Sustainable Communities and Waste

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Impact Priority 4 (IP4) Air Quality – Report on wood heater smoke project stakeholder workshop held on 12 Dec 2022.

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Cover Image: Smoking chimney. Photograph by Charles Sims on Unsplash.

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1 Introduction to wood heater smoke

In Australia, an average of 10% of households use wood as their main source of heating. This ranges from less than 5% in some capital cities, to more than 50% in many country towns.[1] Wood heaters (also referred to as solid fuel burners and wood burners) produce extremely large pollution emissions relative to the amount of energy they provide,[2] and wood heater smoke significantly contributes to air pollution in regional, rural and urban areas across Australia. Smoke from wood heaters causes numerous health impacts and creates a major health and economic burden for Australia.

Wood heaters have a significant impact on human health. A large number of people are exposed to wood smoke due to the use of wood heaters in populated locations[3] and the ability of smoke to infiltrate homes.[4] For example, in Sydney, only 5% of households use a wood heater, however they cause approximately 100 deaths per year.[3]

Harmful health impacts from air pollution, including wood heater smoke, are not distributed evenly in a community. The greatest impacts are experienced by people living with existing illnesses, those with lower social or economic advantage, those who are older, those who are pregnant and those who are very young.[5]

While other sources are also relevant to overall environmental pollution, interventions to mitigate wood heater smoke would be highly impactful for improving public health because of the high proportion of air pollution related health impacts attributable to wood heaters. Additionally, wood heater use is associated with a large economic cost. For example, in the regional Australian city of Armidale, population 24, 504, it has been estimated wood heaters incur a cost of AUD$10, 930 per wood heater per year.[6] Further, wood burning is a highly polluting source of energy, and many cleaner and affordable options for home heating exist.[2]

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[1] Australian Bureau of Statistics. 4602.0.55.001 - Environmental Issues: Energy Use and Conservation, Mar 2014. Canberra: Australian Bureau of Statistics; 2014.

[2] Press-Kristensen K, Tolotto M. Where there's fire, there's smoke: Emissions from domestic heating with wood. In: Bureau EE, editor. Brussels, Belgium 2021.

[3] Broome RA, Powell J, Cope ME, Morgan GG. The mortality effect of PM2.5 sources in the Greater Metropolitan Region of Sydney, Australia. Environment International. 2020;137:105429.

[4] Allen R, Wallace L, Larson T, Sheppard L, Liu LJ. Evaluation of the recursive model approach for estimating particulate matter infiltration efficiencies using continuous light scattering data. J Expo Sci Environ Epidemiol. 2007;17(5):468-77.

[5] Dockery DW. Health effects of particulate air pollution. Ann Epidemiol. 2009;19(4):257-63.

[6] Robinson DL, Horsley JA, Johnston FH, Morgan GG. The effects on mortality and the associated financial costs of wood heater pollution in a regional Australian city. Med J Aust. 2021;215(6):269-72.

2 Workshop rationale and background

As part of the co-design process for the Impact Priority 4 Air Quality (IP4) wood heater project (IP4.02.03), the project team hosted a three-and-a-half-hour workshop which included both IP4 members and stakeholders, to hear talks from experts in wood heater smoke, and to discuss potential interventions to reduce exposures to wood heater smoke.

A wide variety of stakeholders and researchers identified by the IP4.02.03 team were invited to the workshop via an email from Morgan Brain (University of Tasmania). Together with the workshop invitation, we circulated a questionnaire to gather background information on attitudes towards wood heater smoke and to elicit key topics of interest for further discussion in the workshop.

The large majority of participants at the workshop were environmental health officers from 66 different local government councils across Australia (Appendix A). Other participants included researchers, community advocacy groups, state policy agency departments, and international experts (Appendix A).

In total, 70 individuals completed the pre-workshop questionnaire (Appendix B) and 140 individuals representing 96 organisations attended the workshop.

3 Pre-workshop questionnaire

A pre-workshop questionnaire was used to gain an understanding of the audience demographics and to gather information from the attendees about their preferred issues for discussion (Appendix B). This informed the information included in the presentations. The questionnaire asked participants eight questions, which included participants selecting the wood heater smoke interventions they believed would be effective (Appendix B). The wood heater smoke interventions listed were based on interventions proposed in the National Environmental Science Program (NESP) SCaW Hub IP4.02.03 Research Plan.

The pre-workshop questionnaire was complete by 50% of participants. Seventy-eight per cent of people who completed the pre-workshop questionnaire worked in environmental health, however most of the respondents were not involved in an intervention into wood heater smoke. Those that were involved in interventions were responding to complaints from the public and working in the policy space.

Table 1. Questionnaire Results – Answers to the question "Assuming that resourcing is not an issue, which wood heater smoke intervention has potential for success (more than one option may be selected)".

Topic	Number of times this option was selected
Wood heater register - all wood heaters need to be registered by local government, with age and model of wood heater recorded.	28
Wood heater licensing - all people purchasing a new wood heater need to undergo education and hold a 'Wood Heater licence'.	29
Wood heater point of sale swap - mandatory removal of wood heater and installation of heat pump when a property is sold.	23
Wood heater buy back scheme - payments made to eligible households following the replacement of a wood heater with a heat pump.	42
Wood heater replacement scheme - scheme where eligible households have upfront costs of wood heater removal and replacement covered.	40
Air quality/wood heater burning notifications - a voluntary system that allows people to check the air quality and decide whether they will use their wood heater.	26

4 Workshop Structure

The workshop was divided into two sessions. Session one had a focus on education and information sharing and consisted of talks from several experts in the field of wood heater smoke and air quality, along with a discussion panel. Session two had a focus on interaction and collaboration, with attendees going into breakout groups for targeted group discussions about the potential advantages and disadvantages of a range of interventions.

4.1 Session one – Summary of presentations

Talk 1: Health Impacts of wood heater smoke

Prof Fay Johnston – University of Tasmania

- In Australia, at least 2,700 premature deaths each year are due to human caused air pollution.
- A preliminary estimate is that 1,300 deaths per year are attributable to particle pollution from wood heater smoke.
- Wood heater smoke both increases background air pollution across communities and can produce localised extreme pollution in the immediate area around a chimney.

- Both impacts are important, as the addition of 1-2 µg/m^3 of particulate matter to the background air pollution causes measurable health impacts.
- In a city with a large population there will be a very high number of individuals at high risk, which increases the public health importance of this issue.
- Deaths are relatively straightforward to model, which is why they are used for reporting (Table 2). However, the impact of wood heater smoke also results in increased hospital admissions, exacerbations of asthma, lost work time, rates of diabetes, rates of cancer, and other illnesses.

Table 2. Estimated deaths from wood heater smoke from source apportionment studies.

Location	Deaths per year
Sydney[3]	100
Tasmania[7]	60
Australia wide (interim estimate) *	1,300

*Taken from ongoing Centre for Air pollution, energy and health Research (CAR) unfinalised study.

- In Australia, the only clear example of a successful large-scale intervention was Launceston Wood Heater Replacement Program 20 years ago, where almost 50% of wood heaters were removed. This was accompanied by education and other initiatives. [6] We could find no published examples of educational campaigns on their own translating to measurable improvements in air quality.

Talk 2: Wood heater smoke in Tasmania

John Innis – Environmental Protection Agency, Tasmania

- How big is the problem of wood heater smoke in Tasmania?
- Though the Launceston Wood Heater Replacement Program was successful and PM_{10} has decreased in Launceston from the year 2000, there are still regular winter-time $PM_{2.5}$ exceedances, and with the standard changing in 2024 from 25 µg/m^3 to 20 µg/m^3, exceedances will increase in the future.
- Also, $PM_{2.5}$ exceedances occur in the smaller towns outside Launceston. For example, in the winter of 2015 (1 May – 15 August), Launceston, with a population of approximately 100,000 people, had 11 $PM_{2.5}$ air quality exceedances, while in the same time period, New Norfolk, with a population of approximately 5,000 people, had 32 $PM_{2.5}$ air quality exceedances.

[7] Borchers-Arriagada, N., Palmer, A. J., Bowman, D. M. J. S., Williamson, G. J., & Johnston, F. H. (2020). Health Impacts of Ambient Biomass Smoke in Tasmania, Australia. *International journal of environmental research and public health*, *17*(9), 3264. https://doi.org/10.3390/ijerph17093264

- Additionally, the air quality measurement at Ti Tree Bend is only one spatial point in Launceston. Measurements taken from a car using a mobile air pollution monitoring unit and using temporary monitoring stations show that there are very smoky areas in Launceston, especially in the outer suburbs. For example, in the sampling period of winter 2021 (24 May – 12 August), in South Launceston, the mean $PM_{2.5}$ was 8 $\mu g/m^3$, with 2 $PM_{2.5}$ air quality exceedances, in comparison to a temporary air quality station at Ravenswood (another suburb in Launceston), which had a mean $PM_{2.5}$ of 20.3 $\mu g/m^3$ and 23 $PM_{2.5}$ air quality exceedances.
- This hints that the Wood Heater Replacement Program may have been implemented more in the central areas of Launceston, rather than the outer suburbs.
- However, it is also notable that even in less smoky areas, one smoky chimney can severely degrade air quality on a very local scale (Table 3).

Table 3. Air quality measurements from stations in Launceston compared to a backyard monitor in suburban Norwood in winter 2018 (30 May 2018 – 4 Jul 2018).

Location	**Mean $PM_{2.5}$**	**$PM_{2.5}$ air quality exceedances**
A backyard close to a smoky chimney in Norwood	20.8 $\mu g/m^3$	13
South Launceston (EPA Station)	12.7 $\mu g/m^3$	1
Ti Tree Bend (EPA Station)	11.2 $\mu g/m^3$	0

- The Australian National Standard for Wood Heaters lacks detail around practical issues that would reduce the effect of smoky chimneys. For example, there is no specification included regarding:
  - A flagging plume: when the vertical velocity of the smoke moving out of a chimney is not fast enough, a low-pressure system builds and forces the smoke downwards and into neighbours backyards and houses.
  - The distance a chimney must be from neighbouring houses.
- In Tasmania, the EPA runs an annual education program, Burn Brighter, however, it does not have a measurable effect on air quality.
- In the winter of 2014, the University of Tasmania undertook a project where ‘SmartBurn’ cannisters were deployed to around 80% of households in Perth (Tas). However, they did not make a difference to the average pollution from wood smoke in that community
- The issue of wood heater smoke is persistent across years.

- In Tasmania, and perhaps elsewhere in the country, there are structural issues whereby the state government (EPA Tasmania) conducts the ambient air monitoring, however the local government (councils) do the wood heater regulation.
- There is no process in Tasmania for the EPA to report the high levels of ambient smoke to the councils. Even if there was a mechanism in place for the EPA to report to the councils, there is no process or resources available for the councils to respond.
- Councils do a lot of work regarding wood heater smoke complaints from individuals; however, they only have the power to act if the complainant is being directly affected (therefore falling under environmental nuisance[8] or environmental harm[9] definitions under the *Environmental Management and Pollution Control Act 1994* (Tas)).
- Additionally, smoke is mostly present at night, outside working hours, and it is hard to see the smoke at night to meet the visible criteria of a 10 m plume.
- Through the use of mobile air quality monitors, EPA Tas has assisted councils and it has been shown that there can be severe and very localised degradation of air quality from one or a small number of wood heaters.

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[8] ***environmental nuisance*** means –
(a) the emission, discharge, depositing or disturbance of a pollutant that unreasonably interferes with, or is likely to unreasonably interfere with, a person's enjoyment of the environment; and

(b) any emission, discharge, depositing or disturbance specified in an environment protection policy to be an environmental nuisance;

[9] **Environmental harm**

(1) For the purposes of this Act, environmental harm is any adverse effect on the environment (of whatever degree or duration) and includes an environmental nuisance.

(2) For the purposes of this Act, the following provisions are to be applied in determining whether environmental harm is material environmental harm or serious environmental harm:

(a) environmental harm is to be treated as serious environmental harm if –

(i) it involves an actual adverse effect on the health or safety of human beings that is of a high impact or on a wide scale; or

(ii) it involves an actual adverse effect on the environment that is of a high impact or on a wide scale; or

(iii) it results in actual loss or property damage of an amount, or amounts in aggregate, exceeding ten times the threshold amount;

(b) environmental harm is to be treated as material environmental harm if –

(i) it consists of an environmental nuisance of a high impact or on a wide scale; or

(ii) it involves an actual adverse effect on the health or safety of human beings that is not negligible; or

(iii) it involves an actual adverse effect on the environment that is not negligible; or

(iv) it results in actual loss or property damage of an amount, or amounts in aggregate, exceeding the threshold amount.

(3) For the purposes of subsection (2) , ***loss*** includes the reasonable costs and expenses that would be incurred in taking all reasonable and practicable measures to prevent or mitigate the environmental harm and to make good resulting environmental damage.

(4) For the purposes of subsection (2) , ***threshold amount*** means $5 000, or if a greater amount is prescribed by regulation, that amount.

(5) For the purposes of this Act, environmental harm is caused by pollution –

(a) whether the harm is a direct or indirect result of the pollution; and

(b) whether the harm results from the pollution alone or from the combined effects of the pollution and other factors.

- These peak, very local exposures will not be captured by 'traditionally sited' air stations, additionally, peak exposures can occur with moderately windy conditions when traditionally sited air quality stations record very low levels of PM.
- This quantitative data on peak, localised exposures are extremely important for the EPA, however, they are of lesser utility in resolving smoke complaints, as $PM_{2.5}$ levels are not explicitly referred to in the regulations.
- Wood heater smoker is a multi-layered problem – not just scientific, economic, social or organisational, it is a combination of all factors.

Talk 3: Biomass burning – Improving health outcomes through effective decision making

Emily Wilton – Environet, New Zealand

- Managing domestic heating emissions brings air quality and health benefits.
- Main approach to managing air quality is first to determine the air quality in a particular airshed, then determine how much it needs to be reduced by, and finally determine what methods are going to be best to reduce the emissions levels by the required amount.
- Air quality improvements in Nelson showed significant reductions since the early 2000s.
- During the early 2000s in Nelson, there were almost daily exceedances in PM_{10}, however, this has since been reduced and since 2019 there have been no exceedances of the National Environmental Standards for Air Quality (NES) for PM_{10}.
- Similarly, the annual average has decreased since 2001 – a reduction of 37 $\mu g/m^3$ to 14 $\mu g/m^3$ in annual PM_{10}.
- This has direct health benefits for the population.
- Christchurch has also had a similar reduction in PM_{10}, following a similar path – identifying the air quality, how much it needs to be reduced, and what are the best methods of reduction.
- Multiple airsheds in New Zealand where a similar reduction has occurred, including Te Kuiti, Taupō, Tokoroa.
- Te Kuiti and Taupō – reduction was achieved through introduction of emissions standards and existing wood burners were replaced with low emission models or heat pumps. These areas only required a smaller reduction in order to meet NES requirements.
- Tokoroa – more extensive reductions were required in this air shed. The same improvements have not been able to be achieved as the extent of additional regulation introduced has not been as extensive as in Christchurch, Nelson etc.
- Scientific methods underpinning effective air quality management in New Zealand include:
  - An assessment of the reduction required:

        - When identifying the reduction that is required, the worst-case meteorology and worst-case site must be accounted for. In doing this the target for the other sites is overshot, however it ensures that the minimum reduction requirements for all sites can be met.
    - Source contributions:
        - Emission inventory - New Zealand has discrete gazetted airsheds. By constructing an emissions inventory, the contributions of different sources of air pollution to the overall airshed air quality can be tracked, for example, emissions from domestic heating, transport, industry.
        - Areas/sources outside of the airshed that might be contributing have been determined through modelling.
        - Natural source emissions – identified through source apportionment modelling.
    - Projections model:
        - Trends in source contributions – including what may happen in areas of new development.
        - Impact of management measures – temporally based on fixed meteorology (second worst day) and spatially based on whole airshed (not a fixed point).
    - Tracking progress towards compliance:
        - Air quality monitoring data: long term record analysis, tracking how the timeframe is progressing, viewing short term records and adjusting for impact of meteorological conditions or tracking trends on high pollution potential days, for example, what proportion of high pollution potential days resulted in exceedances.
        - Emissions inventories: do estimated emission changes correlate with monitoring data.
        - Gathering of new information if required: updating of natural sources evaluations, outdoor burning outside the airshed, accounting for any new industrial sources not included in assessment.
- The pathway to effective decision making (Table 4):
    - Decision makers need to know the ***why*** – this typically requires effective communication of health risks and use the media if appropriate.
    - The science backing any interventions needs to be known, and if not known, plan what can be done to bridge any knowledge gaps.
    - Assess what regulatory tools are available and the mechanisms in place, as well as the support mechanisms that are available.
    - Evaluate barriers to decision making.

Table 4. Facilitating effective decision making.

Barrier	How to overcome
Lack of progress on scientific pathway.	Acknowledge there is a lot of information that is not known; however, it is known that action needs to be taken and it can start with the introduction of an emission limit for wood burners to no public detriment.
Negative impacts of making a decision (cost).	Communicate the negative impacts of not making a decision causes direct negative health effects to the public, including deaths.
The risk that negative impacts might outweigh the benefits.	Do not implement measure that result in, for example, cold homes. Put in place support for vulnerable households.
Unpopularity of interventions.	Understand that measures may be temporarily unpopular but when air quality in an area improves, most residents in an area are pleased.
Uncertainty about the interventions.	Ensure that there is conviction in the process and allow for uncertainty in the process.

- There have been numerous successful wood smoke interventions in New Zealand (Table 5).

Table 5. Wood smoke interventions in New Zealand.

Location	Intervention details
Nelson	Replacement of old burners with NES compliant burners, not allowing new installations, and outdoor burning and open fires prohibited. This achieved the predicted reductions. Mid-process found prevalence of slightly worst meteorological conditions and predicted that additional reductions were required. This was achieved through a behaviour change campaign.
Christchurch	Replacement of older burners with NES compliant burners was not predicted to achieve compliance without significant mode shift to non-solid fuel (70%). No installation of wood heaters in new dwellings prior to ultra low emissions burner (ULEB) introduction. Significant improvements were achieved, however the shift to ULEB technology allowed compliance to be achieved.
Hastings/Napier	Significant reductions in PM_{10} through burner phase out rules with no bans in new dwellings required to meet compliance.
Te Kuiti and Taupō	No phase outs required with new standards for burners were introduced, which allowed compliance to be met.
Blenheim	Difficulty in making significant reductions resulting in introduction of phase out rules. Monitoring data is showing progress towards NES compliance.
Tasman	Adopted measures such as point of sale rule and open fire ban, which were not predicted to meet NES. Older burners were not phased out. Currently considering round two of interventions.

- ***Key points:***
  - Different scales of problems require different degrees of management.
  - A high degree of scientific reasoning is not critical for low-cost decisions.
  - One-size-fits-all is not an efficient management approach as the cost effectiveness of management measures varies – some locations, for example Te Kuiti, required only low-cost management.
  - Some low-cost management measures are efficient, and effectiveness is just a matter of time, for example, introducing a new standard.
  - There are a range of issues to traverse, including where costs lie, the potential for cold homes, and equity (who is targeted and who benefits).
  - Though the issue may be complex to resolve, it is still possible, and many low-cost options are not complex.
  - Low-cost, easy adoption options are typically slow impact as they rely on natural attrition, and so they need to be implemented as quickly as possible, for example to capture households replacing burners this year.

Talk 4: Wood heater smoke reduction – Regulation or behaviour change?

Richard Popenhagen – Nelson City Council, New Zealand

- Nelson, situated at the top of the South Island of New Zealand, has a significant winter wood heater smoke issue.
- In Airshed A, in 2001 –
  - 81 winter exceedances of the 50 $\mu g/m^3$ 24-hour average for PM_{10}.
  - Concentrations of up to 165 $\mu g/m^3$ (24-hour average).
- In Airshed B1, in 2006 –
  - 25 winter exceedances of the 50 $\mu g/m^3$ 24-hour average for PM_{10}.
  - Concentrations of up to 112 $\mu g/m^3$ (24-hour average).
- A useful analogy is a bathtub overflowing with water – once it is full, it does not matter how little water you add, it will continue to overflow. The supply of water needs to be cut off.
- A number of key regulatory measures were introduced.
- 2003:
  - Prohibited outdoor burning within the urban area.
  - Outdoor braziers only allowed during the months of September to April.
  - Food cooking still allowed.
  - Capped the number of solid fuel burners in the urban area.
  - Set performance standards for solid fuel burners.
- 2008:
  - Prohibited the use of existing open fires (with support packages).
- 2010 – 2012:
  - Phased out older more polluting solid fuel burners (with support packages).

- Conscious not to replace an air pollution problem with a cold home problem, and so a number of support packages were brought in alongside interventions.
- Clean Heat Warm Homes scheme –
  - If you had an open fire or a wood burner that required phasing out, council would pay for the cost of a new heating device, and home insulation, and the cost was added to the rates bill which was interest free. Additionally, if you qualified as being low-income, you did not have to make the repayments.
    - 433 open fires replaced.
    - 1,546 old burners replaced.
    - 1,370 homes insulated.
- 2016:
  - Update of science.
  - Plan Change A3: Allows for a limited number (1,600) of Ultra-Low Emission Burners (ULEB) into non-polluted airsheds[10] under New Zealand's *Resource Management (National Environmental Standards for Air Quality) Regulations 2004*.
  - Enhancement of non-regulatory behaviour change program.
- Regulation only gets you so far – reoccurring issues:
  - Wet firewood.
  - Operator error.
  - Lack of maintenance and incorrect installation.
- Run an extensive education program – try to work with people first before any regulatory actions.
- Smoke patrols morning and evening in winter – compliance officers will leave a letter for a smoky chimney and arrange to come to the property during the day, discuss with the homeowner why the chimney may be smoky, carry moisture meters to check firewood, try to talk through how it could be reduced.
- Case study:
  - Continuously excessively smoking chimney, owners were taking every action to try and find the reason why, (correct moisture content, air control used and was fully open, flue cleaned annually) to no avail.
  - Upon further inspection of the wood burner itself, discovered that it had a number of structural issues, and needed to be repaired.
  - Once repaired, it produced much more heat for the household, and no visible smoke for the community.
- Good wood program – number of providers that are signed up to this program, where they deliver dry wood to customers, other incentives where it is encouraged to buy wood pre-Christmas, to ensure the wood is dry. These kinds of programs work well for the community but also the wood providers, as they get increased

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[10] s 17 (4) For the purposes of this regulation, —
(a) an airshed becomes a polluted airshed on and from 1 September 2012 or any later day if, for the immediately prior 5-year period—
(i) the airshed has meaningful PM10 data for at least a 12-month period; and
(ii) the airshed's average exceedances of PM10 (as calculated under regulation 16D) was more than 1 per year; and
(b) an airshed stops being a polluted airshed on and from any day if the PM_{10} standard was not breached in the airshed in the immediately prior 5-year period.

sales in what was historically their low season, and they are able to have a continual stream of sales.

- Community engagement – talks at English as a second language class, talks at garden shows, competitions for wood sheds, educational programs for fireplace installers, building inspectors, general upskilling.
- Community support – Warmer Kiwi Homes initiative, information on how to operate wood burners properly, how to use heat pumps effectively, how to keep the house warm and healthy.
- All of these things combined have made a significant difference, with PM_{10} levels dropping steadily since 2001, and since 2019, no exceedances of the World Health Organisation threshold.
- In summary –
  - it does not matter how efficient a burner tests in the laboratory, if it is not installed correctly, or maintained over its life span, or operated correctly, its performance in reality will be terrible.
  - Burner installation and flue cleaning does require specialist knowledge.
  - Regulation and behaviour change need to be done in unison.
  - Incentives and education required to be done in unison.
  - The community needs to be taken on the journey towards improved air quality – they need to be a part of each step and understand reasoning behind actions.
  - Important to remember to not replace air pollution with people having cold homes – there must be support packages.
  - Finally, repeat messaging is required.
  - Improving air quality is possible – it takes time and effort, but it is achievable!

Talk 5: Reducing PM_{10} emissions from domestic wood burners – Lessons from the Rotorua Airshed

Elsa Weir – Bay of Plenty Regional Council, New Zealand

- Rotorua is located in the centre of the North Island of New Zealand and has a population of approximately 80,000.
- The urban area of Rotorua is a gazetted airshed, and the main source of winter air pollution is the smoke from wood burners.
- Rotorua has a relatively high altitude, sits in a volcanic caldera with low wind movement, and has a high solid fuel burner dependency.
- These factors result in frequent inversion layers and has seen the area have the worst wintertime air quality in the North Island numerous times.
- Over the last 15 years, action has been taken to try and combat this issue.
- The core action has been the phasing out of old and inefficient solid fuel burners and moving to cleaner and more efficient technology, such as ULEBs, heat pumps, pellet burners, infrared heaters, and other alternatives.
- These actions have resulted in significant improvements in air quality.
- In 2008 there were 37 exceedances of the PM_{10} standard, to 0 in 2021.
- The program has been running since 2005, and there have been many lessons learned.

- In order to provide legislative backing, a by-law and a regional air plan were introduced to the Rotorua airshed.
- Air quality by-law:
  - Initially enforcement was difficult for the regional council, as they could not regulate removal of the inefficient solid fuel burners – only the discharges to the air could be regulated.
  - To combat this, the regional council worked with the district council and introduced an air quality by-law (Air Quality Control Bylaw 2010 can be found in Appendix of Rotorua Air Quality Control Bylaw – Administration and Enforcement Strategy and Air Quality Control Bylaw 2017) and completed a transfer of powers so that the regional council could help enforce the by-law, allowing for the actual wood burners to be directly targeted.
  - The key provision is the point-of-sale rule, which requires any non-compliant solid fuel burners to be removed or replaced by the vendor, prior to the sale of the property.
- Regional Plan (PC 13):
  - There are no new wood burners allowed in the airshed, unless you are replacing an existing burner, or you offset the installation by removing a wood burner somewhere else in the airshed.
  - The use of older wood burners has also been phased out with discharge from any wood burner installed prior to 2005 no longer allowed.
  - Pellet burners are allowed to be installed; however, these have not been a popular option.
- Incentives:
  - Between 2008 and 2021, grants and long-term loans were offered to households to replace their old heating.
  - Incentives needed to be relevant and effective, and so were regularly reviewed to meet the needs of the community.
  - Incentives are necessary to make the change possible, especially for low-income families.
- Rules are necessary to influence the market and to justify for manufacturers to put the money in research and development to meet new criteria.
- It is important to think outside of the box and to be bold in approaching problems. For example, Bay of Plenty Regional Council put in a tender to three manufacturers for the direct supply of ULEBs. This resulted in the manufacturers offering the ULEBs to the council at a rate cheaper than retail cost, and the council was able to secure ULEBs for only NZD$1,500 more than the cost of installing a regular wood burner.
- In 2021, Bay of Plenty Regional Council applied for the Rotorua airshed boundaries to be re-gazetted. This was due to the growth of the city, with future development proposed to occur in previously undeveloped areas directly adjacent to the airshed boundaries. Without being in the airshed, these houses could have all installed wood burners (with much higher emission rates) and the gains that had been made in reducing PM_{10} could have been lost.
- Generous transition times have been included in all regulations, to allow the community to adjust.
- Education is always the first step, rather than enforcement.

- Continual community engagement is also a main factor in the success of the Bay of Plenty Regional Council's approach to air pollution. For example, changing the conditions of loans that were offered to the community, in order to suit how it would be best repaid by them.
- Additionally, improving air quality is not a quick fix, it is a sustained movement towards improved air quality.
- Also, it is important to include the other sources of air pollution, and the actions needed to address these, such as industrial emissions. This also allows the community to see that all sectors are contributing to improving air quality, and it is not only the residents that have to work towards the goal.
- In summary, improving the air quality in the Rotorua airshed has required a wide variety of methods to help the community move towards cleaner forms of domestic heating. Making this achievable for the community and ensuring that people were not inadvertently disadvantaged along the way has been a key factor.

4.2 Session two

Session two was focused on communication and collaboration. Attendees were presented with a Zoom poll, which listed serval possible interventions into wood heater smoke. Attendees voted on which intervention they were interested in discussing further. Attendees were asked to vote for one of six options, the top four were then used to form breakout groups. The options presented in the Zoom poll differed slightly to those from the pre-workshop questionnaire following further discussion amongst IP4.02.03 prior to the workshop. The questions polled in the workshop consolidated some of the options of the pre-workshop questionnaire and included a wider variety of possible interventions. The six options are listed below in Table 6.

Table 6. Topics voted on via Zoom poll for breakout group discussion.

Breakout group topic	Description
Wood heater register.	All wood heaters need to be registered by local government, with age and model of wood heater recorded.
Wood heater licensing and/or compulsory education.	All people purchasing a new wood heater, or households with a smoky chimney, required to obtain a licence following education, similar to a boat licence.
Wood heater point of sale swap.	Mandatory removal of wood heater installation of heat pump when a property is sold.
Certified wood merchant program.	Endorsement and discount for retailers who meet criteria for sales of appropriately seasoned and sustainably sourced wood.
Wood heater replacement scheme.	Scheme where eligible households have upfront costs of wood heater removal covered or receive a rebate following removal.
Air quality/wood heater burning notifications.	A voluntary system that allows people to check the air quality and decide whether they will use their wood heater.

5 Workshop Responses

5.1 Breakout groups

The top four topics were selected, and attendees were able to allocate themselves to their preferred breakout group. Within each breakout group there was a facilitator, who was there to guide the conversation and assist with recording information. Some breakout groups also had a person acting as a notetaker. Each breakout group was asked to respond to the following questions regarding their intervention:

- What are the advantages of this approach?
- What are the disadvantages of this approach?
- What are the key enabling factors for implementing this intervention?
- What are the main barriers to this approach?

There were also two general questions:

- Are there any important issues that have not been raised in today's workshop?
- Would any of your organisations be interested in implementing and evaluating this intervention?

All information was recorded using Miro boards, and breakout groups lasted for an hour. The following information is summarised from the Miro boards used in each group.

Breakout group 1: Wood heater register

The topic for this breakout group was a wood heater register, whereby all wood heaters need to be registered by local government, with the age and model of the wood heater recorded.

What are the advantages of this approach?

The wood heater register group noted the following advantages:

- A register would allow councils to monitor wood heaters, to track the make, model and instalment date of heaters in operation, and whether they need maintenance.
- A register would allow for non-compliant wood heaters to be recorded in a centralised location.
- A register would allow for consistency when monitoring air quality in an airshed as air quality measurements for areas could be compared against the register to determine if areas of greater emissions have older wood burners.
- There would be no cost directly placed on wood heater owners.

- A register would allow for suburbs that are using older heating technology to be targeted with swap or trade schemes to upgrade the heating device.
- Due to certain specifications being recorded in the wood heater register which is monitored and updated by the regulating authority, it may prompt wood heater manufacturers to improve design as they need to meet these specifications.

What are the disadvantages of this approach?

The wood heater register group noted the following disadvantages:

- People may be reluctant to register for fear of enforcement action if they are using a multi-fuel burner.
- Councils will bear the cost to run and administer the register, which includes cost of training staff, as well as an increased workload.
- A register would largely rely on individual's honesty. If the register is to be actively monitored by council, it would require officers to inspect properties to ensure the wood burner matches the information reported.
- A register would require voluntary participation as there is currently no legislative requirement.

What are the key enabling factors for implementing this intervention?

The wood heater register group noted the following as key enabling factors:

- In New Zealand, it is already required for solid fuel burners and wood heaters to have council consent to be installed, and so there is already a public record for their existence. This kind of requirement could allow for an easy transition to setting up a register used by council.
- A key enabling factor would be positive working relationships between stakeholders, for example, between Local, State and Federal government. For example, in New Zealand, good working relationships with district council are required as they hold the data regarding wood heater installation consents.
- Education would be a key enabling factor, both for the council through training programs and upskilling, and also for the public and wood heater manufacturers, to explain why a register is a positive step forward in reducing air pollution.
- Clear communication to the public about the health and environmental effects of wood heater smoke and the rationale behind putting in place a wood heater register would be a key enabling factor for the register to be embraced by the public.

What are the main barriers to this approach?

The wood heater register group noted the following as barriers:

- To move beyond a voluntary opt-in intervention, legislative change would be required to enable the register to be mandatory, and to provide backing for regulation and compliance work. Legislative change is often a lengthy process.
- As was raised in the disadvantage section, to set up and monitor a wood heater register council resources are required. Local councils currently have a full

business-as-usual workload therefore a barrier would be having the capacity to add to this workload, as the register would require the time of council personnel and bring an increased administrative workload.

- Related to the above point, if the register is not legislatively mandatory, some agencies may be averse to adding another step to their process unless they are forced to, due to limited workforce and high workloads.
- A potential barrier for having a wood heater register are privacy laws surrounding information sharing between levels of government and other organisations. For example, in New Zealand there needed to be consideration about what was permissible for district council to share information with regional council.
- A potential barrier faced by regional and rural areas of Australia could be the logistic issue of being able to access some properties to monitor. For example, odd-grid properties, or properties that are remotely located. This may be a barrier faced if a register was mandatory, however it would be less relevant if it is an opt-in intervention.
- Another barrier is the general lack of understanding about the detrimental health and environmental effects of using wood heaters in the home. If the public does not understand the reasoning behind the register, they are less likely to accept this additional form of government intervention.
- There may be community backlash, as mentioned in the above point due to the lack of understanding, but also due to the traditional and cultural importance of wood heaters, and the public's reluctance to have the government regulating another aspect of their life.
- The public may have reluctance to notify or register a wood heater due to possible self-incrimination through registering an old or non-compliant system. This would be a potential barrier if the register was not mandatory.

Breakout group 2: Wood heater licensing and/or compulsory education

The topic for breakout group 2 was wood heater licensing and/or compulsory education, which would require wood heater owners to take part in education regarding wood heater operation and maintenance, and owners would also be required to hold a valid licence for the operation of the wood heater.

What are the advantages of this approach?

The wood heater licensing group noted the following advantages:

- A licensing system with a compulsory education component would ensure that education is delivered directly to the people who need it – the wood heater owners and operators.

- Issuing and recording licenses, in a similar way to a wood heater register, would allow council/regulators to know the number of wood heaters and their location, which would allow for town planning and for the adjustment of other interventions. For example, in New Zealand there are gazetted airsheds within which air quality standards must be met. Knowing the number of wood heaters in a certain area could allow for targeted education in wood heater dense areas, for swap-out programs or for future regulations on the installation of new wood heaters to be planned for, and for an understanding of wood heater's contribution to air pollution in an area, compared to other potential sources, such as industry.
- Licensing would allow for uniformity in application of any regulation, as all wood heater owners would have the same background level of knowledge and understanding of their responsibilities.
- A licensing and education program is a relatively simple and pragmatic step towards providing education for people who are not familiar with operating wood heaters, including people moving from warmer climates.

What are the disadvantages of this approach?

The wood heater licensing group noted the following disadvantages:

- Requiring wood heater owners and operators to hold a licence may be seen by the public as over regulation and local council trying to overreach.
- A disadvantage is the cost involved to both the licensee (if a fee is required) and the organisation issuing the licence.
- Complications arise when accounting for rental properties. It will need to be determined who in a household is required to have a licence, for example, the home owner, a designated wood heater operator, or any adults in the house. This brings additional issues regarding enforcement and compliance, depending on who is licenced in the house, and who is ultimately responsible for the operation of the wood heater.
- Linked to the above point, the person being educated may not be the one who operates the wood heater and the intervention may not reach all of the intended people.
- A licensing and education program will require a lot of administrative work, and there may be time delays in terms of program delivery and other business-as-usual work that council is required to do, due to this workload.
- If mandatory, a licensing and education intervention may put an 'unnecessary' burden on owners that are in remote areas and not impacting on neighbours.
- Licensing in itself will not create direct air quality improvements, it is a supporting intervention that needs to be done in concert with others.

What are the key enabling factors for implementing this intervention?

The wood heater register group noted the following as key enabling factors:

- An enabling factor would be to provide incentives and use a staged approach in the implementation of the intervention. For example, there could be a free time period

for licensing, or upon getting a licence in a time period there could be a free load of firewood.

- A key enabling factor would be collaboration with stakeholders who are already collecting the information needed for a licensing system. This collaboration could make the system semi-automated in the future, for example, working with the building authority to know which households are having wood heaters added, and in turn, which households need to undergo licensing.
- Furthermore, collaboration with other organisations that can assist in stakeholder engagement would be enabling factors for this intervention. For example, in Bendigo a community health service helps with translations and the production of pictorial guides for numerous rules and regulations in Australia to allow new Australian residents and citizens to understand the documents. A similar arrangement would be beneficial for wood heater licensing and accessible education.
- An enabling factor would be to have this intervention driven by State government due to the resourcing and workload requirements.
- Transparency would be a key enabling factor, and there would need to be a clearly defined outcome and structure around the intervention. This would ensure that the community understands the reason behind the action, which would also help with compliance.
- Linked to the above point, communication and engagement with community would be a key factor in implementing this intervention. This could involve education campaigns, flyers, letters, and community surveys.
- A licensing and education intervention could be done alongside a wood heater register intervention. Alongside both of these interventions, an audit of existing wood heaters would provide useful background information, with the information recording in the wood heater register. The use of the register would allow for a record to be kept of which households require a licence.

What are the main barriers to this approach?

The wood heater register group noted the following as barriers:

- Determining when the education occurs, and whether it needs to be ongoing, or if the education requires refreshing and relicensing may be a barrier to this intervention.
- Currently in Tasmania, there is not a requirement to submit a notification to council when someone installs a wood heater, and there is not an overarching reporting system. Therefore, an additional process would need to be introduced to ensure council is aware of the households that need to be licenced and educated.
- The above point ties in with the overall lack of records regarding wood heaters in Australia, including information on their ownership, age, and location. The paucity of records will be a barrier in implementing this intervention.
- A major barrier could be the attitudes of the public, as there may be community resistance due to people not being aware of the extent of health or environmental effects of wood heater smoke. Additionally, the costs and time requirements of the intervention may cause a negative public reaction.

- The relationship the local council has with the community, and with other organisations, for example if another body holds the records of wood heater instalment, could be a barrier if there were tensions in the area.
- A barrier in implementing the intervention, is the lack of legislative backing, which means it cannot be enforced.

Breakout group 3: Wood heater point of sale swap

The topic for breakout group 3 was a wood heater point of sale swap, which would require vendors to replace wood heaters with reverse cycle air conditioners upon the sale of their property.

What are the advantages of this approach?

The wood heater point of sale swap group noted the following advantages:

- This intervention ensures that the numbers of wood heaters are being reduced which in turn is actively reducing harm to the public.
- A wood heater point of sale swap ensures some certainty in terms of the rate of change of wood heaters, with the eventual turnover of homeowners.
- An advantage of requiring the removal of the wood heater when the previous owners leave the property is that they will be less likely to have an issue with sentimental attachment to the wood heater, as they are leaving the house.
- There are many inactive wood heaters in the community, and with a house being sold and a new owner moving in, it may result in these wood heaters being used. By removing the wood heater at the point of sale, the risk of re-activation of previously dormant wood heaters is removed.

What are the disadvantages of this approach?

The wood heater point of sale swap group noted the following disadvantages:

- A disadvantage of swapping out a wood heater for another form of heating is that there may be unintended consequences of alternative heating technology. For example, the noise from the heat pump or emissions from electricity generation.
- Removing the wood heater and purchasing a heat pump is expensive and may be time consuming, placing an extra burden on the home vendor. For example, finding a technician to remove the unit and install an alternative may cause a time delay.
- As this intervention only comes into effect when houses change ownership, it does not allow for the older, more polluting wood heaters to be prioritised for removal.
- A disadvantage to this approach is the additional waste that will generated through the old, discarded wood heaters.

What are the key enabling factors for implementing this intervention?

The wood heater point of sale swap group noted the following as key enabling factors:

- This intervention is not a full ban, rather it is a package of solutions. Therefore, it needs to be considered as part of a broader suite of solutions. For example, a buy-back program, health messaging, national register, and compliance program all conducted in unison.
- In order to facilitate public acceptance for this intervention, community education and engagement will be essential, including communicating the cost-benefit analysis to the public.
- This intervention is an incremental change, therefore it may be more readily accepted by the public as the overall change itself is slow but there will still be measurable air quality improvements.
- The involvement of health agencies is a key enabling factor, as their backing will lend further legitimacy to the public health messaging.

What are the main barriers to this approach?

The wood heater point of sale swap group noted the following as barriers:

- A barrier to this intervention would be determining where the funding for the program will come from, and what body is responsible for its administration.
- Another barrier will be the likely pushback from the wood heater industry due to manufacturers being unable to install new wood heaters.
- The need for increased workforce capacity across different sectors, for example, electricians and council compliance officers, and their availability at a high-stress time for the homeowner, may present a barrier to this intervention.
- A barrier for a point of sale swap may be how to ensure that another wood heater is not installed in the house at a later date.

Breakout group 4: Wood heater replacement scheme

The topic for breakout group 4 was a wood heater replacement scheme, which eligible households would have the upfront costs covered or receive a rebate for the removal of a wood heater and replacement with an alternative source of heating.

What are the advantages of this approach?

The wood heater replacement scheme group noted the following advantages:

- This intervention is a clear and definitive approach allowing for the installation of best practice heating appliances in homes.
- Under this intervention, the criteria for being ‘eligible’ may refer to means testing and would allow for the ability to tailor the scheme to socioeconomic challenges thereby supporting vulnerable community members.
- An advantage to this intervention is that there have been similar regulatory interventions in the past, for example the septic systems regulations, which can provide transferable lessons.

- The wood heater replacement scheme is a carrot focussed intervention. It provides incentives to be compliant and applies to all wood heaters.
- An advantage to this intervention is that a wood heater replacement scheme would begin to immediately address the problem of wood heater smoke in communities.
- In comparison to buying firewood and the efficiency of properly heating a home, reverse cycle air conditioning has lower running costs than most wood heaters (the exception is for those who are able to use wood from their property at no monetary cost).
- There is precedence for this approach, as several authorities have implemented successful programs, for example, the ACT and Victoria in Australia, and Utah in the United States.
- The benefits have been shown to outweigh the costs. The cost of the entire replacement with subsidy will be covered by the health cost savings for the community, for example, in Melbourne, health cost of each wood heater is $6,900/year.
- This intervention is one of the priority preferences for consumers (from Asthma Australia national consumer survey results).
- A wood heater replacement scheme provides opportunities to link with other programs to make it more affordable, and to improve other housing factors such as insulation and design.
- Even if this intervention was altered such that a *new* wood heater was installed (rather than reverse cycle air conditioning), this intervention would still lead to the phasing out of old and smoky wood heaters, and would lead to an updating of the wood heater fleet with more efficient and safe wood heaters.
- Reverse cycle air conditioning also brings cooling for summer, which is extremely important for Australia.

What are the disadvantages of this approach?

The wood heater replacement scheme group noted the following disadvantages:

- Implementing a wood heater replacement scheme requires a significant initial cost.
- There is the risk of ostracising the wood heater industry, particularly if the replacement is required to be an alternative form of heating.
- Those who collect their own firewood (therefore have the heating for free) may not be interested in taking part in the scheme if they do not understand the health benefits. Even if the health benefits are understood, they may still be overridden by financial considerations.
- If the intervention is the wood heater replacement scheme with a rebate only, this will exclude lower socio-economic households and the initial financial outlay may be too much.
- Due to rising energy costs, and the overall cost of living crisis, this intervention may require subsidy of fuel bills to reduce financial impacts and resistance from the community.
- Without close regulation, there is the risk that the ‘replacement’ is sub-standard, causing detrimental flow-on effects. The intervention may see low-quality appliances entering the market.

- Increasing energy costs may (even unintentionally) drive people to inadequately heat homes if unable to carry costs.
- In order for this scheme to be well accepted by the public, there may be a long lead in time during which education campaigns and community outreach is conducted.
- There is the problem that if a new wood heater is installed it may undo all of the prior good work in the airshed.
- The intervention would need to be mandatory for the greatest effect, to ensure that people with the problem wood heaters are captured, as a single smoky chimney can decrease an area's air quality.

What are the key enabling factors for implementing this intervention?

The wood heater replacement scheme group noted the following as key enabling factors:

- A key enabling factor would be the clear communication of the vast body of evidence that there is no safe level of air smoke pollution to the public to reduce resistance.
- Another enabling factor comes from the understanding of the intersections between various air pollutants (viruses, pollens), and wood heater smoke. In general, there is currently a good understanding of concepts such as air pollutants, pollen, viruses, and climate issues across the public.
- An enabling factor would be the demonstration of the impact on climate and alignment with climate protection, including native bush and habitat conservation.
- Energy companies, psychologists, and medical professionals working together to develop the best communication strategies would be a key enabling factor.
- Having existing data to build a case, and precedence in other programs (including the New Zealand precedent) will allow the public and decision makers to see this is a pragmatic intervention.
- This intervention allows for areas with good likelihood of success to be targeted in the first instance and can then cascade to other areas.
- The existing wood heater replacement schemes in Victoria can be used to encourage other jurisdictions to adopt the scheme.
- Support from peak medical organisations such as Asthma Australia, and the Australian Medical Association, would lend credence to the intervention.
- There are collaborators and stakeholders available to multiply the messaging (for example, Asthma Australia) allowing for wider reach and impact.
- There have been previous examples of partnerships with organisations like Aurora Energy with a wood heater replacement scheme. Such industry partnerships would assist in enabling a current intervention.

What are the main barriers to this approach?

The wood heater replacement scheme group noted the following as barriers:

- There is a level of misinformation from multiple sources, including the wood heating industry, on the health costs, $PM_{2.5}$ emissions and climate impacts of wood heaters.

- There is public misconception about the carbon-neutrality of wood burning and other climate forcing emissions, and the biodiversity impacts of wood harvesting.
- There also exists general climate change denial in the community, which presents a barrier when trying to communicate the environmental impact of wood heaters.
- Currently in Australia there is inadequate regulation regarding wood smoke. Enforcement action is difficult as there needs to be visible smoke and it requires the use of a video recording or $PM_{2.5}$ monitor for evidence.
- People like the ambience of wood fires which is a barrier that exists for the public willingly participating in a wood heater replacement scheme where old wood heaters are removed, and alternative sources of heating are installed.
- Additionally, faux wood heaters are either problematic (gas emissions) or aesthetically displeasing (electric).
- There is a lack of understanding in the public that there is no save level of $PM_{2.5}$.
- A lack of political will exists due to the fear of backlash from voters and from industry, with the examples from Victoria being politically divisive.

6 Summary

It was clear from the number of workshop attendees that wood heater smoke pollution is a pressing issue in public and environmental health. Workshop attendees came from seven of the eight Australian States and Territories, indicating clearly that this is a national problem.

The panel discussion touched on the concept that work in this space is completed in steps. As there is no safe level of air pollution, standards and guidelines need to change in order to protect the population, however this is best done by setting targets, meeting those targets, and continuing the process. This allows for the public to be brought along on the journey, and it also allows for checks and reflections, to ensure actions do not have unintended consequences.

The range of discussions held at the workshop, along with the survey results, highlighted that though there is a high level of interest in wood heater smoke interventions, there are a lot of practical barriers that exist when attempting to address the problem. However, the case studies from New Zealand and the panel discussion, together with problem solving discussions in breakout groups, showed that it is a problem that can be addressed, and that there are practical steps forward that can be taken to improve air quality.

Overall, the general consensus of the workshop participants was that there is a need to take action regarding wood heater smoke, which needs to be evidence based. The main themes that presented themselves across the talks and the breakout group discussions are:

i) The importance of communication, education, collaboration and community/stakeholder engagement.

ii) For the greatest effect, an intervention should consist of more than one component and work in unison, for example, a wood heater replacement scheme, alongside education and community engagement.

iii) Additionally, education on the health, economic and environmental impacts of wood heater use is crucial to allowing the public to understand the reasoning behind interventions.

iv) Close cooperation with advocacy groups, such as Asthma Australia, are vital in reaching those most affected by wood heater smoke and ensuring that interventions are having the desired effect.

v) Consideration needs to be taken to ensure that the most vulnerable of our society are looked after to ensure that any intervention does not place undue financial stress or result in improperly heated homes.

vi) Legislative backing is required to enable enforcement.

vii) Interventions need to be tailored for each specific location.

viii) A large barrier is the monetary cost of implementing an intervention. Therefore, interventions should be supported at a Federal and State level. Also, interventions would increase the workload for various organisations, and if these are government bodies, this needs to be accounted for in terms of extra staff, training, and resources provided.

7 Next Steps

Through the pre-workshop questionnaire, stakeholders were able to provide their information if they would be interested in potentially collaborating further with the project. Additionally, in the workshop, during the breakout groups, there was space to include this information.

The next steps for this project will be following up with these stakeholders in early 2023 in order to have one-on-one or smaller group meetings with the intent of co-designing interventions to be trialled as part of the ongoing project as part of IP4.

The discussion points generated in the breakout groups will also be useful inputs towards further community based research that we are conducting in 2023.

8 Appendices

Appendix A: Stakeholders invited to participate in workshop and questionnaire

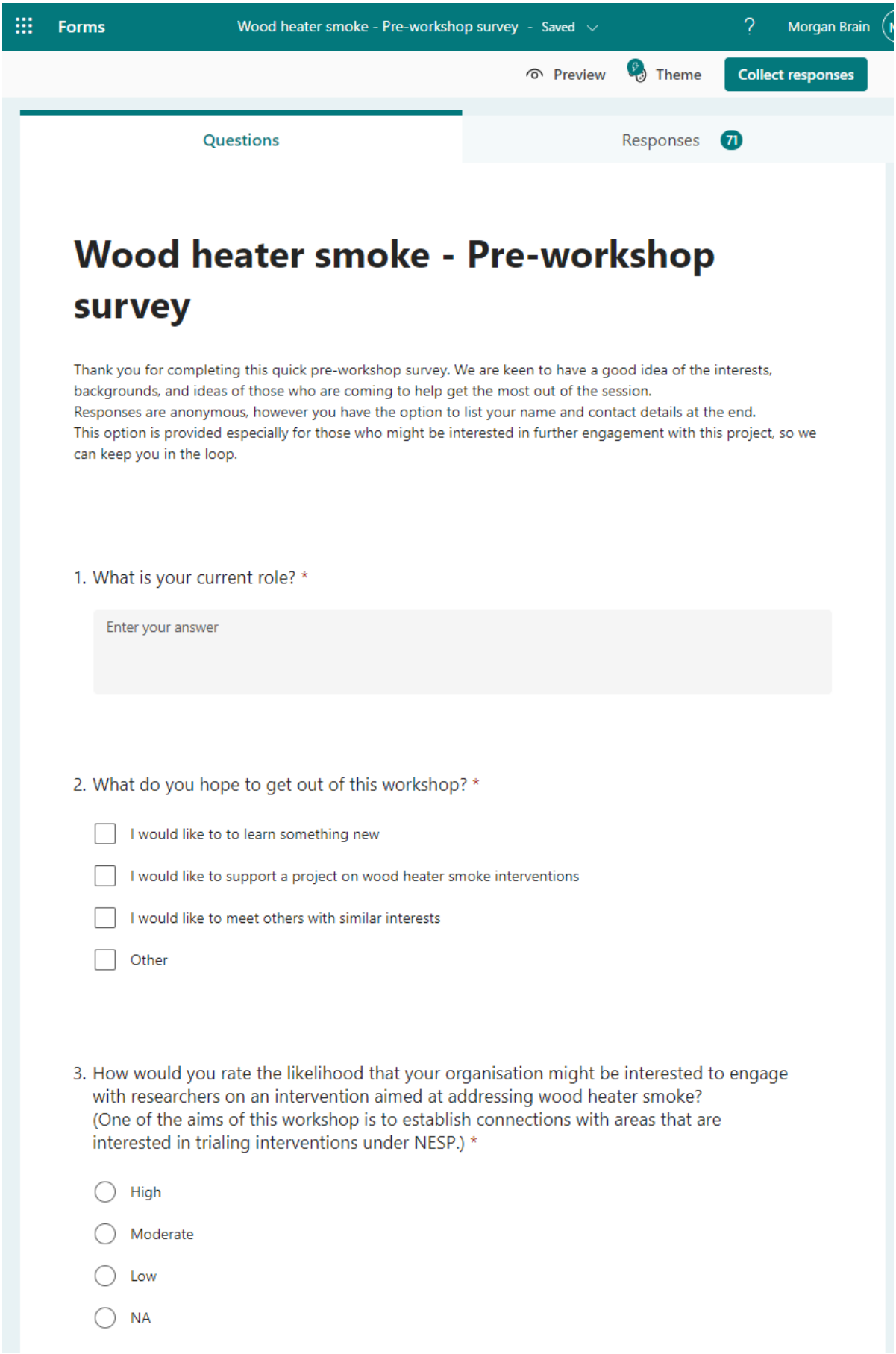
- Australian Capital Territory Health, ACT
- ACT Commissioner for Sustainability and the Environment, ACT
- Albury City Council, NSW
- Asthma Australia, Aus
- Australian Air Quality Group, Aus
- Australian National University, ACT
- Ballina Shire Council, NSW
- Balonne Shire Council, QLD
- Bay of Plenty Regional Council, NZ
- Berrigan Shire Council, NSW
- Blackall-Tambo Regional Council, QLD
- Blacktown City Council, NSW
- Brighton Council, Tas
- Brisbane City Council, QLD
- Camden Council, NSW
- Campbelltown City Council, NSW
- Circular Head Council, Tas
- City of Casey, Vic
- City of Greater Bendigo, Vic
- City of Greater Geraldton Council, WA
- City of Parramatta Council, NSW
- City of Ryde Council, Vic
- City of Sydney Council, NSW
- Clean Air Communities, Aus
- Coffs Harbour City Council, NSW
- CSIRO, Aus
- Cumberland City Council, NSW
- Curtin University, WA

- Department of Climate Change, Energy, the Environment and Water, Aus
- Department of Environment and Science, QLD
- Dorset Council, Tas
- East Gippsland Shire Council, Vic
- Environet Limited, Aus
- Environment Protection Authority (EPA) South Australia, SA
- EPA Tasmania, Tas
- EPA Victoria, Vic
- Fairfield City Council, NSW
- Fraser Coast Regional Council, QLD
- Glenorchy City Council, Tas
- Griffith University, QLD
- Hawkesbury City Council, NSW
- Hobart City Council, Tas
- Hornsby Shire Council, NSW
- Inner West Council, NSW
- James Cook University, QLD
- John Holland, Tas
- Kernow Environmental Health & Immunisation, Aus
- Kingborough Council, Tas
- Knox City Council, Vic
- Ku-ring-gai Council, NSW
- Lake Macquarie City Council, NSW
- Lane Cove Council, NSW
- Latrobe City Council, Vic
- Launceston City Council, Tas
- Lismore City Council, NSW
- Livingstone Shire Council, QLD
- Logan City Council, QLD
- Mansfield Shire Council, Vic
- Mitchell Shire Council, Vic
- Moree Plains Shire Council, NSW
- Moreton Bay Regional Council, QLD

- Mount Barker District Council, SA
- Murray River Council, NSW
- Murweh Shire Council, QLD
- Nelson City Council, NZ
- Newcastle City Council, NSW
- New South Wales Department of Planning and Environment, NSW
- New South Wales Environment and Heritage, NSW
- New South Wales Health, NSW
- Northern Beaches Councils, NSW
- Penrith City Council, NSW
- Port Macquarie-Hastings Council, NSW
- Port Stephens Council, NSW
- Proterra Group, QLD
- Queanbeyan Palerang Regional Council, NSW
- Queensland Health, Qld
- Redland City Council, QLD
- Scenic Rim Regional Council, QLD
- Shoalhaven City Council, NSW
- Sorell Council, Tas
- South Burnett Regional Council, QLD
- Sunshine Coast Regional Council, QLD
- Sutherland Shire Council, NSW
- Sydney Local Health District Public Health Unit, NSW
- Tasmanian Department of Health, Tas
- TierraMar, Aus
- Toowoomba Regional Council, QLD
- Tweed Shire Council, NSW
- University of Tasmania, Tas
- Victorian Department of Health, Vic
- Western Downs Regional Council, QLD
- Willoughby City Council, NSW
- Woollahra Council, NSW
- Wyndham City Council, Vic

- Yarra Ranges Council, Vic
- Yass Valley Council, NSW

Appendix B: IP4 Survey circulated to stakeholders



4. Assuming that resourcing is not an issue, please select which options from the list below you consider to have good potential for success. (Tick as many as apply.) *

- [ ] Wood heater register - all wood heaters need to be registered by local government, with age and model of wood heater recorded.
- [ ] Wood heater licensing - all people purchasing a new wood heater need to undergo education, and hold a 'Wood Heater' licence.
- [ ] Wood heater point of sale swap - mandatory removal of wood heater and installation of heat pump when a property is sold.
- [ ] Wood heater buy back scheme - payments made to eligible households following the replacement of a wood heater with a heat pump.
- [ ] Wood heater replacement scheme -scheme where eligible households have upfront costs of wood heater removal and replacement covered.
- [ ] Air quality/wood heater burning notifications - A voluntary system that allows people to check the air quality and decide whether they will use their wood heater.

5. What interventions have you seen that were effective in addressing wood heater smoke?

Enter your answer

6. Are you working on a wood heater smoke intervention that you would like to share with the group?
If so, please provide a summary in the text box below.

Enter your answer

7. Are you working on a wood heater smoke intervention that you would like to share with the group?
If so, please provide a summary in the text box below.

Enter your answer

8. Do you have a question you would like to put to our expert panel for them to discuss during the workshop?

Enter your answer

9. The following two questions are optional however they will help us understand who would be interested in staying engaged with the project - What is your name?

Enter your answer

10. What is your email address?

Enter your answer

+ Add new

Appendix C: Project Roadmap