Regulatory Impact Solutions

Variation to the
Waste Management Policy
(Solid Fuel Heating)

POLICY IMPACT ASSESSMENT

Prepared for Environment Protection Authority Victoria

November 2017

POLICY IMPACT ASSESSMENT

Variation to the
Waste Management Policy (Solid Fuel Heating)

Authorised and published by Environment Protection Authority Victoria, 200 Victorian Street, Carlton, VIC 3053

This report was prepared for EPA Victoria by Regulatory Impact Solutions Pty Ltd.

Definitions of key terms

The Act	*Environment Protection Act 1970*
The Policy	Waste Management Policy (Solid Fuel Heating) 2004
The efficiency standard	AS/NZS 4012:2014 Domestic solid fuel burning appliances—Method for determination of power output and efficiency
The emissions standard	AS/NZS 4013:2014 Domestic solid fuel burning appliances—Method for determination of flue gas emission
The proposed action	To vary the Waste Management Policy (Solid Fuel Heating) 2004 to adopt the efficiency standard as a mandatory requirement in Victoria. (The Policy already incorporates the emissions standard.)
AHHA	Australian Home Heating Association—the peak industry body representing over 250 manufacturers, retailers, installers, maintenance companies of the home heating industry
CRIS	*Consultation Regulation Impact Statement for Reducing Emissions from Wood Heaters* released by the National Environment Protection Council Service Corporation in April 2013
Efficiency	The ratio of useable heat energy output to the chemical energy input (gross calorific value of fuel load), as measured and calculated in accordance with AS/NZS 4012:2014
EPA	Environment Protection Authority Victoria
NCAA	National Clean Air Agreement (December 2015)
Particulate emission factor	The amount of particulate matter emitted (in grams) from burning 1 kilogram of dry fuel, as measured and calculated in accordance with AS/NZS 4013:2014
PIA	Policy Impact Assessment *(this document)*
PM	'Particulate matter' is a term used to describe liquid or solid particles suspended in the air. It can be a primary pollutant (from emissions) or a secondary pollutant (resulting from atmospheric reactions on primary pollutants). An index in the term refers to a maximum size in micrometres of the particles. For example, PM_{10} refers to particulate matter smaller than 10 micrometres in diameter; $PM_{2.5}$ refers to particulate matter smaller than 2.5 micrometres.
PPAQCR	Port Phillip Air Quality Control Region – the airshed that covers greater Melbourne and Geelong (see Appendix A for map)
Solid fuel heater	More commonly referred to as wood heaters. Domestic solid fuel (wood) burning appliances, including space-heating appliances. It does not include site-built masonry appliances (e.g., open fireplaces), central heating appliances, cooking appliances, appliances intended solely for heating water, and some other exclusions.
SEPP	State Environment Protection Policy, a declaration of policy made under the Environment Protection Act.
NEPM	National Environment Protection Measures, a special set of national objectives designed to assist in protecting or managing particular aspects of the environment.
NO_X, NH_3, SO_X, VOCs	Oxides of nitrogen (NO_X), ammonia (NH_3), sulphur oxides (SO_X) and volatile organic compounds (VOCs). These are types of air pollutants.

Summary

Solid fuel heaters (or wood heaters) are a contributor to air pollution—in particular pollution known as particulate matter which is known to cause significant adverse health impacts. There is no evidence of a level of particulate matter (PM) where health effects do not occur, and therefore actions that reduce emissions—in this case from wood heaters—can result in improved health outcomes. There is already a range of actions taken at the national, state and local government level to reduce particulate emissions from wood heaters, although the extent of emissions is still significant. This Policy Impact Assessment (PIA) quantifies total health costs from PM emissions from the use of wood heaters in Victoria at over $8 billion over the next ten years, or $5.8 billion in present value terms. Burning of wood for heating will remain one of the largest contributors of non-natural sources of PM emissions over the next ten years, due to the number of wood heaters already in Victorian homes.

In Victoria, the Waste Management Policy (Solid Fuel Heating) already incorporates the Australian Standard AS/NZS 4013:2014 that limits the emissions factor of wood heaters (the amount of PM emitted per kilogram of wood burnt). The EPA is proposing to vary the Policy to formally adopt the Australian Standard for wood heater efficiency (AS/NZS 4012:2014) in Victoria ("the proposed action"). This will require all wood heaters newly manufactured or supplied in Victoria after the adoption of the Standard to have a minimum certified efficiency of 55 per cent from the time the standard is adopted, and of 60 per cent from August 2019. A higher efficiency level means burning less wood to achieve the same heat output, thereby working with the emissions factor standard to control the total PM emitted from using wood heaters.

One priority issue in the National Clean Air Agreement is reducing the adverse health impacts of particulate matter from wood heaters. The incorporation of the standard into the Policy, the objective of the draft variation to the Policy, gives practical effect in Victoria to measures agreed under this priority issue.

The proposed variation is estimated to result in a net benefit over the next ten years of $33 million (NPV). This reflects, in present value terms, a benefit of $33.2 million, and costs of $180,067 to industry to meet the standard, and $32,820 in additional costs to government to enforce the new standard. This compares to other options assessed in this PIA as follows (all figures over 10 years, net present values):

	Proposed action – adopt efficiency standard	**Alternative – tighten emission factor standard to 1g/kg**	**Alternative – increase replacement rate of existing heaters**
PM emissions avoided (tonnes)	671	674	11,241
Value of avoided emissions	$33,171,837	$30,197,783	$521,873,961
Costs	$212,887	$2,143,957	$58,996,108
Net benefit	$32,958,950	$28,053,826	$462,877,853
Benefit-cost ratio	155.8	14.1	8.8
Cost effectiveness (cost per tonne of PM avoided)	$317.43	$3,179.83	$5,248.28

All impacts are relative to the 'base case' of taking no further action beyond the current Policy (which incorporates the emissions standard that requires a maximum emissions factor of 1.5g/kg from 2019) and existing actions to promote awareness of wood heater emissions and information to reduce emissions (including activities undertaken by industry and local councils).

The proposed action is superior to tightening the emissions factor standard to 1g/kg (i.e., to achieve the same reduction in PM emissions). While taking actions to increase the replacement rate of existing heaters has a higher net benefit in dollar terms, this is only because of the scale of the option; it has the worst benefit-cost ratio and the highest cost per tonne of PM avoided. There are also legal and practical limitations on EPA's power to mandate such increased replacement of existing heaters.

An option to ban the supply of new wood heaters was also assessed. It was found that there is a high likelihood that this option would not achieve any additional reduction in PM emissions over ten years relative to the business as usual case, as households who would have otherwise replaced their heater with a more efficient new heater may instead keep using a low-efficiency, high-emitting heater. If 50 per cent of households that would have naturally replaced their existing heater instead keep it for a further 5 years as a result of the ban on new heaters, there would be no reduction in PM emissions over ten years.

An option to require new heaters to have a star rating label was also considered. The label (separate to the compliance plates required under the efficiency and emission standards) would reflect total PM emissions associated with using the heater under typical household heating conditions, and take account of both efficiency and emission factor performance. A labelling scheme would be costly for businesses and the EPA to administer. To achieve the same level of PM emission reductions as the proposed action, the labels would need to lead to significant behavioural change. There is no reliable evidence that such a change could be expected, particularly because the label would only indicate relative emissions performance and not—as is with the case of similar water or energy efficiency labelling—the cost to the owner of using the appliance.

The proposed action is expected to result in an increase in the average price paid for new wood heaters in the short term. This is estimated at around $6 per heater, due to manufacturers recovering costs of redesigning and retesting heaters to make them compliant, and some non-compliant imported models no longer being available.

With costs passed on to consumers in this way, households in regional Victoria would bear 85 per cent of the costs (excluding EPA costs) as this is where most of new wood heaters are installed. However, regional Victoria is expected to enjoy only 44 per cent of the benefits of reduced PM emissions, as PM emissions have lower health impacts in areas of lower population density. Despite this imbalance in the share of costs and benefits, all areas are expected to have a net benefit.

The proposed action will have a material impact on competition, by directly restricting the heaters able to be sold. Most wood heaters currently available already meet the 55 per cent efficiency standard, although a material number do not meet the 60 per cent efficiency standard (required from August 2019) and will require manufacturers to change their designs and manufacture processes in order to make all heaters comply with the 60 per cent level. It is likely that some models will be discontinued if it is too costly or too difficult to achieve compliance. These impacts are considered justified based on the expected net benefit of adopting the standard, and that the proposed action is assessed as being the most cost-effective means of achieving the desired objective. It is also relevant that all other jurisdictions are adopting the standard, thus the proposed action creates a level playing field across Australia.

The impacts may be disproportionately larger for smaller manufacturers, if they have a larger proportion of their product lines that need to be made compliant, have smaller research and development (R&D) capability, and have fewer sales over which costs can be recovered. This relative disadvantage would also affect the level of competition. EPA has consulted with industry representatives and a number of manufacturers and is not aware of any manufacturers that are not either already compliant with the proposed standard, or are taking steps to achieve compliance in line with the adoption of the standard in all other states. The actual impact on small businesses in Victoria is expected to be very minor.

Incorporation of the efficiency standard means that if the standard is changed in the future, any change will automatically become part of the Victorian Waste Management Policy requirements. The efficiency standard was reviewed and amended in 2014, and is not expected to be reviewed again in the foreseeable future. There is a rigorous process for changing the standard at the national level, including consultation with industry and state governments. In particular, there will be the opportunity for EPA to assess the impact of any proposed changes to the standard on Victoria, and if need be, review the inclusion of the standard in the Policy.

Under the Act, waste management policies are required to be reviewed at least every ten years. The Independent Inquiry into the EPA and Government response commits to an overhaul of the Environment Protection Act to deliver a modern, fit for purpose legislative framework. It recommends a significant legislative reform agenda including a recommendation to replacing waste management policies with a simplified approach to standard setting. The proposed revision of the Act and legislative framework may provide a further opportunity to review the Policy before the statutory 10-year review period.

Table of contents

1. Background to this Policy Impact Assessment

The EPA is responsible for activities relating to the discharge of wastes into the environment, and protecting and improving the quality of the environment. It does this through exercising a range of functions and powers under the *Environment Protection Act 1970* ("the Act") and its related policies.

Waste Management Policies may be declared under section 16A of the Act. Part VI of the Act requires discharge or emission of wastes into the atmosphere to be in accordance with declared waste management policies, with penalties applying for non-compliance. EPA may also issue a pollution abatement notice for non-compliance with a Waste Management Policy.

In December 2015, national Environment Ministers established the National Clean Air Agreement (NCAA). Environment Ministers agreed upon three key initial actions under the Agreement, one of which was measures to reduce air pollution from wood heaters, including the adoption of new emission and efficiency standards for new wood heaters. New Australian standards for wood heater efficiency (AS/NZS 4012:2014) and emissions (AS/NZS 4013:2014) had been developed by Standards Australia in 2014, in consultation with industry and governments. The NCAA Initial Workplan (2015-17) required all jurisdictions to implement actions to address wood heater emissions.

Victoria has incorporated the emissions standard into the Waste Management Policy (Solid Fuel Heating) since 2004. It is now proposed to vary the Policy to incorporate the efficiency standard.

The Government response to the Independent Inquiry into the EPA supports the recommendation for a comprehensive overhaul of the Act to deliver a modernised, fit for purpose legislative framework. Given this broader context and prospect for significant legislative changes, this is not a comprehensive review of the Policy. This PIA assesses the impact of adopting the efficiency standard in Victoria, as part of ministers' NCAA commitment.

Before a Waste Management Policy can be varied, the Act requires the EPA to:

The notice of intention to vary the Policy was published in April 2017. Five submissions were received and have been considered by the EPA. The EPA has now prepared a draft variation of the Policy for affected parties to review. Affected parties may make submissions to the EPA on the draft variation by for a period of three months after the publication of the last notice of the preparation of the draft policy.

To assist parties to comment on the variation, the Act requires the preparation of a Policy Impact Assessment (PIA), to be made available with the draft variation of the Policy. A PIA must include:

- a statement of the purposes of the variation of policy
- an identification of the different means by which the purposes of the variation of policy can be achieved including the alternative of not varying the existing policy
- an assessment of the possible financial, social and environmental impacts of each alternative in qualitative and, to the extent practicable, quantitative terms to ensure that the costs are not disproportionate to the benefits.

By agreement with the EPA, the Commissioner for Better Regulation provides an independent assessment of PIAs, to be assessed (as far as applicable) against the *Victorian Guide to Regulation*. The Commissioner has determined that this PIA meets the requirements of the Act.

Following consideration of submissions received in response to the draft variation, this PIA will be revised to reflect any changes and given to the parliament's Scrutiny of Acts and Regulations Committee, together with a summary and evaluation of the submissions received and explanation of any changes made to the variation of policy resulting from the consideration of the submissions.

2. What is the problem being addressed?

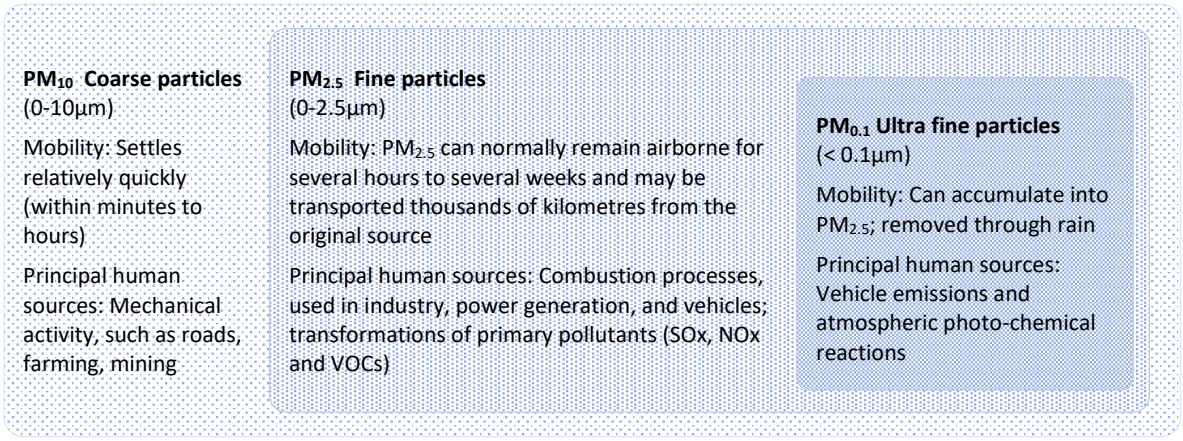
This section of the PIA discusses the evidence supporting the need for action. It finds that wood heaters are a significant contributor to air pollution—in particular, pollution known as particulate matter which is known to cause significant adverse health impacts. There is no evidence of a level where health effects do not occur, and therefore actions that reduce emissions—in this case from wood heaters—can result in improved health outcomes. There is already a range of actions taken at the national, state and local government level to reduce emissions from wood heaters, however, significant emissions still remain.

Particulate matter and known health impacts

High levels of air pollutants have been shown to result in a wide range of adverse health and visual impacts on society. Health effects associated with air pollution include respiratory and cardiovascular effects, ranging in severity from coughs, chest congestion and asthma to chronic illness and possible premature death in susceptible people. Numerous studies have reported an association between hospitalisation and short-term exposure to particles (i.e., exposure to air particles on day of hospital admission or several days before).

Particles are emitted from a wide range of sources. Particles are measured using their aerodynamic diameter and range in size from 0.001 to 500 micrometres (µm) in diameter. Different particle sizes behave differently both in the atmosphere and the human respiratory system. Particles larger than 10µm do not usually enter the human respiratory system. Smaller particles are more easily inhaled with a potentially stronger impact on human health. Figure 1 below sets out the categories of particulate matter by size, differences in mobility and principal human sources.

Figure 1: Categorisation of particulate matter



Particulate matter is associated with adverse health effects in humans, especially respiratory and cardiovascular effects and was classified as a human carcinogen by the International Agency for Research on Cancer in 2013.[1] Particles are easily inhaled and can be retained in, or absorbed through, a person's lungs. The health effects of particle exposure include increased mortality rates, cardiopulmonary disease and reduced lung function. PM_{10} and $PM_{2.5}$ are associated with increases in mortality and morbidity, with much stronger evidence now for cardiovascular outcomes. PM_{10} can settle in the bronchi and lungs and cause health problems. Similarly, $PM_{2.5}$ tend to penetrate into the

[1] International Agency for Research on Cancer (2013). Press release 221: Outdoor air pollution a leading environmental cause of cancer deaths. Retrieved 6 August 2017 from https://www.iarc.fr/en/media-centre/iarcnews/pdf/pr221_E.pdf

gas exchange regions of the lung, and very small particles (less than 100 nanometres) may pass through the lungs to affect other organs.

An EPA study[2] of air quality and hospital admissions in 2001 found that, for data from 1994 to 1997, ambient levels of air pollution are associated with increases in daily hospital admissions for respiratory and cardiovascular conditions in Melbourne. Fine particles in Melbourne are associated with hospital admissions for respiratory disease for all age groups. Strong associations were also found for admissions for asthma in children (0–14 years) and all age groups. Admissions for cardiovascular disease, particularly for the elderly, and ischaemic heart disease were also strongly associated with exposure to particles.

Some recent studies have quantified the health effects of particulate pollution. For example, in Sydney, Melbourne, Brisbane and Perth, annual mortality attributable to current long-term $PM_{2.5}$ exposures above background is estimated to be equivalent to approximately 1,590 deaths at typical ages.[3] A 10µg/m^3 elevation in $PM_{2.5}$ concentration was associated with a 1 per cent increase in the daily total number of deaths.

There is no evidence of a concentration threshold for exposure to PM_{10} or $PM_{2.5}$ where adverse health effects have not been observed.[4] Even low levels may have an adverse impact on human health, and the impacts can be both immediate and long term.[5,6]

Health benefits from lower emissions will vary between regions due to climatic, meteorological, demographic and population exposure factors. Within Victoria, the health impacts of particulate matter emissions are more severe within the Port Phillip Air Quality Control Region (PPAQCR) airshed (see Appendix A) due to higher concentrations of both emissions accumulated and population exposed.[7]

Population growth increases the extent of the harms, as a larger population creates a higher volume of particulate matters (e.g., more households using wood heaters), as well as increasing the number of people exposed to a given pollution concentration. Our population is also predicted to age significantly. This is important because people aged over 65 years are known to be more sensitive to air pollution.

[2] EPA Victoria, 2001, *Ambient Air Pollution and Daily Hospital Admissions in Melbourne*

[3] Simpson R, Williams G, Petroeschevsky A, Best T, Morgan G, Denison L et al. The short-term effects of air pollution on daily mortality in four Australian cities. *Australian and New Zealand Journal of Public Health* 2005; 29: 205–12.

[4] University Centre for Rural Health, North Coast (2013), *Summary for Policy Makers of the Health Risk Assessment on Air Pollution in Australia*, Prepared for the NEPC, Canberra, Australia.

[5] Carey, M. and Dennekamp, M. Air quality and chronic disease: why action on climate change is also good for health, *NSW Public Health Bulletin* Vol. 21(5–6) 2010.

[6] Climate and Health Alliance, Submission to Senate Standing Committee on Community Affairs, Inquiry into the impacts on health of air quality in Australia, March 2013.

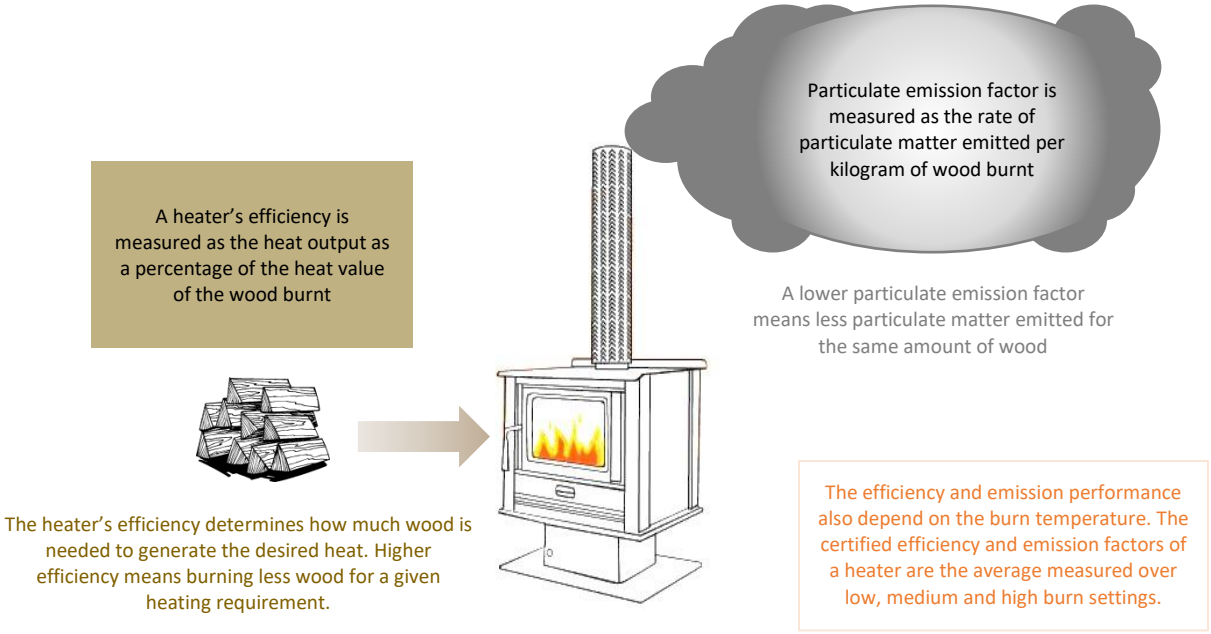
[7] The use of the 'airshed' concept in this PIA does not imply that emissions of particulate matter affect the entire area. The analysis in this PIA is not based on modelling of air quality within an airshed, but only emissions from heaters. Particulate matter from solid fuel heaters often does not easily disperse (contributing to its risk of harm), and only has a localised impact. For this PIA, the PPAQCR provides a convenient way to group areas where there are different geographic concentrations of heaters and population, that is relevant for assigning values to localised emissions.

Wood heaters and particulate matter

Wood heating has long been a popular form of heating in Victoria for social, economic and environmental reasons. Many households prefer the ambience provided by a wood fire that cannot be replaced by gas heating, and some consumers consider wood fires decorative and believe they provide a level of comfort and homeliness.[8] Wood heating is likely to be a cheaper option in non-urban areas of Victoria where fuel costs are lower (e.g., a significant proportion of wood heater users source free wood fuel through scavenging) and in areas that do not have gas reticulation. In very cold areas, heat pump heating is less efficient.

Wood heaters emit particulate matter and other pollutants. This is a result of the combustion process of burning wood. The amount of particulate matter emitted from using a wood heater depends on its *efficiency* and its *particulate emission factor*.

Figure 2: Emissions from wood heaters



In other words, the total emissions of particulate matter from using a wood heater are affected by both the heater's efficiency (how much wood is needed to be burnt to achieve a desired heat output) and its emission factor (the rate of emissions per kilogram of wood). The heater's efficiency and emission factor vary according to the design of the heater, and for a given heater vary according to the type of wood used and the temperature at which it is operated. Under standard testing methods, efficiency and emission factors are measured for consistent types of wood and averaged over different temperatures. A change to a heater design to improve the emission factor may result in a worsening of the efficiency, meaning total emissions may not change or may increase, and this is why the EPA considers that the emission standard should be retained alongside a new efficiency standard.

Efficiency and particulate emission factors are generally measured at the design stage, tested under specific laboratory conditions and methods. This includes specifying type of wood and its moisture content (between 12 and 16 per cent), and taking a statistical average of emissions over different burn settings. In practice, wood heaters are likely to emit a higher amount of particulate matter due to user operation, types of wood used, and the condition and maintenance of the appliance.

[8] For example, see Upper Hunter Wood Smoke Community Research Project undertaken for NSW EPA http://www.epa.nsw.gov.au/resources/woodsmoke/UHWSCR-consultant-report.pdf

Emissions of air pollutants contribute directly to the quality of the air. The amount of particulate matter emitted from wood heaters—at both PM_{10} and $PM_{2.5}$ levels—is significant. The extent to which emissions from wood heaters contribute to poor air quality is more complex. For example, even though emissions to air may be relatively constant over a period of days, large variations in air pollution levels can occur, due to the impact of meteorological factors. The most important meteorological factors are winds, atmospheric structure (i.e., the stability of atmospheric conditions[9]) and sunlight. Local and broader regional topography can both be important for air quality: natural physical barriers such as mountains and valleys can influence the mixing and dilution of pollutants.

The following figures show the contributions of different sources of particulate matter emissions ($PM_{2.5}$) in Victoria and PPAQCR, taken from the EPA 2006 Air Emissions Inventory.

Figure 3: Sources of PM2.5 emissions in Victoria, 2006

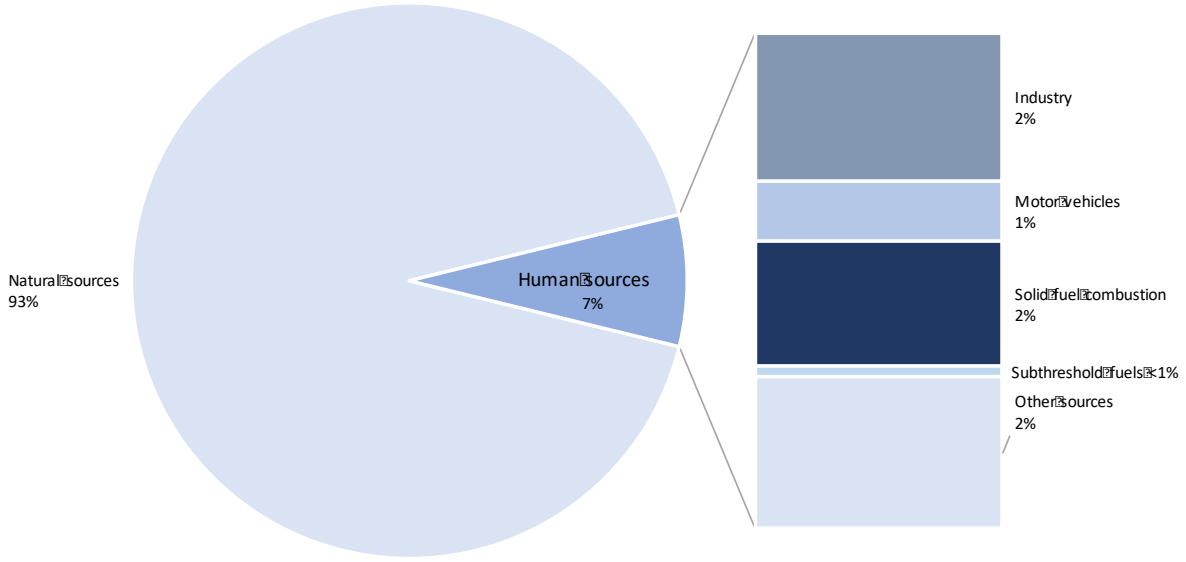
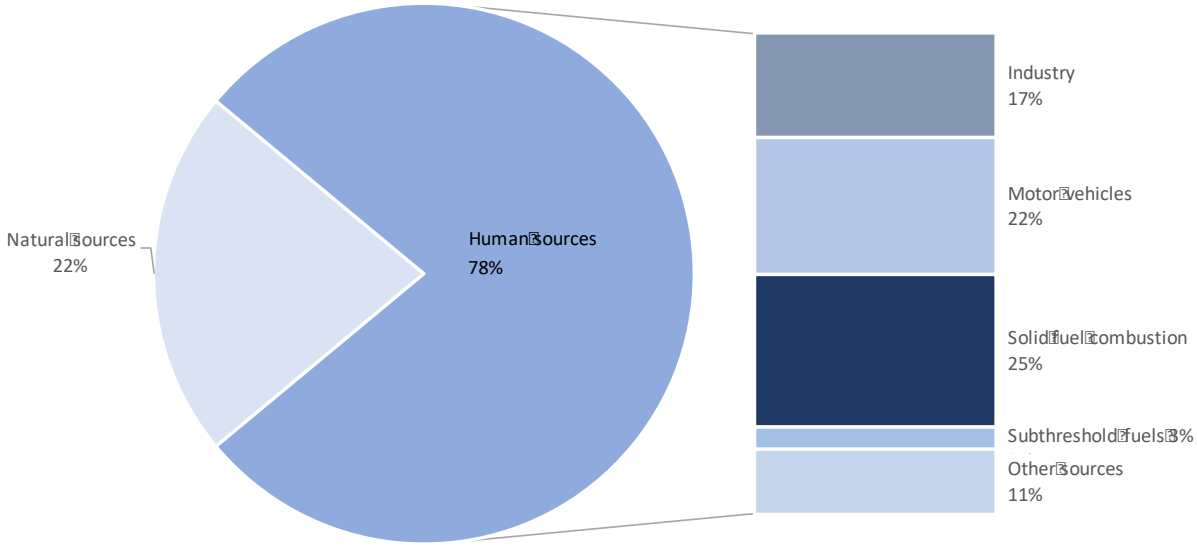


Figure 4: Sources of PM2.5 emissions in the Port Phillip Region, 2006



[9] For example, inversions very close to the ground develop on clear calm nights leading to high levels of particles from wood heaters in some locations.

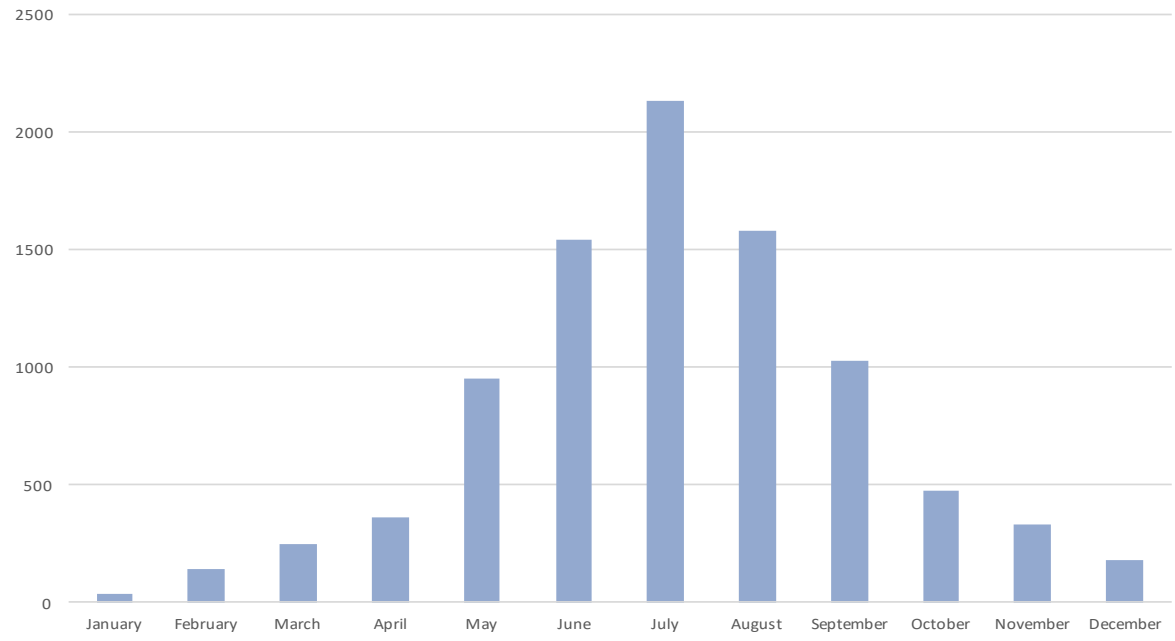
Solid fuel combustion (which in the above figures includes wood heaters as well as open fireplaces and combustion for cooking purposes) contributes around 25 per cent of total particulate matter ($PM_{2.5}$) pollution in the PPAQCR. The smaller contribution in regional Victoria reflects greater prevalence of natural sources (dust and fires), although solid fuel combustion contributes to over 25 per cent of human sources. Most emissions from solid fuel combustion in these figures is from wood heaters, with only a small proportion being from fireplaces and cooking.

Air currents and turbulence can spread air pollution out over a large area, diminishing the concentration of emissions further away from sources. Similarly, in a vertical direction, when pollution is emitted from a point high above the ground, the pollutants are usually well spread out by the time they reach the ground. Pollutants emitted close to the ground (such as houses) are more likely to affect our air quality. For example, controlling emissions near ground level would result in a greater benefit than would be obtained if the same emissions were reduced from industrial stacks.

Figures 3 and 4 show that particles are emitted from a wide range of sources. In the future, there is expected to be significantly reduced particle emissions from vehicles (mostly diesel engines), but this will be somewhat offset by growth from domestic, commercial and industrial activities.[10] While wood heaters are a significant source of particles in Melbourne, this source is not expected to grow as the effects of population growth are likely to be offset by the reduced popularity of wood heaters in the future.[11]

In past studies of air quality and hospital admissions, the strongest effects were observed in the cool season. In winter, domestic heaters (including wood heaters) make a significant contribution to air pollution. Figure 5 shows the total particulate emissions per month in Victoria in 2016, using the total emissions modelled for 2016 and the monthly contribution factors estimated for the 2006 emissions inventory.

Figure 5: Total emissions from wood heaters, Victoria, 2016 (tonnes)

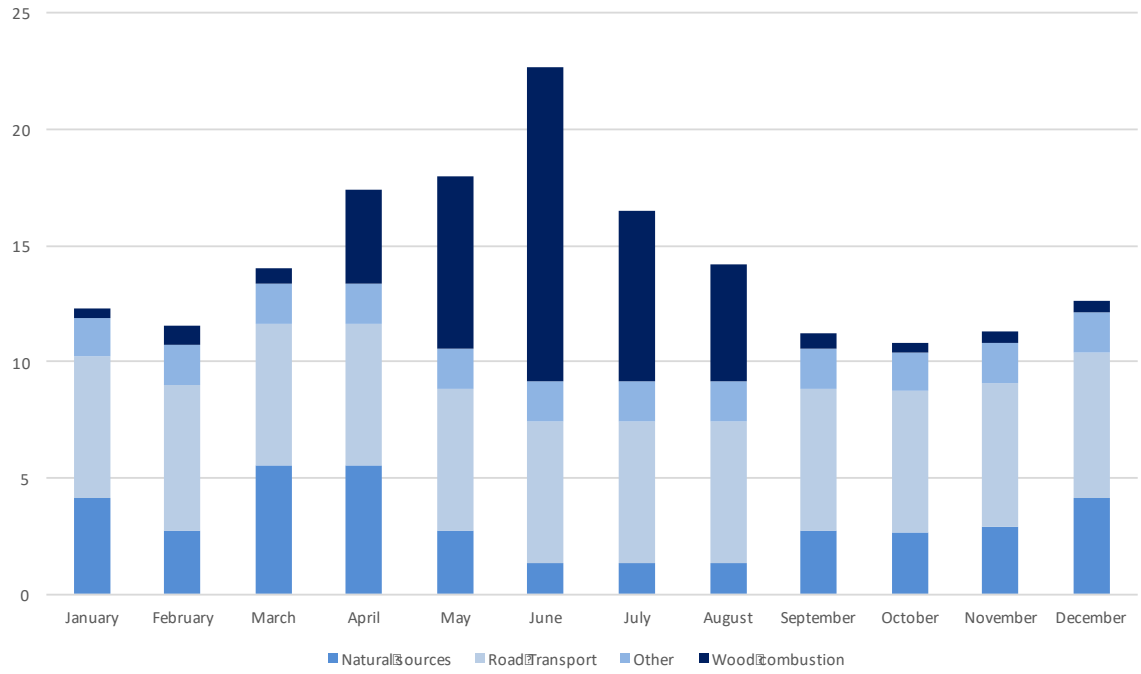


[10] EPA, *Future air quality in Victoria – Final report*, EPA scientific report, July 2013.

[11] Ibid., p. 49.

Figure 6 below provides an example illustration of how $PM_{2.5}$ emissions vary over a year, and shows indicative contributors to particulate emissions concentrations. This demonstrates how use of wood for heating can have a material impact on the overall air quality. Alphington, an inner suburb north-east of Melbourne, is an area known for having a high use of wood heaters and a relatively high population density.

Figure 6: Average daily maximum $PM_{2.5}$ concentration in Alphington, 2016 (ug/m^3)

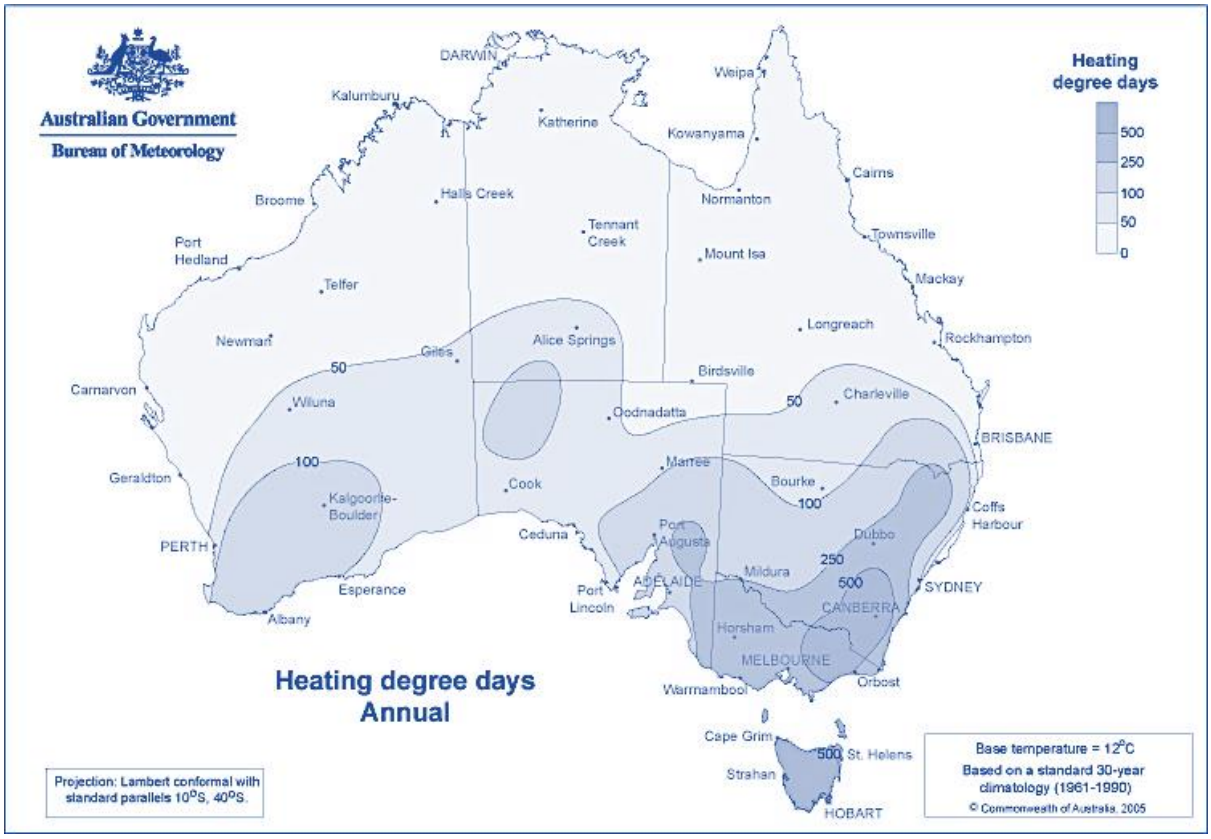


The above figures show how burning of wood is a primary driver of increases in total particulate matter emissions over the year. A previous ABS survey indicated that most Victorians (over 75 per cent) use heaters for more than 3 months of the year, with 20 per cent using heaters for more than six months of the year.[12]

[12] ABS 4602.0.55.001 - *Environmental Issues: Energy Use and Conservation*, March 2011

Victoria has among the highest number of heating degree days[13] in Australia, as measured by the Bureau of Meteorology, indicating the relative amount of heating required in different areas.

Figure 7: Annual heating degree days in Australia



Source: Bureau of Meteorology

The exact number of wood heaters in use is not known precisely, however estimates can be made based on various past surveys. This PIA estimates that there are around 96,900 wood heaters in use in PPAQCR and around 142,800 wood heaters in the rest of Victoria—see modelling assumptions in Appendix B.

This PIA estimates that there are currently 8,995 tonnes of particulate matter emitted from domestic wood heaters each year: 3,464 tonnes are emitted within the PPAQCR, while 5,531 tonnes are emitted in the rest of Victoria. These estimates have a medium confidence (see Appendix B), but are an adequate baseline to measure the change in emissions attributable to the options assessed in this PIA.

[13] The heating degree days are determined by the difference between the average daily temperature and the comfort level temperature each day, added up over a year. The comfort level value used is 12 degrees Celsius for heating.

Other impacts of wood heaters

In addition to particulate matter, wood smoke can consist of over a hundred different chemical compounds including carbon monoxide, nitrogen dioxide and some air toxics (for example benzene, formaldehyde and polycyclic aromatic hydrocarbons), which are also harmful to human health. Some components are known to be carcinogenic and chronic exposure is known to cause heart and lung disease and certain cancers. Oxides of nitrogen (NO_X), ammonia (NH_3), sulphur oxides (SO_X) and volatile organic compounds (VOCs) are also precursors to the formation of secondary particulate pollution (formed in the atmosphere through chemical reactions).

While health impacts from air pollution are the primary purpose for regulating wood heaters, there are other impacts that provide further reason for taking action in this area. These include:

- vegetation and ecosystems: Particles can be carried over long distances and settle on the ground or in water. The effect of this settling has the potential to change the nutrient balance in aquatic environments; deplete nutrients in soil; damage sensitive forests and farm crops; and affect the diversity of ecosystems. Wood clearing for use in wood heaters can also adversely affect wildlife habitat if not well managed.
- visibility and amenity: Particles scatter and absorb light and are responsible for brown haze. Poor visibility caused by particle pollution has a direct impact on a location for living, tourism and investment as well as reducing residents' sense of wellbeing. Smoke from wood heaters can also be a significant nuisance problem for neighbours if heaters are poorly operated, as emissions can be highly odorous and irritating.
- building materials: Particle pollution can stain and damage stone and other building materials, including heritage buildings.
- global warming: Black carbon, the main component of soot particles, is also considered to be a powerful global warming agent.

Further, while most firewood is taken from fallen or dead trees, firewood harvesting and collection impacts on wildlife habitat and biodiversity.

Actions being taken to reduce emissions from wood heaters

A number of actions are already in place to reduce air pollution from wood heaters. These include:

New heater design requirements

At the wood heater design level, Victoria has adopted AS/NZS 4013:2014 (the emissions standard). This standard was incorporated into the Waste Management Policy (Solid Fuel Heating) in 2004. Since its incorporation, the standard has been reviewed and amended. Since 2015 it requires all new wood heaters to have a particulate emission factor of less than 2.5g/kg. This will reduce to 1.5g/kg from August 2019, which is expected to reduce PM emissions by around 6.3 per cent by 2028.

Compliance with existing requirements

At the compliance level, the Policy allows the EPA to audit wood heaters on sale to test for compliance with AS/NZS4013 and investigate complaints relating to manufacturers and suppliers and issuing of notices in accordance with the Act. EPA can serve Pollution Abatement Notices on manufacturers or suppliers that do not comply with the Policy.

EPA has received information about some retailers selling non-compliant heaters. In 2010, EPA undertook an inspection of the manufacturer that produced eight models of wood heaters. EPA found that all eight models were compliant with the Policy and labelled in accordance with the standard.

EPA is of the view that the industry is broadly self-regulating in terms of compliance with the current Policy, and the majority of wood heater models are compliant with the relevant standards.

In-service operations and replacement

The Policy also requires that a wood heater must be installed in accordance with the *Building Act 1993*. This requires wood heaters to be installed by practitioners licensed by the Victorian Building Authority, and the installation must comply with AS2918 (Domestic solid fuel burning appliances—Installation). This ensures that wood heaters are less likely to be installed incorrectly, which could adversely affect their performance.

At the operation level, there are a suite of programs to encourage wood heater owners to reduce emissions from their heaters. The current Policy provides that the EPA may:

- work with industry, government agencies, local government and community
- provide public information and education programs, including by undertaking research and raising awareness of the emission standard
- develop neighbourhood environment improvement plans.

EPA has information on its website pertaining to tips for operating a wood heater correctly. It also has advice about what to do if a neighbour's wood heater is unduly impacting on the community.

When EPA receives information from the community about potentially non-compliant wood heaters, it undertakes an assessment of the claims. There are few complaints of non-compliance. To date, investigations of alleged non-compliance has found that the heaters do meet the current requirements.

Other actions that will affect PM emissions

There are also a number of relevant actions not administered by the EPA that are likely to have an impact on the level of emissions from wood heaters. These include:

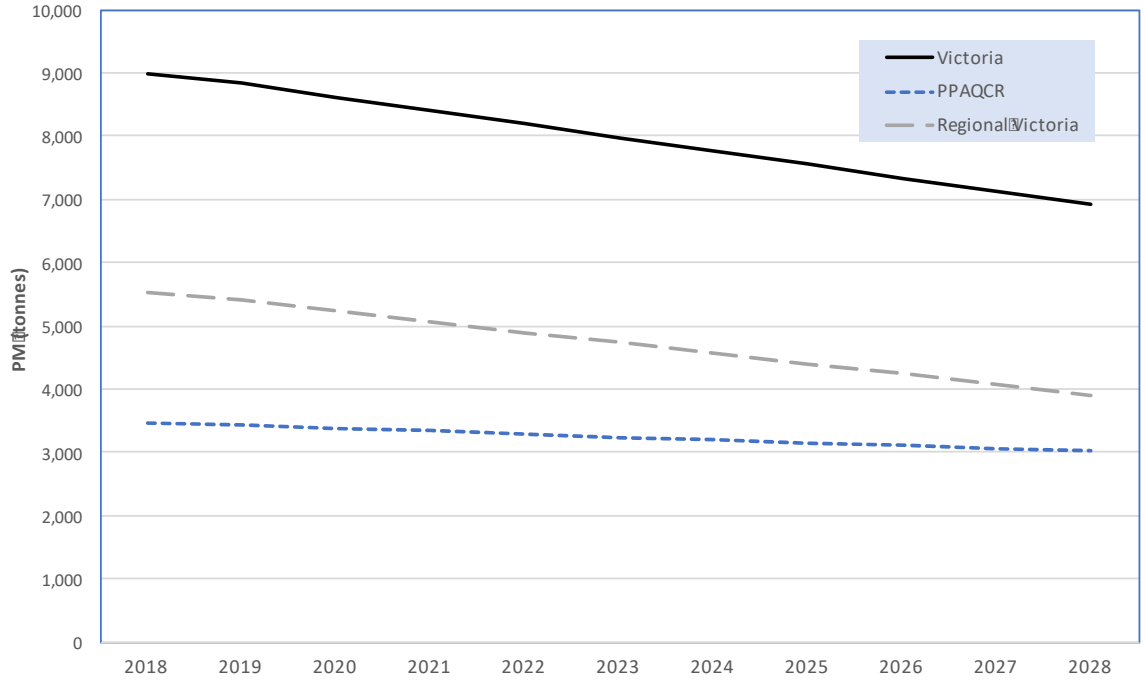
- Nuisance smoke—under provisions of the *Public Health and Wellbeing Act 2008*, the owner of a property or the person causing a nuisance must take all reasonable steps to eliminate the nuisance. Smoke from wood heaters can be a nuisance dealt with under that Act. The provisions are enforced by local councils.
- Choice of wood—the choice of wood may have an effect on the emissions from a wood heater. Wood with a high moisture content (greater than 25 per cent) cannot burn at a sufficiently high temperature to achieve low particulate emissions. The Firewood Association of Australia (FAA) Code of Practice requires "where practicable, seasoned firewood (i.e. that with an internal moisture content of less than 25 per cent (dry weight)) will be sold. Where unseasoned wood is sold it will be accompanied by advice on the time at which the wood will be sufficiently dry to burn." The FAA provides information to local councils to assist them to target high emitting wood heaters. Heater manufacturers also provide advice with each heater on recommended types of wood to use.
- Voluntary compliance with the efficiency standard—virtually all heater models available in Victoria already meet the efficiency standard AS/NZS 4012:2014 as it applies now, and around 83 per cent already meet the minimum efficiency rate that the standard requires by 2019. Despite it not being mandated in Victoria, many of these heaters are tested under the standard and carry efficiency information on their compliance plates. The industry publishes information about the compliance of heater model with the efficiency standard (e.g., Australian Home Heating Association (AHHA) website).
- Increased availability of natural gas—data from 2011 indicates an inverse relationship between access to articulated gas and use of wood heaters, for local councils outside the PPAQCR: for every 10 per cent increase in proportion of houses with access to gas, the proportion of houses burning wood for heating fell by 3.7 per cent. Since 2011, the government's Regional Gas Infrastructure Program has aimed to supply reticulated natural gas to communities across

regional and rural Victoria. The program is expected to make reticulated natural gas available to around 18,000 homes and businesses. While not all these homes will necessarily decide to connect to natural gas, it is expected that increased access to natural gas will reduce use of wood heaters in regional Victoria by around 0.2 per cent by 2028.

Residual problem

The above suite of actions is expected to continue in the future. These in combination will result in a gradual fall in total emissions from wood heaters over the next ten years, as shown in Figure 8.[14] (Increase in population is expected to be offset by an ongoing fall in consumer preference for wood heaters.)

Figure 8: PM emissions from wood heaters, projections to 2028



$PM_{2.5}$ emissions from wood heaters are expected to fall by 13 per cent in PPAQCR and by 29 per cent in the rest of Victoria, for a total fall of 23 per cent for the whole state.

Despite the emissions from wood heaters projected to fall over the next ten years, there is still a clear policy case for taking further action in this area. The quantified total health costs from the level of PM emissions in Figure 8 is over $8 billion over the next ten years, or $5.8 billion in present value terms (see Appendix B for assumptions on quantifying the impacts from PM emissions). Burning of wood will remain one of the largest contributors of non-natural sources of PM emissions over the next ten years, and there have already been a number of actions put in place to reduce emissions from other sources.

While the extent of this problem is significant, a key area that limits large gains is the difficulty in dealing with existing heaters (unless existing heaters are deemed no longer permitted). Approximately 80 per cent of PM emissions from wood heaters over the next 20 years will be from existing wood heaters unaffected by the new standards that apply only to new heaters.

The scenario in Figure 8 is the 'base case' against which options in this PIA are assessed.

[14] Modelled for the purposes of this PIA. See Appendix B for details.

Views of stakeholders

The notice of intention to vary the Policy was published in April 2017, inviting feedback from affected stakeholders. Five responses were received. Some of these were only to seek to be kept informed about the process. Specific issues raised by individuals included:

- concern about whether the Policy variation would affect wood heaters already in use in homes, or about to be installed before the Policy variation comes into operation
- questioning the focus on emissions from wood heaters at a time when there is a high level of smoke caused by planned burning in some parts of the state.

EPA has previously conducted community surveys in 2005 and 2011 in Victoria of practices with impacts on air quality including activities involving wood and wood heater use. EPA consulted with other government departments in the development of the Future Air Quality report in 2013, and consulted with industry and community as part of EPA's five-year plan. These past consultations support EPA's belief that there is still a high degree of community concern about air quality, including concern about the use of wood heaters.

EPA records pollution reports made to the EPA about smoke from houses. Since 2013 there have been 50 pollution reports logged, including both direct complaints about smoke from houses as well as complaints about inaction by local councils to address problems (complaints about nuisance smoke should in general be made to local councils in the first instance). This figure does not represent the extent of community concern, as some people would be more likely to report their concerns directly to local councils or local members of parliament.

Views of other stakeholders are known from previous consultation in this area. The National Environment Protection Council Service Corporation released the '*Consultation Regulation Impact Statement for Reducing Emissions from Wood Heaters*' (CRIS) report in April 2013 as part of the Council of Australian Governments (COAG) process to inform the developed of agreed national actions to improve air quality. That process received 59 submissions. The main themes from all submissions reflected a common concern as well as general agreement that wood heater emissions are deleterious to human health and there is a need to act to bring about a reduction in emissions. There were no respondents raising explicit objections to government action being undertaken, but ten submissions were supportive of either the wood heater industry or continued wood heater use.[15] Of those submissions relevant to Victoria, views included:

- numerous submissions from individuals citing concern about air quality around where they live
- a high level of support for efforts to reduce pollution from wood heaters, noting that wood heaters should be the least preferred method of heating
- support for national standards, emphasising that education is key, and suggesting manufacturer and/or suppliers of non-compliant heaters should be prosecuted. Several submissions supported reducing smoke from wood heaters but suggested this could be better achieved through education, encouragement and enforcement
- questioning the balance, accuracy and use of statistics and analysis in CRIS. Several submissions considered that contribution of wood heaters to ambient air pollution is over represented
- noting that the wood heater industry supports a lot of people in many small businesses
- a belief that the removal of wood heaters on the sale of a house or the banning of wood heaters in critical airsheds is feasible. Against this, industry was not supportive of a ban on new heaters.

[15] Copies of submissions and a summary report can be found at http://www.nepc.gov.au

During the development of this PIA, a number of stakeholders were consulted to inform the assessment of options, including data on current wood heaters and how different options could be implemented. The Australian Home Heating Association (AHHA)[16] and a sample of manufacturers/suppliers provided information that has been used in this PIA. While industry in general does not consider further regulation of wood heaters a priority, or the most effective course of action, in terms of improving overall air quality, the industry does recognise that national consistency of heater standards is necessary. Industry also believes that more can be done to improve compliance with the existing requirements.

Views were also sought from local councils. The Municipal Association of Victoria (MAV) and a sample of local councils indicated that smoke from houses was not a significant source of complaint across most of Victoria, but that local councils were not best placed to address air quality issues.

EPA has also consulted with the Department of Environment, Land, Water and Planning, and interjurisdictional environment agencies during the development of the variation to the Policy.

[16] AHHA is the peak industry body representing over 250 manufacturers, retailers, installers, maintenance companies and firewood suppliers.

3. Objectives

This section of the PIA sets out the policy context and objectives of any proposed action. The primary objective of the draft variation to the Policy is to give effect in Victoria to measures agreed in the NCAA priority issue to reduce air pollution from wood heaters.

Victorian policy framework

The *Environment Protection Act 1970* ("the Act") creates the legislative framework for the protection of the environment in Victoria having regard to legislated principles of environment protection, to which regard must be given in the administration of the Act. The principles outlined in the Act include:

- the principle of integration of economic, social and environmental considerations
- the precautionary principle
- the principle of intergenerational equity
- the principle of shared responsibility
- the principle of product stewardship
- the principle of integrated environmental management.

The Act provides for the declaration of environment protection policies. In relation to air quality, the State Environment Protection Policy (Ambient Air Quality) (SEPP AAQ) sets air quality objectives and goals for the whole State of Victoria. The SEPP adopts the requirements of the NEPM(AAQ), and includes an additional objective for visibility reducing particles. An amendment was made in 2016 to incorporate the changes to the particle standards made to the NEPM. Victoria's State Environment Protection Policy (Air Quality Management) (SEPP AQM) establishes the framework for managing emissions into the air environment in Victoria from all sources. The aims of the SEPP AQM are to:

- meet the air quality objectives outlined in the SEPP AAQ
- drive continuous improvement
- achieve the cleanest air possible.

The SEPP AQM sets out EPA's responsibility in managing diffuse emission sources and managing emissions from large line sources, for example, roads. The SEPP AQM does not set specific emission limits for wood heaters. The Waste Management Policy contributes to achieving Victoria's environmental quality objectives and goals for air quality by promoting efficient use of resources and reducing emissions from solid fuel heating.

Current Waste Management Policy (Solid Fuel Heating)

The objectives of the current Policy are to:

- improve air quality in Victoria by reducing emissions from wood heaters
- protect the environment, including human health and amenity, from the hazards posed by the emissions from wood heating
- minimise the generation of emissions from wood heaters through the manufacture, supply, installation and operation of wood heaters.

The Policy is guided by the principles of environment protection set out in the Act.

The Policy intent is to ensure that only compliant wood heaters are sold in Victoria and that they are

correctly installed and operated to minimise emissions. The Policy requires minimising the generation of emissions through appropriate and efficient use of wood heating devices and improved operating practices. This is achieved through point of manufacture and supply compliance with AS/NZS 4013 and correct installation through compliance with Part 12A of the Building Act.

EPA considers the objective and intent of the Policy remain appropriate.

National Clean Air Agreement

In 2011, COAG identified air quality as a *Priority Issue of National Significance*.

In December 2015, national Environment Ministers established the National Clean Air Agreement (NCAA). Environment Ministers agreed three key initial actions under the Agreement, one of which was: "measures to reduce air pollution from wood heaters, including the adoption of new emission and efficiency standards for new wood heaters and sharing best management practices across jurisdictions."

The NCAA Initial Workplan (2015-17) required all jurisdictions to implement the decision on wood heater emission commencing in 2017. Victoria has incorporated the emissions standard into the Waste Management Policy (Solid Fuel Heating) since 2004, which automatically incorporates the revisions to the standard in 2014.

ACT, NSW, South Australia and Queensland have already adopted both standards as required by the NCAA Workplan. Tasmania expects to have both standards incorporated in their remade regulations by mid-October this year. Western Australia expects to have both standards adopted by mid-2018. There are some implications of Victoria not meeting its commitments to adopt the efficiency standard. Firstly, the agreed actions on wood heaters are part of the wider national agenda to improve air quality, for which participation of all jurisdictions is essential for success.

Secondly, the ability for any jurisdiction to enforce the national standards is affected by the *Mutual Recognition Act 1992* (Commonwealth), which has the effect that any wood heater that is legal to sell in Victoria may be sold in any other state without meeting additional requirements of those states. If Victoria did not require the same standards for wood heaters as the other states, it would compromise their ability to enforce their required standards/the standards required by their legislative frameworks.

Objective

The primary objective of the draft variation to the Policy is to give effect in Victoria to measures agreed in the NCAA priority issue to reduce air pollution from wood heaters.

In considering options giving effect to this primary objective, EPA has recognised that burning wood is often the cheapest form of winter heating for many households, and some households in some regional areas may have limited access to other forms of heating. This PIA will also consider impacts on the manufacturers and suppliers of wood heaters, which employ 3,000 to 4,000 people in Victoria and include a high proportion of small businesses.

4. Options

This section of the PIA identifies different options that are available to meet the objectives. The options identified for analysis are:

- The proposed action – to require the manufacture and supply of wood heaters in Victoria to meet the minimum efficiency level as stated in the standard AS/NZS 4012:2014
- Alternative 1 – lower the maximum particulate emission factor to achieve the same overall level of emissions reductions as the proposed action
- Alternative 2 – increase the rate of replacement of wood heaters
- Alternative 3 – ban the sale and installation of any new wood heaters
- Alternative 4 – require wood heaters display a star rating to better inform consumer choice when purchasing wood heaters.

This PIA also identified other options that are not considered feasible alternatives.

The primary purpose of this PIA is to determine whether Victoria should adopt the efficiency standard as a mandatory requirement for all new wood heaters in Victoria. The decision to be made involves determining whether to:

- incorporate the efficiency standard into the Waste Management Policy (Solid Fuel Heaters), or
- not incorporate the standard into the Policy.

The efficiency standard should not be incorporated if the costs outweigh the benefits, or if there are other superior options that could be implemented (although some alternatives could be implemented together with adopting the efficiency standard). This section discusses the range of options that could be used to achieve the policy objective. Not all options included in this section will be feasible, but have been included for comparative purposes. For example, while the practical effect of the Mutual Recognition Act is that Victoria must adopt the efficiency standard so as to not undermine the actions taken by other jurisdictions, analysis of alternative options—and in particular their impacts for Victoria–may inform decisions about proposing changes to the NCAA or commence a process to make an exemption from the Mutual Recognition Act, should adoption of the efficiency standard prove not to be the action most effective option for Victoria.

The 'business as usual' scenario, where no further action is taken, represents the base case against which any other option is assessed. The existing actions, and expected future emissions and impacts under this scenario, are discussed in chapter 2 of this PIA.

Proposed action: Incorporate the efficiency standard

Under the proposed action, the Waste Management Policy (Solid Fuel Heating) would be varied to require the manufacture and supply of wood heaters in Victoria to meet the minimum efficiency level as stated in the standard AS/NZS 4012:2014. This is:

- 55 per cent from the time the incorporation becomes operative (expected to be mid-2018)
- 60 per cent from August 2019.

The requirement applies only to the manufacture or supply of new wood heaters. The efficiency requirements apply to the design of the heater and the standard sets out a methodology to test and verify a heater complies with the Standard before it is available for sale. The standard requires heaters to be labelled with a plate that states the efficiency of the heater as tested under the standard.

This proposed action incorporates the current efficiency standard. If this approach results in benefits that exceed the costs, another option could be to set efficiency requirements in Victoria that exceed

the current standard, particularly as any additional reductions in PM emissions is considered beneficial. However, such an option is not considered in this PIA: while benefits would increase in line with a higher efficiency requirement, so too would costs. Costs are likely to increase faster than benefits as it gets progressively harder to design wood heaters to perform at higher efficiency levels. This still may provide an opportunity for a net benefit, however EPA notes:

- any action to increase the efficiency requirement to higher than 60 per cent would need to be phased in to allow for adjustments and lead time in design processes, so a decision on higher standards can be made later
- the costs to achieve efficiency above 60 per cent are much more uncertain, and a later decision would be better informed
- there will be a formal process to review the efficiency standard in the future, which is the preferred avenue for considering changes to the efficiency requirements.

As well as incorporating the standard, the EPA will need to implement a suitable compliance and enforcement arrangement. While no additional enforcement activity would be necessary (as there is already an enforcement approach under the current Policy that would be able to also monitor compliance with the efficiency standard), EPA considers that the current approach has limitations. Instead, EPA proposes to amend the Policy to allow any third party (independent of the manufacturer and with appropriate skill and competence) to verify compliance with both standards. This will formalise the current practices, whereby AHHA issues certificates, but will provide for a clearer basis for EPA enforcement. A discussion of different enforcement options is included in Appendix C.

Alternative 1: Tighten the emissions standard

The immediate impact of increasing the efficiency of a wood heater is to reduce total particulate emissions by reducing the amount of wood needed to be burnt to achieve the same heat output. Another way of reducing the total emissions is to tighten the emission standard (i.e., reduce the amount of particulate emission permitted for a given amount of wood burnt).

Instead of incorporating the efficiency standard, the EPA could instead lower the maximum particulate emission factor to achieve the same overall level of emissions reduction. This would require setting a maximum particulate emission rate less than the current Australian Standard already incorporated in the Policy.

Based on the estimated reduction in emissions from the proposed action, total emissions from wood heaters can be reduced by an equivalent amount by setting the maximum particulate emission factor at 1g/kg from 2019.

Some parts of New Zealand have set a 1g/kg emission limit.[17]

Relying on a tightening of emission standard means that no new compliance and enforcement framework would be needed, however as with the proposed action, EPA considers there is merit in clarifying the current enforcement approach.

Alternative 2: Increase the replacement of old wood heaters

The majority of particulate emissions over the next ten years will come from existing wood heaters already in homes and will be unaffected by the above options. Total emissions could be reduced by encouraging faster replacement of older wood heaters with new, lower emission wood heaters. This is already encouraged by a number of non-regulatory means (see Chapter 2), which will continue and be improved going forward. This option would involve a way to force faster replacement of

[17] It is important to note that testing of heaters in New Zealand uses a different type of wood than in Australia, and therefore emissions performance may not be directly comparable.

wood heaters. One such way would be to require property owners to upgrade any existing wood heater that does not meet current requirements (i.e., the emission standard) at particular events, such as sale of a home. This particular approach has not been implemented elsewhere in Australia, but was considered in Western Australia as a potential alternative. In Christchurch, New Zealand, the use of solid fuel burners that are 15 years or older in certain zones in Christchurch is banned.

There are legal and practical limitations on EPA's power to mandate such increased replacement of existing heaters and therefore implement this option, however, it has been included as an alternative option for the purposes of comparing potential costs and benefits.

Alternative 3: Ban the sale of new wood heaters in Victoria

Rather than setting new requirements for new wood heaters, new wood heaters could be banned in Victorian homes. No new wood heaters would be used, and existing wood heaters would need to be replaced with other types of heating when they reach the end of their useful lives.

This approach has been implemented in areas including Montreal, Dublin and regions in New Zealand. In Australia, local government planning instruments have been used to ban the installation of wood heaters in several new release areas in NSW by Camden and The Hills Shire Councils, and in the ACT suburb of Dunlop under the ACT's leasehold system.

Alternative 4: Mandate consumer information about emissions

There is some evidence that people may buy more efficient wood heaters if they know its efficiency, and have access to the information in a useful way. Currently, efficiency rates are available for many heater models (e.g., AHHA website) and is marked on the plates of most heaters on the market. However, this efficiency measure is only relevant in terms of the standard and relates to design testing under precise conditions. This means a consumer may not fully appreciate how the measured efficiency rate relates to the amount of emissions or the amount of wood used in typical use of the heater.

Similar to water and energy appliances, manufacturers or suppliers could be required to place labels on all new heaters that show indicative particulate emissions and wood consumption under a standardised 'typical' operating scenario. The label would reflect total PM emissions associated with using the heater under typical household conditions, and take account of both efficiency and emission factor performance. This could be done by star ratings to allow consumers to more easily compare heater models.

Other options not separately considered

Aside from the above alternative options, other ways to reduce total emissions from wood heaters include:

- better enforcement of the current Policy (which includes the emissions standard)
- education and awareness
- working with industry (e.g., AHHA accreditation).

These options are already in place to some degree, and increasing activities in all these areas does not preclude the proposed action being taken at the same time. As such, these are not considered alternatives, and EPA will continue to review its actions in these areas.

A number of other options were identified but are not further assessed in this PIA:

- Requiring existing heaters to meet current standard (e.g., In Otago New Zealand, heaters with emissions ratings greater than 1.5g/kg were required to be removed by 2012). This would be extremely costly in terms of the costs of replacing heaters as well as establishing a new compliance regime to inspect wood heaters in homes.

- Buy-back/replacement of old heaters. Some jurisdictions have trialled schemes that provide financial payments to encourage households to replace high-emitting wood heaters with newer more efficient heaters, including finite programs in Launceston, NSW, ACT and Perth. In all cases, these trials have not been extended. A common shortcoming of this type of approach is that payments are made to households that would have acted anyway, leading to no genuine improvement in air quality. This suggests this approach is unlikely to be cost effective.
- Regulating the quality of firewood. The energy content of wood does not vary much from one species to another; eucalypt hardwoods typically release 19 MJ/kg in full combustion and softwoods about 21MJ/kg. However, old and dead trees (often with hollows) and fallen timber are preferred sources of firewood, as these tend to burn well and produce less smoke. Victoria regulates collection of firewood from Crown land; while emissions are not part of the policy rationale, the regulations do require people collect only fallen or felled trees.

Water content also affects how much smoke if produced. Above 25 per cent moisture level, wood begins to burn inefficiently leading to increased emissions. The Firewood Association of Australia (FAA) Code of Practice requires seasoned firewood (i.e., that with an internal moisture content of less than 25 per cent (dry weight)) to be sold wherever practical; where unseasoned wood is sold it will be accompanied by advice on the time at which the wood will be sufficiently dry to burn. South Australia prohibits the sale of firewood or solid fuel with a moisture content greater than 25 per cent (dry weight). ACT and Western Australia go further, prohibiting sale of firewood with more than 20 per cent moisture content. There is no existing regulatory framework for commercial firewood sales in Victoria and the costs to government to set up such a system are likely to be significant. Further, these requirements in other jurisdictions are new and their effectiveness is yet to be determined.

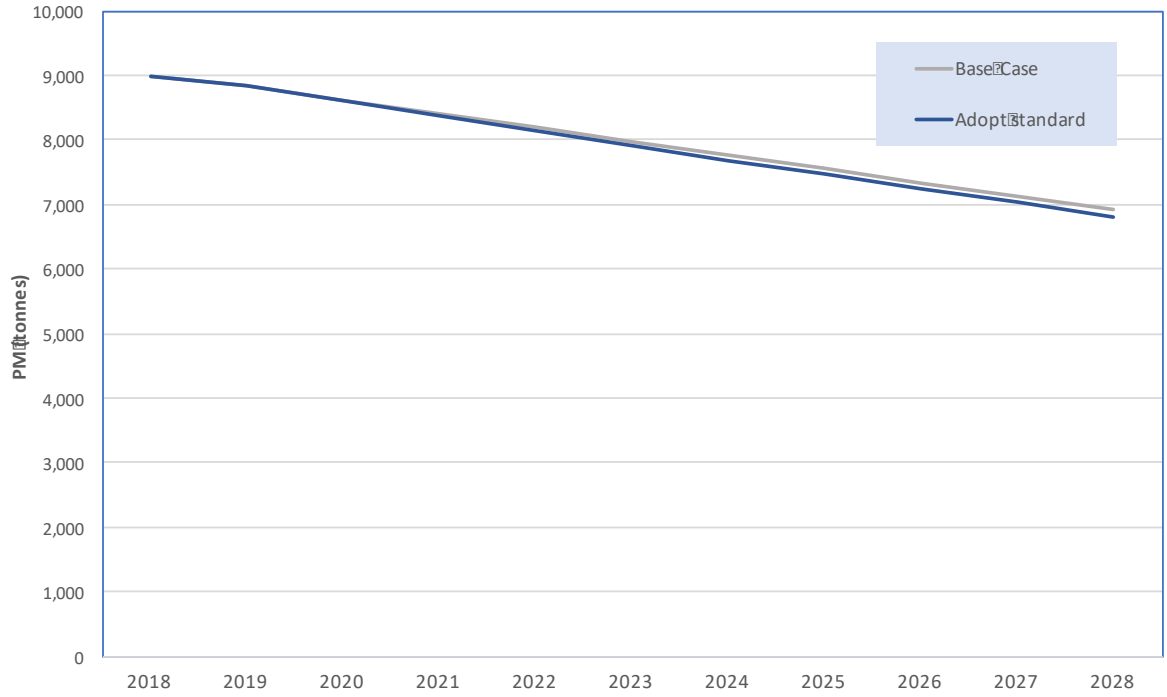
5. Costs and benefits

This section of the PIA presents the costs and benefits of the options identified in the previous section. Modelling assumptions for each option are detailed in Appendix B.

Proposed action: Incorporate the efficiency standard

Incorporation of the efficiency standard is estimated to reduce PM emissions relative to the base case by 671 tonnes over 10 years. This is only a small reduction in the emissions from wood heaters (around 1.7 per cent).

Figure 9: Reduction in PM emissions under the proposed action



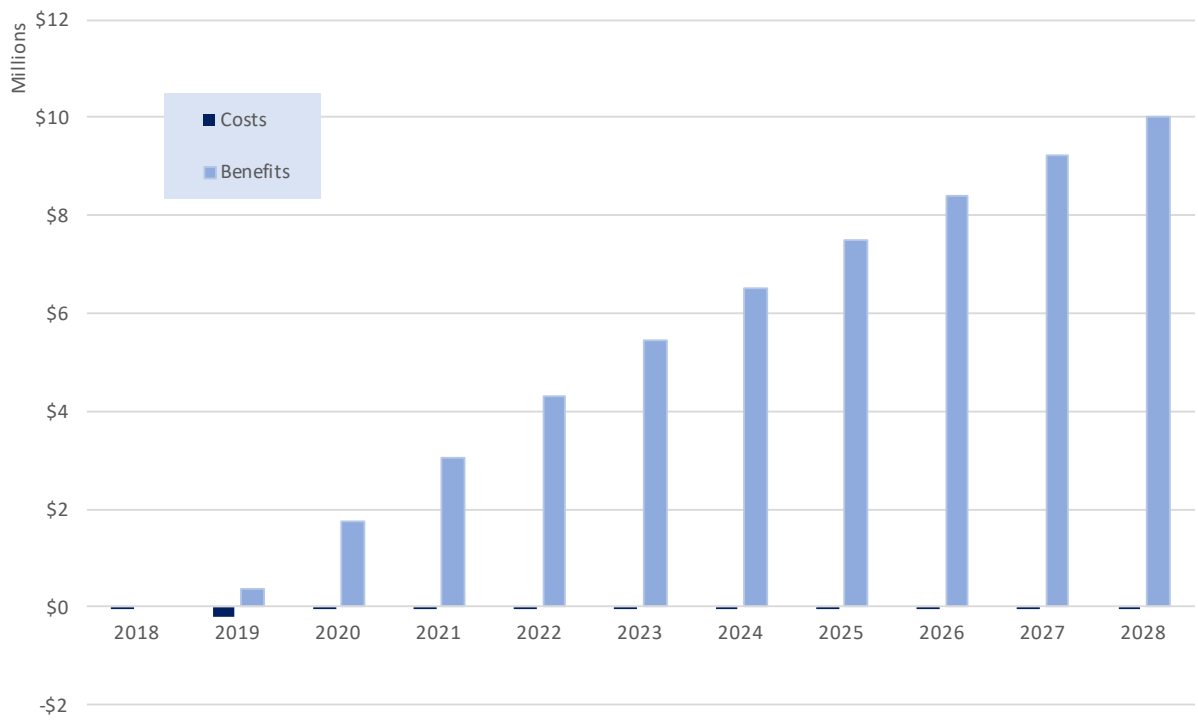
The benefit of this additional reduction in PM emissions is valued at $33.2 million to 2028 (present value) (see Appendix B for basis of quantifying these benefits).

Against this benefit, there are costs of implementing this proposed action. Total costs are estimated to be $212,887 over ten years (present value). This comprises the present value of costs as follows:

- $138,052 in costs to manufacturers to redesign non-compliant heaters to meet the standard, and retest those heaters for certification. These costs occur only in 2018 and 2019. This amount reflects the costs for models manufactured in Victoria plus an allocation of additional costs for models manufactured in other states but sold into Victoria. This cost would be lower if a manufacturer discontinues a particular model rather than modify it.
- $42,015 over ten years in higher costs for imported heaters. It is assumed that some non-compliant heaters would require redesign and retesting where manufactured outside Australia for predominant sale in Australia. Models manufactured in New Zealand would not incur any additional costs as the standards already apply in New Zealand. Some models manufactured overseas would no longer be able to be sold into Australia, with the resulting average price of remaining imported heaters increasing as a result.
- $32,820 over ten years in additional costs to EPA directly related to enforcement and compliance with the new standard.

In annual terms, benefits exceed costs in each year as shown in Figure 10.

Figure 10: Costs and benefits of the proposed action (2017 dollars)



If the additional costs to manufacturers are recovered through prices over a three-year payback period, it is estimated that this proposed action would result in increases to the average price paid by consumers for a new wood heater of around $6 in the short term.[18] This is a small increase (0.2 per cent) relative to the average price of a new wood heater, which is around $4,000 (including standard flue and installation).

This gives an overall net benefit of this option of $33.0 million over ten years.

In addition, there are also avoided costs of wood as the total amount of wood burnt will be lower than the base case as the average efficiency of heaters in service increases. With an average price of firewood of $300 per tonne, this option will result in a saving of wood costs of $16.2 million over ten years. This would be a cost saving to the operation of each wood heater of around $65 over ten years (present value), meaning that consumers would be better off financially, on average, under the proposed action. However, cost savings from firewood have not been treated as a benefit in the above net benefit calculation, because most of the value is an economic transfer (i.e., offset by a reduced production of firewood), or in many cases firewood is collected by the user.

Alternative 1: Tighten the emissions standard

Under this option, the emission standard would be tightened to achieve a similar level of PM emission reductions as the proposed action. As modelled, reducing the maximum emission factor to 1g/kg from 2019 would reduce PM emissions relative to the base case by 674 tonnes over ten years. Because the profile of reduction is slightly different within the ten-year period, the present value of the avoided PM emission under this option is $30.2 million.

The costs of this option are more significant. A greater number of heater models will need to be

[18] This figure is if additional costs are spread over all new heater sales, including models already compliant. For some models, the cost increase could be more significant.

redesigned and retested to meet this emission limit, because there is a greater number of heater models that do not currently meet such an emissions limit, and because all such heater models would need to be tested against the new limit. This results in costs to manufacturers of around $2.4 million, incurred in 2018 and 2019. This would likely result in an increase in the average price paid for a new heater of around $54, or a 1.3 per cent increase in prices.

As with the proposed action, this option would also involve costs to EPA of around $50,000 over ten years related to enforcement and compliance with the reduced maximum emission factor requirement.

This results in a net benefit of this option of $28.0 million over ten years.

As this option focuses on improving the emission factor of the heater and not its burning efficiency, this option does not of itself result in any change to the amount of wood burnt.

Alternative 2: Increase the replacement of old wood heaters

This option is unlikely to be feasible, but has been included for comparison purposes. It assumes that a suitable trigger event could be set which compels households to remove a wood heater or upgrade to a model that complies with the current emission factor standard.

For the purposes of modelling, the costs and benefits examine the situation where a doubling of the replacement rate of wood heaters is achieved. Under this situation:

- PM emissions would be reduced by 11,241 tonnes over ten years, with a present value of $521.9 million.
- The costs necessarily involve costs to consumers. To achieve this replacement rate, an additional 7,846 heaters would be replaced each year, with households incurring the costs of a new heater and installation costs. The additional cost is not the entire cost of the new heater, but reflects the forced bringing forward of the replacement, by an estimated average of 5 years. This results in additional costs of this option of $59 million over ten years.

Additional costs to government are unknown, as an appropriate enforcement regime would need to be developed.

Alternative 3: Ban the sale of new wood heaters in Victoria

While a ban has been implemented in a number of other jurisdictions, there are no published evaluations to date on the cost or effectiveness of these actions. For this PIA, this option was not separately estimated, but two scenarios were examined.

If the ban on new heaters coincided with the same rate of heater replacement as the base case (but now wood heaters were replaced with other types of heating, most likely to be gas), the total avoided PM emission from this option would be 3,252 tonnes over ten years, with a value of $120 million.

However, it is unreasonable to assume no changed behaviours in response to a ban. In particular, a proportion of existing wood heaters would continue to be used beyond the time at which they would otherwise be replaced with a more efficient, low-emitting new heater. Hence, while the total number of wood heaters would reduce over time, the average performance of in service heaters would worsen in terms of PM output.

If 50 per cent of households with existing wood heaters that would have naturally replaced their heater instead keep it for a further 5 years because of the ban on new heaters, there would be no reduction in PM emissions over ten years. And the other 50 per cent that do remove their old wood heaters would face a higher cost of converting to a different type of heater.

EPA considers it highly likely that a large proportion of households would extend the use of existing

wood heaters if new wood heaters were no longer available. This is particularly the case where wood heating is by far the cheapest heating option for a household, or where no other heating sources (e.g., reticulated gas supply) are similarly affordable or available.

On this basis, there is a high risk that this option would not result in a net benefit over ten years.

Banning new wood heaters may also cause some households to use inadequate alternative heating, which in turn could lead to adverse health impacts from cold. Wood heater bans were previously considered in 2004 by EPA as part of the development of the current Waste Management Policy. A ban was not supported on the grounds that in some circumstances it would place economic pressure on disadvantaged groups in the community which could result in health impacts during the cooler months.

Alternative 4: Mandate consumer information about emissions

The costs and benefits of this option were not quantified, as the effectiveness of such an approach is not known. To achieve the same level of PM emission reductions as the proposed action, the labels would need to lead to significant behavioural change. Around half of new heater purchasers would need to choose a heater primarily because of its PM emission performance.

There is no reliable evidence that such a change could be expected[19], particularly because the label would only indicate relative emissions performance and not—as is with the case of similar water or energy labelling—the cost to the owner of using the appliance. Previous ABS survey data suggests that environmental impact was a primary factor in less than 20 per cent of heating decisions. While the use of labelling may increase awareness of environmental impacts, it is unlikely to be significant enough to achieve the same level of benefits as the proposed action. RMIT (2007) found that the impact of product environmental labelling is complicated by the fact that environmental consciousness does not necessarily affect purchasing behaviour directly.

A labelling scheme would be costly for businesses and the EPA to administer. While this has not been quantified, it is reasonable to assume costs would be higher than the proposed action because not only would heaters need to be tested and certified (as in the proposed action), but would also require development of an agreed methodology for the information to be contained on the consumer labels and checking of both the performance of the heater and accuracy of the label.

[19] In a report prepared for Sustainability Victoria, RMIT University (2007) reviewed product environmental labels in Australia and overseas. They found that very little information exists as to the specific environmental savings delivered by environmental labels. The environmental labelling literature indicates that it is difficult to measure and assess these benefits quantitatively or qualitatively.

6. Conclusions

This section of the PIA outlines the choice of the preferred option, and summarises its impacts. It describes the preferred option as adopting the efficiency standard in Victoria, in line with the commitments of the NCAA. The proposed action would reduce PM emissions by 671 tonnes over the next ten years, and provide a net benefit to Victoria of around $33 million over that period. Most of the expected benefit accrues in the PPAQCR. If industry costs are fully recovered through higher heater prices, consumers would pay, on average, $6 more for wood heaters in the short term, although there would be less spent on firewood (in purchase or time spent collecting) over the longer term. The proposed action may have a higher cost burden on small businesses, particularly those that only manufacture and supply within Victoria.

The preferred option

The following table compares the examined options (all figures over 10 years, net present values):

	Proposed action – adopt efficiency standard	**Alternative – tighten emission factor standard to 1g/kg**	**Alternative – increase rate of replacement of existing heaters**
PM emissions avoided (tonnes)	671	674	11,241
Value of avoided emissions	$33,171,837	$30,197,783	$521,873,961
Costs	$212, 887	$2,143,957	$58,996,108
Net benefit	$32,958,950	$28,053,826	$462,877,853
Benefit-cost ratio	155.8	14.1	8.8
Cost effectiveness (cost per tonne of PM avoided)	$317.43	$3,179.83	$5,248.28

The proposed action is superior to tightening the emissions factor standard to achieve the same reduction in PM emissions. Increasing the replacement rate has a higher overall net benefit, but this is only because of the scale of the option. It has the worst benefit-cost ratio and the highest cost per tonne of PM avoided. There are also legal and practical limitations on EPA's power to mandate such increased replacement of existing heaters.

An option to ban supply of new wood heaters was also assessed. It was found that there is a high likelihood that this option would not achieve any additional reduction in PM emissions over ten years, as households who would have otherwise replaced their heater with a more efficient new heater may instead keep using a low-efficiency, high-emitting heater. If 50 per cent of households with existing heaters that would have naturally replaced their existing heater instead keep it for a further 5 years as a result of the ban on new heaters, there would be no reduction in PM emissions over ten years.

An option to require new heaters to have a star rating label was also considered. The label would reflect total PM emissions associated with using the heater under typical household heating conditions, and take account of both efficiency and emission factor performance. A labelling scheme would be costly for businesses and the EPA to administer. To achieve the same level of PM emission reductions as the proposed action, the labels would need to lead to significant behavioural change. There is no reliable evidence that such a change could be expected, particularly since the label would only indicate relative emissions performance and not—as is with the case of similar water or energy efficiency labelling—the cost to the owner of using the appliance.

It is noted that options such as tightening emission factor standards or banning sale of new wood heaters is contrary to the principle of mutual recognition, and the ability to enforce such options would require additional steps to be taken to exempt wood heaters from the operation of the Mutual Recognition Act.

For the purposes of additional comparison, the CRIS provides further data on cost effectiveness of other options considered in that RIS. These were:

	Cost per tonne of PM avoided
Require all existing heaters to meet new standard by a certain date	Not quantified but assessed as 'high'
Remove non-compliant heaters on house sale (based on experience in Perth)	$200,000
Subsidy programs to replace wood heaters in critical airsheds	$45,000 to $100,000
Education end enforcement programs	$2,000

Social and regional impacts

The proposed action is expected to result in an increase in the average price paid for new wood heaters in the short term. This is estimated at around $7 per heater, due to manufacturers recovering costs of redesigning and retesting heaters to make them compliant, and some non-compliant imported models no longer being available. Against this increase in average costs, the reduced need for firewood is expected to save each household around $65 over ten years (present value).

With costs passed on to consumers in this way, it is expected that households in regional Victoria would bear 85 per cent of the costs (excluding EPA costs) as this is where the majority of new wood heaters are installed. However, regional Victoria is expected to enjoy only 44 per cent of the benefits of reduced PM emissions, as PM emissions have lower health impacts in areas of lower population density. Despite this imbalance in the share of costs and benefits, all areas are expected to have a net benefit.

It is also noted that consumers who pay more for a new wood heater would also pay less for firewood as a result of its improved efficiency, making them better off over the longer term.

Small business and competition impact

The proposed action will have a material impact on competition, by directly restricting the heaters able to be sold.

Most wood heaters currently available already meet the 55 per cent efficiency standard, although a number do not meet the 60 per cent efficiency standard and will require manufacturers to change their designs and manufacture processes to make all heaters comply with the 60 per cent level. It is likely that some models will be discontinued if it is too costly or too difficult to achieve compliance.

These impacts are justified based on the expected net benefit of adopting the standard, and that the proposed action is assessed as being the most cost-effective means of achieving the desired objective. It is also relevant that all other jurisdictions are adopting the standard, thus the proposed action creates a level playing field across Australia.

The impacts are likely to be disproportionately larger for smaller manufacturers, which may have a larger share of their product lines that need to be made compliant, have smaller R&D capability, and have fewer sales over which costs can be recovered. This relative disadvantage also affects the level of competition.

A transitional option would be to incorporate the efficiency standard but allow a further 2 years before heaters are required to meet the 60 per cent level. This would give time for manufacturers to identify the best way to make all heaters meet the standard. The consequences of this delay are shown below:

	Proposed action – adopt efficiency standard	Alternative – delay 60% efficiency until 2021
PM emissions avoided (tonnes)	671	486
Value of avoided emissions	$33,171,837	$23,424,956
Costs	$212,887	$296,966
Net benefit	$32,958,950	$23,127,990
Benefit-cost ratio	155.8	78.9
Cost effectiveness (cost per tonne of PM avoided)	$317.43	$610.70

While modification and retesting would be delayed, the higher costs associated with the delay are a result of having to re-certify heater models in 2021 that, under the proposed action, would already need to be recertified to meet the emission factor standard. Most manufacturers would seek to avoid this additional retesting costs by seeking to be certified for all relevant standards at the same time (in 2019).

Further, it is noted that most other jurisdictions have already adopted the efficiency standard, and therefore any business that manufactures outside Victoria or sells heaters outside Victoria will likely already meet the 60 per cent efficiency rate by 2019. Consultations with industry suggest even small businesses sell heaters into other states.

EPA is aware of five heater models that are manufactured in Victoria that already meet the 1.5g/kg emission factor standard but do not meet the 60 per cent efficiency level. One of these models is due for recertification in 2019. The other models are sold nationally.

7. Implementation and review

This section of the PIA outlines how the proposed action will be implemented, and how (and when) its effectiveness will be reviewed.

It is expected that a formal decision to vary the Policy to incorporate the efficiency standard will be made shortly after the consultation period ends and completion of a 'final' PIA taking account of all feedback received.

EPA has given consideration to whether any transition arrangements are warranted, including for dealing with any non-compliant stock or inventory at the time the varied Policy commences. EPA considers that there has been adequate notice given of the intention to vary the Policy and the proposed timeline for the commencement of the new Policy has allowed sufficient time to adjust. As such, no special transition arrangements are considered necessary.

The varied Policy will allow the current practices for testing and verification (e.g., through AHHA) to continue.

Incorporation of the standard means that if the standard is changed, any change will automatically become part of the Victorian Waste Management Policy requirements. The efficiency standard was reviewed and amended in 2014, and is not expected to be reviewed again in the foreseeable future. There is a rigorous process for changing the standard, including consultation with industry and governments. In particular, there will be opportunity for EPA to assess the impact of any proposed changes to the standard on Victoria, and if need be, review the inclusion of the standard in the Waste Management Policy.

As part of its monitoring of compliance with the standard, EPA will monitor on an ongoing basis the changes to the efficiency rates of heaters in the market to determine if the assumed average efficiency of new heaters is realised. EPA will also monitor any trends in emission factors of new heaters (as part of existing activities) to identify if implementation of the efficiency standard has any implications for the average emission factors of new heaters.

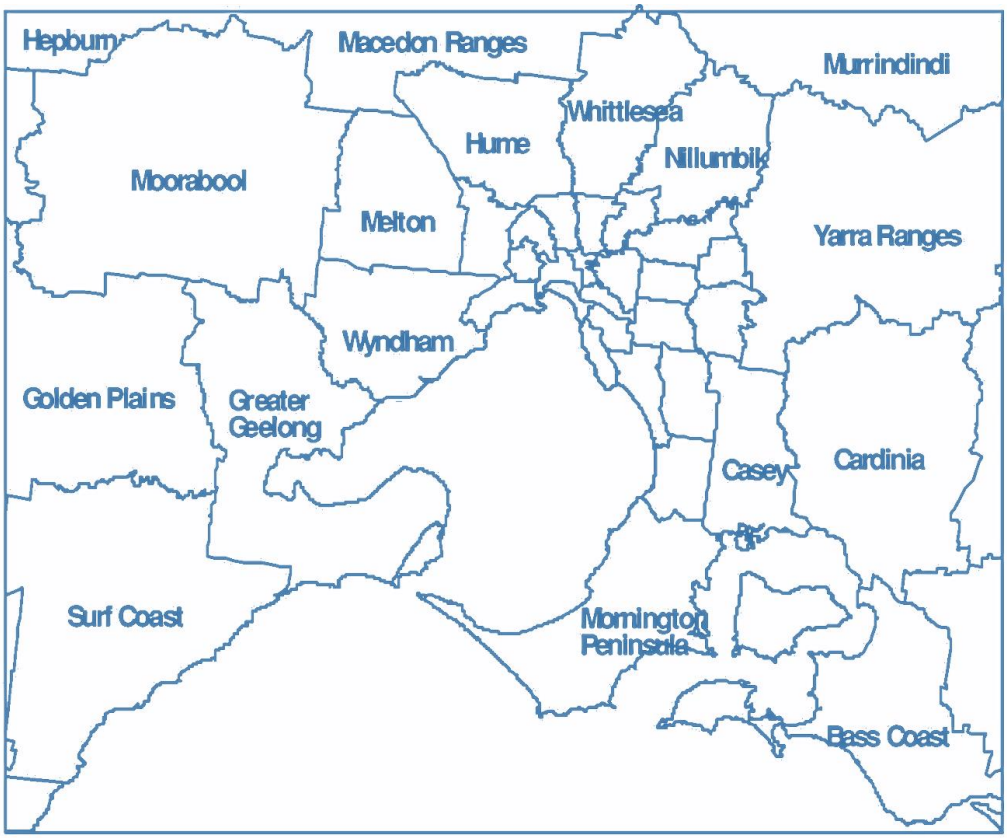
Under the Act, waste management policies are required to be reviewed at least every ten years. Therefor the next review will be undertaken before the expiry of the period of 10 years after the day on which this Policy comes into effect. This will be the point at which the outcomes of the proposed variation will be assessed.

The Independent Inquiry into the EPA and Government response commits to an overhaul of the Environment Protection Act to deliver a modern, fit for purpose legislative framework. It recommends a significant legislative reform agenda including a recommendation to replacing waste management policies with a simplified approach to standard setting. The proposed revision to the Act and legislative framework may provide a further opportunity to review the Policy before the statutory 10-year review period.

Appendix A: Port Phillip Air Quality Control Region

The Port Phillip Air Quality Control Region (PPAQCR) is defined in the area spanning 171km east-west and 141km north-south covering greater Melbourne.

Figure 11: Port Phillip Air Quality Control Region

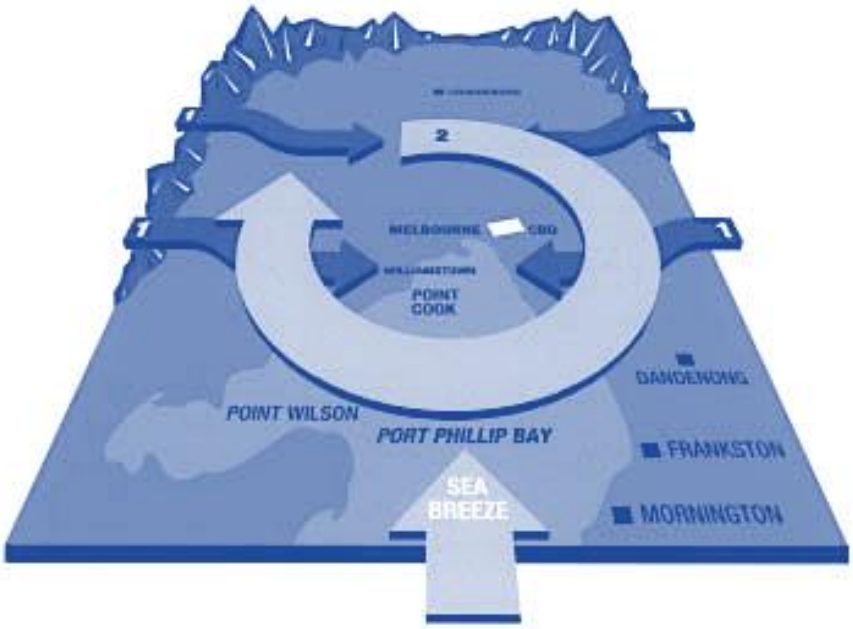


The analysis in this PIA is not based on modelling of air quality within an airshed, but only emissions from wood heaters. Air quality levels vary significantly over time and between locations because conditions that impact on those levels can vary greatly during a day or season, or across an airshed. As a result, there are locations within an airshed where pollution levels can be higher than those generally experienced across the region. Particulate matter from wood heaters often do not easily disperse (contributing to its risk of harm), and only has a localised impact.

The use of the 'airshed' concept in this PIA does not imply that emissions of particulate matter affect the entire area. For this PIA, the PPAQCR provides a convenient way to group areas where there are different geographic concentrations of heaters and population, that is relevant for assigning values to localised emissions.

However, the PPAQCR also corresponds with a common regional scale topography that can lead to the clockwise circulation of winds that can occur in Melbourne leading to a build-up of pollution levels, known as the Melbourne or 'Spillane' Eddy that forms to the south of the Great Dividing Range under certain weather patterns. As shown in Figure 12 below, under a special set of meteorological conditions, air flowing from the north-east is funnelled by mountains to the north and east of Port Phillip Bay (1) creating a circular, horizontal motion of about 100 kilometres in diameter (2) trapping pollution over the Bay, taking it away from Melbourne. The eddy pushes air pollution out over the Bay and back over Melbourne with afternoon sea breezes.

Figure 12: The Melbourne Eddy



Appendix B: Modelling assumptions

This Appendix sets out the assumptions, data sources and calculations used to estimate the costs and benefits contained in this PIA.

Base case

Wood burnt

The following modelling assumptions have been used in this PIA:

	PPAQCR	Rest of Victoria	Source of data
Number of households	1,938,052	582,861	*ABS Census data 2016*
Percentage of households burning wood as main source of heating	5%	24.5%	*ABS 4602.0.55.001 - Environmental Issues: Energy Use and Conservation, Mar 2014*
Average tonnes of wood burnt per household per year	3.75	4.4	*Commonwealth RIS based on ABARE (2008)*
Tonnes of wood burnt each year	363,385	628,324	

These are considered very conservative estimates. A survey of Victorian households in 2011 found much higher proportions of households that burn wood, and higher estimates of the average amount of wood burnt (EPA 2011). These survey results would suggest total wood burnt of 1.2 to 1.4 million tonnes in PPAQCR and 1.9 to 2.1 million tonnes in the rest of Victoria. These are likely to overstate the amount of wood burnt—implying total PM emissions far in excess of what has been previously measured—and not used for this PIA.

Efficiency and emissions of existing and new wood heaters

The following table shows the average emissions and efficiency by age of heater, and the assumed proportion of heaters in place.

	Average emission factor (g/kg)	Average efficiency	PPAQCR	Rest of Victoria
Uncertified	11.9	50%	16%	9%
Pre-1999 certified	10.6	50%	47%	43%
Certified 1999-2010	7.7	55%	30%	30%
Certified 2010-2017	4.8	59%	7%	18%
New heaters (from 2017)	4.5	60%		
New heaters (from 2019)	2.6	60%		

These are adapted from WalterTurnbull (2009), Todd (2008), CSIRO (2008), DEH (2004), National Environment Protection Council CRIS (2013), and average of available heaters on the market over the past 5 years, allowing for natural replacement and growth since that study.

The average emission factor reflects an assumed distribution among heaters in each age category, and different operation types (good, average and poor operation by the user in terms of temperature and airflow, repair and maintenance). Overall, these assumptions are consistent with around 15 per cent of heaters accounting for around 80 to 85 per cent of total wood heater emissions.

Replacement and growth of wood heaters

This PIA uses similar replacement and growth rates as used in the Commonwealth RIS prepared for the COAG decision. These have been resolved to align with the estimated sales of wood heaters in Victoria each year of 10,400, based on Victoria's share of 26 per cent of national sales of 40,000 (from industry consultation, and WalterTurnbull 2009); and industry views that 85 per cent of sales are for non-metropolitan areas.

	PPAQCR	Rest of Victoria
Replacement rate	1%	2.6%
Growth in number of wood heaters	0.4%	0.8%

Implications of national approach

All other Australian states have already adopted the efficiency standard, or will have adopted it by the time a final decision in Victoria is made. Due to the effect of the *Mutual Recognition Act 1992*, non-compliant models could continue to be sold in other states contrary to the adoption of the standard there, until the standard is also adopted in Victoria. This would suggest from a technical point of view that national compliance with the standard is only triggered once Victoria adopts the standard, and all costs should be attributed to Victoria's action (as the 'last mover'), regardless of where the heaters are manufactured or sold.

However, consultation with industry suggests manufacturers and importers are already taking steps nationally to meet the efficiency standard, and most will likely meet the standard for heaters sold in Victoria whether or not Victoria adopts the standard. This is simpler for businesses to offer products that can be sold in any state, and prudent as failure of Victoria to adopt the standard may cause other states to take steps to exempt wood heaters from operation of the Mutual Recognition Act.

For the purposes of modelling the impacts for Victoria, costs of compliance and resulting benefits are assessed in their own right (i.e., all costs of redesigning and retesting heater models is attributed to the introduction of the efficiency standard in Victoria, for the share of wood heaters sold in Victoria). To the extent that manufacturers will move to comply with the efficiency standard even if Victoria did not adopt it, the costs and benefits of this PIA would be reduced proportionately.

Proposed Action

Under the proposed action, it is assumed that the average efficiency rate of heaters in the market will rise to 61 per cent from 2018 and 64 per cent from 2019—this is based on the number of existing heater models that already exceed the standard, and the number of non-compliant heaters that are adapted to reach the minimum level, or are discontinued.

Based on itemised data on heater models available provided by AHHA and supplemented with consultation with non-AHHA members, all heater models manufactured in Australia already meet the 55 per cent efficiency standard, while 12 models do not meet the 60 per cent efficiency standard. Of these, three also do not meet the 1.5g/kg emission factor standard, and would therefore already require further redesign and retesting by 2019. Of the other nine non-compliant models, five are manufactured in Victoria and the full cost of redesign and retesting has been included in the industry costs. For the 4 non-compliant models manufactured in other states, 26 per cent of industry costs has been attributed to Victoria, in line with the proportion of sales of wood heaters in Victoria. Of the 269 models that are manufactured outside Australia, two models would require modification to meet the 55 per cent efficiency standard and a further 12 would need modifications to meet the 60 per cent standard. However, of these, half are manufactured in New Zealand, which will already be required to meet that standard by 2019, and therefore no additional cost is included. For other imported models, 26 per cent of additional costs has been attributed to Victoria, in line with the proportion of sales of wood heaters in Victoria. For costing purposes, it has

been assumed that most imported models would be modified to meet the standard; in practice, some models would simply be no longer sold in Australia, although this would result in consumers having to buy a different heater, at a higher cost, with an increase in the average price paid. This increase in average price attributed to discontinued models is effectively modelled as the cost of modification.

Non-compliant heaters will incur costs of $15,000 per model to be adapted to meet the 60 per cent efficiency standard, and a further $13,000 per model for testing and accreditation. These costs were obtained through consultation with manufacturers.

Costs to government were modelled as $40,000 per annum for 2018 to 2020 and $20,000 per annum thereafter, to reflect the level of effort of EPA compliance officers to inspect testing locations to check the accuracy of the certification process, spot checks on heaters being sold, and investigation of complaints about non-compliance. This cost reflects that most of these activities will already be required in relation to the emissions factor standard.

Alternative 1

Tightening the emission factor requirement to 1g/kg from 2019 would require a further 239 heater models needed to be redesigned and retested. Thirty-seven of these are manufactured in Victoria and the full cost of modifications and retesting is attributed to Victorian costs in this PIA. Costs of the other non-compliant heaters are attributed only as 26 per cent, based on sales shares in Victoria.

The costs of redesign and retesting each model are the same as the proposed action ($15,000 and $13,000, respectively), although this is considered very conservative as manufacturers considered that it would be much harder to adapt a heater to achieve 1g/kg than it would be to achieve 60 per cent efficiency.

Costs to government are assumed to be the same as the proposed action. While compliance activities are already required in relation to the current emissions factor standard, additional effort would be required if the maximum emission factor were lowered, as a larger number of heaters would need to be re-certified.

While the design emission factor would be 1g/kg, the in-service performance of such new heaters is assumed to be 2g/kg in practice, consistent with the base case assumptions.

Alternative 2

It is not known how this option would affect the replacement rate. For the purposes of comparison, this option is based on achieving a doubling of the natural replacement rate, and then determining the consequential costs of achieving this. This will allow cost-effectiveness of this option to be compared to the proposed action.

On this basis, this option involves replacing an additional 7,846 heaters each year. An average wood heater is estimated to cost $4,000 (including standard flue and installation by a licensed practitioner). This is at the lower end of costs based on desktop research of advertised prices.

The entire cost of a new heater is not attributable to this option, as it only involves the bringing forward of a replacement. It is estimated that, on average, heaters would be replaced five years earlier than would otherwise occur. This gives a bring-forward cost of $1,073 per replacement.

Cost of PM emissions/benefit of avoided emissions

About 97 per cent of particulate matter emission is less than 10µm (PM_{10}), while 93 per cent of total emissions is smaller than 2.5µm ($PM_{2.5}$), the more dangerous sized particles.[20] This PIA calculates the cost of $PM_{2.5}$ emissions.

[20] EPA (US) 1998 cited in British Columbia Ministry of Environment, *Emissions from Wood-Fired Combustion Equipment*, 2008 (Table 7, residential wood combustion).

The cost of PM emissions varies enormously due to local population density, and the influence in some centres of meteorological factors that can trap night-time and predominantly winter wood heater emissions in temperature inversion layers.

The following values are used:

	PPAQCR	Rest of Victoria
Cost per tonne of $PM_{2.5}$	$180,000	$50,000

The values indicate the avoided health impacts (health costs and deaths) associated with a tonne of PM emissions, as a terminating present value amount.

These values are derived from PAE Holmes (February 2013), *Methodology for Valuing the Health Impacts of Changes in Particle Emissions – Final Report*, prepared for the NSW Environment Protection Authority. Values have been averaged for areas within the PPAQCR and those outside. This averaging approach masks a wider range of values for local areas, however is necessary in the absence of detailed geographic modelling of emission sources. Values have been increased from 2013 values to 2017 values.

It is assumed that there is a linear relationship between the amount of PM emissions and health effects. This means that the health impacts arising from the emissions related to the policy proposal are not dependent on the background level of pollution; and there is no clear minimum threshold for particulates under which adverse health effects would not be observed. In this regard, the Discussion Paper (Air Quality Standards, released in July 2010 as part of the National Environment Protection Council's Review of the National Environment Protection (Ambient Air Quality) Measure noted (at page 100):

> The exposure-response relationship has been extensively analysed primarily through studies that examined the relationship between particles and mortality. These studies, which have focused on both short- and long-term exposures to particles, have consistently found a linear response and no safe threshold for effect.

The Review's Final Report (May 2011) confirmed this conclusion (at page 28):

> The health reviews show a current understanding that there is no threshold for the health effects of air pollution. This means that wherever the standards are set there will be some residual risk associated with them.
>
> The achievement of the desired environmental outcome requires driving improvements in air quality even if the standards are met in order to minimise the risk to the population arising from exposure to air pollution. One approach that is being implemented internationally and which was considered during this review is to add an exposure reduction overlay to the standards.
>
> The exposure reduction approach is based on the principle that for pollutants with a low or zero threshold for adverse effects, it will generally be more beneficial to public health, and potentially more cost-effective, to reduce pollutant levels across the whole population of an urban area or region rather than in a specific localised area for compliance purposes.

This likelihood provides support for the use of single point estimates of 'marginal damage' costs that have been used in previous studies. That is, it has commonly been assumed when valuing the benefits of reducing particulate emissions in Australia that the marginal benefits of emission reductions (i.e., a lessening of health costs) will not change in-line with changes in ambient particulate levels.

Other studies have also quantified benefits of reduced VOCs and GHG emissions. The impact of VOCs reductions is considered small relative to the impacts from PM reductions and has therefore been ignored for the purposes of testing net benefit of the options in this PIA. While a reduction in the burning of wood for heating also reduces GHG emissions, there are complex consequences of

burning less wood including implications for forestry and consumer shifts to alternative heating sources that may produce higher GHGs. It is also noted that the policy instruments considered in this PIA are directly targeted at limiting PM emissions, and the impact on other types of emissions would be less reliable.

Net Present Value and Discount rate

This PIA uses a timeframe of 10 years to assess future costs and benefits. While adoption of the Policy effectively means the efficiency standard becomes part of the 'business as usual' forever (including automatically mandating any changes made to the standard), the degree of uncertainty suggests that projections beyond this timeframe should not be relied on. Should benefits that occur beyond 10 years be relied on to demonstrate a net benefit, a higher level of analysis would be warranted to provide additional confidence.

Future values need to be discounted by the social discount rate, to take account of the opportunity cost to the community. Discounting costs and benefits allows a consistent determination of net benefit or cost. The discount rate is a critical parameter in cost-benefit analysis whenever costs and benefits differ in their distribution over time, especially when they occur over a long time period.

Best practice uses a social discount rate equal to the long-term average market rate of return, which gives a real discount rate of 7 per cent.[21] As with any uncertain variable, sensitivity analysis should be conducted, so in addition to the 7 per cent 'central' discount rate, the net present values were also calculated with real discount rates of 4 per cent and 10 per cent. If the sign of the net present value changes, the sensitivity analysis reveals that the choice of discount rate is important. For the options considered in this PIA, the relative results of the options were not sensitive to the discount rate used. The table below shows the results for the quantified options using 4 per cent and 10 per cent discount rates.

	Proposed action – adopt efficiency standard	**Alternative – tighten emission factor standard to 1g/kg**	**Alternative – increase replacement rate of existing heaters**
Using 4% discount rate			
Value of avoided emissions	$41,363,997	$37,975,029	$649,118,645
Costs	$234,904	$2,273,684	$45,264,996
Net benefit	$41,129,093	$35,701,345	$603,853,648
Benefit-cost ratio	176.1	16.7	14.3
Cost per tonne of PM avoided	$350.25	$3,372.23	$4,026.77
Using 10% discount rate			
Value of avoided emissions	$26,886,205	$24,264,903	$424,211,913
Costs	$193,826	$2,025,484	$63,860,282
Net benefit	$26,692,378	$22,239,419	$360,351,631
Benefit-cost ratio	138.7	12.0	6.6
Cost per tonne of PM avoided	$289.00	$3,004.11	$5,681.00

The choice of discount rate does not affect the conclusions about the preferred option. Of note, using a 4 per cent discount rate increases the cost per tonne of PM emissions avoided under the proposed action and the alternative option to tighten the emission factor standard, but reduces the

[21] This is consistent with the Commonwealth Office of Better Practice Regulations (2016) and NSW Treasury (2007), but slightly below that recommended by Harrison (PC, 2010). This rate used in the Commonwealth RIS process to support the NCAA agreement for all jurisdictions to adopt the national standards.

cost per tonne of PM emissions avoided under the alternative option to increase the replacement rate. This is due to the different time profiles of costs under each option. However, the cost-effectiveness of the replacement option would never be better than the proposed action (unless the discount rate was zero), and would only be better than the alternative emission factor option if the discount rate was less than 3 per cent.

Appendix C: Compliance and enforcement

Current approach to enforcement

Both Australian Standards (4012 and 4013) prescribe a test method for testing solid fuel heaters to determine their average efficiency and emissions output when operated at (optimal) conditions.

Additional to the test method the standards stipulate reporting and compulsory marking requirements. Solid fuel heaters that have been tested are required to be labelled with the test results, on plates permanently attached to the appliance. To demonstrate compliance with the standards, a manufacturer is required to test the solid fuel heaters they manufacture as per the test method, and ensure they meet the compulsory marking requirements by attaching plates with the required information to each model.

The current approach to compliance relies on industry being largely self-regulating, with industry practices embedding testing and certification against the relevant standards. EPA has powers to test wood heaters and take actions where non-compliant. EPA applies a risk-based approach to enforcement and as such has not pursued compliance and enforcement activity in this area.

The current Policy states that EPA will authorise a body to issue "certificates of compliance". To date, EPA has not authorised a body to issue certificates. AHHA, the peak industry body, has been fulfilling this role for the most part, with most known manufacturers and suppliers obtaining a certificate from AHHA in the absence of a formally authorised body.

Options for compliance in the future

There are four approaches to achieve compliance:

- authorise a body to issue certificates of compliance under the current Policy
- formalise the current arrangements so that AHHA and other bodies can issue verification statements
- develop a scheme that is accredited by the Joint Accreditation Scheme of Australia and New Zealand and require verification by entities that are accredited by JASANZ for this scheme
- EPA conduct regular audits to verify that solid fuel heaters have been tested in accordance with the standards and comply with the requirements of the standard, specifically that the compliance plates are true and accurate.

Option 1 – Authorise a body under the current Policy

This option would involve EPA identifying a suitable body to issue certificates of compliance. This would be resource intensive for EPA to develop a process to assess and select the body, and have an ongoing role to oversee the performance of the authorised body. Under the current Policy, this would be limited to a single body which may lead to undesired outcomes in terms of containing costs for industry as EPA would endorse an effective monopoly provider.

Option 2 – require independent third-party verification

This option would allow any body to issue verification statements provided they are independent and have the relevant skills and competence. The verification statements are essentially the same as certificates of compliance, however the body does not need to be authorised by EPA.[22]

There is merit in having third party verification due to the potential for a conflict of interest to occur

[22] Certification requires a scheme under which certification is conducted, whereas verification does not require such a scheme to be developed but instead sets requirements that must be met by the person(s) issuing the statement of verification. Another difference is that a person issuing a statement of verification is self-identifying as opposed to EPA identifying appropriate person(s).

where manufacturers make their own compliance plates.

This option would allow AHHA to continue its current role, providing their processes continue to meet the proposed requirements to issue verification statements and the certificates issued by AHHA satisfy the requirements of a verification statement (thereby allowing the system to continue with no additional costs), while allowing other bodies to also issue statements of verification in the future.

Option 3 – require any JASANZ accredited body to issue certificates

The Joint Accreditation Scheme of Australia and New Zealand (JASANZ) is one of four organisations that provide services within Australia's conformance infrastructure. JASANZ accredit bodies to, among other things, certify that products for sale in Australia meet relevant standards. JASANZ have a rigorous and regular review of accredited bodies to ensure they continue to impartially determine whether the products within their scheme meet the standards.

To become accredited by JASANZ, an applicant must develop a scheme under which they intend to certify specified products. There is currently no body accredited by JASANZ to certify products against Australian Standards AS/NZS 4012 or AS/NZS 4013.

The costs to become accredited by JASANZ are:

	Initial year	**Each subsequent year**
Accredited body fee	$20,000	$12,000
Application fee – per Standard	$5,000	$2,000

In developing this PIA, EPA consulted JASANZ who suggested that it would not make economic sense for a party to become accredited for the sole purpose of administering one scheme only (in this case solid fuel heaters against the two Australian standards). Rather, JASANZ suggested it would be more likely (and financially viable) for party/body already accredited by JASANZ to apply to administer the scheme for certifying compliance with the standards. It was also suggested that the scheme would likely need to be developed jointly by EPA(s) and JASANZ. This would be potentially resource intensive, requiring a scheme to be developed and approved and then bodies approved to administer scheme.

There are risks that a party may not become accredited by JASANZ, leaving no body able to issue certificates in Victoria. Also, delegating accreditation to JASANZ removes a level of direct control by EPA in ensuring that certification occurs in line with EPA's expectations,

Option 4 – EPA undertakes regular auditing

EPA already has the power to undertake audits of wood heater manufacturers and suppliers for whatever purpose deemed necessary. This option however, does not require any independent verification that wood heaters have been tested as per the standard and are labelled appropriately. It relies on EPA auditing actual compliance against the standards, which is more costly (for EPA and manufacturers) than an audit of documentation under the above options.

The implementation framework for this audit program would necessarily be very flexible and start with an initial audit of manufacturers and sellers of wood heaters. The results of that audit would feed into EPA's assessment of the need for frequency and extent of subsequent audits.

It is estimated that undertaking an initial audit of 200 wood heater models would be approximately $40,000 and be done with the use of consultants.

In addition, this option provides little clarity to manufacturers or suppliers, beyond the methods in the standards, on how they can demonstrate their heaters are compliant. With no documentation, it would be very difficult for EPA to hold suppliers to account as they could potentially plead ignorance of any non-compliance or may be completely unaware that the heaters they supply are not

compliant with the standards as they only have the information on the plates produced by the manufacturers themselves to rely on.

Preferred option

Both manufacturers and suppliers of solid fuel heaters must ensure that compliance with the standards is capable of being verified. Labelling alone is not considered sufficient proof of compliance as the manufacturer themselves produce the labels (i.e., not independent).

Of the above options, option 2 is preferred as this can be achieved at minimal additional cost.

The preferred option for this is that a verification statement is obtained that stipulates in the opinion of the person providing the statement, that the solid fuel heater complies with AS/NZS 4012 and AS/NZS 4013. The person making this statement must not have participated in the design, manufacture or import of the solid fuel heater, must have an appropriate level of skill and knowledge, and must have checked the relevant documentation, or otherwise tested the solid fuel heater to ensure that it has been manufactured, tested and labelled appropriately. The verification statement is EPA's main method of assessing compliance with the standard.

Third party verification would provide EPA, industry and the community with confidence that the labels on a solid fuel heater accurately reflect the test results and that the heaters comply with both Australian standards. This would also enable suppliers of solid fuel heaters to satisfy themselves that the wood heaters they supply comply with the required standards. If needed, EPA would still have the power to audit actual heater performance.

EPA consulted with AHHA and understands that AHHA currently meet the requirements required to issue verification statements and that the certificates issued by AHHA satisfy the requirements of a verification statement. It is expected AHHA's role in verifying compliance with the standards will continue.

Though EPA recognises the significant role of AHHA, the preferred option for demonstrating compliance does not preclude other parties that satisfy the requirements for issuing a verification statement from doing so.

Under this preferred option, there would be no additional costs to industry, as verification could continue as it currently does through AHHA. There would be additional costs to EPA in checking verification documentation. This is expected to be a small cost of less than $10,000 per year.[23] While the enforcement activities would deal with compliance against both efficiency and emission standards together, for the purposes of this PIA it is assumed that half this cost is attributed to the incorporation of the efficiency standard.

[23] Two EPA officers (base salary of $76,274 plus oncosts and overheads) would be expected to devote one week each in planned audits of certification documentation, and one additional week each in follow up of complaints or alleged non-compliance.

References

Australian Bureau of Statistics*, Census data 2016*

Australian Bureau of Statistics, *4602.0.55.001 - Environmental Issues: Energy Use and Conservation,* March 2014 and March 2011

Carey, M. and Dennekamp, M. Air quality and chronic disease: why action on climate change is also good for health, *NSW Public Health Bulletin* Vol. 21(5–6) 2010

Climate and Health Alliance, Submission to Senate Standing Committee on Community Affairs, Inquiry into the impacts on health of air quality in Australia, March 2013

CSIRO 2008, *Measurement of Real World PM10 Emission Factors and Emission Profiles from Wood heaters by In-situ Source Monitoring and Atmospheric Verification Methods*, prepared for the Australian Commonwealth Department of the Environment Water Heritage and the Arts, May.

Department of Environment and Heritage, 2004, *National Wood Heater Audit Program*, Report, May

EPA Victoria, 2001, *Ambient Air Pollution and Daily Hospital Admissions in Melbourne*

EPA Victoria, 2006 Air Emissions Inventory

EPA Victoria, *Future air quality in Victoria – Final report*, EPA scientific report, July 2013

EPA (US) 1998 cited in British Columbia Ministry of Environment, *Emissions from Wood-Fired Combustion Equipment*, 2008

International Agency for Research on Cancer (2013). Press release 221: Outdoor air pollution a leading environmental cause of cancer deaths. Retrieved 6 August 2017 from https://www.iarc.fr/en/media-centre/iarcnews/pdf/pr221_E.pdf

National Environment Protection Council, National Environment Protection (Ambient Air Quality) Measure Review, May 2011

National Environment Protection Council, National Environment Protection (Ambient Air Quality) Measure Review Discussion Paper (Air Quality Standards), July 2010

National Environment Protection Council Service Corporation released the 'Consultation Regulation Impact Statement for Reducing Emissions from Wood Heaters' report in April 2013

PAE Holmes (February 2013), *Methodology for Valuing the Health Impacts of Changes in Particle Emissions – Final Report*, prepared for the NSW Environment Protection Authority

Productivity Commission (Harrison, M.) 2010, Valuing the Future: the social discount rate in cost-benefit analysis, Visiting Researcher Paper, Productivity Commission, Canberra

Simpson R, Williams G, Petroeschevsky A, Best T, Morgan G, Denison L et al. The short-term effects of air pollution on daily mortality in four Australian cities. *Australian and New Zealand Journal of Public Health* 2005; 29: 205–12

Todd 2008, *Wood heater Operation and Firewood Parameters: Australia,* prepared for the Australian Department of the Environment, Water, Heritage and the Arts, May

University Centre for Rural Health, North Coast (2013), *Summary for Policy Makers of the Health Risk Assessment on Air Pollution in Australia*, Prepared for the NEPC, Canberra, Australia

Upper Hunter Wood Smoke Community Research Project undertaken for NSW EPA http://www.epa.nsw.gov.au/resources/woodsmoke/UHWSCR-consultant-report.pdf

WalterTurnbull 2009, *Industry Survey of Wood Heaters and Other Solid Fuel Heaters,* prepared for the Department of the Environment, Water, Heritage and the Arts, June