

Health Cost of Allowing New Wood Heaters – over \$3,000 per heater per year

Real-life – 8 times worse than lab test pollution

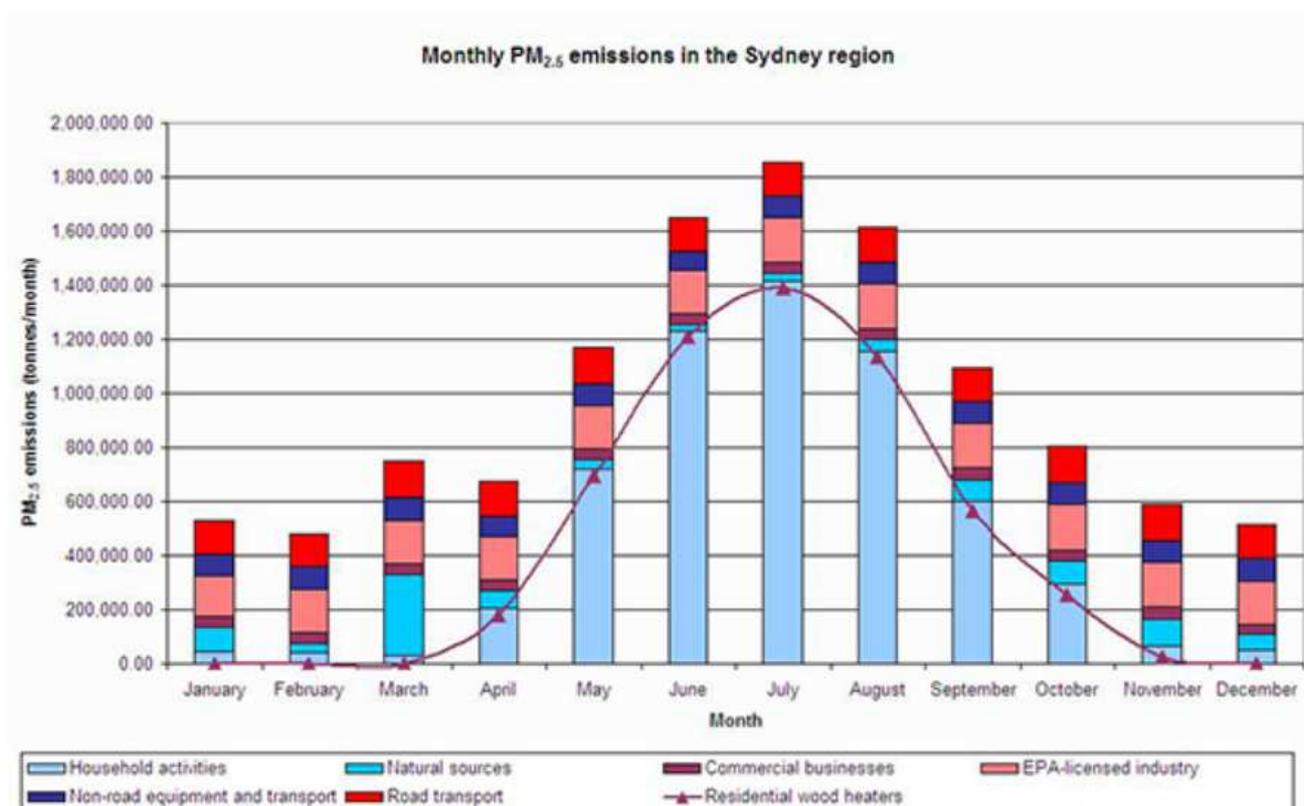
The Australian lab test for wood heaters bears little or no relationship to real-life pollution. In New Zealand (NZ) real-life emissions averaged 8 times worse than the lab test (6.5 grams per kg wood burned in real life, 0.85 g/kg in the AS4013 lab test). This is despite the volunteers knowing their pollution was being measured and presumably being motivated to avoid embarrassment by operating their heaters carefully (see Appendix for details). There are no tests in Australia of wood heaters satisfying current standards, so the studies in NZ are the best available evidence of real-life pollution from new wood heaters in Australia.

The lower the lab test result, the greater the discrepancy with real-life. Real-life emissions of stoves rated below 0.65 g/kg averaged 9 times worse; those rated 0.65 to 0.95 averaged 7.6 times worse; those rated 0.95 to 1.2 g/kg averaged 6.2 times worse. This is another indication that the lab test doesn't reflect real-life.

Wood heaters – Australia's major source of health-hazardous air pollution

Wood heaters are **the most important source of health-hazardous air pollution** in Greater Sydney's Metropolitan Region (SMR), according to a study published in 2020 and funded by the NSW Environment Protection Authority and the NSW Ministry of Health (EPA/NSW-Health study) [2].

PM2.5 is the most health-hazardous air pollutant. Wood is the main form of heating of only 4.4% of capital city residents (75,900 households out of 2.8 million) [3]. The NSW Emissions inventory shows that wood heater emissions dominate all other sources of harmful pollution emissions from May to September [4].



*Source: [Air Emissions Inventory for the Greater Metropolitan Region in NSW](#)

New wood heaters– health costs exceed \$3,000 per year

The EPA/NSW-Health study concluded that wood heater pollution causes an estimated 100 premature deaths per year, or 1,400 years of life lost (YLL) annually, compared to 990 YLL for on-road sources and 660 for power stations [2]. Based on Access Economics' valuation of a YLL of \$433,437 [5] and 100,000 wood heaters in the SMR, this amounts to over \$6,000 per wood heater per year.

Using the best available evidence of real-life pollution (6.5 g/kg in the NZ real-life studies), the EPA/NSW-Health study implies that **estimated health cost per new wood heater still exceed \$3,500 per year**.

The health costs above are remarkably similar to estimates from 2013, based on estimated health costs per kilogram of PM2.5 emissions – \$263 in major capital cities such as Sydney, and \$113 in smaller capitals and

Some final context - Public health and economic impacts of biomass smoke in Tasmania – comparing wood heaters and landscape fires (N Borchers – preliminary data only)

Estimated health impacts on average per year over the past 10 years

Landscape fire smoke

- 3 deaths,
- 13 hospital admissions
- 2 asthma ED visits per year.

Impacts are highly sensitive to fire conditions and 'average' yearly impacts can be misleading – almost all the above impacts were attributed to three particular years with large bushfire smoke impacts. Eg estimated deaths per year ranged from zero to more than 10 as estimated for 2019 – estimated 2019 economic impact to date \$44M.

Wood-heater smoke

- 80 deaths
- 88 hospital admissions
- 11 asthma ED visits

Economic costs - Estimated yearly costs are \$350M for wood heating (\$5,800 AUD/year/woodheater)

[Above: A/Prof Fay Johnston's presentation to the Biomass Smoke in the Human Environment \(BISMITHE\) II conference, last slide \[1\].](#)

regional centres such as Armidale ([6], Table 3.2). Adjusting for inflation, this is now \$297 and \$128. The average heater burns about 1.9 tonnes of wood in Sydney [6] and 4 tonnes in Armidale. Brand new heaters with average real-life PM2.5 emissions of 6.5 g/kg (lab test of 0.85 g/kg) therefore have estimated health costs of \$3,653 (Sydney) and \$3,304 (Armidale).

No policymaker has ever refuted these estimates, or explained why governments consider them acceptable.

Health Costs - Tasmania

A/Prof Fay Johnston's presented her group's research to the Biomass Smoke in the Human Environment (BISMITHE) II conference on estimated health costs of landscape fires and wood heaters in Tasmania. The latter had estimated health costs of almost \$6,000 per heater per year – see slide above [1].

Pollution & Health Costs - Armidale

The extent of the problem in Armidale, NSW became only too evident after an official NSW Government Air Quality station was installed in April 2018. The chart, right, from the 2018 NSW Annual Air Quality Statement shows that Armidale had 32 exceedances of National Air Quality Standards. The Statement explains that all exceedances were in winter and due to wood heater pollution. Efforts to reduce the health damage from woodsmoke air pollution have been largely ineffective because of an intense well-funded lobby campaign to protect the profits of the wood heating industry based on false and misleading information [7].

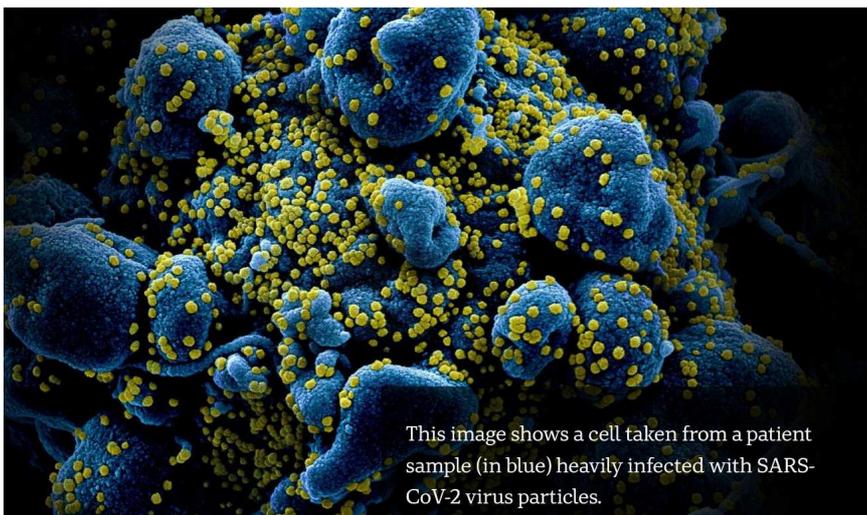
Peer-reviewed research published in 2007 put the estimated health costs of wood heater pollution at over \$4,000 per heater per year [8]. Estimates based on the current valuation of YLL [5] would be many times higher.

Woodsmoke reduces the ability of the lungs to fight infection

When mice were forced to breathe woodsmoke for 6 hours, then



challenged with a respiratory bug, 21% were dead 2 weeks later compared to only 5% that breathed oil furnace fumes or clean air [9].



This image shows a cell taken from a patient sample (in blue) heavily infected with SARS-CoV-2 virus particles.

PM2.5 Pollution and COVID-19

Researchers at Harvard compared COVID-19 death counts in over 3,000 counties in the United States (representing 98% of the population) with PM2.5 pollution. They found a 15% increase in COVID-19 death rates for every 1 $\mu\text{g}/\text{m}^3$ of PM2.5 exposure [10].

Air pollution was also linked to higher COVID-19 death rates in Italy, with mortality rates up to 12% in the most polluted parts of northern part of Italy and only approx. 4.5% in the rest of the country [11, 12].

The virus that causes COVID-19 was identified on air pollution samples at one urban and one industrial site in Bergamo province, Italy. Italian scientists are investigating whether this could enable the virus to be carried over longer distances and increase the number of people infected [13].

[Observational studies show that air pollution worsened the 1918, 1957-58 and 1968-69 flu pandemics. In China, the risk of dying from SARS more than doubled at high levels of air pollution.](#)

A single modern woodstove is likely to increase PM2.5 exposure of the downwind neighbour by at least 5 $\mu\text{g}/\text{m}^3$ suggesting a much higher risk if, the Harvard research showing a 15% increase for every additional 1 $\mu\text{g}/\text{m}^3$ of PM2.5 exposure [10] proves to be correct.

Some authorities are now taking action to reduce woodsmoke pollution to ease the health burden of COVID-19. In March 2020, British Columbia's environment ministry introduced temporary restriction on burning, saying that smoke's impact could lead to increased numbers and severity of COVID-19 cases, adding to the burden on the province's health care system. Michael Brauer, a respiratory and environmental health professor at the University of British Columbia, Vancouver, explained that, like the social distancing measures being widely implemented, cleaner air would help "flatten the curve", reducing the number of patients requiring hospitalization at any one time [14].

One wood heater/hectare, 7% increase in children under 3 needing emergency treatment

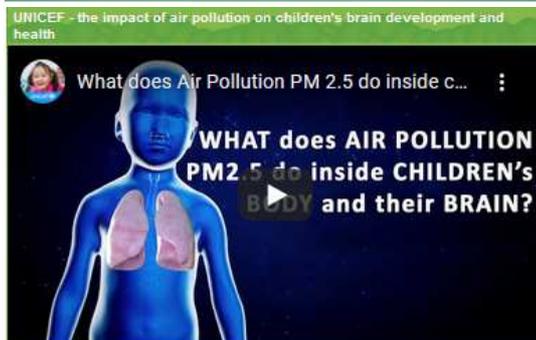
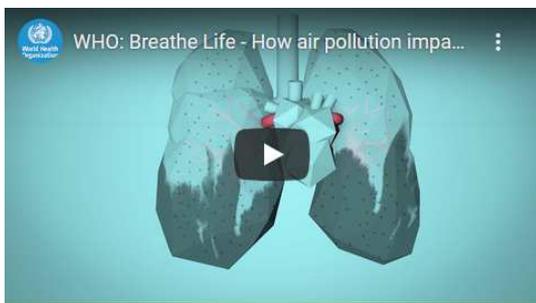
New Zealand research shows that a single modern wood-stove per hectare (meeting 2020 NSW standards) causes a 7% increase in the risk that a child under 3 will need hospital emergency treatment [15].

No safe PM2.5 level. In Tasmania, wood-smoke PM2.5 pollution over 4 $\mu\text{g}/\text{m}^3$ (16% of the current National Standard) increases the risk of hospital admission for heart attack

In Tasmania, air pollution is mainly associated with wood-burning for winter heating and from bushfires and planned burns at other times. Above a threshold of 4 $\mu\text{g}/\text{m}^3$, hospital admissions for heart failure increased by 14.5% for a 5 $\mu\text{g}/\text{m}^3$ increase in 3-day mean PM2.5 concentrations [16]. A single, modern AS4013 wood stove is likely to increase the downwind neighbour's PM2.5 exposure by much more than 5 $\mu\text{g}/\text{m}^3$.

Single wood heater can pollute 10 hectares over 10 hours

The substantial harmful effects of even a single wood-stove complying with NZ's stricter standard (than required in 2020 in NSW) are easy to understand, given the remarkably low threshold (4 $\mu\text{g}/\text{m}^3$) above which harmful effects are observed. Pollution of 6.5 grams per hour (real-life emissions of brand-new wood heaters with average lab test emissions of 0.85 g/kg) is enough to increase PM2.5 concentration over 1 hectare (100 x 100) metres by 65 $\mu\text{g}/\text{m}^3$ to a height of 10 metres. In a valley where pollution builds up, that level of emissions over 10 hours would result in health-hazardous pollution over at least 10 hectares.



Videos – UNICEF, WHO & New Scientist

UNICEF 170 sec video: [What does Air Pollution PM 2.5 do inside children's body and brain?](https://www.youtube.com/watch?v=QcS3ovdsgNI)

<https://www.youtube.com/watch?v=QcS3ovdsgNI>

WHO: Breathe Life 80 sec video: [How air pollution impacts your body.](https://www.youtube.com/watch?v=GVBeY1jSG9Y)

<https://www.youtube.com/watch?v=GVBeY1jSG9Y> Air pollution is an invisible killer that lurks all around us, preying on the young and old. Learn how it slips unnoticed past our body's defences causing deaths from heart attack, strokes, lung disease and cancer.

[New Scientist Report and Video: log-burning stoves are harming our health and speeding up global warming \(Feb 2017\)](https://www.facebook.com/watch/?v=10155097669589589)

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Recommendations – Health experts

NSW Chief Medical Officer Kerry Chant said [wood heaters are so detrimental to health she supports banning and phasing them out in built-up urban areas](#). The NSW Asthma Foundation warned that: [wood smoke emissions in winter pose a bigger immediate health danger in built up urban areas than cars or cigarettes](#). Australian Lung Foundation spokesman Dr James Markos said [wood fire heaters should be banned from urban areas](#). He said [real-life emissions from new wood-heaters have little relationship to measurements from a perfectly operated test model under laboratory conditions](#) [17].

Ecologically Sustainable Development: no new wood heaters

Complying with ecologically sustainable development principles is required under section 89 of the Local Government Act (LGA), which requires councils to consider the public interest including (a) protection of the environment, and (b) protection of public health, safety and convenience, and the 'polluter-pays' principle.

Major health, environmental and economic gains – use COVID-19 stimulus money to subsidize the replacement of wood heaters with non-polluting alternatives that have lower running costs, cause less global warming

Efficient heat pumps (also called heater-air-conditioners or reverse cycle aircon) have very low running costs compared to buying firewood. Most of the heat is from renewable sources - they move air heated by the sun from outside to inside the home. Wood heaters, by contrast, emit methane, black carbon, carbon monoxide and CO₂, so the average wood-heated home will cause more global warming over the next 20 years (the critical period if we are to keep global warming well below 2 degrees) than 50 similar homes heated by reverse cycle.

On 6 April 2020, Darebin council unanimously supported a motion to reduce the health damage from wood smoke pollution, including calling on the Victorian Government to support households with no other form of heating to rapidly switch to electric heater options through the introduction of a bulk-buy, subsidy or other incentive scheme.

With COVID-19 continuing to threaten our economies, and recent research showing that PM_{2.5} pollution has a major impact on the COVID-19 mortality rate, incentives to remove the major source of PM_{2.5} pollution in our cities and towns would have multiple benefits including stimulating the economy, cleaning up our air, protecting our health and reducing the risks from COVID-19.

Appendix – Additional Information

Christchurch's wood-smoke pollution still unacceptable, 20 years after adopting NSW's current wood heater standards

Progressively stricter wood heater emissions limits were introduced in Christchurch from 2000, when all new

wood heaters were required to have emissions ratings < 1.5 g/kg (the limit adopted in NSW from September 2019). Christchurch reduced the limit to 1.0 g/kg in 2002. The entire Canterbury area adopted the 1.0 g/kg limit on 1 January 2004.

Despite the significantly stricter limit in Christchurch from 2002 (1.0 g/kg compared to 1.5 g/kg currently required in NSW), PM2.5 measurements St Albans (a residential area of Christchurch) exceeded the World Health Organization PM2.5 standard (25 ug/m³ daily average) 27 times in 2014 and 22 times in 2015 [18]. NSW needs to meet an even stricter PM2.5 daily average standard of 20 ug/m³ from 2025. A health impact assessment review of Environment Canterbury's Air Plan noted "Most wood burning households are middle or upper income earners" [19].

To address the failings of the current lab test used in Australia, the 'Canterbury 1' test procedures were published in January 2015 to encourage the development of ultra-low emission wood burners with thermal efficiency of at least 65% that "under strict real life operating conditions can meet an emissions and efficiency standard of 38 milligrams per megajoule or emits less than 0.5 grams of particulate per kg of fuel burned".

All wood heaters installed in the Christchurch Clean Air zone must now meet the 'Canterbury 1' standard. Existing wood heaters (including those satisfying emissions limit of 1.0 g/kg in the Australian lab test) are considered so polluting they must be removed after 20 years service.

Despite the new regulations, progress in cleaning up the air is still slow. PM2.5 measurements at St Albans, Christchurch, exceeded the WHO PM2.5 standard 19 times in 2019.

Unacceptable pollution in small towns from even half NSW's current wood-heater standard

Several small towns in NZ, e.g. Alexandra (pop 4824), Arrowtown (pop 2400), Clyde (pop 900), Cromwell (pop 4896) have virtually no other sources of air pollution apart from wood heaters. These towns reduced the limit for new heaters to 0.7 g/kg and required those with AS4013 ratings over 1.5 g/kg to be removed by January 2012. Information on PM2.5 (the most health-hazardous air pollutant) is not readily available, but the four towns had respectively 42, 24, 7 and 29 exceedances of the 50 mg/m³ PM10 limit in 2012. In 2013, there were 50, 15, 9 and 24 exceedances and in 2014, 51, 48, 20 and 47 exceedances. These results demonstrate that a 'standard' that does not reflect real-life emissions (such as 1.5 g/kg on the Australian lab test) cannot provide acceptable air quality or protect public health.

Estimated Health Costs in NZ

The wood heater emissions limit adopted by NSW in September 2019 was required in NZ for all urban areas (residential blocks < 2 ha) from September 2005. As noted above, many local authorities required heaters with emissions ratings above 1.5 g/kg to be removed, so wood heaters in NZ currently have lower emissions ratings that might be expected in 2035 under current NSW policies. Despite this, wood heaters account for 56% of the estimated health costs of man-made air pollution in NZ, equivalent to NZ\$4,425 (approx. A\$4,238) per wood heater per year [20],[21].

New Scientist: wood heaters damage health & speed up global warming

Like diesels, wood heaters were once thought to be climate-friendly, but we now know that they cause more global warming than other forms of heating due to their methane and black carbon emissions [22]. A good source of easy-to-understand information is a New Scientist Report [23] and video: *log-burning stoves are harming our health and speeding up global warming* (Feb 2017) [24].

Australian Research

Australian research on real-life emissions was conducted in Tasmania in 2006 and 2007. Real-life emissions averaged 9.4 g/kg. Only 4.4% of Sydney's households use wood as the main heating (the remainder use electricity: 48.1%, gas: 23.1%, or no heating: 22.3%, [3]), but research published in 2019 found that in the NSW Metropolitan Region (NSW GMR) "wood heaters", "industry", "on-road motor vehicles", "power stations" and "non-road diesel and marine" account for 31%, 26%, 19%, 17% and 6% of population exposure to PM2.5 from human-made sources [25]. A study of air quality measurements, including PM2.5 and air toxins in Auburn, a western suburb of Sydney for approximately eighteen months in 2016 and 2017 concluded that policy-makers should place a greater focus on reducing wood-smoke pollution in Sydney and on communicating the issue to the public.

Policy Implications

The evidence presented here shows that the current lab test for new wood heaters does not reflect real-life emissions and indeed that wood heaters satisfying an even stricter standard of 1.0 g/kg were found to be so polluting that their installation is no longer permitted in Christchurch, NZ. All such heaters now have to be removed after 20 years of use.

The ‘Dieselgate’ scandal revealed that, instead of designing low-emission vehicles, companies were designing vehicles to pass a specific emissions test. In response, new tests were designed to better reflect real-life emissions.

Real-life measurements in NZ show that the AS4013 wood heater test suffers exactly the same problem – it does little or nothing to reduce real-life emissions. Environment Canterbury responded by designing a new test for wood heaters. Those that cannot pass the new test will be phased out.

Australia needs to do the same, and also consider the policy implications of its current inaction. Local councils have not been provided with any guidance about their obligations under the principles of ecologically sustainable development. What are the consequences of permitting the installation of new heaters that could damage the health of people living nearby? The NZ research cited above shows that even a single wood heater per hectare that satisfies current NSW standards per hectare increases by 7% the risk of a child under 3 will need emergency treatment in hospital. The Tasmanian research shows that any wood-smoke pollution over 4 ug/m³ (much less than might be expected from living near to a modern wood heater) increases the risk of hospital admission from heart attack. Are either of these consequences acceptable?

If not, Governments should introduce an immediate moratorium on the installation of new wood heaters until new procedures have been developed to guarantee that people living nearby will not suffer adverse health effects.

NZ Research – open fires

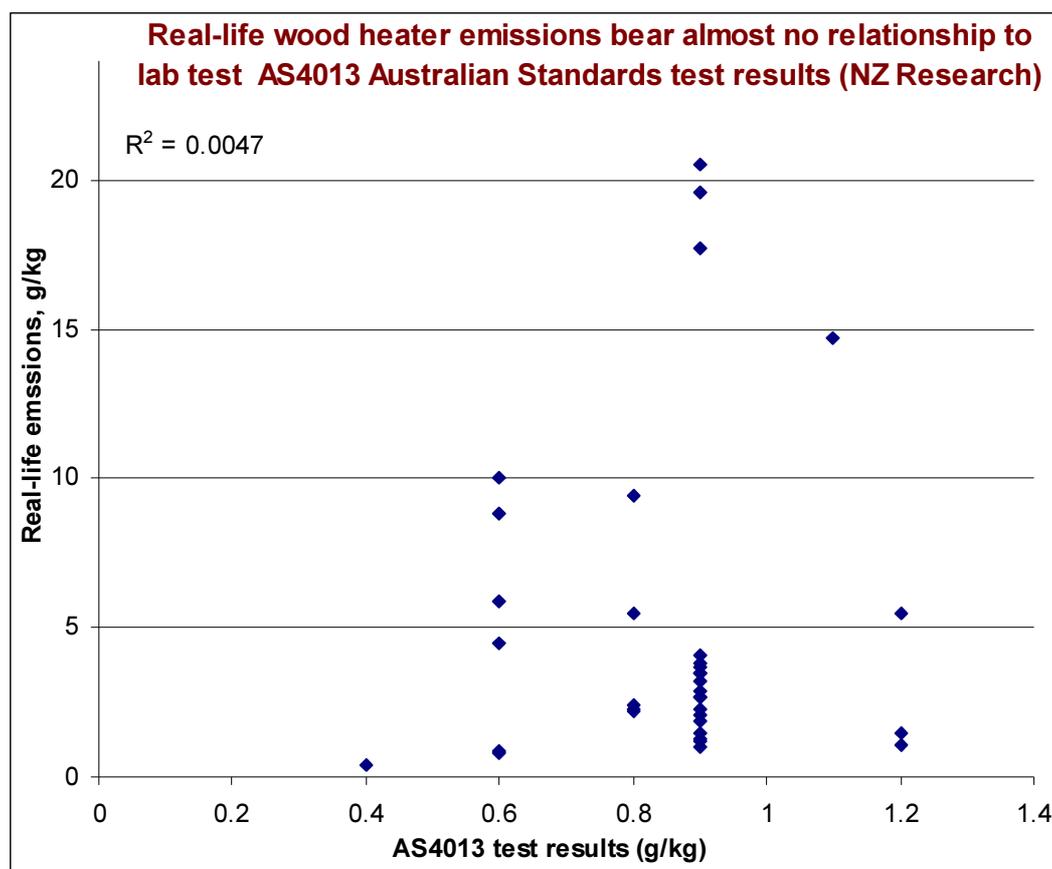
A NZ review of emissions factors in 2005 concluded that the best estimate of emissions from open fires was 9 g/kg and that fuel burnt per heating session was similar that of residents using wood heaters [26].

Comparison of real-life and AS4103 lab test results of 35 wood heaters in NZ

Data (from Wilton[27])

Year	Location	4013 lab test	Real-life	Ratio
2007	Nelson	0.4	0.5	1.2
2009	Christchurch	0.6	6.9	11.6
2009	Christchurch	0.6	10.5	17.5
2007	Nelson	0.6	1.0	1.6
2007	Nelson	0.6	1.1	1.8
2007	Nelson	0.6	5.7	9.5
2003/04	Christchurch or Nelson	0.6	11.9	19.8
2009	Christchurch	0.8	6.6	8.3
2007	Rotorua	0.8	2.8	3.5
2007	Taumarunui	0.8	3.1	3.8
2007	Taumarunui	0.8	13.8	17.3
2007	Taumarunui	0.8	3.1	3.9
2009	Christchurch	0.9	23.0	25.5
2007	Nelson	0.9	1.2	1.3
2007	Rotorua	0.9	1.8	2.0
2007	Rotorua	0.9	1.4	1.6
2007	Rotorua	0.9	3.1	3.5
2007	Rotorua	0.9	3.6	4.0
2007	Rotorua	0.9	2.9	3.2
2007	Taumarunui	0.9	2.7	2.9
2007	Taumarunui	0.9	28.9	32.1
2007	Taumarunui	0.9	5.7	6.3
2006	Tokoroa	0.9	4.3	4.7

2006	Tokoroa	0.9	4.6	5.1
2006	Tokoroa	0.9	4.3	4.7
2006	Tokoroa	0.9	4.9	5.5
2006	Tokoroa	0.9	3.0	3.3
2006	Tokoroa	0.9	3.8	4.2
2006	Tokoroa	0.9	2.4	2.7
2006	Tokoroa	0.9	3.6	4.0
2003/04	Christchurch or Nelson	0.9	26.1	29.0
2003/04	Christchurch or Nelson	1.1	18.1	16.5
2009	Christchurch	1.2	1.9	1.6
2007	Nelson	1.2	1.3	1.1
2003/04	Christchurch or Nelson	1.2	7.0	5.8
Grand Mean		0.85	6.47	7.73
Heaters rated 0.9 g/kg or less		0.81	6.39	7.92



Further information

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