

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-361
Response Date	1/05/15 7:46 AM
Consultation Point	13 MANDATORY INFORMATION (View)
Status	Submitted
Submission Type	Web
Version	0.1

Trade Competition

Pursuant to Schedule 1 of the Resource Management Act 1991, a person who could gain an advantage in trade competition through the submission may make a submission only if directly affected by an effect of the proposed policy statement or plan that:

- a) adversely affects the environment; and
- b) does not relate to trade competition or the effects of trade competition.

Please tick the sentence that applies to you: I could not gain an advantage in trade competition through this submission; or

To Be Heard

Please select the appropriate option from the following: I DO wish to be heard in support of my submission;

If so . I would be prepared to consider presenting your submission in a joint case with others making a similar submission at any hearing

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-363
Response Date	1/05/15 8:02 AM
Consultation Point	Map Proposed Christchurch tautahi Clean Air Zone (View)
Status	Submitted
Submission Type	Web
Version	0.1
Support Oppose	
Supports in Part or Opposes in Part	

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that: . Oppose

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

I understand the former buffer zone has now been incorporated into the Clean Air Zone, with correspondingly stronger sanctions against wood burning. (My computer cannot view the legend on this map). This unnecessarily forces more residents to remove their wood burners; it fails to promote the objectives 5.8 and 5.9.

Administrative convenience in managing activities in clean air zones is no excuse for depriving residents of the benefits of responsible wood-fired heating in locations where they are judged unlikely to breach mandated particulate levels.

This opposition applies to all other maps where buffer zones have been removed.

Please give precise details for each provision. The more specific you can be the easier it will be for the Council to understand the outcome you are seeking.

I seek the following decisions from Environment Canterbury:

Restore buffer zones in all maps where they have been removed.

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-407
Response Date	1/05/15 2:03 PM
Consultation Point	1 Introduction (View)
Status	Submitted
Submission Type	Web
Version	0.1

Support Oppose

Supports in Part or Opposes in Part

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that: . Oppose

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

I oppose the "PM10 Rule" of the Air Plan, which mandates the progressive removal of over 20,000 wood burners, almost all of which will be replaced by the most economic alternative, electric heating.

Reason: The "PM10 rule" has the stated purpose of protecting health by cleaning up the air. But it seeks to reduce the number of days of visible smog instead of the more health-harming cumulative exposure to invisible fine particles.

The RMA requires Environment Canterbury (ECan), when managing air pollution, to consider alternative methods of protecting health, and evaluate their efficiency (through cost/benefit analysis), and effectiveness (calculating how much reduction is expected in the health-harming particles).

One alternative is to make it easy for wood burners to start and re-load almost smokelessly, through education and by ensuring householders have plenty of kindling. Another is to find how much expansion is planned by polluting industries, and support their installing more effective pollution control instead of offsetting their expansion by removing wood burners.

Compared with these approaches the proposed regulation fails to give effect to the RMA in a number of ways:

- 1 Section 5 requires ECan to mitigate effects by enabling “people and communities to provide for their social, economic, and cultural well-being **and** for their health and safety” [emphasis added]. This means that when selecting between approaches to mitigation of the effects the social, economic and cultural costs of any proposed regulation needs to be weighed up against the health benefits. It is my submission that when compared with alternatives the proposed regulation fails this net benefit test (and in any case that ECan has failed to demonstrate that they have considered this and demonstrated that it does);
- 1 Section 7 requires ECan to have regard for “the efficient use and development of natural and physical resources” (Section 7 (b)); “the risks to the efficiency of the end use of energy” (Section 7(ba)) and “the benefits to be derived from the use and development of renewable energy” (Section 7(j)). The proposed regulation calls for the installed base of wood burning equipment to be scrapped (fails Section 7 (b)); it removes the option for an efficient end use of energy by prohibiting low capital cost conversion technology (fails Section 7 (ba)); and it will prohibit the low cost use and development of renewable energy (wood) while increasing demand for electricity generation around peak load times that will predominately use non-renewable fuel (fails Section 7 (j)). It is my submission therefore that the proposed regulation fails to adequately take into account each of these subsections (and in any case ECans has failed to demonstrate that they have considered these as required of them under Section 7).
- 1 Section 32 requires ECan to describe the economic, social and cultural effects of the proposal, in detail commensurate with the reduced well-being of so many people who strongly prefer wood burning to electric heating of their house. This is a social and a cultural issue, as well as an economic one. A warm house with a wood fire is inviting to householders and their visitors. And some people value highly the ability to take personal responsibility for their energy needs while reducing their contribution to climate change. Wood-fired heating is the most renewable household heating option, excepting only opening the curtains to let the sun pour in.

Overall the proposed regulation is poor because rather than addressing the effects directly it addresses a particular technology associated with the effect. Further, it gives undue weight to a potential hazard while ignoring the low benefits and the high costs of regulation. Sections 3 (e) and (f) of the RMA make it clear these factors that make up risk (likelihood and probability) are to be taken into account.

Removing wood burners is making more houses cold, and this has health impacts which may be as serious as from air pollution, or more. It is reducing resilience in case of blackouts. It is increasing electricity peak demands, requiring more gas fired peakers which in turn will support continuing residential power price rises. (MBIE's draft supply demand scenarios now under consultation will show this clearly).

The health and economic costs of cold houses are extensively discussed but not quantified in ECan's supporting documents. The science of health impacts is in serious dispute: the Parliamentary Commissioner has called for a review of the air quality standard that underlies the Air Plan.

Power prices will be higher than they otherwise would be, as wood burners are being replaced by electric heating thus increasing both peak demands and kilowatt-hour demands. All-electric houses create captive consumers who cannot avoid price rises.

Public controversy that followed previous Air Plans has been so great that the RMA demands a more thorough approach this time around. It must focus on the purpose of pollution control, not the proposed action of removing wood burners. It needs to be based on an independent review of NESAQ, and a true balancing of the costs and benefits of air pollution management in Canterbury.

= = =

I SUPPORT

I support all the non-regulatory moves to reduce particulate emissions that are described in this introduction, in particular the “Good Wood” programme which should enable existing wood burners to emit much less smoke. These must begin with those households most in need of efficient and affordable heating.

Reason: these moves will give the earliest reduction of particle pollution, and might even be sufficient to bring cumulative PM2.5 levels down close to background pollution levels. Already the annual PM 2.5 levels are now almost at WHO recommended levels,

Over the long term, the proposed actions to encourage development and use of ultra-low emissions burners (ULEBs) and advanced gasifier burners (AGBs) will give permanent results, at the same time encouraging local industry and employment, and improving resilience of the community to blackouts and high power prices.

Please give precise details for each provision. The more specific you can be the easier it will be for the Council to understand the outcome you are seeking.

I seek the following decisions from Environment Canterbury:

For the regulatory moves:

ECan should defer the mandated removal of wood burners until the controversial health impacts are fully explored, and the industrial offset requirement of NESAQ is fully justified through cost-benefit analysis. A review of the National Environmental Standard on Air Quality, as recommended by the PCE, is the preferred but not the only mechanism for reviewing the science of air pollution. The RMA does not allow ECan to evade responsibility for this task if it is not done nationally.

Meanwhile ECan should require removal of only those wood burners which are persistently smoky. Sanctions must progress from warnings, to fines, and only afterwards, removal of the offending appliances.

I would apply similar sanctions to persistent industrial/ commercial polluters, with warnings followed by fines if necessary.

For both households and industry/ commercial solid fuel burning, I recommend ECan offer loans or targeted rates to enable the owner to invest in a cleaner burning system, and (for householders), to upgrade insulation.

Finally, ECan should permit installation of a limited number of advanced gasifier burners (AGBs), designed to emit less than 0.1 g of carbon-containing particulates per kg wood, to enable real-life

testing, commercial development and marketing of this exciting new technology. These will have a minimal impact on pollution in the short term because of the high capital cost during the development phase.

Other innovative household and commercial clean heating systems include scrubbing of open fire emissions, recovering heat as well as reducing particulates to low levels. Also the fuelling of pellet burners by wood chips able to be delivered by auger. A very large range of wood burning technologies could be enabled by merely allowing a small number to be installed and their emissions tested in real life, without compromising the pollution levels in the airsheds as a whole.

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For the non-regulatory moves:

I seek the following decisions from Environment Canterbury:

As part of the "Lets Clean the Air" project, ECan should expand its program of visiting smoky householders, and actually provide kindling to demonstrate the proper way to start a fire with minimum smoke.

ECan should increase its funding for Good Wood programmes, including even free kindling for the many householders unable to split their own; this alone would greatly reduce the smoke. Describe any supply of free kindling as a way for ECan to "purchase clean air".

ECan should continue its urgent work to adapt Schedule 8 to adept the standard test for emissions of LEBs to a wide range of ULEB and AGB [see definitions] designs. At least for AGBs, there should be no need to test for thermal efficiency, as the pollution level is so low. This should be part-funded nationally as many other airsheds would benefit – however Canterbury is one of the most important.

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-409
Response Date	1/05/15 2:09 PM
Consultation Point	Table 2.1 General Definitions (View)
Status	Submitted
Submission Type	Web
Version	0.1

Support Oppose

Supports in Part or Opposes in Part

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that: . Support

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

I support the definitions in general, but note the three omissions:

Advanced Gasifier Burner (AGB)

Definition: A wood burner which passes volatiles outgassed from the fuel billets through incandescent charcoal, producing a fuel gas which is burned with secondary air in a separate chamber to achieve emissions of no more than 0.1 grams of carbon-containing particulates per kilogram of fuel burned, excepting at startup.

Note: Two types of household-sized AGBs are now being developed in New Zealand. The first is a downdraft burner, demonstrated by Roger Best as early as 2002 and now being commercialised. The second is a pyrolysis burner being developed by Ian Cave, which has achieved very stable

near-flameless combustion using natural draft, at an output of 3-4 kW, at a temperature at which no nitrogen oxide pollution is expected to be generated, and which leaves a deep bed of charcoal ready for the next burning cycle. Both types are able to burn unseasoned wood once the combustion is fully established. See attachments 1 - 4.

“Air quality” should be defined: the present definition based on PM10 measured daily should, following an independent review organised by MfE, be replaced by cumulative exposure to PM2.5. PM10 and daily exposure should be retained as objectives but secondary to cumulative/ PM2.5.

Clean Air Zone is not defined, nor does the Air Plan itself state the fact that the former buffer zones in several districts have been converted into Clean Air Zones. This should be reversed. The administrative convenience of a single Clean Air Zone is far outweighed by the many people who will be deprived of their preferred heating technology.

Please give precise details for each provision. The more specific you can be the easier it will be for the Council to understand the outcome you are seeking.

I seek the following decisions from Environment Canterbury:

Incorporate the definitions above, most importantly that for an Advanced Gasifier Burner.

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-412
Response Date	1/05/15 2:14 PM
Consultation Point	3 How the Plan Works (View)
Status	Submitted
Submission Type	Web
Version	0.1

Support Oppose

Supports in Part or Opposes in Part

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that: . Oppose

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

Firstly: The Plan works through use of the National Environmental Standard for Air Quality (NESAQ), revised in 2011, to mandate removal of an increased number of wood burners – even those compliant with the wood burner standard - in order to allow polluting industries to expand.

The NESAQ was strongly criticized by the Parliamentary Commissioner for the Environment, who recommended it be reviewed. She says the target should be long-term exposure to PM2.5 instead of short term exposure to PM10. The target level is unnecessarily strict and probably unattainable in view of background levels of particles. The review should determine the impact of air quality rules on other public health issues such as cold damp homes.

Decision sought: Implementation of the mandated removal of wood burners in the Proposed Canterbury Air Regional Plan (pCARP) should be put on hold until the NESAQ has been reviewed and altered to

set more realistic pollution targets, and to balance in the several different impacts on health and premature deaths.

Secondly: The plan is biased towards the interests of industry. It specifically provides for polluting industry to expand in Canterbury, in Policies 6.4 and 6.22, with residential wood burners to be removed to offset new industrial emissions. The 2011 revision of NESAQ was strongly influenced by the Jobs Summit, and a hundred industries were invited to make submissions on the revision.

In contrast, maintaining and even expanding clean wood burning will support a wide range of jobs in the community. These will include manufacture of ULEB wood burners, firewood supply, and energy efficiency businesses. This will increase the number of warm healthy houses and make many power bills more affordable. Some \$42 million was spent by ECan on the clean heat project during the first Air Plan, and submissions on the Air Plan review and on earlier consultations demonstrate the value put by the community on wood-fired home heating. An OIA request to EECA revealed the fact the 70% of their clean heat customers chose to replace older wood burners with compliant ones rather than heat pumps or clean gas or diesel burners.

Decision sought: ECan must collect evidence of the intended potential expansion of polluting industry. The many evaluation reports (Section 32) do not include information about the supposed industrial growth for which removing wood burners was to provide “headroom”. They fail to

“examine whether the provisions in the proposal are the most appropriate way to achieve the objectives [that is, to reduce pollution levels] by—

(i) identifying **other reasonably practicable options** for achieving the objectives; and

(ii) assessing the efficiency and effectiveness of the provisions in achieving the objectives;”

Facilitation by ECan of best technology for emissions reduction in new industry would undoubtedly be the most cost-effective way to maintain or improve pollution levels – unless polluting industry is not actually growing much, in which case little “headroom” is needed in pollution levels.

A neutral assessment would eliminate the bias in favour of industry over householders through an analysis of the costs involved in reducing a given level of particle pollution. This should focus on PM2.5 rather than PM10 – thus it does put the focus on home wood burning. Non-regulatory moves to reduce emissions from approved “low-emission” wood burners should be fully costed, and compared to the cost of ECan potential support for increased emissions control on industrial premises. The most cost effective methods should be preferred.

Thirdly: The Plan is supported by Cost Benefit Analyses (CBAs) that are theoretically neutral but actually favour centralised electricity supply over local provision of energy needs. The Plan virtually recommends that heat pumps replace wood burners. The critical factor in the health impact assessment is the number of premature deaths ostensibly caused by pollution. This is quantified in the CBA, while the costs of the health impact of cold houses – even the long-recognised statistics of some 1600 excess winter deaths in New Zealand - are left as a matter for political judgment. This difference in analytical treatment re-creates the bias, making the pollution seem to be the far higher cost compared to cold houses.

Decision sought: the CBA for space heating needs to be re-cast to treat health impacts from pollution and from cold houses equally, and the cost-effectiveness of policies and rules re-assessed in terms of the CBA results.

Please give precise details for each provision. The more specific you can be the easier it will be for the Council to understand the outcome you are seeking.

I seek the following decisions from Environment Canterbury:

Decisions sought are incorporated in three parts in the above "Reasons" section.

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-418
Response Date	1/05/15 2:42 PM
Consultation Point	5 Objectives (View)
Status	Submitted
Submission Type	Web
Version	0.1

Support Oppose

Supports in Part or Opposes in Part

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that: . Oppose

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

All I'm noting is that this is section 6, not section 5, in my copy of the Plan. How confusing!

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-419
Response Date	1/05/15 2:43 PM
Consultation Point	5.1 Paragraph (View)
Status	Submitted
Submission Type	Web
Version	0.1

Support Oppose

Supports in Part or Opposes in Part

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that: . Oppose

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

Reason: there's no indication of how the balance is to be struck between the health impacts (primarily Pm 2.5) in comparison to the amenity impacts (e.g smog).

Please give precise details for each provision. The more specific you can be the easier it will be for the Council to understand the outcome you are seeking.

I seek the following decisions from Environment Canterbury:

The "effectiveness evaluation" of 6.1 needs to compare effectiveness of removing smoky fires instead of wood burners, in reducing PM2.5 pollution – the ECan report correlating visible smoke with measured PM2.5 indicates the former might be more effective as it acts quickly on the worst offenders. Also more efficient because it would allow retention of the lower cost heating option in many households. The same argument applies to section 6.2.

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-421
Response Date	1/05/15 2:50 PM
Consultation Point	5.2 Paragraph (View)
Status	Submitted
Submission Type	Web
Version	0.1

Support Oppose

Supports in Part or Opposes in Part

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that: . Support

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

My support of Objectives 5.1 and 5.2 is conditional on the definition of Air Quality being revised to reflect the most important influences on health, namely cumulative exposure to PM2.5

Note that under 5.1, I copied the wrong section of my original paper, which had been written to relate to Policy 6.1. Please move it to the appropriate place.

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-422
Response Date	1/05/15 2:51 PM
Consultation Point	5.3 Paragraph (View)
Status	Submitted
Submission Type	Web
Version	0.1

Support Oppose

Supports in Part or Opposes in Part

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that:

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

No comment on 5.3-5.5 from my householder's viewpoint.

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-423
Response Date	1/05/15 2:53 PM
Consultation Point	5.6 Paragraph (View)
Status	Submitted
Submission Type	Web
Version	0.1

Support Oppose

Supports in Part or Opposes in Part

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that: . Support

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

I strongly support this. It is the key to turning the air quality controversy into a major change in policy that simultaneously protects air quality, reduces carbon emissions throughout the economy, and provides jobs locally and regionally, including likelihood of export markets.

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-425
Response Date	1/05/15 2:55 PM
Consultation Point	5.7 Paragraph (View)
Status	Submitted
Submission Type	Web
Version	0.1

Support Oppose

Supports in Part or Opposes in Part

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that: . Support

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

The main infrastructure I am aware of is Lyttleton Harbour with its diesel exhaust emissions from shipping and trucking. If this section refers also to the roading network, then what is "efficient and effective operation"? – Development and upgrading are valid for roads and would have some effect on polluting emissions, which are almost entirely from diesel vehicles.

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-428
Response Date	1/05/15 3:10 PM
Consultation Point	5.8 Paragraph (View)
Status	Submitted
Submission Type	Web
Version	0.1
Support Oppose	
Supports in Part or Opposes in Part	

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that:

- . Support
- . Oppose

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

I support improved spatial location of polluting sources, which is now highly refined in European practice: see http://ec.europa.eu/environment/integration/research/newsalert/pdf/latest_emission_control_technology_could_eradicate_pollution.htm

.

“Switching to the best available emission control technologies could eliminate 99% of particulate matter pollution ‘hitherto’ reached this conclusion by expanding the local-scale capabilities of an existing computer model that estimates the effect of best available emission control technologies could

An Austrian researcher, Ulrich Uhrmer worked recently in NZ, applying these techniques as part of an Otago University project. This work enables calculation of the likely effect of specific policies on reducing pollution in specific locations and to Source Apportionment Studies to another level.

Use of a simple box model of pollution is simply unacceptable given the some 20,000 people affected by the

Please give precise details for each provision. The more specific you can be the easier it will be for the Council to understand.

I seek the following decisions from Environment Canterbury:

As a first step, set up monitoring stations in locations particularly close to major roads, and where wood-fired home heating is common. Choose a location and focus your "Good Wood" kindling trial, and actually observe the results in terms of PM10.5 emissions. Trial the use of wood-burning stoves in Europe may prove cost-effective in setting out policies, and is now being trialled in Wellington. However more important is the need for more information, of the effect of ensuring householders are able to use recommended practices – sufficient kindling during winter months on PM 2.5 emissions nearby.

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-430
Response Date	1/05/15 3:11 PM
Consultation Point	5.9 Paragraph (View)
Status	Submitted
Submission Type	Web
Version	0.1

Support Oppose

Supports in Part or Opposes in Part

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that: . Support

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

Support, for the same reasons as for Objective 5.8

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-431
Response Date	1/05/15 3:14 PM
Consultation Point	6.1 Paragraph (View)
Status	Submitted
Submission Type	Web
Version	0.1

Support Oppose

Supports in Part or Opposes in Part

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that: . Oppose

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

This refers to objectives 6.1-6.3.

This lacks the “balance” required by the RMA. For example, the amenity statement in the RMA purpose, which is primarily impacted by the coarser fraction of PM10, should not outweigh the health-protecting statement, primarily affected by cumulative exposure to PM2.5.

As noted under “Introduction”: Section 5 requires ECan to mitigate effects by enabling “people and communities to provide for their social, economic, and cultural well-being **and** for their health and safety” [emphasis added]. This means that when selecting between approaches to mitigation of the effects the social, economic and cultural costs of any proposed regulation needs to be weighed up against the health benefits. It is my submission that when compared with alternatives the proposed regulation fails this net benefit test (and in any case that ECan has failed to demonstrate that they have considered this and demonstrated that it does);

Please give precise details for each provision. The more specific you can be the easier it will be for the Council to understand the outcome you are seeking.

I seek the following decisions from Environment Canterbury:

The “effectiveness evaluation” of 6.1 needs to compare effectiveness of removing smoky fires instead of wood burners, in reducing PM2.5 pollution – the ECan report correlating visible smoke with measured PM2.5 indicates the former might be more effective as it acts quickly on the worst offenders. Also more efficient because it would allow retention of the lower cost heating option in many households. The same argument applies to section 6.2.

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-432
Response Date	1/05/15 3:15 PM
Consultation Point	6.4 Paragraph (View)
Status	Submitted
Submission Type	Web
Version	0.1

Support Oppose

Supports in Part or Opposes in Part

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that: . Oppose

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

Two issues.

Firstly – PM2.5 should be the primary not the secondary target, and thus should be driven down at a faster rate, not delayed till 2030.

Secondly - because it skews the balance identified in S 32 (1)(a) towards industry's and against many residents' interests, by implementing the offset strategy set up by NESAQ. A better policy would be for ECan to offer significant incentive for any expanding industry to install the very best pollution reduction technology. This would restore a concept applied previously, of the regional council "purchasing clean air". The actual cost of this – per particle not emitted - is likely to be lower than the per-particle cost (to householders) of replacing a compliant household wood burner with a heat pump.

Please give precise details for each provision. The more specific you can be the easier it will be for the Council to understand the outcome you are seeking.

I seek the following decisions from Environment Canterbury:

apply a cost-benefit test based on actual data of cost of upgrading existing polluting industrial heat plant, starting with the most seriously polluting of them. Compare this to the cost-per-particle that would be spent on the non-regulatory actions. According to this, set a budget for particle removal, and negotiate with the relevant industries to maximize the pollution reduction per ECan dollar spent.

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-434
Response Date	1/05/15 3:17 PM
Consultation Point	6.10 Paragraph (View)
Status	Submitted
Submission Type	Web
Version	0.1

Support Oppose

Supports in Part or Opposes in Part

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that: . Support

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

I support use of the “best practicable option” concept, and call on ECan to “provide” for this policy with actual funding to incentivise the best options for reducing pollution. One option should be to work in partnership with wood merchants, to ensure a low-cost kindling product is always available, as the “supermarket kindling” shown on the instructional video by the Home Heating Association’ costs some \$8 or \$9 per box, in Wellington at least; regular use of this product would swamp any cost savings of wood heating over electricity.

Please give precise details for each provision. The more specific you can be the easier it will be for the Council to understand the outcome you are seeking.

I seek the following decisions from Environment Canterbury:

Collate the extensive work done to date on costs and benefits of ECan actions that reduce pollution, set a budget for ECan taking such actions, and do it.

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-436
Response Date	1/05/15 3:20 PM
Consultation Point	6.19 Paragraph (View)
Status	Submitted
Submission Type	Web
Version	0.1

Support Oppose

Supports in Part or Opposes in Part

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that: . Oppose

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

The term "Enable" is the strongest of the options for ECan to support the activity (industrial discharge of contaminants). The principle should be to balance the need for affordable warm homes, with the need for industry to contribute to economic development.

Please give precise details for each provision. The more specific you can be the easier it will be for the Council to understand the outcome you are seeking.

I seek the following decisions from Environment Canterbury:

"Balance the benefits of expansion of industry against the benefits of retaining affordable home heating for those residents using wood burners ..."

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-437
Response Date	1/05/15 3:21 PM
Consultation Point	6.22 Paragraph (View)
Status	Submitted
Submission Type	Web
Version	0.1

Support Oppose

Supports in Part or Opposes in Part

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that: . Oppose

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

This is the mechanism by which the regulations provide for new industry pollution to be offset by removing domestic log burners. It skews the decision towards industry interests. The RMA requirement to consider employment (section 32 as well as health and amenity can well be met through employment in end-use energy efficiency and local supply of both wood burners and firewood.

Please give precise details for each provision. The more specific you can be the easier it will be for the Council to understand the outcome you are seeking.

I seek the following decisions from Environment Canterbury:

delete this clause.

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-438
Response Date	1/05/15 3:23 PM
Consultation Point	6.27 Paragraph (View)
Status	Submitted
Submission Type	Web
Version	0.1

Support Oppose

Supports in Part or Opposes in Part

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that: . Support

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

I strongly support this, because ULEBs and AGBs will enable wood fired home heating to expand even in currently polluted airsheds; their costs will decrease as the market develops. They will also be important for use in industry and commercial buildings including hospitals, rest homes and schools and universities. Householders must be offered a choice of heating methods, instead of being recommended to change from wood burning to heat pumps. Attachment 5 is a compendium of comments from Sustainable Energy News, describing why some people greatly prefer wood burning over electric heating. This can be described as evidence of the likely diminishing of cultural well-being, through removal of wood burning heating choices.

Please give precise details for each provision. The more specific you can be the easier it will be for the Council to understand the outcome you are seeking.

I seek the following decisions from Environment Canterbury:

Enable a limited number of ULEBs and AGBs (perhaps 20 of each type, increasing to perhaps 100 if the first trial is satisfactory) to be installed without resource consent immediately, to facilitate commercial development of the technology. Low-cost emissions tests – of the flue gas only without worrying about the 65% thermal efficiency – must be part of the trial, and the manufacturer must undertake to correct any failure, either in the installed appliance or, if too costly, in subsequent models. A small number of trial appliances is a small pollution impact compared to the 20,000 due to be removed under the current Air Plan.

Seek co-funding from central government for development of ULEBs and AGBs. The Roger Best burner had research funding from central government, but that was withdrawn in about 2003, when EECA's promotion of heat pumps became prominent.

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-440
Response Date	1/05/15 3:25 PM
Consultation Point	6.28 Paragraph (View)
Status	Submitted
Submission Type	Web
Version	0.1

Support Oppose

Supports in Part or Opposes in Part

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that: . Support

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

I strongly support this. With rebuild of Christchurch, wood-fuelled district heating schemes should be planned for medium to high density housing, and commercial buildings with high heating requirements. ECan should be planning, or strongly encouraging, firewood plantations close to end-use demand. These may not and should not be of radiata pine. Many native second-growth species are fast-growing – lacebarks, mahoe, five-finger, ... The appropriate species for Canterbury, plus tree lucerne and other exotics that attract bees and native birds, could be planted as a multiple-use reserve to provide firewood as well as extend biodiversity near the city. This is particularly appropriate for degraded sites as tree roots will improve poor soils, and harvesting for firewood actually encourages root growth. Our experience on a quarter acre section in Eastbourne with second-growth natives has demonstrated this, with steadily increasing bird life and native insects as we harvest firewood and compost.

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-441
Response Date	1/05/15 3:26 PM
Consultation Point	6.29 Paragraph (View)
Status	Submitted
Submission Type	Web
Version	0.1

Support Oppose

Supports in Part or Opposes in Part

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that: . Oppose

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

I strongly oppose this. Older space heating appliances should generally be retained, as a valuable contribution to resilience in case of blackouts; some people will also want to use them on the coldest days when they can be run hot and nearly smokeless. The principle must be to ban the smoke not the wood burner.

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-443
Response Date	1/05/15 3:28 PM
Consultation Point	6.30 Paragraph (View)
Status	Submitted
Submission Type	Web
Version	0.1

Support Oppose

Supports in Part or Opposes in Part

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that: . Support

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

. I strongly support this. It implements "ban the smoke", and should incorporate progressive measures beginning with advice (as provided for in the Lets Clean the Air project), moving to actual sanctions (perhaps fines), and removal of the wood burner as a last resort. Note that the ECan report last December correlating visible smoke with PM2.5 indicates that visible smoke is a very good indicator of health impact.

Please give precise details for each provision. The more specific you can be the easier it will be for the Council to understand the outcome you are seeking.

I seek the following decisions from Environment Canterbury:

a formal mechanism for monitoring smoky fires, designed to be low-cost, aimed to catch the worst offenders early.

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-450
Response Date	1/05/15 3:41 PM
Consultation Point	7.14 Paragraph (View)
Status	Submitted
Submission Type	Web
Version	0.1

Support Oppose

Supports in Part or Opposes in Part

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that: . Oppose

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

I reject the PM10 off-set mechanism as described [above]. Note the "off-set" is not defined in section 2. It is defined instead in the NESAQ.

Reason: As described under policy 6.4, I believe domestic and industrial emissions should bear equal responsibility, implemented through a neutral cost-benefit test. ECan needs to propose alternatives to the progressive ban on wood burners, including its non-regulatory proposals.

Firstly – PM2.5 should be the primary not the secondary target, and thus should be driven down at a faster rate, not delayed till 2030.

Secondly - because it skews the balance identified in S 32 (1)(a) towards industry's and against many residents' interests, by implementing the offset strategy set up by NESAQ. A better policy would be for ECan to offer significant incentive for any expanding industry to install the very best pollution reduction technology. This would restore a concept applied previously, of the regional council

“purchasing clean air”. The actual cost of this – per particle not emitted - is likely to be lower than the per-particle cost (to householders) of replacing a compliant household wood burner with a heat pump.

Please give precise details for each provision. The more specific you can be the easier it will be for the Council to understand the outcome you are seeking.

I seek the following decisions from Environment Canterbury:

Apply a cost-benefit test based on actual data of cost of upgrading existing polluting industrial heat plant, starting with the most seriously polluting of them. Compare this to the cost-per-particle that would be spent on the non-regulatory actions. According to this, set a budget for particle removal, and negotiate with the relevant industries to maximize the pollution reduction per ECan dollar spent.

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-457
Response Date	1/05/15 4:17 PM
Consultation Point	7.76 Paragraph (View)
Status	Submitted
Submission Type	Web
Version	0.1

Support Oppose

Supports in Part or Opposes in Part

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that: . Oppose

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

(1) is the section that allows Low-emission burners but disallows older burners. Reason, the same as stated above, under Policy 6.29:

Older space heating appliances should generally be retained, as a valuable contribution to resilience in case of blackouts; some people will also want to use them on the coldest days when they can be run hot and nearly smokeless. The principle must be to ban the smoke not the woodburner.

(2) Oppose prohibition of wood with moisture >25%. This can be burned cleanly in a low-emissions burner by a skilled operator, and even green wood can be burned cleanly in either a downdraft burner or a pyrolysing gasifier. As before, ban the smoke not the wood or the wood burner.

(3) **strongly support**, as described in answer to Policy 6.30: This implements “ban the smoke”, and should incorporate progressive measures beginning with advice (as provided for in the Lets Clean the Air project), moving to actual sanctions (perhaps fines), and removal of the wood burner as a last resort. Note that the ECan report last December correlating visible smoke with PM2.5 indicates that visible smoke is a very good indicator of health impact.

Please give precise details for each provision. The more specific you can be the easier it will be for the Council to understand the outcome you are seeking.

I seek the following decisions from Environment Canterbury:

Ban the smoke not the wood burner. ECan needs to propose alternatives to the progressive ban on wood burners, including its non-regulatory proposals: a formal mechanism for monitoring smoky fires, designed to be low-cost, aimed to catch the worst offenders early.

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-458
Response Date	1/05/15 4:18 PM
Consultation Point	7.82 Paragraph (View)
Status	Submitted
Submission Type	Web
Version	0.1

Support Oppose

Supports in Part or Opposes in Part

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that: . Support

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

Domestic emission reducing secondary technology could be variable in its effectiveness and is not yet tested to a particular standard, so discretion is appropriate in allowing it.

Please give precise details for each provision. The more specific you can be the easier it will be for the Council to understand the outcome you are seeking.

I seek the following decisions from Environment Canterbury:

Urgently provide a testing method for emission-reducing technology, with an initial focus on household-scale emissions reduction. Once validity is proven, the requirement for a resource consent should be immediately withdrawn – as is happening with ULEBs now.

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-459
Response Date	1/05/15 4:20 PM
Consultation Point	7.84 Paragraph (View)
Status	Submitted
Submission Type	Web
Version	0.1

Support Oppose

Supports in Part or Opposes in Part

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that: ☐ Support ☒ Oppose

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

Note that this section separates out Clean Air Zones of each of the 8 or so airsheds, and subjects them to more stringent requirements. It is right to be stricter in clean air zones than outside of them. But I strongly oppose the extension of "Clean Air Zone" to include the former buffer zones; it is important for the number of PM2.5 monitoring stations to be increased, so the clean air measures are better targeted to the pollution sources.

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Make Submission

Consultee	Mrs Molly Molly Melhuish (60659)
Email Address	melhuish@xtra.co.nz
Address	42 Waitohu Rd, York Bay Eastbourne 5013
Event Name	Proposed Canterbury Air Regional Plan
Submission by	Mrs Molly Molly Melhuish
Submission ID	pCARP-466
Response Date	1/05/15 4:39 PM
Consultation Point	Schedule 8: Space heating appliance auditing process (View)
Status	Submitted
Submission Type	Web
Version	0.1
Support Oppose	
Supports in Part or Opposes in Part	

State concisely whether you support or oppose the provision being submitted on, or wish to have amendments made.

My submission is that: . ☐ Oppose

Please state your reasons for supporting/opposing/amendments sought

My reason(s) for supporting, opposing or requesting amendments to this specific provision are:

This is incomplete.

Please give precise details for each provision. The more specific you can be the easier it will be for the Council to understand the outcome you are seeking.

I seek the following decisions from Environment Canterbury:

An additional testing methodology is needed for any wood burner that claims to be an Advanced Gasifier Burner, with expected emissions of 0.1 g/ per kg wood fuel. This is so low that efficiency testing is essentially unnecessary.

The test should be of the particles emitted, with a microscopic examination to ensure no soot has been discharged (if so, then no condensable organics will have been discharged either). Microscopic examination of the filter can establish than any discharge is of inorganic fly-ash, a small amount of

which may go up the flue if there is turbulent heat exchange. This has little health impact, whereas if the filter contains dark particles this is a sign of incomplete combustion and discharge of harmful particles.

An inexpensive test of flue gas for particles would enable a range of AGB designs to be installed on a trial basis, and tested in real life.

Air Shed

Which Air Shed does this submission relate to or none

Choose one of the following three

Tick relevant topics

Advanced gasifier burners (AGBs) are a step-change beyond low- and ultra-low emissions wood burners (LEBs and ULEBs). AGBs are able to burn even green wood once combustion is fully established, with no more particulate emissions than when they burn seasoned wood. Fuel quality depends not on moisture content, but on shape and size, as awkward shapes could hang up inside the fuel bin; you want straight pieces of even length.

AGBs establish a layer of incandescent charcoal on a grate where the pre-heated primary air enters, and let the firewood warm gradually as it drops onto the burning zone. First the resins and moisture in the wood, then the cellulose, are vapourised and drawn downwards to react with the charcoal to form hydrogen and carbon monoxide. This burns cleanly, with the hydrogen quickly burning up any smoke particles that remain in the secondary chamber.

This requires the secondary chamber to be insulated so it becomes hot enough to ignite the fuel gas. In the Cave burner, the fuel bin is also heavily insulated and fully sealed, but the top of the fuel bin and secondary chamber are simply heavy steel plate acting as a stove top and space heater, like the well known Pyroclassic. The Best burner will take most of its heat off as hot water.

Both types of AGB are far less subject to operator error than LEBs and existing ULEB designs, but both could be abused by burning unsuitable materials such as treated timber, plastics, or old socks. What matters for the Air Plan is whether AGBs would create more or less pollution than LEBs or ULEBs when unsuitable fuel is used.

On the face of it, the fact that all the combustion in AGBs occurs in the gas phase means the heavy metals are likely to stay in the ash. But the arsenic will go up the flue – a complete no-no, as are any chlorine-containing plastics. And boron-containing older treated timber will corrode the refractory linings. The operator is unlikely to trust treated timber or plastics in a burner in which the combustion surfaces are contained deep within the burner itself, lest they become clogged. Any abuse therefore is sure to be less of a problem in AGBs than LEBs.

AGBs however are likely to have a very different effect – they will be a serious competitor to electricity in the home heating market. The ease of burning landscape arisings, whether dry or green, will make fuel supply very cheap for those people who can be bothered to collect it locally. The very high efficiency means less firewood to cart and store, and the ease of burning wood with high moisture content means less management of firewood storage. Their automated operation will be attractive to busy owners who are not skilled in laying a fire – the Cave burner can leave a deep layer of charcoal which cools down gradually over two or three days, and this can simply be re-lit, if necessary with barbecue fuel.

If AGBs cost on the order of \$10,000-15,000, as has been suggested in some quarters, this is still no more than the installed cost of many solar rooftop systems, though the price of those is falling as the market develops. The market for rooftop PV is growing rapidly, and that will be the case for AGBs as well. Unlike solar electricity, AGBs give extra value as they will displace electricity generated from gas-fired stations at times when transmission and distribution losses are high.

The electricity industry labels solar as a “disruptive technology” because it reduces their sales and profits. Meridian cut its solar buyback rate from the retail 25 c/kWh to 7c in summer and

10c in winter, and Contact Energy also slashed its buyback rate. This made solar rooftops uneconomic for many or most – until Vector and Solar City entered the market with some very attractive financing deals.

Environment Canterbury's PM10 rule limiting the lifetime of LEBs will make them uneconomic for many people. Instead of banning wood burning outright, ECan is requiring them to be replaced by ULEBs that cost twice as much or more, and still require high quality firewood to burn cleanly. This is an economic attack far, far outside of the requirements of the RMA which require the purpose of regulation to be identified (protecting health from air pollution) and the most cost-effective solutions identified.

Both Government and industry have heavily promoted heat pumps since about 2000. Yet Government's Warm Homes/ Clean Heat scheme found that 70% of the clean heat applicants chose wood burners over heat pumps. But these make a householder even more captive than before to the electricity industry and more vulnerable to electricity price rises.

The most exciting potential of AGBs will be realized if the industry stops punishing disruptive technologies with low buyback rates and a move to increased fixed charges. Instead they should contract with householders to supply a dual-fuel system that reduces the overall cost of electricity supply.

Unlike solar energy, AGBs can provide energy whenever the householder, or the electricity supply industry, chooses. Best's AGBs are particularly suited to storing excess energy as hot water in thermal buffer tanks, as they will capture the heat of combustion in hot water. An electric element could be added to absorb surplus electricity – while a thermoelectric element in the burner could provide around a kilowatt of electricity at times when centralised supply is short. Cave has designed his burner at a very low 3-4 kW output, suitable for smaller houses, and has less need for heat storage.

If only the electricity industry approached wood burning using a cooperative rather than a competitive pricing model, AGBs could benefit both centralized suppliers and consumers.¹ But those benefits will not be realized until or unless the current electricity surplus disappears, or else the Electricity Authority's pricing models are changed to reflect long term benefit to the national economy, including environmental sustainability and climate change.

¹ <http://www.iea.org/textbase/npsum/givar2014sum.pdf>

Woodburners a hot prospect

Community energy project shows promise

■ Jamie Adams

Industry could soon return to Wainuiomata thanks to the actions of Grey Power and the work of a Canterbury inventor.

Roger Best, of Rangiora, paid a visit on Friday to demonstrate his "downdraught" eco-friendly woodburner, which promises near-zero-level emissions.

Mr Best holds a New Zealand patent on the model, which he says has few equivalents worldwide.

His visit came after a discussion involving members of the local branch of Grey Power, Mayor Ray Wallace and Hutt South MP Trevor Mallard, after Mr Best's woodburner was mentioned at May's Grey Power meeting with Labour leader Phil Goff.

Te Kaupapa Training Ltd, better known as the Wainuiomata Training Centre in the old Bruger factory on Parkway, hosted the demonstration, with its chief executive keen to see the woodburners assembled there.

Mr Best told a small audience of local politicians and Grey Power members the burner's downdraught design meant emissions exited via the bottom, preventing ash from exiting via the flue.

"A conventional burner is a very poor combustion unit. It puts out a huge amount of soot and inorganic components," Mr Best says.

"It's been known since 2003 that the burners currently put into homes are still high-emission burners if tested properly. They put out up to 2.3g per kg. I've seen results as high as 15g per kg.

"I've worked with Gillies McIndoe (research unit) and if tested in the same way as standard woodburners we will be rated below 1g per kg."

The added bonus is its cost-efficiency — refractory liners on each side of the flue would trap heat, then after a short time let it out through the burner's outer walls.

The burner had been around since 2001, but Mr Best says "obstruction of policy" by



CLEAN AIR: Those involved in the Wainuiomata Community Energy Project surround a prototype of the eco-efficient "downdraught" burner. From left: Molly Melhuish, Trevor Mallard, Roger Best, Holly Walker, Margaret Willard and Anania Randall.

Photo: Jamie Adams / CCN010711JAWoodburner01

Canterbury's regional council, known as Environment Canterbury or "ECan", prevented further progress on it.

However, that changed after the entire council was replaced by commissioners in March 2010.

"We are lucky we now have people who are looking at what should be happening," Mr Best says.

Already restaurants in Oamaru and Queenstown have bought downdraught burners and Mr Best wants to make them commercially available.

Grey Power energy spokeswoman Molly Melhuish, who initiated the idea of assembling them here, says this could be Wainuiomata's first community energy project.

"The vision is Wainui becoming self sufficient on energy supply, through biofuel, solar and wind, using local energy sources if possible."

“The vision is Wainui becoming self sufficient on energy supply, through biofuel, solar and wind, using local energy sources if possible.”

MOLLY MELHUISH

She hopes that could expand to the training of domestic heating engineers, who would understand the heating needs of households in

the valley.

Mr Mallard thanked Mrs Melhuish for being the "genesis" of a "fantastic" idea and bringing it to fruition.

He says power output is highest between 5 and 7pm at night, when people come home from work to cook dinner.

"Anything we can do to reduce the peaking effect and bringing energy loss down is a really good thing. There's the

added value of jobs too."

Te Kaupapa Training CEO Anania Randall says as well as having his staff and apprentices building the burners in his workshop the project could also see them design different models.

"It would mean qualifications and new skills."

Another meeting is planned to get a working group established for community energy projects.

"The working group will work on many things, such as testing for regulations and potential buyers," Mrs Melhuish says.

She plans to get Mr Best to return with another prototype burner designed to heat water, and hopes the next demonstration will attract the attention of regional councillors as well as local engineers to critique it.

The Green Party's Hutt South candidate Holly Walker also attended the demonstration to express her party's support of the proposal.

Attachment 3, Melhuish submission to Canterbury Air Resource Plan, 1 May 2015
Ian Cave's first experimental MILD combustion burner

The Cave family has used two simple gasifying burners using the same combustion principle as Roger Best's on their property for more than 30 years.
The new MILD combustion system now being trialled will recycle flue gas into the primary chamber to achieve flameless combustion.



LH Side wall showing secondary air entry (lower port) and just installed flue gas extraction port for recirculation and oxygen dilution of (secondary) MILD combustion air. Insulated flue immediately above, issuing from the combustion chamber cover plate.




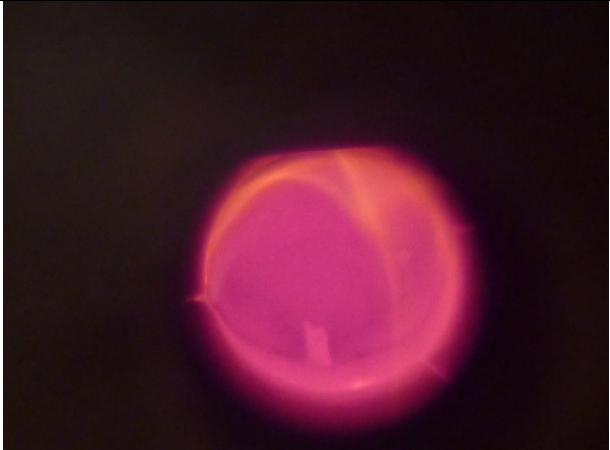
Burner top viewed from side opposite 004. 3 parallel 10 mm thick steel plates, of which the middle one is the fuel bin cap, and the RH one the combustion chamber cap with flue off-take at the far end.



RH Side face showing thermocouple leads penetrating case and the primary air inlet at the base



View into the fuel bin with small amount of charcoal sitting above a 10x340 mm slotted grate. Primary-secondary fuel gas port, centre just above the charcoal.

	
<p>Looking into the bottom of the cyclonic combustion chamber through its exit port 400 mm down from the top of the burner shell. To the left is the recently installed (and yet to be used) flue gas recycling port. Main-stream flue gas path exits at the top left of view.</p>	<p>Here is an image of near pure MILD combustion.</p> <p>The combustion chamber has internal diam of 140mm and is 460mm deep. The exit vent is 80mm in diam.</p> <p>You can see the laminar straw coloured flame at the top of the cyclone where the combustion air first meets the fuel gas stream.</p> <p>Fuel gas tangential from the left at the top, combustion air from the bottom at 9 o'clock. At the base can be seen the thermocouple housing projecting out from under the cyclone cap. The bright spot near the thermocouple is due to a small air leak through a crack in the cyclone wall.</p>

➤ In your MILD system (it's in the washing machine bowl)?

NO. its inside the 700x700 mm case of the largest F&P top loader. That size is necessary to get sufficient insulation around a fuel bin that can take 30mm long wood billets lying flat in the fuel bin. The insulation requires dense fibre glass batts as well as aluminosilicate fibre blanket around the hottest parts of the whole system, (except for the dividing wall between the fuel bin (hot retort wall) and the upper combustion chamber). The face walls are of H30 grade firebrick and high density aluminosilicate castable in the fuel bin, and Isolite aluminosilicate insulating brick in the combustion chamber and plenum space above the combustion chamber.

> I hope your drawing can indicate whether there's a cook top, Image 005 shows the top clearly. It consists of 3 10mm thick plates, of which the middle one is the fuel bin lid. Don't ask how it can be lifted by a consumer, this is an experimental rig, to demonstrate how to achieve MILD combustion in a domestic scale solid fuel burner, at very low gauge pressures. It is possible to cook at all positions on the top, which is almost 0.5m² in area.

and where else heat is taken off for space and or water heat.?

No where else, except for the loses through the walls to the room, and the sensible heat up a very short flue. *Again. .. this is an experimental rig, to demonstrate how to achieve MILD (flameless) combustion....* Once more heat extraction is applied post combustion chamber the characteristics of this experimental burner will be changed, quite likely substantially.

The space above the outlet to the combustion chamber is 400 h x 400 l x 150 mm deep, so there is scope to mess around with what-ever heat extraction is wanted including embedding a water heater inside the 155 mm thick insulating walls.

The application that interests me is the Whisper-gen (a fully sealed sterling engine electrical generator), manufacture now departed ChCh for Mondragon in Spain to service the European severe cold climate market. It requires a burner that runs around the clock, to provide central heating but it also produces a healthy 1 kW of electrical energy as it transfers heat to its cold reservoir, - a very handy heat pipe.

Attachment 4: a pdf , to be attached separately

A CLEAN WOODBURNER, VII

--- updating an efficient domestic wood heating system ---

I. D. Cave M.Sc. Ph.D.

Attachment 5, Melhuish submission to Canterbury Air Resource Plan, 1 May 2015

Comments on Sustainable Energy Forum News relating to Proposed Air Plan, April 2015

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(Efficient) wood burners provide a high quality of heating.

Quality parameters include:

The additional comfort provided by a radiative heater -- comfort is achieved at lower ambient temperatures than warm air systems such as heat pumps;

Appropriate ventilation, as air is drawn into the house to replace that which is consumed by the burner and ejected via the flue; this reduces dampness, mould growth, recirculation of germs;

Health benefits from the exercise of collecting the fuel.

Versatility -- my wood burner heats spaces, also the hot water and can be used for cooking.

Air quality measurements are, I understand, made outside, even in winter when household heaters are operating and people are mostly indoors. My nose tells me that air quality inside at such times is better than outdoors. I think there is some precipitation and filtering as air enters a building.

Ought air quality measurements to be made where the lung intakes are?

If wood burners are banned, what happens to the unused wood? Yesterday I collected a week's supply of firewood by pruning dead branches from one of my totaras. I have three dead trees to fell and process sometime . . . plus fire-less friends depend on me taking surplus wood growth from their sections.

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The proposed Canterbury Air Plan would effectively mandate the removal 18,000 existing efficient woodburners, to be replaced by very costly (heat pump or pellet stoves) that would cost more to run, or electric heaters which would mean houses are cold and damp and a minimal reduction in pollutions related illness and death would be more than replaced by illness or death from cold damp houses.

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The PCE says we should be measuring long term PM2.5's and using the WHO guidelines for this. Nelson is one of the few places that has been measuring PM2.5s albeit in a rather spasmodic fashion. You should note that we are pretty much down to the NZ National Emission Standard for Air Quality (which measures short term exposure to PM10's) even in our worst airshed, but are 40% above the guideline recommended by the PCE (long term exposure to PM 2.5s).

Personally I think the solution lies not in banning burners but in making a smoking chimney socially unacceptable - see this from Susan Krumdiek

"I did a study for Christchurch City Council in 2001 and applied my then "new" Strategic Analysis methodology and the result was that control of visibly smoking chimneys with application of a fine was the only way to deal with the ghastly air pollution problem that made us all sound like 2 pack a day smokers in the wintertime. Since then, actually, climate change has improved things a lot by reducing the number of cold nights with temperature inversions. And of course knocking down all those chimneys has been brilliant.

I stopped into the houses of every wood smoker on my bike route. Riding through a cloud of thick smoke on a cold night is enough to give you asthma. All but one of them never smoked again after I

showed them how to burn their fire without smoking and showed them what they were doing outside - they didn't know. The one that has gone back to smoking is a damp, cold nasty rental property. I think that the old log burner is the only source of heat, and every time a new tenant turns over - the smoking is back.

But hey, this is the only way to go. My research showed that the smoking is not a technology problem it is a behaviour problem and people can change how much air and how much wood they put in a fire. My research also showed that people thought it was fair to ask people who were polluting the neighbourhood to stop."

I think the proposed fines when combined with a behavioral change campaign is what SEF should be submitting on - after all anybody can make even the best logburners smoke if they want to. We just need to make sure they really don't want to and know how not to.

Cantabrians could face \$350 fines for smoky chimneys

Cantabrians could be prosecuted for having visibly smoky chimneys under proposed air plan changes. ...

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As a retired member of IRHACE (Institute of Refrigeration, Heating & Air Conditioning Engineers) and a past-president, but no longer actively involved there needs to be some comment around the use heat pumps, which are a legitimate form of space heating/cooling and hot water heating, and a means of moving heat around in a variety of applications. In my day, and hopefully it still does IRHACE works very hard to improve quality and performance within the industries it represents, and encourages its members to advise consumers on the most appropriate technology to use, and not just heat pumps.

Heat pumps are mechanical devices and as such in due course wear out. My understanding is that the economic life of most heat pumps is seven years. The capital cost of installing a heat pump is relatively high, and therefore like housing may be unaffordable to those who are not able to make ends meet. I suspect log burning fires need not be so expensive as heat pumps and are very durable. I am not sure about chip burners, but would imagine augers need to be replaced from time to time and these be relatively costly.

If I were living in a garage and my children were cold, sick and uncomfortable I would not be too concerned about the prevailing regulations, and if a brazier, or similar were lying around and there was plenty of fuel around too, like derelict houses I would not hesitate to light a match. Especially when the sun went down.

It is also worth reminding ourselves that mechanical devices, especially compressors decline in performance as use increases. My guess is that many heat pump users imagine their units are still performing as new, whereas they have gone past the 7 year itch and as such efficiency has fallen by the wayside . They switch them on and they get the heat, or the cool; but they do not have a COP meter. They may run on for 15 years, but are they getting the optimum COP? Albeit I guess designs, quality control, etc. have moved on and upwards since my day? Also penetration of the market and acceptance of the technology allows complacency to creep in with a consequential loss of performance across all elements of the industry sectors.

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In answer to a question: How much "headrom" is needed for expanding industry? Are you aware of any documents supporting the Air Plan that say how much polluting industry is actually expanding? Surely you have to remove fewer wood burners if industry is expanded less than some expected amount - is there actually a forecast??

I've not come across any. Off of the top of my head in Christchurch "polluting" industry and in most other places is contracting. It's way less than when I was a kid, or even when I left University and what does remain is considerably cleaner than it was. Any forecasts will invariably be based on history and I think that history is a very poor basis.

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I wholeheartedly endorse SEF getting involved in this, with the benefit of all the technical work and numbers that Molly has done. Thank you so much for making the effort.

= = =

Having lived in ChCh for more than 50 years, initially at a time (mid-1960s) when some 60,000 tonnes of coal were being burned mostly in open fires, and we still had a coal gas works in the centre of the city, my impression is that the local air quality has improved substantially since then!

Yes, wood smoke is now the main source of local pollution during cold, still winter evenings. We've also known for a century or more that burning clean, dry wood at a reasonable rate produces relatively little smoke, even in open fires, of which few are left anyway. Even old wood-burners can be operated relatively cleanly if dry, clean wood is used at a good fire rate. For that reason, while I'm keen for (almost) fool-proof burners to come onto the market (at an affordable price), the reality is that when fired with wet wood, sawdust and old socks, smoke is inevitable and independent of the appliance. That's why I think Molly and Susan et al are on the right track. It should be smoke that is the "enemy", not wood-burners that are past their theoretical best-by date. ECAN is going over the top on this issue and getting quite a lot of local flak for it – and a lot of "ignore" as well.

Molly's policy suggestion about connecting it to cultural well-being makes sense, too, in the context of examining or challenging policy initiatives. In ChCh, the sheer quantities of waste wood available (eg from demolition) are substantial, and a great deal is being burned by low-income people, simply to keep warm. If ECAN's more extreme ideas come to pass, people and landlords will largely ignore them, as they have done so far. If ECAN could follow Susan's example, and embark on a public education campaign to encourage a lot of other people to do so, we can surely achieve something. Maybe get a Student Smoky Chimneys Army going – after all, students in cold, damp, crummy accommodation are heavy users of wood in old burners and are also strongly-represented in 350.org and Gen Zero. A win-win possibility?!

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I'd be inclined to take a harder line on the economic costs of poor regulation in the context of the RMA.

I think the only things the regulators worry about when looking at submissions is who is setting them up for a challenge in the Env Court, so you need to cast any case in terms of their legal obligations.

The purpose of the RMA (sect 5) is to provide for the sustainable management of natural and physical resources and this includes consideration of the economic costs (including the costs of

regulatory behaviour) and these rank equally alongside health and safety (i.e. there is balancing act here).

In this case the argument is that the economic cost of the regulation and “the risks to the efficiency of the end use of energy” (sect 7(ba)) and “the benefits to be derived from the use and development of renewable energy” (sect 7(j)) are not outweighed by the health benefits. Part of the argument is that marginal electricity generation in NZ isn’t renewable, so by pushing this load (presumably in the evening peak) into electricity means you are burning gas or whatever.

I feel this where the strong ground lies – much more so than climate change and cultural issues.

The whole notion that regulation (particularly if its poorly targeted as this one) has costs often gets lost in the clamour to “do something”. *Primum non nocere*.

There are a couple of quite mainstream ideas in public economics that tend to get lost and should be referenced in the submission.

1. In general it is better to regulate on the basis of targeting the thing that causes the mischief rather than the mandating particular methods for mitigation. I’ve just done a brief submission to the Oz Dept of Env on “Working towards a National Clean Air Agreement” arguing this line. Emulsified fuel technology (that we do) is a drop in technology that reduces emissions, but regulators start saying you have to have filters as you means of compliance forcing unnecessarily high capital cost on people who might otherwise be able just pay a bit more for their fuel.
2. In general it is better to manage the risk (likelihood of damage X probability) than manage the hazard. Section 3 (e) & (f) of the RMA gives a nod in this direction. This is central to the case here. The risk of adverse health effects from the fires is low probability and relatively low level damage, whereas the economic and renewable energy cost of the regulation is absolute and easily quantified.

We’ve had the latter problem with coastal erosion on the Kapiti Coast. If all the regulator thinks about is the potential hazard they go for blanket regulation. On the Kapiti Coast there is longstanding ongoing accretion on the majority of the coast so for the majority the likelihood of damage is non-existent and regulation is unnecessary (and the local authority’s mistaken attempts to impose it created large costs for the residents directly affected and the community).

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I didn't have enough time to go through all the posts re the ECAN wood burner regulation, but my gut feeling is that the whole construct is legally quite weak in terms of equal treatment of polluting activities and particularly the lack of comparison to motor vehicles.

If the 500 mgPM10/kg fuel is the red line for wood burning in the future then my back of the envelope calculation, if correct, tells me that translated to a motor vehicle this would mean Euro 4 or 5. Euro 3 doesn't appear to be sufficient, but I had to do a bit of rough rounding with the unit conversions mg/kgfuel, mg/m³exhaust gas, mg/kWh etc. Maybe someone like Murray can do the calculation more accurately. However Euro 4 and 5 vehicles are still a minority in NZ, so how can ECAN mandate a red line for wood burners that isn't met by the majority of motor vehicles?

Furthermore if the argument for removing wood burners is that they can be operated in a way that produces lots of PM 10, but it is not proven that they could not be operated with < 500mg/kg fuel under optimum conditions (kiln dried wood, maximum air etc), wouldn't that also mean that ECAN

would have to ban all vehicles from the road, because they could (and would) have huge PM10 emissions if the air filter is almost blocked? I don't think Ecan proposes mandatory air filter checks at the city limits to prevent such issues.

I also think that Arthur's old argument is worthy of consideration: If there are 10 days per year when the limits are exceeded by 33% and wood burning is responsible for 66% of the problem, then there is no need to ban 100% of wood burning but a max of 50% (or 50% on 10 days), which in reality will boil down to the 10 - 15% worst offenders.

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[Wellington Regional Council's] Policy AQ.P47 – Domestic fires (page 55 in the draft plan) says that domestic fires will be managed by using good management practices. This is our main policy for domestic fires, which is linked to the non-regulatory Method 5: Airshed action plan for polluted airsheds (page 220).

We are moving towards the elements that would make up an action plan, and that is the recent addition of the rate-buy back scheme for domestic fires in Masterton, and some work that is beginning on social marketing for behaviour changes to the management of domestic fires at the household level. Once we are certain about these elements they will be written up into an action plan in conjunction with stakeholders, MDC and the community.

The proposed regional plan does not have any regulations to control domestic fires. We didn't go down this path because of the strong opposition from the MDC and that at best we didn't have enough evidence regulation would make a difference in a small area such as Masterton compared with longer term behaviour changes.

There are other factors than made regulation less palatable including:

1. the fact that many home owners self-collect fire wood so there is little chance to control the supply of dry wood,
2. recent evidence from NIWA shows even new woodburners fail to comply with the national standard because of the variations in wood dryness and poor operation of the fire,
3. the cost for the homeowner to make the change to new woodburners is high – running at \$6000 to \$8000 for a new woodburner. This is out of range for most people in the town (as many are on low incomes), and a large subsidy would be required to make it happen. The council has gone some of the way with the rate-buy back scheme.

Overall, we are hedging our bets that the long term advantages of behaviour change for the management of individual domestic fires will win out over straight regulation. This is where places like Ecan are heading – in spite of the having strict regulations for the past decade. More recently, in Nelson, their Air Plan has come under heavy opposition for their strict regulations and people are wanting regulations relaxed to allow time to adjust to the new woodburner requirements.

Note also, that the national standard has a regulation controlling woodburners, which is if there is a change to a new woodburner, this new burner must be compliant with the standard.

A CLEAN WOODBURNER, VII

--- updating an efficient domestic wood heating system ---

I. D. Cave M.Sc. Ph.D.

July 2011

SUMMARY

A two chamber wood burner is described in which the function of the primary chamber/fuel bin is modified to act primarily as a pyrolytic gasifier of batch loaded fuel by enhancing the level of thermal insulation of the primary chamber. By this means the large depths of charcoal developed in the base of the primary chamber are used to crack the pyrolysis gas to synthesis gas which is then readily burned in the secondary chamber with activated oxygen in a preheated secondary air stream.

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A Clean Wood Burner, v.II

Prologue

My more formal experience with wood burning began with trying to improve the efficiency of our family's small domestic open faced chip heater by inserting an inverted 250ml tin can in the centre of the grate, and building the fire around that. The can had a series of holes punched around its base, after the manner of a gas burner's distributor plate. The result was that smoke rising from the fire burned as jets issuing from the top of the can as if a conventional gas burner, when the preheated air ignited the smoke.

This was in the time of the first oil shock in the early 1970s, and it lead me on to initiating a programme at Physics and Engineering Laboratory, DSIR, New Zealand, to investigate the means by which the thermal performance of domestic wood burners could be improved. In 1975 I published a description of a two chamber domestic wood burner¹, with superior performance.

In the 36 years since then I have designed a number of wood burning systems ranging from simple room heaters up to a 1MW crop dryer. I have also built and used two whole of house wood burning units in my own family's homes over this period, and have recently refurbished both systems based on those years of experience, and the availability in NZ of new refractory materials. The results of these developments are reported here.

The 1975 publication¹ is now decidedly dated, with respect to the way materials are used and in certain critical construction details, so that the burner to be described here is very different. However the numbers derived there for gas flow rates and opening sizes have proved over the years to be appropriate for the natural draught mode of operation.

Why burn wood cleanly

With today's regulation of solid fuel burners in urban and suburban areas a more complete answer to the question of why one would want to burn wood cleanly is perhaps being lost in the focus on the visual aspects of smog in areas where atmospheric inversion layers regularly trap smoke in extensive layers at ground level. There appears to be little public knowledge of the consequences of inefficient combustion apart from the effects on the health of citizens with respiratory problems such as asthma and emphysema.

However the products of the poor combustion of wood are extremely toxic to the extent that the health hazards of wood burning have become the part of fundamental research of the fire safety of structures. Hence my use in the appendices of information from the *Harmonized Euroclass system of reaction to fire performance of building products*³, to provide a more technical description of some aspects of wood burning.

The improved efficiency of combustion is also important for wider environmental and economic reasons. The calorific value of wood ranges from 5kWh/kg for oven dry to less than 2kWh/kg for green wood. But the greatest effect of moisture in fuel is to make smokeless combustion difficult; and it is incomplete combustion that has the greatest effect on heat yield. An efficient burner has the ability to raise thermal performance by an order of magnitude. Fuel costs are drastically reduced, particulate emissions (smoke) are virtually nil, and CO₂ recycled to the atmosphere/unit of useful heat is minimised.

The Combustion of Wood

To successfully design for clean combustion it is necessary to understand the combustion process itself. In general **combustion** is a chemical process that requires two basic ingredients: a **fuel** and an **oxidiser**, usually oxygen in air. Put a small amount of energy in - with a small flame for example - and an **exothermic reaction** can be triggered that rapidly releases the energy trapped in chemical bonds in the fuel. Once initiated it is self-sustaining. This is due to the fact that some of the energy released by combustion heats up the fuel around it. This feedback process increases the reaction rate and keeps the combustion going.

Solid wood of itself does not burn. Rather the heating that occurs at the initiation of burning causes the breakdown of some of the macromolecular structure of the surface wood into smaller volatile molecules that escape into the surrounding space. On meeting oxygen in the air at temperatures above ignition point these fragments begin to react, releasing energy and generating gases, water vapour, and small solid particles – mostly unburned carbon, or soot – that is called **smoke**. **Flames** occur when large amounts of released energy generate light. In wood burning the flame is known as a **diffusion flame** because oxygen from the air must diffuse inwards towards the combustion region, while the volatiles must diffuse outwards from the charring wood surface to mix with the air. Some of the light – mainly the orange and yellow glow – is caused by incandescent soot particles generated during combustion. The redder area near the centre of the flame is at about 800 °C. The outer orange and yellow regions are hotter reaching temperatures up to 1400 °C, Fig1a.

Extreme local differences in gas temperature generated through the burning process produce severe turbulent mixing of fuel and air, while wider temperature differences result in the establishment of convective currents under the influence of gravity within the burning region, Fig1b.

In the discussion that follows it will be understood that combustion is taking place under the influence of gravity, so that a region of hot gas embedded in air under ambient conditions will be subject to buoyancy forces proportional to its absolute temperature relative to that of ambient. In considering an otherwise closed burner connected to a flue with elevated temperatures, there will in most circumstances be negative pressures within the enclosure that will draw in ambient air if an opening to the outside is made.

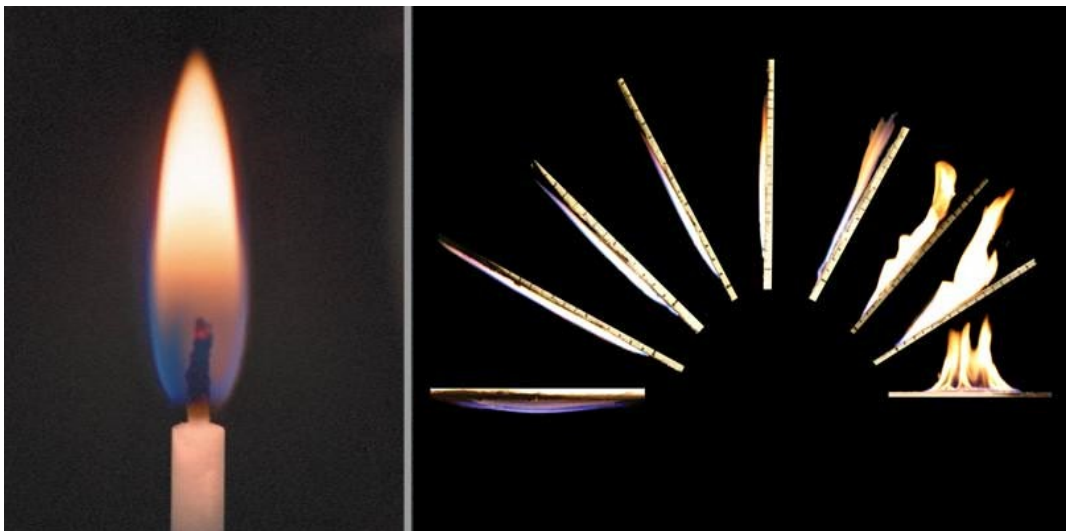


Figure 1.

a) *Diffusion flame*

b) *The “ceiling fire” on the left resulted in a blue flame flattened to the substrate. As inclination increases flame becomes more turbulent.*

Blue areas are produced when visible light is released in chemiluminescence. White, yellow, orange areas burning soot.

3 Stage Burning of Wood.

With wood fuel three stages of burning can generally be recognised.

Stage 1

A flame held to a piece of wood will at first heat the surface causing decomposition with the emission of smoke from pores in the wood to leave a chary residue on the surface.

Volatilisation, largely by **pyrolysis*** begins at 100 °C with the production of H₂O, CO₂, and CO.

And as the temperature increases production of tars, hydrocarbons and H₂ increases and production of CO₂ and CO decrease. The rate of volatilisation increases rapidly above 275 °C. Ignition from the flame takes place between 260 °C and 290 °C. As the decomposition rate increases, oxygen becomes excluded and the flame lifts off from the surface and dances about where sufficient mixing of fuel and air has taken place, initiating stage 2 burning.

Stage 2

In stage 2, gas above 450 °C ignites readily and at about 500 °C hydrocarbons dissociate. Above 900 °C tars are completely broken down. However with the progression of time as the exterior of the wood is converted to a deepening layer of charcoal, gasification slows as the inner core becomes increasingly insulated from the continuing heat flux from this phase of combustion. Finally a state is reached when the core is completely out-gassed and the gas flow through the surface has ceased allowing oxygen to again reach the surface, now a hot charcoal residue.

Stage 3

In stage 3 the hot char is first oxidised by water vapour, carbon dioxide and free oxygen, to produce carbon monoxide and hydrogen. This new gaseous phase in turn oxidises in oxygen to carbon dioxide and water with the typical blue flame (Figure 1a), to bring stage 3 to a conclusion when all the carbon is consumed. All that remains is ash at only 0.5-1% of the original wood mass.

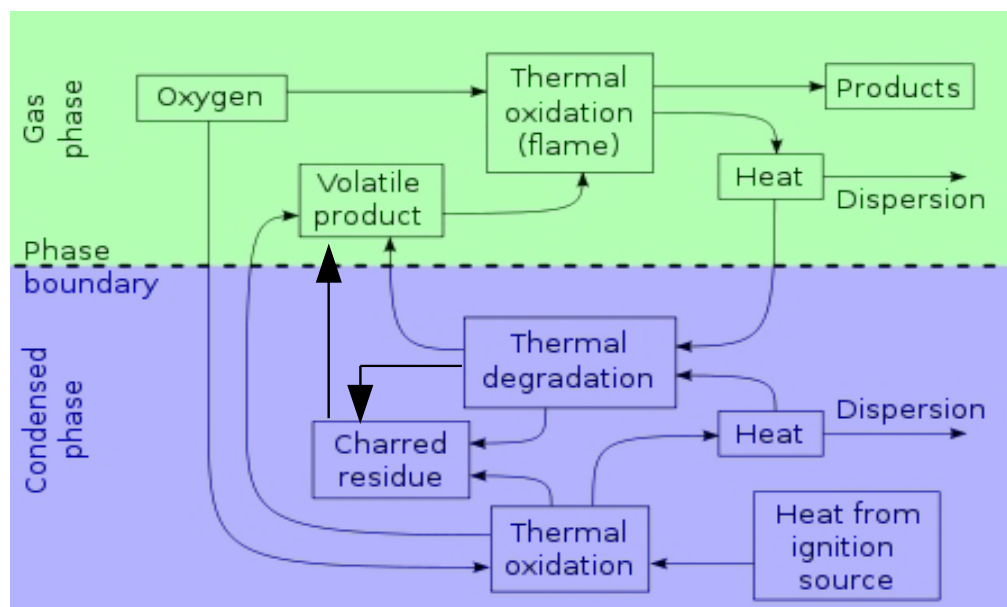


Figure 2. Processes involved in the first 3 stages of burning of a solid fuel.
(after Wikipedia² on solid fuel combustion)

*oxygen free thermal breakdown (Appendix A).

5 Stage Burning of Wood.

However because charcoal at incandescence is highly reactive in air, a bed of charcoal of 50mm depth is capable of completely stripping all oxygen from an air flow through it. The consumption of the charcoal by oxygen in stage 3 will not proceed above the 50mm level in a burning chamber filled with wood blocks. Because of this and because 20% of the original wood mass is fixed carbon considerable depths of charcoal can be developed in a well insulated fuel chamber.

Two further stages of combustion can then be considered in the design of a wood burner, with features that can virtually guarantee the smokeless combustion of an almost indifferent fuel.

Stage 4

A deeper charcoal bed reaching above the primary/secondary port in Figure 3 will allow pyrolysis gas accumulating in the fuel chamber to be drawn off into the secondary chamber through the top of the incandescent bed where it is oxygen free. Incandescent char is even more reactive with water vapour, carbon dioxide, hydrocarbons and tar than it is with oxygen so that all the volatile products of the destructive distillation of wood get broken down into a fuel gas mixture comprised of carbon monoxide and hydrogen (synthesis gas), a range of other simple gases and fuel radicals (appendices A & B); and carbon is condensed and added to the mass of char⁴ (appendix C). Thus the fuel chamber becomes a **fuel gas producer**. The discharge gas is a **high quality fuel gas** that may contain only a small amount of nitrogen, the residue of any air allowed entry at the base of the char bed to provide heat to maintain the gasification process.

Stage 5

Introduction of this cracked-out hot pyrolysis gas to a hot **secondary gas combustion chamber** where it is mixed with preheated secondary air, in which its oxygen is in an activated state, appendix B), can guarantee complete combustion.

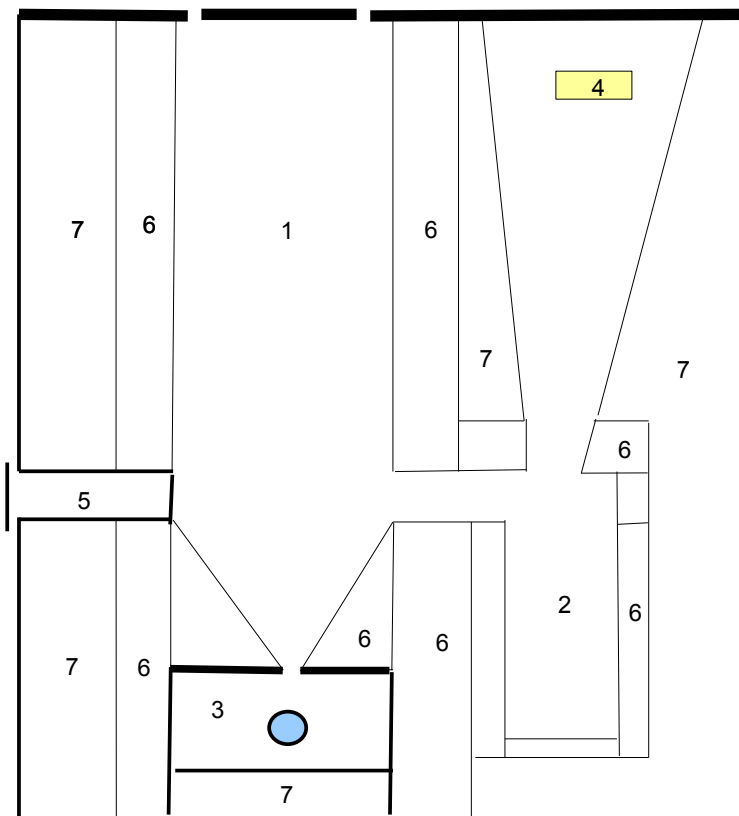


Figure 3. Schematic layout of the 5 stage woodburner through the central transverse-vertical plane:

- 1 fuel bin and gas producer with fuel door at top, grate slot at base,
- 2 secondary combustion chamber,
- 3 ash pit (with primary air entry in door indicated on front face),
- 4 flue gas exhaust duct (indicated on back face),
- 5 entry to secondary air heater,
- 6 elements of chamber walls made from castable refractory material,
- 7 fibre refractory insulation.

Fabricated steel-work in heavy outline

Drawn approximately to scale.

An advanced combustor using 5 stage burning

From the foregoing it will be apparent that 5 stage burning in the first instance requires that there be a restricted air supply to the area where the 3 earliest stages of burning take place, coupled with considerable heat retention, in order to promote the development of a deep charcoal bed.

An outline of the essentials of the new burners is set out below and illustrated with a schematic transverse cross-section in Figure 3.

Burner shell

The burner shell should be airtight, with seal-able openings for the removal of ash, input of fuel, and controllable ingress of both primary and secondary air. These provisions will ensure that only air that is to be used in combustion can gain entry. Excess air leads to unwanted cooling. The flue should be sealed to the shell and be insulated for its full length to maximise draught development. Within the burner shell the flow paths of both the primary and secondary air should be unique. i.e. it should not be possible for any primary air to reach the secondary combustion chamber or flue except through the grate and the primary/secondary chamber connecting channel. Likewise the secondary air should only be able to enter the top of the secondary combustion chamber. The only egress for fuel gas produced in the primary fuel chamber should be through the primary/secondary connecting channel into the top of the secondary chamber. These provisions are very important.

Fuel chamber

Years of experience have shown that for wood billets of 300 mm length laid horizontally in a vertical fuel chamber of 200 mm width that a grate opening at the base of the chamber of 10 x 340 mm is quite adequate to give a fire with easy start-up and fast response time. It is necessary to have control of the amount of air admitted through the grate. It will be found that the amount of primary air admitted controls the overall burning rate, (at least at start-up and until the fuel chamber reaches the deep charcoal stage). The fuel bin walls should be built to be impact, heat and thermal shock resistant, backed by 100 mm of densely packed refractory fibre insulation.

Such an arrangement will deliver a char bed of considerable depth (depending on fuel quality). Depth enough to be able to draw pyrolysis gasses off through oxygen free incandescent charcoal into an adjacent secondary combustion chamber, giving surety that those gasses are cracked-out on the hot carbon and readily combustible.

Secondary combustion air pre-heating

To further facilitate good burning the air to be used for secondary combustion is pre-heated to red heat to aid production of activated oxygen (Appendix B). This can be done by constructing an air channel around the fuel chamber at the depth of the char bed. The air is injected into the pyrolysis gas stream at the entrance to the secondary combustion chamber. The flow rate of this air needs to be controllable too and is adjusted to give maximum temperature of combustion in the secondary chamber.

Secondary combustion chamber

A secondary chamber volume of about 1 litre/kilowatt of heat output is required. Shaping it in a form to induce cyclonic behaviour will ensure that retention time and flame length in the combustion chamber is maximal.

I have found that a symmetric twin cyclone centred on the central transverse-vertical plane of the primary chamber will vortex downwards (see Figure 3). This is convenient in space terms since the exit duct from the fuel chamber into the secondary combustion chamber will be about 350 mm above the base of the burner shell, allowing of a cyclone of 300 mm depth. A pair of merged

cylinders of 100 mm diameter 300 mm depth will give a combustion volume of about 5l. and will therefore be suited to a 5kW heat output. The combustion chamber should be built from high temperature castable refractory, to resist high velocity erosion, and be backed by 50mm of high temperature insulating refractory blanket that is in turn backed by further fibre insulation to ensure high wall temperatures (preferably above the ignition temperature of synthesis gas).

To achieve easy ignition by flame in the secondary chamber the passage between the two chambers should be as short as possible. I use 50mm, but that does mean that low conductivity high temperature insulating board may need to be inserted into the wall separating the chambers, to limit the feedback of heat from the secondary chamber into the fuel chamber.

From this point the burner system is ready to receive heat exchange devices to extract heat energy from a now chemically benign hot gas stream.

Heat Exchange devices

It is only once combustion is complete that energy extraction devices should be employed. Examples could be; adsorption of radiation by a cooking top; convective and conductive transfer from the exhaust gas to the walls of an oven. But always a by-passable efficient water heater should be the final stage, to maximise overall thermal efficiency. Allowing for an overall efficiency of 85% will ensure a good draught at all times when an insulated flue is used. My present burners use double pass fire tube boilers of 16 or 20 vertical tubes with counter current and parallel flows in each section respectively. However it is not the purpose of this communication to make recommendations for energy recovery.

Aspects of construction

Images of early and late stages of assembly of the burner are shown in Figures 4a & 4b respectively.



Figure 4a

*LHS: Top of secondary combustion chamber;
RHS: Base of fuel chamber;
viewed through the water heater opening on
the rear face of the burner shell during
assembly. (Top plate temporarily in place)*



Figure 4b

*LHS: Completed secondary chamber;
RHS: completed fuel chamber;
viewed before emplacement of the top plate.*

How does it perform

The short answer is brilliantly. Its behaviour is completely predictable in terms of the theory, and it can be set up to run for a period of 24 hours on one charge of fuel with a minimum of attention, albeit to a particular heat output regime.

However to be successful the operator does need to have a good understanding of the burner's operation in terms of the differing processes taking place in each of the 5 stages of combustion.

Importantly at the outset it needs to be understood that in 2nd stage burning when a deep bed of charcoal has been established below vigorously pyrolysing fresh wood, that the primary chamber is full of pyrolysis gas which may be above its auto-ignition temperature with oxygen. Opening the fuel bin lid at this stage without taking care to discharge excess pyrolysis gas to the secondary chamber will result in a spectacular flash. And if the fuel bin lid seal is ineffective spontaneous regular small explosions can occur as leaking air builds up oxygen concentration above safe levels, which are then repeatedly consumed and replaced. These nuisance explosions can cause pressure pulses that will extinguish the flame in the secondary chamber.

Start-up from cold:

If high quality kindling, such as a single rank of air dry pine cones laid along the full length of the grate slot is used to start the preheating process, ignition in the secondary chamber can be achieved in 15-20 minutes. Follow this with ½ kg of straight air dry kindling billets to build-up further heating and once this has turned to charcoal, load another small charge of larger billets. Once this is vigorously alight the burner will be ready for a full charge air dry billets to progress 2nd stage burning. The billets ideally fit the length of the grate so that they can lie flat and parallel with minimal gaps between them and can have cross-section as large as can be passed through the fuel door, (up to 150mm). Thus 4 or 5 such billets will fill the bin. Reduce primary air, to slow to a steady burning rate in the secondary chamber. A small amount of over-fire air may be required for a short time to produce a flame long enough to ignite secondary combustion. In the current burners this is achieved by lifting one end of the fuel bin lid by a millimetre or two. Tune the secondary air to maximise combustion temperature in the secondary chamber.

2nd stage steady state burning:

From this point charcoal will be building up on the grate. Once the char depth reaches more than 50mm the primary air can be shut off as burning rate control has passed from primary air to the temperature of the primary chamber, maintained by retained heat and feedback from the secondary chamber. Depending on burning rate a full fuel charge will produce gas for 4 or 5 hours, before becoming exhausted to leave the charge converted to charcoal at stage 3.

4th and 5th stage burning:

On the way to the establishment of the 3rd stage the charcoal depth will pass through the 200mm level at which point 4th stage cracking out of the gas will commence and 5th stage burning of synthesis gas will be taking place in the secondary chamber. Reduction of burning rate maybe necessary in this stage. There are 3 strategies available. Decrease the draught developed by engaging exhaust gas flow through the water heater to a greater or lesser extent to lower the flue temperature, or open the secondary air to its maximum to extract more heat from the primary chamber, or finally put green wood in the fuel bin. The burner will happily consume green wood but the extra water vapour released will result in the consumption of charcoal through the water gas reaction.

3rd stage stasis:

Once only charcoal remains in the primary chamber all air can be shut off, and the charcoal will remain red hot indefinitely, to sit until required to start up another fuel cycle with a fresh charge of wood.

Recent advances in the Chemistry of the Combustion of Wood

The toxicity of wood smoke as noted earlier has prompted many of the member countries of the European Union (EU) to adopt, as from the year 2000, the *Harmonized Euroclass system of reaction to fire performance of building products*.

The following appendices are largely based on;

- *topic 1, Ignition and combustion of wood* in the chapter *Burning of Wood*,³ of the Euroclass System of reaction to fire performance of building products.
 - the Wikipedia entry on the combustion of solid fuels².
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Appendix: A

Pyrolysis of wood

Overall, the breakdown of solid wood in burning is a pyrolysis reaction that gives more easily oxidized, gaseous fuels. These reactions are endothermic and require constant energy input from the combustion reactions further out in the region of the flames. A lack of oxygen or other poorly designed conditions result in these noxious and carcinogenic pyrolysis products being emitted as thick, black smoke.

Wood consists largely of a series of long chain polysaccharide polymers (mostly cellulose) in which oxygen is intimately linked with carbon and hydrogen in the basic cyclic sugar (glucosidic) residues and the bridges between them, Figures 5b, 5c. A small amount of water is hydrogen-bonded to particular OH groups on the sugar rings. In addition in **fuel wood** more or less free water is present in the wood cell lumens.

Depending on environmental conditions (such as temperature, humidity, oxygen concentration, fuel moisture etc.), the pyrolysis of wood can proceed mainly along two pathways, represented in Figure 5a. The tar forming pathway, taking place at a temperature of approximately 300 °C, is related to the “normal” burning of wood, by the breaking of the oxygen bridge. In this case, pyrolysis produces a lot of tar including levoglucosan that decomposes easily into burnable gases under the influence of heat, (Figure 5b). Thermal decomposition can take place also through the char forming pathway, in which the glucosidic oxygen is removed. In this process cellulose decomposes so that the reaction products are mainly carbon dioxide and water (non-combustible), and a “backbone” of carbon as solid charcoal, (Figure 5c).

The pyrolysis of wood can yield more than 200 breakdown products. Only a few occur in significant quantities. These are charcoal, water, methanol, acetic acid, turpentine, tars, and non-condensable gases mainly CO, H₂, CH₄, and CO₂.

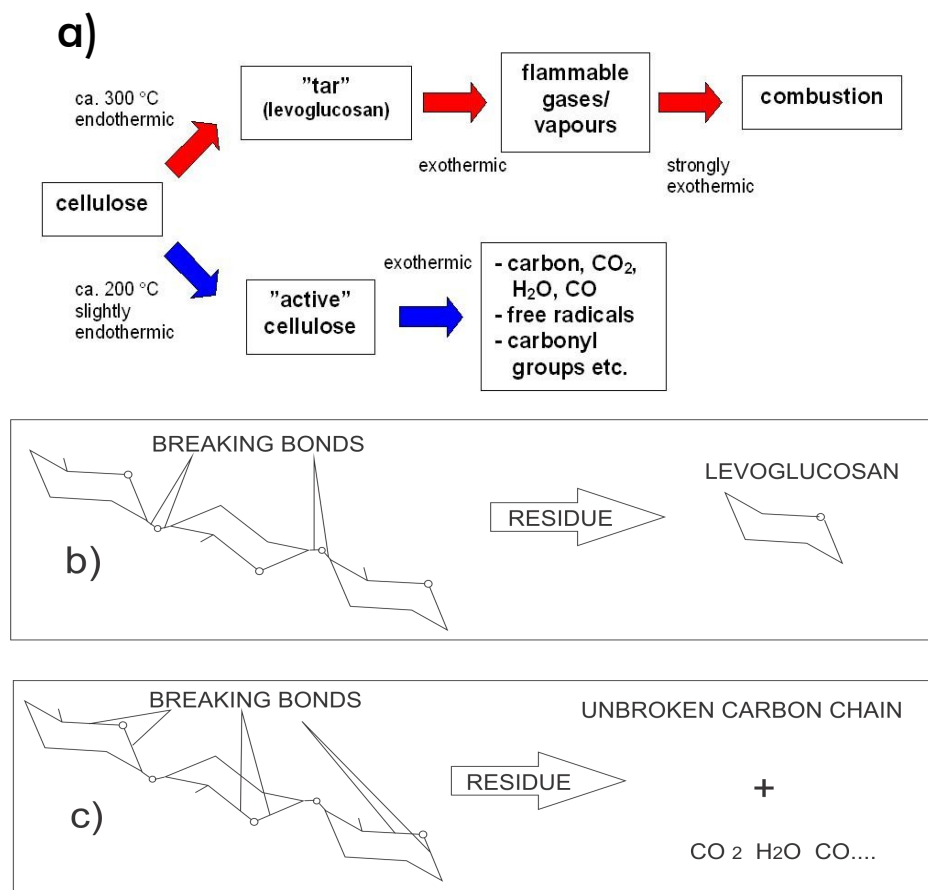


Figure 5. a) The two main reaction pathways of thermal decomposition of wood.
 b) Splitting of cellulose molecules about the bridge oxygen in the tar-forming reaction
 c) Splitting of cellulose molecules about the ring oxygen in the char-forming reaction.

Appendix B

Combustion of Pyrolysis gas

The combustion in oxygen of the products of pyrolysis is a radical chain reaction where many distinct radical intermediates participate. The high energy required for initiation is explained by the unusual structure of the O_2 molecule. Quantum mechanically the molecule can be described as having non-zero total angular momentum⁵. Most fuels, on the other hand, have zero total angular momentum. Interaction between the two is quantum mechanically a "forbidden transition", i.e. possible with a very low probability. To initiate combustion, energy is required to force the O_2 molecule into a spin-paired state, with singlet outer molecular orbitals. This intermediate is extremely reactive. The energy is supplied as **heat**. The combustion reaction produces heat, which keeps it going.

Combustion of **hydrocarbons** is thought to be initiated by hydrogen atom abstraction from the fuel to oxygen, to give a hydroperoxide radical (HOO). This reacts further to give hydroperoxides, which break up to give hydroxyl radicals. There are a great variety of these processes that produce fuel radicals and oxidizing radicals. Oxidizing radicals are short-lived and cannot be isolated. However, non-radical intermediates are stable and are produced in incomplete combustion. In the combustion of carbon and hydrocarbons, carbon monoxide is a non-radical intermediate of special importance because it is poisonous and has a high calorific value. Its

formation is almost inevitable if the mixture is rich in fuel, or if the fuel and air are poorly mixed, because excess fuel molecules mop up OH radicals before they can oxidise the carbonmonoxide to carbon dioxide.

Appendix C

Formation of Soot

The formation of soot starts with some of the simplest species found in fuel-rich flames. Molecules such as C_2H_2 and free radicals such as C_2H_3 , which are formed as the fuel molecules degrade, can react together by free radical polymerisation to generate large particles made up of long carbon chains. They can also react to form polycyclic aromatic hydrocarbons (PAHs). Then in much the same way that water droplets condense out of water vapour, the large carbon molecules clump together to form solid particles of soot. As these structures grow, they can yield structures of enormous molecular mass, such as the fullerenes C_{60} and C_{90} (buckyballs).

References:

1. Cave, I.D. (1976). A Clean Wood Burner. D.S.I.R. Physics and Engineering Laboratory, New Zealand. Report 552. 14pp.
2. Wikipedia. (2011). Combustion of solid fuels
http://en.wikipedia.org/wiki/Combustion#Solid_fuels
3. Euroclass system: Harmonized Euroclass system of reaction to fire performance of building products; Burning of Wood. *Ignition and combustion of wood*. (2000).
<http://virtual.vtt.fi/virtual/innofirewood/stateoftheart/database/database.html>
4. Our Changing World. (26 May 2011). RadioNZ National, reporting on Biochar project at Massey University, Palmerston North.
5. Atkins, P.W. (1983). Physical Chemistry 2nd Ed. O.U.P. Pp481-482.