

Cosy Home, Clean Air

A Strategy for Addressing Wood Smoke issues
in Armidale

WSAG Report

26th September, 2019

Wood Smoke Advisory Group Report

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1. Introduction – what and why

The Wood Smoke Advisory Group (WSAG) was formed in late 2018 by Armidale Regional Council (ARC) Mayor, Simon Murray. Assorted members of the community were invited to join the reference group in order to “review information about Armidale’s air pollution and wood heating and to clearly define what Council’s role should be in addressing this issue.”¹ Concern for wood smoke emissions and air quality have been seen as an issue in Armidale for some years, and whilst various options to address the issue have been discussed, and in some cases implemented, none have to date succeeded in significantly reducing the problem.

Much has been written, discussed, presented and debated over the issue locally for several decades. Suggestions have been made, but little action taken. We are not attempting to repeat all this information here, but, agreeing that there is a particulate problem as the result of wood heating, bring it all together for a constructive strategy for moving forward. The most important change, however, is to see the issue as a health problem, rather than just a pollution problem. In this regard, taking action may get taken more seriously and trigger more imminent action to resolve the problems.

- This report aims to focus on strategies to reduce, alleviate and prevent the issues at hand specific to air pollution, and the potential health impediments that result, from the use of wood heating.
- The debate is not whether there is a problem, but rather the community’s perception and understanding of the problem, and what we can do about it.
- It is not about taking away the right to have a wood heater but rather about ensuring the right to have a healthy, clean-air environment.

As such, as members of WSAG, we have not come to a 100% consensus on the best set of solutions to move forward. Rather, the proposed strategy is an amalgam of the majority views of the group while taking into account the overall views. Some things that were included and some that were omitted are a compromise on the opinions of the group as a whole.

The WSAG has met from late 2018 to August 2019, and considered the available data, documents and an array of supporting information – both pro and con – in an attempt to provide an unbiased and objective set of recommendations to address the issues. This also included information from other councils in Australia and New Zealand that have had varying levels of success addressing the same issues in relation to air pollution from domestic wood fire heaters. As a result, WSAG has come up with a package of recommendations that we believe can best address these issues with an equitable, viable, sustainable and effective solution specific to Armidale. These are broad based only – as a volunteer group we are not in a position to drill down into the detail of how these strategies can be delivered, though general suggestions are included in the recommendations. We believe this approach will assist Council in developing a realistic strategy to meet the National Air Quality Standards and reduce Armidale’s wood smoke problems. Ultimately, it will be up to Council to take on board these recommendations and implement a program to improve the air quality in Armidale as a result.

Mahalath Halperin, WSAG Chair
06 August, 2019

¹ Mayor’s Letter of Invitation to members to join WSAG, 05 September, 2018

2. Executive summary of report

For many winters, there has been a significant wood smoke problem in Armidale. Largely a result of the topography of the valley, it creates an inversion layer of the smoke generated by wood fires, especially on typically cold still winter nights. There are many nights when the national permissible levels of PM2.5, ie particulates in the air, is exceeded. The fundamental shift in attitude must be that this needs to be treated as a health issue, rather than a pollution issue. It is not about taking away the right to have a wood heater but rather about ensuring the right to have a healthy, clean-air environment.

Various programs, discussions and policies have ensued over the years to address the issue, but none with outstanding success. As a working group, WSAG has revisited these programs, as well as those in other jurisdictions both in Australia and New Zealand, to determine the best way forward for our specific situation here in Armidale. We are not attempting to repeat all this information here, but, agreeing that there is a particulate problem as the result of wood heating, bring it all together for a constructive strategy for moving forward.

Focussing on strategies to reduce, alleviate and prevent the issues at hand specific to air pollution and the potential health impediments that result from the use of wood heating, WSAG has arrived at a broad base of strategies and ideas to guide Armidale Regional Council in successfully resolving this issue.

A three pronged approach is needed, namely –

- Education
- Replacement
- Enforcement

Education centres around a range of issues from the broader aspect of raising awareness on the issue of wood smoke as a health issue, to the more specific process of correct operation of wood heaters. In between is education on keeping warm and behavioural changes within the home. An initial survey of the current status of awareness and understanding will help reignite the conversation within the community. All discussion with the community needs to be well-worded and non-aggressive in order to give it traction without resistance.

Replacement of existing wood heaters is unresolved as to whether this should still – and/or ultimately long-term – include wood heaters or only other forms of heating. To this end, any replacement program needs to include incentives and/or rebates to upgrade housing infrastructure to help retain heat generated, as well as maximise the benefits of Armidale’s typically sunny winter days. Otherwise, simply replacing heaters with better ones is partially a waste of money and fuel. Rather, it can reduce the overall heating needs and thus make heater-selection options more viable. A range of relevant heating options and associated fuels has been discussed within the report.

Funding will need to be investigated to enable delivery of educational programs, as well as rebates for new heaters and housing infrastructure. Funds to cover the costs of Smoke Rangers (either existing staff with additional roles or even a new position) and enforcement will also be needed, and ongoing monitoring kept up-to-date and the public informed of the data. The opportunity to work with other organisations, such as NGOs, retailers, schools and local environmental and welfare bodies should be maximised.

Ultimately, this must be treated as a holistic, long-term program, with immediate action centred around education, broadening to longer-term actions including replacement of high-polluting heaters. Education and transition periods will be needed, but with advocacy, responsibility, accountability and monitoring by Council, the ultimate outcome of a cleaner and healthier Armidale has to remain the long-term objective.

3. Background

3.1 Wood Smoke Issue

It is generally acknowledged that within the CBD area and immediate surrounds of the city of Armidale, there is a significant – and dangerous – wood smoke problem during winter months. There are many occasions on which the air quality exceeds the acceptable levels as determined by the EPA and in line with the National Air Quality Standards.² (refer Diagram 1)

This is caused by a combination of topography – the valley in which Armidale sits – and the way in which wood heaters are used. With sub-zero overnight temperatures and high pressure meteorological conditions, the resultant inversion layer sits over the city creating potentially serious health risks to inhabitants.

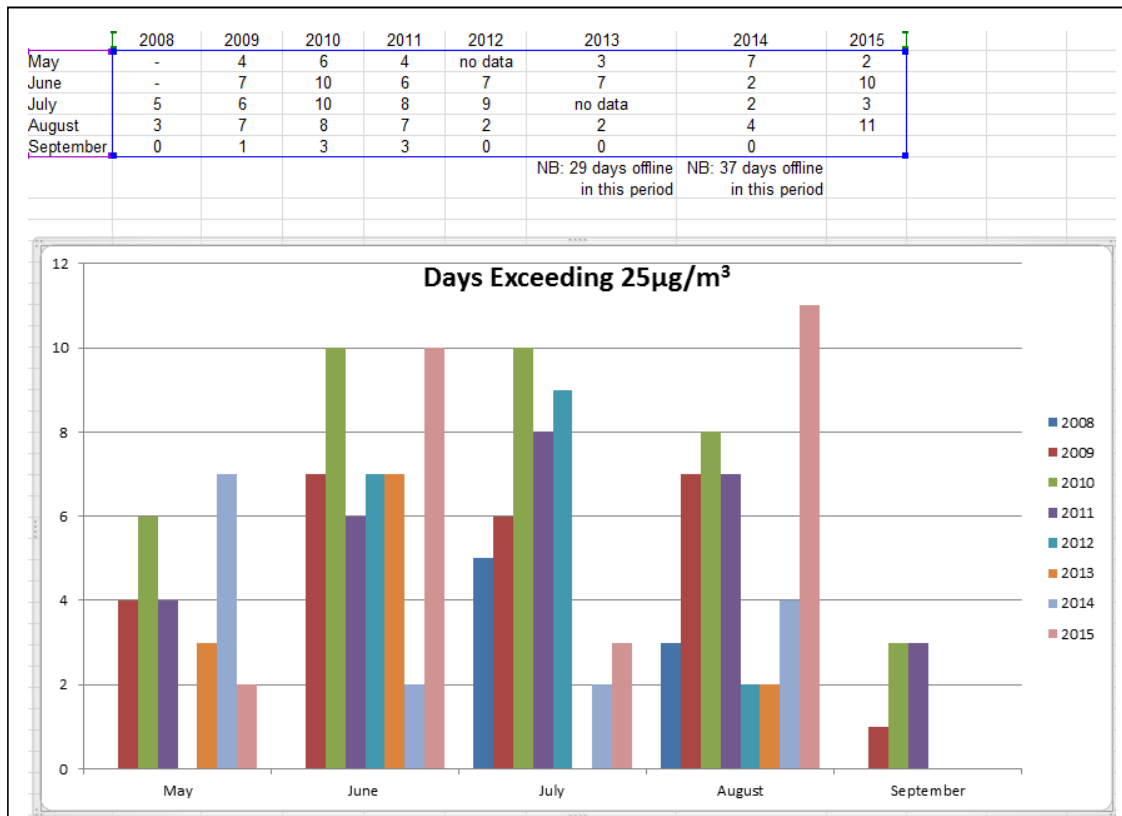


Diagram 1: Excerpt from DustTrak master data collected from roof of Armidale Council Administration Building

Wood heating is a popular form of space heating in Armidale and can be efficient when used correctly. Wood fires also have psychological and social benefits of perceived warmth. There is also the opportunity for many to obtain 'free' wood, anecdotally estimated as up to 50% of wood used in Armidale is collected by residents or their families. This makes wood more cost effective than other heating fuels.

Consideration has been given to the following –

1. There is sound evidence that wood heaters are a major source of PM2.5
2. Exposure to PM2.5 at levels exceeding national air quality standards is associated with adverse health effects
3. There is concern among the local community with PM2.5 levels often exceeding acceptable levels

² OEH Air Quality Monitor Armidale summary Dec 2018, www.environment.nsw.gov.au/AQMS/search.htm

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4. Determination of the level of community perception of whether it is or isn't an issue; and if perceived as yes, are they willing to act on it?
 5. What are the barriers to change?
 6. What actions will give the greatest reduction in wood smoke issues – ie education vs incentives vs physical changes – or should it be a combination thereof?
 7. Consciousness of potential issues of energy poverty – ie what happens to those no longer able to access free heating supplies.

Health effects associated with wood fire burners

Quantifying the health effects associated with exposure to wood fire smoke is challenging due to the varying composition and concentrations of physical and chemical substances in the emissions. Factors contributing to these variations³ include

- the type, age and condition of the heater
- the type, quality and characteristics of the wood used in the heater
- and the operation of the heater by the user

Also contributing to the challenge is the fact that wood fire smoke is only one source of particulate matter and air pollution. Established sources of air pollution include vehicle and industrial emissions, agricultural spraying, dust and bush fires.

Determining with certainty the health effects associated with PM2.5 levels observed in Armidale would require analysis, controlling for all known factors contributing to health outcomes associated with exposure to air pollutants. Without this, extrapolating from published data is the next best option, however, limitations of doing so must be noted. The main limitation being the inability to control for environmental, individual and population level characteristics that influence associations between exposure to particulate matter and adverse health outcomes. The literature on the human health effects of exposure to air pollution is largely from ecological studies that examine air pollution level and health effects at a population level, without being able to adjust for individual exposure levels. Further, these studies are not necessarily from the local situation. Such studies quantify exposure based on average levels of the air pollutant measured in the environment, and often do not take into account other individual factors known to be associated with outcome of interest. While such studies are useful in generating hypotheses and identifying potential public health concerns, the findings cannot and should not be used to make conclusions on the health of individuals.

Despite these limitations, there is sufficient published evidence to suggest that exposure to residential wood fire smoke and PM2.5 is associated with cardiovascular and respiratory illness.⁴ Along with other extensive research⁵ (which is not the purpose of this report to repeat here) the broad acceptance that wood smoke is a health issue is why local, state, and national governments have developed policies to limit emissions and mitigate the negative health effects associated with particle exposure. And therefore the urgency for Armidale Regional Council to do likewise.

That said, it is important to use the right wording when addressing the issue. A positive approach – ie one focused on better air quality and the community's ability to cope with cold winters in a good way will be more productive than just focusing on eliminating wood smoke because it is bad for our health. There is ultimately a cost benefit if we put a value on the overall health of the community, but the average resident with their wood heater can't necessarily see that benefit if the funds simply don't exist to pay for alternative energy bills.

³ Refer assorted referenced documents throughout this report and also as listed in the Appendix

⁴ Naeher, Brauer et al. 2007

⁵ For example, Barregard, L., et al. (2006). "Experimental Exposure to Wood-Smoke Particles in Healthy Humans: Effects on Markers of Inflammation, Coagulation, and Lipid Peroxidation." *Inhalation Toxicology* **18**(11): 845-853; Naeher, L. P., et al. (2007). "Woodsmoke Health Effects: A Review." *Inhalation Toxicology* **19**(1): 67-106.

Past and present actions and policy in Armidale

Various attempts have been made by the Council over the past decades to address the issue. Current ARC policy relating to local air quality is set out within POL134 – Regulatory – Policy for Sustainable Domestic Energy Use and Local Air Quality (incorporating Local Approvals Policy for Solid Fuel Heaters) Version V; adopted by Council in May 2013.⁶ The preamble to the policy document briefly describes the measures taken since the mid-1990s in this area -

1. Established a community reference group (now a full advisory Committee to Council) to assist with appropriate policy direction and implementation
2. Provided significant financial incentives, such as interest free loans and subsidies for insulation and new heating systems
3. Undertaken a range of public education and related media programs on domestic energy efficiency, including the construction of a display home
4. Obtained related Government funding to supplement local program resources
5. Monitored air quality in Armidale and regularly reported the results to the community
6. Conducted smoke patrols and issued abatement notices for excessively smoking chimneys
7. Maintained a dialogue with relevant Government agencies and industry groups, including making submissions for future actions and initiatives

Many of these measures were implemented in 1994 when Armidale City Council adopted an Energy Efficiency Action Plan for Armidale which had the following vision statement:

“To achieve national recognition for New England as the leader in energy efficiency practice for rural Australia by the year 2000.”⁷

Whilst wood smoke was not the primary focus of this plan, increased energy efficiency was seen as potentially providing a “win-win” solution in terms of reducing heating requirements and hence smoke. Incentives, in the form of interest free loans of up to \$3000, were provided for installation of energy-efficient equipment (e.g. reverse-cycle air conditioning and solar and heat pump hot-water heaters) and for home insulation. Public information (monitoring of air quality in Armidale began in 1996) and education programs were also integral to the plan.

The pursuit of the vision was, however, short-lived and the incentive schemes and the momentum of public education work had largely petered out by the end of the 1990s. Since this initial drive for energy efficiency, action has been more focused upon the specific issue of wood smoke, but that action has been periodic and somewhat piecemeal. Examples include:

- Rebates to households of up to \$1000 to replace wood heaters with an alternative form of heating (as part of the NSW Government’s Woodsmoke Reduction Program in the early 2000s)
- Provision of information and educational material via the Lifestyle2350 website and Facebook page (both of which now appear to be defunct)
- Allowing users to borrow a moisture meter from the library to enable them to check the moisture content of fuel wood
- Providing a 20% discount on chimney cleaning for a short period of time in 2013

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<https://www.armidaleregional.nsw.gov.au/ArticleDocuments/499/INT%20Policy%20for%20Sustainable%20Domestic%20Energy%20Use%20and%20Local%20Air%20Quality%20incorporating%20Policy%20for%20Solid%20Fuel%20Heaters%202013%20REVIEWED%20VERSION.pdf.aspx>

⁷ *State of the Environment Report 1997*, Armidale City Council (1997)

- Early morning smoke patrols, checking that chimneys were not emitting excessive smoke

More specific control is detailed within POL134. Any domestic solid fuel heater installed must be approved by Council and conform to an emission standard of between 2.5 and 3.0g/kg depending on location. The Council also has powers to remove or replace such heaters if installed without approval, as well as issuing fines for non-approved installations. The policy document also details a series of stepped actions that can be taken against households which are observed to consistently emit excessive smoke. Such steps include written warnings, education and ultimately a penalty of \$3300 (however, the extent to which these more punitive measures have been employed by the Council appears to be low, possibly because there is limited political will to do so).⁸

Measures undertaken elsewhere

Canberra: Wood Heater Replacement Program

In 2004 the ACT Government introduced a rebate to assist households replace wood heaters with alternate heating systems. The scheme resulted in the removal of 1135 wood heaters by 2017 and replacement with reverse cycle systems (although a relatively recent article in the Canberra Times quotes a government spokesman as stating that new wood heater installations are, “*increasing rather than decreasing*”).⁹ The current level of rebates on offer are:

- \$250 for wood heater removal or decommission
- \$1250 for wood heater removal and installation of ducted electric reverse cycle system
- \$750 for wood heater removal and installation of electric reverse cycle split system
- \$750 for wood heater removal and upgrade of electric reverse cycle system¹⁰

Launceston: Wood Heater Replacement Program

Launceston, like Armidale, is located in a valley and suffers from similar inversion events which trap air pollution over the city. It is estimated that 60% of households used wood heaters in the 1990s, with the absolute number of heaters reaching 17,500 in the year 2000.¹¹ From 2001 to 2004 a Wood Heater Replacement Program was implemented offering households up to \$500 to replace wood heaters with alternative (gas and electric heating systems). Other interventions were run alongside this program; education and advertising by the local council are thought to have contributed to reducing pollution by improving the operation of remaining wood heaters, and; environmental officers monitored chimneys, offered targeted education where appropriate and were empowered to serve infringement notices to households which continued to emit excessive smoke. When the programme finished a significant improvement in wintertime air quality had been achieved and the number of households with wood heaters had fallen to 30%.¹² The improvement in air quality can be translated into the avoidance of approximately 30 premature deaths every year for the city’s population of 70,000.¹³

Whilst this program has undoubtedly been successful there is some evidence of an increase in use of wood heaters in recent years. With significant price rises on electricity and gas, there is anecdotal evidence from Council that some people are reverting to firewood as a low-cost option, particularly for those on lower incomes for whom heating costs form a larger proportion of household income.

⁸ *Wood Pellets Stoves for Pollution and Green House Gas Reduction*,

D Carr, I Reeve, S Andres, D Robinson, (2013) RIRDC Publication No. 12/065

⁹ <https://www.canberratimes.com.au/story/6021798/wood-fires-still-popular-in-canberra-despite-suburban-bans/>

¹⁰ <https://www.energy.gov.au/rebates/wood-heater-replacement-incentive>

¹¹ *Evaluation of interventions to reduce air pollution from biomass smoke on mortality in Launceston, Australia: retrospective analysis of daily mortality*

F Johnston, I Hanigan, S Henderson, G Morgan, (2013). 1994-2007. *BMJ : British Medical Journal*, 346, e8446. doi:10.1136/bmj.e8446

¹² *Woodheaters in Launceston—impacts on air quality*. Department of the Environment and Heritage, 2005:52. CSIRO Atmospheric Research. (2005). <https://www.environment.gov.au/system/files/resources/1056c046-eb25-4d75-9aa4-1dd87db6a79a/files/launceston-woodheaters.pdf>

¹³ <https://theconversation.com/everyone-loves-a-wood-burning-heater-but-is-the-harm-worth-it-13536>

Christchurch (NZ): Clean Heat Project (CHP)

Widespread use of wood heaters and open fires (and again, topography) resulted in high PM₁₀ concentrations in Christchurch into the 1990s (in 1999 there were estimated to be 57,000 of these appliances in use).¹⁴ Measures to combat air quality issues have been in place since the 1970s (such as a ban on installation of open fires and emission limits on solid fuel burners), however, these failed to halt increases in the number of exceedances of government PM₁₀ thresholds.

The CHP was initiated in 2003 and its main thrust was to provide financial incentives to encourage households to improve levels of insulation and convert to cleaner, alternative heating. Through the scheme, and as a result of accompanying measures (educational and informational campaigns) about 34,000 open fires and solid fuel burners had been replaced by the end of 2009 and this was coincident with a 71% decrease in PM₁₀ emissions over the period 2002 to 2009.

Whilst the CHP no longer operates a variety of other measures have been put in place which include:

- Stringent control of the types of burners that can be installed in homes, for example only ultra-low emission burners can be installed as from the beginning of 2019, and burners older than 15 years must be replaced;
- Financial assistance is available for heater replacement for; those on low incomes (subsidies of up to NZ\$5000), and; via a fixed low interest loan of up to NZ\$6000 which is added to the householders rates bill and repaid over a period of up to nine years.¹⁵

What is effective?

This is brief overview of measures taken elsewhere is by no means definitive in coverage, but it does suggest that improving air quality is dependent upon implementing, and maintaining a consistent set of integrated tools over a long period of time. Financial incentives are effective, as long as they are provided at a sufficiently high level, and are accompanied by consistent educational and informational programmes which bang home messages about poor burning practices, old and inefficient heaters, and the use of good dry wood, in addition to the health consequences of poor air quality. Over time then receptivity to more stringent restrictions on types of heaters used may become more socially acceptable.

A major challenge to the success if these types of programmes will be a continuation of high energy prices in Australia.

¹⁴ *Impacts of residential heating intervention measures on air quality and progress towards targets in Christchurch and Timaru, New Zealand.*

A Scott, C Scarrott, (2011) *Atmospheric Environment*, 45(17), 2972-2980.

doi:<https://doi.org/10.1016/j.atmosenv.2010.09.008>

¹⁵ <https://ecan.govt.nz/your-region/your-environment/air-quality/home-heating/>

The Wood Smoke Advisory Group (WSAG) was formed by invitation from ARC Mayor Simon Murray in 2018. Comprising a group of community members, including academics and industry-related persons, the group was formed to address the issues of air quality in relation to wood smoke, as noted above. Terms of Reference were developed as guidelines to carry out the work required (refer Appendix 6.3).

As a committee appointed by the mayor, it is not a Council Committee, with no Councillors involved and not beholden to Council as such. Nonetheless, issues raised by Councillors in the Council's December 2018 meeting have been addressed as considered appropriate by the WSAG (refer Appendix 6.4).

Members are as follows –

Ms Mahalath Halperin (Chair) – Architect & Environmental Consultant, Mahalath Halperin Architects

Dr Navjot Bhullar – Assoc Prof Community & Applied Psychology, UNE

Mr Dave Carr – Southern New England Landcare Ltd

Mr Peter Ducat – Community member, former Ducats Earthmoving, Armidale

Mr John Grills – Barbecue Galore, Armidale, Representing Australian Home Heating Association (AHHA)

Dr David Hadley – Senior Lecturer in Agricultural Economics, UNE

Prof Don Hine – Professor, School of Psychology and Behavioural Science, UNE

Dr Jeffrey Kirkland – Lecturer & Lab technician, Chemistry & Environmental & Rural Sciences, UNE

Dr Geetha Ranmuthugala – Prof & Head of School Rural Medicine, Epidemiologist, UNE



Figure 1: Armidale Aerial photo, ~1995 (MHA)

4. Discussion points

4.1 Boundaries & limitations

While it would be ideal to address all the issues relating to wood smoke and air quality, including now and into the long term future, the WSAG decided that in order to reach some tangible options, the core recommendations would focus on the following –

- Only addressing the issue of wood smoke within an approximate Armidale city boundary (refer Diagram 2), though bearing in mind that where smoke accumulates is not necessarily where it is generated.
- Only addressing wood smoke and air quality issues generated by housing. Other sources such as The Armidale School's coal-fired burner for example, outdoor open fires, or pollutants from motor vehicle emissions, were not considered.
- Focusing on existing installed heaters, though recommendations are included for renovated, new and future housing stock.
- Focusing on changes to wood heating use from a health and pollution aspect only, ie not addressing resource depletion (ie firewood), or changing weather patterns or demographics, both of which may influence heating requirements long term.

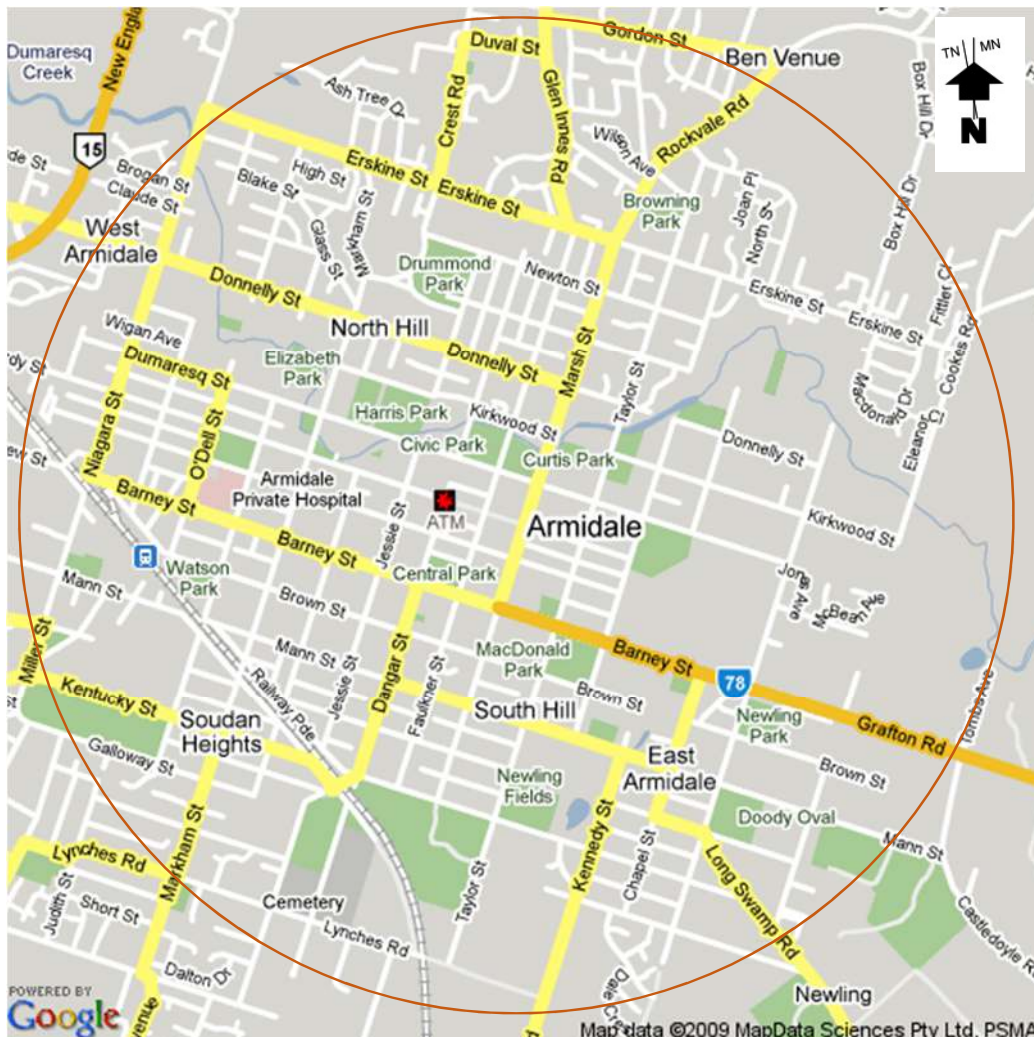


Figure 2: Map of Armidale showing general area affected by wood smoke

In this way it is believed that tangible outcomes can be achieved, with long term planning to eventually address the issue in total. It is understood that the core of the problem in Armidale is existing older heaters. While realising that these existing heaters will eventually fail and need replacing with either new heaters or alternative forms of heating, in the meantime they are the generators of the current emissions problems. Based on observations of smoking chimneys and anecdotal evidence, it would be a fair estimate that it is 10% of the current heaters that are causing 80% of the current problem, though this may on the one hand increase with aging appliances, but be offset with replacement of newer, more efficient, appliances. The implication, therefore, is that if we can fix 10% of the heaters, we can fix a large amount of the problems.

The adoption of a formal Air Shed may assist in defining where the issues are and how they might be addressed. This has been adopted in other communities as a way of dividing the region into physical areas where each Air Shed has maximum allowable level of pollutants such as PM2.5 emissions. Once these levels are exceeded, the Air Shed is deemed to be 'full' and no further emissions are permitted – though how that is achieved is open to debate. However, Armidale's affected area may not be large enough to divide and may simply constitute a single Air Shed, with the appropriate limitations still applied.

National figures from AHHA indicate that whereas 20 years ago, heater sales were around 60,000 – 70,000 annually, they are now currently around 33,000 – 38,000 per year¹⁶, indicating a reduction in heater sales. However, this is not necessarily indicative of known sales in Armidale which are fairly static. In the meantime, wood heater sales in Armidale have included better appliances, with the best three regularly sold appliances rated at 1.5 ppm emissions.¹⁷ However, this does not reflect heaters purchased second hand (including on social-media sale websites) or those purchased from outside Armidale. Formal wood sales have fluctuated but are not necessarily indicative of use as the data does not include wood freely sourced, nor take into account warmer vs cooler winters. (refer Table 1)

Year	Total sales	Remarks
2009	1,700	Calendar year
2010	1,600	Calendar year
2011	2,770	Calendar year
2012	2,690	Calendar year
2013	1,130	Part – Jan to July only
2014-2015	2,100	Financial year
2015-2016	2,200	Financial year
2016-2017	2,200	Financial year
2017-2018	1,800	Financial year

Table 1: Firewood Sales in Armidale as supplied to FAA (Firewood Association Australia), data supplied by P Ducat.

However, changes in purchasing behaviour (of appliances and fuel) may also reflect a combination of alternative forms of heating now available (mostly notably reverse cycle air conditioners and the promotion of roof-top solar energy systems) and the decreasing length and overall severity of winters.

Data for 2018 shows that while approximately 100 - 150 wood heaters were sold during the year, ARC received 50 Section 68 Applications for installation during the same period¹⁸. This implies that approximately either half the heaters were installed beyond the required Section 68 approval area – or that purchasers are not submitting applications or approval upon installation. The majority of applications that are submitted are installed by qualified installers, mostly being Peter Fittler Plumbing, therefore ensuring correct installation procedures are followed.

¹⁶ Bruce Mogg, AHHA, Operation & Management of Wood Heaters, CASANZ 2019

¹⁷ Data from Barbecues Galore Armidale, J Grills 2019

¹⁸ Data from Barbecues Galore Armidale, J Grills 2019

Additionally, a small number of Pellet heaters have been sold and installed in Armidale – refer later discussion (Section 4.3) as to operation and benefits.

How do we address rentals and landlords?

The committee also identified the challenges associated with almost a third of dwellings in Armidale being rental properties¹⁹, and the need to provide incentives for landlords to replace existing old wood fire heaters. This is also in combination of many of these rental properties being older and not necessarily well insulated or thermally efficient, thus demanding a higher rate of heating in winter.

Coupled with this is the fact that Armidale has a higher than state average of residents over 65.²⁰ This may support the argument for a higher need for heating, as well as possible challenges in changing behaviour.

Tenure <i>Occupied private dwellings</i>	Armidale Regional (A)	%	New South Wales	%	Australia	%
Owned outright	3,536	34.4	839,665	32.2	2,565,695	31.0
Owned with a mortgage	2,669	26.0	840,004	32.3	2,855,222	34.5
Rented	3,704	36.1	826,922	31.8	2,561,302	30.9
Other tenure type	87	0.8	23,968	0.9	78,994	1.0
Tenure type not stated	274	2.7	73,763	2.8	224,869	2.7

Table 2: 2016 Census data showing types of dwelling ownership in Armidale Regional Council area

Recommendations

- That if possible, a database of existing heaters, their make, model and age, be established within the boundary area as a way of benchmarking current and future use
- That Council better promote the requirement for Section 68 approval for heater installation, working with the retailers at point of sale (though this will not pick up non-local purchases)
- That, if possible, ensure only wood heaters that are compliant with current regulations are available for sale in Armidale; Note that the on-lien second-hand market may be problematic as there is no control over sales
- That any rebate replacement/upgrade program also address rentals with possible incentives for landlords

¹⁹ quickstats.censusdata.abs.gov.au/census_services/getproduct/census/2016/quickstat/LGA10130?opendocument

²⁰ quickstats.censusdata.abs.gov.au/census_services/getproduct/census/2016/quickstat/LGA10130?opendocument

4.2 Community awareness and feedback

It has also been determined that while some community attitudes may have changed, it is not clear to what extent – ie is it or is it not perceived as a problem, and if so, how serious a problem; and importantly, are people willing to act on it? Previous surveys and research provide some indication, but it would be advisable to obtain more up-to-date information. A new survey, possibly conducted by UNE researchers, would ensure current information and feedback from the community, and revise an awareness of the issue.

Further, it would be appropriate that once a plan has been developed, that this be put to the community for feedback and input, prior to finalising any decisions. An open forum (such as the monthly SLA forum) might be a suitable venue to discuss the proposals and how Council can move forward with the community to address the issues.

In the meantime, raising awareness within the community is needed. The occasional information in newsletters accompanying rates notices, and in the local paper, are going some way to addressing this. However, a more prominent ‘in-your-face’ approach is likely to have more impact. This could be in the form of a graph or highlighted PM2.5 levels such as that shown in Table 3 (from the DustTrak monitor and local Purple Air monitors) publicised in a more visual way – such as the LED screen on the corner of the Armidale Ex-services Club (cnr Dumaresq and Dangar Sts), or a similar display somewhere in the Mall. If people are seeing daily that the pollution is off the charts, they may be more inclined to do something about it.

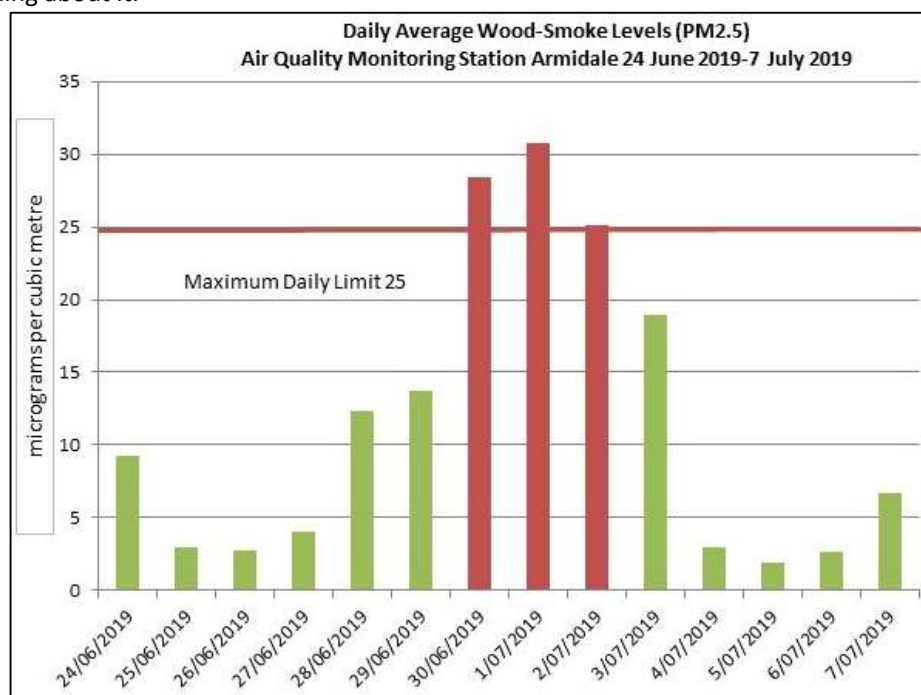


Table 3: Sample graph typically published in Armidale Extra (courtesy ARC)

Recommendations

- That a new survey be conducted to determine the community’s level of awareness, perception and understanding of the wood smoke issue; in so doing, the survey itself will reignite the discussion
- That a visual display of daily PM2.5 levels be shown in the Mall and/or on the Armidale Ex-services’ external screen
- That once the report and proposed Council strategies are nearing finalisation, that a public forum be held to inform the community and allow for constructive feedback for inclusion

4.3 Heating options

Currently it is estimated that there are between 2,500 to 3,700²¹ wood heaters installed in Armidale, being 42%-62% of the approximate 6,000 existing houses in the core of the city. Many of them are not necessarily new and some potentially quite old, especially in rental properties. While it is a minority of these that cause major problems, all wood heaters, including new ones, create emissions to some degree.

Replacing these heaters would need consideration of:

- What to replace them with – the alternative source of heating that would be available and affordable
- Will it still do the same job – the effectiveness of heating houses that are mass produced and/or not designed for the local conditions
- Will it be as / more / less affordable – the cost of replacing the heater and the cost of the alternative fuel (if appropriate)
- Who bears the cost – for rentals in particular
- Will residents 'give up' their wood heaters – willingness of long standing residents of the region to consider alternative heating options

Wood heaters are effective in heating houses overall, and coupled with perceptions of warmth and comfort, are often a preferred option for this reason. However, while upgrading to the most efficient wood heater with reduced emissions output *may* be one option, it is also necessary to consider alternative forms of heating. Even the most efficient heater produces some PM2.5 particulates, and can still be operated poorly, thus the need to ensure education in operation.

Some wood heaters – new and old – have the additional installation of a 'SmartBurn' tube. The steel tube provides a combustion catalyst for wood heaters and is based upon a mixture of natural, non-toxic and non-corrosive ingredients which dissolve existing creosote accumulations whilst preventing further build-ups in the flue. Intended – and marketed as – a chimney flue cleaner, there is no debate that they do result in cleaner flues and chimneys. However, there is some debate as to their effectiveness in reducing emissions – the product claims to provide up to 17% longer wood burn and up to 54% less smoke emissions.²² Feedback from Peter Fittler Plumbing in Armidale, who do the majority of flue cleaning in Armidale, indicate that the flue systems are significantly cleaner where a SmartBurn has been installed, thus supporting the claims of reduced soot and by implication reduced emissions. Either way, it would seem that those who have installed a SmartBurn are therefore aware of at least creosote build-up issues and consequently aware of their heating behaviour and usage – which can only be a good thing.

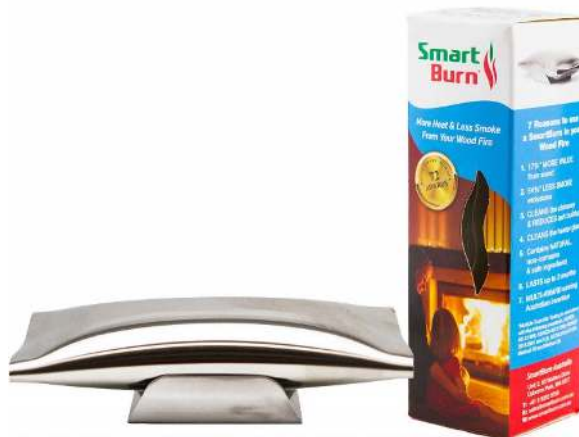


Figure 3: SmartBurn Chimney Flue Cleaner

²¹ Based on various WSAG discussions and assorted data available

²² www.smartburn.com.au

As well as consideration of types of appliance to provide the necessary warmth, fuel sources, quality and associated costs of operation needs to be considered.

- Some residents are able to source wood themselves and/or 'for free' so cost is not considered an issue. Were these residents required to pay for their fuel, this could be seen as an impost with significantly increased costs.
- However, the availability of 'free' wood is likely to change as wood resources continue to be depleted, which may also in the short term drive users of poor quality wood as a substitute, especially as there is no objective quality control with this method.
- Supply and use of quality wood is a must. However, for those sourcing their own wood, control measures are more difficult. Availability of moisture metres and possibly even a community kiln (to ensure fully wood is fully dried) may assist in this. Pre-empting use – ie having wood at home a season in advance – allows time for it to dry out and then be stored correctly once fully dried.
- Moisture testing of wood might assist in ensuring that only dry wood is used, and encourage residents to ensure it is stacked in a dry location. Again, this would be especially useful for those sourcing their own wood. However, whilst retailers receive wood to a prescribed moisture content, if stored outside prior to purchase from residents, it may become less acceptable than when first delivered. Note that moisture meters are currently available for around \$40 from most wood heating retailers. Alternatively, Council currently stock a supply of moisture meters at the Library for residents to borrow (similar to the power meters available).
- Wood needs to be stored correctly – ensuring that wood is stored under cover and off the ground to keep it dry. A competition to build such stores might be an option as an incentive for those currently without suitable storage (note this was successfully carried out in New Zealand²³), with a load of quality wood being the prize.



Figure 4: Woodshed ideas from Nelson Woodshed competition (www.nelson.govt.nz)

- Australian wood heaters rely on hardwood for successful operation. While there have been some ultra-low emission burners (ULEB) developed, these are designed specifically for softwood use (such as in New Zealand) and are also currently considerably expensive (~\$10,000). Development of a ULEB that uses hardwood is a future possibility.
- Electricity is also considered to be expensive, though the expense is partially in the grid-connection costs rather than just the energy itself. However, if replacing a wood heater, a reverse cycle air conditioner is likely to be less cost than buying wood, though this is negated by those homeowners who obtain wood for little or no costs, thus making electricity an expensive option.

²³ www.nelson.govt.nz/environment/air-quality/burn-bright/best-little-wood-shed-competition

- Note that many Armidale roofs already have solar panels (PVs) installed, (approximately 2,100 small-scale systems in 2017²⁴) with an average size of 3.7 kW (the Australian average is 3.15 kW)²⁵. This includes many smaller, older houses, not just new ones. The solar can provide free energy during the day to run air con or feed into a Heatbank, the latter with use of Catch Software (refer later). This diverts the excess power being generated by PVs into the Heatbank prior to feeding into the grid, thus storing excess energy in the form of heat – and no ongoing cost. Additionally, as batteries become more affordable, ‘free’ electricity then becomes available at night as well.
- Gas is considered an expensive fuel. Only bottled gas is currently (and likely to remain) available in Armidale, with its delivery and hire of tanks adding to the cost of the fuel itself.
- Costs of fuel depends on usage, sourcing and of course how well the house retains any heat generated.
- However, overall costs also need to be taken into consideration – ie initial cost of appliance vs ongoing fuel costs.
 - Gas, for example, also includes cost of hiring bottles, though can be complicated if cooking and/or hot water is also involved;
 - Electricity has daily charge rates but all houses likely to be using electricity anyhow;
 - Wood and pellets may incur delivery costs, and non-costed factors of labour should be considered;
 - Gas appliances may cost more than a wood heater, which in turn may cost more than a RC air conditioner; Installation costs also need to be taken in account.

Heater type	Fuel	Comparative costs per annum \$ based on 4 months usage	
Wood heater	wood	600-900 ¹	Or free if sourced independently
RC Heat pump	electricity	160-200 ²	Or free to preheat from PVs
Convection	electricity	450-550 ³	Or free to preheat from PVs
Radiant	electricity	600-800 ⁴	Or free to preheat from PVs
Heatbank	electricity	430-500 ⁵	Or free to store heat from PVs Also able to run on off-peak
Gas	bottled LPG	400-600	
Pellet Heater	pellets	400-550 ⁷	
Ethanol	bottled ethanol spirit	900-1,500 ⁸	

Table 4: Comparative costs of various fuels for heating²⁶

NOTES: Assumptions – average cost grid electricity \$0.30/kWh

1: operation morning, evening, overnight, no daytime input but continues to provide decreasing radiant heat

2, 3, 4: evening and morning use, 8 hours energy input

5: average 13 kWh daily to reach capacity, no other input but continues to provide radiant heat 24/7

6: operation morning, evening, overnight, no daytime input

7: operation morning, evening, overnight, no daytime input but continues to provide decreasing radiant heat

8: operation morning, evening, no overnight or daytime input

²⁴ ABS Quickstats Armidale Regional 2018

²⁵ www.energymatters.com.au/solar-location/armidale-2350

²⁶ Various sourced based on existing bills, data, and feedback from retailers and suppliers

Replacement options

Replacing the existing heaters that collectively create the problem, followed by limiting the installation of new heaters, is the simplest solution – but what with and how? Replacement incentive programs can potentially reduce emissions in a very short time, but need to be balanced with funding opportunities and community willingness to participate. Whereas education programs, ie behavioural changes, may take longer but have surer long-term benefits in that they continue to be employed.

Measure	Emission reductions	Environmental effectiveness	Cost-effectiveness	Simplicity & risks
Education/ "nudge" programs	Potentially significant	Targeted & gains in medium term	Medium	Low risk
Incentives for replacement	"	Targeted & gains in short term	High	Low risk
Common definition of excessive smoke	Small	Targeted but at a very small number of heaters	Uncertain	Medium risk without supporting enforcement
Controls on modification & installation	"	"	"	High risk without supporting enforcement
Controls on 2 nd hand heaters	"	"	"	"
Removal of non-compliant heaters	Small to significant	Targeted but gains over longer term	Medium	High policy risk due to poor stakeholder acceptance
Installation bans	"	"	Medium	"

Table 5: Summary of relative merits of in-service measures

(<https://ris.pmc.gov.au/sites/default/files/posts/2016/03/Reducing-emissions-from-wood-heaters-RIS.docx>)

Choice of heater is also dependant on a range of issues, and will vary from one household to another. As well as cost of fuel (as noted above), preferences will also relate to

- availability of fuel – eg Armidale no longer has reticulated natural gas; wood resources are deteriorating
- efficiency of fuel (and obviously appliance) – ie more expensive fuel may provide better heat
- capital cost for the appliance – ie up-front cost of new heater, and any additional infrastructure costs cost if appropriate such as flues or piping
- convenience – chopping, storing and carting wood vs flicking a switch
- immediacy – instant heat vs needing to wait
- longevity – staying warm or generating heat even after fuel is stopped; pre-set timing options
- aesthetics – perceived comfort, ambience and overall appearance

1. **Upgrade** to wood heaters with reduced emissions capacity

- **Pros:**
 - Those wishing to still have a wood heater can have one
 - Easy to retrofit replacement of existing heater (ie no new additional infrastructure required)
 - Hot appliance will continue to leech some heat as it cools down after use
 - Perceived comfort and 'ambience' factor
- **Cons:**
 - Even a good heater can produce emissions if run poorly (damped down, wet/green wood etc)
 - Requires storage area for dry wood, and prior commitment (ie purchasing prior to need)
 - Increasing cost of wood
 - Reducing supply of sustainable timber
 - Laziness can result in use of poor quality / wet / green wood which then increases emissions
 - Can be drying to internal air
 - Time lag to fire up



2. **Replace with electric heater**

2.1 **Reverse-cycle air conditioners (heat pumps)**

Modern heat pumps have become one of the most cost-effective methods of heating in Australia. Efficient heat pumps can provide 5-6 times as much heat as they use in electric energy. Given they also work well at low temperatures, even when drawing on external air up to -10C, makes them effective as a form of heating in Armidale.



- **Pros:**
 - Instant heat; thermostat and timer control
 - Ability to run during the day for preheating using free in-house solar energy (if available)
 - Highly efficient COP if used correctly
 - Ability to also cool for summer
- **Cons:**
 - Can be drying and noisy
 - Can be expensive to use if direct from grid
 - Only heats (or cools) whilst on
 - Potential to create 'laziness' for cooling in summer rather than addressing cooling issues

2.2 **Convection heaters:**

- **Pros:**
 - Relatively instant; thermostat and timer control
 - Ability to run during the day for preheating using free in-house solar energy (if available)
 - Heat large area well over extended period of time
- **Cons:**
 - Can be expensive to use if direct from grid
 - Less efficient COP than Reverse-cycle
 - Only heats whilst on
 - Not good with high ceilings as heat pushed upwards



2.3 Radiant Heaters

- Pros:
 - Good for small areas and/or short periods
 - No moving air or potential drafts
 - Heat retained at source (ie not pushed towards ceiling)
 - Ability to run during the day for preheating using free in-house solar energy (if available)
- Cons:
 - Can be expensive to use if direct from grid
 - Can take longer to warm a large area due to lack of moving air
 - Can be hot to touch



2.4 Heatbank:

Effectively a convection heater but with large thermal mass acting as heat storage

- Pros:
 - Ability to be powered during the day using free in-house solar energy (if available)
 - Alternatively can run overnight using off-peak electricity
 - Can still be used as 'normal heater' from grid, including at night
 - Continues to leech heat into room 24/7 without energy input
 - Price competitive appliance
- Cons:
 - Lag time initially to warm up (once only)
 - Limited by size –ie larger houses may need several



3. Replace with Gas heater

- Pros:
 - Instant heat; thermostat and timer control
 - Comparatively cost-effective with direct electrical heating (though this may change)
 - Suitable for full ducted system (whole house)
 - Efficient for quick heating
- Cons:
 - Expense of gas (only bottled LPG available in Armidale)
 - Limited availability of fossil fuel
 - Can be expensive to buy and install
 - Infrastructure costs - should to be externally flued
 - Other potential health issues, including indoor-air environment



4. Other options:

4.1 Pellet stove heaters:

Fireplaces that burn pellet fuel, a renewable sawdust-like timber residue. Claims of exhaust emissions <1.0 gram /hour.

- Pros:
 - Highly efficient (70-83%), near zero emissions
 - Instant heat
 - Fuel from waste products (sawdust, wood chips, kernels etc)
 - Thermostat control
 - Cool touch to appliance
- Cons:
 - Pellets not readily available in Armidale, though can be purchased
 - Require electricity (fans, controls, pellet feeder)
 - Comparative costs dependant on how many installed
 - Bulk storage required for pellets



4.2 Ethanol Spirit burners

Spirit burners – bio-ethanol fuels - (such as Ecosmart Fireplaces) potentially portable, not requiring any permanent fitting or gas connection. No flue required.

- Pros:
 - Biodegradable combustion producing heat, CO₂ and steam
 - No mess (ash etc)
 - Highly efficient (90%), near zero emissions
 - No infrastructure required (chimney or flue)
 - Instant heat
- Cons:
 - Potentially not hot enough as primary heat source (for Armidale winters)
 - Operational issues (requires 'cool down' before refuelling)
 - Possible condensation issues
 - Ventilation required to offset oxygen consumption
 - High cost of fuel; high cost of appliance
 - Storage required for ethanol



There are other heating options such as in-slab heating, hydronic (under-floor or wall) heating, solar-pre-heated systems, oil and other sources but they have not been discussed here. Rather the selection above are deemed the most likely to be equivalent replacements for existing, or in lieu of new, wood heaters.

Recommendations

- That consideration of the various fuels and appliances need to take into account costs, availability and convenience
- That use of daytime solar electricity be encouraged to pre-heat houses with electrical appliances
- That the public be made aware that moisture meters are freely available to residents to ensure dry wood is being used
- That a wood-storage competition be held to encourage people to store their wood correctly

4.4 Housing stock

While addressing the issues of heating, however, the housing infrastructure itself needs to be investigated –ie, is this just a waste of money anyhow if the house can't retain that heat. That is, if the house could be better insulated, better operated (behaviour) etc, it would reduce the need for heating and therefore a different system (or even the same system) would be more efficient and ultimately result in less usage (and therefore less emissions if still a wood heater).

Addressing the type of heater (and heating) alone, may to some degree, defeat the purpose. While it is possible to build new houses that require negligible heating, even in Armidale, it is the existing houses that need to be addressed. Many of these houses are either single skin weatherboard, or solid double brick. Most have no insulation in walls, limited insulation in floors, and only some with insulation in ceilings. Where living areas are not facing north, they do not benefit from the warmth of winter sunshine. If it were possible to upgrade these houses at minimal costs – such as ceiling and floor insulation, retrofitted double glazing, and of course quality curtains and blinds, this would assist in reducing the heating demand. In so doing, alternatives to wood heaters – which despite their emissions issues are themselves effective in heating houses – become more viable, and potentially 'acceptable'. Further, many of these homes may well be rentals – so incentives for landlords to take action is required.

Also as noted above, many houses already have PVs on their roofs and so have the benefit of free daytime electricity that could be used towards providing heating operations during the day – effectively pre-heating the house. But for this to be efficient, ways of retaining that heat in the house is essential – such as better insulation, glazing, and operation of curtains and blinds. Fully insulating a home can improve its Energy Performance rating by ~ 2.2 stars²⁷, and so by default therefore reduces the need for heating (and cooling).

Extent of Insulation	Heating	Cooling	Heating & Cooling
Ceiling only (added R2.5)	15-25%	30-45%	20-30%
Ceiling (added R2.5) and Walls (added R1.0)	40-50%	40-55%	40-50%
Ceiling (added R2.5), walls (added R1.0) and floor (added R1.0)	45-55%	35-50%	45-55%

Table 6: Typical energy savings due to insulation (www.sustainability.vic.gov.au)

Improvement on single glazing	% improvement	Note
Adding heavy curtains, no pelmet	13	Assumed behaviour
Standard Double Glazing	35-45	Varies due to frame types
Heavy curtains with pelmet	37	Assumed behaviour
Double glazed with Low-e coating	43	
Double glazed heavy curtains & pelmet	54	Assumed behaviour

Table 7: Typical reduction in heat loss for different window treatments (AIA-ABSA Holistic Sustainable Design-MHA_HELP 2011);

²⁷ <https://insulation.com.au/support-article/energy-cost-savings>

Recommendations

- That any rebate program for new heaters includes requirements and/or funding to upgrade house infrastructure as appropriate (eg minimal insulation levels, in order of priority)
- That SLA's previous curtain- and pelmet-making workshops might be revisited
- That information on improving existing housing stock be made readily available with possible incentives for upgrading
- That a program that addresses rentals and incentives for landlords needs to be developed and implemented



Figure 5: SLA 'I Can Do It' previous workshops (slarmidale.org/2012/07/4682)

4.5 Education & Behaviour

Behavioural issues are two fold – running of the heating appliance, and running of the house overall. Educating the community in appropriate behaviour is necessary for this reason. While wood heaters continue to be used, efficient and correct operation is essential to reducing the appliances' emissions, and previous education programmes have assisted in this, including ensuring only quality, well-seasoned and dry wood is used, and dampers are kept open to reduce smoking.

To enforce behavioural change, people need motivation. However, the values that motivate them may be opposing –comfort vs cost vs health vs adhering to regulation. If motivated to change, then people will more readily accept education on behaviour. Getting the right message across is therefore imperative – ie the right to a healthy, clean-air environment rather than the right (or not) to have a wood heater. As earlier mentioned, a message that focuses on a resilient community with healthy clean air is better than one that one that continues to highlight the negatives of bad behaviour and dirty chimneys – proof in the fact that the latter approach , despite years of trying, has not worked. Focusing on positive outcomes – cleaner air, healthier population, increased tourism, and so on – is more likely to grab people's attention than negativity.

For operation of wood heaters, there are an assortment of education brochures and videos available, including from the Australia Home Heating Association.²⁸ Links to Council websites are also available for further information. It is understood that the AHHA forwarded the link to ARC in 2018 for inclusion on the council portal, but it is unclear if this has been done.

Issues that need to be reinforced in relation to using wood heaters include –

- Use of well-seasoned, dry, quality wood
- Storage of wood to keep it dry
- Appropriate sized fuelling of the heater (ie size of logs, kindling etc)
- Operational issues of starting up, ongoing fuelling, overnight burning, etc
- Maintaining clean heaters and flues

It has been noted that those who install a SmartBurn, by default, become more conscious of the output of their heaters, and so therefore of what they are doing. As to whether the SmartBurn reduces emissions, there is no consensus on this (refer section 4.3). However, given that they result in cleaner flues, based on feedback from local chimney cleaners in Armidale, , the implication is that wood burning becomes more efficient, so therefore wood use is reduced, and potentially emissions also reduced by default.

With the option to become 'lazy', the ability to be able to flick a switch becomes more appealing than loading up the fire when coming home after dark to a cold house. This leads to the possibility of a dual fuel option – ie preheating during day with air con or a Heatbank, and then only using the wood heater as backup or for 'effect' and willing to let it go out overnight.

However, education must also address general behaviour such as opening and closing windows, doors, curtains and blinds appropriately, dressing appropriately and so on. Efficient operation of the house itself and behaviour by the occupants, can also significantly improve the benefits of any heating input.

Demonstration programs, workshops and how-to resources are either available or doable, with opportunities for Council to approach State (or Commonwealth) government for grants and/or assistance for educational programs, setting-up demonstration projects and providing resources to assist action.

²⁸ www.homeheat.com.au/how-to-videos

Recommendations

- That council provides links to 'how-to' videos on the Council website
- That a series of educational workshops be run to cover both heater operation and household behaviour
- That SLA's previous 'I Can Do It' program might be revisited
- That language used to address the issue be focused on positive outcomes rather than negative impacts
- That Council investigate opportunities to set up demonstration projects (eg either individual homes or whole-of-community) for improving air quality



Figure 6: <https://aurorasuspendedfires.com/huge-list-proven-tips-firewood-fire-starting-operating-procedure-ash-handling/>

4.6 Monitoring

There are currently several monitoring processes being carried in in Armidale. There has been ongoing monitoring since 1995, with the monitor upgraded in 1999, then eventually replaced with the DustTrak monitor in 2008. This sits atop the Council Administration Building (CAB), with a reasonable volume of data now collected, but ceased operation in 2018 once the Purple Air monitors were installed. The more recently added Purple Air Monitors are located around the city and provide real-time data on particulate emissions. And of course, everyone can see the smoke, especially on a cool, still morning when the inversion layer is at its worst. There has also been use of a Smoke Ranger in the past – someone canvassing the streets early in the morning and late at night to observe gross-emitting chimneys.

Highlighting the data (refer section 4.2) will raise awareness and make residents more conscientious of their own personal emissions where applicable. Whereas foot patrols that observe gross-emitting chimneys allows for immediate action – ie knock on the door and take action straight away (refer section 4.7). Use of drone imaging could also provide real-time location of the worse-case emitters.

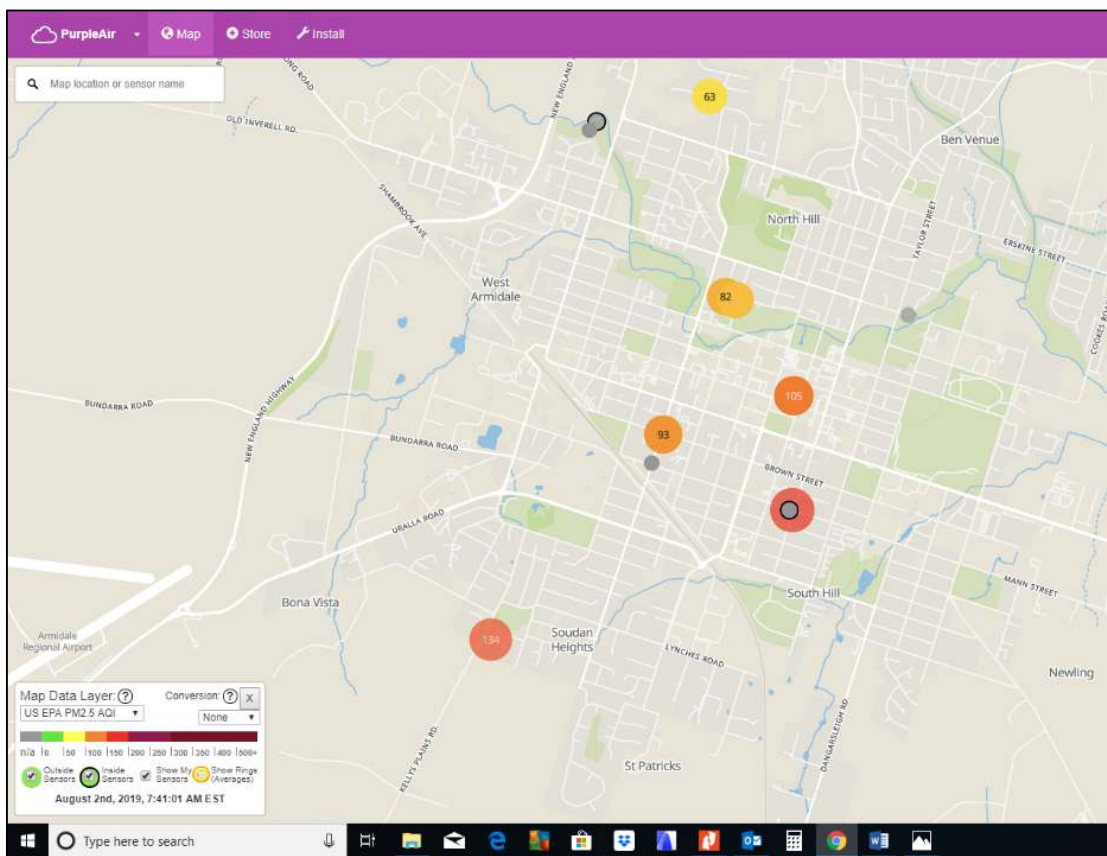


Figure 7: Screenshot of Purple Air Monitors in Armidale (www.purpleair.com/map?#13.79/-30.52054/151.66626)

The major benefit of monitoring is the evidence it provides, especially real-time data, and can be useful incentive for people to take action. But also, given Armidale's specific situation, it would be the ideal 'case study' for the NSW Government research in addressing the overall state-driven legislation for air quality. It is understood that ARC has previously suggested this via written application to the NSW EPA²⁹ but nothing forthcoming has resulted.

The other side of monitoring is visual patrols, and while it does not provide admissible data it does give the opportunity for direct interaction with those creating the emission levels. Council's Environmental

²⁹ 'Clean Air for NSW' 2016 Consultation Paper – Submission, Armidale Regional Council, ref AINT/2017/00702

Health Officer or similar staff member doing patrols (akin to the previous Smoke Ranger role) would be able to contact gross-emitters immediately the problem is detected and, hopefully, result in immediate mitigation measures as well. Follow-on visits to ensure good practice and/or reiterate the need for better practice (and ultimately imposition of fines if appropriate) is the next step. Such officers might also detect heaters that do not have Council approval, though this may be difficult given that many heaters were installed prior to the DA requirement was brought into practice.

Training of these officers would be required to ensure they are appropriately skilled in both technical issues and communication skills. Assisting homeowners is more productive than punishing them, and being able to explain the reasons behind decisions, and ways to improve their heating environment, may appease over-reactions from homeowners. While specifically developed to address issues relating to bushfire, the skills applied by California's ARA (Air Resource Advisors)³⁰ might provide some guidance in this area.

Recommendations

- That data continue to be collected via the OEH Air Quality Monitor in Kirkwood Street, tied into the OEHAQ website, and the Purple Air monitors to provide hard evidence of the situation
- That such data be publically available and visible
- That OEH officers or Smoke Rangers be re-engaged to conduct smoke patrols and household interactions
- That these officers be suitably trained in both technical and communication skills



Figure 8: DustTrak monitor atop Council's Administration Building (photo N Smith, ARC)

³⁰ sites.google.com/firenet.gov/wfaqrp-external/air-resource-advisors?authuser=0

4.7 Legislation

Whilst legislation is unlikely to affect current housing stock and currently installed heaters, it does at least address newer heaters being installed and possible future options. The latest EPA regulations which limit emissions output from wood heaters to 1.5g/kg will assist with newly installed heaters, but does not address those currently installed.

Whilst this report has been prepared specifically for ARC, local government in NSW generally has limited level of authority on some of these issues. In New Zealand, the National Environmental Standards for Air Quality³¹ legislated by the government, enables local councils to enforce strategies that address wood smoke pollution as a health issue. This is on the basis that emissions reduction correlates to improved health. The relevant national standards in Australia, ie relating to PM2.5 levels and to wood heater emission standards (refer below) are not necessarily clear enough to outline the necessary actions needed to comply (especially the former), and are partially outdated. In the meantime, however, there are some councils that are willing to make strong 'recommendations', and the previous Armidale Dumaresq Council's policy regarding home heating was considered, at the time, to be leading edge. However, DCPs are not enforceable, and efforts to date have not, overall, worked to reduce the issues.

Local Councils have the ability to assess the appropriateness of wood heating in their local government areas, and through their LEPs and DCPs, can influence the type of heating installed in new homes. To this end, ARC currently requires a Section 68 Application for wood heater installation. Currently, under the NSW Local Government Act 1993, Council approval is required to install a solid fuel heating appliance. Wood heaters must have compliance plates that meet the current Australian standard – AS/NZS 4013:2014. ARC specifically had POL134-Sustainable Domestic Energy Use & Local Air Quality (incorporating Local Approvals Policy for Solid Fuel Heaters) which was adopted by Armidale Dumaresq Council in June, 2010. This addresses issues of installation, education, enforcement and monitoring.³² And while Council can monitor and penalise those who operate heaters poorly, imposing penalties for such behaviour is limited by lack of resources (ie staff time and costs). However, this policy is not operational at the moment. Separation of the installation from behavioural aspects of the policy – ie split Air Quality and LEP requirements, may assist in better control and implementation.

POL134-Regulatory - Policy for Sustainable Domestic Energy Use and Local Air Quality (incorporating Local Approvals Policy for Solid Fuel Heaters)

Policy Objectives

- To promote and increase the responsible and efficient use of resources to meet energy needs in homes in Armidale Dumaresq.
- To improve community health and life expectancy by reducing exposure to toxic fine particle, air Particulate Matter 2.5 micron, (PM_{2.5}) pollution in the Armidale urban area, to meet relevant national air quality advisory standards by 2020.
- To apply local regulation having regard to relevant standards and legislation.
- To implement this Policy in a manner which is fair to our community, balancing consideration of local climate, environmental sustainability, and community health.
- To support Council's vision for "Excellent Lifestyle – Sustainable Growth".

³¹ www.mfe.govt.nz/air/air-regulations/national-environmental-standards-air-quality

³²

www.armidaleregional.nsw.gov.au/ArticleDocuments/499/INT%20Policy%20for%20Sustainable%20Domestic%20Energy%20Use%20and%20Local%20Air%20Quality%20incorporating%20Policy%20for%20Solid%20Fuel%20Heaters%202013%20REVIEWED%20VERSION.pdf.aspx

At the time it was written, initially in 2010 and updated in 2013, this policy was considered 'leading edge'. However, with subsequent state and national legislation and other Councils taking stricter action, and the fact that this policy has now lapsed, the question arises - is this enough, and how will Council assert these actions to make this happen? Given the wealth of technology and the ability to now build better houses, including the conditions being applied by BASIX and the NCC (which are soon to become stricter in terms of energy efficiency), it is possible to avoid the physical need for wood heating in new homes.

The heaters themselves are subject to standards relating to their purchase and their installation. Under the Clean Air Regulation, all new solid fuel heaters sold in NSW (both local and imported) must have a compliance plate meeting the Australian Standard - AS/NZ 4013:2014. The current emission limit for all new wood heaters sold in Australia is 2.5 grams of particulate emissions per kilo of wood burnt.³³ However, from 1st September, 2019, standard for emissions has been reduced to 1.5g/kg (tested for hardwood) and introducing a 60% efficiency. However, there is also evidence that real-life behaviour is equivalent to a factor of x2 in regards to laboratory/industry testing, ie 1.5 really equates to about 3, based on real behaviour and operations³⁴. Ideally, a stricter requirement at say 1, or even less, is therefore likely to achieve better results in the 'real world'.

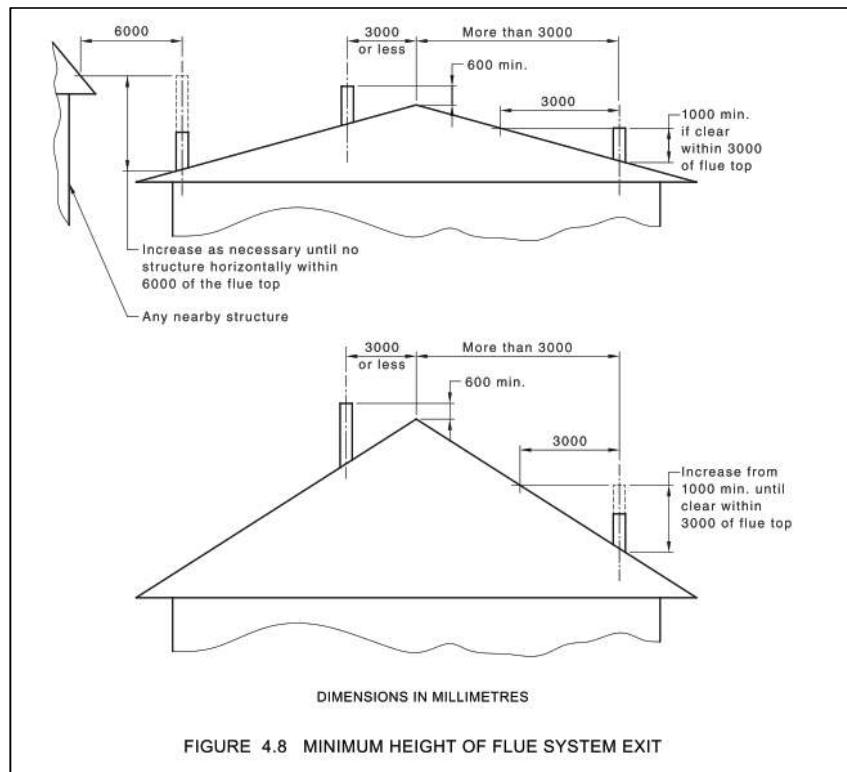


Figure 9: Sample installation from AS/NZS 2918:2018

Heater installation itself is regulated by Australian Standard AS/NZS 2918:2018. However, there has also been a proposal put forward to regulate the installer themselves, with an online AHHA Certified Installers Certification' course.³⁵ Currently while training courses are available, there is no assurance that the heaters are being installed by accredited and correctly trained installer, which potentially may create problems – such as too-short flues which create more smoke.

But again, while the new EPA rules and the other building regulations are tighter, they only address new heaters going in and not those that are existing - it would appear not possible to legislate use of current

³³ www.environment.gov.au/resource/wood-heater-particle-emissions-and-operating-efficiency-standards

³⁴ Dr Emily Wilton, Woodheater Management in NZ, including Nelson Case Study, CASANZ 2019

³⁵ www.pointsbuild.com.au/ahha-installers-program

appliances. That said, current NSW legislation does allow for fines post-monitoring of poorly-performing heaters which would hopefully encourage better usage.

Nor can we legislate against poor behaviour and operation of even the best quality heater. However, can ARC regulate the operation of wood heaters through a 3 strike policy? Is it possible to have a dedicated ranger to patrol in winter evenings, and possibly enforce the excess smoke notices and fines? The previously mentioned survey could include a question as to community support for this process.

Recommendations

- That Council commits to its policy of advice, warning and fines for those with repeatedly smoking chimneys
- That Council impose a '3 strike policy' – ie if continually failing to improve heater behaviour, more drastic action be taken - dedicated Ranger patrol in winter warns and advises residence on effective operation, 2nd time a warning and notification, 3rd time substantial fine if cannot show cause and so on
- That local retailers are held to account to only sell fully compliant heaters to most recent EPA regulatory requirements
- The any new development (ie brand new homes) are not permitted to install wood heaters on the basis that it is now possible to create houses that do not require that degree of heating, commencing in say 2022, with prior promotion and education; However, it is unclear at this stage what legislation would be required or possible to enforce this, and Council needs to lobby NSW government for such legislation
- The Council, where possible, provides advocacy, consultation and collaboration with higher levels of government (ie NSW and Commonwealth governments) to create a national standard that addresses the issues, thus allowing Council themselves to act with clarity and without reprisal.

5. Recommendations

5.1 Packages

The best solution to address the localised issue of Armidale's wood smoke problems would appear to be threefold, a combination of

- heater upgrade/replacement,
- house infrastructure upgrade, and
- education

However, in order of ability to proceed and create initial effectiveness,

1. education
2. incentives for replacement/upgrades
3. enforcement

Education & Behaviour

First and foremost, the community needs to be made well aware that there is an issue – and an updated survey will determine both the current level of awareness and concern, and in so doing reignite the issue for those who may be unaware or uninformed. As noted earlier, education programs that address both heater and household operation are a key to reducing emissions, the former by reducing smoke directly, the second by reducing overall heating needs. There are a myriad of videos and links available that Council could, and should, make available for viewing on the Council website. However, face-to-face workshops may be more effective in changing behaviour. Recommendations are that –

- Council revisit a community-wide survey to determine the level of awareness and concern of the issue
- Council facilitate (possibly directly or through other organisations such as SLA or Homes North) a series of free public forums and workshops conducted in early Autumn each year (or at least in the next few years)
- These could include a series of educational workshops be run to cover both heater operation and household behaviour
- Council provides links to 'how-to' videos on the Council website
- Incentives for good behaviour be considered – such as a Firewood Store competition
- That a series of educational workshops be run to cover household behaviour
- That SLA's previous curtain- and pelmet-making, and heating workshops might be revisited
- That information on improving existing housing stock be made readily available with possible incentives for upgrading

Replacement

As noted above, simple replacement of heating appliances without additional structural and behavioural changes may negate the benefits. A rebated program that is a combination of improvements to the home along with a new appliance would eventually address the wood smoke issue that is being generated by existing housing stock.

This ideally would include the following, with options to mix and match as appropriate to the existing house's infrastructure–

- Replacement of existing wood heater with new appliance (optional fuel source, with criteria)
- Installation of ceiling insulation (min. R3.5)
- If ceiling insulation already in place, then installation of under-floor insulation (min. R2)
- If ceiling and floor insulation already in place (or floor not viable, ie concrete slab), wall insulation retrofit where possible

- If all possible (viable) insulations already in place, double glazing key windows (retrofitted vs new)
- If all above infrastructure already in place, curtains/blinds/pelmets – access to 'I Can Do It' resources to assist
- Additional to any of the above, education package (how to 'use' your house and heater etc)



Figure 10: Previous Council loans for insulation

It is essential that any program that provides for new heaters must also improve the house infrastructure as well, as previously noted. To the best of our knowledge, none of the replacement schemes implemented elsewhere in Australia required compulsory housing improvement as a condition of the rebate for the new heater. Combining the two ensures a more cost-effective and efficient outcome as heating needs are also reduced in the process.

The Rest

As per the body of this document, there are a range of other recommendation that address raising community awareness, monitoring, legislation, enforcement and advocacy. Any detailed program that Council develops will need to include these issues and the various recommendations as well as the core issues of education and replacement to maximise overall effectiveness and achieve long-term goals of ultimately improving air quality.

As previously noted, all of the above are broad based recommendations only – Council will need to engage a consultant(s) and/or relevant staff members to fully develop these recommendations into a tangible, viable and equitable program of achievable strategies and outcomes.

5.2 Funding

Funding is required in several areas –

- To fully develop a detailed strategy based on the recommendations contained herein
- To carry out a new community survey
- To cover the cost of rebates for new heaters and/or building infrastructure
- To cover the costs of employing Smoke Rangers

Rebates to cover the packages may be in the form of one-off or staged payments, interest free loans, or other offsets such as reduced rates or fuel costs. Council in its previous iterations, namely Armidale City Council and Armidale Dumaresq Council, along with the then New England Electricity Council (later NorthPower) have previously provided various interest-free loans (up to \$3,000 in 1990's) for wood heater replacement, insulation and solar hot water (refer section 3.2). Investigation of how these were funded and functioned is recommended.

Note that WSAG has not proposed an actual amount for the possible rebate, pending further research into the best options. However, it would need to be an amount that provides enough incentive, though not necessarily the whole cost, with a minimum sum dedicated towards purchase of a new heater, and the balance going towards home improvements. Determination of an appropriate amount will depend on funding options as much as material costs.

Further access to funding may require additional partnerships with providers, such as energy companies, state government, NGOs or retailers. In the case of Launceston, a partnerships was set up with TasGas to assist in replacement of wood heaters with gas heaters, with both state government funding available through TasGas. However, this was limited to simply replacing wood heaters with gas heaters, and has had some long term limitations as the price of gas has significantly increased, and appliances are being reverted back to wood.

SLA's 'I Can Do It' program was partially funded by the NSW Government Environmental Education Trust, and revisiting the trust program may provide funding to run further educational programs and/or piggy back onto content already developed by SLA.

Application to the State Government for a program similar to that carried out in the Hunter may provide funding for research and monitoring, and possibly case demonstration projects. But ultimately, a dual program of education and replacement will have the greatest impact.

Given the relationship between wood smoke emissions and health issues, as heaters are installed with Council approval, they could also entail an annual license fee which could contribute to the cost of implementation of Council's various smoke-abatement strategies, though it is unclear what legislation this might come under, if any.

Other funding might provide

- incentives for landlords – ie in lieu of rebates for heaters, rebates on rates on proof of installation (effectively costing Council same costs)
- costs to cover Environmental Health Officers or Council rangers to carry out 'smoke patrols' and carry out inspections, fines etc
- funding for publications and educational materials
- one-off funds to construct signage such as Pollution-level screen in the mall

Other partnerships to be considered might include Australian Home Heating Association, Starfish, NSW Hunter New England Area Health Service, Homes North, General Practitioners & Allied Health Professionals, UNE and even local schools.

5.3 Short, medium & long term directions

Short term

- survey to reconfirm community attitude – and raise the issue again with those not taking notice
- regardless of proposed directions, a strong education program to holistically address the issues of warmth which include not only heater operation, but household behaviour as well
- community consultation and feedback on proposals
- development of detailed delivery of strategies and directions
- implement final decisions and apply for funding as appropriate
- set up for future actions

Medium term

- implement packages with funding
- ongoing education program for long-term planning
- ongoing monitoring

Long term

As more houses are slowly upgraded and/or ultimately replaced, they will, ideally, perform better thermally. BASIX currently has some impact on this but until it is tightened up, along with NCC (National Construction Code) requirements, most new houses still do not maximise these design and construction opportunities, even though they are readily available. It is totally feasible – and has been done – to successfully build new houses in Armidale that do not require major heating infrastructure. And this does not need to cost more than the ‘average’ house cost if it is designed correctly.

Ultimately, it may be the decision of an assertive Council to enforce suitable heating systems in Armidale’s homes. This might start with new construction only, then possibly evolve to include renovations, then removal of existing heaters. If building regulations result in better-performing houses, this will more easily be achievable as major heating infrastructure is no longer needed. Education and transition periods will be needed, but the ultimate outcome of a cleaner and healthier Armidale has to remain the long-term objective.

6. Appendix

6.1 Recommendations by Section

4.1 Boundaries & Limitations

- That if possible, a database of existing heaters, their make, model and age, be established within the boundary area as a way of benchmarking current and future use
- That Council better promote the requirement for Section 68 approval for heater installation, working with the retailers at point of sale (though this will not pick up non-local purchases)
- That, if possible, ensure only fully-compliant wood heaters are available for sale in Armidale in accordance with OEH requirements
- That any rebate replacement/upgrade program also address rentals with possible incentives for landlords

4.2 Community Awareness & Feedback

- That a new survey be conducted to determine the community's level of awareness, perception and understanding of the wood smoke issue; in so doing, the survey itself will reignite the discussion
- That a visual display of daily PM2.5 levels be shown in the Mall and/or on the Armidale Ex-services' external screen
- That once the report and proposed Council strategies are nearing finalisation, that a public forum be held to inform the community and allow for constructive feedback for inclusion

4.3 Heating Options

- That consideration of the various fuels and appliances need to take into account costs, availability and convenience
- That use of daytime solar electricity be encouraged to pre-heat houses with electrical appliances
- That the public be made aware that moisture meters are freely available in the Library to residents to ensure dry wood is being used
- That a wood-storage competition be held to encourage people to store their wood correctly

4.4 Housing Stock

- That any rebate program for new heaters includes requirements and/or funding to upgrade house infrastructure as appropriate (eg minimal insulation levels, in order of priority)
- That SLA's previous curtain- and pelmet-making workshops might be revisited
- That information on improving existing housing stock be made readily available with possible incentives for upgrading
- That a program that addresses rentals and incentives for landlords need to be developed and implemented

4.5 Education & Behaviour

- That council provides links to 'how-to' videos on the Council website
- That a series of educational workshops be run to cover both heater operation and household behaviour, whether run by Council or external groups such as SLA
- That SLA's previous 'I Can Do It' program might be revisited
- That language used to address the issue be focused on positive outcomes rather than negative impacts, though the message that wood smoke is not good for health still needs to be included
- That Council investigate opportunities to set up demonstration projects (eg either individual homes or whole-of-community) for improving air quality

4.6 Monitoring

- That data continue to be collected via the OEH Monitor and Purple Air monitors to provide hard evidence of the situation
- That such data be publically available and visible
- That OEH officers or Smoke Rangers be re-engaged to conduct smoke patrols and household interactions
- That these officers be suitably trained in both technical and communication skills

4.7 Legislation

- That Council commits to its policy of advice, warning and fines for those with repeatedly smoking chimneys
- That Council impose a '3 strike policy' – ie if continually failing to improve heater behaviour, more drastic action be taken - dedicated Ranger patrol in winter warns and advises residence on effective operation, 2nd time a warning and notification, 3rd time substantial fine if cannot show cause and so on
- That local retailers are held to account to only sell fully compliant heaters to most recent EPA regulatory requirements
- The any new development (ie brand new homes) are not permitted to install wood heaters on the basis that it is now possible to create houses that do not require that degree of heating, commencing in say 2022, with prior promotion and education - appropriate legislative options will need to be investigated and lobbied for
- The Council, where possible, provides advocacy, consultation and collaboration with higher levels of government (ie NSW and Commonwealth governments) to tighten up national standards that address these issues, thus allowing Council themselves to act with clarity and without reprisal.

6.2 Terms of Reference for WSAG

Mayor's External Wood Smoke Advisory Group - Terms of Reference

Purpose

The Mayor's External Wood Smoke Advisory Group has been formed by the Mayor, Armidale Regional Council, to provide a representative body to contribute to the management of wood smoke and to recommend actions to improve air quality as affected by wood smoke in the Armidale city area.

Objectives

By sharing their expertise, experience and community knowledge, group members will work together to develop recommendations on wood smoke management in Armidale.

The group will analyse and review studies into health issues, behavioural response to managing wood smoke problems, appropriate educational messages, policy and any other relevant issues, and consider suggestions for improvement and mitigation of wood smoke issues.

A written report will be provided to the Mayor by the end of May 2019. It is understood that the recommended actions may vary across time-scales (ie. short, medium and long-term).

Membership

The Group consists of the following membership:

- Community (4 representatives)
- University of New England (4 representatives)
- Wood heating industry (1 representative)

Term of membership

The group will operate for a period of 6 months from its commencement. It shall be reviewed by the Mayor in June 2019.

Meetings

The group will meet as needed, decided by the members.

Roles

The group chairperson will advise meeting dates / venues via agenda circulation (e-mail).

The agenda for the meeting shall be prepared by the group chairperson. Members can forward agenda items to the chairperson not later than 2 working days before the meeting for consideration.

Minutes of each meeting shall be prepared by the chairperson or a member of the group as agreed. The chairperson will maintain a file of confirmed minutes for reference by group members.

The report will be prepared by the group.

A council officer will support the group by providing, as requested, background information that Council may hold, and liaising with the Mayor as needed.

Reporting

The group will report to the Mayor.

Media Liaison

The chairperson is the primary spokesperson for the Mayor's External Wood Smoke Advisory Group and will communicate with the Mayor before liaising with the media.

Final WSAG-TOR/22jan19/R01

6.3 Council proposed amendments to WSAG

Response by WSAG to tabled Amendments from Council Meeting held December 2018

This response was prepared at 22nd January meeting and forwarded to the Mayor within the minutes of that meeting.

Our agreed responses to the Tabled amendments are as follows:

a) *The external advisory group complete its work and provide its advice in the form of a written report to Council in due course.*

Our response: We will be submitting a report in June 2019.

b) *That councillors may provide submissions in writing to the advisory group, at which the advisory group can invite Councillors to further discuss submissions as deemed relevant by the advisory group*

Our response: Any Councillor or member of the public can make a submission. We are not required to invite them to meet with the Advisory Group.

c) *The external advisory group meet with any Armidale Regional Councillor and the CEO if they wish to make submission to it or discuss any relevant issues with it.*

Our response: As above.

d) *The external advisory group meet with Council's Environmental Sustainable Committee in February 2019 to discuss its brief (issues related to woodsmoke and its impact on air quality in Armidale including related health issues) with that committee of Council.*

Our response: Mahalath and Navjot are both members of this Committee, but Mahalath will be away and will not be attending the next meeting. Navjot will be attending. There will be no report submitted by our Advisory Group. There is nothing to report as yet

6.4 Background Report

Wood smoke from solid fuel heaters causes a serious air quality issue in Armidale. Over several years, Dustrak monitors and more recently, the EPA air quality monitoring device show that National Air Quality Standards are exceeded many times every winter. There is increasing scientific evidence that chemicals and particles in wood smoke are bad for human health and contribute to climate change.

Wood heaters are a popular heating option in Armidale, however, the town's climate and geography exacerbates pollution issues. The majority of wood smoke pollution in Armidale is caused by overnight burning and the "shutting down" or stifling of wood heater during the 10pm to 6am period by operators to maintain a burning ember/flame. Overnight burning is not recommended by the NSW EPA or the Home Heating Association, as it causes high levels of pollution. However, most people are actively making the decision to burn overnight and stifle the operation of their chimney; this is a choice based on convenience and economics.

Every year Council conducts a wood smoke surveillance education and some enforcement programing accordance with the provisions and powers available to Authorised Officers under the Protection of the Environment Operations Act 1997. In this regard premises observed with excessively smoky chimneys/flues are visited and discussions are held with the occupiers of the property in relation to the operation of their fireplace, the type of wood used and its moisture levels. We routinely test the moisture content of residents' firewood and advise them of best practise techniques to ensure efficient combustion and minimal smoke. There is not a single solution for reducing wood smoke emissions; it is often a combination of quality wood, minimal moisture levels, correct heater operation and ongoing yearly maintenance that results in well-operating solid fuel heaters.

Over many years, Council staff have also undertaken a range of community education activities. Face to face consultation has been conducted at Market stalls demonstrating the best wood to burn and how to operate wood heaters effectively. Information on wood fire operation to minimise pollution and health risks is available on Council's website and is dispersed through media channels over winter. Education kits have been available using the EPA material. According to research by UNE staff (Professor Don Hine and Dr Navjot Bhullar) residents prefer education and incentives to regulation, however, to date, education concerning the health risks associated with wood smoke has not been effective in motivating a change in heater operation practices by *high* wood smoke emitters. In 2018, Council, with input and feedback from the community, is developing an Air Quality GreenPrint, one of nine GreenPrints to guide the direction of sustainability actions. Much of the focus of the Air Quality GreenPrint is to improve air quality in Armidale through appropriate intervention and education; advocacy for incentives, research and planning improvements; and use of data from the air quality monitors, experience from other towns with air pollution issues and research to inform education.

In addition to Council's wood smoke Surveillance and enforcement program, and community education, Council ensures that the performance requirements of solid fuel heaters installed legally meets the relevant Australian Standards, and that the location of any such heaters minimises smoke nuisance on a local level. The emission criteria of solid fuel heaters is set to become more efficient across NSW within 2019. From 1 November 2016 all wood heaters sold in NSW were required to meet a 55 per cent fuel efficiency standard and produce no more than 2.5 grams of particle pollution per kilogram of wood burnt. Then from 1 September 2019, all wood heaters sold in NSW will be required to meet a 60 per cent efficiency standard and a particle emission limit of no more than 1.5 grams per kilogram of wood; or 0.8 grams per kilogram for heaters with catalytic combustors.

The new standards set more stringent emission limits and efficiency limits on wood heaters and may subsequently assist in reducing wood smoke pollution within the Local Government Area as wood heaters are routinely replaced over time.

Provided to WSAG members from Executive Office, ARC, December 2018

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