level of air pollution

Implications for Australian policy

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No level of air pollution should be considered 'safe': Implications for Australian policy

A position paper from the Centre for Air pollution, energy and health Research (CAR)

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Key points

- In Australia, ambient air pollution is regulated by a set of guidelines – the Ambient Air Quality National Environment Protection Measures (NEPM) – which aims to protect human health and well-being.
- The latest evidence suggests that adverse health effects are seen at **all** levels of air pollution, including those below the current NEPM standards.
- CAR proposes that Australian policy moves away from the current NEPM guidelines approach that defines simple thresholds and instead focus on continuous improvement in air quality by setting targets for continuous air pollution reduction over time.

Why is air pollution regulation important for health?

Air pollutants are known to cause a range of adverse effects on health (Box 1). Regulation of air pollutants is one mechanism for reducing these adverse health effects.

Box 1:

Which pollutants are covered in the Air NEPM and why are they harmful?

Carbon monoxide (CO)- is a gas produced from the incomplete burning of fuel. Outdoors, the key sources are vehicles and machinery, while indoor sources include heaters and gas stoves. In the human body, carbon monoxide reduces the amount of oxygen that is transported in blood reducing oxygen supply to vital organs including the heart and brain [1].

Nitrogen dioxide (NO_2)- is a gas produced from the burning of fossil fuel and is generated by vehicles (cars, trucks and buses), power plants, and machinery [2,3]. It irritates the airways and short-term exposure can aggravate respiratory conditions e.g., asthma. Exposure over longer periods can contribute to the development of asthma and potentially increase susceptibility to respiratory infections.

Ozone (O_3)- is a secondary pollutant, that is produced when emissions of volatile organic compounds (VOC) and nitrogen oxides interact with sunlight. Ozone exposure irritates and damages the airways and exposure to high levels has been linked to deaths from respiratory causes [4].

Sulphur dioxide (SO_2)- comes from burning of fuels containing sulphur. Major sources are power plants and industries, but also ships and vehicles that use fuel containing sulphur. Exposure to SO_2 causes problems for people with asthma, who are particularly sensitive to this gas.

Lead (Pb)- is a metal whose levels in air have decreased since the introduction of unleaded fuel. Historic use in paints and ceramic glazes can cause small amounts of lead to leach out of glazed wear into foods, and lead dust re-circulates from domestic renovations. It remains a problem in communities close to lead mines and smelters. Lead is known to have significant effects on the brain and nervous system and young children are particularly susceptible [5].

Particles as PM_{10}- particles smaller than 10 thousandths of a millimetre in diameter - can enter the respiratory system. Short-term exposure is linked to increased hospitalisations and deaths from heart and lung conditions [6]. Long-term exposure is linked to ongoing heart and lung conditions and disorders affecting metabolism e.g., diabetes [7].

Particles as $PM_{2.5}$- fine particles smaller than 2.5 thousandths of a millimetre - can reach deep into the respiratory system and cross into the blood stream. Exposure to $PM_{2.5}$ is one of the leading causes of death and disease around the world [8]. It is associated with heart and lung conditions, type 2 diabetes, pre-term birth and impaired brain health [9].

How air pollution is regulated in Australia

In Australia, air pollution levels are regulated at the national level by the Ambient Air Quality National Environmental Protection Measure (Air NEPM). The Air NEPM sets a level, or threshold, for each of the seven pollutants listed in Box 1. States and Territories must regulate emissions of these pollutants to ensure that the Air NEPM thresholds are met (Table 1).

The aim of the Air NEPM is to "[allow] for the adequate protection of human health and well-being" [10]. For each pollutant, the Air NEPM states the threshold that ambient air must remain below (presented as a 'maximum concentration standard') and the time period over which the measurement is taken.

For example, for fine particles ($PM_{2.5}$), the NEPM states that over a period of one day the average concentration of these particles should not exceed 25 µg/m^3 (micrograms per cubic metre of air). A microgram is one-millionth of a gram. Over a period of a year, the average concentration should not exceed 8 µg/m^3 (see last row in Table 1).

Table 1: Air NEPM standards with thresholds ('maximum concentration standard') and averaging period for each pollutant

Pollutant	Maximum concentration standard	Averaging period
Carbon monoxide (CO)	9.0 ppm *	8 hours
Nitrogen dioxide (NO_2)	0.12 ppm 0.03 ppm	1 hour 1 year
Ozone (O_3)	0.10 ppm 0.08 ppm	1 year 4 hours
Sulphur dioxide (SO_2)	0.20 ppm 0.08 ppm 0.02 ppm	1 hour 1 day 1 year
Lead (Pb)**	0.5 µg/m^3 ***	1 year
Particles as PM_{10}	50 µg/m^3 25 µg/m^3	1 day 1 year
Particles as $PM_{2.5}$	25 µg/m^3 8 µg/m^3	1 day 1 year

Source: Australian Government Federal Register of Legislation, *National Environment Protection (Ambient Air Quality) Measure*. Available at: https://www.legislation.gov.au/Details/F2016C00215

*ppm- parts per million (by volume)

**Note that lead may soon be removed from the Air NEPM

*** µg/m^{3-} microgram per cubic meter

States and Territories must report annually to the National Environment Protection Council (NEPC) on how well they have fared in adhering to these standards. However, as the NEPC does not have the power to take action, this reporting does not result in any real consequences for the jurisdictions that fail to meet the NEPM standards.

Why is the way that air pollution is regulated a problem?

Our concern with using the current NEPM to regulate air quality is that it assumes a 'safe' threshold for air pollution, below which there are no health impacts. For example, for $PM_{2.5}$ the implication is that if, on any given day, the average concentration in the air is below 25µg/m^3, then there will be no negative health effects and there would be no benefit in achieving further reduction in $PM_{2.5}$ levels. There is a further assumption that any increase in air pollutant concentrations that can be achieved without breaching the Air NEPM threshold, will not cause adverse health effects. As we show in the next section, these assumptions are not supported by evidence.

"Using air pollution thresholds in the NEPM implies there is a 'safe' air pollution level, below which no health effects occur. The evidence tells us otherwise."

Health impacts are seen at 'low' levels of air pollution

The current evidence suggests there is no 'safe' level of air pollution [11]. We now know that **health effects are seen at very low levels, well below the Air NEPM standards** and that, for most of Air NEPM pollutants, **there is no evidence of a 'safe' level of exposure.** That is, there is no cut off below which no health impacts are seen. The clearest evidence for this is for $PM_{2.5}$, PM_{10} and lead. The evidence that exists for a health effects threshold for NO_2 shows that it is five times lower than the current Air NEPM standard [12]. This indicates that countries with low to moderate levels of air pollution, such as Australia, have the potential for substantial improvements in health if we can achieve further reductions in air pollution levels.

We have known about this issue for many years

The lack of a threshold for most Air NEPM pollutants and evidence of health impacts at relatively low air pollution levels has been widely acknowledged by various governments and international agencies and was outlined by the World Health Organization (WHO) in 2005:

*.. **the evidence for ozone and PM shows risks to health at concentrations currently found in many cities in developed countries**; these epidemiological findings imply that guidelines cannot provide full protection, since **thresholds below which adverse effects do not occur have not been identified**. Second, an increasing range of adverse health effects has been linked to air pollution, and at **ever-lower pollutant concentrations. This is especially true of airborne PM** [13].*

Guidelines used to set the Air NEPM also acknowledge the lack of a safe air pollution threshold:

*A **non-threshold approach should be taken for the current criteria pollutants** and genotoxic carcinogens. For the criteria pollutants, this approach is **based on the evidence from epidemiological studies that indicate that there is no threshold for effects** [14].*

CAR strongly believes that all Australians will benefit if our air quality standards reflect this evidence.

The methodology used to develop the NEPM acknowledge the absence of a 'safe' threshold for air pollution

An evidence-based solution: towards exposure minimisation

The Air NEPM states that it aims to provide adequate protection of human health and well-being. We argue that the current approach to setting the Air NEPM does not achieve this aim. There is compelling evidence of the absence of a 'safe' threshold and of significant health gains to be made by reductions in air pollution, even in generally low air pollution environments such as Australia.

Australia has plans to reduce the Air NEPM thresholds for $PM_{2.5}$, SO_2 and NO_2 by 2025 [15, 10]. While CAR acknowledges and welcomes these reductions in NEPM standards, they are still based on the premise of a safe threshold for air pollution. Instead, CAR proposes that national policy should be updated to reflect the latest scientific evidence by seeking to achieve continual air pollution reductions.

Australian policy should be updated to reflect the latest evidence by focusing on continuous reductions in air pollution

One approach is the European Union's model under the 2016 National Emissions Ceilings Directive which sets out clear goals to reduce air pollution exposure. Under this Directive, countries have committed to reduce $PM_{2.5}$ by 49%, NO_2 by 63% and SO_2 by 79% by 2030 [16]. It is estimated that these continuous improvements in air quality will reduce the health impacts of air pollution in Europe by half compared with those seen in 2005 [16].

CAR's latest review proposes a similar air pollution minimisation approach:

*In the absence of a mechanism to promote continual improvement and best practice by regulators and industry, **we are failing to adequately protect the Australian community** from the health impacts of air pollution [13].*

A continual air pollution reduction program would improve the health of Australian communities.

About the Centre for Air pollution, energy and health Research

The Centre for Air pollution, energy and health Research (CAR) is a National Health and Medical Research Council Centre for Research Excellence in Australia. It is the only group of its kind nationally to bring together researchers focusing on the impacts of air pollution and new versus traditional forms of energy on our health. Our vision for a healthier community is the driving force behind our research.

CAR supports teams of researchers in the fields of epidemiology, exposure assessment, toxicology, chemistry, biostatistics and clinical respiratory medicine to pursue collaborative projects and to develop their capacity. We are based in seven of Australia's leading universities and research institutions.

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For more information

This position paper has been produced by the Centre for Air pollution, energy and health Research (CAR).

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