National Environment Protection Council Service Corporation

Consultation regulation impact statement for reducing emissions from wood heaters

Released 11 April 2013

Acknowledgement

The National Environment Protection Service Council engaged BDA Group, in collaboration with Environment Link, to prepare a consultation Regulation Impact Statement that assesses options to reduce emissions from wood heaters in Australia. The National Environment Protection Service Council is grateful for BDA Group's report provided on 10 September 2012, and the assistance and support provided by members of the EPHC Wood heater Reference Group and stakeholder representatives who had input into the report.

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FOREWORD

Consultation

This consultation regulation impact statement explores options for a national policy and/or regulatory framework for reducing emissions from wood heaters. Its purpose is to help community, interested parties and other stakeholders to identify potential impacts of the various policy and regulatory options presented.

As such, the Council of Australian Governments (COAG) Standing Council on Environment and Water is seeking feedback on the data, information and options within this document and the potential impact of the options presented. Questions have been posed at the end of most chapters to prompt stakeholder feedback.

Written submissions should be sent to:

scew.secretariat@environment.gov.au
Standing Council on Environment and Water Secretariat
GPO Box 787, Canberra, ACT 2601

Further information is available at www.scew.gov.au.

The closing date for submissions is 15 July 2013. Late submissions will not be accepted. All submissions are public documents unless clearly marked "confidential" and may be made available to other interested parties, subject to Freedom of Information Act provisions.

Council of Australian Governments

In 2008, the Environment Protection and Heritage Standing Committee agreed on the need for a nationally consistent approach to wood heater emissions management. The National Environment Protection and Heritage Council (EPHC) engaged BDA Group, in collaboration with Environment Link, to assess policy options to reduce emissions from wood heaters in Australia, and to prepare this consultation regulation impact statement.

The Australian Government has also identified air quality as a priority under the Standing Council on Environment and Water reform agenda. As part of that agenda the Commonwealth is working with states and territories to develop and implement a National Plan for Clean Air to improve air quality and community health and wellbeing.

The establishment of the Standing Council on Environment and Water Standing Council was part of reforms to national Ministerial Council arrangements, with the Council replacing EPHC. The Council first met in September 2011 and the emissions reduction projects, including the wood heaters project, were brought under the work program for developing a National Plan for Clean Air.

The National Plan for Clean Air will bring together a strategy for responding to the review of the National Environment Protection (Ambient Air Quality) Measure, including the revision of air quality standards and development of an exposure reduction framework, and a robust framework for identifying cost effective actions and implementation arrangements to reduce air pollution. It will be delivered to COAG by the end of 2014.

The first stage of the plan focuses on particulate matter as an air pollutant. Particulate matter was chosen as a priority because of the potential size of health benefits to be gained, the current population exposure to particulates in the atmosphere and the range of cost-effective actions available to address particulate emissions. Further details of the plan can be found at www.scew.gov.au/strategic-priorities/national-plan-for-clean-air.html.

Standards Australia

The current Australian Standards that cover wood heater emissions and efficiency are:

- AS/NZS4012:1999 Domestic Solid Fuel Burning Appliances – Method for determination of power output and efficiency
- AS/NZS4013:1999 Domestic Solid Fuel Burning Appliances – Method for determination of flue gas emissions

AS/NZS 4012 and 4013 cover a standard test method (including fuel loading, operating procedures and sampling methods) and an emission criterion of 4 grams of particulate matter (PM_{10}) emitted per kilogram of fuel burnt (4g/kg). There is currently no efficiency criterion, but there is a requirement that the efficiency result be reported (along with other information) on a label permanently attached to the appliance.

In April 2012, the Australian Home Heating Association (AHHA) submitted an application to Standards Australia to update the standards applicable to emission and efficiency requirements for all new wood heaters offered for sale in Australia. The AHHA proposal specifically sought a revision of the emissions and efficiency criteria respectively to 2.5 grams of particulate matter (PM_{10}) emitted per kilogram of fuel burnt (2.5g/kg) and a new efficiency standard of 55 percent.

Representatives from Commonwealth and state jurisdictions, along with industry and community stakeholders, are on the Standards Australia committee reviewing AHHA's proposal. Any revised standard arising from this process will be made available for public comment prior publishing the final standard. Further details on the Standards Australia process can be found at www.standards.org.au/StandardsDevelopment/Developing_Standards/Pages/Development-phases.aspx.

The Standards Australia process is happening in parallel with, but is separate to, the consultation processes for this consultation regulation impact statement. Finalising the standard prior to concluding the consultation regulation impact statement process may have some bearing on other aspects of the regulation impact statement process (e.g. the standards to

which a policy or regulation will eventually refer). The regulation impact statement, however, provides for a variety of policy and regulatory options over the short- to medium-term. Any new emission standards will only apply to new heaters that are sold on the Australian market.

Any improvements to the emissions that may be finalised under Standards Australia will be an important step in reducing harm to Australian communities. This is one component of the framework considered by the regulation impact statement. There are other aspects that cannot be covered within the Standards Australia process, such as education programs, compliance processes etc that need to be considered within a national approach to reducing the harmful effects of wood heater pollution.

Data Currency

The analysis, which forms the basis of this study, was performed in 2010/11 by BDA Group. It deals with air pollution and particulate matter emissions from wood heaters and the consequent health impacts on communities in Australia. Further studies and information relating to this topic have been published while this document was in preparation. In particular:

The Australian Bureau of Statistics (ABS) has published an update of their "Energy Use and Conservation survey dated March 2011 (ABS Catalogue 40602055001DO002_ 201103). Information within this update indicates that there has been a slight increase in wood heater usage compared to previous decreases from earlier surveys.

Preliminary legal advice received by DSEWPaC indicates that the implementation of a National Environmental Protection Measure (NEPM) as an option for national coverage may require changes to the *National Environment Protection Council Act*.

While the data contained in this consultation regulation impact statement could be updated, such a revision would require extensive work and further delay the release of the document without overly changing the nature of the policy and regulatory options considered, and the associated cost-benefit analysis undertaken. It is therefore considered important to make this consultation regulation impact statement available to the public now in order to better consider what appropriate national actions could be undertaken to reduce harmful wood heater emissions.

Air Thematic Oversight Group
Standing Council on Environment and Water

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Particulate emissions from wood heaters are a significant contributor to ambient levels of particle pollution, and in several regions of Australia the national goal for this pollution is not being met.

Epidemiology studies show a strong association between exposure to increased particulate levels and adverse health impacts, including respiratory and cardiovascular effects which can increase morbidity and mortality. Exposure to particulate matter can affect all Australians. There are also those who are more sensitive to particulate matter, for example people with existing respiratory or cardiovascular illnesses, children or the elderly, and who would be more severely affected.

The problem associated with wood heater emissions arises as owners of wood heaters cannot realise all of the air quality benefits of reducing particulate emissions from their heaters. As a result, individuals will typically not adjust their behaviours in line with what is socially desirable and there will be a corresponding loss in clean air amenity. The market failure leads to unwanted health impacts and provides the necessary conditions for government policy intervention. As poor wood heater operation is usually the main reason for excessive emissions, improvements in technology may be appropriate to ensure emissions are less dependent on operator skill.

The need for a national approach to wood heater emissions management

Australia's existing approach to managing wood heater emissions is to limit emissions from new heaters through a particulate emission performance standard and to undertake education and a range of targeted jurisdictional programs to reduce emissions from in-service heaters. Notwithstanding these programs, emissions from both new and in-service heaters continue to contribute to high ambient levels of particulates in some areas with associated health impacts.

In March 2008 the Environment Protection and Heritage Standing Committee (EPHSC) agreed on the need for a nationally consistent approach to wood heater emissions management and requested a detailed assessment of the options. Noting the existing regulatory framework for wood heater management in many jurisdictions, EPHSC agreed to develop this regulation impact statement to inform a future decision on the preferred management approach. In 2011 the Council of Australian Governments (COAG) identified air quality as a *Priority Issue of National Significance* and agreed that the COAG Standing Council on Environment and Water (SCEW) would develop a National Plan for Clean Air to improve air quality, and community health and well being, to be delivered to COAG by the end of 2014.

The first stage of the National Plan for Clean Air will focus on particles and this consultation Regulation Impact Statement will be included within this process. The consultation Regulation Impact Statement assesses alternative policy options that could be employed to reduce emissions from wood heaters in Australia, and establishes their relative costs and benefits.

Policy options considered

There is a large range of potential policy measures that could be implemented to reduce emissions from wood heaters. The potential measures fall into three major categories:

- wood heater design or performance standards;
- measures to promote compliance of retail models against these standards; and
- measures influencing the in-service operational performance of wood heaters.

These measures could be delivered through a range of policy 'vehicles'. The policy delivery approaches examined are a voluntary national program, a collaborative approach or a national regulatory approach.

A summary of the thirteen policy options (including sub-options) examined in this document is provided in Table E.1.

Reduction in particulate emissions from wood heaters under policy options

Sales of wood heaters in Australia have dropped from a peak of 120 000 units per year in 1988 to around 25 000 units per year currently and sales around this level are expected to continue. National turnover of the existing stock of wood heaters is estimated to be less than 2% per annum, with turnover highest in rural areas where wood is cheaper and reticulated natural gas is often not available. Therefore there is a need to consider policy options for both in service heater and those entering the market.

There has been an ongoing debate about the level of emissions from new and old wood heaters, as well as the extent to which improvements in new heater emissions performance is reflected in in-service operational performance. Drawing on the available research findings, we have developed a suite of emission factors for this study distinguishing wood heater emission differences attributable to design (emission standard), to compliance of retail models with the design standard, and due to how the heaters are operated in people's homes.

In total, current particulate emissions from the 1.1 million wood heaters in service in Australia are estimated at around 40 000 tonnes per annum. This is twice the amount of emissions estimated under the National Pollution Inventory, which uses design standard emission factors which have not been adjusted for differences in design compliance and operating practices.

Under the business-as-usual or 'base case' scenario, particulate emissions from wood heaters in Australia are expected to fall by around 5000 tonnes (or 12%) over the next twenty years, as old heaters are progressively replaced with new, lower particulate emitting heaters.

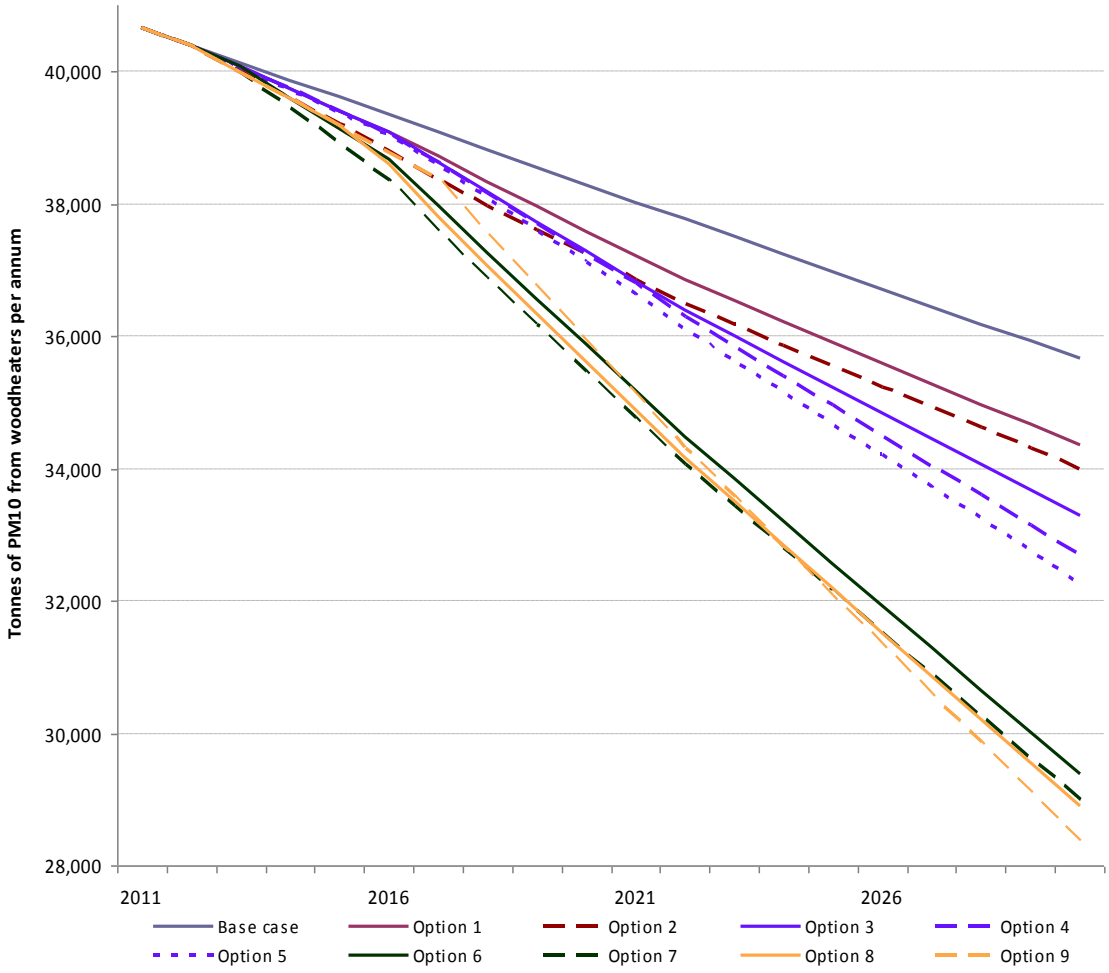
The reduction in annual particulate emissions from wood heaters under the policy options examined, over and above the business-as-usual reductions, range from 3% (for Option 1) to 18% (for Option 9).

Table E.1: Policy actions and policy delivery vehicles under each option

Option	Type of approach	Policy vehicle/s	Policy actions		
			Standards	**Compliance**	**In-service**
1	**Voluntary**	National program		National audits	Education (targeted at critical airsheds)
2	"			as above	Education Wood heater replacement incentives
3	**Collaborative**	Enhanced jurisdictional regulatory arrangements calling up Australian Standards, with complementary Commonwealth programs	Emissions labelling (compliance plate)	Nationally coordinated funding for state-based standard audit and enforcement	Education
4	"		Emissions labelling (compliance plate) National star rating labelling scheme	as above	as above
5	"		Emissions labelling (compliance plate) National star rating labelling scheme Efficiency standard (60%)	as above	as above
6	**National regulatory approach**	Sub-options: A. NEPM B. Commonwealth legislation C. Mirror legislation	Emissions labelling (compliance plate) Efficiency standard (60%) Emission standard (3 g/kg)	Independent testing and national certification National audits	Education
7	"		as above	as above	Education Common definition of excessive smoke Controls on modification and installation Controls on 2nd-hand heaters Wood heater replacement incentives
8	"		Emissions labelling (compliance plate) Efficiency standard (65%) Emission standard (3 g/kg)	as above	as above
9	"		Emissions labelling (compliance plate) Efficiency standard (60%) Emission standard (1.5 g/kg)	as above	as above

Figure E.1 shows the expected reduction in total particulate emissions from wood heaters in Australia over the twenty year assessment period under the various options.

Figure E.1: Reduction in wood heater particulate emissions over time, by option



Economic impacts of policy options

The main economic impacts of the options are the costs to government of implementing the various measures to reduce emissions from wood heaters; the costs to manufacturers to meet changes to standards applicable to new wood heaters; and the health benefits for communities arising from lower particulate emissions from wood heaters.

The estimated costs to government of implementing the options range from $15 million over the twenty years under Option 1 (for national audits and education programs in critical airsheds) to around $39 million under Options 7 to 9 (for setting up and administering a national regulatory framework including national certification and independent auditing as well as education and wood heater replacement programs in critical airsheds).

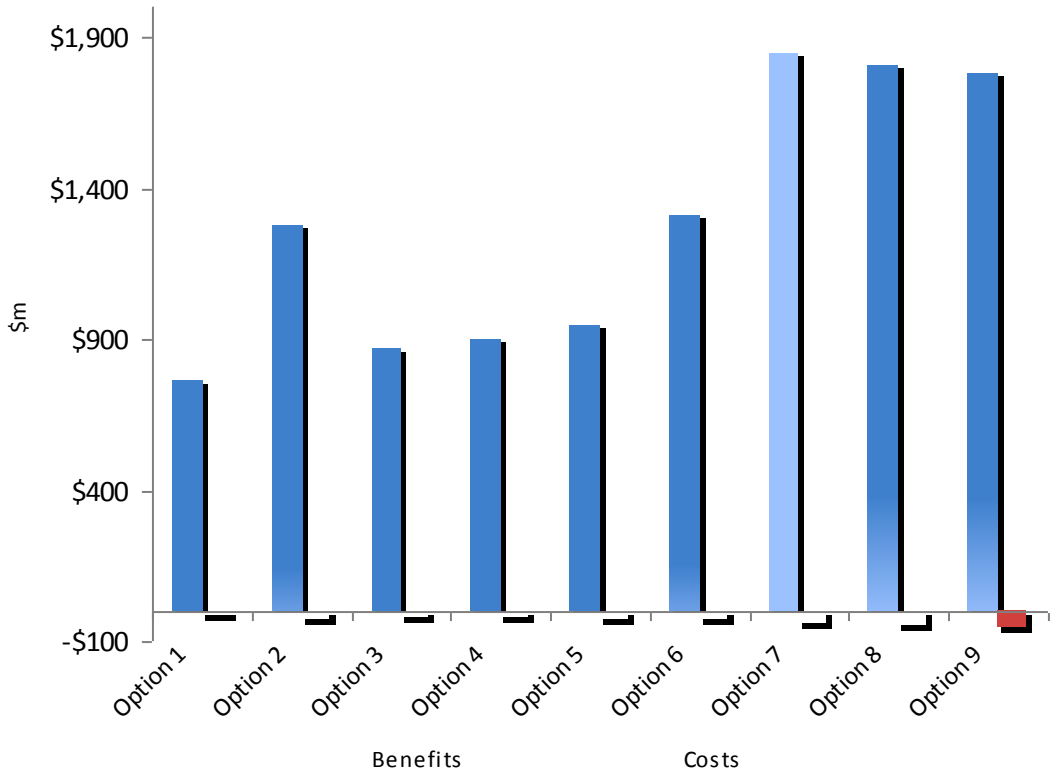
The estimated costs to manufacturers range from $240 000 under Option 1 (for improvements to heaters to comply with the existing standard and any re-testing required where heaters fail) to

$17m under Option 9 (primarily heater model development costs to meet an efficiency standard of 60% as well as an emission limit of 1.5 g/kg).

The health benefits of the options are estimated to range from $760m to around $1,850m over the twenty year assessment period. Although the greatest emission reductions are estimated for Option 9, the highest health benefits are estimated for Option 7 due to a shorter phase-in period for the new standards under this option.

The benefits and costs of each option are shown in Figure E.2. The estimated benefits far outweigh the estimated costs of all options included in the analysis. The present value of the net benefits range from around $750m to $1,800m.

Figure E.2: Benefits and costs of options ($m present value over twenty years)



Social impacts of policy options

As well as the cost implications identified above for governments and manufacturers, the suite of measures incorporated in each policy option will have implications for wood heater prices, employment within the wood heater manufacturing sector and the broader community in urban and rural and regional areas in Australia.

The estimated impact of the options on wood heater prices is estimated to range from $20 - $230 per heater. A tightening of efficiency and emissions standards to 60% and 3 g/kg respectively under Options 6 and 7 may have an impact on small wood heater producers. It is difficult to predict the likely outcome for the industry of any further tightening of standards,

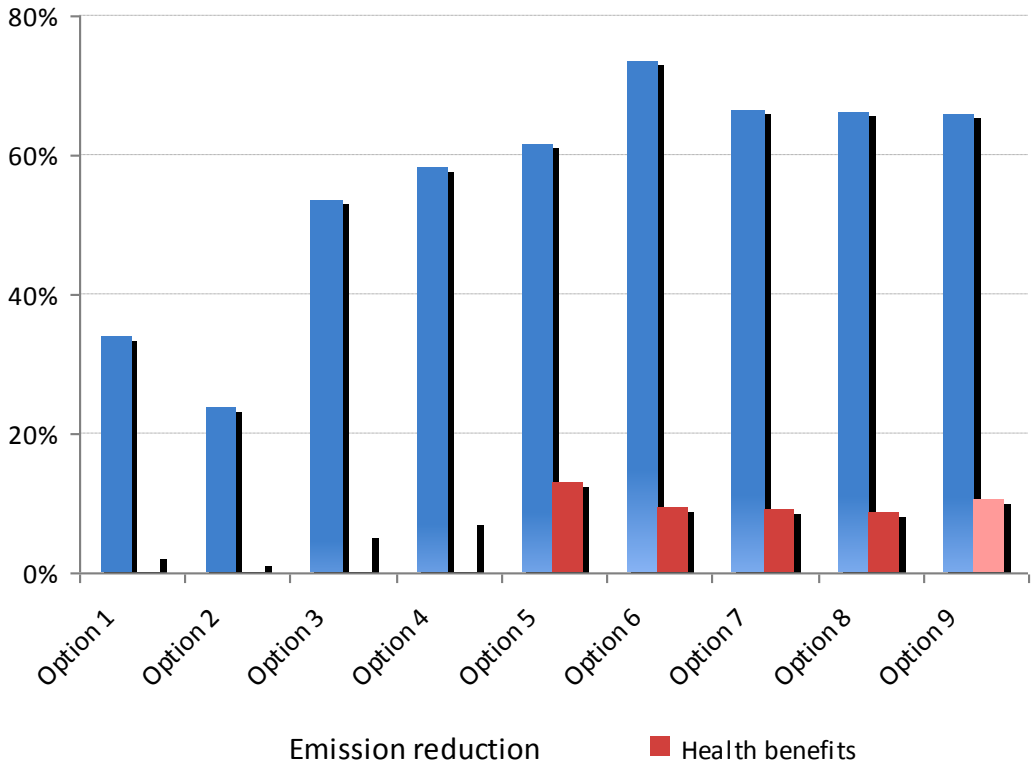
however a move to a 1.5 g/kg emissions standard examined under Option 9 would be expected to have a much greater impact.

The proportion of particulate emission reductions that are in rural and regional areas varies across options. Measures to reduce emissions under Options 1 and 2 are dominated by in-service programs targeted at critical urban airsheds. Conversely, Options 3 to 9 utilise standards and compliance measures impacting on new heaters which are predominately being sold into rural areas.

However urban residents would receive the majority of the health benefits of reducing wood heater particle emissions under all options. This occurs as the assumed health benefit per tonne of particulate emissions reduced is considerably higher in urban areas, primarily due to higher population exposure. It should be noted however that the assumed health benefit per tonne of particulates and resulting estimates of health benefits masks significant variation that would be expected across individual rural and regional communities.

Figure E.3 shows the share of emission reductions and health benefits that would be realised in rural and regional communities across the options.

Figure E.3: Share of emission reductions and health benefits in rural and regional areas



Sensitivity analysis

The sensitivity of the benefit cost findings was tested across key assumptions, including the assumed level of retail compliance with new standards and the relationship between new emission standards and resulting in-service emission performance achieved. The benefit cost results were not found sensitive to either of these assumptions, or other parameters tested.

The proportion of health benefits arising from measures directed at existing wood heaters is much higher than the proportion of emission reductions attributable to these heaters, as in-service measures are focused primarily in urban airsheds where health benefits per tonne of emission reduction is much higher.

In turn, this serves to moderate the importance of assumptions relating to new heaters, such that the benefit cost ranking of options was not found sensitive to the assumed 'pass through' of new wood heater emission performance capability (due to a lower standard and / or improved retail compliance) to in-service operation.

Notwithstanding the importance of measures directed at existing wood heaters, the benefits of emission reductions from new wood heaters is still substantial, such that if there were only a 5% pass through of new wood heater emission performance capability, the resulting benefits would still far exceed the total cost of all measures under any option.

A national approach for managing wood heater emissions

Overall, the analysis supports national action to reduce emissions from wood heaters. All options examined in the cost-benefit analysis are estimated to provide significant emission reductions and net benefits to the Australian community.

The greatest net benefits are likely to be achieved via a national regulatory approach for managing wood heater emissions, rather than through a voluntary or collaborative approach. This could be achieved either through a Commonwealth regulation, a National Environment Protection Measure (NEPM) or through mirror legislation.

A Commonwealth regulation could provide regulatory consistency. Through national coverage, consistent standards, monitoring and enforcement are likely, and hence all industry participants would face uniform requirements. However there is a small possibility that some new wood heaters entering the market would not be covered under a Commonwealth regulatory approach. Of greater concern would be that Commonwealth legislation could only apply to new wood heaters, and would not be able to cover second hand wood heaters, controls on installation or modification or other measures directed at improving in-service emission performance.

Alternatively, complete industry coverage could be achieved via either a NEPM or mirror legislation. A NEPM is expected to cost more than Commonwealth regulation, due to the need for multiple state and territory regulations and the reporting requirements under a NEPM. However, the differences in costs are relatively minor (a present value of around $1m) in the context of the estimated net benefits over the assessment period.

The development of mirror legislation may be a more costly and lengthy process than a NEPM, requiring new legislation in all jurisdictions as well as the Commonwealth, and most likely the development of a separate intergovernmental agreement. Implementation costs may also be higher depending upon the agreed implementation arrangements.

A further consideration is that the use of a NEPM or mirror legislation, with administration at the jurisdictional level, would allow each jurisdiction to align their level of compliance activity on the risk posed to the jurisdiction. The administration of wood heater emissions compliance by local jurisdictions may provide for more cost-effective audit and enforcement activities given their local presence, better local knowledge and contact with manufacturers and retailers.

The merits of the alternative vehicles with which to deliver a national approach for managing wood heater emissions requires specific consideration during the formal public consultation period.

1 INTRODUCTION

1.1 Context

According to the World Health Organisation, air pollution continues to pose a significant threat to health worldwide (WHO 2006b). Although Australia's urban air quality is generally good (DITRDLG 2009), concerns remain regarding the concentration of air pollutants and the impact they can have on community health and wellbeing. Air quality is also a headline indicator in the recently announced *Sustainability Indicators for Australia*[1]. High levels of common air pollutants can result in an increase in respiratory and cardiovascular diseases and premature deaths.

The *State of the Air in Australia: 1999–2008* report identified particles and ozone as air pollutants of concern in Australia[2]. Peak particle levels frequently exceeded the national standard for particulate matter in nearly all regions over the assessment period. Particulate matter can be emitted from many sources, both natural and anthropogenic.

The Australian Government has taken initial steps to manage particle emission and increase understanding of the nature and impacts of particulate matter. The Australian, state and territory governments have also agreed on a National Environment Protection Measure (NEPM) for Ambient Air Quality. The NEPM sets an air quality standard for PM_{10}[3] which was varied in 2003 to include advisory reporting standards for $PM_{2.5}$[4]. The Commonwealth *National Environment Protection Council Act 1994* (NEPC Act), and complementary state and territory legislation allow the National Environment Protection Council (NEPC) to create NEPMs. The NEPC Act is currently under review.

All Australian states and territories have legislation that relates to ambient air quality, with specific policies or protocols associated with minimising generation of particulate matter. State authorities conduct air quality monitoring and regulate industrial emissions through licensing and compliance, some examples include environmental audits of landfills, quarries and crematoria, and management of particulate matter emissions from coal mines.

1.2 Wood Heater Consultation RIS

Wood heaters are a significant source of particulate matter in winter months, especially in some of the more highly populated southern airsheds of Australia. Wood smoke from residential wood heaters is made up of a complex mixture of gases and particulate matter which can cause adverse health effects when inhaled. 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).

1 Measuring Sustainability program http://www.environment.gov.au/sustainability/measuring/indicators/index.html

2 DSEWPaC 2010

3 PM_{10} commonly refers to particulate matter with a diameter of less than 10 µm

4 Particulate matter with a diameter of less than 2.5 µm

The factors that can contribute to the amount and type of emissions produced by wood heaters include fuel moisture content, maintenance and cleanliness of the flue. Usually the major reason for excessive emissions is due to poor wood heater operation, therefore, improvements in technology are considered appropriate to ensure emissions are less dependent on operator skill[5].

The current approach for controlling wood heater emissions in Australia is to limit particulate emissions from new heaters through the implementation of Australian Standards. Further tightening of the standards to reduce the airshed particle load from wood heaters, continues to be discussed. Some jurisdictions regulate other aspects associated with wood heaters that can influence emissions, for example, modification of wood heaters and moisture content of firewood. Additionally education and targeted jurisdictional programs to reduce emissions from in-service heaters have been undertaken. Notwithstanding these programs, emissions from both new and in-service heaters continue to contribute to high ambient levels of particulates in some areas with associated health impacts.

There are a vast number of combinations of wood heater emission reduction measures that could be crafted as the basis of a national response. The approach taken has been to develop a suite of policy combinations that will allow the relative importance of different measures and policy approaches to be assessed, and hence inform subsequent stakeholder consultations. Identification of the best suite of policy combinations will be more achievable following consultations, further data collections and in the preparation of a decision RIS. It should be noted that the word national, used throughout this report, is not necessarily synonymous with Commonwealth responsibilities and may refer to cooperative action taken by jurisdictions with or without the cooperation of the Commonwealth.

Section 2 of this Consultation RIS provides an overview of the wood heating industry in Australia and Section 3 identifies the scale and scope of impacts of particulate emissions from wood heaters. Section 4 considers the underlying market failure that has led to the problem of wood smoke, why current policies have not been sufficient to manage the problem and the rationale for and objective of new policy interventions.

Section 5 identifies a range of policy measures and the outcomes of a short listing exercise undertaken to select measures for more detailed analysis. Section 6 evaluates three broad policy vehicles for national action which could be employed to introduce various combinations of measures.

Section 7 provides the results of a benefit-cost analysis of options in terms of their economic, social and environmental impacts and Section 8 presents our overall conclusions. Section 9 provides details of the current consultation phase of the project and how to participate, while Section 10 explores implementation issues and review processes.

5 OECD 2007

2 AUSTRALIAN WOOD HEATERS

This section provides an overview of the wood heating industry in Australia. It discusses the size and nature of the industry, the use of wood heaters across Australia and the profile of wood heaters sold and in use in Australia.

2.1 Characteristics of the industry

The Australian Home Heating Association (AHHA) is the peak industry body representing over 250 manufacturers, retailers, installers, maintenance companies and the firewood sector of the wood heating industry. The AHHA estimates that the industry employs around 10,000 Australians nationwide[6]. Around 70% of the workforce is unskilled and a significant proportion of workers are from rural and regional areas[7].

Wood heater manufacture is predominantly in NSW and Victoria and most manufacturers also produce barbeques. While there are 27 Australian manufacturers, four companies account for around 80% of the sales[8]. The industry's turnover is around $90 million per year[9]. In addition there are second and third tier industries that are dependent on the wood heater manufacturing industry as they supply the industry with paint, glass and steel.

The AHHA reports that wood heater sales have dropped from a peak of 120,000 units per year in 1988 to around 25,000 units per year on average over the last three years[10]. The 18 respondents to an earlier manufacturer survey reported retail sales of 24,180 units in 2007-08 (up from 21,896 units in 2006-07[11]). Over 60% of retail sales are estimated to be in NSW, ACT and Victoria as shown in Figure 2.1.

The sales figures above include sales of imported units, estimated at around 6,000 units in 2007-08 (or around 25% compared with around 15% reported by the AHHA in 2005/06). Over 90% of these are assembled units, with a small proportion requiring local assembly. Almost 50% of imported units are estimated to come from New Zealand and around 20% from China as shown in Figure 2.2.

The wood heater industry also has a small export market. Four respondents to the 2009 industry survey provided export data for 2007-08, with 890 assembled units exported to Japan, the US, Canada and New Zealand.

6 www.homeheat.com.au

7 AHHA 2003

8 Barbeques Galore, AF Gason, Shamic Sheetmetal and Pecan Engineering

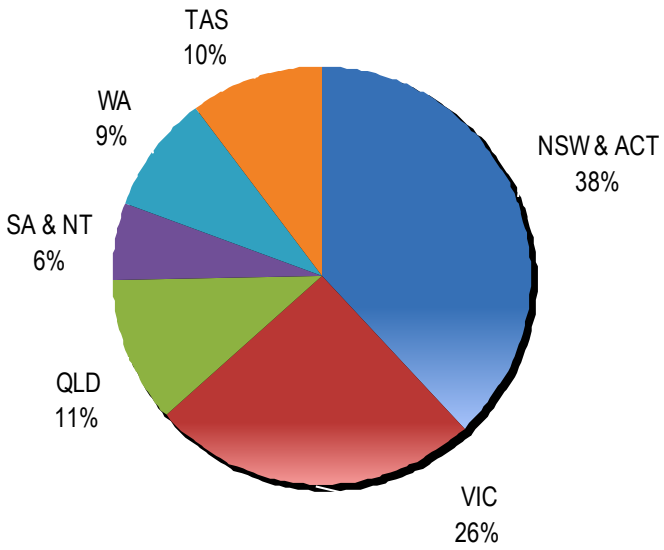
9 www.homeheat.com.au

10 AHHA 2009

11 Walter Turnbull 2009

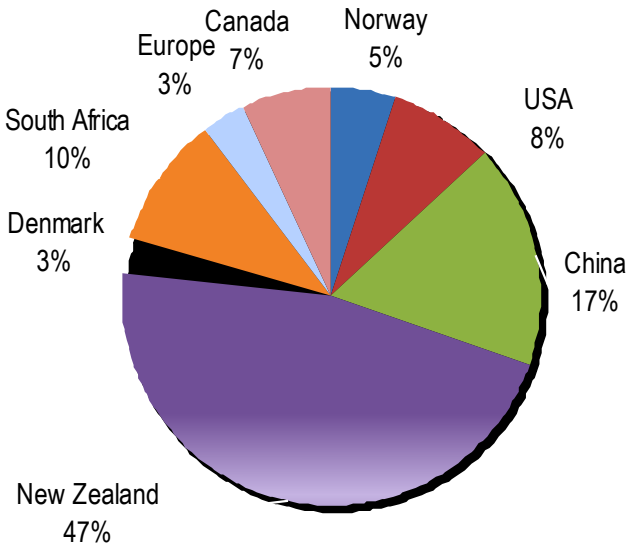
The industry produces 240 certified models[12] from around 130 different fireboxes. Sales are seasonal with nearly 50% of sales occurring in the April to June quarter.

Figure 2.1: Retail sales of wood heaters by state, 2007/08



Source: WalterTurnbull 2009: Includes wood heaters meeting standard AS 4013, other wood heaters that are excluded from AS4013 and pellet heaters; results shown as totals for those companies who provided a breakdown.

Figure 2.2: Imports of wood heaters by country, 2007/08



Source: WalterTurnbull 2009: totals for the eight companies who provided import figures.

12 Ibid

A survey of wood heater manufacturers and importers conducted in 2009 reported an annual turnover of around $180 million and 1,025 employees[13]. The total turnover figure is much higher than reported by the AHHA suggesting some companies may have reported turnover for their whole business (rather than the heater component). Table 2.1 summarises the company characteristics reported in the 2009 survey.

Table 2.1: Characteristics of wood heater manufacturers

	Annual turnover ($m)	Number of employees
Lowest	$0.1	2
Average	$11	60
Highest	$100	600

Source: WalterTurnbull 2009: 16 companies provided annual turnover; 18 companies provided number of employees. Approximate figures shown.

2.2 Wood heater usage

Australians have a preference for wood heaters with large fireboxes compared to the fireboxes sold in New Zealand and Europe, and Australian wood heaters are designed to use hardwoods whereas wood heaters manufactured overseas are designed primarily to use softwoods. The average lifespan of a wood heater operated in Australia is estimated to be 15-20 years[14].

The Australian Bureau of Statistics (ABS) conducted a survey on energy use and conservation in March 2008 providing information on household practices in relation to domestic energy use[15]. The survey results show around 1.1 million Australian dwellings use wood as a source of energy. There has been a downward trend in the use of wood as a source of energy in dwellings, from 18% in 2002 to 13% in 2008. On average around 10% of Australian dwellings use wood as their main heating source for space heating in 2008 compared with 14% in 2002. Figure 2.3 shows the downward trend by state.

Detailed surveys of wood heater use have been carried out in Sydney, Launceston and Perth. The results of these are summarised in Appendix 1.

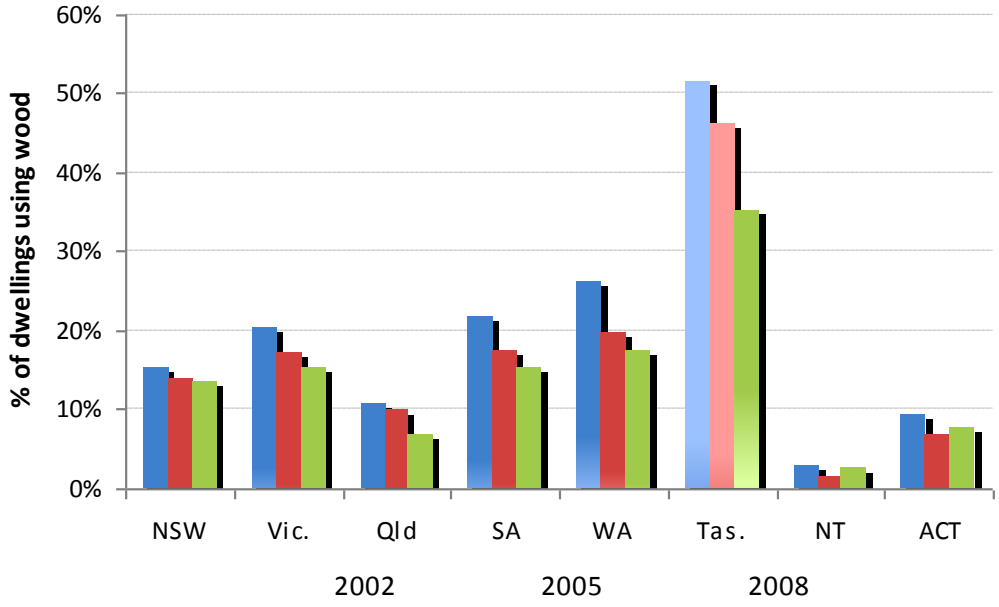
The ABS survey also collected information on the frequency of heater use. Figure 2.4 shows how the months of heater use differs by state / territory.

13 WalterTurnbull 2009

14 Environment Link and BDA Group 2006

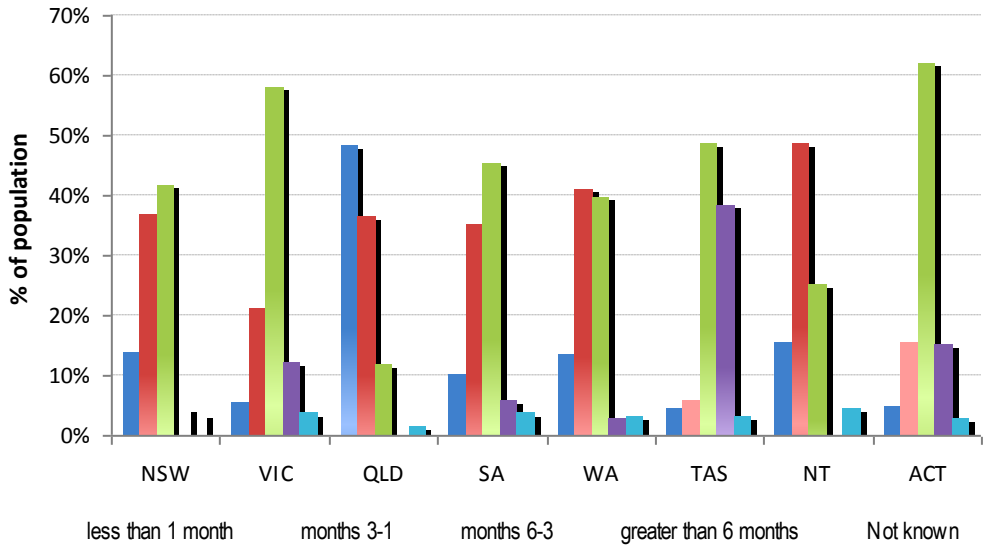
15 ABS 2008 *Environmental Issues: Energy Use and Conservation* (Catalogue 4602.0.55.001) A new ABS survey in this series dated March 2011 shows a slight increase in wood heater usage.

Figure 2.3: Dwellings using wood as the main space heating energy source by state, 2002-2008



Source: ABS 2008.

Figure 2.4: Months of heater use (all heater types) by state, 2008

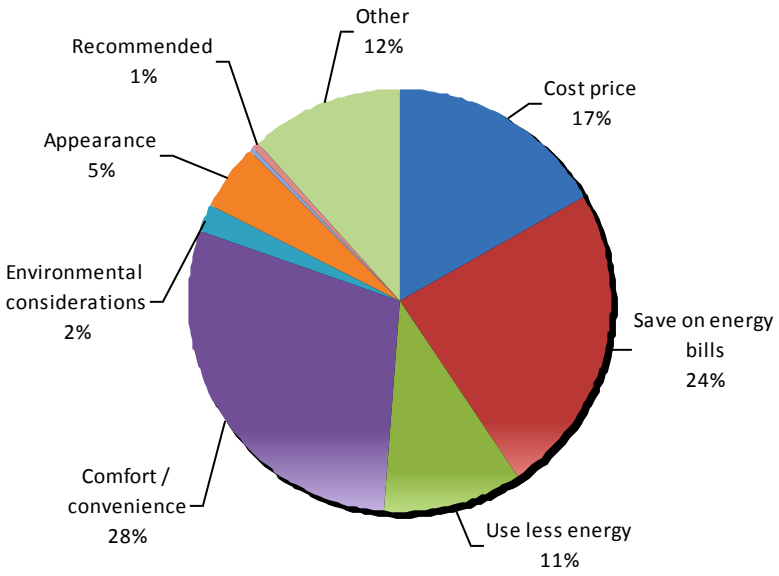


Source: ABS 2008

The results show that households in the cooler and temperate climates of Tasmania, Victoria and the Australian Capital Territory used heaters more frequently than households in the warmer areas, such as in the Northern Territory and Queensland.

The survey also provides information on the reasons for choosing different forms of heating. Figure 2.5 shows the main reason reported for choosing a wood heater.

Figure 2.5: Main reason for choice of heater, 2008



Source: ABS 2008

Over 40% of people reported the cost of heating as the primary reason for choosing a wood heater (24% for ongoing savings and 17% for a lower upfront price). Around 30% of people reported comfort / convenience as the main reason for choosing a wood heater.

Estimates of the annual cost of wood heating in selected locations are shown in Table 2.2, along with recent estimates of the cost of firewood and wood use in each place.

Table 2.2: Estimated annual cost of heating per household, selected locations

	Price ($/tonne)[a]	Wood use tonnes[b]	Annual heating cost
Tasmania	$150	10.28	$1,540
Sydney	$380	3.43	$1,300
Wagga Wagga	$180	4.08	$730
Melbourne	$300	3.75	$1,130
Perth	$270	3.09	$830

Sources: a Firewood Association of Australia

b ABARE residential wood consumption data 2007/08, except for Sydney & Wagga Wagga where NSW GMR inventory assumptions are used

The annual heating cost varies in different locations due to both differences in wood purchase costs and levels of wood use.

The shift away from wood heaters across Australia highlighted in Figure 2.3 is likely to continue due to a range of factors including:

- lifestyle changes (higher density housing, convenience);
- improved alternative heating options available (central heating, gas-fired, log fires);
- increasing price of wood heaters relative to other heating options; and
- government programs such as buy-back schemes and 'don't light tonight' programs.

On the other hand, people's concerns over greenhouse emissions[16] and higher energy prices may cause a swing back to wood heating in some areas. On balance, total wood heater numbers are likely to remain steady as higher energy prices and continued population growth offset those factors listed above.

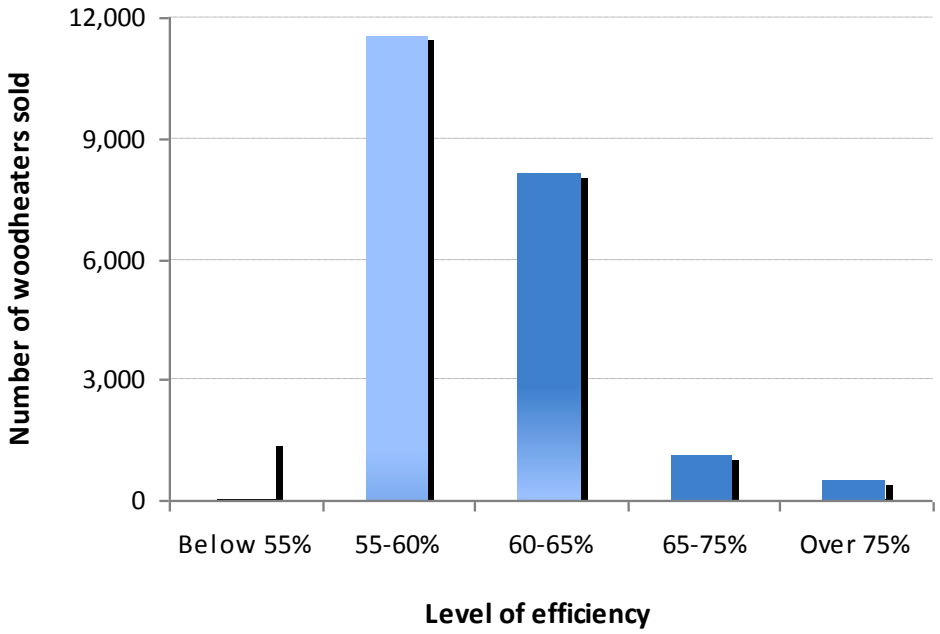
2.3 Profile of new wood heaters

Two key measures are typically used to characterise the performance of wood heaters. The wood heater's operating efficiency and the wood heater's particle emission level. The operating efficiency measures how much of the heat value contained in the wood is extracted and delivered into the living space. Particle emissions are measured in terms of particle mass (in grams) emitted for each kilogram of wood burnt under test conditions. This may differ from actual emissions for a wood heater in use as the quantity of particles also depends on how the wood heater is operated (for example the type of firewood used and whether it is dry; the size and spacing of logs; and whether the fire is burning brightly).

The survey of wood heater manufacturers conducted by Walter Turnbull in 2009 provides information on the design profile of wood heaters sold in Australia in 2007-08. Figure 2.6 provides the number of wood heaters sold in different efficiency categories in Australia in 2007-08.

[16] Although poorly designed or managed wood heaters may have higher greenhouse emissions than other forms of heating, there is a general perception by the community that wood heaters have lower greenhouse emissions.

Figure 2.6: Design efficiency of wood heaters sold in Australia, 2007-08

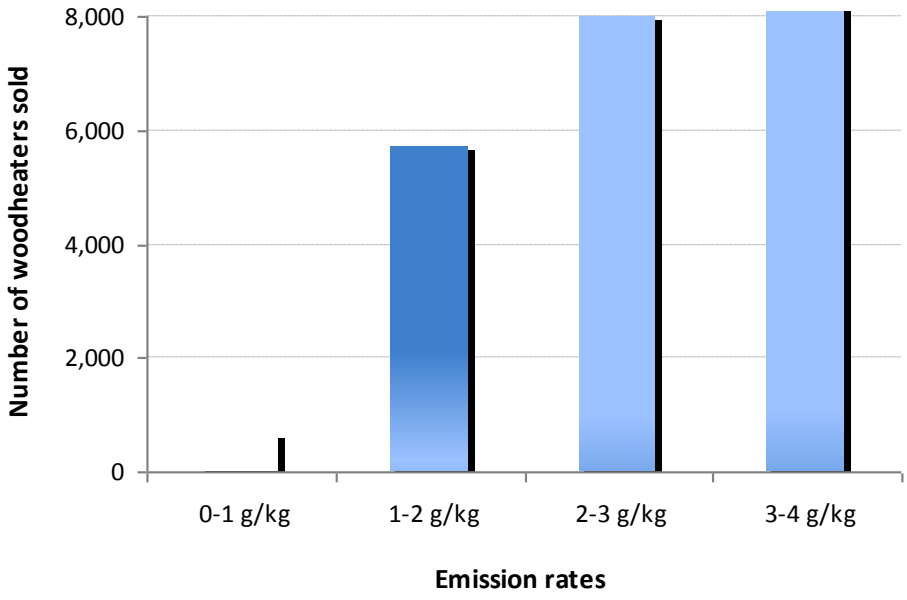


Source: WalterTurnbull 2009

Around 50% of wood heaters sold had a design efficiency of 55-60%, and around 35% had an efficiency of 60-65%.

Figure 2.7 shows the number of wood heaters sold with various design particle emission levels.

Figure 2.7: Design emission levels for wood heaters sold in Australia, 2007-08



Source: WalterTurnbull 2009

The survey results suggest around 70% of wood heaters sold had a design emission level between 2 grams per kilogram and 4 grams per kilogram. Around 25% had an emission level of between 1 and 2 grams per kilogram. The results suggest an average design emission level of around 2.6 grams per kilogram and an average design efficiency of 59.6%[17].

2.4 Particulate emissions from in-service wood heaters

In practice wood heater efficiencies and performance may differ from their design performance because the wood heater sold may differ from the model tested in a laboratory or the wood heater may have been modified, for example, to achieve longer burn times between refuelling. Emissions from wood heaters in use may also differ because of different fuels used and because householders operate heaters differently to the standard test method. In particular, householders generally switch the heater to medium or low air inflow before the fire is established.

Since 1992, Australian Standard/New Zealand Standards have existed to improve the performance of wood heaters. These are discussed in more detail in section 3.2. The industry performance standards include a test method that uses highly specified, controlled operating conditions to assess the operation of wood heaters.

As noted by Todd[18], the original intention of the standard test method was not to obtain emission values for each wood heater model representative of in-service values. Rather, the intention was to eliminate wood heater designs that produced excessive emissions and to rank compliant wood heaters as a function of their emission factors. There was an assumption that if two wood heaters were tested, the one that performed better under test conditions would also perform better when used in people's homes.

However there has been considerable debate in recent years about the veracity of this assumption. This has led to a number of studies examining the in-service emissions of wood heaters. An overview of the results from those studies is provided in Appendix 2.1.

The studies have consistently found that emissions from in-service wood heaters exhibit a large variation in emissions due to heater operation and installation. In addition, in-service emissions have been found to be much higher than that specified in regulatory standards, with 10 g/kg thought to be indicative of average in-service emissions.

However due to the large variation in in-service emission performance, the small sample sizes used in the studies and limited testing undertaken under Australian conditions, considerable uncertainty remains as to the relationship between emissions identified with the test method and model at the time of certification and in-service emissions. The significant level of non-compliance of retail models with test models (discussed further in section 4.2), and some

17 The averages have been derived using AHHA 2010 certification data to determine the likely average emissions and efficiency in each category in the Walter Turnbull survey

18 Todd 2008a

evidence of poor wood heater installation practices, further complicates postulating particle emission factors from wood heaters certified under earlier, current or future emission standards.

Drawing on what information is available, we have identified emission factors for currently in-service wood heaters and for new heaters entering the market. The emission factors are presented in Table 2.3 and their derivation described in Appendix 2.2.

Importantly, the assumed emission factors seek to distinguish differences attributable to design (emission standard), compliance of retail models with the standard, and due to how the heaters are operated in-service, as wood heater control measures examined in this RIS variously influence these parameters.

Table 2.3: Average wood heater particulate emissions (g/kg)

Heater type	Design performance	Retail performance	In-service performance based on operating practices[1]		
			Good	Careless	Poor
Open fireplace	-	17	17	17	17
Uncertified heater	-	9.9	9.9	11.9	17.9
Certified 1992	≤ 5.5	8.8	8.8	10.6	15.8
Certified 1999 - 2009	≤ 4.0	6.4	6.4	7.7	11.5
New heater 2010 -	≤ 4.0	5.0	5.0	6.0	8.9

Notes: 1. As described in Appendix 2.2, the classification is based on a CSIRO (2008) study of in-service heaters, from which we have classified the heater operation of the 25% with the lowest emissions as 'good', the next 70% as 'careless' and worst 5% as 'poor'.

The NSW Department of Environment, Climate Change and Water undertook a preliminary assessment of the emission estimates reported in Table 2.3 and concluded they were sound for the purposes of the analysis undertaken.

QUESTIONS

Stakeholders are welcome to provide feedback on any aspect of this chapter. The following questions have been formulated to provide a starting point for submissions. Please provide references where required.

1. ***What is your view of the wood heater industry in Australia? Are there specific aspects of the industry that require attention? Please provide details.***

2. ***Can you provide evidence of new or different operational or marketing paradigms that would affect the stated view?***

3 STATEMENT OF THE PROBLEM

A range of environmental and health impacts have been associated with the use of wood heaters, including reduced habitat and biodiversity impacts from firewood harvesting and collection, as well as health and environmental impacts associated with the emission of particulates and air toxics from wood heaters. The use of wood heaters can however lead to lower greenhouse gas emissions relative to some alternative space heating options and associated energy sources.

The most significant impact and focus in this study are the health implications of particulate emissions. In this section we briefly identify the scale and significance of particulate emissions from wood heaters in Australia.

3.1 Contribution of wood heater emissions to particulate pollution in Australia

Wood smoke consists of particulate matter (PM) and other air pollutants, which when inhaled into our lungs can have negative health effects. Major anthropogenic sources of particles include industrial activities such as mining and electricity generation, controlled burns, domestic wood heaters and motor vehicles. Major natural sources of inhalable particles include bushfires, windblown dust and sea salt.

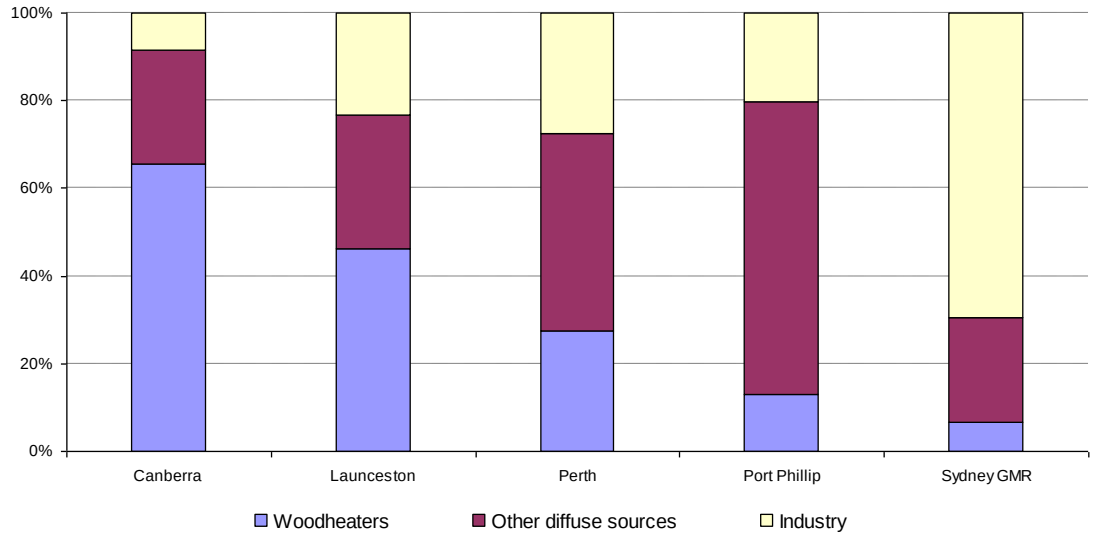
Based on data from the National Pollutant Inventory, domestic solid fuel burning (including wood heaters) is among the top eight sources of PM_{10} in Australia. Of the main non-industrial sources of PM_{10}, vegetation burning / wildfires is the most significant contributor (38%), followed by windblown dust (31%) and road dust (26%)[19]. However, these sources are largely beyond regulation and not easily mitigated. Domestic solid fuel burning contributes more PM_{10} emissions per year than motor vehicles (20 000 tonnes and 12 000 tonnes respectively) [20].

Wood heaters are a major source of emissions of particles in many regions of Australia during the cooler months of the year, as well as a significant source of air toxics. Figure 3.1 shows an estimation of the contribution of wood heaters and other sources to total PM_{10} emissions in selected regions of Australia in 2008-09.

[19] DSEWPaC 2010

[20] NPI 2011

Figure 3.1: Wood heater contribution to total PM_{10} emissions, 2008-09



Source: National Pollutant Inventory

Based on the National Pollutant Inventory (NPI) data, wood heaters are a major source of emissions in smaller regional centres such as Canberra and Launceston, and can be significant contributors in larger centres. Notably, wood heater emissions are concentrated in the winter months (for example, in Sydney, wood heaters account for 3% of total PM_{10} emissions in summer but 43% in winter)[21] when in some airsheds they can be trapped under a cold layer of air that prevents dispersion and may pose a more significant health risk due to increased exposure.

The NPI estimate of aggregate emissions Australia wide from domestic solid fuel burning for 2008-09 is around 20 000 tonnes. This is only half the amount of emissions we estimate are actually generated by wood heaters, and which for the purposes of this RIS is used in establishing 'base-line' emissions (section 7.1). The difference arises for two key reasons.

Firstly, while the NPI requires industries that meet specified emissions thresholds to submit annual reports, pollutant releases from domestic and commercial sources and from diffuse industry sources that are not required to report, are estimated by jurisdictions. These assessments are only undertaken periodically.

The NPI notes that "*diffuse data may be from a study completed in 1998-99; however it is the most up-to-date information available at that time*." This imposes limitations on the accuracy of the data, especially for example, in airsheds such as Launceston where there has been a concerted effort to reduce wood heater emissions.

Secondly, the NPI estimates are based on compliance with emission standards without making any adjustments for 'real life' operating conditions, where heaters sold may not comply with

21 NSW Department of Environment, Climate Change and Water 2010b

emission design standards and due to variations in operating practices (as described in section 2.4). Accordingly, the NPI wood heater estimates significantly underestimate actual emissions.

Nevertheless, the levels of wood heater emissions reported by the NPI are still sizeable, such that wood heaters are clearly a significant contributor to ambient levels of particulates in at least some airsheds.

3.2 Ambient levels of particulates are exceeding national standards

The national ambient air quality standard for particles with a diameter of less than 10 micron (PM_{10}) is 50 µg/m^3 averaged over a day. The 2008 goal was to meet the standard allowing for five exceedance days each year accounting for unforeseen events such as bushfires and dust storms[22].

Table 3.1 summaries compliance with the national air quality standard and goal for PM_{10} in recent years for a number of airsheds. The table shows the number of exceedences reported against the PM_{10} National Air Quality Standard for each airshed and the sources contributing to those exceedences.

Table 3.1 shows that wood smoke has been a major contributor to exceedances in the reported years in Canberra and Launceston, although no exceedences of the standard have been observed in Launceston since 2006. Apart from the most recent year, the ambient goal was not met in the Port Phillip region over the reported years, largely due to dust storms and bushfires during the summer period. However urban sources, including wood smoke, are reported as a contributor to exceedances in 2005, 2008 and 2009. Only one exceedance is shown for the Perth airshed, two for SE Queensland and four for Sydney, with bushfires and dust storms indicated as the key contributors in these airsheds.

22 National Environment Protection (Ambient Air Quality) Measure

Table 3.1: Summary of compliance with PM_{10} National Air Quality Standard for selected airsheds

Airshed	2002	2003	2004	2005	2006	2007	2008	2009	2010
Canberra	5 Met 2 due to woodsmoke	13 **Not met** dust & bushfires	3 Met 2 due to woodsmoke	10 **Not met** 8 due to woodsmoke	4 Met bushfires	5 Met 2 due to woodsmoke	3 Met other	9 **Not met** 4 due to woodsmoke	0 Met
Launceston	13 **Not met** 12 due to woodsmoke	22 **Not met** 19 due to woodsmoke	10 **Not met** All due to woodsmoke	13 **Not met** All due to woodsmoke	6 **Not met** 3 due to woodsmoke	5 Met 4 due to woodsmoke	1 Met bushfire	0 Met	0 Met
Perth	2 Met fires & dust	1 Met other	1 Met	3 Met fires	0 Met	1 Met fires	7 **Not met** dust	0 Met	4 Met fires
Port Phillip	6 **Not met** most due to fires & dust	13 **Not met** most due to fires & dust	11 **Not met** dust	9 **Not met** 6 urban sources	17 **Not met** All due to dust and bushfires	14 **Not met** dust & fires	10 **Not met** most due to fires & dust, 3 due to urban sources	20 **Not met** due to fires & dust, 9 due to urban sources	0 Met
SE Qld	8 **Not met** due to bushfires or dust	2 Met none due to woodsmoke	3 Met none due to woodsmoke	3 Met none due to woodsmoke	0 Met	1 Met dust	2 Met dust	8 **Not met** due to bushfires or dust	0 Met
Sydney	17 **Not met** 10 due to bushfires or dust	10 **Not met** bushfires	2 Met	2 Met 1 bushfire	4 Met bushfires	2 Met	1 Met dust	11 **Not met** due to bushfires or dust	10 **Not met** due to bushfires or dust

Source: Jurisdictional National Environment Protection (Ambient Air Quality) Measure compliance reports to the National Environment Protection Council

Notes: Where there is more than one monitoring station in an airshed the exceedences given above are from the station that recorded the highest number of exceedences.
Fires can be bushfires or planned burns; Urban sources (Port Phillip) are typically from motor vehicles and wood heaters; Other generally means localised activity such as construction.
NSW only cites events that can be clearly identified as influencing pollution levels, mainly dust storms or bushfires

3.3 Health effects associated with failure to meet particulate standards

Particulate matter consists of a mixture of solid and liquid particles suspended in the air. Particles can vary in size, composition and origin, with the particles of greatest concern to public health being those with a diameter of less than 10 micrometers (µm) (PM_{10}) as they can be inhaled into lungs. Particles with a diameter of less than 2.5 µm ($PM_{2.5}$) are small enough to be inhaled deep into the lungs where they can directly enter the bloodstream.

Particulate matter can remain suspended in the air for some time, depending on the size of the particles[23]. Coarse particles ($PM_{2.5\text{-}10}$) are more easily deposited and tend to remain in the air for minutes to days, typically travelling a distance of less than 10 km. Fine particulates ($PM_{0.1\text{-}1}$) can remain airborne for days to weeks, and can therefore travel large distances of hundreds to thousands of kilometres potentially crossing regional borders. Current science suggests that the health impact of $PM_{2.5}$ may be most pronounced in relation to cardiovascular illnesses and mortality, and that PM_{10} is more important in exacerbating asthma and upper respiratory illnesses.

Exposure to particulate matter has been associated with a range of different health outcomes including: an increased risk of upper respiratory tract irritation and infection; impaired lung function; exacerbation of existing respiratory and cardiovascular illnesses; and increased risk of death from these diseases. Although all populations can be affected, people with existing respiratory and cardiovascular illnesses (for example, chronic obstructive pulmonary disease, asthma and ischemic heart disease), the elderly and children are at a greater risk of effects from particulate matter.

The health costs associated with exposure to air pollution can be linked to: direct costs to the health system for hospital admissions and visits to the doctor; medication costs; costs to businesses for reduced productivity and absenteeism; and costs to individuals experiencing mild or severe health impacts.

A range of adverse health impacts of particle emissions are widely acknowledged by health experts, including:

- increases in total, respiratory, and cardiac mortality;
- increased hospital, surgery and casualty admissions for respiratory disease, bronchitis, asthma, cardiovascular disease and chronic obstructive pulmonary disease;
- increased limitations to functional activity, either as absence from school (children) or work days lost and other restrictions for adults;
- increase in the daily numbers of respiratory symptoms; and
- pulmonary function decreases in healthy children or adults with obstructive airways problems.

23 WHO 2006a

Current science indicates that there is no clear threshold for adverse health effects from particulate matter in the atmosphere, and that adverse effects can be experienced after both short-term and long-term exposures. Studies show that adverse health effects have been demonstrated at exposures currently experienced in urban populations in developed countries[24] and that levels below the Ambient Air Quality NEPM can still represent a measurable health risk to the Australian population[25].

As there is no clear level below which adverse health effects from particulates would not be observed, any reduction in ambient air concentrations of particulates will reduce population exposure and risk, resulting in a net positive health benefit. As noted in the review of the Ambient Air Quality NEPM:

> *'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.'*[26]

An exposure reduction approach can improve air quality in areas of high population density where higher numbers of individuals are likely to be exposed and the greatest net health benefits can be expected. Similarly, improvements in air quality in regional areas are expected to realise improved health outcomes, albeit at a lower quantum.

Health benefits from lower particle emissions will vary between airsheds due to climate, meteorological, demographic and population exposure factors. A few studies in Australia[27] and internationally[28] have sought to derive 'primary' valuations[29] of particulate damage values, drawing on pollution emission inventories, relationships for particulate exposure and health outcomes and the application of valuations of health outcomes. For example, the impact of particle emissions on ambient air quality is examined, the likely level of exposure determined given the size of the population, the cause and effect relationship between exposure and a health outcome such as respiratory illness determined, and an estimation of the resulting health costs provided.

More commonly, studies have drawn on the available primary valuations to infer damage values appropriate for the location and policy context being considered. As most of these studies have been concerned with particulate damage costs arising from transport emissions, primary

24 WHO 2006b

25 NEPC 2011

26 Ibid

27 For example, NSW DEC 2005

28 For example EC 1995, Holland and Watkiss 2002, European Commission 2003, Holland et al. 2005, AEA Technology Environment 2006

29 A 'primary' valuation refers to an estimate from an original research study to estimate economic values for changes in environmental goods and services or human health in a particular location

valuations have on occasion been adjusted for the size of the populations exposed relative to populations that were the subject of the primary valuations.

Despite this effort, a large range in postulated particulate impact values that may be applicable in the Australian context exists, and these are briefly canvassed in Appendix 3. Postulating particulate impact values for wood heater emissions is further complicated by the influence in some centres of meteorological factors that can trap night-time and predominantly winter wood heater emissions in temperature inversion layers. Accordingly, wood heater particulate impact values could vary significantly between two centres with similar populations.

Nevertheless, due to limitations in available primary valuations, the use of average impact values across a broad range of circumstances cannot be avoided. The impact values assumed for this study are shown in Table 3.2, while their derivation is given in Appendix 3.

Table 3.2: Assumed particulate emission damage costs ($/tonne PM_{10})

Community	Damage cost
Large capital cities (Melbourne and Sydney)	$263,000
Smaller capital cities and large regional centres experiencing high particulate pollution levels (e.g. Launceston, Armidale, Wagga)	$113,000
Other areas	$1,500

The values shown in Table 3.2 for particulate emissions are broadly consistent with those employed in recent policy evaluations undertaken at the national level, such as by the Department of Infrastructure, Transport, Regional Development and Local Government for a 2009 Regulation Impact Statement on vehicle emission standards[30]. However in that study, the latter two categories, that is smaller capital cities and other areas, were combined.

In this study, we have sought to differentiate impacts in metropolitan and rural areas due to the significance of wood heater sales in rural areas, and implications this will have to the evaluation of policy measures (such as heater emissions standards) whose benefits are linked to the performance of new wood heaters.

However as noted in Appendix 3, the value for 'other' areas will clearly mask a wide range of values that would exist between the almost negligible impacts associated with farm and remote households to those in rural communities where wood heater emissions may be of a greater concern, such as perhaps Tamworth, Albury, Bathurst in NSW or Albany, Bunbury and Busselton in WA. Nevertheless, the values shown in Table 3.2 are sufficient for a national level analysis.

30 DITRDLG 2009

3.4 Summary

There are approximately 1.1 million dwellings using wood heaters throughout Australia. The majority of wood heaters are in the southerly and more populous airsheds in the country, and are used more frequently than those in households in warmer areas. Emissions from wood heaters are a major source of emissions of particles in many regions of Australia during the cooler months of the year.

National air quality standards, including those governing particulates and other air toxics generated by wood heaters, have been in place since 1998 under the National Environment Protection (Ambient Air Quality) Measure. While Table 3.1 shows that exceedences of the national standards for particulate emissions have been an issue for only a few troubled airsheds across the country, caution is needed in drawing inferences from this.

Firstly, the level of particulate emissions attributable to wood heaters when identifying sources contributing to exceedences of the national standard has been based on those reported under the NPI. As discussed in section 2, the NPI estimates are believed to report only half the level of actual emissions.

Secondly, there is no clear level of particulate emissions below which adverse health outcomes in communities would not be observed. This means that there is no "safe" level of particulate pollution and that further improvements in air quality below the standards currently set in the Air Quality NEPM will continue to provide public health benefits. There are therefore significant health benefits to the community in implementing national policy options to reduce particulate emissions from all sources (including wood heaters) for all airsheds across the country.

QUESTIONS

Stakeholders are welcome to provide feedback on any aspect of this chapter. The following questions have been formulated to provide a starting point for submissions. Please provide references where required.

3. ***Do you consider wood heater emissions to be a significant issue relative to other forms of air pollution?***
4. ***Do you agree with the conclusions provided in this section? If not, please provide reasons.***
5. ***Are there other variables that have not been considered or not been attributed sufficient weight in the discussion?***

4 RATIONALE FOR GOVERNMENT INTERVENTION

In this section we consider the rationale for and objective of any new policy intervention; the underlying market failure[31] that has led to the problem of wood smoke; why emissions from wood heaters continue to contribute to high ambient levels of particulates in some areas; and issues in crafting combinations of policy measures.

4.1 Objective of new policy measures

The purpose of this consultation Regulation Impact Statement is to assess alternative policy options that could be employed to reduce emissions from wood heaters in Australia, and to establish their relative costs and benefits. Identifying potential net benefits from new policy interventions would in turn provide the 'sufficient' conditions for government intervention and support the development of a decision Regulation Impact Statement - the 'necessary and sufficient' conditions for (new) government intervention are that market failure exists and that the benefits of intervention will outweigh the costs.

As noted earlier, the EPHSC has indicated a preference for a national statutory approach to ensure regulatory consistency and provide greater certainty of an environmental outcome. The objective of new policy measures considered in this study is therefore to:

- reduce wood heater emissions
- reduce associated health impacts, and
- achieve these two outcomes through a national policy initiative.

In Section 4.2 the nature of the market failures in relation to wood heater particulate pollution are presented, while Section 4.3 indicates that current policy interventions are not successfully limiting wood heater emissions in line with policy objectives.

The case for further policy intervention therefore rests on whether or not such intervention could deliver net benefits to the community. Available information presented in Section 4.3 indicates potentially significant benefits from reducing particulate emissions, and a 2006 study of the costs and benefits of new wood heater particle emission and efficiency standards indicated that some policy measures could deliver large net benefits[32].

However, more recent information on compliance with existing emission standards and the significant difference between certified emissions and real-world emissions indicates that new standards by themselves may not realise the estimated net benefits.

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31 Market failure is where a market fails to efficiently provide or allocate goods or services. A common type of market failure is an externality, where a third party is affected by the decisions and actions of others.

32 Environment Link and BDA Group 2006

4.2 Market failure

Available information presented in Section 2 indicates that particulate emissions from wood heaters are a significant contributor to ambient levels of particle pollution, and that in several regions the national goal for this pollution is not being met. In addition, a number of studies of health costs arising from particle pollution indicate that the costs to society from wood heater emissions could be high.

There are clear market failures that have contributed to the current situation. Firstly, many households will not have clear and comprehensive information on the impacts that emissions from their wood heaters cause to their communities or on how they could operate their heaters differently to mitigate these impacts. These information failures prevent households from voluntarily adjusting their behaviours.

Secondly, householders may believe that changing their behaviours may cause them inconvenience, loss of amenity or other costs. As these households are not liable for the impacts that their wood heater emissions create, even well informed households may choose not to adjust their behaviours.

Thirdly, wood heater designs that limit or remove human interaction with the primary air flow, thus reducing emissions by design rather than relying on operator behaviour, are not currently available in the Australian market. In this situation, the 'externalities' that households impose on others in the community reflects a market failure. That is, as the air quality benefits of reducing particulate emissions cannot be captured by owners of wood heaters, typically they will not adjust their behaviours relative to what is socially desirable – and there will be a correspondingly loss in clean air amenity. This market failure leads to economic efficiency costs (health impacts) and represents the necessary conditions for government policy interventions, which are considered in the next section.

4.3 Limitations of current policies

An overview of the current regulatory framework for controlling wood heater emissions in Australia, as well as brief comment on approaches in New Zealand, the US, and Europe is provided in Appendix 4. Brief comment on the effectiveness of key Australian control policies and programs is provided in Appendix 5.

The Australian approach is characterised by the use of emission standards to limit emissions from new heaters, to provide education plus a range of targeted jurisdictional programs to reduce emissions from in-service heaters.

Since 1992, Australian Standard/New Zealand Standards have existed to improve the performance of wood heaters. The first standard for wood heater emissions was revised and published as a joint Australian/New Zealand Standard in 1999; *AS/NZS4013 (1999) Domestic solid fuel burning appliances - Method for determination of flue gas emission*.

The 1999 Standard includes an upper limit for acceptable particulate emissions of 4 grams of particles per kilogram (oven-dry weight) of fuel burnt. The Standard applies to solid-fuel burning space-heating appliances with a heat output of 25KW or less. It does not apply to masonry fireplaces, cooking stoves, central heating appliances or water-heating-only appliances.

AS 4013 (1999) is complemented by the following standards:

- AS/NZS4014 (1999) Domestic solid fuel burning appliances - Test fuels, specifies the test fuel to be used in the performance and emission test standards.
- AS/NZS4012 (1999) Domestic solid fuel burning appliances - Method for determination of power output and efficiency is used for measuring the heat output rate (power) and efficiency of residential solid-fuel burning heating appliances.

These Australian/New Zealand Standards are industry performance standards that use highly specified, controlled operating conditions to assess the operation of wood heaters. They simulate 'correct' wood heater operations using a standard fuel and do not include emissions during the lighting phase of wood heater operation. They therefore differ from 'real' world wood heater use where different types of wood and operating conditions are used that could vary particle emissions to ambient air.

Most Australian jurisdictions require new wood heaters to meet the 1999 emissions standard. No jurisdiction currently requires wood heaters to meet a minimum efficiency standard, although there is a requirement under *AS/NZS4013 (1999)* for the test efficiency to be shown on each heater's certification label.

Some jurisdictions have extra measures to curb particle emissions from in-service wood heaters, which for example, include incentives for the replacement of old wood heaters, education programs and regulations applicable to the resale of second-hand wood heaters.

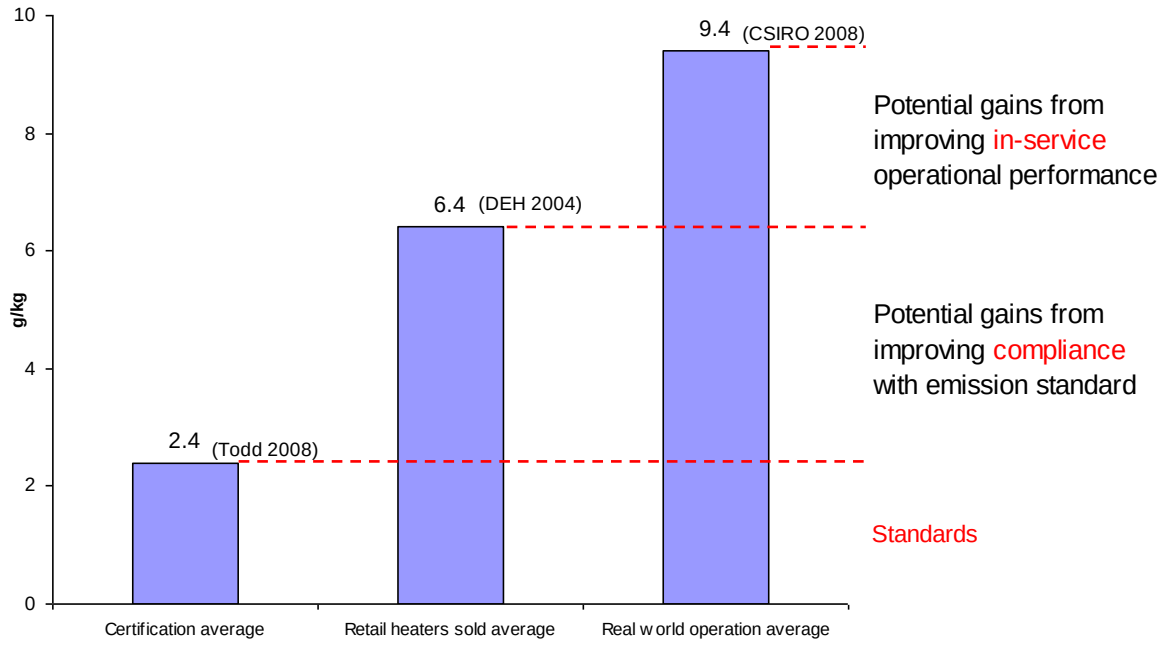
An analysis of wood heater testing data by Todd[33] shows that the average particulate emissions of heaters certified since 1999 to the Australian standard (of 4 g/kg) is some 2.4 g/kg (shown in Figure 4.1). However there is no routine auditing of emission performance by jurisdictions or evidence that models entering the market perform as well as models tested at the time of certification.

For example, the results of a 2003 audit showed that the average emissions from wood heaters on sale at retail outlets (based on the standard test method) was some 6.4 g/kg, despite all the models being certified as compliant with the current standard[34].

[33] Todd 2008b

[34] DEH 2004a

Figure 4.1: Particulate emissions from certified, retail and in-service wood heaters



In addition, and as shown in Figure 4.1, in-service emissions are likely to be even higher again. A 2008 study by CSIRO of actual emissions from a sample of in-situ heaters in Launceston indicated a wide range of emissions depending upon fuel use and operating practices, with 24 hour average emissions across the sample of 9.4 g/kg.

CSIRO found that the main determinant of particulate emissions was combustion efficiency, which in turn was determined by the air supply rate. While some wood heaters were operated largely with the dampers set fully open, most were operated at significantly reduced air flow leading to higher particulate emissions. The range in emission performance was from 2.6 g to 21.7 g/kg of fuel burned with a median of 8.6, indicating that there was a significant cohort of poor performers rather than a few responsible for raising the average survey result.

Key implications from this study are that:

- the emission rate determined by the AS/NZ 4013 compliance test does not give a good indication of the real-world performance of domestic wood heaters installed in houses, probably underestimating it by at least a factor of 2 [35];
- emission inventories using the NPI wood heater emission factor of 5.5 g/kg underestimate the contribution made by wood heaters to gross PM_{10} airshed emissions;
- in the absence of a technological design solution, in-service operating performance will need to be managed to significantly reduce wood heater emissions; and

[35] This finding is supported by earlier analysis by Todd and Greenwood (2005) who found that wood heater emissions using a 'real world' test method compared to the 'correct' method embodied in the certification standard, would be some 2.5 time higher. It is also supported by more recent analysis in New Zealand by Ancelet et al. (2010).

- significant gains in overall wood heater emissions may be possible through programs targeting those households with the worst operating skills.

Lastly, the implementation of policy initiatives such as education campaigns, policing and a wood heater buy-back scheme has contributed to significant ambient air quality improvements in Launceston, with annual PM_{10} exceedences declining from 50 to less than 5 within a decade. Emissions from in-service wood heaters in localities that have not benefited from such extensive wood heater emission programs may be even higher than suggested by the CSIRO 2008 study of real-world emissions.

In summary, the current regulatory and policy framework to control wood heater emissions in Australia has failed to meet its objectives, with emissions from both new and in-service heaters contributing significantly to ambient levels of particulates and associated health impacts. This 'regulatory' failure presents a prima-facie case for further government intervention, to either amend existing policies and programs and / or to introduce new requirements.

4.4 Defining policy combinations

There is a large range of potential policy measures that could be implemented to reduce emissions from wood heaters.

The potential measures fall into three major categories:

- wood heater design or performance standards;
- measures to promote compliance of retail models against prevailing standards; and
- measures influencing in-service operational performance of wood heaters.

Standards could cover emissions, fuel type, fuel efficiency and / or technology (such as starter controls). The compliance test method used to measure performance is also an integral part of the standard and the test method may reflect best practice or real world conditions.

Measures to promote compliance by manufacturers with certified standards involve enforcement including the certification process and auditing programs.

Measures influencing in-service operational performance could cover both new and old heaters and may include labelling requirements, installation requirements, education to promote better heater operation, replacement of old heaters and banning of new heaters in certain areas.

An assessment of the relative merits of these measures is provided in Section 5. Importantly however, these measures could be delivered through a range of policy 'vehicles'. That is, there is a range of policy mechanisms at state and territory or at the national level that could be used. The alternative policy vehicles are briefly introduced in this section.

In addition to a business as usual option which will be the baseline used when assessing the various policy options, the potential policy delivery approaches examined are a voluntary national program, a collaborative approach or a national regulatory approach.

4.4.1 A non-regulatory national program

A continuation but expansion of the current approach could be pursued through enhanced national programs. Potential actions that could be pursued include national audits, education and incentives. Education and incentives could be targeted at critical airsheds to maximise gains.

4.4.2 Collaborative approach

A collaborative approach could be pursued continuing the current jurisdictional regulatory arrangements calling up the Australian Standard, supplemented by Commonwealth legislation and national programs. Potential actions for inclusion under this framework include emissions labelling, an efficiency standard, a new emissions standard, a new test method and nationally coordinated state based audit, enforcement and education. Such an approach would require adequate levels of funding.

It is recognised that under this option, standard regulations and enforcement remain as a jurisdictional responsibility. Existing concerns with the potential impacts of the Mutual Recognition Agreement would continue. As there are inconsistencies in jurisdictional wood heater regulations, there is a risk that the effective level of regulation is potentially at the lowest common denominator – essentially no regulation.

4.4.3 National regulatory approach

A national regulatory approach could be implemented in a number of different ways. The four main options include:

- ***National Environment Protection Measure***

  A National Environment Protection Measure could be established for wood heaters through the National Environment Protection Council (the Council) framework. Emissions limits for wood heaters, for example, could be established as a 'National environment protection standard' under a NEPM. An agreed test method for measuring wood heater emissions could be covered by a 'National environment protection protocol', and auditing provisions could be established as a 'National environment protection guideline'.

  When a NEPM is made all jurisdictions agree to adopt the provisions of the NEPM in their legislation. Each jurisdiction would be required to allocate sufficient resources to enforce the NEPM and report on its implementation annually.

- ***Commonwealth Legislation***

  The Commonwealth could establish new legislation requiring that any person who offers a prescribed product (wood heater) for *sale* must ensure that the product complies with specified conditions (e.g. performance and certification requirements). This would apply to manufacturers and importers of the relevant products, as well as wholesale and retail

suppliers so far as they are constitutional corporations within the meaning of the corporations' power under the Constitution.

Alternatively, the Commonwealth could regulate to prohibit the *manufacture or import* of wood heaters for use in Australia unless the appliance complies with specified conditions. Intrastate trade of wood heaters manufactured by unincorporated businesses may not be covered.

- ***Mirror Legislation***

  All states and territories and the Commonwealth could enact identical legislation to provide complete national coverage of wood heater regulation, with federal law applying to constitutional corporations and entities engaged in overseas or interstate trade, and the state laws dealing with all other persons.

- ***Referral of Powers***

  The states could refer their powers to regulate wood heater emissions to the Commonwealth, enabling the Commonwealth to create a single national wood heater management scheme. Each state would pass a referral Act through their parliament.

QUESTIONS

Stakeholders are welcome to provide feedback on any aspect of this chapter. The following questions have been formulated to provide a starting point for submissions. Please provide references where required.

6. ***Do you agree that the current policy measures for the abatement of wood heater emissions are not successful in realising the policy objectives? Can you provide other evidence to support this?***
7. ***Which policy delivery method do you believe should be adopted by government and why?***

5 IDENTIFICATION OF FEASIBLE POLICY MEASURES

Through a review of policy experiences in Australia and internationally, supplemented with consultation with government and stakeholder representatives, we have identified a range of policy measures which could be employed to reduce emissions from wood heaters in Australia.

The various measures are assessed under the categories of:

- new wood heater performance standards;
- measures to promote compliance against standards; and
- measures influencing in-service operational emissions.

In Appendix 6, comment on experiences to date with each measure is provided, along with an assessment of each against a number of short-listing criteria, namely:

- potential magnitude of emission reductions;
- environmental effectiveness across jurisdictions;
- cost-effectiveness in reducing emissions; and
- administrative simplicity and risks.

In this section, a summary of our evaluation of the various wood heater emission reduction measures is provided, along with identification of those that were chosen for inclusion in the formal impact analysis described in Section 7 of this RIS.

5.1 Measures to improve standards

More stringent emissions, efficiency and labelling standards as well as a new test method and starter controls have the potential to generate reductions in particle emissions by improving the design performance of new wood heaters purchased.

However potential benefits:

- may be slow, with annual sales at less than 2% of the number of heaters currently in service;
- will not specifically target airsheds experiencing poor air quality; and
- will be critically dependent upon parallel reforms to measures to ensure compliance of retail models sold to these standards.

In addition, more stringent emissions, efficiency and labelling standards may not significantly reduce in-service emissions if real-world emissions are poorly correlated to certified standards. A new test method or starter controls may 'force' improved operational performance, but these approaches are yet to be fully developed and agreed, and for this reason were not short-listed.

Table 5.1: Summary of relative merits of measures to improve standards

Measure	Emission reductions	Environmental effectiveness	Cost-effectiveness	Simplicity & risks	Short list
New emission standard	Potentially significant	Not targeted & gains only in long term	Low	High risk without supporting enforcement & efficiency standard	Yes
Efficiency standard	"	"	Low	High risk without supporting enforcement	Yes
Emissions labelling	Low to modest	"	Medium	Small risk with effective education program	Yes
New test method	Potentially significant	"	Unknown but probably medium to high	High risk given need for R&D & supporting enforcement reforms	No
Starter controls	Unknown	"	"	"	No

More stringent emissions and efficiency standards would not generate significant costs to industry (as a whole) or government. Testing and certification processes already exist and many models already on the market would comply with a 3 or even 2 g/kg emission limit and a 60% efficiency standard. For reasons discussed in Appendix 6, a more stringent emission standard may provide little benefit without introducing a parallel efficiency standard.

An emission standard of less than 2 g/kg or an efficiency standard greater than 60% would make most models currently on the market non-compliant and lead to greater industry costs.

On balance, emissions, efficiency and labelling standards have been identified as policy measures for further investigation and are included in the formal impact analysis provided in Section 7 of this RIS.

5.2 Measures to improve compliance with standards

This group of measures focuses on ensuring retail models comply with the current or revised standards, and includes independent testing and certification, auditing programs and enforcement.

As this group of measures is focused on ensuring the efficacy of standards, benefits share similar characteristics to standard setting, namely that potential benefits could be significant but

slow to be realised, and they are not targeted at problematic airsheds and could potentially be undermined by poor in-service operational practices.

Table 5.2: Summary of relative merits of compliance measures (to enforce standards)

Measure	Emission reductions	Environmental effectiveness	Cost-effectiveness	Simplicity & risks	Short list
National audits	Potentially significant	Not targeted & gains in long term	Medium	High risk without supporting enforcement	Yes
Nationally coordinated state audit & enforcement	"	"	High	Medium risk	Yes
Independent testing & certification	Potentially modest	"	Medium	Significant change to processes & highly dependent on supporting auditing & enforcement reforms	Yes

Costs for the various compliance measures are likely to be significant, as they require new or expanded programs, sometimes with the establishment of new organisations. All three measures are included in the formal impact analysis provided in Section 7 of this RIS.

5.3 Measures to improve in-service wood heater performance

This group of measures is targeted at reducing in-service emissions from poorly installed or operated heaters and / or in airsheds experiencing poor air quality due to wood heater emissions.

Replacement incentive programs have the potential to deliver significant outcomes in the short term, and subject to funding availability present a low implementation risk. One disadvantage of incentive schemes is the difficulty in directing the incentives to the people who would otherwise not have replaced their non-compliant wood heater and avoiding the 'free-rider effect'.[36] Also, while they have the potential to deliver significant outcomes they do rely on voluntary participation.

Similarly, education programs that can be effectively targeted have the potential to contribute to significant gains over the medium to longer term even though they rely on voluntary behaviour change. This could include "nudge" type programs currently being considered in Britain, where

[36] EnergyConsult 2004

behavioural economic concepts are applied by agencies operating at the local level to influence public outcomes, thus delivering social benefit[37]. Accordingly, incentive and education programs have been included in our fuller analysis of policy options.

Table 5.3: Summary of relative merits of in-service measures

Measure	Emission reductions	Environmental effectiveness	Cost-effectiveness	Simplicity & risks	Short list
Education/ "nudge" programs	Potentially significant	Targeted & gains in medium term	Medium	Low risk	Yes
Incentives for replacement	"	Targeted & gains in short term	High	Low risk	Yes
Common definition of excessive smoke	Small	Targeted but at a very small number of heaters	Uncertain	Medium risk without supporting enforcement	Yes
Controls on modification & installation	"	"	"	High risk without supporting enforcement	Yes
Controls on 2nd hand heaters	"	"	"	"	Yes
Removal of non-compliant heaters	Small to significant	Targeted but gains over longer term	Medium	High policy risk due to poor stakeholder acceptance	No
Installation bans	"	"	Medium	"	No

It is difficult to assess the likely impact of a common definition of excessive smoke, controls on modification and installation of heaters and controls on second hand heaters. These measures target a relatively small number of households and may not be cost-effective if enforcement were directed solely at compliance with them. However the measures could be included in broader regulatory approaches where they can be leveraged off existing enforcement programs, including community reporting of non-compliance. These measures are included in the formal impact analysis in Section 7 of this RIS.

[37] See http://www.britac.ac.uk/policy/Nudge-and-beyond.cfm and associated links

The removal of non-compliant heaters on the sale of a house and bans on installation in critical airsheds were not considered feasible as part of a national program and these measures have not been included in the formal impact analysis in Section 7. Such measures would be blunt in terms of imposing unnecessary restrictions on households in areas not experiencing air quality impacts related to wood heaters, while local governments may still introduce bans in situations where wood heaters were demonstrably major contributors to poor air quality.

QUESTIONS

Stakeholders are welcome to provide feedback on any aspect of this chapter. The following questions have been formulated to provide a starting point for submissions. Please provide references where required.

8. ***Do you agree that the policy measures listed for the abatement of wood heater emissions will be successful in realising the objectives? If not, please provide your reasons including supporting evidence.***
9. ***Do you believe that the "nudge" programs will be helpful in reducing wood heater emissions?***
10. ***Are there other measures that are not listed in the document that should be considered?***

6 IDENTIFICATION OF FEASIBLE POLICY COMBINATIONS

In Section 4, three broad policy vehicles for national action were identified in addition to the status quo option, namely a non-regulatory national program, a collaborative approach and a national regulatory approach. Policy combinations under each of these approaches are considered below.

6.1 A non-regulatory national program

This approach recognises that the control of wood heater emissions and air quality has to date been primarily a state / territory and local government responsibility. Commonwealth programs have primarily been to promote research and education (including commissioning the 2003 wood heater audit and studies on in-service wood heater emissions and alternative test methods), community awareness and funding for targeted wood heater replacement programs in airsheds experiencing the poorest air quality.

An extension of this voluntary approach to promote broader national reforms and improvements in the management of wood heater emissions would seek to build on these experiences, and work cooperatively with industry and jurisdictions. Key elements of this approach include:

- leaving standard setting and enforcement as a jurisdictional responsibility, but implementing a regular and robust national audit program to assist jurisdictions identify non-compliant wood heaters and take enforcement action under current powers;
- developing and implementing in conjunction with stakeholders a national wood heater education and awareness program and/or "nudge" type programs; and
- funding a national wood heater replacement program, jointly delivered by relevant local and state governments and applicable to wood heaters in priority airsheds.

Combining these measures provides two policy combinations, namely:

Policy combination 1: National audit and education programs

Policy combination 2: National audit, education and replacement incentive programs

The first combination will promote longer term benefits through improved compliance with standards and improved operation of in-service wood heaters. The second combination will add to the longer term benefits of combination 1 by seeking more immediate emission reductions by taking the worst performing wood heaters out of service.

6.2 Collaborative approaches

Under this approach, the focus of collaborative jurisdictional efforts would be on making the standards process robust, largely (but not exclusively) within the existing regulatory arrangements. That is, rather than introducing significantly new standards, the Commonwealth and state governments within the current jurisdictional regulatory arrangements which call up

the Australian Standard, would agree on a set of reforms to ensure consumers could have confidence that only well designed heaters were entering the market.

Jurisdictions could make regulatory amendments to call up an emissions labelling requirement (to be included on heater compliance plates) based on the current AS 4013 (1999)[38]. Similarly, jurisdictions could make regulatory amendments to call up an efficiency standard based on AS 4012 (1999) to ensure the current emissions standard was not being compromised by inefficient heaters entering the market.

A lowering of the current emission standard, or introduction of an efficiency standard higher than 60%, was not considered under this approach. Either of these measures would represent a significant tightening in design standards, and would be better pursued within an integrated national management program for wood heaters where the risks of not achieving common jurisdictional reforms could be minimised (and this is considered in Section 6.3).

A further measure that would complement reforms under a collaborative approach would be a national regulation requiring a front-of-heater emission and efficiency star rating, similar to the current water and energy star rating schemes (as distinct from the mandatory minimum efficiency performance standards for a subset of these products). Such a scheme could readily draw on the certified emission and efficiency performance to be included on heater compliance plates and provide this to consumers in a more obvious and simplified fashion.

In addition, a nationally coordinated but jurisdictionally-based audit and enforcement program would ensure the efficacy of the standards and labelling processes.

The management of in-service wood heater emissions would continue to be a jurisdictional and local government responsibility, but similar to the voluntary approach there would be a national wood heater education and awareness or "nudge" type programs.

Combining these measures provides three policy combinations, namely:

Policy combination 3: ***Inclusion of certified emission performance on heater compliance plates, education and audit programs***

Policy combination 4: ***Inclusion of certified emission performance on heater compliance plates, a star rating labelling scheme, education and audit programs***

Policy combination 5: ***Inclusion of certified emission performance on heater compliance plates, a star rating labelling scheme, education and audit programs and a 60% efficiency standard***

[38] Note SA currently has no regulatory standard and hence would require new legislation rather than an amendment if the state sought consistent reforms as the other jurisdictions.

Combinations 3 and 4 would provide enhanced information to consumers on wood heater performance and in-service operation, as well as resources for enhanced jurisdictional audit and enforcement programs to secure improved compliance of retail models with certified models.

Combination 5 extends these programs to introduce an efficiency standard at the 60% level. This will serve to take the less efficient models out of the market.

Notably, these approaches require significant collaboration between the Commonwealth, state and territory governments, and the programs will only deliver longer term improvements. By implication, improvements in in-service wood heater emissions and consequent air quality in the short to medium term would rest primarily with the jurisdictions.

6.3 National regulatory approaches

Under this approach, the focus would be to develop an integrated national management program for new and in-service wood heaters. This approach would pick up most of the measures proposed under the other approaches, but with the benefit of a national regulatory framework facilitating tighter emission and efficiency standards, and the incorporation of additional in-service measures.

A number of regulatory policy vehicles for these measures were identified in Section 4.4.3. A NEPM is considered a feasible policy vehicle and has been used successfully to address other air quality issues. Commonwealth legislation is also feasible, and has, for example, been used successfully to set standards for motor vehicle exhaust emissions.

Mirror legislation would require new legislation in all jurisdictions as well as the Commonwealth. The *Water Efficiency and Labelling Standards Act 2005* is an example of this approach. A mirror legislation scheme would provide complete uniformity in state and territory legislation, provided all jurisdictions enact the necessary legislation.

The forth policy vehicle, the referral of powers, is not considered a feasible option as jurisdictional governments have been reluctant to refer powers to the Commonwealth unless there is no other alternative, and this is not the case for the management of wood heater emissions.

The recommended policy option combinations under a national regulatory approach would all include compliance and education programs consisting of:

- independent testing and national certification of wood heaters;
- inclusion of certified emission and energy performance on heater compliance plates;
- a national audit program;
- a national education and/or “nudge” type program.

These measures would be included with a 60% efficiency standard and 3 g/kg emission standard under the first policy combination.

A star rating labelling scheme has not been included in these options, as the focus is on promoting the uptake of improved models through regulatory rather than suasive means.

The following combinations would all include a suite of in-service measures - agreement to a common definition of excessive wood smoke, controls on heater modification and installation, controls on the sale of second hand heaters, and incentives for the replacement of old wood heaters - and progressively incorporate tighter standards with these measures.

The recommended policy option combinations are:

Policy combination 6: ***A compliance and education program, 60% efficiency standard and 3 g/kg emission standard***

Policy combination 7: ***A compliance and education program, 60% efficiency standard and 3 g/kg emission standard and in-service measures***

Policy combination 8: ***A compliance and education program, 65% efficiency standard and 3 g/kg emission standard and in-service measures***

Policy combination 9: ***A compliance and education program, 60% efficiency standard and 1.5 g/kg emission standard and in-service measures***

With there currently being no efficiency standard and a 4 g/kg emission standard, a large number of emission and efficiency standard combinations could be crafted and investigated. To make the task manageable, we have chosen the above combinations which have received some support in stakeholder consultation and take into account the certified performance of current models. So for example, a number of models would currently comply with a 65% efficiency standard OR a 1.5 g/kg emission standard, but only a handful would comply with both. In addition, industry sources have emphasised significant lead times, costs and risks would be involved in moving to the combined standard.

Other regulatory vehicles also exist for some individual measures to reduce wood heater emissions. For example controls on installation could be achieved by amending the Building Code of Australia and using existing building regulations. For simplicity in the impact analysis presented in Section 7, we have chosen to group the suite of in-service measures together under the national regulation option (agreement to a common definition of excessive wood smoke, controls on heater modification and installation, controls on the sale of second hand heaters, and incentives for the replacement of old wood heaters). We return to implementation issues and consider the best policy vehicle to implement different measures in Section 10.

A summary of the 13 policy options (including sub-options) to be examined in the impact analysis is provided in Table 6.1.

Table 6.1: Policy actions and delivery vehicles under each option

Option	Type of approach	Policy vehicle/s	Policy actions		
			Standards	**Compliance**	**In-service**
1	**Voluntary**	National program		National audits	Education (targeted at critical airsheds)
2	"			as above	Education or "nudge" type programs Wood heater replacement incentives
3	**Collaborative**	Enhanced jurisdictional regulatory arrangements calling up Australian Standards, with complementary Commonwealth programs	Emissions labelling (compliance plate)	Nationally coordinated funding for state-based standard audit and enforcement	Education or "nudge" type programs
4	"		Emissions labelling (compliance plate) National star rating labelling scheme	as above	as above
5	"		Emissions labelling (compliance plate) National star rating labelling scheme Efficiency standard (60%)	as above	as above
6	**National regulatory approach**	Sub-options: A. NEPM B. Commonwealth legislation C. Mirror legislation	Emissions labelling (compliance plate) Efficiency standard (60%) Emission standard (3 g/kg)	Independent testing and national certification National audits	Education or "nudge" type programs
7	"		as above	as above	Education or "nudge" type programs Common definition of excessive smoke Controls on modification and installation Controls on 2nd-hand heaters Wood heater replacement incentives
8	"		Emissions labelling (compliance plate) Efficiency standard (65%) Emission standard (3 g/kg)	as above	as above
9	"		Emissions labelling (compliance plate) Efficiency standard (60%) Emission standard (1.5 g/kg)	as above	as above

Table 6.2 shows the assumed dates for introduction of new heater standards and phase-in periods assumed for the impact analysis presented in Section 7. The phase-in periods allow time for research and development, testing and certification of new heaters as well as time for old stock to be sold.

Table 6.2: Assumed timing and phase-in period for new measures

New measure	Phase-in period	Introduction	Effective from
Emissions labelling	1 year	2014	2015
National Star Rating Scheme	1 year	2014	2015
3 g/kg & 60%	2 years	2014	2016
3 g/kg & 65%	4 years	2014	2018
1.5 g/kg & 60%	6 years	2014	2020

The timeframes shown in Table 6.2 are indicative only. For example, if the national regulatory options were to be approved, the Commonwealth Government would need to develop new legislation, along with associated regulations, to give effect to the proposed outcomes. Assessment of the legislative development process indicates that the time needed to develop legislation may be in the order of two years. This timeframe takes into account all Commonwealth legislative and regulatory requirements and assumes no major delays.

QUESTIONS

Stakeholders are welcome to provide feedback on any aspect of this chapter. The following questions have been formulated to provide a starting point for submissions. Please provide references where required.

11. Which of the listed policy combinations do you favour in addressing a reduction in wood heater emissions? Why do you favour these measures?

12. Are there policy combinations that you would not support? Please provide reasons.

7 IMPACT ANALYSIS OF FEASIBLE POLICY OPTIONS

Our methodology for the impact assessment is a conventional cost-benefit analysis of economic impacts, including those related to environmental impacts. We also identify the distribution of costs and benefits across stakeholder groups and regions.

The overall methodology for the cost-benefit analysis and key assumptions are presented in Appendix 7. This section focuses on a description of the base case and the results of the analysis in terms of the economic, social and environmental impacts of options.

7.1 Base case emissions from wood heaters

In any cost-benefit analysis, it is the incremental impact of the options that is of interest. This is the difference between what will happen as a result of the option, compared to what would have happened in the absence of the option. Analysis of this difference requires a 'base case' that defines how the future will unfold without intervention over a period long enough to capture all potential costs and benefits of the proposal. The base case is sometimes referred to as the "business as usual" or the "do nothing" alternative.

The period of assessment chosen for the benefit cost analysis is the twenty year period from 2011 to 2030.

Data from the Australian Bureau of Statistics[39] suggests there are around 1.1 million heaters in-service in Australian homes. The type and location of in-service heaters assumed for the analysis is shown in Figure 7.1.

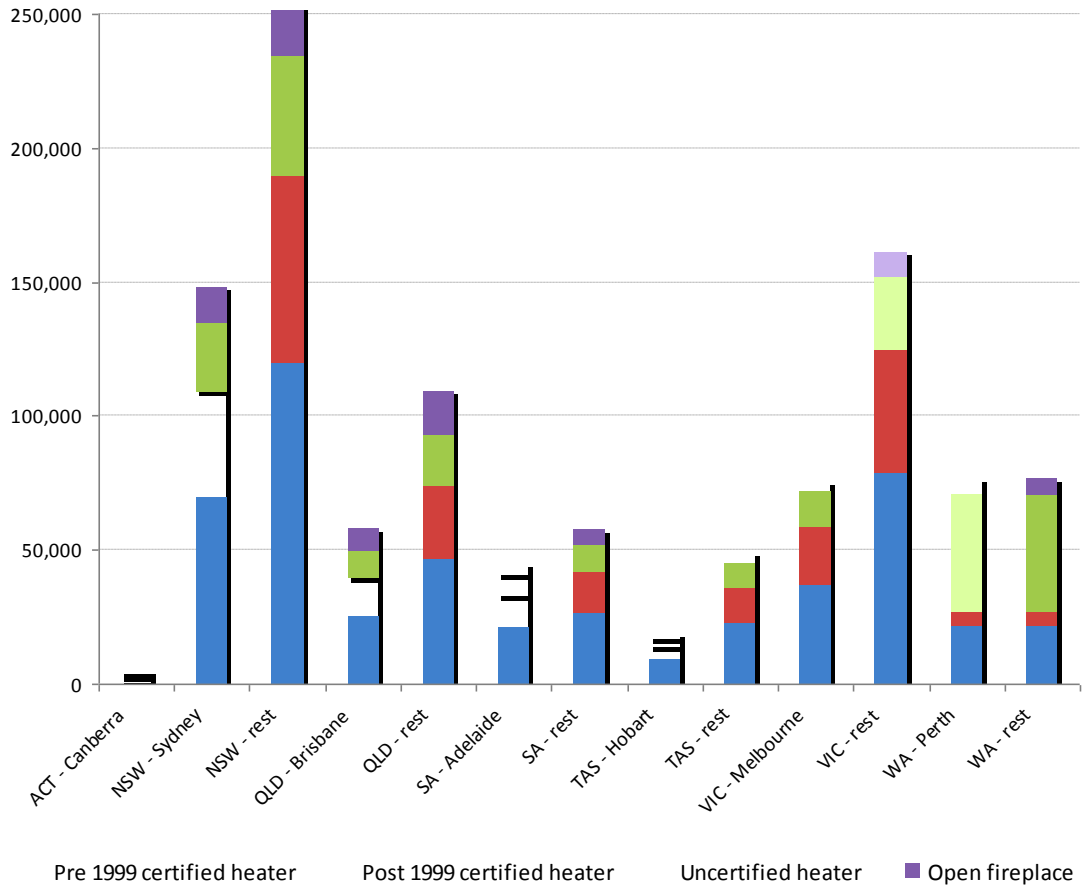
Around 17% of wood heaters are estimated to be uncertified for all locations (based on Sydney data) except for Perth, where specific data was available suggesting that over 50% of wood heaters were not compliant with any standard. Our analysis takes the conservative approach of assuming the breakdown is similar to Sydney for locations where there is no specific data available.

The ABS reports around 1,600 wood heaters in the Northern Territory (less than 0.2% of heaters Australia-wide). However due to the high error margin embodied in this survey estimate they urge caution in its use. Accordingly we have not included the Northern Territory in our analysis of options.

Emissions from wood heaters under the base case are determined by the amount of wood used as well as the characteristics of heaters and operator practices. Heater characteristics (such as whether they are certified) and operator practices are reflected in the emission factors used for the analysis (shown previously in Table 2.7).

[39] ABS 2008 *Environmental Issues: Energy Use and Conservation*

Figure 7.1: Number and type of heaters currently in-service in Australia



Sources: Aggregate numbers from 2008 ABS data (Cat. 4602), breakdown by type derived from household surveys in Sydney (2003 data) and Perth (2004 data)

Figure 7.2 shows wood currently used for certified heaters across the different regions of Australia. Lower wood consumption is assumed for uncertified heaters and open fireplaces as these are more often used as a secondary heating source. Wood consumption is assumed to be around 12% lower for uncertified heaters based on a NSW survey[40].

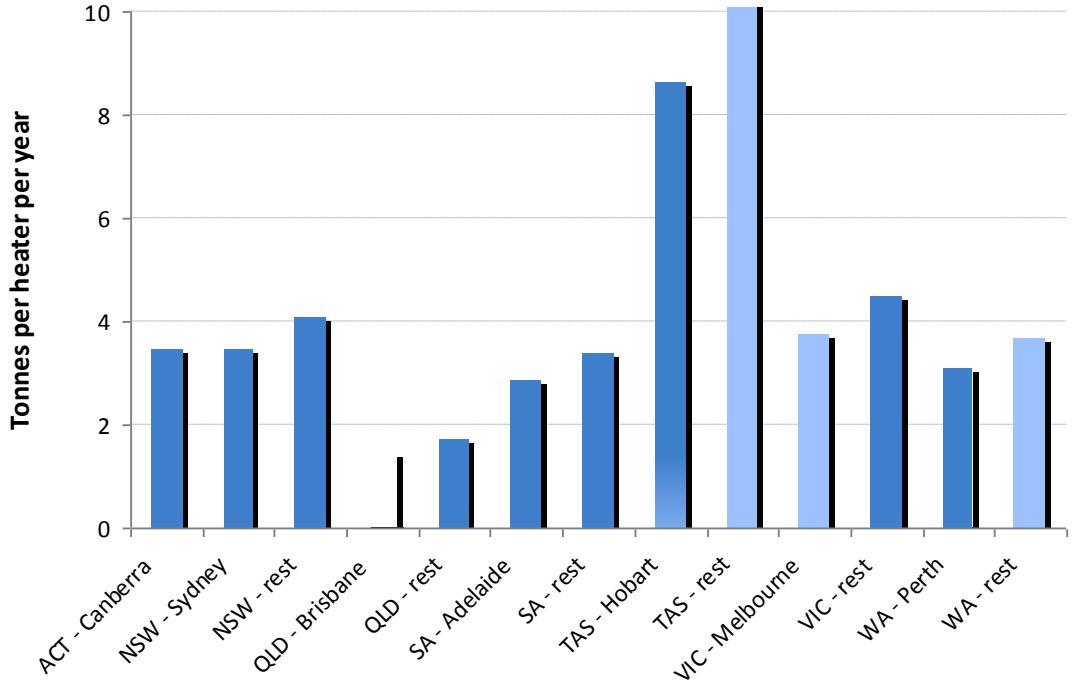
Section 2.2 highlighted the downward trend in the use of wood as a source of energy in dwellings across Australia from 18% in 2002 to 13% in 2008. Some of the factors reinforcing the shift away from wood heaters include higher density housing, improved availability of alternative heating options (including reticulated gas) and government programs such as buyback schemes and education. However population growth and higher energy prices may moderate this trend.

On balance we expect the number of new heaters sold each year under the base case over the assessment period to remain similar to the current level of around 25,000 heaters. Around 80% of these new sales are expected to replace existing heaters in-service. This results in an

40 NSW Domestic Survey results reported in NSW DECC 2007

average replacement rate for the existing stock of wood heaters of 1.8% per annum. Wood use is expected to remain at the same level over the assessment period.

Figure 7.2: Estimated current wood use for certified heaters across Australia



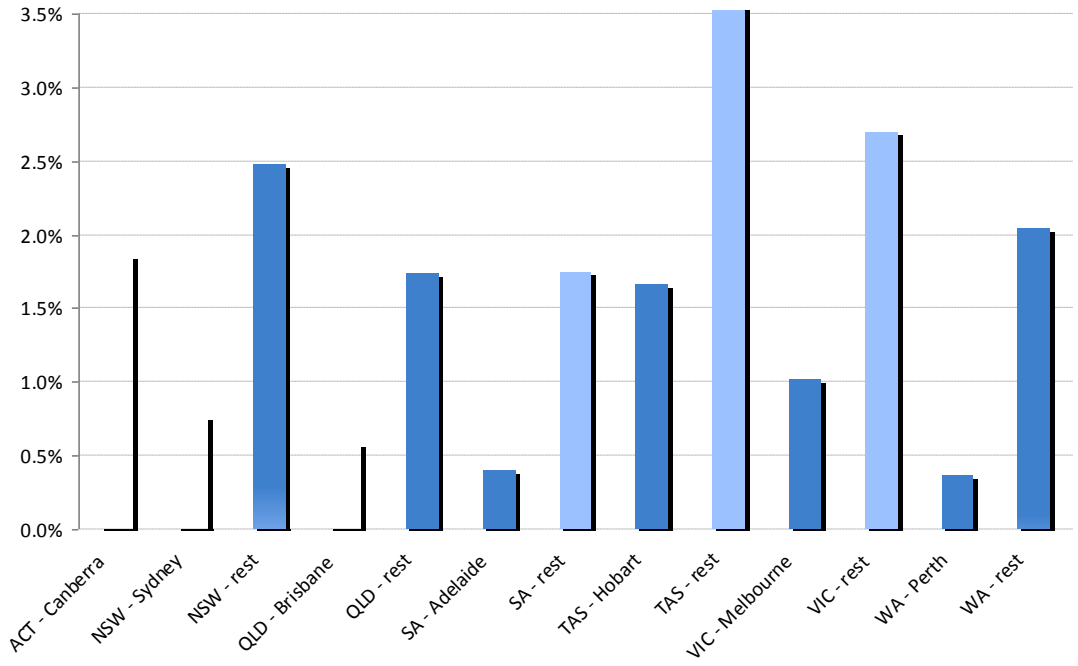
Sources: ABARE residential wood consumption data 2007/08, ratio of urban to rural wood use from Environment Australia 2002, NSW GMR inventory used for NSW and ACT.

Section 2.1 provided a breakdown of sales of wood heaters by state and territory for 2007/08 with most sales in NSW / ACT (around 38%) and the lowest sales in SA (around 6%).

Discussions with wood heater manufacturers suggests around 85% of new heater sales are for homes in rural and regional areas and this is expected to continue under the base case. This results in higher expected rates of replacement in rural and regional areas. The resulting replacement rates used in this study vary from 0.4% in Adelaide to 3.6% in rural and regional Tasmania.

Figure 7.3 shows the replacement rates by location.

Figure 7.3: Assumed replacement rates for stock of wood heaters under base case



Notes: Breakdown of new sales by state from Walter Turnbull 2010 shown in Figure 2.1 in section 2.1, assumes 85% of new heater sales are in regional areas and 80% of new sales replace existing wood heaters.

Based on the information reported above and the emission factors in Table 2.3, current particulate emissions from wood heaters in Australia are estimated at around 40,000 tonnes for 2010.

Figure 7.4 shows the expected trend in particulate emissions under the base case.

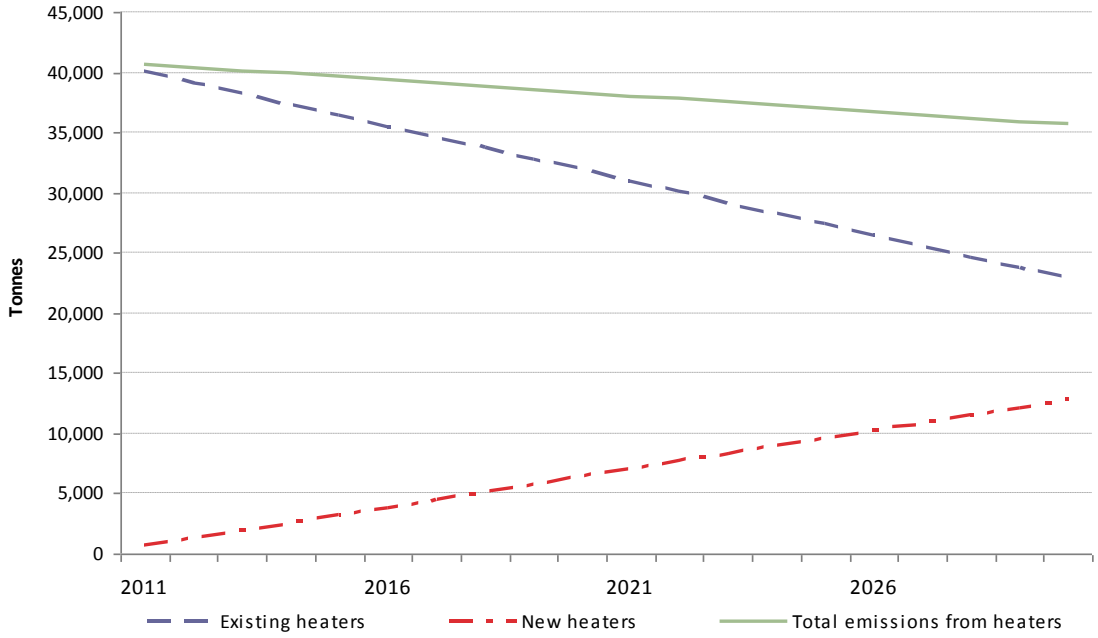
As existing heaters are retired over time, the total emissions from existing heaters falls and as new heaters are purchased the total emissions from new heaters increases over time. Under the base case total emissions are expected to fall by around 5,000 tonnes (or 12%) as a result of the replacement of old heaters with new lower emitting heaters.

It should be noted that the estimate for current emissions is double the National Pollutant Inventory estimate of aggregate emissions from domestic solid fuel burning for 2008-09. The limitations of the NPI data were discussed in Section 3, in particular that the emission factors used to derive wood heater emissions do not represent 'real life' operating conditions. Thus the figure of 40,000 tonnes is considered to be the more reliable figure.

The reduction in particulate emissions from wood heaters under the base case is expected mainly in regional and rural areas (around 85% of the tonne reduction), as over 60% of wood heaters are in these regions (Figure 7.1) as well as there being a higher turnover of old for new models (Figure 7.3).

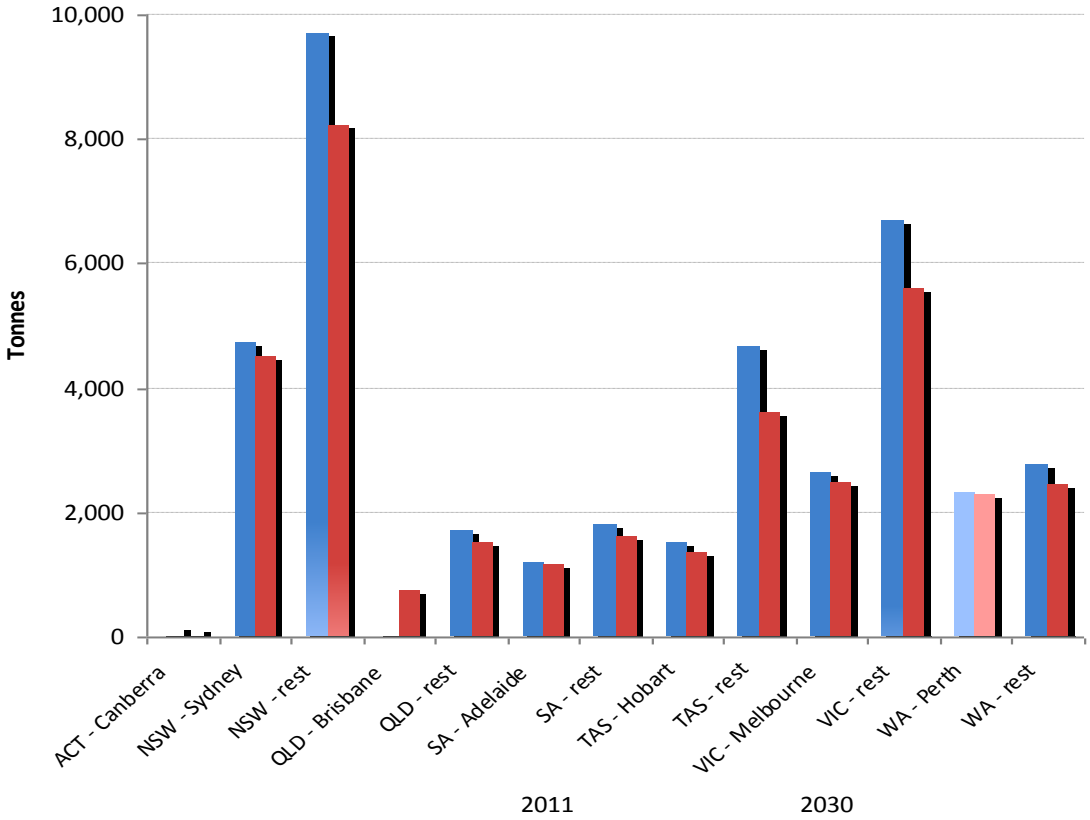
Figure 7.5 compares the expected change in emissions across locations.

Figure 7.4: Trend in overall PM_{10} emissions from wood heaters under the base case



Notes: Derived from data in Figures 7.1, 7.2 and 7.3 and emission factors shown in section 3.3

Figure 7.5: Wood heater particulate emissions under the base case, by location



Notes: Derived from data in Figures 7.1-7.3 and the emission factors shown in Section 3.3

Table 7.1 lists the percentage reductions in emissions shown in Figure 7.5 for each location. In Adelaide and Perth the reduction in particulate emissions expected is as low as 2%, whereas a reduction of 21% is expected in rural and regional Tasmania.

Table 7.1: Reduction in wood heater particulate emissions under base case by location

Location	Reduction in emissions under base case over 20 years
Canberra	11%
Sydney	5%
Rest of NSW	15%
Brisbane	4%
Rest of QLD	11%
Adelaide	2%
Rest of SA	10%
Hobart	10%
Rest of TAS	21%
Victoria	6%
Rest of VIC	15%
Perth	2%
Rest of WA	12%

Notes: Derived from data in Figures 7.1-7.3 and the emission factors shown in Section 3.3

7.2 Health and environmental impacts of policy options

In this next section, the particle emission reductions under each policy option are estimated. It should be noted that the options may also generate other health, social and environmental benefits which have not been identified or included in the following valuation of economic benefits. Such benefits could include:

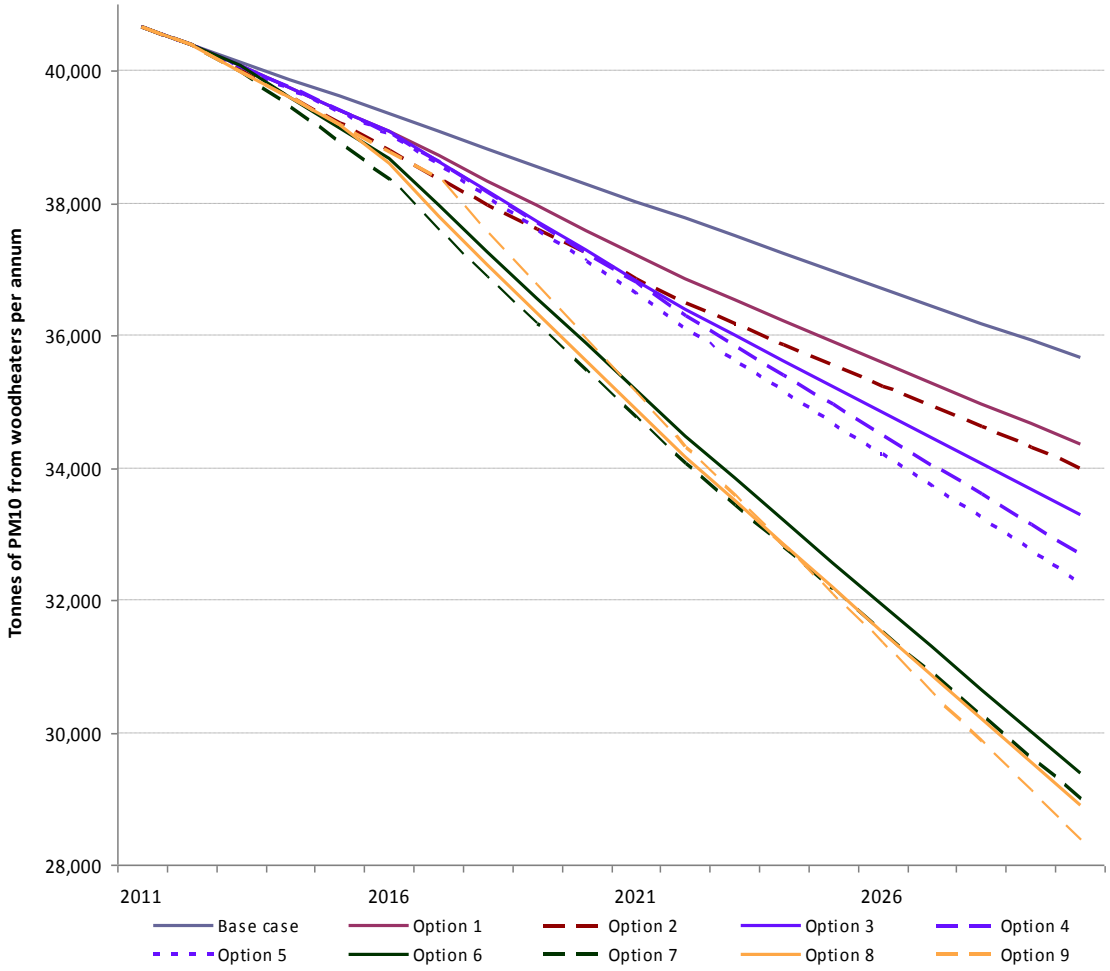
- health benefits of reducing exposure to air toxics (such as 1,3-butadiene, benzene, formaldehyde, isomers of xylene, polycyclic aromatic hydrocarbons (PAHs) and toluene), with exposure to these linked to cancer, birth defects, genetic damage, immune deficiency, and respiratory and nervous system disorders);
- other health and environmental benefits from reducing particle emissions including improved visibility, healthier vegetation, crops and ecosystems and an improved condition of the built and natural environment; and

- potential for reduced habitat and biodiversity impacts from firewood harvesting and collection.

The options assessed provide annual reductions in particulate emissions from wood heaters by 2030 (over and above those expected under the base case) ranging from 1,300 tonnes per annum (for Option 1) to around 7,300 tonnes per annum (for Option 9).

Figure 7.6 shows the expected reduction in aggregate particulate emission from wood heaters in Australia over the assessment period under the various options.

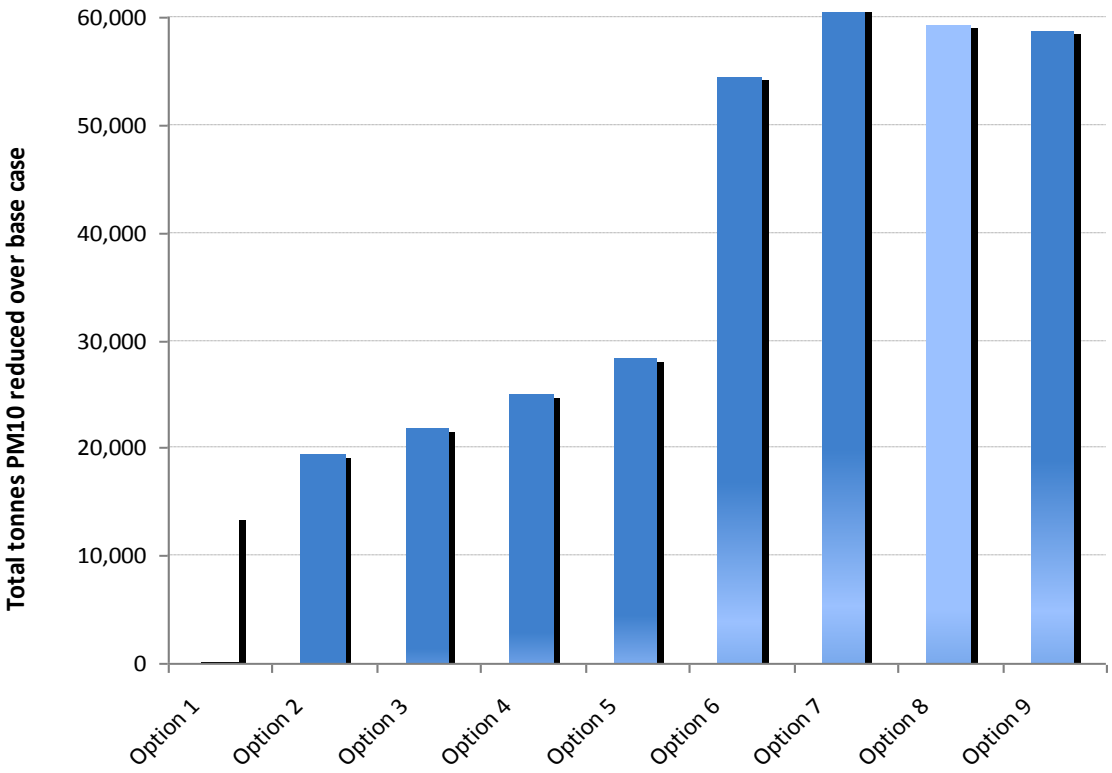
Figure 7.6: Reduction in wood heater particulate emissions over time, by option



With additional measures progressively included from Options 1 to 9, overall particulate emissions progressively increase across the options. The most significant step reduction in emissions is between Option 5 and Option 6 with the introduction of a lower particulate emission limit for new wood heaters and introduction of a national certification scheme with independent auditing.

The total cumulative reduction in particulate emissions expected to be achieved over the 20 year assessment period under each option is shown in Figure 7.7.

Figure 7.7: Cumulative reduction in wood heater particulate emissions by 2030, by option



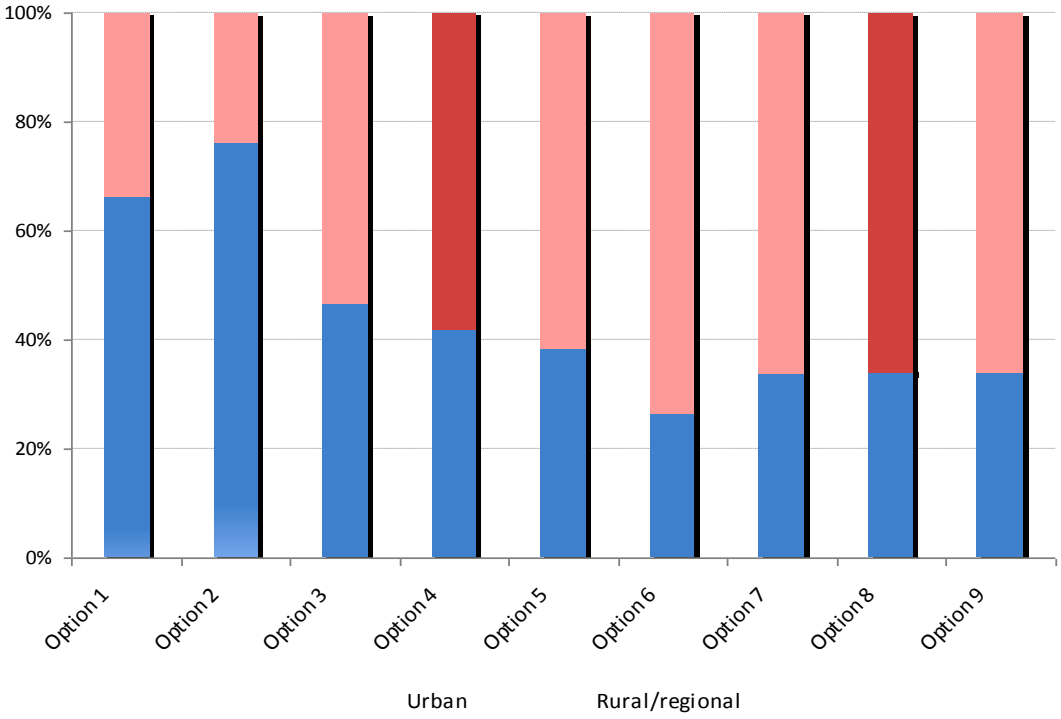
The voluntary options (Options 1 and 2) provide total cumulative reductions of 10,000 - 20,000 tonnes of particulates over the twenty years; the collaborative options (Options 3, 4 and 5) provide reductions of 20,000 - 30,000 tonnes; and the regulatory options (Options 6, 7, 8 and 9) provide total reductions of 50,000 – 60,000 tonnes.

Although total emissions from wood heaters are expected to be lowest in the year 2030 under Option 9, Option 7 provides the greatest *cumulative* reduction in emissions. This is a result of Option 7 having a shorter phase-in period, even though it has less stringent standards than Option 8 and 9.

The proportion of reductions in particulate emissions that are in regional / rural areas varies across options. Measures to reduce emissions under Options 1 and 2 are dominated by in-service programs targeted at critical urban airsheds. Conversely, Options 3 to 9 utilise standards and compliance measures impacting on new heaters which are predominately going into rural areas.

Figure 7.8 shows the urban and rural and regional split for each option.

Figure 7.8: Share of reduction in particulate emissions in urban and rural areas



Option 2 has the highest proportion of emissions reduced in urban areas (76%) and Option 6 has the highest proportion of emissions reduced in rural and regional areas (74%).

Figures 7.9 and 7.10 provide a further breakdown of the location of emission reductions under Options 2 and 6.

For Option 2 the highest percentage reduction in particulate emissions is predicted to be in Sydney (around 27%) followed by Melbourne (15%), Perth (13%) and Hobart (9%). The reductions would be delivered through education and wood heater replacement programs in critical urban airsheds.

For Option 6 the highest percentage reduction in particulate emissions is predicted to be in rural and regional NSW (around 25%), followed by rural and regional Victoria (19%), rural and regional Tasmania (18%) and Sydney (9%). The reductions would be delivered primarily through new efficiency and emission standards for new heaters and supporting national certification and independent auditing.

Figure 7.9: Reduction in particulate emissions by location under Option 2

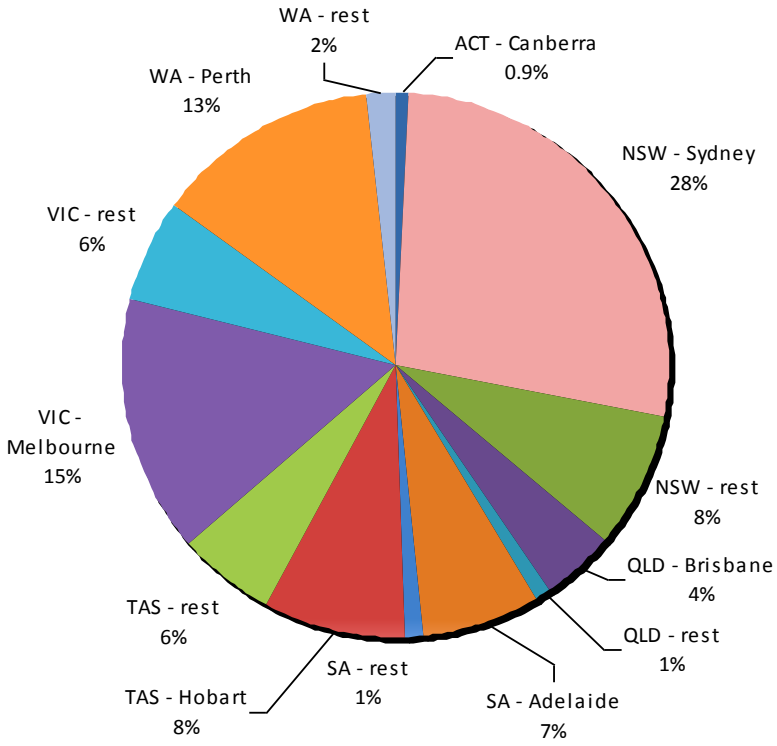
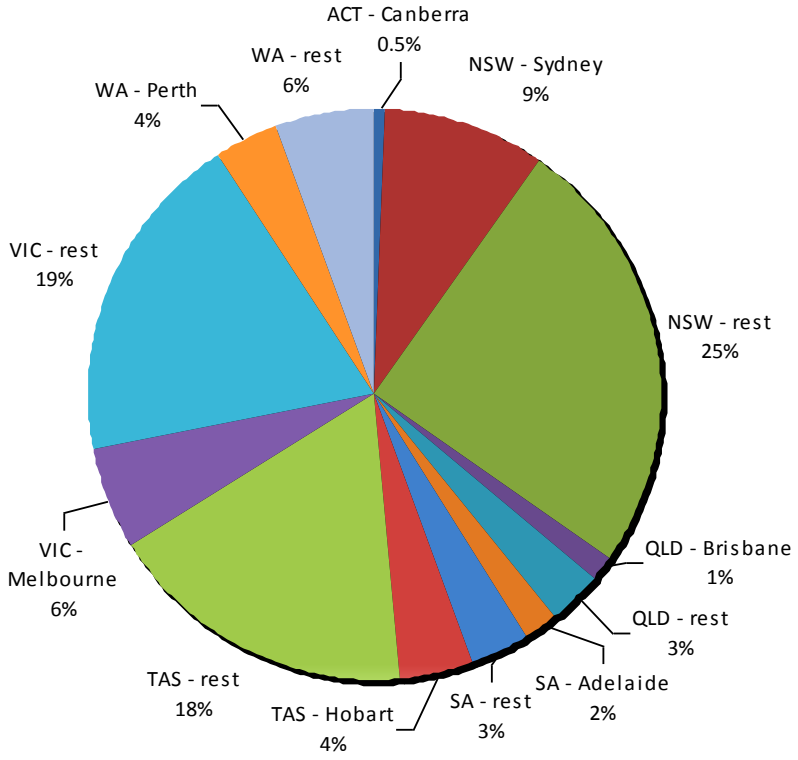


Figure 7.10: Reduction in particulate emissions by location under Option 6



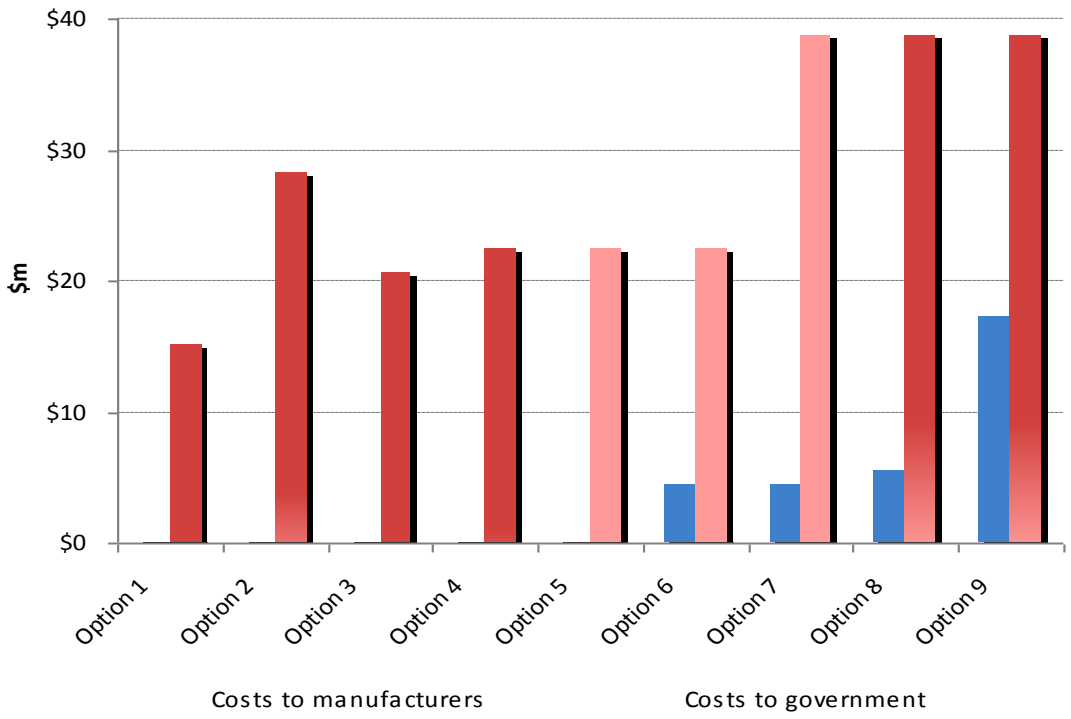
7.3 Economic impacts of policy options

The main economic impacts of the options are the costs to government of implementing the various measures to reduce emissions from wood heaters; the costs to manufacturers to meet changes to standards applicable to new wood heaters; and the health benefits for communities from reducing particulate emissions from wood heaters. In this section we include costs associated with implementation via either Commonwealth legislation or a NEPM. Cost and broader implications for the use of an alternative policy vehicle, mirror legislation, is considered in Section 10.

The estimated costs to government of implementing the options range from $15 million over the twenty years under Option 1 (for national audits and education programs in critical airsheds) to around $39 million under Options 7 to 9 (for setting up and administering a national regulatory framework including national certification and independent auditing as well as education and wood heater replacement programs in critical airsheds).

The estimated costs to manufacturers range from $240,000 under Option 1 (for improvements to heaters to comply with the existing standard and any re-testing required where heaters fail) to $17m under Option 9 (primarily heater model development costs to meet an efficiency standard of 60% as well as an emission limit of 1.5 g/kg).

Figure 7.11: Costs of options ($m present value over twenty years)



Notes: The costs to government of Options 6 to 9 include implementation through a NEPM

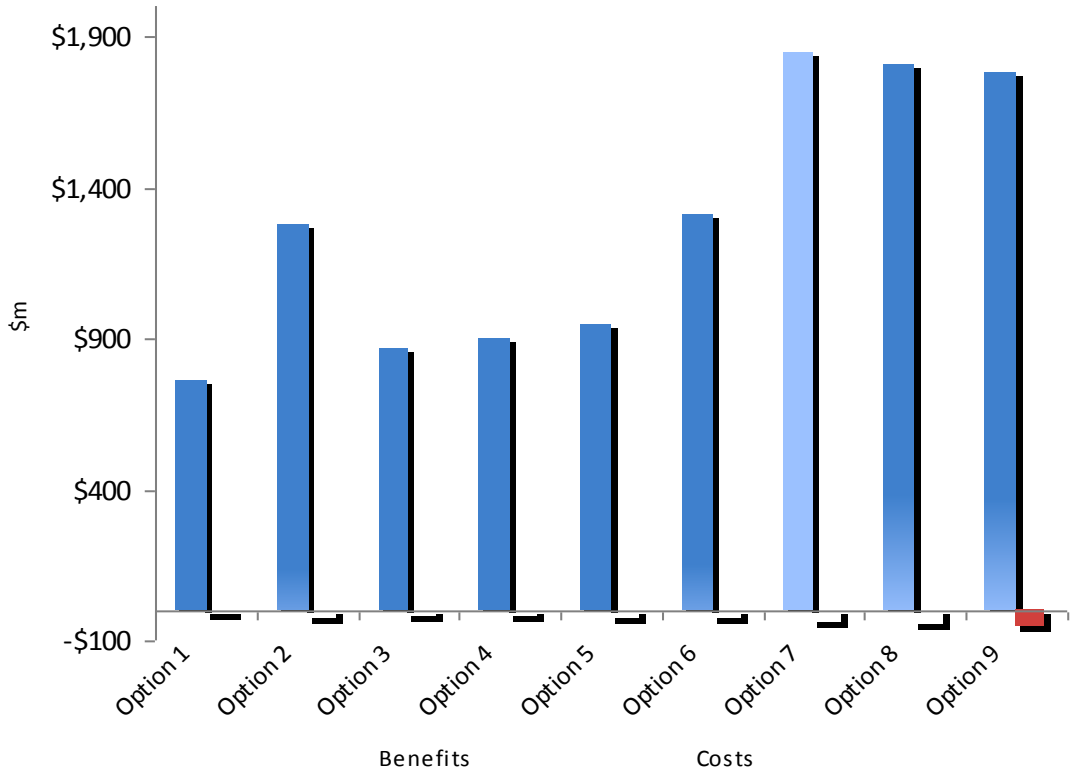
The costs to government are substantially higher for options that include the wood heater replacement schemes (Options 2, 7, 8 and 9). The differences in costs under other options

primarily reflect the different approaches to wood heater auditing programs. The costs of implementing a national regulatory framework through a NEPM for Options 6 to 9 are expected to be around $1m higher than through Commonwealth legislation.

The costs to manufacturers increase steadily with the introduction of an efficiency standard of 60% (Option 5), a new emission limit of 3 g/kg (Option 6) and a more stringent efficiency standard of 65% (Option 8). A tripling of costs to manufacturers is estimated for the more stringent emission limit of 1.5 g/kg under Option 9.

The health benefits of the options are estimated to range from $760m over the twenty years to around $1,850m. Although the greatest emission reductions are estimated for Option 9, the highest health benefits are estimated for Option 7 because of the shorter phase-in period under this option. Figure 7.12 shows the estimated health benefits for each option and compares them with the total costs.

Figure 7.12: Benefits and costs of options ($m present value over twenty years)



The estimated benefits far outweigh the estimated costs of all options included in the analysis. The net benefits range from around $750m to $1,800m over the twenty year assessment period. Table 7.2 provides the estimated net benefits under the options for each policy vehicle considered.

Table 7.2: Net benefits of options

Option	Net benefits ($m)	
Option 1	$748	
Option 2	$1,248	
Option 3	$845	
Option 4	$876	
Option 5	$920	
	A. NEPM	*B. Commonwealth legislation*
Option 6	$1,282	$1,282
Option 7	$1,803	$1,803
Option 8	$1,765	$1,766
Option 9	$1,723	$1,724

All options are estimated to provide significant net benefits to the Australian community. Option 7 is estimated to provide the highest net benefits – although Options 8 and 9 include more stringent standards for new heaters these cost more and take longer to provide benefits due to the longer phase-in periods required.

Interestingly, the voluntary Option 2 involving wood heater replacement schemes in critical airsheds is estimated to provide similar net benefits to Option 6 which includes a new efficiency standard and emission limit for new heaters.

The NEPM as a policy vehicle for a new national regulatory framework is expected to cost more, however it is a small difference in the context of the ranking of options, with a difference of around $1m between the two approaches in total over the twenty year assessment period. The estimated implementation costs are detailed in Appendix A7.6. The merits of each approach, or mirror legislation as an alternative, are less related to the economic analysis than to jurisdictional and implementation issues which are discussed further in Section 10, Implementation and Review.

The analysis of economic impacts in this section focuses on the major costs and benefits including costs to government and manufacturers and health benefits for communities. Section 7.2 above outlined the nature of the benefits that have not been quantified in this analysis. There is also the potential for cost savings in wood costs for those options incorporating

efficiency standards and these have not been quantified. Other studies have shown savings in wood costs to be significant[41].

7.4 Social impacts of policy options

The options included in the analysis have a range of impacts on different stakeholders including wood heater manufacturers, wood heater consumers, taxpayers / ratepayers and broader communities across Australia.

The financial impacts on industry are significant for the options that include new standards relating to heater efficiency and / or emissions (Options 5-9). Table 7.3 summarises the financial impacts of options on industry and the likely magnitude of costs passed on to consumers.

Table 7.3: Financial impacts on manufacturers and consumers

Option	Standards combination	Cost to industry over 20 yrs	Impact on price of wood heater
Option 5	60% efficiency	$2m	$20
Option 6	60% efficiency + 3 g/kg	$4m	$60
Option 7	60% efficiency + 3 g/kg	$4m	$60
Option 8	65% efficiency + 3 g/kg	$4m	$60
Option 9	60% efficiency + 1.5 g/kg	$17m	$230

Notes: Estimate of impact on price of wood heater assumes a payback period of three years

The estimated impact of the options on wood heater prices ranges from $20 - $230 per heater. Industry stakeholders argue that few companies would have the margins to support the significant research and development effort required to move beyond 3 g/kg. The AHHA reports that 15 companies produce less than 2,000 units per year and that these low volumes result in inadequate capital to fund a sustained research and development effort[42].

Price effects have not been incorporated into the analysis and we have assumed no change in the base case assumption of continued sales of around the 25,000. However, our analysis assumes a reduction of up to 28% in the number of models that would be available, and this would lead to changes in market shares held by different manufacturers.

A tightening of efficiency and emissions standards to 60% and 3 g/kg under Options 6 and 7 may have an impact on small wood heater producers, which sell around 500 wood heaters each, closing. These producers represent around 10% of current sales. If our assumption of continued sales at around the 25,000 unit level holds, this implies the sales from these

41 For example Environment Link and BDA Group 2006

42 AHHA 2009

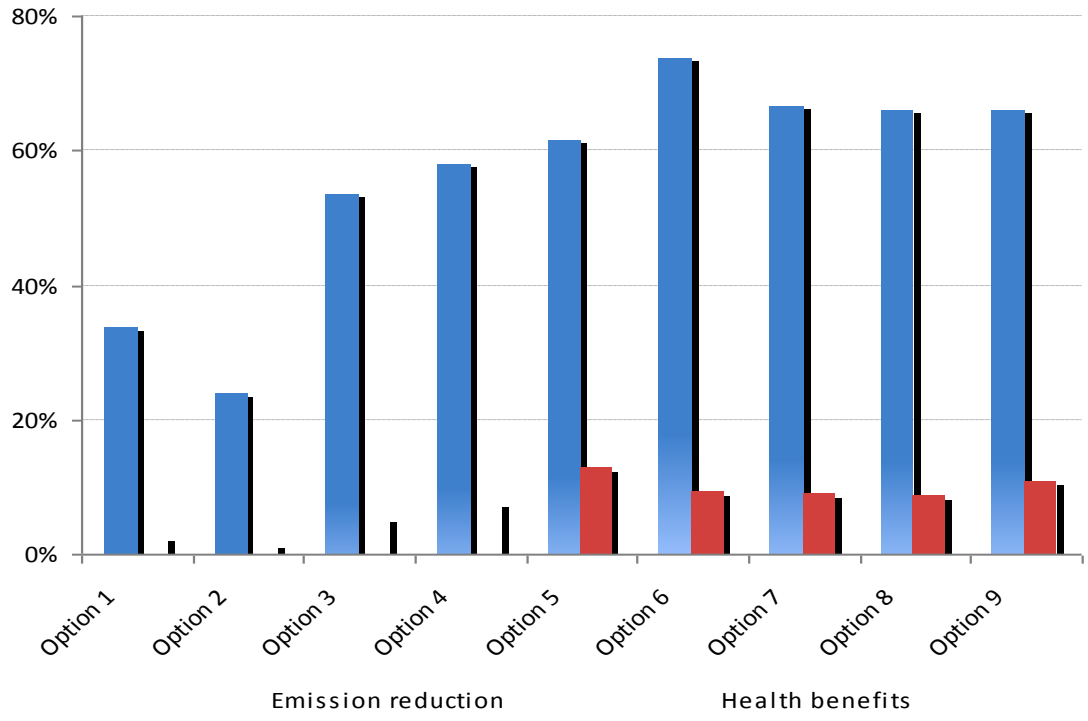
producers would be picked up by other manufacturers with compliant models. Potential economies realised with a greater concentration in both models and producers could be expected to moderate any residual price effects, but for similar reasons may lead to some small employment impacts. It is difficult to predict the likely outcome for the industry of further tightening of standards, however a move to 1.5 g/kg under Option 9 could have a much greater impact.

The economic analysis has identified the costs to government of implementing the options. The final incidence of these costs would depend on the government financing arrangements and would be passed on to taxpayers and ratepayers accordingly.

Urban residents would receive the majority of the health benefits of reducing particle emissions under all options, due to higher population exposures and assumed damage cost estimates (and notwithstanding the significant benefits that would accrue to those regional centres currently experiencing high wood heater emissions, such as Launceston).

Figure 7.13 shows the share of health benefits estimated for rural and regional communities across options and compares this with the share of emission reductions in rural and regional communities.

Figure 7.13: Share of emission reductions and health benefits in rural and regional areas



While most emission reductions are in rural and regional areas for the majority of the options, the assumed health benefit per tonne is considerably less, such that the overall health benefits identified in rural and regional areas were found to be small. This finding however will mask a wide range of values that would exist between the almost negligible impacts associated with

rural and remote households to those in rural communities where wood heater emissions may be of a greater concern, such as perhaps Tamworth, Albury, and Bathurst in NSW or Albany, Bunbury and Busselton in WA.

Box 1 provides a brief case study showing the scale of impacts likely under the various options for a regional town.

Box 1: Case study of option impacts on a regional town

This short case study provides information on the likely impact of the options being considered on a regional town in NSW with around 7,000 dwellings. The town is estimated to have around 1,700 existing heaters. Around 50 new heaters are sold each year with 80% of these replacing existing heaters.

Current emissions from wood heaters in the case study town are estimated at around 64 tonnes per year and these would be expected to fall to around 54 tonnes per year with the replacement of older heaters with new lower emitting heaters over the assessment period.

The voluntary options (Options 1 and 2) are expected to result in a further small reduction in emissions of 10 tonnes over the 20 year assessment period. The town is not considered part of a critical airshed and therefore no direct education or heater replacement programs would be implemented in the town under the options being considered. A small reduction in emissions would be expected as a result of better operator behaviour likely to arise with operators of new wood heaters given the broader education programs being implementation at a national level.

The collaborative options (Options 3 to 5) are expected to result in reductions in emissions of 25 to 40 tonnes over the 20 year assessment period as a result of new labelling and efficiency standards for new wood heaters and improved compliance with standards.

The regulatory options (Options 6 to 9) would each provide a reduction in emissions of around 90 tonnes over the 20 year assessment period. This would be a result of the more stringent labelling, efficiency and emission standards and national certification and independent auditing scheme to improve compliance with standards.

The estimated value of the health benefits of the emission reductions over the 20 year assessment period would be between $5,000 and $50,000.

7.5 Summary of impacts of options

A summary of indicators of the economic, social and environmental impacts of each option are shown in Table 7.4.

Of the voluntary options (Options 1 and 2), Option 2 is estimated to provide relatively high net benefits of $1,250m over twenty years for a relatively small cumulative reduction in emissions over the base case of almost 20,000 tonnes by 2030. This is because the bulk of the reductions in emissions occur in critical airsheds and targets the older higher emission heaters.

The collaborative options (Options 3, 4 and 5) all have similar net benefits of around $900m over twenty years and provide cumulative reductions in emissions of 20,000 – 30,000 tonnes by 2030. Option 5 is the only collaborative option with an impact on manufacturers and therefore wood heater consumers estimated at around $20 per heater.

Table 7.4: Summary of economic, social and environmental impacts of options

Option	Economic impact: Net benefits	Social impacts	Environmental impacts: Cumulative reduction in PM_{10} by 2030
Option 1	$750m	98% benefits in urban	13,650
Option 2	$1,250m	99% benefits in urban	19,400
Option 3	$850m	95% benefits in urban	21,650
Option 4	$900m	93% benefits in urban	24,900
Option 5	$900m	87% benefits in urban +$20 price of wood heaters	28,250
Option 6	$1,300m	91% benefits in urban +$60 price of wood heaters	54,400
Option 7	$1,800m	91% benefits in urban +$60 price of wood heaters	60,800
Option 8	$1,750m	91% benefits in urban +$60 price of wood heaters	59,250
Option 9	$1,700m	89% benefits in urban +$230 price of wood heaters	58,800

For the regulatory options (Option 6 to 9), Option 7 is estimated to provide the highest net benefit to the community of $1,800m over twenty years and a cumulative reduction in particle emissions of around 60,000 tonnes over the base case by the year 2030. Over 90% of the health benefits of Option 7 would accrue in urban areas and the impact on consumers would be an increase of around $60 in the price of a wood heater.

7.6 Sensitivity analysis

This section presents the results of sensitivity analysis of the key assumptions used to estimate costs and benefits in order to identify the key drivers influencing the ranking of options. Two important areas for sensitivity analysis are the retail compliance level expected to be achieved with different measures and the relationship between emission design standards and real world emissions.

7.6.1 Retail compliance level achieved with different measures

Three categories of factors contributing to wood heater emissions have been examined - standards, standard compliance and in-service operation. Based on the preceding analysis and using Option 6 for illustrative purposes, the relative significance of each of these to in-service emissions from new heaters entering the market is shown in Figure 7.14.

Figure 7.14: Impact of selected measures on average in-service emissions of new heaters

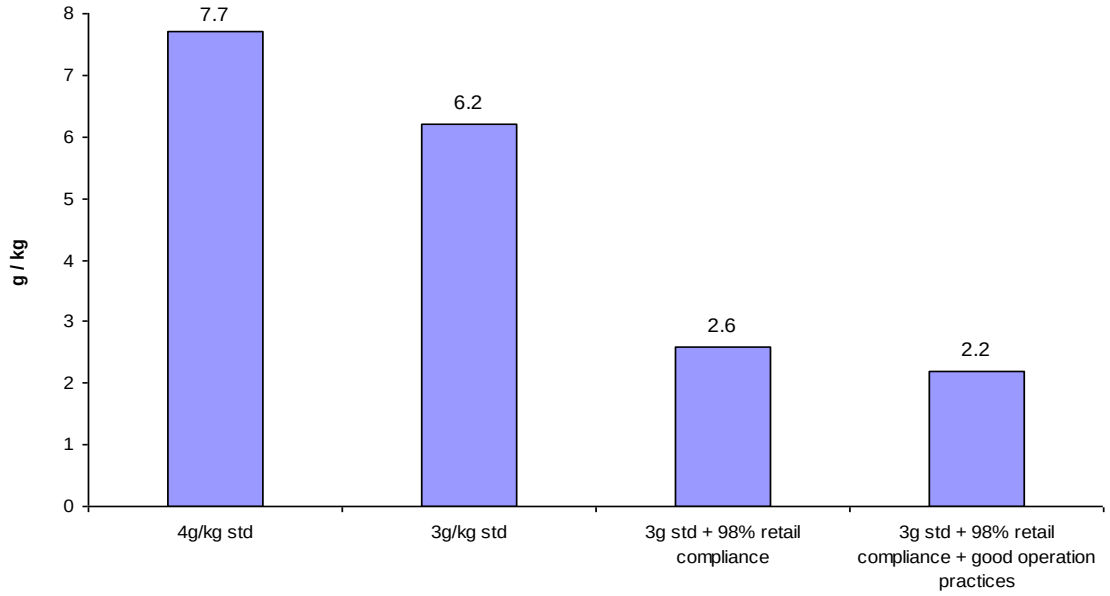


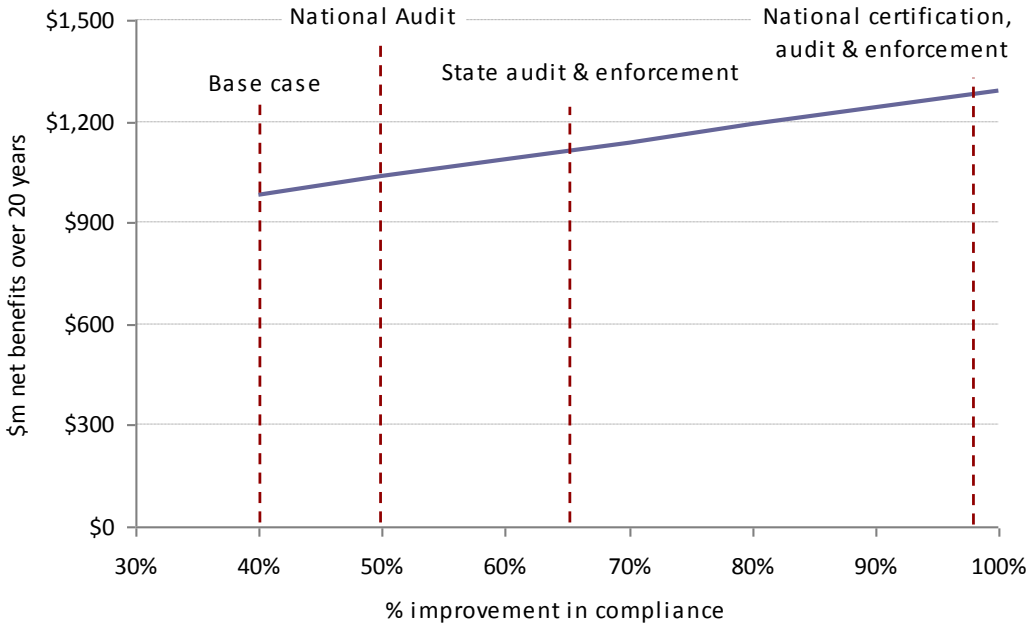
Figure 7.14 shows that ensuring retail compliance with a new emission standard can have a much greater impact on reducing average emissions than the tightening of the standard itself or improvements in in-service operating practices *once* retail compliance has been achieved.

The 2003 audit of retail wood heaters by DEH provided the base case assumption used in this study, namely that the average emission performance of retail models has been 63% higher than the 4 g/kg standard. As noted in section 5.2, a number of measures have since been introduced to improve compliance, and a number of alternative auditing and enforcement regimes were considered in the options that could deliver even higher levels of retail compliance. However significant uncertainty exists in relation to how effective current and alternative compliance regimes may be.

To assess the importance of retail compliance to estimated net benefits, and the sensitivity of those benefits, Figure 7.15 shows net benefits for Option 6 under the full range of retail compliance outcomes.

The predicted outcomes for Option 6 are not overly sensitive to the assumed compliance level, with outcomes by compliance level shown. If the national certification and audit scheme assumed under the option to deliver a 98% improvement in retail compliance actually failed to deliver any improvement in retail compliance over the base case, the net benefits of Option 6 fall by just over 20% to $985m.

Figure 7.15: Sensitivity of net benefits to level of retail compliance (Option 6)

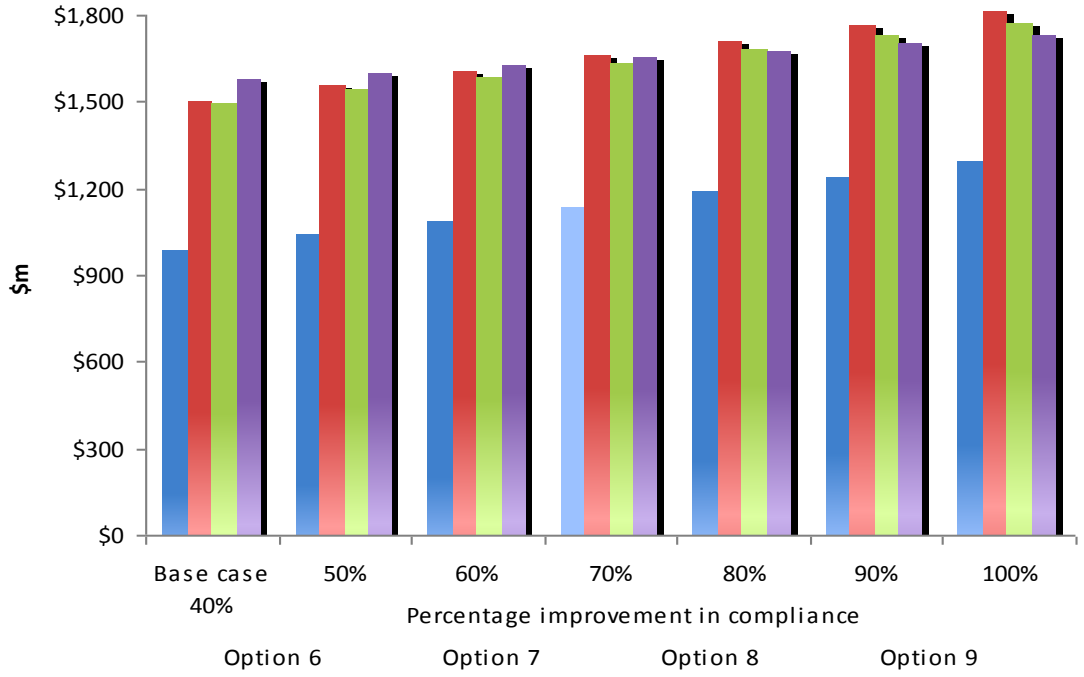


In order to examine whether the relative performance of options is sensitive to the assumed success of compliance measures, Figure 7.16 shows the net benefits for the options that include the national certification and auditing scheme (Options 6 to 9) under varying levels of retail compliance.

The assumed success of the national certification and independent auditing scheme results in relatively minor changes in the net benefits of options, however it does have some impact on the ranking of options.

At lower levels of compliance under the national certification and independent auditing, Option 9 has the highest net benefit, whereas with higher levels of compliance Option 7 has the highest net benefit. Particulate emission reductions increase under all options at the higher levels of compliance, but the earlier emission reductions achieved under Option 7 has a greater impact on the present value of benefits.

Figure 7.16: Sensitivity of option ranking to level of retail compliance



Notes: Only the assumed % compliance level has been changed, all other assumptions (e.g. costs and phase-in periods remain the same).

7.6.2 Relationship between emission design standards and real-world emissions

Underlying the benefits achievable from improved retail compliance are assumptions about the impact that changing standards and compliance measures actually has on real-world emissions. The BCA model has a number of pertinent assumptions, including in relation to:

- emission standards and average certified emission performance;
- certified emission performance and emission performance of retail models;
- emission performance of retail models and average in-service emissions; and
- average in-service emissions given the range of operator practices.

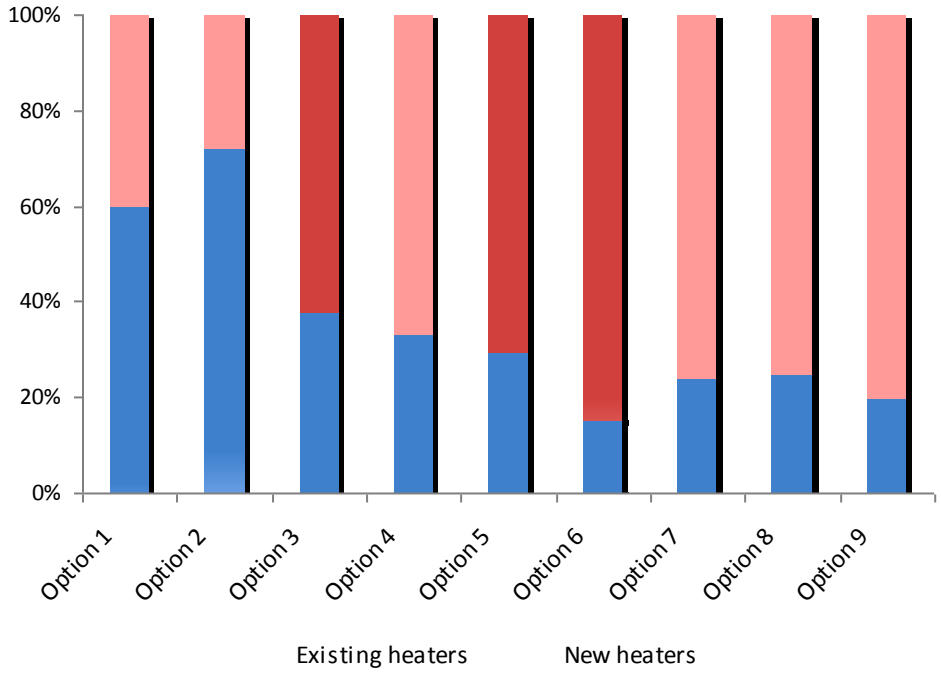
Collectively these assumptions imply a relationship between new wood heater emission design standards and likely real-world in-service emissions. Our investigations indicate that a robust relationship between certified emissions under the current test procedure and real-world emissions has not been established. Indeed the most recent study (by CSIRO 2008) concluded that *'the AS/NZ 4013 compliance does not guarantee low PM10 emissions from in service heaters'*.

While we have incorporated 'reasonable' assumptions, based on the available literature, as to in-service emissions from wood heaters with different certified emission performance, caution is required in making inferences from the resulting analysis of both changes in standards and of measures to promote compliance with those standards.

To investigate the sensitivity of our results to the relationship between test emissions and real-world emissions we firstly examine the contribution of in-service measures compared to standard (including labelling) and compliance measures to the emission reductions and benefits estimated for different options.

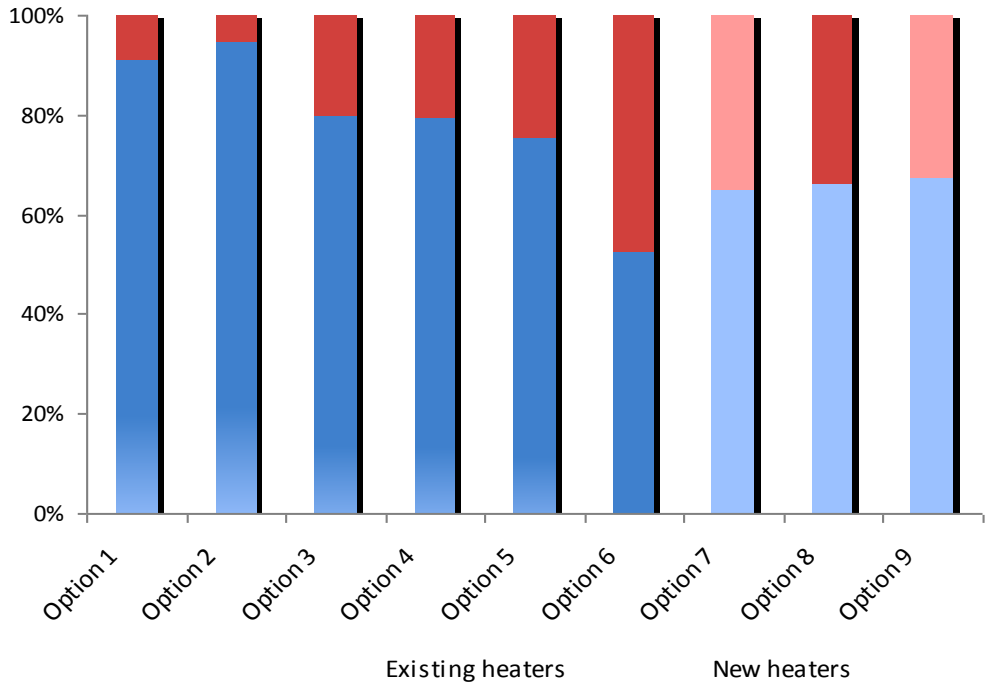
Figure 7.17 shows the proportion of emission reductions expected from existing and new heaters for each option. Apart from Options 1 and 2, new heater standards and compliance measures lead to the greatest reductions in overall emission reductions. Of the options, Option 2 has the greatest focus on in-service measures, resulting in over 70% of the emissions reductions coming from existing heaters. Option 6 has the lowest focus on in-service measures resulting in only around 15% of emission reductions coming from existing heaters.

Figure 7.17: Proportion of emission reductions relating to existing and new heaters



The proportion of benefits estimated for each option is influenced by the location of emission reductions as well as the timing of benefits across options. Figure 7.18 shows the breakdown of benefits between in-service and standards / compliance measures across options.

Figure 7.18: Proportion of benefits relating to existing and new heaters



The proportion of benefits arising from measures directed at existing wood heaters is much higher than the proportion of emission reductions shown in Figure 7.17 as in-service measures are focused primarily in urban airsheds where health benefits per tonne of emission reduction is higher.

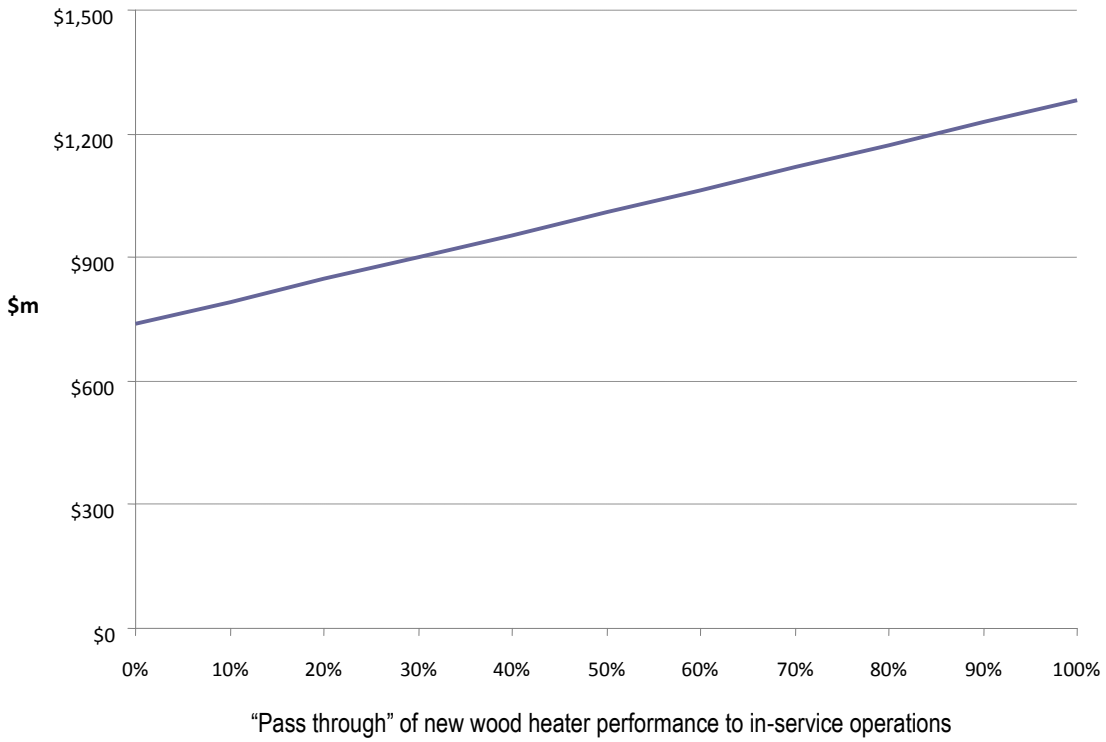
The significance of benefits from measures directed at existing wood heaters suggests that the overall analysis of options will not be particularly sensitive to the assumed relationship between new wood heater emission design standards and likely real-world in-service emissions.

Our second analysis of this relationship focuses more directly on considering the impact on option net benefits if the assumed relationship was weaker. Specifically, Figure 7.19 shows the net benefits to Option 6 with varying levels of 'pass through' of new wood heater emission performance capability (due to a lower standard and almost full retail compliance) to in-service operation.

Option 6 delivers the highest emission reductions from new heaters (85%) and so the effect of weakening this relationship should be the most pronounced. However as shown in Figure 7.19, even if no pass through of improved design performance (under the standard test method) to real-world operational performance was achieved, net benefits would only fall by around 40%. As indicated in Figure 7.18, significant benefits would still be delivered by targeted in-service measures.

Notwithstanding the importance of in-service measures, the benefits of emission reductions from new wood heaters is still substantial, such that if there were only a 5% pass through, the resulting benefits would still far exceed the total cost of the option ($27m in NPV terms).

Figure 7.19: Net benefits with varying levels of 'pass through' of emission design improvement to in-service performance (Option 6)



In summary, while the net benefits of options exhibits some sensitivity to the assumed relationship between emission performance as measured by the standard test method and actual real-world emissions, the benefits from improved standards and compliance measures are large enough that they are worthwhile even if the relationship is weak.

7.6.3 Other sensitivity analysis

Sensitivity analysis has also been undertaken on a range of other assumptions. The key findings are:

- the results are not very sensitive to the estimate of health benefits per tonne of particulate emissions reduced. Benefit values per tonne would need to be reduced by 97% for any option to have a net cost to the community.
- if education has no impact on operator behaviour this reduces the benefits under all options, with a 90% reduction in benefits under Option 2 down to around 13% reduction in benefits for Options 7-9. All options would still provide net benefits and Option 7 remains the option with the highest net benefit.
- if all heaters replaced under replacement programs would have been replaced anyway (100% rather than 50%) this reduces the benefits of Option 2 by 40% and the benefits of Options 7-9 by 30%. All options would still provide net benefits and Option 7 remains the option with the highest net benefit.

QUESTIONS

Stakeholders are welcome to provide feedback on any aspect of this chapter. The following questions have been formulated to provide a starting point for submissions. Please provide references where required.

13. ***Do you believe the base case has been correctly identified, or are there other variables that need to be considered?***
14. ***Have all health, environmental, economic and social impacts been identified? If not, please suggest others that need to be included. Has sufficient weight been given to these impacts within their relationship to the policy options being proposed?***
15. ***Have all key assumptions been correctly identified and included in the analysis? If not, please suggest others that need to be included.***

8 CONCLUSIONS

In many of Australia's major metropolitan areas, and in some regional locations, particulate emissions from both new and in-service wood heaters continue to be significant contributors to high ambient levels of particulates. Exposure to ambient particulate matter has been associated with adverse health effects.

Under a business as usual (or 'base case') scenario wood heater emissions are expected to fall over time. This arises as more efficient new wood heaters gradually replace older models, and premised on overall sales remaining around current levels. However with the turnover of the existing national stock of wood heaters estimated at only 1.8% per annum, emission reductions and associated health benefits will be slow to be realised.

The objective in this consultation Regulation Impact Statement has been to assess policy options that could reduce emissions from wood heaters in Australia. Following a short-listing of possible national measures, some thirteen policy options (including sub-options) were defined that variously incorporate measures to alter wood heater performance standards, measures to promote compliance of retail models against prevailing standards, and measures to improve the in-service operational performance of wood heaters.

The analysis of options has indicated that by the year 2030 an annual reduction in particulate emissions from wood heaters, over and above those expected under the base case, of between 1,300 to 7,300 tonnes is possible. The present value of health benefits under the options over the twenty year evaluation period are estimated to range from $760m to $1,850m, while the cost of options ranges between $17m and $56m. Clearly, all options examined are estimated to provide significant net benefits to the Australian community.

The net benefits are greatest for the options involving national regulation and including a broad range of measures covering standards, compliance and in-service emissions (Options 7, 8 and 9). Option 7 is estimated to provide the highest net benefits. Although Options 8 and 9 include more stringent standards for new heaters, the modifications would cost more and take longer to provide benefits. This is due to longer phase-in periods that would be needed to allow manufacturers to develop, and have certified, models compliant with the new standards.

The impact of Options 7 and 8 on the Australian wood heater manufacturing industry (and consumers) is estimated to be modest, and much lower than under Option 9 which would require more significant research and development to design fireboxes that could meet an emission limit of 1.5 g/kg *and* an efficiency standard of 60%.

In summary, the analysis supports the introduction of a national regulatory approach to accelerate emission reductions from wood heaters in Australia, rather than voluntary or collaborative approaches. The merits of alternative policy vehicles and responsibilities for implementing different parts of a national policy package are considered in Section 10, Implementation and Review of a National Regulatory Approach.

An exposure reduction framework for particles to improve Australia's ambient air quality is being targeted in the development of the National Plan for Clean Air. As wood heaters contribute to the level of particulate matter in the ambient air, this consultation document aims to address possible options for reducing wood heater emissions. The options that arise from this consultation process will contribute to the national response to particulate pollution under the plan. Outcomes from the wood heater consultation, as well as similar consultation documents covering non-road spark ignition engines and equipment and non-road diesel engines, will be included in an overall response aimed at national coverage.

The COAG Standing Council on Environment and Water[43] will decide on the appropriate level of response, whether through the exposure reduction framework; via product standards; or through other options that may emerge during the consultation process.

QUESTION

Stakeholders are welcome to provide feedback on any aspect of this chapter. The following questions have been formulated to provide a starting point for submissions. Please provide references where required.

16. Do you agree with the conclusions? If not, please provide reasons.

17. Can other conclusions be made based on the outcomes of this analysis?

[43] The COAG Standing Council on Environment and Water is a Ministerial council made up of federal, state and territory ministers with the authority to provide national outcomes.

9 CONSULTATION

In March 2008, the Environment Protection and Heritage Standing Committee agreed on the need for a nationally consistent approach to wood heater emissions management. An EPHC Wood heater Reference Group was established to provide input to the assessment of options. The EPHC Wood heater Reference Group is chaired by the Commonwealth Department of Sustainability, Environment, Water, Population and Communities and includes representatives from:

- ACT Department of the Environment, Climate Change, Energy and Water
- NSW Department of Environment, Climate Change and Water
- QLD Department of Environment and Resource Management
- SA Environment Protection Authority
- TAS Department of Primary Industries, Parks, Water and Environment
- WA Department of Environment and Conservation
- Victorian Environment Protection Authority
- NZ Ministry for the Environment

The National Environment Protection Council engaged BDA Group, in collaboration with Environment Link, to assess policy options to reduce emissions from wood heaters in Australia, and to prepare this consultation Regulation Impact Statement (RIS).

The project team consulted with a range of stakeholders during the preparation of this document, seeking information and perspectives on options for reducing emissions from wood heaters.

Table 9.1 summarises those consulted during this informal phase of consultation. A number of other groups were contacted and provided an opportunity to meet with the study team, but had not taken up the invitation at the time of submitting this report.

The Consultation RIS has been released to facilitate formal public consultation on options for reducing emissions from wood heaters. This RIS will enable all stakeholders, including the broader community, to respond to the options presented and the analysis of their costs and benefits.

Table 9.1: Stakeholder consultation

Stakeholder Group	Consultations held
Jurisdictions	Environment ACT
	Commonwealth Department of Environment, Water Heritage and the Arts
	NSW Department of Environment, Climate Change and Water
	QLD Department of Environment and Resource Management
	SA Environment Protection Authority
	TAS Department of Primary Industries, Parks, Water and Environment
	WA Department of Environment and Conservation
	NZ Ministry for the Environment
Industry	Australian Home Heating Association
	Barbeques Galore
	AF Gason
	Shamic Sheetmetal
	Pecan Engineering
Other stakeholders	ECO Energy Options Pty Ltd
	Firewood Association of Australia
	Standards Australia
	Armidale Dumaresq Council
	Launceston Council

There are a number of uncertainties and issues arising from the analysis which should be considered during the formal consultation phase, including:

- the ongoing use of wood heaters over time and at different locations, and the likely replacement of heaters in the absence of a national program;
- the emission standard compliance levels likely to be achieved under alternative audit and enforcement regimes, including:
  - under the AHHA's relatively new industry certification and auditing program;
  - with voluntary national audits, recognising that voluntary participation by manufacturers in 2003 led to subsequent enforcement action;
  - with a nationally coordinated but state based audit and enforcement regime; and
  - with national certification and independent testing.

- the relationship between new wood heater emission design standards and likely real-world in-service emissions;
- the costs to manufacturers of meeting different standards and likely impacts on the wood heater manufacturing industry;
- appropriate phase-in arrangements for new wood heater standards; and
- preferences for responsibilities across different levels of government and funding arrangements for national initiatives.

All submissions will be treated as public documents, unless requested to be treated as confidential by the author.

Written submissions should be sent to:

SCEW.secretariat@environment.gov.au
Standing Council on Environment and Water Secretariat
GPO Box 787, Canberra, ACT 2601

Contact number for enquiries: [INSERT NUMBER]

The closing date for submissions is [DATE]. Late submissions will not be accepted. All submissions are public documents unless clearly marked "confidential" and may be made available to other interested parties, subject to Freedom of Information Act provisions.

10 IMPLEMENTATION AND REVIEW OF A NATIONAL REGULATORY APPROACH

The cost-benefit analysis incorporated estimates of the upfront development and implementation costs as well as the ongoing enforcement costs for two alternative policy vehicles for the implementation of a national regulatory approach - a NEPM and Commonwealth regulation.

As noted in Sections 6.3, a new national regulatory approach for managing wood heater emissions could also be achieved through the use of 'mirror' legislation.[44] There are a number of issues that are relevant when comparing the merits of the alternative policy vehicles, and these are canvassed in this section.

It should also be noted that the policy vehicles considered - Commonwealth legislation, a NEPM and mirror legislation - are not mutually exclusive. Some measures may be better suited to one or the other, and a coordinated national regulatory program could involve a mix of these legislative mechanisms.

In addition, a number of complementary measures that could be introduced to support the regulatory instruments are also canvassed in this section.

10.1 Merits of alternative vehicles to support a national regulatory approach

The merits of Commonwealth regulation, a NEPM and mirror legislation are considered here in relation to likely industry coverage, ease of establishing the regulatory arrangements, implementation, monitoring and enforcement, and cost.

Coverage of the wood heater industry

The Commonwealth could establish new legislation that would set national performance limits and a test method in its regulations. Other measures such as certification and auditing provisions could be included. The Commonwealth could do this through its corporations powers for the sale of wood heaters (applicable to manufacturers and importers, as well as wholesale and retail suppliers so far as they are constitutional corporations) or through its trade and commerce powers to the *manufacture or import* of wood heaters for use in Australia (and this is not limited to corporations).

Commonwealth legislation may lead to compliance gaps where wood heaters were being sold by non-incorporated businesses. A review of wood heater manufacturers and importers as at March 2011 identified only one small manufacturer which appeared to be unincorporated (see Appendix 9). The status of the much larger number of retail supplies of wood heaters has not been undertaken, but clearly there is much greater scope for some of these to be unincorporated.

[44] This could entail either new and uniform legislation, or where appropriate, the amendment of existing state and territory regulations governing wood heaters to include new regulatory provisions and standards.

To the extent that Commonwealth legislation for wood heater manufacturing and import controls were considered insufficient, a NEPM or mirror legislation could be used to cover the entire industry. An advantage of these approaches is that the regulatory provisions could also cover measures more broadly applicable than only for new heaters (such as in relation to modifications, installations, second hand heaters and excessive smoke).

An advantage of using a NEPM or mirror legislation approach is that it can also include requirements and/or guidance on a range of in-service factors that influence wood heater emissions. The impact analysis reported in Section 7 highlighted the importance of measures directed at improving the emission performance of existing wood heaters.

It is likely that Commonwealth legislation could only apply to new wood heaters, and, because of issues such as constitutional limitations and the lack of a local presence, would not be able to effectively exert control on the sale of second hand wood heaters, wood heater installation or modification, or other factors that affect wood heater operation.

Ease of establishing the regulatory framework

Making a Commonwealth regulation would be subject to Australian Government policy approval and legislative priorities.

Making a NEPM requires agreement of nine separate jurisdictions (or at least two thirds of the National Environment Protection Council) at a whole of government level. Once made, implementation is outside the Council's jurisdiction under the Act and is achieved by each state and territory adopting the provisions of the NEPM in their legislation. National consistency in regulations could be achieved by a NEPM provided that key provisions are made mandatory requirements under the Measure (i.e. they are included as part of a NEPM goal, standard or protocol) - essentially a NEPM with mirror legislation.

Mirror legislation, which can be introduced outside of the NEPM process, would require uniform regulatory requirements in all jurisdictions[45] and possibly the Commonwealth. It would probably require the development of a separate intergovernmental agreement to obtain commitment from all jurisdictions to enact identical legislation.

Implementation, monitoring and enforcement

Implementation would be the responsibility of the Commonwealth under a Commonwealth regulation. Through national coverage, consistent requirements, monitoring and enforcement is likely, and hence impose uniform standards on all industry participants.

A NEPM would establish processes for the development, review and cost sharing arrangements relevant to its goals, standards, guidelines and protocols. The states and territories would carry out monitoring and enforcement functions in line with the implementing legislation in each

45 Again, this could entail either new and uniform legislation, or where appropriate, the amendment of existing state and territory regulations governing wood heaters.

jurisdiction. This presents a risk that the effective level of enforcement will vary between states because of differences in administrative processes and available resources. This could affect effective levels of compliance and lead to unequal compliance costs for industry across jurisdictions.

Under a mirror legislation scheme uniformity in legislation would be achieved, but the effective level of enforcement could still vary between states. A key factor would be the agreed arrangements for scheme administration.

For example, the *Water Efficiency and Labelling Scheme* (WELS) is a national legislative scheme with Commonwealth, state and territory legislation. The legislation specifies the Secretary of the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) as the regulator for the scheme, and includes delegation arrangements. The regulator has a number of functions including consideration of applications for product registration, assisting in the development of product standards, and compliance and enforcement tasks. As the regulatory requirements relate to the sale of products, compliance action to date has largely targeted retail premises.

A review of WELS has found that administering the scheme, including the processing of product registrations and conducting retail inspections by the Commonwealth, has been more resource intensive and expensive than was predicted at the scheme's commencement, largely due to a much higher take up rate. Specifically, the total scheme cost for 2009-10 has been put at some $2.2 million, nearly three times higher than anticipated by the 2004 Cost Recovery Impact Statement, with seven times the expected number of products being registered [46].

The review also considered the current co-operative legislative arrangements for the scheme, in which the Commonwealth, states and territories have each passed equivalent legislation. The review noted that an applied legislative model whereby amendments agreed by governments are presented in one parliament and, if passed there, are then automatically adopted by all other parliaments, may provide for greater consistency of legislation and expediency when legislative amendments are required. However, the review also noted that this means that the upper houses in the other parliaments lose their capacity to review the decisions of governments. Accordingly, the applied legislative model is regarded as being most suited to technical subject matters. The review did not recommend adoption of the model for the WELS scheme at that time [47].

Alternatively, the use of mirror legislation but with a scheme administered by state and territory governments, would allow each jurisdiction to align their level of compliance activity on the risk posed to the jurisdiction. Jurisdictions may also have a better local knowledge and contact with manufacturers and retailers. The administration of wood heater emissions compliance by local

46 Guest 2010, Table 2

47 Guest 2010, page 17

jurisdictions may provide for more cost-effective audit and enforcement activities given their local presence, better local knowledge and contact with manufacturers and retailers.

Cost

A NEPM is likely to cost more than a Commonwealth regulation, due to the need for multiple state and territory regulations and reporting requirements under a NEPM. However, the differences in costs outlined in Section 7 were relatively minor (a present value of around $1m) in the context of the estimated net benefits over the 20 year assessment period.

Alternatively, and for the reasons canvassed above, 'mirror' legislation may be considered. From a cost perspective, the development of mirror legislation may be a more costly and lengthy process than a NEPM, requiring new legislation in all jurisdictions as well as the Commonwealth, and most likely the development of a separate intergovernmental agreement. Implementation costs may also be higher depending upon the agreed arrangements.

10.2 Complementary action

As noted above, beyond standards and compliance measures, a range of in-service measures have also been investigated. Most are appropriately managed at a state and territory level and most jurisdictions already have regulations in place or the measures could be implemented administratively (e.g. education programs and wood heater replacement incentives). Alternatively, they could be incorporated into a NEPM.

In addition, if a national regulatory approach is adopted, some measures may benefit from complementary action. These include:

- installation of compliant heaters in new homes - consistent controls on installation to ensure heaters comply with relevant standards could be achieved through the Australian Building Codes Board. The initial changes could be co-ordinated by the Commonwealth government and implemented by jurisdictions through existing building regulation processes as is done in Tasmania;
- proper installation practices - A new national certification scheme for installers administered by the Commonwealth and associated training programs would support enforcement by jurisdictions; and
- the Commonwealth could co-ordinate consistency in state and territory regulatory provisions for proper installation practices, installation of compliant heaters in existing homes, controls on heater modification, controls on the sale of second hand heaters, and common definition of excessive wood smoke.

REFERENCES

AEA Technology Environment 2006, *Damage Costs for Air Pollution*. Prepared for DEFRA, ED48796, March.

Ancelet, Davy, Trompetter, Markitz and Weatherburn 2010, *A Comparison of particulate emissions from a modern wood burner with those of an old wood burner*, Air Quality and Climate Change Volume 44 No 3 August.

Armidale Dumaresq Council 2003, *Woodsmoke Reduction Program 2003: Final Report*, November.

Auckland Regional Council 2009, Effects of Wood Moisture on Particulate Emissions from Woodburners, Auckland Regional Council Memo, 6 October 2009 in New Zealand Technical Advisory Group on National Air-Quality Standards (2009), Air Quality – Getting the Balance Right, November Ref. CR 90.

Australian Bureau of Statistics (ABS) 2008, *Environmental Issues: Energy Use and Conservation,* Catalogue 4602.0.55.001, March.

Australian Government 2007, *Best Practice Regulation Handbook,* Canberra

Australian Home Heating Association (AHHA) 2003, *Woodheating in Australia,* submission to the Federal Government.

Australian Home Heating Association (AHHA) 2009, *Wood heater Consultation Regulatory Impact Statement,* submission to the Federal Government.

Beer 2002, *Valuation of Pollutants Emitted by Road Transport into the Australian Atmosphere*, Proceedings of the 16th International Clean Air & Environment Conference, New Zealand, August.

Bureau of Transport and Regional Economics (BTRE) 2005, *Health Impacts of Transport Emissions in Australia: Economic Costs*, BTRE Working Paper 63.

Coffey Geosciences Pty Ltd 2003, *Fuel Quality and Vehicle Emissions Standards Cost Benefit Analysis*, a report prepared for the Department of Environment and Heritage.

CSIRO 2004, *Launceston Wood heater Replacement Program – Impacts on Regional Air Quality*, prepared for the Department of Environment and Heritage.

CSIRO 2005, *Wood heaters in Launceston – Impacts on Air Quality*, prepared for the Commonwealth Department of Environment and Heritage, September.

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 (DEH) 2004a, National Wood heater Audit Program, Report, May.

Department of Environment and Heritage (DEH) 2004b, National Wood heater Audit Program, Action Plan.

Department of Infrastructure, Transport, Regional Development and Local Government (DITRDLG) 2009, *Draft Regulatory Impact Statement for Review of Euro 5/6 Light Vehicle Emission Standards*, December 2009.

DSEWPaC 2010, *State of the Air in Australia: 1999-2008*, Australian Government Department of Sustainability, Environment, Water, Population and Communities.

EC/R Incorporated 2009, *Subpart AAA – Standards of Performance for New Residential Wood Heaters: Draft Review Document*, prepared for US EPA, November.

EnergyConsult 2004, *Evaluation of Launceston Wood heater Replacement Program and Associated Measures*, prepared for the National Heritage Trust, Commonwealth Department of Sustainability, Environment, Water, Population and Communities, November.

Energy Efficient Strategies 2008, *Decision Regulatory Impact Statement Household Refrigerators and Freezers*, prepared for the Department of the Environment, Water, Heritage and the Arts, Australia & the Energy Efficiency & Conservation Authority, New Zealand.

ENVIRON 2010, *Cleaner Non-road Diesel Engine Project – Identification and Recommendation of Measures to Support the Uptake of Cleaner Non-road Diesel Engines in Australia*, Prepared for NSW Department of Environment, Climate Change and Water, April.

Environment Australia, National Pollutant Inventory 1999, *Emission Estimation Technique Manual for Aggregated Emissions from Domestic Solid Fuel Burning*, November 1999.

Environment Link and BDA Group 2006, *Wood Heater Particle Emissions and Operating Efficiency Standards: Cost Benefit Analysis*, prepared for the Department of Environment and Heritage in January 2005, updated and revised June.

Environment Protection and Heritage Council (EPHC) 2010, *Reducing emissions from non-road spark ignition engines and equipment, consultation regulation impact statement*, Prepared by the Non-Road Engines Working Group on behalf of the EPHC, May.

European Commission (EC) 1995, *Externalities of Energy, 'ExternE' Project*. European Commission, DGXII, Science, Research and Development.

Guest 2010, Independent Review of the Water Efficiency Labelling and Standards Scheme (WELS), report to the Commonwealth Minister for Environment Protection, Heritage and the Arts, 30 June

Holland, Pye, Watkiss, Droste-Franke and Bickel 2005, *Damages per tonne emissions of PM2.5, NH3, NOx, and VOCs from each EU25 Member State (excluding Cyprus) and surrounding seas*, March.

Holland and Watkiss 2002, *Benefits table database: estimates of the marginal external costs of air pollution in Europe*, V E1.02a.

Institute for Sustainable Futures 2008, *Cost effectiveness analysis of WELS the water efficiency labelling and standards scheme*, report to the Department of the Environment, Water, Heritage and the Arts, May.

Kelly, Mues and Webley 2007, *Real Life Emissions Testing of Wood Burners in Tokoroa*, prepared for the NZ Ministry for the Environment, Warm Homes Report No. ME814, June.

NEPC 2010, *Review of the National Environment Protection (Ambient Air Quality) Measure: Discussion Paper Air Quality Standards,* July.

NEPC 2011 *Review of the National Environment Protection (Ambient Air Quality) Measure: Review Report,* May.

NPI 2011, *2010/2011 data within Australia - Particulate Matter 10.0 um from All Sources,* National Pollutant Inventory, Department of Sustainability, Environment, Water, Population and Communities.

NSW Department of Environment and Conservation (NSW DEC) 2005, *Air Pollution Economics: Health Costs of Air Pollution in the Greater Sydney Metropolitan Region*, Sydney.

NSW Department of Environment Climate Change (NSW DECC) 2007, *Air Emissions Inventory for the Greater Metropolitan Region in NSW, Domestic-Commercial Emissions Module: Results, Technical Report No. 5*, prepared jointly by DECC and Optimised Operations Pty Ltd, August 2007.

NSW Department of Environment, Climate Change and Water 2010a, *Regulatory Impact Statement, Proposed Protection of the Environment Operations (Clean Air) Regulation 2010*, June.

NSW Department of Environment, Climate Change and Water 2010b, *Current air quality in New South Wales*, A technical paper supporting the Clean Air Forum 2010.

OECD 2007, *OECD Environmental Performance Reviews: Australia,* Organization for Economic Cooperation and Development.

RMIT University 2007, *Product Environmental Labels Scoping Study Stage 1: PELS Review*, Prepared for Sustainability Victoria.

Scott 2005, *Real Life Emissions from Residential Wood Burning Appliances in New Zealand*. Ministry for the Environment Sustainable Management Fund Report.

Smith, Bluett, Wilton and Mallett 2008, *In home testing of particulate emissions from NES authorised burners*: *Nelson, Rotorua and Taumaranui* 2007, NIWA Report CHC2008-092.

Todd 2002, *Review of Literature on Residential Firewood Use, Wood-Smoke and Air Toxics*, Technical Report No. 4, prepared for Environment Australia, Canberra, June 2002.

Todd 2006a, *Cost-Benefit Analysis of Wood Smoke Reduction in Perth*, prepared for the WA Department of Environment and Conservation in November 2005, revised August.

Todd 2006b, *Design of a Study to Inform the Development of New Emission Standards*.

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

Todd 2008b, *Trends in Australia Wood heater Performance*, Clean Air and Environmental Quality Vol 42(2), May.

Todd and Greenwood 2005, *Proposed Changes to AS/NZS 4013 – Determination of Particle Emission Factors*, Draft Final report.

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.

Watkiss from AEA Technology Environment 2002, *Fuel Taxation Inquiry: The Air Pollution Costs of Transport in Australia*, prepared for the Commonwealth of Australia.

Western Australian Department of Environment 2006, *Perth Home Heating Survey: Technical Report*, January.

Western Australian Department of Environment and Conservation (WA DEC) 2007, *Wood Heater Policy Options Paper, Consultation Document*, May.

Wilkenfeld and Associates 2004, *Regulation Impact Statement: Proposed National System of Mandatory Water Efficiency Labelling and Standards for Selected*, prepared for the Department of the Environment and Heritage.

Wilton and Smith 2006, *Real Life Emissions Testing of Pre 1994 Woodburners in New Zealand*, Technical Report 2006/05, Environment Waikato, New Zealand.

Wilton, Smith, Dey and Webley, 2006 *Real Life Testing of Wood Burner Emissions*, Clean Air and Environmental Quality 60(4).

WHO 2006a, Health risks of particulate matter from long-range transboundary air pollution, World Health Organization.

WHO 2006b, *WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide: Global update 2005*, World Health Organization.

APPENDIX 1: Local survey results of wood heater use

This appendix provides a brief summary of local survey results or estimates of wood heater use – available for Perth, NSW and Launceston.

Perth Home Heating Survey 2004

The Western Australian Department of the Environment carried out the Perth Home Heating Survey in three local government areas within the Perth metropolitan region in 2004 receiving over 3,100 responses[48]. The key findings of the survey were:

- 25% of homes in the survey area had a wood heater and 11.5% of homes used a wood heater as their primary source of heating
- slow combustion wood heaters were the most common form of heating
- wood heating has decreased in recent years due to inconvenience, decreased availability of wood, increased cost of purchasing wood and the availability of gas
- a third of all wood heaters found in homes were not used
- active wood heaters were used a few times per week (36%) or everyday (31%)
- almost three quarters of wood heater owners use their wood heater only in the evenings and 15% in the evening and overnight
- the main reasons for using a wood heater were the aesthetics and the nature of the heat (radiant)
- the average age of wood heaters was 15.5 years
- 92.1% of slow combustion heaters in homes were not certified to meet the current Australian Standard
- 70% of people who inherited a slow combustion wood heater with their home used the wood heater as their main source of heating
- almost half the wood heater users indicated they would be influenced by targeted programs to remove wood heaters, with half indicating they would replace it with a $700 rebate
- although the community recognised wood smoke as an air pollutant contributing to winter haze and health impacts, air pollution was not considered to be a major environmental issue in the Perth metro region.

NSW Community Surveys

The NSW Department of Environment, Climate Change and Water (formerly EPA) periodically undertakes telephone surveys, supplemented by focus groups, on environmental issues.

48 WA Department of Environment 2006

Community attitudes to solid fuel home heating were the focus of surveys undertaken in 1995, 1998 and 2000. The surveys questions were not exactly the same in each survey. The relevant results are summarised as follows:

Table A1.1: Summary of selected data from NSW Community Surveys

	1995	1998	2000
Wood heating as main source			
State-wide	19%	17%	NA
MAQS*	13%	12%	12%
Sydney metro	NA	NA	11%
Wood as secondary heating source	6%	3%	NA
Types of wood heaters used by those with wood heaters			
Open fireplace	29%	NA	28%
Slow combustion heater	66%	NA	66%
Pot belly	4%	NA	6%

Source: DEC 1995, 1998, 2000

*MAQS includes Sydney, Central Coast, Newcastle and Wollongong

In the 1995 survey the reasons for using solid fuel heating were as follows:

- cheap to run (35%)
- effectiveness (33%)
- atmosphere (25%)
- comfortable/pleasant/even (21%)
- plentiful fuel available (21%)

Almost one third of households using wood heating (22% in the Metropolitan Air Quality AQS study area (MAQS) and 43% in country NSW) said they use wood heating 24 hours per day and a further 22% of households using wood heating between 8 hours and 24 hours a day. The majority, statewide, using wood heating said they used hardwood (58% specified hardwood, 5% softwood and 18% whatever wood available and 12% just wood).

Respondents to the 2000 survey indicated that the 21% of wood heaters were less than 5 years old, 41% were 5 years old and the rest of respondents were unsure of the age of their wood heaters. Sydney respondents used an average of 1.9 tonnes of wood per year, with 37% purchasing wood and 61% harvesting wood from forests.

Wood heater use in Launceston

The percentage of private dwellings that used wood as the main form of heat in Launceston was estimated to decrease over time: 66% in 1992, 60% in 1996, 47% in 2000 and 30% in 2004 (reported in CSIRO, 2004) with the total number of wood heaters estimated to be 13,166. Using various estimates of the wood heater population in Launceston, CSIRO (2004) provided the following wood heater projections:

Table A1.2: Projected wood heater use in Launceston

	2005	2006	2007
% of dwellings with wood heaters	27%	23%	20%
Types of wood heaters			
Compliant	69.2%	72.6%	75.9%
Non-compliant	24.5%	21.6%	18.1%
Open fireplaces	6.3%	6.1%	6.0%

Source: CSIRO 2004

The number of households using wood heaters in Launceston in 2010 is estimated to have dropped to around 15%[49].

49 Pers comm. John Todd, August 2010

APPENDIX 2: Wood heater emission factors

A2.1 Comparison of certified and in-service particulate emissions

In-service particulate emissions may vary from test emissions due to:

- variations between test and retail models;
- modification of retail models (e.g. at installation); or
- differences between test and in-service operating factors.

Todd and Greenwood (2005) measured emissions from four wood heater models operated to the current test method, and two modified test methods that were thought to better reflect the way householders actually operate their wood heaters. The ranking of the four heaters from cleanest to smokiest were different for each of the three methods. This was unexpected and could not be explained by the authors.

While emissions under the postulated real-world practices were consistently higher than under the test method, no conclusions could be drawn as to any relationship between test and in-service emissions.

A number of studies of in-service emissions have since been completed in New Zealand:

- Scott (2005) found in-service emissions were on average nine times greater than certified emissions and that there was a poor correlation between certified and in-service emissions, however the sample size was too small to postulate robust conclusions;
- Wilton et al. (Wilton and Smith 2006, Wilton et al. 2006) found that most of the variation in in-service emission factors was attributed to heater operation and installation. However again, the study was restricted to a small number of appliance types and test homes were targeted rather than randomly selected;
- The NZ Ministry for the Environment (Kelly et al. 2007) estimated in-service emissions from 9 heaters compliant with the 1994 NZ standard of 1.5 g/kg, and found average emissions to be 4.6 g/kg. By comparing these results to the average in-service emissions of 14.0 g/kg found in an earlier 2005 study by Environment Waikato of pre-1994 wood heaters in Tokoroa, the NZ Ministry for the Environment concluded that the emission standard was an effective tool for reducing emissions. However, due to the small sample size, test methodology and narrow range of heater designs covered, they argued that it was premature to conclude exactly how much lower emissions from standard compliant wood heaters are compared to old heaters;
- Smith et al. (2008), found in-service emissions from heaters made since the introduction of the 1994 standard were much lower than for older heaters. However while the difference between the emission factors was found statistically significant, there was again considerable variability in in-service emissions;

- Ancelot et al. (2010) compared a compliant heater with an older non compliant heater over 84 test cycles using softwood. They found that PM_{10} emissions were very similar during start up and low burn cycles but the compliant heater had about half the emissions during the high burn cycle;
- Auckland Regional Council (2009) undertook testing of emissions from wood with different moisture content and found emissions from wet wood can be twice those from dry wood. The results are summarised in Table A2.1. Damp or wet wood contains more moisture and needs more energy to evaporate the water in the fuel. This causes the fire temperature to drop and reduces combustion efficiency. As a result, more particulates are emitted.

Table A2.1: Wood moisture content and emission factors

Wood	Moisture (%)	Emission factor (g/kg)	Uncertainty (+ or -)
Dry	15	2.9	0.7
Damp	25	6.5	1.5
Wet	35	7.9	1.6

Source: Auckland Regional Council 2009

Todd (2008)[50] examined the manner in which in-service wood heaters were operated in Australia, and documented a number of differences relative to the test method employed in the Australian standard. He indicated that it was beyond the scope of his review to speculate on the different outcomes of the (earlier) NZ in-service emission studies, but argued that it is not possible to use the New Zealand results to draw conclusions about in-service emissions from wood heaters operated in Australia because most New Zealand households burnt pine and the heaters sold in New Zealand often have slightly different design features to those sold in Australia.

CSIRO (2008) investigated emissions from 18 in-situ heaters in Launceston and found an average emission performance of 9.4 g/kg. They also found:

- a large range in performance;
- that the major determinant was the rate of air supply (indicating the importance of how heaters are operated); and
- that emission factors for pine did not fit the relationship observed for the hardwood fuels.

CSIRO 2008 concluded that *'the AS/NZ 4013 compliance does not guarantee low PM10 emissions from in service heaters'*.

50 Todd 2008a

They also reviewed the available studies on in-service emissions, and along with the results from their own investigations and concluded that *'there is increasingly strong evidence that the average emissions for in-service domestic wood heaters is approximately 10 g/kg*.'

A2.2 Derivation of in-service emission factors used in this study

We have drawn on the available research findings canvassed in Section A2.1, along with estimates postulated in a range of studies (Table A2.2) to qualitatively develop a suite of emission factors for in-service wood heaters for use in this RIS.

Table A2.2: Estimates of particle emission factors for wood heaters in Australia

Heater type / operation / location	Emission factor (g/kg)	Source
Extremely badly operated heater	100.0	WA DEC 2007
Open fireplace	17.3	NPI emission factor EA 1999
Poorly designed, carelessly operated wood heater	15.0	WA DEC 2007
Australian heaters non-compliant with Australian standards	12.0	NPI emission factor EA 1999
Average wood heater in use in Perth	11.0	WA DEC 2007
Average wood heater in use in Launceston	10.0	CSIRO 2008
Well designed, carelessly operated wood heater	10.0	WA DEC 2007
Average US in-service emission factor	9.8	Todd 2008a
Wood heater complying with 1992 Australian standard (revised test method)	8.7	Environment Link and BDA Group 2006
Poorly designed, correctly operated wood heater	7.0	WA DEC 2007
Wood heater complying with 1999 Australian standard (revised test method)	6.3	Todd & Greenwood 2005
Wood heater complying with 1992 Australian standard	5.5	NPI emission factor EA 1999
Wood heater complying with 1999 Australian standard	4.0	NPI emission factor EA 1999
Well designed, correctly operated wood heater	3.0	WA DEC 2007
Average for new wood heaters sold in Australia in 2007-08	2.6	WalterTurnbull 2009
Average wood heater certified to 1999 Australian standard in 2004	2.6	DEH from AHHA in 2004
Best design, best operation for wood heater	1.0	WA DEC 2007

In the case of open fireplaces, it has been assumed that particulate emissions average 17 g/kg, with emissions insensitive to in-service operation. For certified wood heaters, consistent with the findings of DEH (2004), we have assumed the average emission performance of retail models (using the standard test method) was 1.6 times greater than the prevailing emission standard.

We have then extrapolated from the findings of CSIRO (2008) to postulate the proportion of in-service heaters (all locations) whose operation we have classified as good (lowest 25% of heaters), careless (next 70%) and poor (last 5%), and the average emission performance across all in-service wood heaters (excluding fireplaces) of around 10 g/kg.

Drawing this information together has then allowed a relationship between retail performance and in-service emission performance to be postulated, and emission factors to be derived by heater type and operation. The resulting emission factors for currently in-service wood heaters is shown in the yellow shaded section of Table A2.3.

Table A2.3: Assumed in-service emission factors (g/kg)

Heater type	Design performance	Retail performance	In-service performance based on operating practices		
			Good (1 x retail)	**Careless** (1.2 x retail)	**Poor** (1.8 x retail)
Open fireplace	na	17	17	17	17
Uncertified heater	na	9.9	9.9	11.9	17.9
Certified pre 1999	5.5 (std)	8.8	8.8	10.6	15.8
Certified 1999 - 2009	4.0 (std)	6.4	6.4	7.7	11.5
New heaters from 2010 meeting an emission standard of:	Average certified emissions	Average retail model emissions			
4 g/kg	2.6	5.0	5.0	6.0	8.9
3 g/kg	2.1	4.0	4.0	4.8	7.2
1.5 g/kg	1.2	2.2	2.2	2.6	3.9

The assumed *average* in-service emissions for wood heaters certified between 1999 to 2009 to a 4 g/kg standard, and those postulated for new wood heaters entering the market from 2010, differ due to assumed changes in retail compliance following the 2003 DEH audit[51] of wood heaters and subsequent changes to testing procedures (including the testing of retail models every 3 years upon applying for re-certification). As described in Section A7.4, it is assumed that these changes will lead to a 40% improvement in retail compliance.

[51] DEH 2004a

Specifically, for wood heaters currently entering the market, we have initially assumed a similar level of retail heater performance as in previous years[52]. From here we have then factored in a 40% improvement in retail compliance, which yields an average retail emission performance of 5.0 g/kg. For new emissions standards of 3 g/kg or 1.5 g/kg investigated in the RIS, we have followed this same procedure, namely:

Actual retail emission factor (as reported in Table A2.3)

= average certified emissions + (1 - compliance improvement) * non-compliance margin

where:

average certified emissions	=	the average certified emissions of current models that would meet the new standard
non-compliance margin	=	retail average emissions - average certified emissions
retail average emissions	=	2.5 times average certified emissions

The same relationship between retail and in-service emission performance as assumed for the earlier wood heaters was then applied to derive emission factors based on operating practices.

The NSW Department of Environment, Climate Change and Water has undertaken a preliminary assessment of the emission estimates reported in Table A2.3 and concluded the historical and projected emission factors were sound for the purposes of the analyses being undertaken.

[52] Time-series analysis of certification results shows that average emissions at certification has not fallen. Therefore if retail compliance had not changed, average emissions of new heaters would continue to be 6.5 g/kg, some 2.5 times the average certified emission performance of 2.6 g/kg.

APPENDIX 3: Health costs of particulate emissions

A bottom-up quantification of health impacts from particulate pollution would necessitate the compilation of detailed emission inventories, the simulation of ambient air pollutant concentrations using air dispersion modelling, the characterisation of exposure potentials, the application of applicable dose-response relationships for exposure and health outcomes (mortality and morbidity), and finally the application of valuations of health outcomes.

A simplified type of such 'damage function' modelling was commissioned by the Commonwealth Department of the Environment and Heritage with the developed estimates of the health benefits of reducing particulate emissions for key airsheds drawn on in the 2006 study of wood heater standards by Environment Link and BDA Group. The health costs per tonne of PM_{10} in 2004 prices was estimated to range from $133,543 in Sydney to $43,106 in SE Queensland.

A simplified approach was also adopted by the Department of Infrastructure, Transport, Regional Development and Local Government (DITRDLG)[53] for a 2009 Regulation Impact Statement on vehicle emission standards. For the study they drew on existing valuations of health costs to derive plausible estimates of health costs associated with air pollution (typically referred to as the benefit-transfer approach).

In their report, DITRDLG provide a summary of recent estimates of the health costs of PM_{10} emissions for Australian capital cities drawn from the available literature. Table A3.1 shows a number of the estimates they reported.

Table A3.1: Health costs from particulate emissions used in recent studies (A$/tonne)

Study	Value
Beer (2002)	$147,429
Watkiss (2002)	$217,415[a]
Coffey Geosciences (2003)	$232,000
BTRE (2005)	$167,626[b]

Notes: a) Simple average for inner and outer areas of major capital cities
b) Estimate for the year 2000, derived from results reported in BTRE (2005).

Source: Department of Infrastructure Transport Regional Development and Local Government (2009)

DITRDLG (2009) ultimately used an average damage cost of $235,261 per tonne of emissions in capital cities, based on a simple average of the estimates from Coffey Geosciences (2003), Watkiss (2002) and Beer (2002), updated to 2009 prices using the consumer price index (CPI). A value of $55,827 per tonne for the rest of Australia was assumed, based on the simple

[53] Department of Infrastructure, Transport, Regional Development and Local Government 2009

average of the estimates for smaller capital cities and non-urban areas contained in Watkiss (2002), again updated by the CPI. Recognising the uncertainty captured in the DITRDLG approach, sensitivity analysis at ± 50% was undertaken.

Given the significance of non-metropolitan regions to the current wood heater study, the broader findings by Watkiss are pertinent. The Commonwealth Government engaged Paul Watkiss from AEA Technology Environment to prepare a report on the air pollution costs of road transport in Australia as input to the Fuel Tax Inquiry conducted in 2002. In this study, pollution unit cost estimates were based on European values of health impacts for a range of air pollutants. The European work was the 'bottoms-up' ExternE Transport Study finalised in 2000 involving fifty sites across twelve European countries.

Watkiss recognised that the most important determinant of particulate pollution damage costs is the population exposed, and he transferred values to Australian conditions controlling for population densities. His average damage cost estimate for the smaller capital cities (Canberra, Hobart and Darwin) in 2010 prices was $113,000 and only $1,500 in the non-urban areas.

The study by the Bureau of Transport and Regional Economics (BTRE 2005) referred to by DITRDLG (2009) estimated health impacts arising from motor vehicle emissions using PM_{10} as an 'indicator' pollutant for the suite of air pollutants associated with vehicles.

Similarly, the New South Wales DEC (2005) used PM_{10} as an indicator for the mix of urban air pollutants. They derived a range of estimates of the health costs of air pollution in the Greater Sydney metropolitan region using high and low exposure-response estimates, high and low cost estimates for each health endpoint, and two different minimum ambient thresholds. Estimated mid-point health costs in 2003 dollars across the metropolitan areas were $132,000 for Sydney, $35,000 for the Hunter and $26,000 for the Illawarra[54]. However caution is needed in extrapolating values for these studies for the current study as the values are a composite across all urban pollutants rather than just the contribution of particulates to health impacts.

ENVIRON (2010)[55], in assessing the potential benefits from reducing emissions from non-road engines, also made reference to the health costs postulated by Coffey Geosciences (2003), and again adjusted them by the CPI to provide health costs for 2008. This yielded an estimate of $269,100 per tonne of PM_{10} reduced.

In preparing a Regulation Impact Statement for measures to control non-road engine emissions, the EPHC (2010)[56] estimated health impact costs via the benefit transfer technique, drawing on studies by the Victoria Transport Policy Institute (VTPI 2005), the European Commission (EC 2005) and Bureau of Transport and Regional Economics (BTRE 2005 and 2003). Rather than simply averaging these, policy options were assessed against each of 11 sets of health costs drawn from low, medium and high estimates variously reported in these source documents.

54 NSW DEC 2005. Costs have been converted to 2006 dollars

55 ENVIRON 2010

56 Environment Protection and Heritage Council 2010

However an estimate of $82,490 derived[57] from EC (2005) was used in the 'headline' results reported.

Notably, the estimated particulate pollution health costs in these studies vary significantly, such as the medium estimate reported from BTRE (2005) of around $230,000 and the medium estimate from VTPI (2005) of $9,350.

In summary, a large range of damage values have been used, implying significant uncertainty as to actual damage costs. In addition, the reported studies provide some insights into the importance of the scale as well as location of emissions.

It has commonly been assumed that there is a linear relationship between the tonnage of emissions for each pollutant and health effects; that the health impacts arising from the emissions related to the policy proposal are not dependent on the background level of pollution; and that there is no clear minimum threshold for particulates under which adverse health effects would not be observed. In this regard, the NEPC in 2010 commented that:

> *'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'* [58].

A recent review of the National Environment Protection (Ambient Air Quality) Measure supports this conclusion:

> *'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.'* [59]

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57 For example, this estimate was based on reported impacts attributable to $PM_{2.5}$ and impacts-per-tonne were adjusted for the lower Australian population density compared with European cities

58 NEPC 2010

59 NEPC 2011

Therefore, while the marginal health costs associated with emission reductions will be sensitive to population and socio-demographic factors, they may not be sensitive to the scale of particulate reductions achieved. This likelihood provides support for the use of single point estimates of "marginal damage" costs that have been used in the reported 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[60].

The second issue is in relation to the location of emissions. Variation in damage costs has sometimes been postulated between different areas to take into account differences in population exposure and demographic factors. So for example, impacts are believed to be much greater in large, densely populated metropolitan areas than in smaller regional centres which in turn will be greater than in non-urban areas.

However there are also likely to be significant differences between communities with similar socio-demographics, due to the influence in some centres of meteorological factors that can trap night-time and predominantly winter wood heater emissions in temperature inversion layers. The studies cited above have predominantly been concerned with transport-related emissions, which are dominated by day-time travel and without any pronounced seasonality. Accordingly, even studies such as that undertaken by Watkiss (2002) which derived estimates for four population related community classifications, have limitations when considering particulate impacts from wood heaters.

A final consideration for this study is that even if it were possible to develop detailed damage cost estimates by a broader range of community settings, limited data on the location of existing wood heaters and the destination of new wood heaters would prevent their use.

The approach implemented in this study is to utilise the damage cost estimates of $/tonne health costs from particulate pollution reported in other studies. On balance, we have chosen to employ damage cost estimates derived from the Watkiss study and updated to 2010 prices, as it appears to provide the most rigorous analysis of health damage costs adjusted to Australian population sizes and density (Table A3.2).

The value assumed for the large metropolitan centres of Melbourne and Sydney are based on an average of the Watkiss values for the inner and outer areas of these centres (the Band 1 and 2 categories). Brisbane, Adelaide and Perth have been included with the smaller capital cities (Band 3) as they have similar population densities.

60 This implies a linear dose-response function with no threshold of effects

Table A3.2: Assumed particulate emission damage costs ($/tonne PM_{10})

Community	Damage cost
Large capital cities (Melbourne and Sydney)	$263,000
Smaller capital cities and large regional centres experiencing high particulate pollution levels (e.g. Launceston, Armidale, Wagga)	$113,000
Other areas	$1,500

All other areas (Band 4) are attributed the same damage cost value. This latter value will clearly mask a wide range of values that would exist between the almost negligible impacts associated with rural and remote households to those in rural communities where wood heater emissions may be of a greater concern, such as perhaps Tamworth, Albury, Bathurst in NSW or Albany, Bunbury and Busselton in WA.

APPENDIX 4: The regulatory framework for controlling wood heater emissions in Australia

This section provides an overview of the existing framework for controlling wood heater emissions in Australia.

A4.1 National

Since 1992, Australian Standard/New Zealand Standards have been introduced to improve the performance of wood heaters. The first standard for wood heater emissions, AS4013 (1992), was published in 1992 and was revised and published as a joint Australian/New Zealand Standard in 1999; AS/NZS4013 (1999) Domestic solid fuel burning appliances - Method for determination of flue gas emission. This Standard provides a test method, using a dilution tunnel, to accurately measure particles emitted by residential solid-fuel burning heating appliances.

The 1992 Standard included an upper limit for acceptable particulate emissions of 5.5 grams of particles per kilogram (oven-dry weight) of fuel burnt. This emission factor was reduced to 4 g/kg in the 1999 revision of the Standard.

The Standard applies to solid-fuel burning space-heating appliances (including those fitted with water heating devices) with a heat output of 25KW or less. It does not apply to masonry fireplaces, cooking stoves, central heating appliances or water-heating-only appliances.

There is a separate standard for pellet heaters (AS/NZS4886: 2007), however this has not been called up in Australian regulations as there are very few sold here. This standard specifies a test method for determining the rate of particulate emission from automatic continuous feed domestic pellet burning appliances and an associated particulate emission acceptance criteria.

AS/NZS 4013 also stipulates that models tested for certification must comply with specified labelling requirements. The Standard requires labelling of the appliance with the average fuel conversion efficiency measured at high, medium and slow burn rates and the average heat output rate for the high burn rate cycle. However there is no efficiency performance standard.

AS 4013 (1999) is complemented by the following standards:

- AS/NZS4014 (1999) Domestic solid fuel burning appliances - Test Fuels, specifies the test fuel to be used in the performance and emission test standards. The test method for AS/NZS 4013 measures particles greater than 0.3 µm in diameter.
- AS/NZS4012 (1999) Domestic solid fuel burning appliances - Method for determination of power output and efficiency is used for measuring the heat output rate (power) and efficiency of residential solid-fuel burning heating appliances.

These Australian/New Zealand Standards are industry performance standards that use highly specified, controlled operating conditions to assess the operation of wood heaters. They simulate 'correct' wood heater operations using a standard fuel and do not include emissions

during the lighting phase of wood heater operation. They therefore differ from 'real' world wood heater use where different types of wood and operating conditions are used that could vary particle emissions to ambient air.

In order to address inconsistencies between emissions performance as determined under ideal operating conditions and in the real world, a revision to the test protocol for determining particle emissions as specified in AS/NZS 4013 (1999) has been proposed.

The current Australian Standards provide a framework for controlling particle emissions from wood heaters. Most Australian jurisdictions require new wood heaters to meet the 1999 emissions standard of 4 grams of particles per kilogram of fuel burnt as determined by the relevant Australian / New Zealand Standards AS/NZS 4013. No jurisdiction currently requires wood heaters to meet a minimum efficiency standard.

The Australian Home Heating Association also administers a non-mandatory certification scheme for new wood heaters.

The installation of new or used wood heaters is currently regulated under the Building Code of Australia (BCA). The BCA requires that wood heaters be installed in compliance with AS 2918. While this standard relates mainly to safety rather than environmental concerns, it does establish requirements relating to flue exits and adherence to manufacturers' specifications – including installers not tampering with a heater's emissions controls.

A4.2 States and Territories

Six jurisdictions have established a regulatory framework for managing wood heater emissions. This section summarises the regulatory frameworks and recent activities of the jurisdictions (summarised in Table A4.1).

Australian Capital Territory

The ACT controls the sale of slow combustion heaters through the *Environment Protection Act 1997* which requires compliance with AS/NZS 4013 for all wood heaters. The restriction applies to all sales (new and used wood heaters) and makes modification of heaters by installers illegal. The ACT accepts national certificates of compliance from the two national energy centres approved under the AS4013 Standard.

The ACT government has also regulated the supply of firewood. Under the *Environment Protection Legislation Amendment Act 2000*, wholesale and retail wood merchants in the ACT require an environmental authorisation issued by the Environment Protection Authority. According to the conditions of the authorisation, a firewood merchant must:

- provide a choice of mixed wood loads;
- supply wood by weight only and not by volume;
- *supply seasoned wood only*; and

- *provide information* on the weight of the load, correct burning practices and the source and type of the wood.

Under the ACT's leasehold system, bans on wood heaters in new residential subdivisions can be employed and have been introduced in the suburb of Dunlop.

In 2001 a major community education campaign was launched. The voluntary *Don't Burn Tonight* campaign encourages households to use alternative heating on cold, still nights when smoke is unlikely to clear quickly. The aim is to issue notices (via media release) on only the worst 5 to 6 nights per winter. None have been issued since 2005 as weather conditions have not met the criteria set.

Under the *Environment Protection Act 1997* a person operating a solid fuel heater must take all practicable steps to minimise smoke emissions. The Guidelines for Acceptable Smoke Emissions state the chimney may smoke for up to 30 minutes when first lit and up to 20 minutes on refuelling. At other times there should be little or no smoke from a properly operated solid fuel heater.

The ACT Department of the Environment, Climate Change, Energy and Water is currently conducting a Wood heater Replacement Program.

New South Wales

In NSW emissions from wood heaters are largely managed at the local government level, supported by NSW Government regulatory controls, funding and education initiatives. The framework has five main components:

- the Protection of the Environment Operations (Clean Air) Regulation 2010 requires that wood heaters sold in New South Wales meet the emission limits specified in the Australian Standard;
- local government planning instruments, such as development control plans, require correct installation of wood heaters or a ban on them in some areas. Under Section 68(1) of the *Local Government Act 1993*, wood heaters cannot be installed without the approval of the local council;
- promotion of the correct use of wood heaters through advertising and providing information to the community, including targeted households;
- local government and the NSW government run wood heater replacement programs at times; and
- the *Protection of the Environment Operations Act 1997* provides that local councils may insist on smoke mitigation measures being taken by particular households through the issue of a smoke abatement notice.

To demonstrate compliance with the emission limits in the Australian Standard the manufacturer or importer arranges compliance testing and certification of the wood heater by the Australian Home Heating Association and makes the certificate available to retailers.

The NSW Government has conducted a program called "Don't Light Tonight – Unless Your Heater's Right" over a number of years issuing alerts asking people to use a different form of heating where possible. The NSW Department of Environment, Climate Change and Water has developed resource kits for local councils on conducting community education programs about woodsmoke.

A number of local councils in NSW are using planning controls to manage wood heater emissions. Camden and The Hills Shire Councils have banned the installation of wood heaters in several new release areas in their local government areas. Armidale Dumaresq Council has adopted a Sustainable Domestic Energy Use and Local Air Quality Policy requiring emissions from wood heaters installed in new homes at levels below the current Australian Standard. From March 1 2011 wood heaters installed in new homes built in urban areas within the Armidale local area will need to meet an emission standard of 2.5 g/kg or less and 57 per cent efficiency. For all installations in all other homes, such as replacement of existing wood heaters or in non-urban areas, wood heaters installed will need to comply with a 3 g/kg limit or below, and 57 per cent efficiency.

The Armidale Wood Smoke Reduction Project is a joint project between the Armidale Dumaresq Council and University of New England funded by the Australian Research Council. The study has included a field experiment involving over 200 participating households to assess the outcomes of strategies to reduce woodsmoke at the household level. The next phase of the project is a study to better understand attitudes, beliefs, and wood heating practices of Armidale residents to develop more effective strategies to reduce winter woodsmoke pollution in the region. Participants can fill in the questionnaire online.

Queensland

Queensland regulates the sale of any (new or used) solid fuel-burning equipment through the *Environmental Protection Act 1994* and Environmental Protection Regulation 2008. The Act requires compliance with the relevant AS/NZS standard and does not allow modifications to certified heaters. The Queensland Government accepts certificates of compliance from the AHHA or the South Australian Energy Information Centre.

In QLD emissions from wood heaters are managed at the local government level. When a smoke nuisance complaint is received, local councils are legally required to enforce the regulation. If the smoke is determined to be an unlawful nuisance, councils will send residents the information about the correct operation of a wood heater and may issue the residents causing the smoke problem with an abatement notice. If the abatement notice is not complied with, councils may issue an on-the-spot fine, up to $1,000 (for an individual) or $2,000 (for a corporation).

Tasmania

Tasmania was the first state to regulate the sale of wood heaters through its Environment Protection (Domestic Solid Fuel Burning Appliances) Regulations 1993. This framework was revised with the introduction of the Environmental Management and Pollution Control (Distributed Atmospheric Emissions) Regulations 2007. All solid fuel heaters manufactured, imported for sale or sold in Tasmania must comply with Australian Standard AS/NZS 4013-1999. Modifications to solid fuel heaters that may increase smoke emissions are prohibited. Visible smoke emissions from solid fuel heaters are prohibited beyond certain limits. The types of solid fuel that may be burnt in heaters are specified.

Tasmania has specific additional requirements relating to the installation of wood heaters under the Building Code of Australia. Each state and territory has an appendix to the Code specifying additional requirements for that jurisdiction. In 2009 the appendix for Tasmania was amended to require wood heaters installed to comply with AS 4013 (including the upper limit for particle emissions of 4 g/kg). As a result building inspectors in Tasmania routinely check for compliance with both AS 2918 and AS 4013 where wood heaters are being installed as part of new buildings and extensions.

From 2001 to 2004 the Commonwealth provided funding to reduce particle pollution from wood heaters in Launceston through the replacement of old wood heaters with more efficient ones. This was complemented by local education initiatives. In the last few years Launceston has been meeting the AAQ NEPM PM_{10} goal with less than 5 exceedences of the standard per year (compared with higher exceedences in the mid 1990s reaching up to 50 per year in 1997).

Launceston City Council has implemented their own wood heater replacement program providing $50,000 per year since 2006/07. The Council has also worked with industry partners to secure additional incentives to supplement their buyback program. For example, in 2010 they formed a partnership with TasGas in areas where the natural gas pipeline is being rolled out.

Households that emit wood smoke visible 10 metres above the chimney for at least 30 seconds can receive an infringement notice with an on-the-spot fine of $240. Local councils can also issue an Environment Protection Notice requiring action to fix the problem.

Victoria

Victoria's Waste Management Policy (Solid Fuel Heating), which was made in July 2004, requires that all solid fuel heaters manufactured and sold in Victoria comply with AS/NZS 4013 and only heaters that meet these requirements can be installed (through compliance with Part 12A of the *Building Act 1993* (Vic.)). The waste management policy provides a legal framework for managing the manufacture and supply of wood heaters in Victoria. It also contains provisions aimed at encouraging correct operation of solid fuel heating appliances installed in homes. This includes community information and education campaigns to reduce smoke from wood heating.

Local government powers concerning wood smoke pollution issues are dealt with under the nuisance provisions of the *Public Health and Wellbeing Act 2008*. Under these provisions, the owner of a property or the person causing the nuisance must take all reasonable steps to eliminate the nuisance.

Western Australia

The Environmental Protection (Domestic Solid Fuel Appliances and Firewood Supply) Regulations 1998 requires that heaters sold (new or second-hand) comply with AS/NZS 4013. The regulations also regulate wood moisture content and prohibit the sale of firewood that has been painted, coated with plastic, or treated with copper-chrome- arsenate. Once sold however, modification to heaters is not restricted. DEC officers audit wood yards to check compliance with moisture content requirements and wood heater retailers to check labelling compliance with the standards.

The Western Australian government began the Halt the Haze program in 2003 encompassing dissemination of information, specialist workshops with environmental health officers on correct wood heater operation and nuisance complaints, and haze alerts on days when pollution dispersion is poor. Pilot wood heater replacement programs were conducted from 2004-2006 in Melville, Joondalup and Kwinana.

Nuisance smoke complaints are dealt with by council environmental health officers under the nuisance provisions of the *Health Act 1911*. The provisions are used as a last resort where information provided to households on correct heater operation and heater maintenance is ignored. While WA has no legislated definition of excessive smoke, patrols run by WA DEC in collaboration with two local government authorities in the 2009 and 2010 winter heating season defined excessive smoke as a visible smoke plume of 5 metres for a period of 30 seconds.

South Australia

There is no regulatory framework for managing emissions from wood heaters in South Australia. A draft Code of Practice for Environmentally Responsible Wood Heater Use was released 2005 that aimed to ensure that only wood heaters which comply with current emission standards are sold in South Australia and that new compliant wood heaters are installed in accordance with the current Australian Standard and the Building Code of Australia.

A number of education activities have been conducted to educate wood heater users to correctly use their heaters to maximise efficiency and minimise wood smoke and odour emissions. The SmokeWatch Challenge was conducted for the Woodside community in 2006-07 encouraging residents to follow certain steps each time they used their wood heater and participate in a survey. Community information sessions were held in Mount Gambier in 2009.

Table A4.1: Summary of wood heater emissions management across Australian jurisdictions

	NSW	VIC	QLD	WA	TAS	ACT	SA
Policy framework	Protection of the Environment Operations (Clean Air) Regulation 2010	Waste Management Policy (Solid Fuel Heating) 2004	Environmental Protection Act 1994 and Environmental Protection Regulation 2008	Environmental Protection (Domestic Solid Fuel Appliances & Firewood Supply) Regulations 1998	Environmental Management & Pollution Control (Distributed Atmospheric Emissions) Regulations 2007	Environment Protection Act 1997	No regulatory framework. Draft Code of Practice for Environmentally Responsible Wood heater Use 2005 recommended AS/NZS4013
Emission limit	AS/NZS4013 (4 g/kg)	AS/NZS4013 (4 g/kg)	AS/NZS4013 (4 g/kg)	AS/NZS4013 (4 g/kg)	AS/NZS4013 (4 g/kg)	AS/NZS4013 (4 g/kg)	-
Certification	Yes accepts national certificates of compliance	Yes accepts national certificates of compliance	Yes accepts national certificates of compliance	Only requires laboratory certificate	Yes accepts national certificates of compliance	Yes accepts national certificates of compliance	-
Standards for new sales	Yes	Yes	Yes	Yes	Yes	Yes	-
Regulation of used heaters	No	No	No	Yes	Yes	Yes	-
Regulation of installation	BCA requires AS2918 Also local council approval under LG Act 1993	BCA requires AS2918	BCA requires AS2918	BCA requires AS2918	BCA requires AS2918 Also appendix to BCA requires AS4013	BCA requires AS2918	BCA requires AS2918
Regulation of modifications	Yes	No	Yes	No	Yes	Yes	-

	NSW	VIC	QLD	WA	TAS	ACT	SA
Regulation of firewood	No	No	No	Yes	No	Yes	-
Enforcement	Councils issue smoke abatement notices. DECCW auditing of compliance plates 2007.	Local government manages nuisance smoke	Local governments manage nuisance smoke. Councils issue smoke abatement notices and on the spot fines.	DEC officer auditing of retailer labelling and woodyards . Councils resolve nuisance complaints	Local council manages excessive woodsmoke	Firewood audits every 1-2 yrs. Reactive follow up of smoke complaints	Nuisance provisions, general env duty under AP Act 1993.
Recent education programs	Don't Light Tonight – Unless Your Heater's Right alerts. Armidale Clean Air Campaign. Council resource kits.		Council resource kits. Raising Community Awareness about the health effects of Burning wood in Residential Areas (CABRA).	Halt the Haze Program 2003		Don't Burn Tonight	The Woodside SmokeWatch Challenge Smoke is no Joke community awareness program
Recent buyback programs	RTA M5 East solid fuel heater buyback program 2006-2007. Woodsmoke reduction program 2002-2004.	-	-	Pilot wood heater replacement programs 2004-2006 Wood heater rebates 2008	Federally funded Launceston Wood heater Replacement Program 2001 - 2004	Wood heater replacement program 2010	-

A4.3 Internationally

This section provides a brief overview of the current regulatory framework for wood heater management in New Zealand, the US, and Europe.

New Zealand

In New Zealand regulations require all new wood burners installed on properties with less than two hectares to have a maximum particle emission of 1.5 g/kg and a minimum thermal efficiency of 65 percent when tested in accordance with AS/NZS 4012/4013.

In Otago, heaters emitting 0.7 g/kg or less are allowed as replacements for more polluting heaters, but new houses and houses currently without wood heaters are not allowed to install them. Moreover, heaters with emissions ratings greater than 1.5 g/kg must be removed by 1 Jan 2012. Christchurch imposed an emissions limit of 1.5 g/kg in urban areas in 2005. From April 2010 the use of solid fuel burners that are 15 years or older in certain zones in Christchurch was banned from April to September each year.

United States

In the United States the Environmental Protection Agency administers New Source Performance Standards (NSPS) for new residential wood heaters. Standards limiting particulate emissions from wood heaters were phased in and differ according to whether a catalytic combustor is used. The format of the emission limits is grams per hour rather than grams per kilogram of wood consumed. Models equipped with a catalytic combustor cannot emit more than a weighted average of 4.1 grams per hour of PM. Models that are not equipped with a catalytic combustor cannot emit more than a weighted average of 7.5 grams per hour of PM. Some individual states have more stringent standards.

The relevant US air pollution in-service emission factors are:

- conventional wood heaters 15.3 g/kg (before certification commenced); and
- certified wood heaters overall 9.8 g/kg (phase I 12.9 g/kg, phase II 10 g/kg, phase III 7.3 g/kg)[61].

However it should be noted that these are based on typical US designs of wood heater and typical US firewood. The NSPS also contains default efficiency values of 72 percent for catalyst wood heaters and 63 percent for non-catalyst wood heaters.

A recent review[62] reports that the NSPS has been extremely successful in encouraging the development of good particulate matter control technology in residential wood stoves. There are over 800 certified wood stove models in EPA's compliance database, most of which are certified at emissions levels well below the current EPA standards. In addition, over 90 percent of

61 Todd 2008a

62 EC/R Incorporated 2009

certified units are reported to meet the more stringent Washington State standards (2.5 g/hr of PM for catalytic stoves and 4.5 g/hr of PM for all other solid fuel burning devices).

The US regulations include testing procedures for loading the test fuel, for setting up the wood heater, for operating the wood heater, and for conducting emissions tests. Test methods are not directly comparable to the Australian method and the format of the emission standards differs as well. However it is interesting to note that there has been a history of stakeholders disagreeing with each other on various aspects of the US testing method.

Frequent comments on the US test method are that it does not reflect real-world practices of consumers in the field; it does not result in reproducible test results, and it does not allow for innovative and unique designs. A 1998 review of the EPA test methods found that the procedure only qualitatively predicts the level of emissions from wood heaters under actual use in homes; wood stove durability varies with model, and a method to assess durability is controversial; and the effect of wood moisture and wood type on particulate emissions appears to be real but to be less than an order of magnitude. A more recent study points to wood moisture content and wood type as the biggest factor in increasing emissions. There is also concern that as emission standards become more stringent the current variability in the test method results could challenge the ability to distinguish between units that meet the standards and those that do not.

Some states and local agencies have developed mandatory curtailment programs to reduce wintertime wood smoke. Some communities implement both a voluntary and mandatory curtailment program depending on the severity of their problem. Curtailment programs often have two stages with Stage I allowing EPA-certified wood stoves to operate and Stage II banning all wood burning appliances, unless it is the homeowner's only source of heat. Alaska, Colorado, Oregon, Texas, and Washington as well as Libby, MT; Maricopa County, AZ; Washoe, NV; and several districts in California have curtailment programs.

Several states and local agencies also restrict the type of fuels that may be burned in a wood-burning device. Some local agencies also restrict sale and/or use of wood above a specified moisture content. Some areas also impose restrictions on ability to install and/or sell houses with wood heating devices.

Europe

There are European Standards for residential solid fuel appliances and for independent boilers with nominal heat output of up to 300 kW. The Standards include minimum requirements for efficiency, construction and safety of appliances. No European Standards include NOx emission performance criteria, and only the independent boiler standard includes PM emissions criteria.

A number of eco-label and biomass grant schemes in Europe specify more stringent performance criteria than the European product Standards and national regulations.

APPENDIX 5: Effectiveness of existing wood heater emission control policies in Australia

This section reviews the effectiveness of the existing framework for managing wood heater emissions in Australia, including the effectiveness of key programs undertaken at local and regional levels to reduce emissions from in-service heaters.

A5.1 Overall effectiveness

A National Wood heater Audit Program was conducted in 2003, with funding from Commonwealth, NSW, Victorian, Western Australian and Tasmanian environment agencies. Retail models representing popular Australian models were purchased from retailers and tested for emissions performance under AS/NZS 4013 conditions. These results were then compared with their certified emissions values.

The audit program found significant non-compliance:[63]

- 58% (7 out of 12) of wood heaters failed to meet AS/NZ 4013 particle emission limits;
- 55% (26 out of 47) of wood heaters had one or more serious design faults that could affect performance; and
- 72% (34 out of 47) of wood heaters had one or more labelling faults that could affect emissions performance.

An analysis of heaters tested for emissions performance showed that the presence of engineering design faults was a good indicator of emissions compliance:

- 100% (7 out of 7) of wood heaters that failed to comply with AS/NZ 4013 emission limits had one or more serious design faults; and
- 20% (1 out of 5) of wood heaters that complied with AS/NZ 4013 emission limits had one or more serious design faults

The most common engineering design fault associated with emissions and engineering design non-compliance was primary air inlets that were smaller than originally specified in design drawings.

The audit program revealed a number of shortcomings in manufacturing and certification procedures for wood heaters. The principal issues arising from the Program's findings were[64]:

- certification procedures require improvement to ensure that certified models truly comply with stated specifications
- testing procedures need to be amended to ensure that modifications made to prototypes during testing are incorporated into production models;

63 DEH 2004a

64 DEH 2004b

- certification procedures need to be clearly documented to ensure that manufacturers understand their responsibilities regarding certification;
- manufacturers need to improve QA/QC procedures;
- a follow-up audit program is needed to fully assess compliance across the woodheating industry and to determine the effectiveness of manufacturers' actions to rectify identified non-compliances;
- action is required to address stocks of non-compliant wood heaters that have already been sold and installed in homes; and
- the Australian Standard for the design and construction of wood heaters needs to be amended to include anti-tampering provisions.

A5.2 New South Wales

The recent Regulation Impact Statement for the remake of the NSW Protection of the Environment Operations (Clean Air) Regulation 2010 estimated the net quantifiable benefits of the wood heater provisions to range from $3.5 million to $36 million per year with total costs of under $200,000 per year (including compliance testing and certification by industry and administration by DECCW). The benefit estimates assume that compliance with the Australian Standard avoids between 3.5 and 8 grams of particulate matter emissions per kilogram of fuel burnt for the 9,600 new wood heaters sold in NSW each year.

Woodsmoke Reduction Program

During the winters of 2002 to 2004 the NSW Government operated the Woodsmoke Reduction Program (WSRP). The WSRP made grants available to assist councils to conduct education and enforcement programs on proper wood heater operation. It also provided cash incentives for households to replace outdated wood heaters with cleaner heating alternatives. A total of 2,024 wood heaters were replaced with cleaner heating alternatives reducing PM_{10} emissions by around 60.8 tonnes. Around 6-8% of households with wood heaters chose incentives and around 67% said that they were planning to replace their wood heaters anyway.

A preliminary assessment covering the first 744 old heaters scrapped, indicated a reduction in particulate pollution of 22 tonnes per year, representing a benefit of some $9m over the life of the heaters, against a Government outlay of $636,000. When all public and private costs were included, the preliminary assessment suggested a benefits to costs ratio of 9:1[65].

Compliance Audit 2007

In winter 2007, DECC conducted wood heater compliance audits across 18 wood heater sales outlets, factories and warehouses in Campbelltown, Penrith, Goulburn/Southern Highlands, Lithgow/Hawkesbury, and the Northern Beaches/Hornsby. The checks involved DECC

[65] pers. comm. NSW DECCW

inspecting a random selection of wood heaters to see if they had valid compliance plates attached. Each of the businesses audited had wood heaters that showed plates with some form of non-compliance. Of the 217 wood heaters inspected, 73 wood heaters (or 34%) had non-compliant plates / labels. Elements of non-compliance included:

- plate not attached
- plate print size incorrect
- evidence of compliance with Australian Standard AS4012 not included
- evidence of compliance with Australian Standard AS4013 not included
- power, fuel or efficiency information not included
- "Burn only hardwood" label not attached or not able to be clearly seen by operator

Armidale Dumaresq Council Wood smoke Reduction Program 2003

The Armidale Dumaresq Council wood smoke reduction program was reviewed in 2003[66]. There were three components to the program:

- cash incentives: to all owners of old wood heaters to upgrade to cleaner heating alternatives. In 2003, 52 wood heaters and open fires were removed in Armidale amounting to $30,150 in cash incentives. Newer lower emission wood heaters were included in the options for replacement and 5% of replacements were new wood heaters.
- community education: awareness of wood smoke pollution was increased from 68% in 2003 to 82% in 2003.
- smoke patrols: rangers were employed to conduct patrols during peak heating times. An initial 164 first notices of excessive smoke. Another 6 further notices were sent resulting in 6 site visits ending with action to assist residents to reduce wood smoke emissions.

Armidale Wood Smoke Reduction Project

The Armidale Wood Smoke Reduction Project is a joint project between the Armidale Dumaresq Council and University of New England funded by the Australian Research Council. The study has included a field experiment involving over 200 participating households. Households were divided into four groups and were provided with different interventions to manage smoke emissions: education only; smartburn[67] only; education and smartburn and no intervention.

The outcomes of the different interventions were assessed based on the visible smoke emissions from chimneys according to a five point visual scale. The households with no intervention had visible smoke emissions assessed at 2.04, education reduced visible smoke emissions to 1.76, smartburn to 1.73 and education and smartburn together reduced the

66 Armidale Dumaresq Council 2003

67 Smartburn is a chimney and flue cleaner

outcome to 1.61. The study concluded that both education and smartburn appear to be effective in reducing household wood smoke emissions although the overall magnitude of the effect is not particularly large[68].

A5.3 Tasmania

The Environment Division of the Department of Environment, Parks, Heritage and the Arts in Tasmania undertook an evaluation of the impact the 2007 regulations on councils twelve months after their introduction. The evaluation was based on survey data with 19 of 29 councils responding. The department found that councils had not used the regulations to any great extent and that they regulations have had little impact on complaint numbers. Key findings relating to wood heater emission management include:

- there were almost no complaints or regulatory action taken for the sale of second-hand non-compliant heaters or heater modification which the department found surprising given anecdotal evidence had suggested these practices were prevalent.
- the number of complaints about visible smoke emissions from heaters at residential premises reduced slightly in the year after the introduction of the regulations (from 9 per council in 2006/07 to 8 per council in 2007/08). The department indicated this is likely to be a continuation of the long term trend in reduced complaints due to the decreasing number of heaters and better operation of remaining heaters resulting from general publicity about smoke emissions.
- written warnings were issued in relation to one in four complaints in the year after the introduction of the regulations. On average councils issued 2 or 3 written warnings per year for visible smoke emissions. The average cost to councils of the provisions for managing visible smoke emissions was around $1,200 in 2006/07 and $700 in 2007/08.

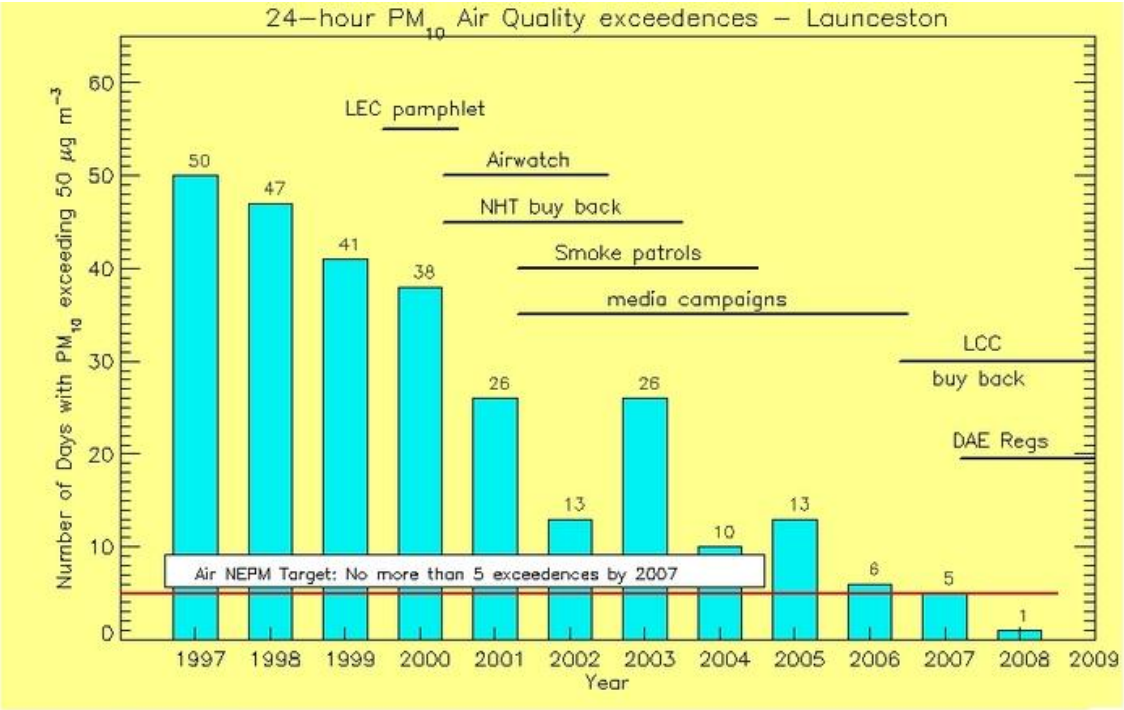
Some comments provided by councils on the provisions for visible smoke emissions are also of interest – two councils commented that it was difficult to estimate smoke distance; one council said it was difficult to treat neighbouring premises equitably; and one council noted that smoke can still be a nuisance even where the regulation is complied with.

[68] Armidale Wood Smoke Reduction Project Year 2 Summary of Key Findings, University of New England unpublished

Launceston Initiatives

A range of programs have contributed to significantly reduce the number of exceedences of the ambient PM_{10} goal in Launceston over a decade. Figure A5.1 shows the reduction in exceedences and the policies and measures implemented over time.

Figure A5.1: Impact of policies on ambient PM_{10} exceedences in Launceston



Key to chart:

LEC - Launceston Environmental Centre – pamphlets published on air pollution and wood smoke (2000).

Airwatch -The national schools program Airwatch ran in Tasmania (2001-2003).

NHT buy back -Natural Heritage Trust allocated $2.01M funding for a wood heater buy back scheme in Launceston. $500 granted to applicants for the removal of a wood heater and replacement with a cleaner alternative heating source (2001-2004). Just over 2,200 wood heaters removals were funded by this scheme.

Smoke Patrols - Wood smoke patrols, in conjunction with buy-back scheme, to identify excessively smoking wood heaters and provide education to identified operators. Patrols were funded by the NHT and Launceston City Council (2002-2005).

Media campaigns - Various community educational media advertisements were conducted throughout the state using local newspapers, TV, and radio (2002-2007).

LCC buy back – A wood heater buy back program funded by the Launceston City Council, with resources to allow up to 100 wood heaters removals (2007 – ongoing).

DAE Regs -The Distributed Atmospheric Emission Regulations were implemented in August 2007 under *Environmental Management and Pollution Control Act (1994)*. The regulations deal with woodheater manufacture, sale and importation for sale, as well as woodheater emissions, and provisions for backyard burning.

The Launceston Wood heater Replacement Program from July 2001 to June 2004 and was administered jointly by the Department of the Environment, Water, Heritage and the Arts and the Launceston City Council, in collaboration with the Tasmanian Government.

The Program provided eligible Launceston residents with rebates to help replace older wood heaters and open fireplaces with new, less polluting heaters. A wide range of replacement heaters were available including new certified wood heaters. By the completion of the Program, wood heater use had declined from 66% to 30% with around 2,200 heaters removed through the program.

Table A5.1 shows a breakdown of the type of heater installed under the program. The subsidy provided for new electric and gas heaters was $500 and for new wood heaters $250.

Table A5.1: Launceston Wood heater Replacement Program, 2000-2004

Type of heater installed	Number of heaters	Percentage of total
New wood heater	53	2.4%
Pellet fuel heater	10	0.5%
Electric heater	2,067	94.1%
Gas heater	67	3.0%
Total	**2,197**	

To maximise the benefits of the Program, a number of additional initiatives were also implemented to reduce wood smoke pollution in Launceston and the surrounding Tamar Valley. These included a targeted community education campaign implemented by the Launceston City Council. New air quality regulations to control wood heater emissions were also introduced by the Tasmanian Government.

The Australian Government commissioned a review by CSIRO to assess the influence of the Wood Heater Replacement Program in reducing pollution in the region. The study found significant improvement in air quality and reduction in particle pollution. The review found the Programme contributed to improved regional air quality by accelerating the existing downward trend in the number of wood heaters in Launceston. The key projections based on current trends were the:

- PM_{10} particle standard of the Air Quality National Environment Protection Measure (Air NEPM) which was estimated to be met by 2007.
- $PM_{2.5}$ advisory reporting standard for fine particles of the Air NEPM which was estimated to be met by 2009.
- PAH benchmark under the Air Toxics NEPM which was estimated to be met by 2009.

Modelling results indicated that the PM_{10} NEPM would be met anywhere in Launceston (assuming typical meteorological conditions and no significant change in dwelling density and background concentration from the levels used here) when the total number of wood heaters is 20% of the total number of dwellings, of which 76%, 18%, 6% would be compliant wood heaters, non-compliant wood heaters and open fireplaces, respectively[69].

The education program by the Launceston City Council was aimed specifically at users of wood heaters that produce excessive smoke and began in 2002. The targeted education program involved personally contacting users and encouraging improved operation practices.

Over the period of the program over 2,000 wood heater users were contacted. In about 80% of cases, excessive smoke was not observed again after one contact and only 27 required more than 2 contacts. Feedback on the program suggested it was the personal nature of the contact that was a key to the success of the program.

Launceston City Council has provided $50,000 per year since 2006/07 resulting in 500 wood heaters being replaced with gas or electric heating systems. Unlike the earlier wood heater replacement program funded by the federal government low emission wood heaters were excluded from the scheme because of uncertainty over their operation and maintenance in the long term[70].

A5.4 Western Australia

Officers of the Western Australian Department of Environment and Conservation audit wood yards to check compliance with moisture content requirements and wood heater retailers to check labelling compliance with the Australian Standard. Initial inspections identified breaches of the regulations after their introduction, but warnings and follow up inspections improved compliance.

Pilot wood heater replacement programs conducted from 2004-2006 in Melville, Joondalup and Kwinana offered a $600 rebate. The initial 2004 program ended slightly unsubscribed due to a small number of participants eventually not removing their heaters. However, subsequent pilot programs were successful in terms of participation with all rebates taken up quickly[71].

In 2004 a pilot home heating survey was conducted of 3,000 households in the areas covered by the wood heater replacement program. The survey indicated that 92.4% of all wood heaters in Perth are not compliant with the current standard and most are near the end of their working life.

DEC offered a wood heater rebate in 2008 of $150 to wood heater owners who were willing to transport their wood heater to one of ten designated landfill sites.

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69 CSIRO 2005

70 Launceston City Council submission to the Australian Government to fund the Air Quality Improvement Plan (including wood heater buyback program) June 2010

71 WA DEC 2007

Community education programs

The community education in Perth is estimated to have reduced PM_{10} emissions by around 16,500 kg/year (assuming it has converted around 5% of very poorly operated and carelessly operated heaters to correct operation). The avoided health costs have been valued at around $100m by 2016. The annual budget allocation is $265,000[72].

WA DEC reports that smoke patrols have been very successful as a targeted education tool and have resulted in behaviour change and better wood heater operation.

A5.5 Australian Capital Territory

Smoke complaints in the ACT have fallen markedly from some 80-100 ten years ago to only 5 in 2009. A penalty notice has only ever been issued on one occasion, with Environment ACT seeing the follow-up of complaints primarily a means to provide educational material.

Environment ACT test the moisture content of wood on sale by wood merchants every 1-2 years and have never recorded non-compliance. Similarly, moisture tests of firewood is undertaken at households which are the subject of a smoke compliant, with no instances of unseasoned wood identified.

A key program in the ACT tackling in-service emissions has been the Wood heater Replacement Program

Wood heater Replacement Program

The Wood heater Replacement Program aims to reduce winter air pollution from wood smoke by offering a financial incentive for replacing an old wood heater with a new mains supplied natural gas heater.

The program has been running since 2004 with some 830 wood heaters replaced. The ACT Government administers the program in association with ActewAGL who provide the funding for rebates paid. Only new mains supplied natural gas heater installations will attract the rebate which is set at:

- ducted gas installations - $800
- flued gas installations - $600

Environment ACT indicated that the rebate levels reflect the break-even cost to ActewAGL, who makes available $100,000 each year for rebates (which has never been fully drawn on). The cost of program administration, advertising and inspections to Environment ACT is around $40,000 per year.

72 WA Dec 2007

APPENDIX 6: Assessment of individual policy measures

In this appendix, experiences to date with a range of wood heater particulate control measures is provided, along with an assessment of each against a number of short-listing criteria, namely:

- ***Potential magnitude of emission reductions*** - this criteria considers the magnitude of potential reductions in PM_{10} emissions that could be achieved, given likely industry coverage, applicability to new and in-service wood heaters, and the level of certainty associated with potential emission reductions;
- ***Environmental effectiveness across jurisdictions*** - this criteria involves assessing the likely targeting and significance of reductions in PM_{10} emissions across key airsheds currently impaired due to particulate emissions;
- ***Cost-effectiveness in reducing emissions*** - this criteria involves assessing the cost-effectiveness of the measure in terms of the expected cost per annum to implement the measure and the expected reduction in tonnes of PM_{10} emissions per annum. The cost-effectiveness information considered was draw from a range of studies using different assumptions and are indicative only; and
- ***Administrative simplicity and risks*** - this criteria involves assessing the compatibility of the measure with existing policy frameworks, likely costs to government, the complexity and risks associated with its implementation and enforcement, and whether the measure would have linkages, synergies or dependencies with other measures.

A6.1 Standards

Potential changes to wood heater standards include in relation to labelling, energy efficiency, emission performance, the test method used for certification and potential design requirements.

A6.1.1 Emission standard

This action could require all new wood heaters entering the market to be tested and certified for compliance against new emission limits according to the current test method. New emission limits could be included in AS/NZS 4013 and called up in jurisdictional regulations in a cooperative approach or directly specified in new legislation under a regulatory approach.

Experiences with this measure

Wood heater emission standards have been used in a number of jurisdictions internationally and in Australia. The Australian Standard for wood heater emissions has been in place since 1992, with the original limit for particulate emissions of 5.5 grams of particles per kilogram of fuel burnt. This emission factor was reduced to 4 g/kg in 1999.

New Zealand regulations require all new wood burners installed on properties with less than two hectares must have a maximum particle emission of 1.5 g/kg. This standard is however based

on the use of softwood, and is not directly applicable to the Australian context where hardwood is more commonly used.

Potential magnitude of emission reductions

A new emissions standard would directly impact on the level of emissions from around 25,000 new heaters sold in Australia each year. The average emission performance of heaters tested in Australia for certification since 1999 is 2.4 g/kg, with 29% of certified models in 2008 at or below 2 g/kg and 9% below 1.5 g/kg (Todd 2008)[73]. Despite variations in sales of various models, the average certified emissions of wood heaters sold in Australia in 2007-08 was similar, with an average of 2.6 g/kg[74] and with 28% of wood heaters having emissions certified at or below 2 g/kg.

The 2006 benefit cost analysis conducted by Environment Link and BDA Group suggests a 3 g/kg emission limit could reduce PM_{10} emissions by around 600 tonnes per annum (in total across six selected Australian cities) and a 1.5 g/kg emission limit could reduce PM_{10} emissions by around 2,000 tonnes per annum. The estimates should be treated as indicative only as a number of simplifying assumptions were made. In particular, the 2006 analysis assumed a 5% annual replacement of in-service heaters, however sales data indicates annual sales in recent years of only around 2% of in-service heater numbers.

Environmental effectiveness across jurisdictions

The impact of the measure across different airsheds would move in line with the regional distribution of new heater sales. In the 2006 analysis sales were assumed proportional with population. However this is unlikely as available data indicates that 70% of sales are in regional rather than metropolitan areas. Reasons for this would include the greater availability of reticulated gas supply in metropolitan areas and the availability of lower cost firewood in regional areas. Accordingly, a large number of sales may be into regions not experiencing poor air quality, reducing the environmental effectiveness of the measure.

Given the low turnover of wood heaters, the measure by itself would not deliver significant improvements in the short to medium term. The success of the measure across jurisdictions would also be very dependant on what supporting compliance auditing and enforcement was implemented (see below).

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73 The average emissions of models available on the Australian market in 2010 and certified using a hardwood fuel is slightly higher at 2.5, while the percentage of models certified at or below 2 g/kg is 30% while some 13% are now at or below 1.5 g/kg (source: AHHA at www.homeheat.com.au)

74 This should be treated as indicative as it assumes emissions are in the middle of each category reported in Walter Turnbull (2009)

Cost-effectiveness in reducing emissions

The 2006 benefit cost analysis[75] estimated a cost-effectiveness of introducing an emission limit of 3 g/kg at around $550 per tonne of particulates reduced compared with the cost-effectiveness of the 1.5 g/kg emission limit of $930 per tonne of particulates reduced.

The apparent cost-effectiveness of a lower emission standard will however be significantly impacted by the qualifications raised above in relation to the magnitude of emissions that may actually be realised, their location as well as other implementation risks (canvassed below).

Administrative simplicity and risks

In theory, introducing more stringent emission limits is compatible with the existing framework. However, the process for introducing more stringent standards for wood heaters under the current framework has proved very difficult with attempts by jurisdictions to tighten the specifications in the Standard consistently failing. This is despite majority support on the relevant Standards Committee for lower emissions limits.

Moreover, a number of factors may prevent the realisation of emission reductions through a tightening of the emission standard.

Firstly, a tightening in the emission standard without introducing a minimum efficiency requirement could see new models compromising efficiency to achieve the emission target, mitigating in part or whole any reduction in total emissions. With reference to an examination of efficiency and emission results for heaters certified since the early 1990's, Todd (2008)[76] found that there was no statistical correlation between the emission factor and the efficiency of a wood heater. He argues that *'there is no technical reason why the two should be inversely related. In fact, lower emissions mean less chemical energy loss and should lead to improved efficiency'*.

However the AHHA (2009) disagree, and provide technical arguments to support a conclusion that a move to lower emissions will often result in higher fuel usage for the same heat output.

Of probably greater significance is that, as reported by Todd (2008)[77], the tightening of the standard from 5.5 to 4 g/kg in 1999 saw the models with emissions higher than the standard removed from the market but did not lead to a significant reduction in the average emission performance of remaining heaters.

The significance of this for another tightening of standards is shown in Figure A6.1. So for example, the introduction of a 3 g/kg emission limit would see 30% of currently certified heaters become non-compliant. This would reduce the average certified emissions of compliant heaters from 2.5 to 2.1 (i.e. a 25% reduction in the standard would deliver only an 18% reduction in average emissions).

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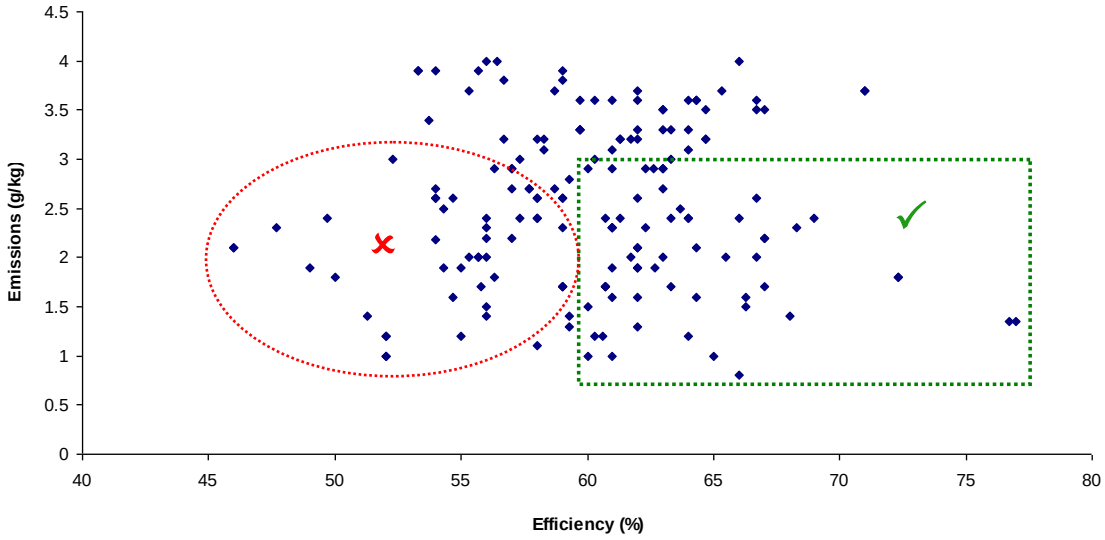
75 Environment Link and BDA Group 2006

76 Todd 2008b

77 Ibid

Figure A6.1: Emissions and efficiency of currently certified wood heaters



Desirably, the displaced sales would shift to the models in the green square in Figure A6.1 which already achieve a 3 g/kg and 60% efficiency performance. However some sales are likely to be picked up by the models in the red circle, which while meeting the new emission limit do not meet a 60% energy efficiency. This shift to greater sales of low efficiency wood heaters would in part negate the benefits from a lower emissions standard.

Alternatively, a combined standard would see sales immediately shift to the 36% of heaters whose high efficiency rating would amplify the emission reductions that could be delivered via a lower emission standard. For this reason, emission and energy standards are highly complementary.

The second implementation factor that is likely to reduce the effectiveness of an emissions standard is the currently poor enforcement of standards. As indicated in Section 3, emissions from models entering the market have been found to be more than twice that of the models tested at the time of certification. Accordingly, enhanced enforcement measures would also be highly complementary to new standards.

Lastly, is the poor relationship between certified emissions and real-world performance. In the absence of complementary measures tackling the use of in-service heaters, or the introduction of a new test method that better reflects real-world heater operation, actual emission reductions achieved may be small. Related to this however, is that, a new standard could be called up in support of measures directed at reducing emissions from in-service wood heaters, such as to support bans on the resale of non-compliant wood heaters. Through these complementary measures, new standards could contribute to greater emission reductions than those associated with new heater sales.

A6.1.2 Efficiency standard

This action would require all new wood heaters entering the market to be tested and certified for compliance against a fuel efficiency standard. The fuel efficiency would be measured as the percentage of the heat value contained in the wood which is extracted and delivered into the living space.

The minimum standard could, for example, be set at either 60% or 65%. Testing for efficiency already occurs as part of the certification process to meet the current labelling requirement. The efficiency standard could be included in AS/NZS 4013 and called up in jurisdictional regulations under a cooperative approach or directly specified in new legislation under a regulatory approach.

Experiences with this measure

New Zealand regulations require all new wood burners to have a minimum thermal efficiency of 65 percent when tested in accordance with AS/NZS 4012/4013. Minimum energy efficiency standards have already been introduced in Australia applicable to a range of electrical products.

Potential magnitude of emission reductions

An efficiency standard would directly impact on the efficiency of around 25,000 new heaters sold in Australia each year. The average efficiency of heater models certified in Australia in 2008 was 60.4% (Todd 2008)[78], however sales data indicates that only 43% of wood heaters sold in Australia in 2007-08 had certified efficiency of 60% or better, with only 7% of heaters performing better than 65% (Walter Turnbull 2009).

The 2006 benefit cost analysis conducted by Environment Link and BDA Group suggests the expected magnitude of PM_{10} reductions resulting from the introduction of a 60% efficiency standard would be around 200 tonnes per annum (in total across six selected Australian cities) and 300 tonnes per annum for a 65% efficiency standard.

However as indicated in relation to the introduction of an emission standard, the previously estimated emission reduction that could be yielded through an efficiency standard is likely to overstate actual reductions given lower levels of heater replacement than previously assumed.

Environmental effectiveness across jurisdictions

The impact of the measure across different airsheds would move in line with the regional distribution of new heater sales. Given the low turnover of wood heaters, the measure by itself would not deliver significant improvements in the short to medium term.

78 The average efficiency of currently certified models is 60.2

Cost-effectiveness in reducing emissions

The 2006 benefit cost analysis estimated that the introduction of a 60% efficiency standard would have a cost-effectiveness estimated at around $1,100 per tonne of particulates reduced and the 65% efficiency standard has an estimated cost-effectiveness of around $730 per tonne.

The apparent cost-effectiveness of an efficiency standard will however be significantly impacted by the qualifications raised in relation to the magnitude of efficiency improvements to in-service heaters that may be realised, their location and implementation risks.

Administrative simplicity and risks

In theory a minimum efficiency standard is compatible with the existing framework. However a number of factors may prevent the realisation of emission reductions through a tightening of the efficiency standard. In particular, the success of the measure would be very dependant on what supporting compliance auditing and enforcement was implemented, as well as programs to promote in-service use in line with the design potential of the new heaters.

A6.1.3 Emissions labelling requirement

This action would require the compliance plate for all new appliances to state the emissions performance of the model in grams per kilogram of wood burnt. The current labelling requirement in AS/NZS 4013 covers efficiency only. Testing for emissions performance already occurs as part of the certification process to meet the current emission standard. The labelling requirement could be included in AS/NZS 4013 and called up in jurisdictional regulations under a cooperative approach or directly specified in new legislation under a regulatory approach.

Experiences with this measure

There is a current labelling requirement in AS/NZS 4013 covering the efficiency of heaters. While there has not been any evaluation of the success of this, Australia's energy labelling program is widely regarded as successful. Energy labelling has encouraged more efficient white goods onto the market and has allowed consumers to identify efficient models. The labelling scheme is interlinked with minimum energy performance standards that have removed the worst performing products.

Potential magnitude of emission reductions

By influencing consumer choice when purchasing heaters this measure has the potential to increase the proportion of *new* heaters that have low emissions. However it is an *indirect* measure, and assumptions as to the importance consumers may place on emissions performance will need to be made, albeit potentially informed by experiences with other environmental labelling schemes.

Importantly, the success of a labelling measure will be directly influenced by the confidence consumers have in the efficacy of the certification process and that emission rates on labels for different models accurately reflect emissions capability.

Environmental effectiveness across jurisdictions

The measure could be expected to have a greater influence on purchasing decisions in regions that are being impacted by wood heater emissions as there is likely to be a greater awareness among these consumers. Accordingly, the effectiveness of the measure would be enhanced by complementary awareness raising programs.

Cost-effectiveness in reducing emissions

This measure should have low implementation costs for both government and manufacturers given that testing for emissions performance already occurs as part of the certification process to meet the current emission standard.

However, compliance plates are typically at the back of heaters and not readily observable by consumers. For this reason, an additional label on the front of heaters at retail outlets may be needed. If this were the case, industry has expressed concern that labelling costs could significantly increase if the front labels had to reference each models' certification number and test results, rather than for example only requiring a sticker with a 'star' rating consistent with each heaters' compliance plate.

Administrative simplicity and risks

Labelling of emissions performance is very compatible with the existing requirement for the testing, certification and labelling of efficiency in AS/NZS 4013.

As noted above, complementary measures to ensure the efficacy of the certification processes and to raise awareness among consumers would be important.

A6.1.4 New wood heater compliance test method

Anecdotal and empirical evidence suggests that a significant percentage of householders do not wait for their fire to become well-established before turning down air flow controls. However the current test protocol in AS/NZS 4013 (1999) specifies that the air flow on medium and low burn cycles must be turned down to the appropriate settings only after the fuel load is depleted by 20% (an indication of when the fire is well established). For this and other operational reasons, emissions from in-service wood heaters have found to be much higher than certified emission levels.

Under this measure, a revision to the test protocol for determining particle emissions would be sought that more closely simulated real world conditions. The requirement could be included in AS/NZS 4013 and called up in jurisdictional regulations under a cooperative approach or directly specified in new legislation under a regulatory approach.

Experiences with this measure

In 2004, in order to address such inconsistencies between emissions performance as determined under ideal test conditions and in the real world, a revision to the test protocol for determining particle emissions under the Australian Standard was proposed. The revised test protocol under the proposed Draft Standard DR04554 attempted to more closely simulate real world operating conditions by specifying that the air flow on medium and low burn cycles must be turned down to the appropriate settings two minutes after the fire is lit. This procedure more closely resembles the "worst case scenario" when a wood heater within a domestic setting is refuelled.

While there has been limited testing to date using the proposed test method, if it were adopted then it is likely that very few heaters currently on the market would be able to achieve the current emissions standard of 4 g/kg[79].

Environment Link and BDA Group (2006) reviewed research by Todd and Greenwood (2005) commissioned by the Commonwealth Department of the Environment and Heritage into the proposed changes to the test method, and concluded:

> *'... the revised test method is a considerable advance on the current AS/NZS 4013 test method, in terms of driving wood heater design improvements that will result in lower emissions from homes, and that adopting a 4 g/kg emissions limit under the revised test method would translate to a significant reduction in emissions. However, further work is required to fully refine the test parameters that accurately reflect real life operation'.*

In 2006 the Department of the Environment, Water, Heritage and the Arts commissioned work to prepare a costed proposal to develop a new test method[80]. Two feasible options were identified: a new simulated in-service test method; or a three burn rate test method (a variation of AS/NZS4013). Following this study a report was prepared demonstrating that the laboratory test method specified in the Australian Standards differs significantly from how people operate in-service wood heaters[81].

Although a new test method has been under consideration in Australia for a number of years, there has not been consensus from stakeholders, and as a result no changes to the Australian Standard have been made.

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79 Environment Link and BDA Group (2006)

80 Todd 2006b

81 Todd 2008a

While the test method is not directly comparable with that used in the United States, it is interesting to note that there has been a history of stakeholders disagreeing with each other on various aspects of the US testing method.

Frequent comments on the US test method are that it does not reflect real-world practices of consumers in the field; it does not result in reproducible test results, and it does not allow for innovative and unique designs. There is also concern that as emission standards become more stringent the variability in the test method results could make it difficult to distinguish between units that meet the standards and those that do not.

Potential magnitude of emission reductions

A new test method would directly impact on emissions from the 25,000 new heaters sold in Australia each year. A new test method would be akin to a tightening of the standard, but more effective as it would encourage modifications (like starter controls) which better manage real world emissions. However, it is not possible to quantify the likely impact on emissions without defining a new test method to be subject to impact analysis.

Environmental effectiveness across jurisdictions

The impact of the measure across different airsheds would move in line with the regional distribution of new heater sales. Given the low turnover of wood heaters, the measure by itself would not deliver significant improvements in the short to medium term.

Cost-effectiveness in reducing emissions

The cost of developing a new test method was estimated by Todd in 2006 at around $200,000. However, the cost to manufacturers of meeting the current emission standard under a new test method is not known as the new method has not been defined.

Administrative simplicity and risks

In theory, introducing a new test method is compatible with the existing framework. However, the process for changing the Australian Standards for wood heaters under the current framework has proved very difficult.

It would also be necessary to reassess the appropriateness of the current emission standard in light of a new test method. In addition, the success of the measure would be very dependant on supporting compliance auditing and enforcement programs.

A6.1.5 Requirement for starter controls on new wood heaters

This action would require all new wood heaters entering the market to have an automatic combustion air control (starter control). The type of options that could be used to ensure that a heater is operated on high flow for a specified period of time after refuelling include door opening control on operations, gas sensors or temperature sensors.

The requirement could be included in AS/NZS 4013 and called up in jurisdictional regulations under a cooperative approach or directly specified in new legislation under a regulatory approach.

Experiences with this measure

Todd et al. (2005) when investigating the merits of a new emission test method, modified two of the three heaters tested that failed the revised method by adding an automated air supply mechanism (starter control). After modification, both these wood heaters achieved emission factors of less than 4 g/kg when tested to the revised method.

Reportedly there are least two overseas companies fitting some heater models with automatic controls designed to minimise smoke emissions through control of combustion air (Todd and Greenwood 2005). Nevertheless, the testing by Todd and Greenwood (2005) indicates that additional research is needed to further assess air quality benefits that could be achieved by using these controls.

Potential magnitude of emission reductions

This measure would directly impact on emissions from the 25,000 new heaters sold in Australia each year. However, it is not possible to quantify the likely impact on emissions until a specific set of controls are identified and testing undertaken to assess likely emission improvements.

Environmental effectiveness across jurisdictions

The impact of the measure across different airsheds would move in line with the regional distribution of new heater sales. Given the low turnover of wood heaters, the measure by itself would not deliver significant improvements in the short to medium term.

Cost-effectiveness in reducing emissions

The cost to manufacturers of meeting a requirement for starter controls is not known.

Administrative simplicity and risks

Again, introducing starter controls is compatible with the existing policy framework, notwithstanding the difficulties experienced to date. As with a new test method, introducing starter controls would also require a reassessment of the appropriateness of the current emission standard, and the success of the measure would be very dependant on supporting compliance auditing and enforcement programs.

A6.2 Compliance

Potential changes to promote compliance by manufacturers with standards involve new auditing and enforcement programs and / or independent testing and certification processes.

A6.2.1 National audits

This action could involve an ongoing national audit program coordinated by the Commonwealth Government. The audit program would involve testing random samples of wood heaters in the period between design specification testing conducted at certification and re-certification to maintain quality control and avoid unapproved modifications to retail models during intervening years. Regular check testing would need to be undertaken by an independent party to ensure compliance.

Under a voluntary or cooperative approach, any breaches of the Australian Standard would be referred to the relevant certification body and recommend suspension of certification. Any prosecution for non-compliance would be a matter for each jurisdiction and subject to their regulatory provisions.

Under a regulatory option, a national audit program would need to be implemented in conjunction with a new independent testing and national certification process. All existing models would need to be re-certified and the audit program would involve random testing. Non-compliant heaters would have their certification suspended, and penalty notices and / or prosecution would follow in accordance with the new regulatory framework.

Experiences with this measure

The National Wood heater Audit Program conducted in 2003 involved testing of the emissions performance of popular Australian models purchased from retailers. The audit program found significant non-compliance and the Australian Competition and Consumer Commission investigated some manufacturers as well as some jurisdictions referring issues to their respective fair-trading authorities. The audit was successful in determining that there was a lack of compliance with certified standards.

Potential magnitude of emission reductions

An audit program in itself would only identify non-compliant heaters. The removal of these heaters from the market would be subject to separate enforcement actions, and emission improvements dependent upon the emission performance of the heaters that capture the market share previously held by the non-compliant heaters.

Overall, these actions could be expected over time to improve the average emissions capability of new heaters entering the retail market (in-line with certified levels). The impact of the measure across different airsheds would therefore move in line with the regional distribution of new heater sales.

Environmental effectiveness across jurisdictions

The impact of the measure across different airsheds would move in line with the regional distribution of currently non-compliant new heater sales. Given the low turnover of wood

heaters, the measure by itself would not deliver significant improvements in the short to medium term.

Cost-effectiveness in reducing emissions

A national audit program would require significant resources in the first two years to cover most if not all models currently certified. After this period check testing would need to continue covering the entire range of models for sale on a rotating basis, say over five years.

The cost of an audit program would depend on the scale of testing and may be in the order of $400,000 per year. This estimate includes the costs of administration (1 full time equivalent project officer) and testing costs for 10% of the models on the market (at $10,000 per test).

Cost-effectiveness ultimately will depend upon the emission reductions achieved, which as indicated above are likely to vary with the different enforcement regimes applicable under a voluntary versus regulatory option. Moreover, given the poor relationship between certified emissions and real-world emissions, an audit program by itself may only deliver small emission reductions and hence potentially have poor cost-effectiveness. However if an audit program were part of a broader suite of measures focussed on improved in-service operation, then the role of audits in ensuring better designed heaters enter the market could be expected to have a more attractive cost-effectiveness.

Administrative simplicity and risks

A national audit program coordinated by the Commonwealth Government would be relatively straightforward. The home heating industry participated voluntarily in the last audit and has indicated support for future audits.

Performance risks would be greater under a voluntary or cooperative approach as enforcement action would be dependent on each jurisdiction's willingness and resourcing. While risks under a national regulatory option would be less, costs could be much higher with the need for a new independent testing and national certification process as well as a new national enforcement regime.

A6.2.2 Nationally coordinated funding for state-based audit and enforcement

This action would involve continued jurisdictional responsibility for state level auditing and enforcement, but under a nationally agreed funding mechanism. The audit and enforcement programs would focus on ensuring compliance with the labelling requirements and relevant standards under each option.

State auditing programs are likely to be similar to a national audit program (described above), however to maximise cost-effectiveness they would probably focus more on the popular models available in each jurisdiction.

The programs would be administered by each jurisdiction and check testing would be undertaken by an independent party. Jurisdictions would refer any breaches of the Australian Standard to the relevant certification body and recommend suspension of certification. Any other breaches of the jurisdictions regulations would be dealt with in accordance with existing penalty and offence provisions.

Experiences with this measure

Some jurisdictions have undertaken auditing activities, for example auditing of compliance plates in NSW and retailer labelling in Western Australia. However, resources have not generally been available for routine auditing of compliance with the Australian Standard.

The AHHA also report that state enforcement has been poor. Notably, a number of reports from the AHHA to state regulators in relation to non-compliant models on the market have not been followed-up, let alone the subject of prosecutions.

Potential magnitude of emission reductions

As indicated above for a national program, state auditing programs could be expected to reduce the average emissions capability of new heaters entering the market, subject to effective enforcement action.

Environmental effectiveness across jurisdictions

The impact of the measure across different airsheds would move in line with the regional distribution of currently non-compliant new heater sales. Given the low turnover of wood heaters, the measure by itself would not deliver significant improvements in the short to medium term.

Cost-effectiveness in reducing emissions

DECCW estimates the administrative costs of compliance and enforcement in NSW to properly support a certification scheme at $56,000 per year in direct costs to the organisation as well as an additional $50,000 per year for external auditing. The Tasmanian EPA estimates the costs of council support and routine inspection of heaters at retailers' premises would be around $70,000 per year.

Based on these indicative resourcing needs, the funding required for all state / territory level audit and enforcement programs could be around $700,000 per year.

Cost-effectiveness will depend upon the emission reductions achieved, which will vary with the different enforcement regimes and contextual setting in each jurisdiction. As for a national program, emission reductions may be small and hence the cost-effectiveness of an audit program by itself poor. However as part of a broader suite of measures could be expected to be more cost-effective.

Administrative simplicity and risks

Implementation of audit programs administered by jurisdictions would be straightforward. The home heating industry has indicated support for future audits. Subject to adequate funding being available to meet the auditing and enforcement costs incurred by jurisdictions, risks should be low.

A6.2.3 Independent testing and national certification

This action would involve an independent testing process and national certification scheme under a regulatory option. The national certification scheme would be administered by the Commonwealth Government through a new certification body and testing would be undertaken by an independent third party. The certification body would co-ordinate the day-to-day management of applications for certification, and could also manage a national audit program if also introduced.

Experiences with this measure

The current certification process was set up in response to the poor compliance identified in the 2003 national audit. The process is administered by the AHHA. Heater models are assessed when applying for certification and again every three years upon applying for re-certification.

No subsequent audit has been undertaken to establish whether the new certification process has improved the compliance of wood heaters available on the market. However, it is noted that none of the jurisdictions have formally endorsed the AHHA, or any other body, to issue certificates of compliance. As a result there appears to be little governmental support for the certification process. In addition, the AHHA indicates that only a handful of models have been tested for re-certification, due to a lack of suitably trained personnel.

Notably, the AHHA is investigating having its certification function being accredited by the JAS-ANZ (Joint Accreditation System of Australia and New Zealand). If this were the case, the benefits of moving to a new national certification scheme may be reduced.

Potential magnitude of emission reductions

Emission reductions arising from an independent testing and certification program will depend on associated auditing and enforcement action. Collectively these measures could ensure retail models comply with prevailing standards and hence drive potentially significant reductions in wood heater emissions.

Environmental effectiveness across jurisdictions

The impact of the measure across different airsheds would move in line with the regional distribution of currently non-compliant new heater sales, or more broadly if introduced in association with changes to emission or efficiency standards. Given the low turnover of wood

heaters, the measure by itself would not deliver significant improvements in the short to medium term.

Cost-effectiveness in reducing emissions

The annual cost to industry of certification of wood heaters has been estimated at around $600,000[82]. The annual costs of an independent testing program would be expected to be similar, however there would be some additional setup costs to establish an independent body and new administrative processes.

Although the testing / certification program alone would not directly reduce particulate emissions from wood heaters it would be an important supporting measure contributing to the reductions outlined in the measures above for emission limits and efficiency standards.

Administrative simplicity and risks

An independent testing and certification process would require establishing a new body and ensuring adequate facilities for testing. While it would be a significant change it is likely to be supported by all stakeholders.

The process would complement a national or improved jurisdictional audit and enforcement programs. In the absence of these program reforms, benefits from an independent testing and certification process are likely to be significantly less.

A6.3 In-service measures

Potential changes to influence in-service operational performance could include new education programs to promote better heater operation, incentives to replace old heaters, a common definition of excessive smoke to enhance enforcement action, regulatory controls on the modification and installation of heaters, controls on second hand heaters, removal of non-compliant heaters and bans on the installation of new heaters in certain areas.

With one estimate of average in-service emissions put at 9.4 g/kg compared to average certified emissions of heaters entering the market since 1999 of 2.4 g/kg, significant in-service improvements are possible.

A6.3.1 Education targeted at critical airsheds

This action could involve Commonwealth funded education campaigns for communities in critical airsheds. The programs could be jointly delivered by the Commonwealth and relevant jurisdictions and local governments.

82 NSW DECCW 2010a

Feedback on past programs indicates that general information provided community-wide needs to be supplemented with highly targeted measures tailored for each airshed / community and:

- aim to improve wood heater operation using a wide range of media;
- directly engage with households whose heaters produce excessive wood smoke;
- build on past education programs and integrate with current education programs conducted in each airshed; and
- inform the community about complementary provisions or other programs.

Experiences with this measure

A number of jurisdictions report that education has been successfully employed in critical airsheds such as in Launceston, Perth and Sydney. In Launceston significant improvements in the operation of wood heaters were achieved with a targeted education program that directly engaged with households that produced excessive wood smoke. In Western Australia, smoke patrols have been very successful as a targeted education tool resulting in behaviour change and better wood heater operation. Education programs have generally been used to alert the community about the potential health impacts of woodsmoke and provide information on correct operating procedures.

Potential magnitude of emission reductions

This measure has the potential to influence emissions from over 1 million wood heaters currently in service across Australia. By focusing on critical airsheds and directly engaging with households that produce excessive wood smoke, the education programs would have the *potential* to achieve large reductions in emissions.

As an example of potential emission reductions in a critical airshed, the education program in Perth has been projected to reduce emissions by around 260 tonnes per annum (based on the education program improving operation for around 10% of wood heater users every year and resulting in a 15% per annum decline in wood heating)[83].

Environmental effectiveness across jurisdictions

Education programs rely on voluntary behavioural changes to drive reductions in wood heater emissions. However as they can be tailored in terms of content, delivery mechanism and target to suit the organisations and community characteristics in each region, they can be highly effective. Experience to date indicates that education programs are much more effective when integrated with a suite of broader 'reinforcing' measures, such as council smoke patrols, replacement incentive programs, regulation of firewood, and so on.

[83] Derived from Todd 2006 total health benefits of $3.8m in Table 6.1 and average health cost per tonne of $14,646 Table D.4

For example, a range of programs have contributed to reducing ambient levels of particulates in Launceston and the targeted community education campaign implemented by the Launceston City Council was a key component.

Cost-effectiveness in reducing emissions

Costs will vary depending upon the nature of the program, while emission reductions will be sensitive to the size of the community targeted, relative cost of wood heating versus alternatives in the area and socio-demographic factors.

As an example, the estimated resources for education and enforcement activity in Tasmania is estimated at $160,000 per year.

The annual budget allocation for the community education program in Perth is estimated at $510,000 per year[84] resulting in an estimated cost-effectiveness of around $2,000 per tonne of emission reduction.

Administrative simplicity and risks

Implementation of education programs does not require new legislation or organisational structures and they are widely supported by all stakeholders as a sensible way to influence emissions from wood heaters in use.

Several other measures considered in this section are dependent on education programs to assist in implementation.

A6.3.2 Incentives for replacement of heaters in critical airsheds

This action would involve subsidy programs funded by the Australian Government, to replace wood heaters in critical airsheds. The programs could be similar to the Australian Government funded *Launceston Wood heater Replacement Program*. The programs could be jointly delivered by relevant local and state governments.

Experiences with this measure

The Launceston Wood heater Replacement Program was a key component of a package of measures to reduce woodsmoke in Launceston. The collective measures are believed to have reduced wood heater use from around 65% to 15% of households. A number of other states / cities have also conducted successful replacement programs, including the *NSW Woodsmoke Reduction Program* with a total of 2,024 wood heaters replaced with cleaner heating alternatives.

Heater replacement programs generally provide subsidies for replacement of wood heaters with alternative heating sources. Notably the Launceston Program allowed replacement of old wood heaters with new certified wood heaters as one of the available options.

84 Todd 2006a

Potential magnitude of emission reductions

By focusing on critical airsheds and targeting residents with older heaters, this measure would have the potential to achieve significant emission reductions.

The NSW Woodsmoke Reduction Program 2002 - 2004 provided an estimated reduction in particulate pollution of 60.8 tonnes.

Todd (2006a) estimated that an extended wood heater replacement program in Perth has the potential to reduce emissions by 46 tonnes per annum (based on the removal of 1,500 heaters per year as well as publicity improving the operating practices of 2% of wood heater users each year).

The federally funded wood heater replacement program for Launceston replaced around 2,200 wood heaters. If the emission reduction per heater replaced is assumed to be similar to that estimated for Perth the Launceston program would have reduced PM_{10} emissions by around 45 tonnes per year.

Environmental effectiveness across jurisdictions

Wood heater replacement programs could be very effective across jurisdictions due to their potential to target critical airsheds and older more polluting wood heaters.

Effectiveness across jurisdictions would be influenced by whether heaters could be replaced with new wood heaters viz-a-viz other forms of heating. As operational practices currently have a greater bearing on heater emissions than their certified level of achievable emissions, emission reductions may be greatest where replacement heaters do not include new wood heaters.

However the experience in Launceston suggests that program participation may be impacted where replacement heaters do not include new wood heaters. This is likely to relate to both a style preference for wood heaters as well as their greater cost-competitiveness in rural areas.

Cost-effectiveness in reducing emissions

Todd (2006a) estimated the costs of an extended wood heater replacement program in Perth to be around $670,000 per year, suggesting a cost-effectiveness of around $100,000 per tonne.

The federally funded wood heater replacement program for Launceston cost $2m and if the emission reduction per heater is assumed to be similar to that estimated for Perth, the cost-effectiveness would be around $45,000 per tonne.

Administrative simplicity and risks

Wood heater replacement programs do not require any new legislation or regulatory bodies and have been successfully implemented in Australia in the past. They are supported by stakeholders.

These programs also offer the opportunity to leverage education and awareness campaigns, increasing their overall policy attractiveness.

A6.3.3 Common definition of excessive smoke

This action would involve the inclusion of a single objective definition of excessive smoke in a national regulation or guideline to facilitate the handling of wood smoke complaints by state and local government officers.

The definition could be based on the provision in the recent Tasmanian and NSW regulations where a breach occurs if the smoke is visible 10 metres or more from the chimney for at least 30 seconds at a time, as well as being generally visible for at least 10 minutes. The Western Australian definition is more stringent – defined as a visible smoke plume of 5 metres for a period of 30 seconds.

Experiences with this measure

All jurisdictions with a regulatory framework currently have provisions relating to nuisance or excessive smoke. The definitions vary, however Tasmania and NSW now have a common definition.

Potential magnitude of emission reductions

A common definition of excessive smoke could contribute to small reductions in particle emissions by improving engagement with households with the poorest wood heater operating practices. However, the potential for emission reductions would be very dependent on whether there was adequate engagement with councils, as well as resources for enforcement by councils. The advantage of uniformity would be to provide more confidence to councils that there was a nationally accepted approach to enforcement of excessive smoke provisions.

More successful enforcement of excessive smoke may also contribute to broader community awareness and other voluntary improvements in heater use.

Environmental effectiveness across jurisdictions

This measure would do little by itself, but is likely to be complementary with other in-service measures. For example, Environment ACT regard the follow-up of complaints primarily as a means to provide educational material.

Cost-effectiveness in reducing emissions

In the ACT, excessive smoke complaints have fallen markedly from 80-100 ten years ago to only 5 in 2009. A penalty notice has only ever been issued on one occasion.

In Tasmania, councils issue 2 or 3 written warnings per year on average for visible smoke emissions. Written warnings were issued in relation to one in four complaints in the year after

the introduction of the regulations. The average cost to councils of managing visible smoke emissions was around $1,200 in 2006/07 and $700 in 2007/08.

Administrative simplicity and risks

This measure would not require any new bodies or administrative processes. Most jurisdictions currently have a definition of excessive smoke and agreement on a common definition would be achievable.

A6.3.4 Controls on modification and installation

There are three key areas of concern considered in this section:

- poor installation practices.
- installation of heaters that do not comply with AS4013.
- modification of heaters.

The measures considered to address these concerns include:

- a national system for certifying people to install wood heaters to address poor installation practices.
- extension of the application of the Building Code of Australia to require heaters installed in new buildings / extensions to comply with AS4013; and a new national regulation requiring heaters installed in existing homes to comply with AS4013.
- a new national regulation banning the modification of heaters.

One option to support certification of installers would be to introduce wood heater installation training into existing programs. Notably, the AHHA has recently approached the Construction and Property Services Industry Skills Council in relation to the development of a unit of competency for skills and knowledge associated with installation of solid fuel heaters. This unit would be supported by existing units of competency in the Construction, Plumbing and Services Integrated Training Package.

Experiences with this measure

Some states / territories / local regulations require installation of wood heaters by a qualified installer such as a licensed plumber. However, there remains a concern that poor installation is significantly increasing particle emissions in some cases.

In contrast to the Australian situation where wood heater performance requirements apply at the point of sale, in New Zealand, they are directed at installation. The Building Code of Australia requires that wood heaters be installed in compliance with AS 2918. This standard establishes requirements relating to flue exits and adherence to manufacturers' specifications – including installers not tampering with a heater's emissions controls. Each state and territory has an appendix to the Code specifying additional requirements for that jurisdiction. In 2009 the

appendix for Tasmania was amended to require wood heaters installed to comply with AS 4013 (including the upper limit for particle emissions of 4 g/kg). As a result building inspectors in Tasmania routinely check for compliance with both AS 2918 and AS 4013 where wood heaters are being installed as part of new buildings and extensions.

The practice of altering certified heaters during or after installation to disable the pollution control equipment is well known in the Australian wood heater industry. A number of jurisdictions have regulatory provisions making modification of heaters illegal, however the extent of enforcement is unclear. Tasmania's recent review of their regulations showed there were almost no complaints or regulatory action taken for heater modification, which the department found surprising given anecdotal evidence had suggested this practice was prevalent.

Potential magnitude of emission reductions

The extent of faulty installation or modification of heaters is not known. Notably, the measures addressing faulty installation or modification only target those households seeking to subvert emission standards or who experience poor heater installation. Arguably these are likely to be a small number of households[85], with the measure contributing nothing to improving heater operation by other households. Moreover, any emission reductions would depend on the nature and level of enforcement action. Anecdotal evidence suggests modification may be high in some areas (for example up to 50% of new and second-hand heaters in Tasmania are thought to be modified to enable reduction of airflow).

One industry source estimates that sales of heaters that do not comply with AS 4013 are around 5% of the market. If this were the case, extension of the application of the Building Code and new national regulation requiring installation of compliant heaters in existing homes could potentially reduce emissions from up to 1,250 heaters per year. However, this may not be necessary if measures were introduced to address these compliance issues at the point of sale. Tasmania has had the requirement in place for building inspectors to check wood heaters, however there has not been any feedback on effectiveness. Installation of heaters in existing dwellings may only realistically be policed via excessive smoke complaints, and this would require significant change in those practices.

Environmental effectiveness across jurisdictions

As the extent and location of faulty installation, installation of non-compliant heaters, or modification of heaters is not known, little can be said in relation to the effectiveness of measures to address these across jurisdictions.

Cost-effectiveness in reducing emissions

[85] Although modification and installation controls may become more important if emission standards were tightened and / or certification better enforced.

Establishing a national certification system for installers would require significant development effort, new administrative processes and adequate resources for enforcement.

The costs of extending the application of the Building Code of Australia to require heaters installed in new buildings / extensions to comply with AS4013 would be small, as enforcement activities for other aspects of the building code already occur. However the costs of a new national regulation requiring heaters installed in existing homes to comply with AS4013 would be much greater as new enforcement activities would need to be established.

The main cost of a new national regulation banning the modification of heaters would be the resources required for enforcement.

Administrative simplicity and risks

Extension of the Building Code of Australia to cover AS4013 was relatively simple for Tasmania. However, there may be reluctance to make this change in other jurisdictions because of difficulties in engaging those involved in new building approvals.

A new national certification scheme for installers and supporting training programs are likely to be supported by all stakeholders.

New national regulations covering installation and modifications are also likely to be supported as long as adequate resources are available for enforcement.

A6.3.5 Controls on second hand heaters

This measure would involve a requirement for sales of second-hand heaters to comply with all current emissions and efficiency standards for new heaters. The requirement would relate to sale of heaters only (not sale of houses with heaters). The measure could be implemented through a cooperative approach where all states introduce controls on second hand heaters or through a new national regulation.

Experiences with this measure

Western Australia, Tasmania and the ACT all have regulatory controls on the sale of second hand heaters. Tasmania's recent review of regulations found there were almost no complaints or regulatory action taken for the sale of second-hand, non-compliant heaters which the department found surprising given anecdotal evidence had suggested this was prevalent.

Regulation of the sale of second hand heaters was considered in NSW in 2002 as unlikely to be a cost effective means of reducing wood heater emissions.

Potential magnitude of emission reductions

It is difficult to estimate the size of the second hand heater market, however it is likely to be relatively small.

Further, compliance with the measure may be poor unless consumers believed enforcement action was credible. Apart from heaters sold with houses, second hand heaters are sold largely through private transactions (e.g. eBay, classifieds, etc) which would be costly to police.

On balance, the extent of emission reductions that may be achieved via this measure is likely to be small.

Environmental effectiveness across jurisdictions

Effectiveness across jurisdictions would depend on the nature and level of enforcement.

Cost-effectiveness in reducing emissions

Cost-effectiveness may be poor given the potential for reducing emissions is likely to be small and enforcement costs significant.

Administrative simplicity and risks

A number of jurisdictions already control second hand heater sales in their regulations. A cooperative approach requiring the remaining states / territories to introduce controls would be relatively simple. A new national regulation would be more complex, requiring new administrative processes.

A6.3.6 Removal of non-compliant wood heaters

This measure would involve requiring heaters that do not meet regulatory standards to be removed when a house is sold. The measure could be applied in critical airsheds.

Experiences with this measure

This measure has not been trialled in Australia, however it was considered in the policy options evaluated by the WA government. The action was recommended to commence in 2010.

Potential magnitude of emission reductions

Todd (2006a) estimated that a program to remove non-compliant heaters on house sale in Perth has the potential to reduce emissions by 130 tonnes per annum (based on the removal of 10,000 non-compliant heaters per year).

Environmental effectiveness across jurisdictions

Effectiveness across jurisdictions would depend on the stock of non-compliant heaters, housing sales and the nature and level of enforcement. It would also depend upon the extent to which non-compliant heaters were replaced with new wood heaters viz-a-viz other forms of heating. As operational practices currently have a greater bearing on heater emissions than their certified level of achievable emissions, emission reductions are likely to be greatest in metropolitan areas where alternative heating methods are more competitive.

For this reason, complementary educational programs may be important in smaller regional centres.

Cost-effectiveness in reducing emissions

Todd (2006a) estimated the costs of a program to remove non-compliant heaters on house sale in Perth to be around $26m per year, suggesting a cost-effectiveness of around $200,000 per tonne of emission reduction. Todd indicates that the majority of this cost is for heater replacement and if this is not included, the program cost is just $200,000 per year. However, there is a real opportunity cost in requiring the removal of these heaters that needs to be recognised.

Administrative simplicity and risks

Some jurisdictions have raised concerns that this measure would be inequitable and hence unacceptable.

A6.3.7 Bans on installation of wood heaters in priority airsheds

This measure would be a ban on the installation of new or second hand wood heaters in critical airsheds. It would not force existing heaters to be removed. A ban may be able to be implemented at the national level (for example under the Trade Practices Act) or could be implemented at a state / territory / local level.

Experiences with this measure

Bans on the installation of wood heaters in designated urban areas have been implemented overseas. Examples include Montreal, Dublin and regions in New Zealand. In Australia, a number of local government bodies have called on state governments to consider state-wide bans or limitations on the installation of wood heaters.

In NSW wood heaters cannot be installed without the approval of the local council under the *Local Government Act 1993*. 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. Under the ACT's leasehold system, bans on wood heaters in new residential subdivisions can be employed, and have been used in the suburb of Dunlop.

Wood heater bans were considered in Victoria as part of the development of its draft Victorian waste management policy - solid fuel heating (2004). The Victorian EPA decided against prohibition 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. It also took the view that as wood smoke impacts are primarily a neighbourhood issue, operation should be addressed at a local level by restrictions introduced and enforced by councils.

Banning installation of wood heaters was considered in Western Australia in 2007 as part of their review of policy options for managing wood heater emissions. A widespread ban was not supported, however local government may choose to restrict wood heater installations in certain new subdivisions if the topography suggests smoke dispersion will be poor or if developers choose to promote better air quality through smoke-free development.

The Launceston City Council also considered a proposal for a ban on installation of wood heaters in new developments in 2009. The council presently has no plans to pursue this proposal.

Potential magnitude of emission reductions

This measure has the potential to avoid emissions from new wood heaters in critical airsheds across Australia. If applied to new housing areas, the measure could be instrumental in preventing new air quality problems from arising.

In the case of established communities, a ban on new wood heaters would see old heaters held for longer periods. With current replacement rates at only 2%, a ban would not result in significant emission reductions in the short to medium term. Indeed it could have a perverse effect where old inefficient heaters were held onto that otherwise would have been replaced with newer more efficient models.

Environmental effectiveness across jurisdictions

Subject to the above caveat in relation to new or existing urban areas, effectiveness across jurisdictions would depend on the extent of current wood heater stocks, and the cost-competitiveness of alternative heating options.

Cost-effectiveness in reducing emissions

The cost-effectiveness of banning the installation of wood heaters will depend upon the compliance and enforcement regime adopted.

Bans in new housing areas could be enforced potentially at low cost via building approval processes, but in established areas there are limited existing controls on heater installation and new enforcement processes would need to be established.

Administrative simplicity and risks

A ban on wood heaters may be unpopular with stakeholders, with some jurisdictions raising concerns that bans would be inequitable and unacceptable. The measure is generally seen as a last resort, if other measures fail to adequately reduce wood smoke. There would be higher risks associated with bans in existing areas, with the possibility of the perverse effect of old heaters being in operation for longer timeframes.

APPENDIX 7: Methodology for cost-benefit analysis

This appendix provides an overview of the approach to the cost-benefit analysis and provides the key assumptions used in the analysis. The overall methodology is provided first, followed by a list of the key assumptions relating to the valuation of benefits, and relating to the three key types of measures assessed: standards, compliance and in-service measures.

A7.1 Overall methodology

In cost-benefit analysis, the incremental benefits of a policy over time need to be compared to the incremental costs over time, using discounting. Discounting takes account of people's preference for producing or consuming goods and services now as opposed to some time in the future. Specifically, the discount rate is the rate of trade-off between having something now or later.

Given alternative approaches to determining a discount rate, most government guidance documents recommend a range of discount rates be used. In this study we use the Office of Best Practice Regulation recommendation of a discount rate of 7% (Australian Government 2007). This discount rate is applied to both costs and benefits incurred over the twenty year assessment period to arrive at "present values".

To identify economic impacts, standard economic assessment techniques are applied, based on aggregate changes in consumer and producer surplus. Market impacts are identified in a financial model; non-market economic impacts are determined by applying monetary valuations to identified changes in emissions.

The economic benefits and costs of the options are compared to the base case over the 20 year assessment period. Costs are defined in terms of marginal opportunity costs and include, for example:

- research and development costs to wood heater manufacturers;
- compliance costs such as research and development costs for designing new heaters;
- resource costs required by governments to change legislative and administrative frameworks; and
- resource costs to jurisdictions involved in administration, certification, enforcement or education.

Benefits include avoided health impacts, avoided costs (such as wood cost savings with greater wood heater efficiency) and other environmental benefits (such as habitat and biodiversity benefits). Health benefits are defined in terms of marginal willingness to pay and the values used in this study are shown below.

The economic assessment provides a ranking of options according to their net benefits to the community over the assessment period. The net benefit is calculated as the net present value of benefits less the net present value of costs over the twenty year assessment period. Sensitivity

analysis of key assumptions used to estimate costs and benefits is used to identify the key drivers influencing the ranking of options.

The analysis of social impacts identifies the incidence of estimated financial benefits and costs across affected stakeholders.

We will present estimates of emissions reduced under each feasible option over the twenty year assessment period, and where possible, describe the likely outcomes for ambient air quality.

A7.2 Valuation of health benefits

Table A7.1 shows the values used in this study. Background to the development of the approach used to estimate health benefits is provided in Appendix 3.

Table A7.1: Assumed particulate emission damage costs ($/tonne PM_{10})

Community	Damage cost
Large capital cities (Melbourne and Sydney)	$263,000
Smaller capital cities and large regional centres experiencing high particulate pollution levels (e.g. Launceston, Armidale, Wagga)	$113,000
Other areas	$1,500

A7.3 Assumptions relating to standards

Table A7.2 shows the average certified emissions assumed for new heaters under the options that include an emissions standard. They have been derived from current industry data (excluding those models that would no longer meet the standard).

Table A7.2: Emissions from new heaters

Option	Emission standard (g/kg)	Average certified emissions (g/kg)
Base case	4	2.6
Options 6,7,8	3	2.1
Option 9	1.5	1.2

Notes: Derived from Walter Turnbull 2010 and AHHA certification data 2010

Table A7.3 shows the average efficiency assumed for new heaters under the base case and options that include an efficiency standard. They have been derived from current industry data (excluding those models that would no longer meet the standard).

Table A7.3: Efficiency for new heaters

Option	Efficiency standard	Average efficiency
Base case	-	59%
Options 6,7,9	60%	63%
Option 8	65%	70%

Notes: Derived from Walter Turnbull 2010 and AHHA certification data 2010

In order to quantify the reduction in emissions likely to result from increases in heater efficiency we use the relationship established by Todd (2002) - a 5% increase in heater efficiency is assumed to result in an 8% reduction in wood use.

Table A7.4 shows the assumed dates for introduction of new heater standards and the phase-in periods assumed for the various options to allow time for research and development, testing and certification of new heaters and sell out of stock. Stakeholder perspectives have informed the development of the assumed phase-in periods.

Table A7.4: Assumed timing and phase-in period for new standards

Option	New standards	Phase-in period	Introduction	Effective from
Options 6,7	3 g/kg & 60%	2 years	2012	2014
Option 8	3 g/kg & 65%	4 years	2012	2016
Option 9	1.5 & 60%	6 years	2012	2018

The timeframes shown in Table A7.4 are indicative only. For example, if the national regulatory options were to be approved, the Commonwealth Government would need to develop new legislation, along with associated regulations, to give effect to the proposed outcomes. Assessment of the legislative development process indicates that the time needed to develop legislation is in the order of two years. This timeframe takes into account all Commonwealth legislative and regulatory requirements and assumes no major delays.

Table A7.5 shows the estimated percentage of models that would not comply with the new standards under different options as well as the estimated costs for research and development of new models. The development costs represent average costs that have been derived from discussions with manufacturers.

Table A7.5: Research and development costs to manufacturers

Option	New standard	Current models that would not comply	Development cost per model
Option 5	60% efficiency	63%	$6,500
Options 6,7	3 g/kg + 60% efficiency	76%	$25,900
Option 8	3 g/kg + 65% efficiency	93%	$25,900
Option 9	1.5 g/kg + 60% efficiency	95%	$116,300

Sources: Consultation with four major manufacturers, Walter Turnbull 2009, AHHA certification data 2010, Environment Link and BDA Group 2006.

Other key assumptions for estimating costs to manufacturers include:

- testing of heater models for certification costs $10,000 per model
- there are currently around 250 heater models
- 50% of models would be able to be certified at their scheduled re-testing time
- the number of models is expected to decline with tighter standards (down by 28% for 1.5 g/kg).

The following assumptions have developed for the outcomes of emissions labelling:

- emissions labelling on compliance plates would have a one year phase-in period and achieve only a 1% reduction in emissions of new heaters sold by 2030
- a national star rating labelling scheme would achieve a 7.5% reduction in emissions of new heaters sold by 2030.

The assumptions about the outcomes of labelling have been developed from a review of environmental labelling schemes provided in Appendix 8.

Table A7.6 shows the estimated costs of implementation of the labelling schemes.

Table A7.6: Costs of emissions labelling

Program	Costs	Based on…
Compliance plate labelling (Options 3-9)	• $25,000 Commonwealth one-off cost	• 0.25 FTE to establish requirement for emissions labelling in ASNZS 4013 • Negligible costs to industry
Star rating labelling scheme (Options 4-5)	• $100,000 Commonwealth one-off cost of developing the labelling standard • $205,000 Commonwealth ongoing costs • $3,750 per year for labelling by industry	• Costs based on review of environmental labelling schemes • Ongoing costs $70,000 promotion and awareness, $85,000 database and website administration, $50,000 general administrative oversight • Costs to industry of 15 cents per label for 25,000 heaters sold per year

Sources: Review of environmental labelling schemes in Appendix 8.

A7.4 Assumptions relating to compliance measures

Table A7.7 shows the assumed impact of audit and enforcement measures on in-service emissions. Our estimates of expected outcomes of different compliance measures is based on the experiences to date and discussions with stakeholders, and has been developed to reflect the risks involved in using voluntary, collaborative and regulatory approaches to improving compliance.

Table A7.7: Improvement in retail compliance with standard

Scheme	Improvement
AHHA program	40%
National audits	50%
National funding for state based standard audit and enforcement	65%
National certification and independent testing	98%

Table A7.8 shows the estimated costs of implementing the compliance measures.

Table A7.8: Costs of compliance measures

Program	Costs	Based on…
National audits	• C'lth: $600,000 per year over 5 years then $50,000 per year • Industry: $25,000 per year for testing over five years • Industry: $187,500 for improvements to heater design to ensure limits are met over five years	• Testing of 20% of 250 models per year @ $10,000 each plus full time project officer, then testing of 1% each year plus 0.25 FTE for project officer • 1% of models fail per year & need retesting funded by industry • Improvements are made to 50% of the 60% of new heaters that don't comply to ensure limits are met @ $25 per heater
State based audits	• C'lth: $100,000 in first year then $700,000 per year • Industry: $25,000 per year for testing • Industry: $243,750 for improvements to heater design to ensure limits are met	• Project officer for initiation, funding provision and guidelines • Funding for state audit and enforcement programs based on NSW & TAS input • 1% of models fail per year & need retesting funded by industry • Improvements are made to 65% of the 60% of new heaters that don't comply to ensure limits are met @ $25 per heater
National testing & certification	• C'lth: $100,000 for two years then $800,000 per year • Industry: $25,000 per year for testing • Industry: $356,250 for improvements to heater design to ensure limits are met	• Project officer for development of regulation & setup of certification body • Resources for operation of certification body – 1 FTE for admin, 5 FTE for enforcement, plus auditing of 5% of models every year • 1% of models fail per year & need retesting funded by industry • Improvements are made to 95% of the 60% of new heaters that don't comply to ensure limits are met @ $25 per heater

A7.5 Assumption relating to in-service measures

The proportion of wood heaters in use with good, careless and poor operating practices has been estimated drawing on 2005 data from Perth on operator practices and the analysis by WA DEC in 2007 of the possible outcomes of education. Education programs are expected to achieve a gradual change in operator behaviour resulting in the outcomes shown in Table A7.9 by 2030.

Table A7.9: Base case operator practices and outcomes of in-service measures

	Base case	Education	Education with star rating scheme
Good operation	25%	50%	80%
Careless operation	70%	47.5%	19%
Poor operation	5%	2.5%	1%

The likely outcomes of wood heater replacement programs have been based on data from Launceston, NSW and the analysis of an expansion of programs in Perth. In NSW around 6-8% of households with wood heaters chose incentives and around 67% said that they were planning to replace their wood heaters anyway. In Launceston 2,200 heaters were replaced over four years and for Perth it was assumed that around 1,100 could be replaced yearly under an expanded heater replacement program.

The key assumptions made relating to wood heater replacement programs are:

- wood heater replacement programs in critical airsheds are expected to remove 5% of wood heaters in-service over five years
- of the heaters replaced under wood heater replacement programs 3% are expected to be new wood heaters
- of the heaters replaced under wood heater replacement programs 50% are expected to have been replaced under the base case.

Implementation of in-service regulatory provisions including the common definition of excessive smoke and regulation of installation, modification and second hand heaters through a national framework are expected to achieve a small shift (1%) in in-service operation from careless to good by 2022.

Table A7.10 shows the estimated costs of implementing the compliance measures.

Table A7.10: Costs of in-service measures

Program	Costs	Based on…
Education in critical airsheds (metro airsheds)	Commonwealth $2.8m every three years, $0.7m in interim years	Costs based on Perth education & training budget of $500,000 per year (in Todd BCA) extrapolated to all critical airsheds based on existing heater numbers. Major program assumed every three years with budget reduced to 25% in interim years.
Wood heater replacement programs in critical airsheds (metro airsheds)	Commonwealth $17m over five years	Around 20,000 heaters removed over five years @ $600 Costs of administration and inspections estimated at 30% of heater funding (Project mgt for grants often estimated at around 15%, however these are small grants, Todd CBA has even higher at 46%) Advertising and printing $100,000 in the seven airsheds
Other in-service regulatory provisions	Commonwealth initial $50,000 Commonwealth $360,000 per year	0.5 FTE to develop new regulatory provisions and changes to Building Code of Australia Costs of enforcement based on NSW estimated costs of comprehensive enforcement for managing in-service emissions including program management, liaison with local govt and planning agencies, response to complaints, regulatory tools review, community awareness, and local government officers training. Costs extrapolated nationally based on existing heater numbers.

A7.6 Costs of different policy vehicles for national regulatory framework

Table A7.11 shows the estimated costs of using different policy vehicles for the national regulatory framework.

Table A7.11: Costs of national regulatory framework

Program	Costs
Commonwealth regulation	$100,000 for regulation impact statement process $350,000 for legislation development $25,000 per year for ongoing administration
National Environment Protection Measure	$100,000 for regulation impact statement process $200,000 for NEPM development $700,000 for establishing / amending state / territory regulations $100,000 per year for ongoing administration

APPENDIX 8: Review of labelling schemes

Product environmental labels are intended to raise consumer awareness of the environmental impacts of products. By providing consumers with objective information on the relative environmental merits of products, particularly where these claims are independently certified, individual consumers can incorporate the importance they place on the environmental impacts into their purchasing decisions.

In a report prepared for Sustainability Victoria, RMIT University (2007) reviewed product environmental labels in Australia and overseas[86]. 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.

RMIT found that the impact of product environmental labelling is complicated by the fact that environmental consciousness does not necessarily affect purchasing behaviour directly. There is a complex set of relationships between purchasing behaviour, environmental intent and the prioritisation of other aspects, such as price, quality and habit. RMIT argue that it is important to recognise that product environmental labelling alone cannot be expected to change consumer behaviour. All of the literature acknowledges that to be effective, product environmental labelling needs to be seen as part of a suite of tools, which includes voluntary measures and regulatory policy and programs for environmental protection

Recent analyses of introducing or amending Australian energy and water efficiency labelling programs[87] have assumed that the projected sales of appliances are identical with and without the proposed labelling measure. Rather it is assumed that the impact of the proposed labelling would be a stronger consumer preference for more efficient models which would produce a more rapid reduction in sales weighted average energy or water consumption than under a business as usual case.

RMIT (2007) found that the Australian energy labelling program was widely regarded as among the most informative in the world, with the sales weighted energy consumption for all appliances covered by the energy labelling program decreasing. For individual appliances, energy consumption per annum from 1993 to 2005:

- of fridges decreased at an average of 3.9%;
- of freezers decreased at an average of 4.0%;
- of clothes dryers decreased at an average of 0.7%;
- of dishwashers decreased at an average of 3.6%.

86 RMIT University 2007

87 For example see Energy Efficient Strategies 2008 and Institute for Sustainable Futures 2008

The *Water Efficiency Labelling and Standards Act 2005* (WELS Act) mandates water efficiency labelling for a range of products, and minimum water efficiency standards for a subset of those products. The WELS scheme currently provides information about the water consumption and relative water efficiency of household water-using products.

In the 2004 Regulation Impact Statement for the introduction of WELS, Wilkenfeld and Associates[88] postulated a reduction in total household indoor water use attributable to the WELS scheme to reach 5.2% by 2021, with the impacts ranging from about 9% for clothes washers to less than 0.3% for taps.

Table A8.1: Estimated impact of WELS

Clothes washers	Dish washers	Toilets	Showers	Taps
9.3%	7.4%	6.1%	3.6%	0.3%

Source: Wilkenfeld and Associates 2004

A more recent assessment[89] of the cost effectiveness of WELS drawing on 18 months of sales data and stakeholder consultations is generally more optimistic about the likely extent of water savings than that postulated by Wilkenfeld and Associates (2004), but it is difficult to determine from their report exactly how much better.

A range of costs will be involved with the development and introduction of environmental labelling. These costs will be most significant where efficiency standards and associated compliance and enforcement programs do not exist. Where they do however, the marginal costs of a labelling program will be modest. That is, additional costs in efficiency testing and certification would not be required, and labelling enforcement is likely to present negligible additional costs when incorporated into standard enforcement activities.

In relation to other costs, the Institute for Sustainable Futures (2008) cost effectiveness analysis of the water efficiency labelling and standards scheme indicates that the direct cost of affixing a label to each appliance is only some 10c to 20c. Other costs to suppliers unique to the labelling provision may include for on-line registration of each model (at around $300), while there were judged to be negligible costs to retailers and consumers.

A range of government administration costs would be incurred for a wood heater emissions labelling scheme. It is difficult to separate these costs from functions to support the standard, but they may reasonably include a one-off cost in developing the labelling standard ($100,000), and on-going annual costs for promotion and awareness ($70,000); database, website and administration ($85,000) and general administrative oversight ($50,000).

88 Wilkenfeld and Associates 2004

89 Institute for Sustainable Futures 2008

APPENDIX 9: Manufacturers and importers of wood heaters in Australia

Information as at March 2011.

Business name	Divisions / brand names	Location of manufacture	Company type
Acorn Metal Products	-	Australia	Australian Pty Ltd *
AF Gason	Eureka heating, Jindara Heating	Australia	Australian Pty Ltd
Albury Consolidated Industries	Thermalux	Australia	Australian Pty Ltd
Aranbe Industries	Aranbe Heat	Australia	Australian Pty Ltd
Barbeques Galore (Aust)	Austwood, Norseman, Saxon, Kent	Australia	Australian Pty Ltd
Bell Brook Industries	Bell Brook	Australia	No current ASIC registration. Registered business name in Tasmania
Castworks (NSW)	Stanley, Morso, Metrofires	Imported	Australian Pty Ltd
Cheminee	Cheminees Phillippe	Europe	Australian Pty Ltd
Cheminees Phillippe Australia	Cheminees Phillippe	Europe	Australian Pty Ltd
Clean Air Woodheating	Clean Air	Australia	Australian Pty Ltd
Current Line Europe	Chazelles	Europe and Australia	Australian Pty Ltd
Dragon Wholesaling	Lopi, Heatmaster	United States	Australian Pty Ltd
Ecomaxx Woodheating	Ecomaxx	Australia	Australian Pty Ltd
Firefox Industries	Firefox	Australia	Australian Pty Ltd
Firemakers Limited	Parkwood, Enviro, Ethos	Both	Foreign Company
Fireplace Products Australia	Regency	North America	Australian Pty Ltd
Glen Dimplex Australia	Masport, Logaire, Osburn	Imported	Australian Pty Ltd
Heatmaster	Heatmaster	Australia	Australian Pty Ltd
Jetmaster Fireplaces Aust.	Jetmaster, Quadrafire	Australia	Australian Pty Ltd
Kelman Industries	Kelman	Australia	Australian Pty Ltd
Laser Imaging	Laser 3D	Australia	Australian Pty Ltd

Business name	Divisions / brand names	Location of manufacture	Company type
Mexco	Mr Stoves	Australia	Australian Pty Ltd
Pecan Engineering	Jotul, Nectre	Australia	Australian Pty Ltd
Pellet Fires Australia	Pellet fires Australia	Australia	Australian Pty Ltd
Pellet Heaters Australia	-	Imported	Australian Pty Ltd
Pivot Stove & Heating Co	Major brands	Imported	Australian Pty Ltd
Richardson Consolidated Industries	Ned Kelly wood heaters	Australia	Australian Pty Ltd
R J Metal	Jarrahdale, Pioneer	Australia	Australian Pty Ltd
Scandia Heating (Aust)	Scandia	Imported	Australian Pty Ltd
Scandia Stoves & Spares	Scandia	Imported	Australian Pty Ltd
Shamic Sheetmetal (Aust)	Coonara, Heat Charm, Arrow	Australia	Australian Pty Ltd
Sherwood Machinery	-	Australia	Australian Pty Ltd
The Good House	Focus	Europe	Australian Pty Ltd
Trazend	Burning log, Warmglo	Australia	Australian Pty Ltd
Ultimate Wood heaters and Gas Log Fires	Ultimate wood heaters, Illusion gas log fires	Australia	Australian Pty Ltd

* Pty Ltd - Proprietary Company, Limited by Shares