JANUARY 2023

Can Canberra 'Burn Right Tonight' or is there 'no safe level of air pollution'?

An Investigation into wood heater policy in the ACT

OFFICE OF THE COMMISSIONER
FOR SUSTAINABILITY AND
THE ENVIRONMENT

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JANUARY 2023

CAN CANBERRA 'BURN RIGHT TONIGHT' OR IS THERE 'NO SAFE LEVEL OF AIR POLLUTION'?

AN INVESTIGATION INTO WOOD HEATER POLICY IN THE ACT

OFFICE OF THE COMMISSIONER
FOR SUSTAINABILITY AND
THE ENVIRONMENT

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Hello

This is Ngunnawal Country

We always respect Elders, male and female

We always respect Ngunnawal Country

Foreword

The 2019 State of the Environment Report highlighted that a significant source of air pollution in the ACT is smoke from wood heaters. While some estimates suggest that less than five per cent of Canberra households rely on wood as their primary source of heating, wood heaters account for a large fraction of Canberra's fine particle air pollution in winter months.

This situation is particularly concerning given current understandings that there is no safe concentration of particles for sensitive people.

The environmental burden of wood heater smoke in the ACT is not evenly distributed geographically. The State of the Environment Report results show that $PM_{2.5}$ pollution (particulate matter less than 2.5 micrometres in size) is far more likely in the Tuggeranong Valley. Wood heaters were responsible for 82 per cent of the daily $PM_{2.5}$ exceedances from the Monash station between 2015 and 2018. Within the reporting period of 2017–2019, air pollution complaints were dominated by smoke (wood heaters and controlled burns), accounting for 403 air pollution complaints (55 per cent of the total).

Following the 2019–2020 Black Summer fires and extended bushfire smoke episodes affecting Canberra and broader south-eastern Australia, there is increasing community awareness of the deep, detrimental impacts of poor air quality. The 2021 whole-of-government *Bushfire Smoke and Air Quality Strategy 2021–2025* recognises the urgent need to improve management of the impacts of smoke.

However, for wood heater smoke, there has been little demonstrable reduction in pollution and associated impacts over time.[1] Wood heater smoke is associated with adverse respiratory and cardiovascular outcomes and Canberra community members are still largely unable to protect themselves from these risks during cooler months.

In 2020–21, only *36* wood heaters were removed from Canberra homes under the Wood Heater Replacement Program. Of greater concern, it remains legal to install and operate a new wood heater in a home in suburban Canberra.

My recommendations herein reflect the urgent need to build on the Bushfire Smoke and Air Quality Strategy to protect the Territory from poor air quality from wood heater smoke.

Dr Sophie Lewis
Commissioner for Sustainability
and the Environment

1 See pg. 176 of Office of the Commissioner for Sustainability and the Environment, 2019. ACT State of the Environment 2019. Canberra, https://envcomm.act.gov.au/soe_about-the-report/.

1. Introduction

1.1 Status of report

This report pertains to the Commissioner's functions under Section 12.1 (c) of the Act, under which the Commissioner has the following function:

> (c) conducting, on the Commissioner's own initiative, investigations into actions of an agency where those actions would have a substantial impact on the environment of the ACT.

As such, this is a Special Report as described in Section 21 of the Act. It must be presented to the Legislative Assembly by the Minister within six sitting days after the day of receipt.

1.2 Background to the Investigation

The Commissioner first explored issues relating to wood heater smoke in 2021, following receipt of a complaint by a community member under Section 12 of the *Commissioner for Sustainability and the Environment Act 1993* (the Act). This complaint related to the Environment Protection Authority's (EPA's) response to reports of excessive and potentially toxic smoke from a domestic wood fire heater.

In investigating this complaint, the Office of the Commissioner for the Environment and Sustainability (OCSE) identified potentially system-wide problems in the regulation of wood fire heater pollution. This finding has implications for the management of environmental impacts from wood heaters more broadly, beyond the immediate effects of this individual complaint case. Through subsequent briefings and community engagement it became clear that wood smoke in the ACT is a persistent and pernicious issue for the environment and human health which is difficult to regulate effectively. The final complaint report, delivered in October 2021, identified seven opportunities for improving regulation and policies around wood smoke pollution, including the following:

- Develop additional criteria for determining environmental harm or nuisance from smoke, such as assessment of smoke composition and air quality monitoring at the affected sites, as part of EPA investigations. Visual assessment of smoke is not sufficient to determine environmental impacts.
- Commission research to determine the number of wood fire heaters in use in the ACT, and to assess their collective impact on the environment and public health. Consideration should be given to the changing environmental context of additional contributions to air pollution from domestic wood fire heaters under climate change scenarios, particularly increased bushfires.
- The Commissioner also encourages the ACT Government to phase out wood heaters in the ACT to align with research demonstrating that there is no safe level of exposure to air pollution.

Although many of the concerns about wood heater smoke relate to human health, poor human health outcomes are an increasingly important indicator of environmental degradation. The responsibility for air quality and pollution policy in the ACT sits with the Environment, Planning and Sustainable Development Directorate rather than with ACT Health. Responsibilities for different aspects of wood heater regulation and air quality monitoring are shared across three ACT Government directorates as follows:

- **Environment, Planning and Sustainable Development Directorate:** Responsible for Environment Protection Policies that help to explain and apply the *Environment Protection Act 1997* and the Environment Protection Regulation 2005, including policies relating to wood heaters. Responsible for the strategic planning and leasehold system, including air quality assessments that have restricted wood heater installations in some new development areas. It is also responsible for building policy and regulation for wood heater installations.
- **Chief Minister, Treasury and Economic Development Directorate:** The EPA is established under the *Environment Protection Act 1997*. As a statutory entity, the EPA is responsible for the administration of the Act. The EPA has responsibility for regulation of wood heater smoke and odour, firewood merchant regulation, and annual reporting under the Ambient Air Quality National Environment Protection Measure (AAQ NEPM), which provides air quality standards for the most common air pollutants. Also responsible for administering building regulations for installation of wood heaters.
- **ACT Health Directorate:** Responsible for reporting on air quality monitoring in the ACT, assessing air quality and issuing public health alerts, if required.
- **Whole-of-Government:** Responsible for the *Bushfire Smoke and Air Quality Strategy 2021–2025*.

The Commissioner has determined there is a need for an investigation of the policy framework which determines the regulation and management of wood heaters in the ACT. While the 2021 complaint investigation looked into the specifics of the EPA's capacity to respond to an individual's adverse experiences of wood smoke, this 2022 investigation explores the ACT's policies for wood heaters more broadly.

Air quality in the ACT

All levels of air pollution are associated with adverse health effects

$PM_{2.5}$

is the most serious air quality issue in the ACT (based on 2015–18 data)

- **31** exceedances of the air quality standard for $PM_{2.5}$
- **28** exceedances in the Tuggeranong Valley
- **24** exceedances from wood heater smoke

CO O_3 NO_2 **ZERO** exceedances of air quality standards for CO, NO_2 and ozone

wood heaters have the greatest impact on ACT's air quality

controlled burns, bushfires and dust storms impact on air quality and are likely to increase with climate change

transport emissions are responsible for most of the year round ambient air pollution

WOOD HEATERS

AND CONTROLLED BURNS were responsible for **403 (or 55%)** of air pollution complaints for 2017–18 and 2018–19

2. Wood heater smoke and air quality in the ACT

2.1 Background to air quality

Poor air quality can result from anthropogenic sources (smoke from wood heaters and controlled burning, motor vehicles – particularly diesel, and industry) and natural sources (dust storms, bushfires and pollen).[2] The number of cars being driven and the use of wood heaters in Canberra's suburbs are major factors influencing air quality. The ACT Government's *Bushfire Smoke and Air Quality Strategy 2021–25*[3] also recognises the impacts of wood heaters as a major source of air pollution over the colder months.

Air quality is one of the most tangible indicators of the state of our local environment, and particle pollution is usually the community's main indicator of air quality. Particle pollution is often evident as a haze which reduces visibility. Due to the low level of industrial activity in the ACT, air quality is largely determined by activities and conditions in our urban areas.

Particle pollution is the most significant air quality problem in the ACT, as high levels are associated with respiratory and cardiovascular illness. Current research suggests that there is no level of pollution at which health impacts do not occur.[4],[5] The specific effect of a particle on health depends on its size, composition and concentration. Particles are associated with increased respiratory symptoms, aggravation of asthma, increased mortality and hospital admissions for heart and lung diseases.

The most common measures of particles are PM_{10} (particulate matter that is 10 micrometres or less in diameter) and $PM_{2.5}$ (particulate matter that is 2.5 micrometres or less in diameter). In comparison, a human hair is about 100 micrometres in diameter. Particles smaller than 2.5 micrometres are considered to have more significant health impacts due to their deeper penetration into the lungs.

2.2 Air quality monitoring in the ACT

Air quality in the ACT is measured using the ACT's air monitoring network. Monitoring data, including a real time Air Quality Index, is available on the ACT Health website.

The ACT's air quality monitoring network has two National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM) compliant monitoring stations at Monash and Florey.[6] The Monash station is situated in the Tuggeranong Valley, the Florey station in Belconnen (**Figure 1**). A third station at Civic does not satisfy AAQ NEPM compliance requirements.

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2 A comprehensive background to air quality can be found in section 5.3 Air of Office of the Commissioner for Sustainability and the Environment, 2019. ACT State of the Environment 2019. Canberra, https://envcomm.act.gov.au/soe_about-the-report/.

3 ACT Government, Bushfire Smoke and Air Quality Strategy, https://www.act.gov.au/__data/assets/pdf_file/0011/1897859/Bushfire-smoke-and-air-quality-strategy-2021-2025.pdf.

4 World Health Organisation, International Agency for Research on Cancer, 2013. IARC Outdoor air pollution a leading environmental cause of cancer deaths. Vol. 109, Monographs, https://www.iarc.who.int/wp-content/uploads/2018/07/pr221_E.pdf.

5 Weichenthal, Pinault et al., Science Advances Vol 8 No 39, 2022 How low can you go? Air pollution affects mortality at very low levels https://www.science.org/doi/10.1126/sciadv.abo3381.

6 Under the AAQ NEPM the ACT is only required to have two monitoring stations.

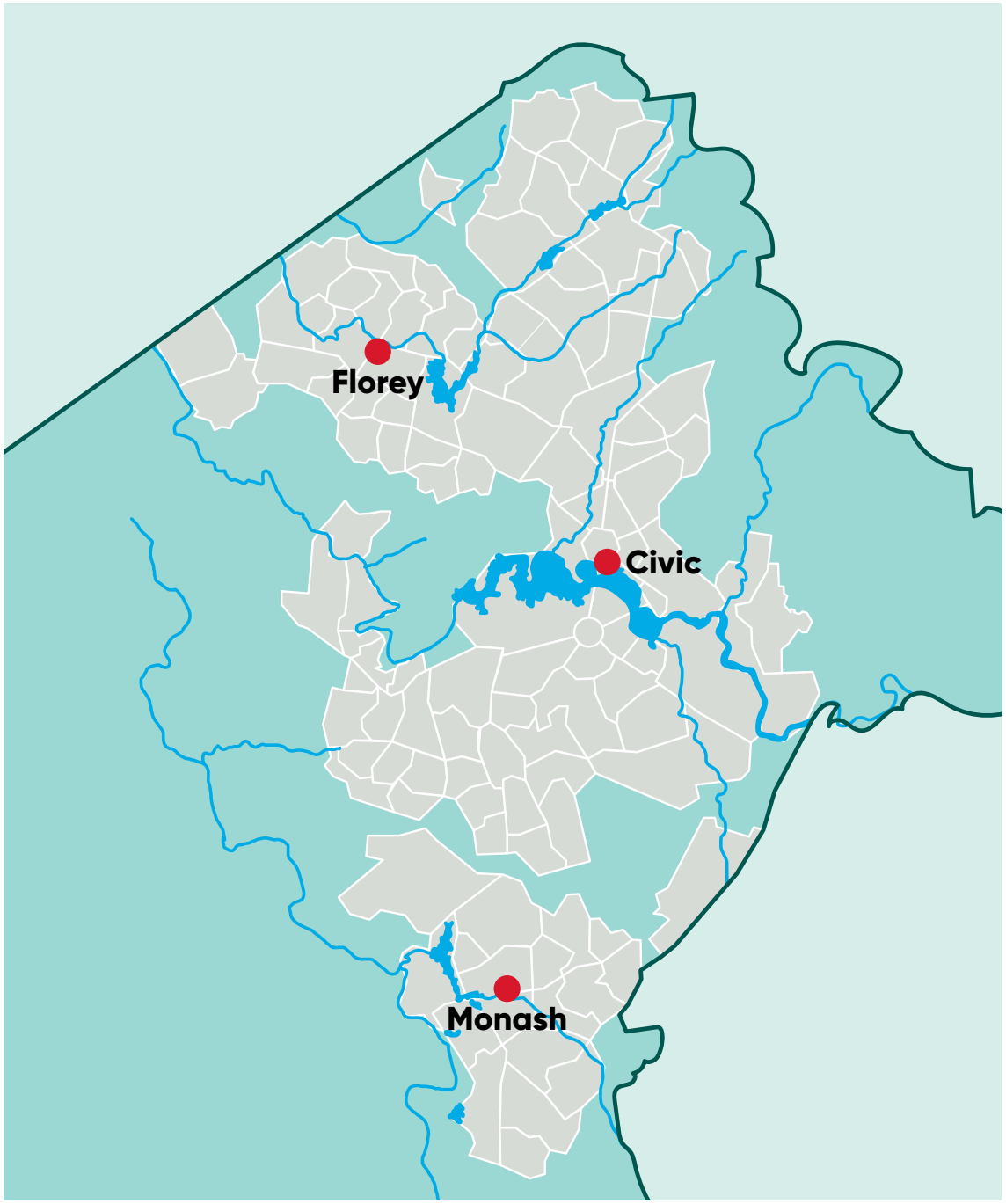

Figure 1 Air quality monitoring stations in the ACT.

Data sourced from: ACT Health Directorate

The National Environment Protection Council (NEPC) sets ambient air quality reporting standards and goals through the AAQ NEPM. This AAQ NEPM prescribes targets for pollutants in ambient air, as well as the methods that should be used to monitor the pollutants. The ACT EPA reports annually against the AAQ NEPM standards and goals. Compliance with the AAQ NEPM standards ensures that the ACT is achieving the national environment protection standards for ambient air quality and that monitoring of AAQ NEPM pollutants is being undertaken appropriately.

The pollutants included in the AAQ NEPM are:

- carbon monoxide (CO)
- lead
- nitrogen dioxide (NO2)
- ozone
- sulfur dioxide
- particulate matter less than 10 micrometres in size (PM_{10})
- particulate matter less than 2.5 micrometres in size ($PM_{2.5}$).[7]

ACT Health monitors the levels of CO, NO2, ozone, PM_{10} and $PM_{2.5}$ in ambient air. The ACT does not monitor sulfur dioxide due to the lack of heavy industry in the region, and lead levels have not been monitored since the phase-out of leaded petrol in 2002.

The limited number of AAQ NEPM compliant monitoring locations in the ACT means that levels of air pollutants cannot be identified for many areas of the ACT. This is an issue as dispersal of smoke from wood heaters is known to respond to local topography and microclimatic conditions, meaning that the concentration of smoke pollution can vary considerably across a relatively small area. As a result, it is impossible to say whether or not specific locations in the ACT experience levels of air pollution which exceed national standards.

The 2019 ACT State of the Environment Report recommended that the ACT Government increase the number of AAQ NEPM compliance monitoring stations (Recommendation 21).[8] In response to this recommendation, the ACT Government agreed that "there would be a benefit of increasing environmental monitoring for particulate matter (PM_{10} and $PM_{2.5}$)" and that "several PM monitors dispersed across Canberra would enable comparison of the impacts of bushfire smoke, smoke from woodfire heaters and dust from activities such as construction, in different regions of the ACT".[9] Additional monitoring stations have not yet been installed. The ACT Government emphasises that the number of AAQ NEPM stations in the ACT is compliant with the AAQ NEPM *minimum* requirements for performance monitoring stations and is hence sufficient.

7 The PM2.5 standard came into effect in February 2016. Before this date, the PM2.5 standard was advisory only.

8 Office of the Commissioner for Sustainability and the Environment, 2019. ACT State of the Environment 2019. Canberra, https://envcomm.act.gov.au/soe_about-the-report/.

9 The Legislative Assembly for the Australian Capital Territory, 2020, Government response to the Commissioner for Sustainability and Environment — ACT State of the Environment Report 2019. The Legislative Assembly for the Australian Capital Territory, Canberra.

The *Bushfire Smoke and Air Quality Strategy 2021-2025* includes actions for investigating the expansion of the air quality monitoring network using low and medium-cost sensors. Population Health Division within ACT Health Directorate is undertaking a study to evaluate options for expanding the air quality monitoring network using distributed and targeted deployment of low and medium cost sensors. The study will provide data to evaluate the reliability, accuracy, and limitations of the additional sensors in comparison to the existing three fixed site testing stations. In addition, ACT Health is exploring options with interstate governments and relevant organisations to access cross jurisdictional data and expanded data sets to draw forecasting intelligence from, to improve their forecasting capability.

Knowledge about the sources of air pollutants is critically important for the management of air pollution. The sources and volumes of emissions of air pollutants in the ACT are reported in the National Environment Protection (National Pollutant Inventory) Measure. Whilst point source emissions are reported annually, data on the sources and emissions of diffuse source air pollution dates from a single 1999 study.[10] This is despite the acceptance that diffuse sources of air pollutants, especially from transport and wood heaters, are the most significant contributors to air pollution in the ACT.[11] The absence of current pollutant source data means that it is not possible to accurately determine air pollution emissions from wood heaters in the ACT. However, air pollution data shows an increase in $PM_{2.5}$ levels during Canberra's colder months, clearly demonstrating the impacts of wood heater use on air quality (see **Figure 2**).

10 Office of the Commissioner for Sustainability and the Environment, 2019.

11 Office of the Commissioner for Sustainability and the Environment, 2015, ACT State of the Environment Report 2015. ACT Government, Canberra, http://reports.envcomm.act.gov.au/actsoe2015/report-summary/act-state-of-the-environment-report-summary/index.html.

2.3 Air quality impacts on human health

The links between wood heater smoke, air pollution and adverse health outcomes have been reported in scientific literature and by national[12] and international agencies such as World Health Organization (WHO) for over two decades. In a 2014 report, WHO noted "The conclusion that PM [particulate matter] kills people has been endorsed by WHO, the US EPA and the European Union in separate scientific reviews".[13]

Wood heater smoke contains a mixture of pollutants including particulate matter, carbon monoxide, carbon dioxide and volatile organic gases, which are detrimental to human health.[14] Of these pollutants, fine particulate matter — $PM_{2.5}$ — is generally considered to be the most health-hazardous air pollutant.[15]

Exposure to $PM_{2.5}$ is linked to a range of adverse health impacts[16,17] including cardiovascular and respiratory illnesses, strokes, cancer, dementia, premature births, and complex developmental conditions such as autism, attention deficit and reduced IQ in children. The impacts of $PM_{2.5}$ pollution on human health is dependent on a range of factors including exposure level and the age and background health status of individuals, though there is currently no evidence of a "safe" threshold below which exposure to PM causes no health impacts.[18] Some members of the community are particularly susceptible to adverse health impacts including the elderly, young children, pregnant people, people with chronic respiratory illnesses like asthma, bronchitis and pneumonia and people with cardiovascular disease.[19]

Long-term exposure to $PM_{2.5}$ contributes to premature mortality and reductions in life expectancy. Research estimates that the number of avoidable deaths due to anthropogenic $PM_{2.5}$ pollution exceeds 2600 each year in Australia, corresponding to 38,962 Years of Life Lost (YLL).[20] In NSW and ACT combined, the number is estimated to reach 940 deaths each year with a corresponding 13,956 YLL.

The health impacts of wood heaters are particularly concerning when considering the level of particulate matter released by wood heaters. Research in the UK found the daily indoor $PM_{2.5}$ concentrations for households using wood heaters certified by the government as "smoke exempt", meaning they produce less smoke, were approximately three times higher than the control group where wood heaters were not used.[21] The study found particulate

12 US EPA, 1999, The Benefits and Costs of the Clean Air Act 1900 to 2010: EPA Report to Congress, https://www.epa.gov/sites/default/files/2017-09/documents/ee-0295a_1-3.pdf.

13 World Health Organization. Regional Office for Europe, 2015. Residential heating with wood and coal: health impacts and policy options in Europe and North America. World Health Organization. Regional Office for Europe. https://apps.who.int/iris/handle/10665/153671

14 World Health Organization. Regional Office for Europe, 2015.

15 See https://www.who.int/teams/environment-climate-change-and-health/air-quality-and-health/health-impacts/types-of-pollutants.

16 See for example World Health Organisation, 2021, Ambient (outdoor) air pollution: Key Facts, https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health#:~:text=PM2.5%20can%20penetrate%20the,well%20as%20of%20lung%20cancer.

17 World Health Organisation, 2018, Air Pollution and Child Health, https://www.who.int/publications/i/item/air-pollution-and-child-health

18 World Health Organisation, 2021. Ambient (outdoor) air pollution, https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health.

19 Australian Government, Department of Climate Change, Energy, the Environment and Water, 2021. Wood heaters and wood smoke, https://www.dcceew.gov.au/environment/protection/air-quality/woodheaters-and-woodsmoke, Commonwealth of Australia, 2021.

20 Hanigan, I. C., et al., 2020. Avoidable Mortality Attributable to Anthropogenic Fine Particulate Matter (PM2.5) in Australia, International Journal of Environmental Research and Public Health. Vol. 18, https://doi.org/10.3390/ijerph18010254.

21 Chakraborty, R., et al., 2020. Indoor Air Pollution from Residential Stoves: Examining the Flooding of Particulate Matter into Homes during Real-World Use, Vol. 11, https://doi.org/10.3390/atmos11121326.

matter "flooded" into indoor areas through normal use of opening wood heater doors to refuel. The findings led the researchers to call for all new wood heaters to be accompanied by a health warning to inform users of health risks.

Moreover, research from Commonwealth Scientific and Industrial Research Organisation (CSIRO) estimated that an average evening's heating using 10 kilograms of firewood emits 100 grams of particulate matter, equating to the smoke of more than 5000 cigarettes.[22] Similarly, another article reported that burning 10 kilograms of wood in a modern, low-emitting wood heater produces the same amount of particulate matter to a truck travelling 500km in heavy traffic.[23]

The associated health costs from wood heater smoke are substantial. Several studies, conducted both nationally and internationally, have documented the economic impacts of wood heater smoke. A 2011 study estimated that in the ACT, the annual health costs per wood heater reached $3800.[24] In Tasmania, the average yearly health costs associated with $PM_{2.5}$ attributed to wood heater smoke and landscape fire smoke reached $293 million.[25] In Denmark, pollution from wood smoke is estimated to create health costs around 0.7–0.8 billion euros each year, making wood smoke the most health damaging and expensive environmental problem in the country.[26]

The health impacts of wood smoke are exacerbated when burning treated timber.[27] Treated timber offcuts from construction or demolition activities are freely available and can often be used as fuel for wood heaters. Burning treated timber poses significant health risks as the wood is often treated with copper chrome arsenate, which makes it highly resistant to pests and fungi. Burning treated or painted wood releases toxic smoke that can be harmful or even fatal when inhaled while ash contaminated with copper, chromium and arsenic is released into the environment causing deleterious impacts.

Smoke from wood heaters has greater health impacts in cities and urban centres where population densities are higher, in areas that experience colder winters with an increased heating demand and in areas that form geographic basins such as Canberra. These impacts are worse in areas such as those where regular temperature inversions and the shape of the valley 'trap' pollutants from wood heater smoke and prevent it from dispersing. In the ACT, this specific topography occurs in the Tuggeranong Valley, where increases in $PM_{2.5}$ levels in the colder months lead to exceedances of air quality standards (see **Figures 2** and **3**).

22 Parliament of Australia, 2013. Chapter 6: Wood Smoke, Completed Inquiries 2010–2013, https://www.aph.gov.au/parliamentary_business/committees/senate/community_affairs/completed_inquiries/2010-13/airquality/report/c06.

23 Irga, P., et al., 2020. 'Like having a truck idling in your living room': the toxic cost of wood-fire heaters, The Conversation, https://theconversation.com/like-having-a-truck-idling-in-your-living-room-the-toxic-cost-of-wood-fired-heaters-140737. accessed 28/10/2022.

24 Robinson, D., 2011. Australian wood heaters currently increase global warming and health costs, Atmospheric Pollution Research. Vol. 2, No. 3, 267-274, https://doi.org/10.5094/APR.2011.033.

25 Borchers-Arriaga, N., et al., 2020. Health Impacts of Ambient Biomass Mass in Tasmania, Australia, International Journal of Environmental Research and Public Health. Vol. 17, https://doi.org/10.3390/ijerph17093264.

26 Green Transition Denmark, 2022. Pollution from Residential Burning, https://rgo.dk/wp-content/uploads/GTD_Pollution-from-wood-burning_2022-1.pdf. Copenhagen, Denmark.

27 See for example NSW EPA Copper chrome arsenate treated timber (nsw.gov.au) and commentary from the University of Technology Sydney https://www.uts.edu.au/about/faculty-engineering-and-information-technology/news/toxic-cost-wood-fired-heaters.

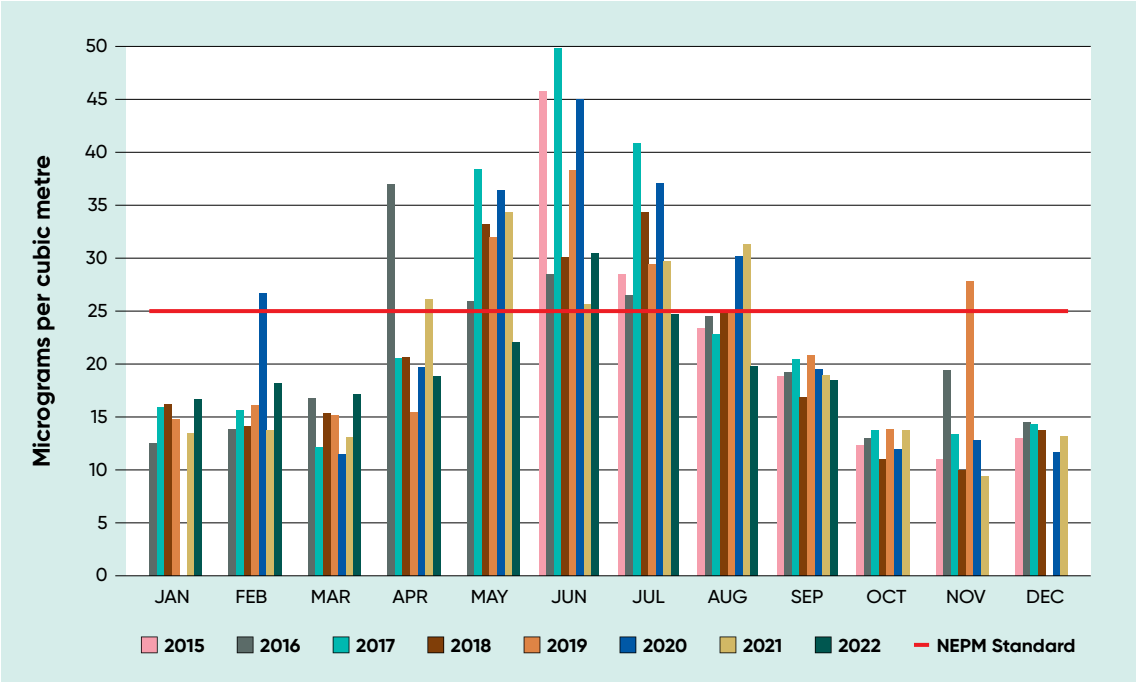

Figure 2 Monthly average daily maximum $PM_{2.5}$ levels from Monash monitoring station, 2015–2022 (data sourced from ACT Health Directorate). This graph shows that $PM_{2.5}$ levels increase during Canberra's colder months because of wood heater smoke and can exceed air quality standards.

Notes: $PM_{2.5}$ standard exceedances in April 2016 were caused by controlled burns, in November 2019 were from dust storms, and in February 2020 were likely from NSW bushfires. $PM_{2.5}$ standard exceedances in the May to August period are caused by wood heater smoke. Data presented for 2022 is for January to September only. The extremely high $PM_{2.5}$ levels caused by the Black Summer bushfires in December 2019 and January 2020 are not shown.

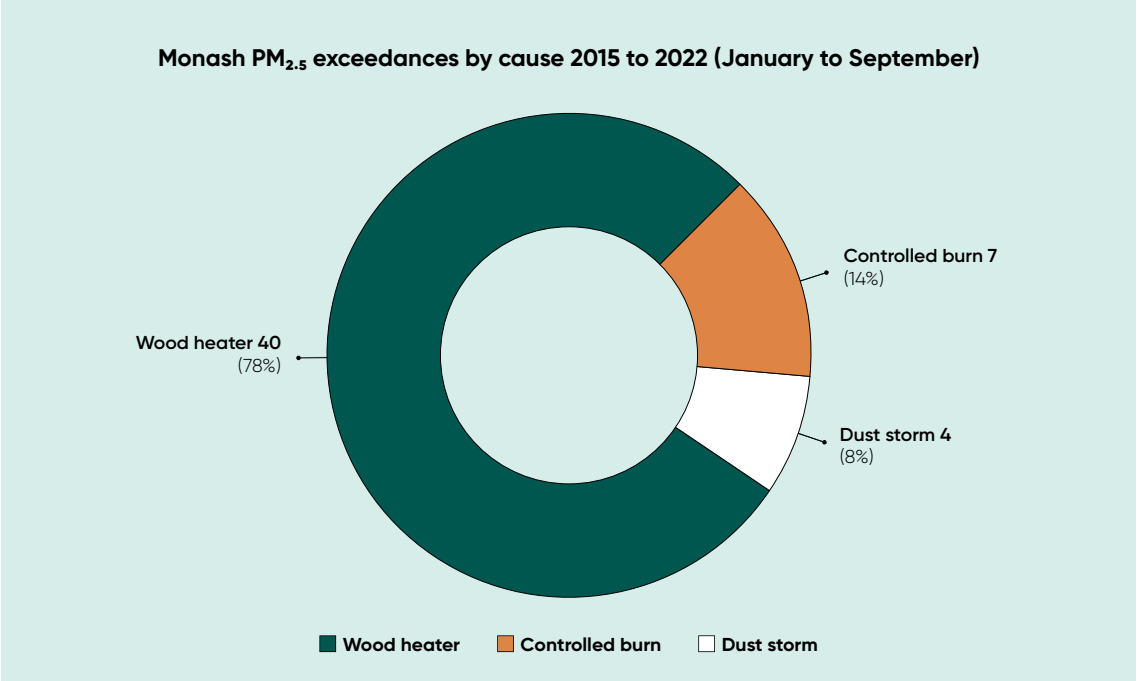

Figure 3 Number of exceedances of air quality standard for $PM_{2.5}$ at Monash station from January 2015 to September 2022 from different sources (51 in total). Data sourced from ACT Health Directorate.

Expert comment: Health impacts of air pollution: a summary of the evidence with reference to wood heater smoke.

Professor Fay Johnston, with the assistance of Morgan Brain and Dr Penelope Jones of the Environmental Health Research team at the Menzies Institute for Medical Research, University of Tasmania.

The scientific literature about air pollution is vast, and the substantial harmful impacts on the health of the population are very well established.[28,29]

The burning of wood releases energy as the stored carbon in the wood is converted into a mixture of hundreds of different solid, liquid and gaseous compounds. Many of these have been well characterised as health-damaging pollutants.[30] These pollutants include volatile organic compounds, toxic and carcinogenic compounds such as free radicals, polycyclic aromatic hydrocarbons, inorganic gases such as carbon monoxide (CO), and particulate matter (PM), including fine PM with a diameter of less than 2.5 µm ($PM_{2.5}$).[31]

$PM_{2.5}$ is one of the most important pollutants in wood heater smoke. When breathed in, $PM_{2.5}$ goes deep into the lungs, enters the blood and travels throughout the body.[32] The body responds to $PM_{2.5}$ by activating several immune and stress response systems which have many different effects. These include, for example, increases in eye, throat and lung inflammation, increases in immune cells and proteins in the blood, increases in the tendency of blood to form clots, increases in blood glucose and cortisol levels, and more stressed cardiovascular functions, such as reduced heart rate variability.[33,34]

Breathing $PM_{2.5}$ from any source, including wood heater smoke, can provoke immediate harmful health impacts through the immune and stress responses described above. These generally happen in people who are susceptible because of existing health conditions such as asthma or heart disease. For example, increased irritation and inflammation in the lungs in someone with asthma could provoke an asthma attack, while an increased blood clotting tendency could precipitate a heart attack or stroke in someone already at risk because of vascular disease.[35]

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28 Dockery D. W. (2009). Health effects of particulate air pollution. Annals of epidemiology, 19(4), 257–263. https://doi.org/10.1016/j.annepidem.2009.01.018

29 Dominski, F. H. et al. (2021). Effects of air pollution on health: A mapping review of systematic reviews and meta-analyses. Environmental research, 201, 111487. https://doi.org/10.1016/j.envres.2021.111487

30 Naeher, L. P. et al. (2007). Woodsmoke health effects: a review. Inhalation toxicology, 19(1), 67–106. https://doi.org/10.1080/08958370600985875

31 Ibid.

32 Chen, H et al. (2021). Cardiovascular health impacts of wildfire smoke exposure. Particle and fibre toxicology, 18(1), 2. https://doi.org/10.1186/s12989-020-00394-8

33 Thurston, G. D. et al. (2017). A joint ERS/ATS policy statement: what constitutes an adverse health effect of air pollution? An analytical framework. The European respiratory journal, 49(1), 1600419. https://doi.org/10.1183/13993003.00419-2016

34 Brauer M, et al. Taking a stand against air pollution—The impact on cardiovascular disease: A joint opinion from the World Heart Federation, American College of Cardiology, American Heart Association, and the European Society of Cardiology. Circulation 2021;143(14):e800-e04.

35 Newman, J. D. et al. (2020). Cardiopulmonary Impact of Particulate Air Pollution in High-Risk Populations: JACC State-of-the-Art Review. Journal of the American College of Cardiology, 76(24), 2878–2894. https://doi.org/10.1016/j.jacc.2020.10.020 Pearce, S., & Scott, V. (2021). Ultra-low emission burners - balancing climate change responses and urban air quality. Air Quality and Climate Change, 55(4), 36–41. https://search.informit.org/doi/10.3316/informit.316065423889164

Breathing $PM_{2.5}$ from any source, including wood heater smoke, also has long-term health impacts. $PM_{2.5}$ is one of many factors that promote the development and worsening of chronic diseases. For example, higher yearly average levels of $PM_{2.5}$ is linked with higher rates of cardiovascular diseases (e.g. heart attacks and strokes)[36], respiratory diseases[37], diabetes[38], cancer[39], changes in cognitive abilities[40], lower birth weight in babies[41] and increases in rates of some pregnancy complications.[42]

Because air pollution contributes to the development and worsening of many common chronic diseases, it is an important – and modifiable – cause of death and illness in the Australian community.[43,44] In Sydney, 100 deaths each year can be attributed to air pollution from wood heaters.[45] In Armidale, NSW, wood heaters are the main source of air pollution, and are used by 40% of households.[46] In winter, the ambient level of $PM_{2.5}$ is high, with multiple days where the national standard of $PM_{2.5}$ levels are exceeded.[47] It is estimated that wood heater smoke accounts for 14 premature deaths or 210 years of life lost per year, equalling an estimated AUD$32.8 million.[48]

There is no safe lower level of $PM_{2.5}$. Even at the relatively low concentrations of $PM_{2.5}$ typically seen in Australia (that is, daily concentrations below the Australian standard of 25 µg/m3), detrimental health effects are present. For this reason, *any* small improvement in air quality in Australia will lead to important community health and economic benefits.

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36 Du, Y. et al. (2016). Air particulate matter and cardiovascular disease: the epidemiological, biomedical and clinical evidence. Journal of thoracic disease, 8(1), E8–E19. https://doi.org/10.3978/j.issn.2072-1439.2015.11.37

37 Xing, Y. F. et al (2016). The impact of PM2.5 on the human respiratory system. Journal of thoracic disease, 8(1), E69–E74. https://doi.org/10.3978/j.issn.2072-1439.2016.01.19

38 He, D. et al (2017). Association between particulate matter 2.5 and diabetes mellitus: A meta-analysis of cohort studies. Journal of diabetes investigation, 8(5), 687–696. https://doi.org/10.1111/jdi.12631

39 Li, R., Zhou, R., & Zhang, J. (2018). Function of PM2.5 in the pathogenesis of lung cancer and chronic airway inflammatory diseases. Oncology letters, 15(5), 7506–7514. https://doi.org/10.3892/ol.2018.8355

40 Thiankhaw, K. et al. (2022). PM2.5 exposure in association with AD-related neuropathology and cognitive outcomes. Environmental pollution (Barking, Essex : 1987), 292(Pt A), 118320. https://doi.org/10.1016/j.envpol.2021.118320

41 Melody, S., et al. (2020). Adverse birth outcomes in Victoria, Australia in association with maternal exposure to low levels of ambient air pollution. Environmental research, 188, 109784. https://doi.org/10.1016/j.envres.2020.109784

42 Bai, W. et al. (2020). Association between ambient air pollution and pregnancy complications: A systematic review and meta-analysis of cohort studies. Environmental research, 185, 109471. https://doi.org/10.1016/j.envres.2020.109471

43 Borchers-Arriagada, N. et al. (2020). Health Impacts of Ambient Biomass Smoke in Tasmania, Australia. International journal of environmental research and public health, 17(9), 3264. https://doi.org/10.3390/ijerph17093264

44 Broome, R. A., et al. (2020). The mortality effect of PM2.5 sources in the Greater Metropolitan Region of Sydney, Australia. Environment international, 137, 105429. https://doi.org/10.1016/j.envint.2019.105429

45 Ibid.

46 Robinson, D. L. (2020). Accurate, Low Cost PM2.5 Measurements Demonstrate the Large Spatial Variation in Wood Smoke Pollution in Regional Australia and Improve Modeling and Estimates of Health Costs. Atmosphere, 11(8), 856. MDPI AG. Retrieved from http://dx.doi.org/10.3390/atmos11080856

47 Robinson, D. L., et al. (2021). The effects on mortality and the associated financial costs of wood heater pollution in a regional Australian city. The Medical journal of Australia, 215(6), 269–272. https://doi.org/10.5694/mja2.51199

48 Ibid.

3. Wood heater impacts on the environment

In addition to producing significant health impacts, wood heaters drive multiple environmental pressures and risks.

Wood heaters produce methane and black carbon which exacerbate climate change. In principle, the production and use of firewood can be carbon dioxide-neutral.[49] This, however, only occurs if the carbon dioxide emitted is fully accounted for by replacement trees, and it has been shown that this is not the case in Australia.[50] This is particularly the case for jurisdictions such as the ACT, where grid supplied electricity is renewably sourced.

Black carbon aerosol particles result from the incomplete combustion of fossil fuels, wood and other biomass.[51] These particulates absorb incoming solar radiation and have a strong warming influence on the atmosphere. Domestic wood heaters are considered the largest single source of black carbon in most Australian cities.[52] Analyses of wood heater usage in Australia demonstrate that a lower contribution to greenhouse warming would occur if all wood heaters were replaced with alternative heat sources, including greenhouse gas emissions-heavy gas or coal-fired alternatives.[53]

The detrimental environmental impact of wood heater usage extends beyond climate change. Firewood for use in wood heaters is harvested from both public and private land. The firewood industry is comprised of commercial, semi-commercial, private and own-use collectors and suppliers. A 2005 estimate suggests that approximately half of the firewood supply in Australia is collected privately from local forest and woodland on private property and roadsides, and is mainly from remnant vegetation in inland agricultural areas of south-eastern Australia.[54] Information specific to the ACT is not available although a broader picture can be gained by looking regionally, from where wood is likely also sourced. In NSW and Victoria, more than 60 per cent of firewood harvested is sourced from woodlands and box-ironbark forests. Even the legal removal of standing dead wood often has a negative impact, by reducing the availability of hollows and input of material to the litter layer which are critical for a range of ecosystems and species. Firewood harvesting has the potential to impact on several species listed as threatened under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

49 Marin et al., 2022, Residential wood heating: an overview of U.S. impacts and regulations, Journal of the Air and Water Management, Volume 72, https://www.tandfonline.com/doi/full/10.1080/10962247.2022.2050442.

50 Robinson, D., 2011. Australian wood heaters currently increase global warming and health costs, Atmospheric Pollution Research. Vol. 2, No. 3, 267–274, https://doi.org/10.5094/APR.2011.033.

51 UNEP & WMO, 2011. Integrated Assessment of Black Carbon and Tropospheric Ozone, https://library.wmo.int/doc_num.php?explnum_id=7737.

52 Robinson, D., 2011.

53 Ibid.

54 Australian Government, Department of Climate Change, Energy and Water, 2005. Continuing net loss of native hollow-bearing trees and coarse woody debris due to firewood harvesting practices, https://www.dcceew.gov.au/environment/biodiversity/threatened/nominations/ineligible-ktp/continuing-loss-trees-due-to-firewood-harvesting-practices. Commonwealth of Australia, 2005.

There is little available information on the provenance of firewood used in wood heaters in the ACT that provides a comprehensive insight into environmental impacts of usage. Permits are not available for collection of firewood from ACT Government tenured land. However, the illegal collection of firewood from the Territory's reserves is a recurring issue and is associated with penalties.[55] Compliance and enforcement of the *Nature Conservation Act 2014* is inherently limited due to multiple constraints such as the large areas managed, small workforce, and risks to staff. Firewood merchants within the ACT are required to comply with standards outlined in the *Environment Protection Regulation 2005*. The EPA requires that each batch of wood sold by local wood sellers provides the buyer with information on the species and location source.

Overall, neither an accurate nor comprehensive assessment of the total environmental impacts of firewood burning in wood heaters in the ACT can be ascertained with the available data.

55 Canberra Times, 2015, https://www.canberratimes.com.au/story/6067115/crackdown-on-illegal-collection-of-firewood-across-canberra/.

4. Wood heater usage in the ACT

4.1 An unknown number of wood heaters in the ACT

The number of wood heaters in the ACT is unknown and specific data on this is not kept by the ACT Government. As of 2022, there is no published government figure, and no figure has been provided to OCSE during this Investigation.

Imprecise estimates of the number of wood heaters can be made using the results of a survey conducted through the ACT Government's YourSay Panel in August 2022. This survey found that 11 per cent of Canberrans have wood heaters in their home.[56] Based on this figure, the current number of wood heaters in the ACT is estimated to be 18,524 out of 168,400 households, although the sample size is notably small and self-selecting.[57]

The accuracy of this estimate is unknown. The 2014 ABS data indicates that only approximately 3.3% (5000) of dwellings had wood heaters in the ACT, which would suggest an increase in the overall number over time, though population and proportion of dwelling types have further changed in the interim.[58]

Estimates obtained through certain Certificates of Occupancy and Use (COU) suggest that there may be large variations in the proportion of homes with wood heaters across suburbs and districts.

56 ACT Government, 2022. Wood heater survey, YourSay Panel, https://www.yoursay.act.gov.au/__data/assets/pdf_file/0009/2083851/YourSay-Panel-Wood-Heaters-Survey-Summary-Report.pdf. Responses to the survey are based on self-selection and the methodology biased towards those with computer literacy and access. While results have been weighted to reflect relative population proportions, including tenure and dwelling type, they are not guaranteed to be a true reflection of the Canberra community. It is also possible that the survey attracted a proportionately higher response from people with a strong interest in the topic, such as those who have wood heaters, or those who are affected by their usage. However, this appears to be the best available estimate of wood heater usage available at this time.

57 Australian Bureau of Statistics, 2021. Australian Capital Territory 2021 Census All persons QuickStats, www.abs.gov.au/census/find-census-data/quickstats/2021/8.

58 See https://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4602.0.55.001Explanatory%20Notes1Mar%202014?OpenDocument

4.2 Attitudes to wood heaters in the ACT

The ACT Government's YourSay Panel[59] responded to a survey about wood heaters in August 2022, providing information about community attitudes to the heaters as well as their own experiences of using them or of being affected by others using them. Some key results included that:

- 32 per cent agreed that wood heaters were a low-cost source of heat and just over half supported a phase-out of wood heaters.
- Almost 30 per cent of respondents were frequently or sometimes impacted by smoke from wood heaters.
- Most of those who complained about wood smoke were dissatisfied by the result as nothing changed.
- Most of the respondents were unaware of the current regulation on wood heaters in the ACT.
- Just over half of respondents support a gradual phase out of wood heaters across all ACT suburbs.
- Objection to a hypothetical ban on wood heaters was much higher amongst heater owners, who represent 11 per cent of survey respondents.
- The survey also highlighted an emotional and aesthetic attachment to wood heaters among a majority of respondents, rather than use from necessity.

59 The YourSay Panel are volunteer members of the Canberra community. Members of the can contribute to surveys, participate in focus groups and community workshops that focus on the planning and development of a range of policies and projects across the ACT.

5. Wood heater management in the ACT

The management of wood heaters is complex. Wood heater appliances and their emissions are regulated by the Australian Standards, which need to be legislated by the Territory Government to be enforceable. The relevant standards to wood heater design — AS/NZS 4012 Domestic Solid Fuel Burning Appliances – Method for Determination of Power Output and Efficiency and AS/NZS 4013 Domestic Solid Fuel Burning Appliances – Method for Determination of Flue Gas Emission — were revised in 2014 to introduce more stringent emissions and efficiency limits and subsequently implemented in the ACT in 2019 through amendments to section 14B and section 14C of the *Environment Protection Regulation 2005*. Under this provision, suppliers of wood heater equipment must obtain a certificate of compliance from an entity authorised by the Environment Protection Authority (EPA), which confirms that the equipment meets the aforementioned standards. This change followed the National Clean Air Agreement 2018–20 work plan, whereby all state and territory environment ministers agreed to the specified actions, which included requiring all jurisdictions to complete the adoption of new wood heater emissions and efficiency standards in 2018.

The regulation of wood heaters within the ACT is underpinned by several pieces of legislation including the *Environment Protection Act 1997* and the *Environment Protection Regulation 2005*, while ancillary Air – Environment Protection Policy contains specific guidance on meeting the air quality requirements stipulated in the Act and Regulation. This integrated legislative and regulatory framework seeks to ensure that air quality in the ACT meets national standards by minimising harm from local emission of air pollutants, while still permitting necessary or socially acceptable activities to take place.

An associated suite of policies, strategies, programs and initiatives has been established to minimise pollution from wood heater smoke. These include the 'Burn Right Tonight' public education campaign, the Wood Heater Replacement Program (WHRP), restricting[60] the installation of wood heaters in new suburbs that experience cold weather inversions and the *Bushfire Smoke and Air Quality Strategy 2021–25*.

60 Approval to install a wood heater can be sought from the ACT Planning Authority.

5.1 Wood heater legislation and policies

5.1.1 *Environment Protection Act 1997*

The *Environment Protection Act 1997* aims to protect and enhance the quality of the environment, prevent environmental degradation and reduce the risk of harm to human health alongside requiring people to change environmental polluting practices. The Act places the responsibility of care for the local environment on all ACT residents, businesses, and industry.

In Part 2.4, the Environment Protection Act stipulates that all wood heater appliances need to comply with the relevant Australian Standards — AS/NZS 4012 and AS/NZS 4013 — which relate to the overall efficiency level and particulate matter emission factors respectively.[61,62] The Environment Protection Act deems it an offence to sell a wood heater that is not compliant with these standards. In accordance with these revised standards, the legislated requirement for wood heaters sold in the ACT is a minimum overall efficiency of 60 per cent and a maximum particulate emission limit of 1.5g/kg.[63] Appliances purchased prior to the introduction of the standards can continue to be used provided they follow steps outlined in the 5.5.3 in the Air Environment Protection Policy, which aim to minimise emissions. To ensure the efficacy of this measure, independent audits of wood heater equipment for sale need to be conducted with appropriate penalties for selling non-compliant models.

However, it is important to note that the adoption of stricter wood heater emissions and efficiency standards will not necessarily translate into large reductions of ambient air pollution. The way that wood heaters are designed in compliance with Australian Standards does not reflect how they are operated in homes. For example, treated or unseasoned wood may be used, or wood heaters are left to smoulder overnight, meaning real-life emissions will be much higher than found in initial tests of the equipment.

The Environment Protection Act establishes the role of the EPA and provides powers and responsibilities to the EPA and Environment Protection Officers (EPO) to address matters that may be causing environmental harm or nuisance, whether originating from a complaint or otherwise. In responding to a complaint concerning a wood heater, an EPO will investigate the complaint to determine if environmental harm is being caused by wood smoke in accordance with **Figure 4** below.

61 Australian Government, Business 2014. AS/NZS 4012 – Domestic Solid Fuel Burning Appliances – Method for Determination of Power Output and Efficiency – Australian Capital Territory, https://ablis.business.gov.au/service/act/as-nzs-4012-2014-domestic-solid-fuel-burning-appliances-method-for-determination-of-power-output-and-efficiency/39156. Commonwealth of Australia, 2014.

62 Australian Government, Businesses 2014. AS/NZS 4013 — Domestic Solid Fuel Burning Appliances – Method for Determination of Flue Gas Emission — Australian Capital Territory, https://ablis.business.gov.au/service/act/as-nzs-4013-2014-domestic-solid-fuel-burning-appliances-method-for-determination-of-flue-gas-emission/3649. Commonwealth of Australia, 2014.

63 ACT Government, 2005. Environment Protection Regulation 2005, https://www.legislation.act.gov.au/sl/2005-38.

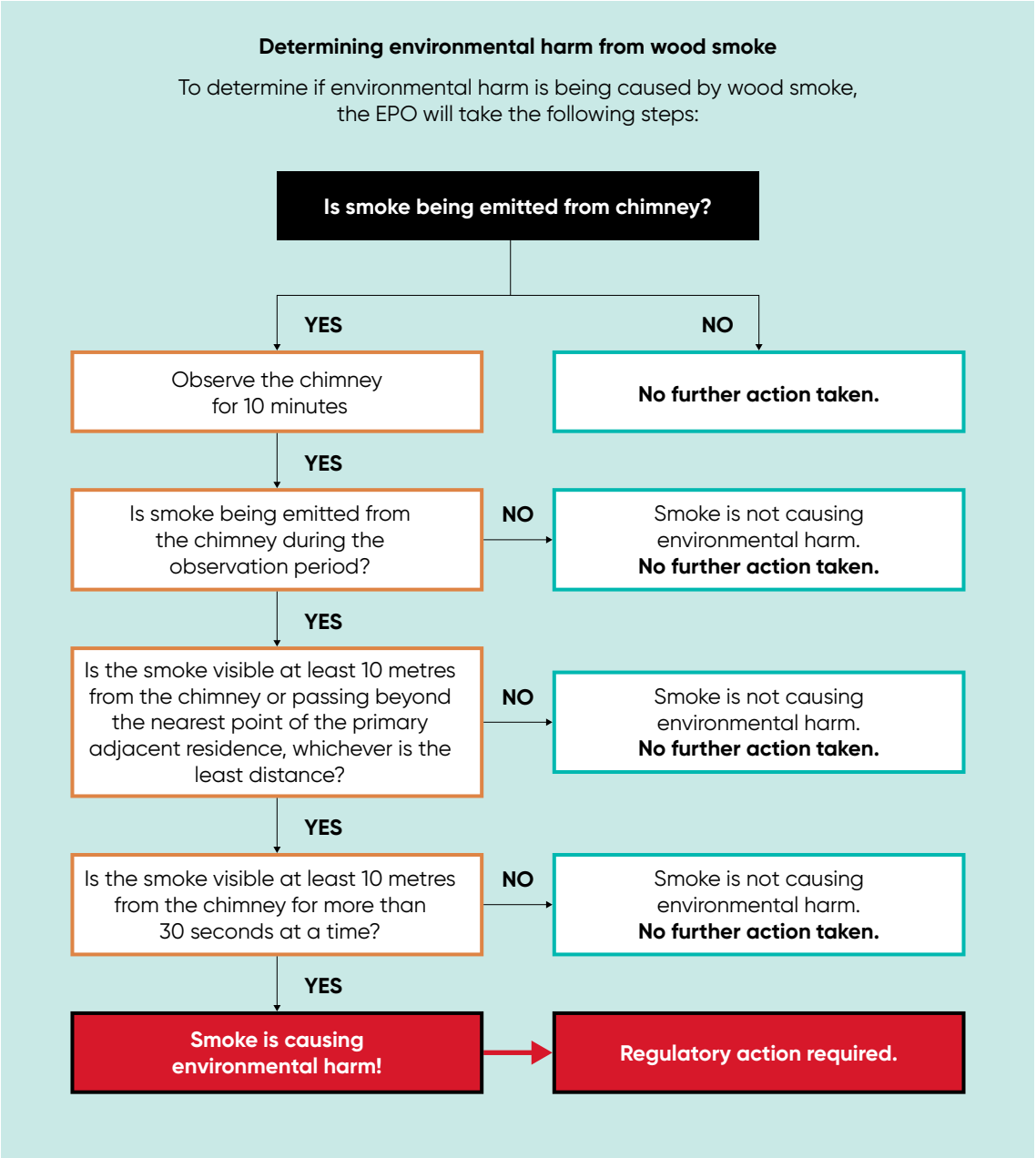

Figure 4 Flow chart showing the steps that an EPO will take to determine if environmental harm is being caused by wood smoke[64]. Chart has been re-published from the Access Canberra website without alteration to text.

If an offence against the Environment Protection Act or the Regulation has been committed, the EPO may issue an Infringement Notice of $120. If the matter is taken to court, the maximum penalty is $1600. The established approach of the EPA, as per the EPA's Compliance and Enforcement Guideline 2016[65] and the General Environment Protection

64 ACT Government, Access Canberra. Smoke and odour complaints from wood heaters, https://www.accesscanberra.act.gov.au/s/article/air-pollution-tab-smoke-and-odour-complaints-from-wood-heaters. Accessed 29/10/2022.

65 ACT Government, Environment Regulation & Protection Compliance & Enforcement Guideline 2016, https://files.accesscanberra.act.gov.au/legacy/3201/Environment%20regulation%20and%20protection%20compliance%20and%20enforcement%20guideline%202016.pdf. Accessed 30/11/2022.

Policy 2016,[66] is to only issue an infringement notice after education and warnings have not been successful, and the person persists in operating their wood heater in a manner that causes environmental harm. However, infringement notices will be issued if blatant disregard for the environment is observed.

5.1.2 *Environment Protection Regulation 2005*

The *Environment Protection Regulation 2005* (the Regulation) sets standards and rules pertaining to, amongst other matters, the environment and regulation of air quality in the ACT. The regulation stipulates in section 10 that it is an offence to burn certain substances such as plastics, painted wood, or chemically treated or contaminated wood.

Firewood merchants are required to comply with the conditions set out in section 14 of the Regulation and the EPA has communicated these conditions to wood merchants operating in the ACT.[67] It is considered an offence for a firewood merchant to sell firewood that does not meet the stipulated conditions. These conditions are as follows:

- If practicable, each buyer must be offered a choice of mixed wood loads;
- Wood must be offered and supplied by weight, not by volume;
- Each buyer must be provided a written statement of the weight of the load supplied;
- If the load is a mixed wood load – the buyer must be given a written statement of the approximate weight of hardwood and softwood in the load;
- Unseasoned wood must not be supplied;
- Each buyer must be given a pamphlet supplied by the environment protection authority that sets out recommended wood burning practices and encourages compliance with those practices;
- Each buyer must be given the following information: the common name and species of the wood; the place from which the wood was originally taken; the kind of wood;
- An annual report for a reporting year must be given to the EPA by 31 January in the year following the reporting year and as such, the EPA possesses information on firewood usage based on the annual reports submitted by merchants under section 14 of the *Environment Protection Regulation 2004*;
- Wooden sleepers must only be obtained from a wholesaler who supplies sleepers in the ACT with the agreement of the Chief Health Officer and the EPA;
- The sale or supply of wooden sleepers must be accompanied by an information sheet, agreed with the EPA, about the risks of burning sleepers, including that sleepers should not be burnt in open fires or for cooking.

As per section 14A of the Regulation, firewood merchants are required to gain written agreement by the EPA or the Chief Health Officer to sell or supply potentially painted, chemically treated or contaminated firewood.

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66 ACT Government, General Environment Protection Policy: Environment Protection Authority May 2016, https://files.accesscanberra.act.gov.au/legacy/3203/General%20environment%20protection%20policy.pdf. Accessed 30/11/2022.

67 The EPA has emailed information to wood merchants operating in the ACT, informing them of the requirement to ensure that only well-seasoned wood be sold. Unseasoned wood is defined as containing more than 20 per cent moisture. Twelve wood merchants have received the information, together with brochures to provide to customers at every wood purchase. Five of the wood merchants have depots, which are all inspected, and firewood tested by EPA to ensure compliance with the seasoning requirements.

Individuals are required under section 12 to take all steps that are practicable and reasonable to prevent, or minimise if prevention is not possible, any environmental harm caused, or likely to be caused, by the emission of pollutants into the air from indoor fires.

5.1.3 Air Environment Protection Policy

The Air Environment Protection Policy was created to provide supplementary information and policies relating to the management of ambient air quality and pollutant emissions in the ACT. It also serves to help people comply with the legal requirements of the Act and Regulation as well as the general environmental duty, which requires people to take reasonable and responsible steps to minimise environmental harm.

The policy echoes the restrictions on substances which may be burnt in accordance with section 10 of the Regulation, and the restrictions on the types of solid fuel burning equipment which can be sold in the ACT in accordance with Part 2.4 of the Act.

The policy outlines clear steps that people can take to prevent or minimise environmental harm caused by the emission of pollutants from the use of wood heaters, which stands in accordance with section 12 of the Regulation. These steps include: 1) using kindling, fire starters and paper to start a fire rather than using large pieces of wood; 2) keeping the air control fully open when adding larger pieces of wood to the fire; 3) stacking wood in the fire box to allow adequate air flow; and 4) maintaining sufficient air flow to keep the fire burning and to avoid incomplete combustion and excessive smoke.

5.1.4 Bushfire smoke and air quality strategy

The *ACT Bushfire Smoke and Air Quality Strategy 2021–25* (the Strategy), which was released following the 2019–2020 Black Summer bushfires, sets out a whole-of-government approach to better understand and manage the impacts on air quality from bushfire events and smoke from wood heaters. The requirement and focus for the strategy were in response to an agreed motion of the Legislative Assembly tabled in 2020.

The strategy identifies eight objectives to direct ACT Government actions between 2021 and 2025, of which objective two focuses specifically on strengthening measures to address air quality impacts from wood heaters. Under this objective, the strategy identifies the suite of existing programs, policies and regulations implemented within the ACT to minimise pollution from wood smoke and commits to reviewing these measures to ensure they better support air quality. Additionally, the strategy commits to using air quality data to inform current and future actions and initiatives on wood heaters.

There are notable shortcomings within the strategy in that it only addresses the Territory-wide air quality impacts of wood heater smoke and not the individual health impacts. The strategy acknowledges that wood heaters are largely responsible for increased $PM_{2.5}$ during the winter months in the ACT and identifies the severe health-related impacts of particulate matter pollution. Despite this, there are no specific actions outlined to respond to the individual health impacts of wood heater smoke exposure. Objective six of the strategy — 'support the health and wellbeing of Canberrans affected by bushfires and wood smoke' — focuses on the provision of health care services in response to bushfire events but makes no reference to the health impact of wood heater smoke.

5.2 Wood heater programs

5.2.1 'Burn Right Tonight' program

The 'Burn Right Tonight' program is a public education campaign that aims to educate the ACT community on the correct use of wood heaters to reduce emissions and the associated impact on air quality and the health of the ACT community.[68]

The program acknowledges that "Smoke from domestic wood heaters is an environmental and health issue, linked to several serious health conditions including asthma, chronic lung disease, heart problems and premature births and deaths. In winter, smoke from domestic wood heaters is the main source of air pollution".

The program, which has run every winter since 2011, promotes simple key steps on the efficient use and maintenance of wood heaters to minimise the smoke it emits. The tips include:

- Have your flue swept by a professional chimney sweep ahead of the winter season.
- Buy wood from a reputable firewood merchant that is dry, well-seasoned and untreated and store in a well-ventilated covered space.
- Always start fires with the air control fully open and use plenty of kindling.
- Place logs in the firebox with enough space between them to allow good air flow.
- Use smaller logs when refuelling and allow the fire to burn on high for 20–25 minutes.
- Don't overfill your heater with wood.
- Don't let your fire smoulder overnight. Make sure to keep the air control open enough to maintain a flame (fire set on low causes excessive smoke pollution).

The campaign is disseminated through the Environment, Planning and Sustainable Development Directorate (EPSDD) — Environment website and various ACT Government social media channels, while residents can access relevant information by ringing Access Canberra. To date, there is no available data to indicate the reach and effectiveness of the campaign.

Paradoxically, some experts believe that focussing on messages about how woods can be used in a less damaging way actually increases the likelihood that people will continue to view them as a safe option. In a 2021 interview with the Australian Medical Journal, Dr Dorothy Robinson reflected that:

> *People take their attitudes and they understand the harms of something from the attitudes of government…the question that they asked was "well if this is so harmful to health why haven't governments and Council done anything about it?" That really is the clincher as far as many people are concerned – [they think] if it's legal, it must be safe.*[69]

Dr Robinson goes on to make a comparison between wood heater smoke and tobacco smoking and drink driving, stating that many people did not take the risks from those activities seriously until after they became illegal.

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68 ACT Government, EPSDD, 2022. Wood fire heating, https://www.environment.act.gov.au/environment/residential/wood-fire-heating. Accessed 29/10/2022.

69 Australian Medical Journal, 2021. MJA Podcasts 2021 Episode 32: Wood heater pollution and its associated risks with Dr Dorothy Robinson, https://www.mja.com.au/podcast/215/4/mja-podcasts-2021-episode-32-wood-heater-pollution-and-its-associated-risks-dr.

5.2.2 Wood Heater Replacement Program

The Wood Heater Replacement Program commenced in 2004 to provide financial incentive to encourage ACT residents to remove wood heaters and replace with an energy efficient alternative.[70] There are a range of rebates available to eligible residents, ranging from $250 to remove wood heaters, and up to $1250 for removing a wood heater and installing a ducted electric reverse-cycle system. The program is complemented by the *2021 Sustainable Housing Scheme*, which provides zero-interest loans between $2000 and $15,000 to support eligible homeowners to purchase energy-efficient products to reduce emissions and energy costs.[71] However, there are limitations with this scheme —it is only accessible to homeowners not renters.

Under the program, 1255 wood heaters were removed between its beginning in 2004 and 30 June 2022, including 31 rebates between 1 July 2020 and 7 May 2021 to replace or remove wood heaters.[72] It is unclear how many new wood heaters have been installed during this period. Informal reports suggest that sales and installations of new wood heaters have increased in the most recent years, possibly due to increased rates of working from home due to COVID-19 and increased gas and electricity costs.[73],[74] It is also unclear how accessible this program is for lower income households given the financial hurdle of the required upfront payment of costs and subsequent reimbursement.

5.2.3 Suburb-wide wood heater restrictions

The installation of wood heaters has been restricted in several suburbs across Canberra including Dunlop, East O'Malley, and the Molonglo Valley (except Wright) where planning studies show that they would have an adverse impact on air quality.

The Molonglo Valley Air Quality Assessment[75] conducted during the planning phase of the development found the area to experience weather inversions in winter similar to Tuggeranong Valley. The report identified that the primary risk to air quality from the development was particulate matter from wood heaters and bushfires. It recommended the ban of wood heater use in the area.

70 ACT Government, 2021. Wood Heater Replacement Program, https://www.climatechoices.act.gov.au/policy-programs/wood-heater-replacement-program. Accessed 29/10/2022.

71 ACT Government, 2021. Sustainable Household Scheme, https://www.climatechoices.act.gov.au/policy-programs/sustainable-household-scheme. Accessed 28/10/2022.

72 ACT Government, 2021. Use wood heaters correctly for safe, clean air, https://www.cmtedd.act.gov.au/open_government/inform/act_government_media_releases/vassarotti/2021/use-wood-heaters-correctly-for-safe,-clean-air. Accessed 28/10/2022.

73 Coleman, J., 2021. Roaring demand for wood heaters as the price of electricity burns holes in pockets, Riotact. https://the-riotact.com/roaring-demand-for-wood-heaters-as-the-price-of-electricity-burns-holes-in-pockets/482215. Accessed 24/10/2022.

74 Le Lievre, K., 2018. Wood fires still popular in Canberra despite suburban bans, The Canberra Times. https://www.canberratimes.com.au/story/6021798/wood-fires-still-popular-in-canberra-despite-suburban-bans/. Accessed 24/10/2022.

75 ACT Planning and Land Authority 2021, Molonglo Valley: Air Quality Assessment, https://files.accesscanberra.act.gov.au/legacy/3224/Molonglo%20Valley%20air%20quality%20assessment.pdf. Accessed 25/11/2022.

Case studies: Wood heater impacts on Canberra community members

While the broad environmental and health issues relating to wood heater smoke are described in the previous sections, the severity of the impacts of smoke on the Canberra community requires further discussion. In the following case studies, the experiences of two community members are presented. Both people have extensively communicated with OCSE and government representatives about their experiences.

CASE STUDY 1: Reported experiences of actual harm vs policy definitions of harm

Photo supplied by Mr A of smoke from neighbour's chimney

Mr A has lived in his north Canberra home for over 40 years, and was never bothered by woodsmoke until 2018, when he believes one of his neighbours burned some old window frames in his wood heater. Mr A reports that thick brown smoke smelling of burned plastic blew across his property for hours at a time.

Mr A talked to his neighbour about the unwanted smoke and odour, and while the neighbour initially seemed sympathetic, he did nothing to change his habits. At times the smoke caused irritation to Mr A's eyes and a tightness in his throat, causing him to cough whenever he went outside, and the smell made him feel nauseous. By the end of winter, Mr A found that he had to stay inside for most of the day and was unable to enjoy his usual pastimes of tending his garden or working in his carport restoring his car.

The problem smoke returned in autumn 2019, as it has done every year since. Mr A believes that now his neighbour has found a cheap or free source of fuel he habitually uses this to supplement his purchased firewood and may have stopped buying firewood altogether.

Increasingly forced to stay indoors, Mr A found that the smoke was making its way into his home even when he kept all doors and windows tightly closed. To try to remedy this, he had his windows and doors sealed with rubber and has fitted plastic sheets over the inside of his windows in an effort to keep the smoke from seeping in. His reverse cycle air conditioner has been sealed off to prevent smoke and odour being drawn into his main living area. He has also stopped up the internal floor vents of his ducted heating system to reduce the circulation of smoke through the house. Unable to use

his central heating, Mr A has spent thousands of dollars on portable oil heaters and an expensive new split system with a double air filter, which is installed on the wall of his house furthest away from his neighbour's house. These measures allow him to heat only a few rooms at a time.

When Mr A's attempts to talk to his neighbour about the problem were ignored, he began reporting the smoke problem to the EPA via the Access Canberra call centre. He did this consistently through the winters of 2019 and 2020, spending many hours on the phone. Although EPA staff visited the house on several occasions and collected photo and video evidence from Mr A, their process for determining environmental harm from wood heater smoke (refer to **Figure 4**) meant that they were unable to conclude that any harm was being caused. Mr A believes his neighbour realised that EPA staff did not attend callouts after dark and subsequently changed his habits, now only lighting his wood heater at dusk. When the burning started again in 2021, Mr A was informed that his case had been closed and the evidence he had submitted in previous years could no longer be considered. He would have to start the process again each year.

Mr A suffers from a chronic respiratory condition which he has managed since 2013 through medication and careful monitoring. Since 2020 he has been admitted to hospital on several occasions due to severe lung infections. He is now supplied with oxygen by ACT Health due to his breathing difficulties. In spite of his efforts to talk to his neighbour and work with the EPA, Mr A is still being impacted by the problem of wood heater smoke. Within the current policy setting, it appears that the right of a citizen to use a wood heater is held more highly than the right of a citizen to clean air in their own home.

CASE STUDY 2:
A district-wide pollution problem

Photo supplied by Mr B showing smoke over local area and emerging from chimneys

Mr B moved to a new home in Tuggeranong in March 2021 with his wife and two young children, aged four and one. One evening, around a month after they had moved in, they smelled smoke in their house and at first thought that something was on fire. However, they soon realised that the smoke inside their home was coming from wood burning heaters across the neighbourhood. The problem became more severe as the year progressed; from April to late November, their house was filled with wood heater smoke almost every night.

On some occasions, the air quality in the children's bedrooms was so poor that their parents sent them to stay at their grandparents' house to protect them. Mr B's eldest child has asthma, and he and his wife worry constantly about the health consequences of their exposure to the polluted air inside their home. While Mr B does not have asthma himself, he developed a persistent cough during the wood burning season, which lasted until around December in 2021 and returned again in autumn 2022. He believes this is caused by being regularly forced to inhale smoke.

In addition to having to live with persistent concerns about their family's health, Mr B and his wife have spent a considerable amount of money trying to mitigate the problem smoke inside their home. They report that they have spent around $50,000 on new windows in the hope that sturdy frames and double glazing would help to prevent smoke from getting into their home. They also say they've spent several thousand dollars on air purifiers to try to reduce the smoke pollution inside the house. In addition to these upfront costs, they now have to pay higher energy bills as a result of running five air purifiers for 12+ hours per day for most of the year, and for replacement filters. Mr B recognises that he is in a very fortunate position in being able to afford these expensive measures. Many Canberrans would not be able to do this and would have to live with unmoderated smoke pollution in their homes.

Mr B has written to the ACT Health Minister and Environment Minister, as well as his MLAs. He reports that he has received almost unanimous agreement from them that wood heater pollution is a serious problem in Tuggeranong. However, within the current policy settings there is no action that can be taken to address wood heater smoke at the neighbourhood level. From Mr B's perspective, ACT Government education campaigns and heater removal programs are not making any difference to his family's situation and experiences of wood heater smoke pollution.

6. Summary

6.1 Effectiveness of wood heater policies

While the ACT Government is committed to strengthening wood heater emissions standards and phasing out older wood heaters that do not meet standards, this Investigation demonstrates that current policies, plans and strategies for managing wood heaters in the ACT are insufficient to protect human health and the environment of the Territory from issues arising from wood heaters. This evaluation of effectiveness focuses on issues around the impacts of wood heaters on people, as the detrimental environmental impacts of wood heater usage have been difficult to determine with any precision.

During this investigation, OCSE was advised by ACT Government officers that *"Members of the Canberra community are able to protect themselves from the risks of woodfire smoke by staying indoors"*.[76] Not only does this approach place an undue responsibility and unreasonable expectation on individual members of the Canberra community, but it is also manifestly inadequate. This inadequacy is highlighted in the December 2022 announcement of community-based safe refuges from smoke[77] that follows from the *ACT Bushfire Smoke and Air Quality Strategy 2021–22* which states on page 19 that "For many people it was impossible to keep smoke out of their homes" during the Black Summer bushfires of 2019–20. The ACT Government's measures to provide community smoke refuges for public health protection demonstrate its recognition that staying at home does not inherently provide protection from poor air quality. It does not make sense to claim that homes which are permeable to smoke from bushfires are impermeable to $PM_{2.5}$ pollution from wood heater smoke.

Insufficiencies in current policies are also revealed in aspects of the YourSay Panel Wood Heater Survey results, which demonstrate that air quality remains an issue for many respondents in the winter months.[78] Furthermore, it is clear that there has been an understanding among ACT policymakers of the risks posed by wood heater pollution in the ACT for decades. A 1991 discussion paper[79] produced by the ACT Legislative Assembly Standing Committee on Conservation, Heritage and Environment recognised that "*fine particulates in the inhalable range are a direct health risk, and that indirectly they affect health and well being through their effect on solar radiation and rainfall*".[80] It further notes that *"the potential health risk of pollutant emissions by solid fuel heaters is intensified by their near ground level release from the average suburban household chimney"*.

76 EPSSD response to OCSE draft Investigation report 30/11/2022.
77 https://www.canberratimes.com.au/story/8003048/community-clubs-to-serve-as-refuges-during-heat-and-smoke-events/
78 ACT Government, 2022. Wood heater survey, Your Say Panel. https://www.yoursay.act.gov.au/__data/assets/pdf_file/0009/2083851/YourSay-Panel-Wood-Heaters-Survey-Summary-Report.pdf.
79 ACT Legislative Assembly Standing Committee on Conservation, Heritage and Environment, 1991. A Discussion Paper on Fuelwood Heating in the ACT, https://www.parliament.act.gov.au/__data/assets/pdf_file/0010/379585/Discuss_paper-Fuel_wood_heating.pdf.
80 Ibid.

This Investigation has identified the following policy issues:

- **Inadequate emissions and efficiency standards:** Wood heater emissions and efficiency standards and best practice management are not sufficient. Current standards require heaters to comply with Australian/New Zealand Standards 4102 and 4103. The Centre for Air pollution, energy and health Research (CAR) notes that 'these standards are not designed to reflect the pollution emitted by heaters under "real world" operating conditions. Further, they are not systemically enforced, and regulation of the industry is inadequate'.[81] Even tightened standards are unlikely to reduce the smoke-related health impacts of wood heaters.[82]
- **Difficulty with enforcement of smoke standards:** Enforcing air quality at the source of emission is difficult. In the ACT, Environmental Protection Officers rely on a visual estimate of smoke (a visible smoke plume of a certain height above a chimney must be sighted to be classified as a breach). This sighting is heavily dependent on light levels and the peak smoke level varies throughout the day and night. The EPA approaches assessments through targeting other parameters such as wood storage and moisture content, operator knowledge and behaviour and wood heater installation and maintenance.
- **Education campaigns have not improved air quality to safe levels in winter:** There is limited evidence that Burn Right Tonight's focus on correct wood heater use has improved air quality in Canberra to a level where standards are not exceeded. Based on publicly available information on wood heaters and the Burn Right Tonight program, OCSE is concerned this may, perversely, have legitimised the use of wood heaters as safe when operated and maintained under these guidelines.
- **Wood heater replacement programs have not been effective:** There is limited evidence of the effectiveness of the Wood Heater Replacement Program in either improving air quality in the ACT or changing attitudes towards the appropriateness of wood heaters in an urban environment. Between the 2015–16 and 2021–22 financial years, only 179 wood heaters were removed from Canberra homes under this scheme, and 36 removals occurred in 2020–21. It is unknown how many additional wood heaters were installed during this period.
- **Wood heater suburb restrictions have been limited to some greenfield areas:** The installation of wood heaters has been restricted in several suburbs identified in the planning phase as likely to risk air quality in the area. Assessment documents from 2011 identify that the topographic specifics of the (then) to-be-developed Molonglo Valley have similarities with the Tuggeranong Valley, which is prone to air quality issues from wood smoke (see case study 2 for understanding of the community's experience of this). While wood heaters are restricted from installation in the Molonglo Valley, they can still be installed in Tuggeranong, and also in assessed problem areas of the Molonglo Valley with approval.

81 Centre for air pollution, energy and health Research, 2021. Position Paper: Reducing the health impacts of wood heaters in Australia, policy implications, https://www.car-cre.org.au/_files/ugd/d8be6e_a27f05a82f8c47378ffa9dcbacb6cc04.pdf.

82 See also https://www.epa.nsw.gov.au/~/media/EPA/Corporate%20Site/resources/air/WoodsmokeControlReport.ashx which notes that an "increase in the emission factor when in-service was approximately 2.5 times the certified level of grams per kilogram of fuel…for the operation of wood heaters outside testing parameters and the fact that wood heater owners do not generally operate the wood heater in an optimal manner."

6.2 The right to a healthy environment

A key point in discussion of wood heater usage is consideration of equity of energy efficiency and health outcomes for lower-income households. The economic considerations in wood heater usage require explication:

- It is a misconception that wood heaters constitute a more economic heating option compared with alternative options. While it is possible that the use of wood heaters may be the most economical heating option, in the vast majority of cases, electric heating options represent the cheapest method for home heating.[83]
- The overall use of wood heaters presents a substantial economic burden beyond their operation. The economic cost of wood heater use on human health is estimated at $3800 per wood heater.[84] Alternative estimates place that cost at over $10,000.[85]

More importantly, this health burden is disproportionately placed on lower-income households with limited options for self-supported transition to alternative heating types. Recent studies indicate that the health risks of wood heaters are comparable to passive smoking, which poses an unacceptable and unnecessary risk for lower-income households.[86] For the estimated fewer than five per cent of Canberra households that rely on wood heater usage for their primary heating source, providing funds to replace heating would require significantly less funding than the estimated overall health costs.[87,88]

This Investigation notes that significant changes in environmental protections will undoubtedly follow from the introduction of a right to a healthy environment in the *Human Rights Act 2004*. The ACT Government's 2022 consultation on this proposal asked the following questions:[89]

- What duties could be included for the Government and private entities to ensure respect for individuals' right to a healthy environment?
- What additional measures could be considered to ensure protection of a right to a healthy environment for vulnerable groups?

The specifics of the definition and content of this human right may impact the management of wood heaters in the ACT. The 2022 YourSay Panel survey found that while 11 per cent of respondents had wood heaters in their homes, only five per cent reported that these were used as the main source of heating for the house. This suggests that wood heaters are predominantly a lifestyle or aesthetic choice for over half of those who have them. This further underpins the inherent inequity in policy settings that prioritises the rights of a small proportion of people to burn wood over the health impacts at both a population scale and on an individual basis for those with respiratory and related health conditions.

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83 Centre for air pollution, energy and health research, 2021.
84 Asthma Australia, 2021.
85 Colyer, S., 2021. Wood heaters: lung cancer risk equivalent to passive smoking, The Medical Journal of Australia InSight+, https://insightplus.mja.com.au/2021/29/wood-heaters-lung-cancer-risk-equivalent-to-passive-smoking/. Accessed 20/10/2022.
86 Ibid.
87 A range of estimates have been published, including around six per cent in Romanach, L. & Frederiks, E., 2021. Understanding the Key Determinants of Residential Firewood Consumption in Australia: A Nationwide Household Survey, Energies. Vol.14(20), https://doi.org/10.3390/en14206777 and 14 per cent in Asthma Australia, 2021.
88 Australia Bureau of Statistics, 2014. Sources of Energy Used by Households, Environmental Issues: Energy Use and Conservation, https://www.abs.gov.au/ausstats/abs@.nsf/mf/4602.0.55.001. Accessed 20/10/2022.
89 ACT Government, YourSay Conversations, Right to a Healthy Environment, https://yoursayconversations.act.gov.au/right-healthy-environment

Forthcoming changes to the ACT's Human Rights Act

The Parliamentary and Governing Agreement of the 10th Legislative Assembly includes a provision to consider the inclusion of a 'right to a healthy environment' in the Human Rights Act 2004 (HRA) (PAGA 10th Assembly Appendix 2.[90]

In October 2021, The United Nations (UN) Human Rights Council passed a resolution recognising the right to a safe, clean, healthy and sustainable environment as a human right that is important for the enjoyment of other human rights. This resolution calls on all countries to build on efforts to protect the environment, and to adopt policies for the enjoyment of the right to a safe, clean, healthy and sustainable environment, including biodiversity and ecosystems.

The UN Special Rapporteur on Human Rights and the Environment outlines which substantive elements form part of the right to healthy environment. These include:

- clean air
- a safe climate
- access to safe water and adequate sanitation
- healthy and sustainably produced food
- non-toxic environments in which to live, work, study and play
- healthy biodiversity and ecosystems.[91]

Inclusion of a right to a healthy environment in the ACT's Human Rights Act means that impacts arising from government policy and legislation would have to be considered. These include policies and legislation relating to:

- land care
- resources and energy
- transport
- planning and development
- heritage and environment protection.

Recognition of the right to a healthy environment is not a new concept. It has been implemented in some form in many jurisdictions globally through a range in approaches. Most encompass three core ideas of i) a right to access environmental information, ii) public participation in decision-making and the iii) right to justice or remedy.

The right to a healthy environment comprises both **procedural** and **substantive** rights and duties that produce a healthier environment. A key procedural aspect of the right to a healthy environment is access to remedies from harm. The proposed inclusion of this right within the ACT's Human Rights Act has implications for the continued installation of and continued use of wood heaters, which are known to cause environmental harm.

In December 2022, the ACT Government announced its commitment to include the right to a healthy environment in the *Human Rights Act 2004* before the 2024 election.

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90 ACT Government, Chief Minister, Treasury and Economic Development Directorate, 2020. Parliamentary and Governing Agreement for the 10th Legislative Assembly, https://www.cmtedd.act.gov.au/__data/assets/pdf_file/0003/1654077/Parliamentary-Agreement-for-the-10th-Legislative-Assembly.pdf.

91 United Nations, 2020. Right to a healthy environment: good practices, Report of the Special Rapporteur on the issue of human rights obligations relating to the enjoyment of a safe, clean, healthy and sustainable environment A/HRC/43/53, https://documents-dds-ny.un.org/doc/UNDOC/GEN/G19/355/14/PDF/G1935514.pdf?OpenElement.

7. Recommendations

This Investigation has found many opportunities to build on the *Bushfire Smoke and Air Quality Strategy 2021–2025* and address wood heater smoke issues in the Territory. This whole-of-government strategy provides a starting point for bringing together and strengthening the air quality monitoring, policy and regulatory aspects of managing wood heaters. The following Recommendations are to assist the ACT Government in further improving air quality on the ACT.

Recommendations 5-7 apply to the interim period before wood heaters are phased out.

Phase out of wood heaters

1. Phase out wood heaters from ACT suburbs through the establishment of a target date for the replacement of wood heaters with electric alternatives in all ACT suburbs (excluding rural areas), as has been done for fossil-fuel gas. This should be supported through accessible financial support for lower income households.
2. Ban the installation of new wood heaters in all ACT suburbs (excluding rural areas), for both new and existing builds.
3. Establish a register of wood heaters in the ACT to determine the number and age of wood heaters.
4. Mandate the removal of wood heaters before a property in any ACT suburb (excluding rural areas) can be sold.

Education about wood heater risks

5. Introduce mandatory labelling explaining the health risks associated with wood heater usage at point of sale for both wood heaters and firewood in ACT
6. Include explicit messaging about the health risks associated with wood heater usage in ACT Government education and communication activities (e.g. Burn Right Tonight program).

Strengthen compliance

7. Develop and apply empirical criteria for determining environmental harm or nuisance from wood heater smoke, such as assessment of smoke composition and air quality monitoring at the affected sites, as part of EPA investigations.

2019 State of the Environment Report recommendations

8. Reconsider responses to the 2019 State of the Environment Report's recommendations 21 and 22:
   - 21 *Increase the number of National Environment Protection (Ambient Air Quality) Measure compliance monitoring stations, and*
   - 22 *Urgently undertake an assessment of air pollutant emissions from diffuse sources to update the National Pollutant Inventory data (1999).*