From:	John Hoare
To:	Mailroom Mailbox; Commissioners
Subject:	Proposed Canterbury Air Regional Plan March 2015
Date:	Wednesday, 29 April 2015 10:59:14 a.m.
Attachments:	Air pollution CNEdit.doc HOW TOXIC IS YOUR PM10.pdf AIR Inc."s Submission on ECan"s Proposed (March 2015) Air Plan.doc

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Freepost 1201
Proposed Canterbury Air Regional Plan
Environment Canterbury
P O Box 345
Christchurch 8140

Dated: 29th April 2015

To whom it may concern

Dear Sir/Madam,

Please find enclosed (via ordinary post)/attached (via email) a submission from the Association for Independent Research (AIR) Inc. regarding the Proposed Canterbury Air Regional Plan March 2015. In this connection you will note that, concerning the 11 references referred to therein, instructions are provided for gaining necessary access to these i.e. in readable form requiring me to provide 2 of the references (papers) as additional attachments to this email.

For the sake of completeness I would be grateful if you could include a copy of this covering letter with our (basic) submission.

I trust this is satisfactory.

Yours sincerely,
John Hoare,
Secretary AIR Inc.

On behalf of:

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Submitter ID:

File No:

Submission on the Proposed Canterbury Air Regional Plan

Form 5: Submissions on a Publicly Notified Proposed Policy Statement or Regional Plan under Clause 6 of Schedule 1 of the Resource Management Act 1991

Return your signed submission by 5.00pm, Friday 1 May 2015 to:

Freepost 1201
Proposed Canterbury Air Regional Plan.
Environment Canterbury
P O Box 345
Christchurch 8140

A

Full Name: John Leonard Hoare **Phone (Hm):** (03) 3326707

Organisation*: Association for Independent Research (AIR) Inc. **Phone (Wk):**
* the organisation that this submission is made on behalf of

Postal Address: 76B Hackthorne Road, Cashmere, Christchurch **Phone (Cell):**

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Contact name and postal address for service of person making submission (if different from above):

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

☐ I could gain an advantage in trade competition through this submission. ***If you have ticked this box please select one of the following:***

- ☐ I am directly affected by an effect of the subject matter of the submission
- ☐ I am not directly affected by an effect of the subject matter of the submission

Signature: (signed J.L.Hoare) **Date:** 29th April 2015

(Signature of person making submission or person authorised to sign on behalf of person making the submission)

Please note:
(1) all information contained in a submission under the Resource Management Act 1991, including names and addresses for service, becomes public information.

B	☐	I do not wish to be heard in support of my submission; or
	✓	I do wish to be heard in support of my submission; and if so,
	✓	I would be prepared to consider presenting this submission in a joint case with others making a similar submission at any hearing

C (1) The specific provisions of the proposal that my submission relates to are: *(Specify page number and subsection numbering for each separate provision).*	(2) My submission is that: *(State concisely whether you support or oppose each separate provision being submitted on, or wish to have amendments made and the reasons for your views.)*

3) I seek the following decisions from Environment Canterbury: *(Please give precise details for each provision. The more specific you can be the easier it will be for the Council to understand your concerns.)*

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1. The specific provisions of the proposal that my submission relates to are:

All parts of the plan related to or concerned with **public health** (cf. page 1 – 1) as understood by:

Health http://www.who.int/about/definition/en/print.html
Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.

Public Health http://www.who.int/trade/glossary/story076/en/
Public health refers to all organized measures (whether public or private) to prevent disease, promote health, and prolong life among the population as a whole.

2. My submission is that:

2.1 As presently governed, Environment Canterbury is unduly influenced by central government to the detriment of the Proposed Canterbury Air Regional Plan March 2015 i.e. considered as a logical successor to/improvement on the current air plan dating, essentially, from 1 June 2002.

2.2 Outdated/faulty science is employed extensively in the Proposed Canterbury Air Regional Plan March 2015 thereby hampering an ability "to identify the objectives, policies and rules needed to manage the human influences on air quality in Canterbury so that our health and wellbeing is optimised' given on Page 1 – 1 as the purpose of the plan.

2.3 Due consideration of public submissions on the proposed regional air plan at the level of:

A. Public Hearings (involving independent commissioners) resulting in a formal decision
B. Appeals related to A
C. Confirmation of the finalized air plan.

demands a high degree of competency in or related to a wide range of disciplines.

However, as shown in this submission, given that:

D. The required skills are not necessarily routinely available and in fact were lacking at crucial points of the above process related to the current plan
E. Essentially the same science/science-based arguments is/are employed both in the proposed (new) plan and the current plan,

recourse to superior/additional dispute resolution procedures presumably is required if the same or similarly flawed decisions, errors of fact, etc. characterizing the current plan and now blatantly obvious in the context of the proposed plan are not to be incorporated as incontrovertible fact in the revised plan.

2.3.1 Because ECan showed no sign of being prepared to change its stance in regard to what we consider to be key issues, AIR Inc. in its November 2007 appeal to the Environment Court asked for the science underpinning the proposed NRRP (air) be reviewed by an independent panel (cf. point 16 of our original appeal[1]). However, during a preliminary "prehearing" conference, ECan's contention that this stipulation fell outside the jurisdiction of the court was supported by the sitting judge who advised that, as a means of resolving various issues, *"--- this court* (i.e. of itself) *will decide matters of science in dispute"* or words to that effect) forcing us to remove this part of our appeal under the threat of having the appeal in its entireity "struck out".

As a consequence of this development preventing, as an inherent requirement of the original appeal, access to the independent, specialized, scientific/technical advice considered desirable in some cases [2, 3], important parts of our

appeal (cf. points 8, 9, 10 and 15 of our revised appeal [4]) were ignored/overruled. As a direct result, faulty interpretations of the public health implications of urban air pollution were incorporated as part and parcel of the current (2011/2009) "operative" air plan as described in Canterbury Natural Resources Regional Plan Chapters 1: Overview and 3: Air Quality.

2.3.2 Pertaining to the circumstances whereby AIR Inc. became a signatory of the November 2008 MOU between AIR and ECan reading as follows:

> *In coming to this agreement, the Association for Independent Research [AIR] Incorporated continues its opposition to the Resource Management [National Environmental Standards Relating to Certain Air Pollutants, Dioxins, and other Toxics] Regulations 2004* (NESAQ), *and maintains its position that managing indoor air quality is necessary to achieve public health outcomes, but accepts that its appeal to the PNRRP is not the process within which to advance these positions,*

since appropriateness of the clause *"--- AIR Inc. --- accepts that its appeal to the PNRRP is not the process within which to advance these positions"* was decided primarily by legal counsel acting for the respective parties, this result clearly is/was less than satisfactory from AIR Inc.'s point of view. Particularly since AIR Inc.'s misgivings in 2007/2008 concerning the validity of a 2004 NESAQ-type approach to air quality regulation were known as early as November 2000 [5] to be entirely justifiable scientifically (see below).

Consequently, given the arbitrary nature of the position taken by the Court (cf. 2.3.1 above), there appears to be no substantive/fundamental reason why AIR Inc.'s appeal should **not** have been a legitimate/opportune process within which to confirm or refute either in general or specific terms the appropriateness of at least one of the two positions referred to. As it is/was, given the end point achieved, important questions pertaining to the PNRRP were left unresolved thus nullifying/defeating the purpose of AIR Inc.'s appeal in the public interest (cf. 2.14 below).

2.3.3 The numbers of premature deaths (435) and hospital admissions (180) attributed on page 1 – 2 to air pollution measured as PM10 have little or no substance in reality and hence are unsatisfactory and/or irrelevant from a planning point of view not least because:

A. There is an absence of clinical or other substantive evidence of the (relatively large) numbers of premature deaths and cases of sickness claimed as having been caused mainly by the "**domestic fire component"** of the total PM10 present
B. The matter of the alleged prematurity of deaths attributed to deficient urban air quality due to air pollution typically is left unstated or unresolved i.e. in terms of the change in life expectancy and causative factors involved or likely to be involved cf. 2.3.3 H below
C. The estimate of 1.5 years/18 months as the degree of prematurity pertaining to the allegedly avoidable premature deaths provided by MfE (May 2004)in their Section 32 analysis of the NESAQ is unrealistic/unverifiable viewed in the context of the whole and/or recognized, urbanized, portions of the Canterbury population
D. Instances of death or ill health implied above as being amenable to remediation via the proposed air plan cannot be identified or confirmed
E. The alleged "polluting" effect is likely to be so small as to be insignificant considered alongside more important and/or "remediable" confirmed causes of ill health or death (see below)
F. Remediation of the "outdoor" PM10 to the extent required under the NESAQ or equivalent standards or limits identified in the plan will compromise severely the ability of significant numbers of people to provide the ambient (mainly indoors) conditions they require/desire in the interests of their own and/or public health
G. The advice proffered in the abstract of the November 2000 publication "Quantification of the Health Effects of Exposure to Air Pollution", Report of a WHO Working Group [5] reading:

Quantifying the impact of air pollution on the public's health has become an increasingly critical component in policy discussion. Those responsible for any health impact assessment must address important methodological issues related to both its design and conduct. A WHO Working Group examined several of these issues as they applied specifically to assessments of air pollution. The Group concluded that the most complete estimates of both attributable numbers of deaths and average reductions in life-span associated with exposure to air pollution are those based on cohort studies. Time-series studies would continue to contribute to scientific understanding of exposure–response relationships. The Group identified sensitivity analysis as an intrinsic part of impact estimation that is critical for quantifying the uncertainty of the estimates. Such analysis should consider deviations of the conditions in the target population from those in The assessed population, which would plausibly affect estimated pollution effects

has, either deliberately or unintentionally not been heeded/followed through by ECan and/or those responsible for/desirous of assessing the actual health consequences of the proposed air plan.
H. On account of points A-G above and for several other reasons (see below) the reference provided by ECan – HAPINZ (Health and air pollution in New Zealand) Study (updated 2012) – is unlikely to be a satisfactory/reliable source of information regarding actual health effects consequent upon urban air pollution in Canterbury

2.4 Information provided on page 1 – 2 of the Proposed Air Plan related to **Contaminants**:
2.4.1 Concerning PM10, the statement

> "------ *Acceptable levels of PM10 have been set nationally by the NESAQ, based on the World Health Organisation Guideline for PM10. This is a limit of fifty micrograms of PM10 per cubic metre (50µg/m3) averaged over a 24 hour period. One exceedence of this standard is allowed each year and targets for compliance with this health-based standard are set for each polluted airshed.*"

is inaccurate/misleading. Rather it needs to be appreciated by all concerned that the WHO stipulates **no** particular number of exceedances "allowed" per year considered as binding. In fact WHO recommends that each situation be/needs to be regarded as a special case as per "--- *governments should consider their own local circumstances carefully before using the guidelines directly as legal standards".*[6]

Moreover, while MfE chose in 2004 "one exceedance per year of WHO's PM10 guideline" as **the standard to be aimed for and ultimately enforced nationally**, this certainly was not done on the basis of AIR's written advice (to MfE).

As presently arranged, 1st September 2020 is the final date for NESAQ (PM10) compliance everywhere in Canterbury i.e. regardless of the degree of non-compliance presently. Accordingly, ECan's claim (above) "---*targets for compliance with this health-based standard are set for each polluted airshed.*" is misleading/untrue given that in the interim everything, everywhere, is effectively subservient to achieving (by 1/9/2020) the "**one** exceedance/year maximum" required according to the NESAQ.* Consequently, to the extent that 20 (Christchurch) and 35 (Timaru) exceedances/yr are representative of the challenge currently facing ECan whereby continued dimunition of domestic heating via traditional means is demanded i.e. if compliance with the NESAQ is to be achieved, significant additional ill health/mortality attributable to increased physiological stress (e.g. hypothermia cf. the publication by P. Moller [7]) seems likely.

* NB Using the same WHO PM10 guideline, the EU allows **35** exceedances per year for (outdoor) air quality as a standard with the USEPA also comparatively lenient (one exceedance allowed per year of **150**µg/m^3 as a standard) compared to the one exceedance (maximum) per year allowed as a standard in New Zealand with no and/or inadequate reasons given for the greater stringency demanded here.

2.4.2 Concerning PM2.5 in regard to:

A.

> *" ---- is a component of PM10 that is made up of even smaller particles. Due to their smaller size they can get deeper within our lungs*."

this emotive/contentious statement is more accurately presented as:

> *"------ is a component of PM10 consisting of particles ≤ 2.5 µm potentially capable on account of their greater inherent respirability of causing more harm on a* ***mass/mass basis***"

B.

> *"---- There are no national guidance values for PM2.5, but the World Health Organisation recommends a limit of 25 micrograms of PM2.5 per cubic metre (25µg/m3) averaged over a 24 hour period. It is likely the World Health Organisation guidance values for PM2.5 are regularly exceeded in all of Canterbury's polluted airsheds. Monitoring shows these values are regularly exceeded in Christchurch and Timaru.*"

the latter statement, in the absence of detail pertaining to:
i) the number and extent of daily exceedances influencing the annual average
ii) the likely specific or average exposures city-wide,

similarly lacks precision/is misleading.

Taking points i) and ii) above into account, a maximum annual average real life exposure level for Christchurch and Timaru residents of ca. PM10 15µg/m^3 **–** quantitatively equivalent to a value for PM2.5 of 10µg/m^3 **-** seems likely to pertain currently. Given the relatively low levels of the potentially harmful co-pollutants present and providing that significant contributions (to the PM) from "non-remediable", probably relatively harmless, naturally-occurring sea salt, "dust", pollen, etc. are taken into account (not done currently) and provided also the confirmed public health-sustaining, collateral (warming), benefits of domestic wood-burning appliances are freely acknowledged as an inherent part of a viable air plan, adequate air quality ought therefore to apply and/or be available to the people of Canterbury as a matter of course as things stand. Meanwhile, where identification of pollution "hot spots" are associated with specific localities, focused remedial action thereto would appear to be the best practicable option as opposed to the ill-directed, "broad brush", approach favoured by ECan.

2.4.3 Concerning **visibility issues** the causal role of particulate air pollution is sometimes alluded to. Clearly, many different types of solid, liquid and gaseous natural and anthropogenic emissions to air are capable of acting as nuclei for the condensation (e.g. of atmospheric water) processes probably mainly responsible. However, given the present state of knowledge, there appears to be no way of discerning which specific sources/natural phenomena are involved ordinarily. Accordingly, ECan needs to ensure that domestic (heating) fires are not blamed inordinately for any potentially harmful or inconvenient 'smog'/fog/haze observed as a rule or in specific instances.

2.5 As suggested by the recent publication "The state of air quality in New Zealand" by the Parliamentary Commissioner for the Environment Dr Jan Wright [8], the NESAQ (PM10) is of limited/uncertain value as a means of regulating urban air quality in New Zealand. As recommended therein, a review of 5 key features of the NESAQ is warranted as follows:

A. Whether $PM_{2.5}$ should be measured across the country in airsheds where there is likely to be a problem;
B. The value of setting rules for $PM_{2.5}$ and for long-term exposure;
C. Whether the PM_{10} short-term rule still has value;
D. The impact of air quality rules on other public health issues, such as cold, damp, homes
E. How air quality policies might be designed so as to achieve progressive improvement

Broadly speaking, based on its own research [7], AIR Inc. supports these conclusions/recommendations of the PCE.

2.6 According to Section 35 subsection (1) of the RMA

> *Every local authority shall gather such information, and undertake or commission such research, as is necessary to carry out effectively its functions under this Act** or regulations under this Act.*

As shown by the PCE's commentary referred to above and also by letters, published papers, critiques, etc. authored by ourselves either sent/copied to ECan or otherwise available via the public domain, the very foundations of both the Proposed Air Plan and the earlier plan, being NESAQ (PM10)-based, are fundamentally flawed/suspect. Yet ECan would appear to be ignorant of/impervious to such advice whereby the present **review** process accordingly is threatened/compromised.

2.7 ECan's definitions of Air and Ambient air quality, as provided in Chapter 1 of the earlier plan, are incompatible with public health, well-being, etc. as described under Section 5: Purpose of the RMA.[9] This follows through the plan being confined to control of the outdoor environment without any consideration of the effect on the indoor environment (where people mostly reside). As an example of the adverse consequences of such 'built-in" bias, the PCE in her commentary observed that public health experts have called for the use of unflued gas heaters to be phased out owing to their ability to release water vapour and nitrogen dioxide (and, if not maintained well, carbon monoxide) directly into the room yet, as presently provided for, ECan makes no provision in the Proposed Air Plan for controlling/optimizing such hazardous activities/emissions.

2.8 While statutory justification for both the current and proposed air plans ultimately is based on the NESAQ, economic justification of either plan ultimately hinges on the value of a statistical life (VOSL) = +$3.56 million based on road accident statistics cf. http://www.hapinz.org.nz/HAPINZ%20Update_Vol%201%20Summary%20Report.pdf However, since people dying as the result of a road accident are aged 40-45yr on average whereas the (weak) associations describing the urban air pollution-mortality relationship involve people ≥ 65yrs old, use of VOSL = +$3.56 million-type methodology in the latter context is inappropriate/illogical (cf. 2nd, 6th and 7th reference listed under

reference 7 below). Meanwhile, ECan's earlier claim that "winter air pollution creates serious health problems for thousands of people each year" is, following a complaint to the Advertising Standards Authority [10], confirmed as unsubstantiated.

2.9 Concerning point 2.8 above, the opinions provided in paragraph 4, Section 4-3, on page 33 of the Section 32 analysis (Consideration of alternatives, benefits, and costs) of the proposed air plan stating:

> *Social, cultural and environmental effects are typically difficult to monetise because there are no agreed methodologies, data is difficult and expensive to obtain, and there is no clear direction from the Courts that they have found monetization to add value to decision-making* -----

are similarly unhelpful. Since practically everything connected with amelioration/loss of public health involves, ultimately, costs or savings expressed in monetary terms, to not put or at least not attempt to put a realistic dollar value on such considerations would appear, in the present context, to amount to dereliction of duty. In any case, ECan's Section 32 analysis here is, we believe, characterized by a lack of practicality.[11]

2.10 Concerning the earlier (current) air plan in respect of concessions granted as a result of AIR Inc.'s earlier appeal to the Environment Court pertaining to installed "non compliant" domestic (wood) burners namely:

A. Operation during the period 1 October – 31 March freely allowed as a permitted activity
B. Retrofitting allowed, in principle, as a means of pollution minimization/control
C. Use of suitable "smokeless" fuels allowed, in principle, as a means of pollution minimization/control
D. Use of weather forecasting allowed, in principle, as an effective means of predicting/minimizing the recording of air pollution episodes as NESAQ-type "exceedances,"

all (excepting, possibly, that described under B above) of the aforementioned concessions and related conclusions reached/recommendations made by AIR Inc. in its earlier submission to ECan (cf. reference 10) appear to have been ignored by ECan in the context of the proposed air plan.

2.11 Because the proposed air plan is based on stringent (compared to the US and EU) PM10 24hr average-based NESAQ-type limits enforceable nationally irrespective of important regional/community differences and with the potential for "user-friendly" remediation as discussed above (cf. point 2.10) not taken up, failure to investigate fully the best practicable option approach in our opinion severely compromises ECan's proposed plan.

2.12 Failure to recognize/acknowledge that air pollution is a natural consequence of ordinary human activity frequently involving significant co-benefits is, we believe, a dominant feature of the proposed air plan. To this extent prohibition of the burning in an ordinary domestic context of **all** plastic - including, therefore, significant (by volume, at least) amounts of e.g. discarded polyethylene chemical formula $(C_2H_4)_n$, polypropylene $(C_3H_6)_n$ or similarly constituted moulded or extruded plastic material eminently suitable thereto as relatively clean burning/non-toxic **kindling** material - is, we believe, draconian/unnecessary.*

* Thus a single translucent plastic (polyethylene) milk bottle makes an excellent firelighter through its ability under "start up" conditions to burn/melt relatively slowly with the production of little or no smoke or other 'nasties' in the form of dioxins/PCBs, HCl, cyanides, aromatic-type compounds, etc., etc. Several other similarly identifiable waste plastic and/or paper products fall into the same category and hence are capable of being conveniently utilised in this manner (cf. **3.11** below) but not recognized by ECan

2.13 Similarly punitive is the proposal to ban outright the use of non-approved domestic (wood) burners when it is clear these are useful/can be safely used on many occasions when the risk of significant air pollution is low and/or significant collateral benefits may accrue. Thus during the summer months little harm and much pleasure presumably derives from the use outdoors of BBQ, pizza ovens and similar devices intended for cooking food. To some extent, fuelling such devices with wood is, or could be within reason, a viable option here.

Meanwhile, during and/or the aftermath of snow/hail, flooding, earthquake, gales and similarly disruptive events known/liable to occur at any time of the year in Canterbury, the potential public health-type benefits offered by wood-fuelled heating appliances are likely to far outweigh the harm caused by or potentially due to any additional air pollution produced simultaneously. For such reasons for ECan to consciously set about eliminating, permanently, provision for domestic heating locally via wood combustion would seem mistaken and/or risky in the extreme.

2.14 Concerning the MOU described under 2.3.2 above:

A. Consequent upon knowledge existing prior [5] to:
i) publication of the NESAQ in 2004
ii) AIR Inc.'s appeal in 2007 (cf. 1st reference listed under reference 7 below)
as well as similar knowledge confirmed more recently, [7]
many of the public health related conclusions and inferences pertaining to the existing NRRP (air) relevant to AIR Inc.'s appeal thereto are now known to be highly dubious and/or wrong in fact.
B. Given that, to the best of AIR Inc.'s knowledge at the time, an appeal to the Environment Court was the only option available, the statement AIR Inc. " ---- *accepts that its appeal to the PNRRP is not the process within which to advance these positions"* misrepresents AIR Inc.'s position/begs the question, at least partially
C. As AIR Inc. sees it, the statement provided under B above confirms that, rather than an appeal hinging on the truth or otherwise of scientific fact, AIR Inc.'s appeal stimulated legal manoeuvring, positioning, etc. on the part of ECan from its position of superior power, resources, etc. in this latter respect
D. Given the points made under A – C above, considering also powers granted under the CERA Act (?) whereby appeals made against the proposed (March 2015) air plan are to be made directly to the High Court, the present public submissions process accordingly would appear to have considerable potential for proving even more problematical/an exercise in futility.

3. Decisions from ECan requested by AIR Inc. (in no particular order)

3.1 Withdraw the Proposed Air Plan March 2015 explaining both the reasons for doing this and implications vis a vis the current plan.
3.2 Related to appropriate due process related to this submission, arrange for a suitable/independent panel of experts to examine, review, etc. the science underpinning both the existing air plan and the proposed (new) one with the aim of distinguishing, as much as possible, fact from fiction, the practical from the impractical, 'good' science from 'bad' science.
3.3 In the context of any future proposed Air Plan, redefine Air and Ambient air quality to include both outdoor and indoor air.
3.4 Based on the latest information available, accept as inappropriate public health-wise vis a vis the NESAQ (and hence the proposed air plan):

A. The meaning of (ambient) air quality
B. The maximum number of "allowable "exceedances/yr of particulate matter PM10 measured as the 24hr average.
C. Current opportunities for satisfying local/regional air quality requirements under the RMA

3.5 Based on the latest information available, accept as being appropriate/purposeful:

A. A new suite of national environmental standards for ambient air quality measured as particulate matter
B. Collection, outdoors, under the prevailing 'ambient' conditions of air samples for the purposes of routine (statutory) monitoring
C. Determination of the "volatile/semi-volatile" organic material comprising the TSP = Total Suspended Particulate matter ≤ 100×10^{-6} meters (aerodynamic) diameter present in the sample collected
D. Determination of "non-volatile" TSP
E. Manipulation of the results obtained enabling estimation of likely acute (e.g. 24hr) and/or chronic (e.g. annual) average exposures
F. Measurement of PM2.5 either directly or by extrapolation from known PM10 values
G. The EU standard for PM10 measured as the 24hr average or, **preferably**, that for PM2.5 (exposure) measured as the annual average
H. Re-evaluation, in terms of this submission, of the cost-benefit justification for any given air quality standard or guideline chosen
I. A suitable combination of all the above A. – H.

3.6 Based on 3.5 I. above and notwithstanding point 3.5 G. above adopt as an intrinsic part of any future proposed air plan a working guideline approach for PM taking into account the climatic, economic, demographic, housing, energy sources, natural emissions to air and other factors relevant to desired public health outcomes for the community of interest.
3.7 As part of any proposed NESAQ revamp, advocate for retention of the existing design standard of 1.5g/kg of wood burned at 65% minimum thermal efficiency as per AS/NZS 4013:1999 and AS/NZS 4012:1999 respectively.

3.8 Alternatively if, in the interests of compliance with whatever PM-based air quality standards are in place or proposed, lower emission limits and different testing methods are seriously contemplated confirm beforehand that such changes:

A. Are feasible/effective technically bearing in mind the vagaries of, and likely disparities between, testing of burners and the particulate air pollution (as measured) produced subsequently
B. Do not lead to significantly higher costs and/or undue commercial/financial risk bearing in mind that the current cost to householders wishing to e.g. upgrade to a locally manufactured "low emissions-approved", appliance of reasonable quality is of the order of $4-5,000 maximum "all up" whereas an upgrade (or potential new installation) based on an approved "Ultra Low Emitting Burner" is likely to cost significantly more than that.

3.9 Concerning 3.8 above whence definition of an ultra low emitting burner provided on page 2 – 6 of the proposed plan is considered useful/necessary, in the interests of accuracy amend this to read:

> " ------- to achieve an emission and efficiency standard of 38mg/MJ **useful energy** when tested to simulated real life conditions as set out in Schedule 8."

bearing in mind that, without the qualifying term **useful energy**, the efficiency of the device is/could be very much an open question.

3.10 Encourage the use/development of "smokeless" solid fuels (including those derived from commonplace, otherwise "smoky", material) for use in ordinary, enclosed, domestic- and industrial-type burners.
3.11 Circulate/notify a list of common plastic objects/materials typically or potentially ending up as municipal sold waste (MSW) considered suitable for use as kindling in a modern, enclosed-type, domestic wood burner.
3.12. As an environmentally-sensitive, potentially "all embracing", solution to the problem of MSW disposal in Christchurch with co-benefits aimed at satisfying local space heating requirements sympathetic to the requirements of a viable air plan for Canterbury, ECan to actively support/encourage efforts directed towards justifying the utilization of such material in a state of the art municipal incinerator.
3.13 Encourage/incentivise appropriate methods of fuelling, maintenance, etc. of domestic cord-wood burners
3.14 Abandon, partly for economic reasons, the 15yr maximum lifetime restriction on domestic (wood) burners replacing this with a requirement to have the burner and flue regularly checked by a licensed inspector/chimney sweep. cf 3.8 above
3.15 Make provision for detection/correction/shutting down of poorly operated/maintained, i.e. "smoky" burners.
3.16 In regard to 3.14 above, householders to be particularly vigilant during the winter months 1st April – 30th September.
3.17 In urban areas ECan to freely permit subject to reasonable constraints regarding e.g. general fire risk and effect on neighbours:

A. Use (day or night) during the period 1 October – 31st March of "non compliant", woodfuelled, domestic fires/burners whether installed indoors or outdoors
B. Two "burn-ups" of dry, vegetative-type, waste per property per year during the same "summer" period (daylight hours only).

3.18 Actively discourage the use, for space heating purposes ordinarily, of unflued, cabinet-type, LPG, kerosene, diesel or similar heaters.
3.19 Encourage the development of locally made appliances and retrofittable devices enabling readily available (solid) fuels to be more efficiently/cleanly burned commensurate with affordable public heath (goals).
3.20 Set up an advisory system whence the public is appropriately warned of pending meteorological conditions, etc. whereby:

A. Internationally recognized unacceptably high levels in the atmosphere (outdoors) of:

i) chemically (re)active substances capable of "acute-type" health effects e.g. nitrogen oxides, sulphur oxides, carbon monoxide, ozone and various gaseous or volatile/semi-volatile organic substances/material/fractions
ii) cumulative or otherwise "slow acting" types of potentially health-harming substances

are likely/unlikely.
B. Levels/"exceedences" of PM10 or PM2.5 (minus "background", measured as the 24hr average) approaching those favoured by the EU (as a standard) are likely/unlikely.
C. Low/high temperatures, high/low humidity, strong winds, frost/snow, etc. are expected/likely to involve

significant public health risks including those attributable to poorly performing/non-operational heat pumps.

3.21 When making public pronouncements related to urban air quality, refrain from disseminating information lacking a sound, solid, practical/scientific basis.
3.22 Redraft or otherwise modify existing initiatives so as to address and/or make good the concerns discussed above.

References.

1. Appeal by AIR Inc. to the Environment Court dated 14 November 2007 containing points 8, 9, 10, 15 and 16 reading, respectively:

(point 8) The approach by the Canterbury Regional Council has been alarmist, and that the link between air pollution and health effects is based on incomplete, statistically-oriented data. Estimates of the effects of PM10 pollution on health and mortality are not consistent with many of the recorded statistics.

(point 9) The Plan, which addresses the effect on health from "ambient" air quality, ignores the fact that people spend the majority of their time indoors. As such, people are not exposed to the levels of air-borne pollutants suggested. The Plan does not address the effects of indoor air quality on health, or propose measures to control indoor air quality.

(point 10) In response to this issue, the Commissioners state that indoor air quality is a private issue, and that it is not appropriate to address these issues through the RMA. This essentially excludes indoor air quality from the scope of the Plan, and as a result it is submitted that the importance and effects of "ambient" (or outdoor) air quality on health are grossly overstated.

(point 15) The reason for these appeals is that the restrictions are unnecessarily stringent given the huge gaps in the science involved

(point 16) The relief sought is for Chapter 3 and the relevant parts of Chapter 1 to be rejected, and for an independent panel of experts to review the scientific basis and methods to facilitate regulation of environmental air quality.

2. cf. Dr Royden Somerville QC Chapter 5: Additional Dispute Resolution in HANDBOOK OF ENVIRONMENTAL LAW (Rob Harris ed., 1st ed. 2004). cf. page 171 concerning use of technical panels; page 180 concerning scientific and technical disputes. Available at Christchurch City Libraries.

3. The Trustpower Wairau River Hydro Power Proposal: A review of the processing of the resource consent applications. 11 Establishment of the Hearing Panel (2006). Available at: http://www.mfe.govt.nz/publications/rma/trustpower-wairau-river-hydro-power-proposal-review-processing-resource-consent-17

4. Appeal by AIR Inc. to the Environment Court dated 18th January 2008 wherein points 8, 9, 10 and 15 of its 14th November 2007 appeal were left intact and point 16 thereto was modified to read:

The relief sought is for the parts of Chapter 1 and Chapter 3 relevant to the above appeals to be rejected, or such other relief as gives effect to the concerns raised.

5. "Quantification of the Health Effects of Exposure to Air Pollution", Report of a WHO Working Group (November 2000). Available at: http://www.euro.who.int/__data/assets/pdf_file/0011/112160/E74256.pdf

6. WHO (Europe). *Air Quality Guidelines Global Update 2005.* (See Introduction p6).
Available at: http://www.euro.who.int/__data/assets/pdf_file/0005/78638/E90038.pdf?ua=1

7. As shown by:

"Interpretation of 'ambient' in the context of Air Quality Management" by J.L.Hoare (Clean Air and Environmental Quality, May 2005). Cf. To view this paper see email from AIR Inc. to ECan dated June 30th 2014.

"Limitations of the scientific basis for the management of air quality in urban New Zealand" by John L Hoare (NZ Med J., March 2011). Cf. To view this paper see email from AIR Inc. to ECan dated June 30th 2014.

"Excess winter mortality, wood fires and the uncertainties" by P. Moller (NZ Med J., March 2011). Available at: http://www.nzma.org.nz/journal/124-1330/4562/content.pdf.

"How toxic is your PM10? A review of some aspects of the HAPiNZ reports" by P. Palmer (CASANZ 20th Conference, July 2011). To view this paper see email version of covering letter related to this submission.

"Comments on US EPA's projections of mortality reductions achieved by reducing levels of particulate (PM-2.5) in our ambient (outdoor) air" by Peter A. Valberg, September 2011. Available at: http://democrats.energycommerce.house.gov/sites/default/files/documents/Testimony-Valberg-EP-EPA-And-Cement-Sector-Regulatory-Relief-Acts-2011-9-8.pdf

"New Directions: Questions surrounding suspended particle mass used as a surrogate for air quality and for regulatory control of ambient urban air pollution" by John L Hoare (Atmos. Environ., July 2014). Cf. To view this paper see email from AIR Inc. to ECan dated June 30th 2014.

"Dubious use of fine particle mass-based standards for regulating urban air quality in a hypothermic environment" by J.L.Hoare (Chemistry in New Zealand, April 2015, in press). To view the final draft of this paper see email version of covering letter related to this submission

8. March 2015. Available at: http://www.pce.parliament.nz/assets/Uploads/The-state-of-air-quality-in-New-Zealand-web4.pdf

9. As per:

5 Purpose

- *(1) The purpose of this Act is to promote the sustainable management of natural and physical resources. (2) In this Act,* ***sustainable management*** *means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their* health and safety *while—*
- *a) sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and*
- *b) safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and*
- *c) avoiding, remedying, or mitigating any adverse effects of activities on the environment.*

10. Communications dated 30th June 2014 from AIR Inc. to ECan via email to mailroom@ecan.govt.nz and ordinary post in regard to: My basic submission. Submission: ECan Air Plan Review due 3rd July 2014; cf. page 3 under point 4.3

11. cf. Letter from AIR Inc. sent via email on 24th March 2015 addressed to Canterbury mayors (copied to ECan Commissioners)

JLH 29th April 2015

Dubious use of fine particle mass-based standards for regulating urban air quality in a hypothermic environment

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Keywords: *air quality, particles, regulation*

Biography

John Hoare studied for his BSc (1957), MSc (1st Class Honours, 1958) and PhD (1962) degrees at Auckland University College, his postgraduate theses being devoted to the chemistry of natural products. During 1961-1964, as a recipient of a Wool Research Organization of New Zealand Inc. Fellowship, he investigated physical and chemical properties of human hair and wool at the University of Leeds, Yorkshire and at the USDA laboratories, Albany, California. During 1964 -1978 he carried out research (mainly at WRONZ's laboratories located at Lincoln, Canterbury) into aspects of wool colour, natural yellowing of wool, bleaching of wool, wool grease recovery/refining, wool scour effluent treatment and allied subjects. From 1978 - 1999 he worked as a technical consultant/engineer for De Spa and Co. Ltd, Woolscourers, Woolston, Christchurch. For the last 14 years he has worked, in retirement, as an active member and Secretary of the Christchurch-based Association for Independent Research (AIR) Inc., aiming, as its stated objective, "*To assess and comment on the scientific basis for public health and resource management policy with particular reference to air quality issues*." The present paper represents, in part, a consequence of such objectives.

Abstract

In New Zealand, outdoor levels of the common air pollutants show considerable regional and seasonal variability; judged by world standards, average values are low. In winter, supplemental space heating using relatively inexpensive solid fuels is often employed domestically. Arbitrarily chosen National Environmental Air Quality Standards (NESAQ), based on a PM_{10} 24 hour average limit of 50 µg/m^3, severely restrict such heating. On a mass/mass basis, the gaseous-volatile/semi-volatile fraction is presumably more injurious, or potentially so, than that comprising the inhalable, essentially non-volatile, particulate matter. Also, in New Zealand regulations controlling urban air pollution define air exclusively as that existing outdoors, ignoring the health consequences of indoor air and/or indoor lifestyles. For these and other reasons, estimates concerning lives that can allegedly be potentially saved by reducing air pollution focused solely on compliance with PM_{10}-based standards are both quantitatively and qualitatively suspect.

Global health

Firstly, what is meant by the term global health? Logically, global health means the collective health of individual human beings amounting, ultimately, to family, community, country and populations worldwide. Consequently, responsible governance pertaining to public health involves encouraging people to, as much as possible, take good care of themselves and each other independently of government , ensuring key natural resources and environments are appropriately managed or controlled and adopting an inherently conservative approach, bearing in mind the steadily evolving nature of scientific knowledge, economies and population dynamics generally.

Air pollution versus air quality

Insofar as the relationship between air quality and public health is concerned, this undoubtedly is a very controversial topic particularly in the context of enforceable policy related to the control and/or regulation of urban air pollution. Typically, suspended fine particulate matter mass less than 10 and 2.5 µm (PM_{10} and $PM_{2.5}$ respectively) determined outdoors is employed as a surrogate for all the harmful consequences allegedly observed or expected pertaining to likely exposures. Since, compared to the recognised causes of death or ill health, the substantive effect of specific instances of ordinary urban air pollution normally are indeterminate, distinguishing between the *actual* consequences and associated hypothetical mortality/morbidity *estimates* related to reduction of the pollution usually is left unresolved to the detriment of affordable, ethical, public health-implicated policy.

Thus according to the WHO[1]

"*….for 2008, the number of premature deaths attributable to urban outdoor air pollution is estimated to amount to 1.34 million worldwide. Of these, 1.09 million deaths could be avoided if the mean annual Air Quality Guideline values of* $PM_{10}=20\mu g/m^3$ *and* $PM_{2.5}=10\mu g/m^3$ *were implemented."*

Clearly this statement is ambiguous and can be taken as meaning either *could*, in the sense of following directly i.e. would/will or *could* in the sense of being possible but by no means certain, with no way of knowing which of these is correct or intended by the author of the report in question.

Real, attributable, deaths?

Given that numbers of deaths cited typically are derived from very small relative risk factors i.e. RR ≈ 1.00 (where RR = 1.00 means zero effect and RRs > 2-3 generally are required if implications of causation are to be taken seriously[2]), not much confidence can be placed in such claims. This is particularly so where, as is usually the case, the crucial exposures are ill-defined, the individuals allegedly affected cannot be identified nor can the substantive causal factors be established with any certainty. In effect, ordinary citizens are being asked to accept the reality of and to fund something they, personally, may never relate to, understand well or benefit from in any substantive way.

Clearly there is a lot at stake here professionally – careers, reputations, industries, economies, statute law, embedded legislation, etc. Whatever the precise explanation, science as a discipline currently is coming a poor second to political expediency employed extensively in the context of urban air quality regulation.[3-5] Thus, for costing purposes, the methodology employed involves i) calculating statistically – from daily mortality data - the number of deaths allegedly attributable to variable (elevated) levels of air pollution and, hence, the number of lives potentially salvable/deaths avoidable in the absence of such pollution and ii) multiplying together such estimates and the monetary value (e.g. NZ$3.56 million; value of a statistical life)[6] ascribed to the average person dying as a result of a road accident. Typically, very large sums of money as potential net positive benefits are estimated thereby leading to calculation of favourable cost/benefit ratios.

Unfortunately, whereas such traffic-related deaths on average involve people aged around 40 years of age, air pollution is most likely to manifestly affect or harm frail, elderly, people.[7] Hence, rather than attempting to justify control of urban air pollution in terms of 'saving' valuable lives, small extensions to (or in some cases detractions from) the lives of already elderly people (cf. population ageing) ought to be accepted

instead as a more realistic end result.[8] Also it needs to be acknowledged that such changes are likely to merge more or less seamlessly with the common scenario of steadily increasing life expectancies (2-3 years/decade currently in New Zealand; average life expectancy of approximately 80 years) having little to do with air pollution.

Meanwhile, the situation in Christchurch, New Zealand (population approximately 350,000), exemplifies what can happen when well funded, stridently promoted, authoritatively-couched environmental policies are, nonetheless, ill-conceived and/or mismanaged.[9] Unfortunately, because the topic is complicated, what follows here necessarily deals with only a cross section of the more important aspects.

Confounding issues

Climate

Typically, mortality is highest during the winter virtually everywhere.[7,10] Comparing the North Island of New Zealand e.g. Auckland (averaging 7-15^0 C in winter, 15-24^0 C in summer) to the South Island e.g. Christchurch (averaging 2-11^0 C in winter, 12-23^0 C in summer) reveals large variations in climate. Yet identical standards (i.e. NESAQ[11]) for permitted air pollution apply everywhere in NZ irrespective of the different domestic heating options available or other local and regional environmental, economic, and demographic distinctions. Sometimes the prevalence of frost or snow and other circumstances favouring low temperatures or otherwise inclement conditions outdoors ensures that provision of adequate warmth indoors is by no means a simple or assured matter.

It follows, therefore, that excessive environmental or other zeal may be a recipe for genuine personal hardship or worse, particularly in the case of elderly or similarly susceptible people of limited means cf. fuel poverty. Having conceded this point, simple logic in the interests of good governance dictates that: a) standards for air pollution measured outdoors ought to reflect the fact that many interconnected properties of the local environment are capable of influencing public health both positively and negatively and b) policy-makers/governments desirous of controlling ordinary urban air pollution need, before taking any major, far-reaching, steps, to as much as possible i) take the wider picture into account ii) provide *full* justification, readily understood by ordinary people, for their actions iii) ensure that if mistakes are made these are able to be rectified quickly and with as little collateral damage as possible.

In recent times, assisted by the implementation of various Regional Natural Resource Management Plans formulated by local and regional government, the need for such commonsensical measures have been ignored or overruled possibly in the interests of promoting, ahead of everything else, a “clean, green, 100% pure” image for New Zealand.

Indoor versus outdoor air

As already indicated, for regulatory purposes Ministry for the Environment (MfE)[12] and Regional Councils such as Environment Canterbury (ECan)[13] define air solely in terms of that found outdoors, i.e. where the measurements are made.

However, because *exposures* of interest often occur elsewhere these may not be reflected well by measurements made on air sampled outdoors. Aware of this, the US Environmental Protection Agency (USEPA)’s definitions of ambient[13] are both self consistent and scientifically robust, i.e.

<u>Ambient Medium</u> (USEPA): Material surrounding or contacting an organism (e.g. outdoor air, indoor air, water, soil, through which chemicals or pollutants can reach the organism).

Whereas, according to Environment Canterbury:

Ambient air quality is the air quality in a general area, outside buildings and structures. It includes air over a wider area and air subject to localized discharges, e.g. street level discharges. It does not include indoor air, air in the workplace, or contaminated air as it is discharged from a source.

How did this difference and confused picture come about? Clearly, air as a natural resource is mostly located outdoors. Hence it would appear influential New Zealand government officials thought that this explained everything and were unaware of, or attached insufficient importance to, the seemingly benign or neutral indoor environment. Also they clearly did *not* have as a primary concern the public health and safety implications of New Zealand's Resource Management Act[14], the purpose of which is described as follows:

5 Purpose

- *(1) The purpose of this Act is to promote the sustainable management of natural and physical resources.*
  *(2) In this Act, **sustainable management** means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their* health and safety *while—*
- *a) sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and*
- *b) safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and*
- *c) avoiding, remedying, or mitigating any adverse effects of activities on the environment.*

Either way these same bureaucrats have succeeded in creating fear amongst the population at large that ordinary urban air pollution kills – directly, unambiguously - as many as 182 people each year (approximately 7% of the total deaths)[15] in Christchurch alone even though substantive (i.e. clinical/autopsy) evidence to this effect is completely lacking. But, evidently, not sufficiently "deadly" as to discourage Environment Canterbury from declaring an NESAQ amnesty following a major emergency in Christchurch:

> *"….The priority for Environment Canterbury over the last two winters has been to ensure people in damaged properties stayed warm and this priority will continue for winter 2013.*
>
> *….the replacement of older heating sources should reduce particulate air pollution over time. In the short term, however, the need for emergency repairs to heating systems has meant that legislation to prosecute those using polluting older wood burners and open fires has been temporarily relaxed for earthquake damaged homes for the winter of 2011."* [16]

But, given that laws embodying the NESAQ still prevail and cannot (legally) be challenged even though the science employed thereto appears to be seriously flawed, not indefinitely!

Origin of acute effects

Regulatory policy focused on PM_{10} 24 hour average (as in New Zealand) assumes that associated *acute* effects are prevalent. Such effects, presumably, are attributable ***less*** to elemental carbon, ammonium nitrate, crustal dust, sea salt and similar comparatively inert, non-volatile, material (conveniently determined by weighing) and ***more*** to the gaseous (e.g. NO_2, CO, SO_2, O_3) and organic volatile/semi-volatile co-pollutants present.[17]

"Collectable" naturally-occurring substances possessing irritant/allergenic/infectious properties e.g. pollen, bacteria, viruses, moulds, etc. are an exception here. Similarly, various mineral-based dusts, metals, tobacco smoke, etc. potentially contribute to serious illnesses and disorders such as cancer, usually following many years exposure. Typically, however, much uncertainty exists regarding actual causality in such cases, mainly because of the large number of extraneous confounding factors involved. It is simpler, in a regulatory context, to focus on acute exposure-type monitoring *assuming this can be done accurately and that the results are relevant to the actual health effects.*

Problems related to sampling and monitoring

Being particularly susceptible geographically, Christchurch regularly exhibits "temperature inversion" phenomena during the winter under calm conditions which serves to concentrate the pollutants. Also, because a few, relatively low-lying and hence poorly drained, predominantly residential (St Albans) and/or "industrial" (Woolston) suburbs are especially prone to air pollution attributable to solid-fuelled stoves, boilers and similar equipment, this is where sampling for "worst case scenario" air quality measurement has traditionally been carried out.

Nowadays, such sampling is assumed to reflect maximum (peak) concentrations relevant to NESAQ (PM_{10}) compliance. Generally speaking, other sites of interest (e.g. traffic-related) give little cause for concern ordinarily regarding emissions of CO, SO_2 and NO_2 at any time of the year. Meanwhile it seems fair to conclude that, considering all the suburbs and great diversity of living and working conditions that go to make up the whole city, if the Christchurch "airshed" is to be sampled representatively insofar as personal exposures are concerned, many more sampling sites are needed than just the two or three "outdoor" sampling arrangements currently provided for. Nonetheless, a steady decrease in PM_{10} levels has been observed over the years with peak levels roughly halved compared to 50 years ago.

Taking such things into account, the inhabitants of Christchurch almost certainly are exposed to relatively low levels of potentially harmful air pollution although few would think so considering the admonishments regularly delivered by MfE and ECan, mostly pertaining to NESAQ (PM_{10}) non-compliance.

Basis of regulations - credible or not?

Meanwhile, although compliance with a PM_{10} 24 hour average-based standard is demanded, cost/benefit justification allied to alleged health risks is ultimately based on PM_{10} *annual average-type* epidemiological studies mainly conducted overseas such as in the USA.[6] Also, the relevant calculations involve a particularly complex mix of assumptions and approximations in any case.[7] All in all, for the various New Zealand Government departments, public bodies and other authorities involved to continue maintaining that the relevant air quality legislation (NESAQ-based) is scientifically valid is to reveal a distinct unwillingness to come to terms with, if not a profound ignorance of, the subject as a whole.

Beginning around 2002, mortality Relative Risk values of around 1.01 based on short-term/acute exposure i.e. PM_{10} 24 hour average-type epidemiology were cited as being relevant to Christchurch leading to estimates of 40-70 'premature' deaths each year attributable to PM_{10} air pollution.[18] Subsequently, substantially larger RR values of approximately 1.043[15] and, latterly, approximately 1.07[6] emerged related to long-term or chronic exposure-type epidemiology yielding estimates ranging from 158-182 "premature" deaths annually in those aged 30 years and over. Meanwhile, the method for measuring PM_{10} has also changed resulting in significantly higher results for this pollutant index related to inclusion of and correction for loss of semi-volatiles.

Taking such matters into account, the topic - air quality - clearly has become something amenable to subjective interpretation i.e. an art rather than a manifestation of good, sound, applied science as normally understood.

Air pollution compliance targets

Christchurch as represented by the St Albans and Woolston monitoring stations currently is unlikely to achieve the present NESAQ requirement of a maximum of 3 exceedances per year of 50µg/m^3 PM_{10} 24 hour average by 2016 let alone the ultimate target of 1 exceedance by 2020[19]. However, it appears to meet the WHO PM_{10} annual average guideline of 20µg/m^3 and seems likely to continue to do so for the foreseeable future.[12] Consequently, considered from the point of view of the city as a whole, the typical *exposures* to PM_{10} (and to $PM_{2.5}$ with this comprising on average about 60% of the PM_{10}) would appear to be of little concern judged alongside the standards and guidelines applicable overseas (see Table 1).

Furthermore, given that there appears to be little or no connection between measured PM_{10} air pollution and both overall and specific types of respiratory health as recorded in New Zealand[20,21] the wisdom and effectiveness of policies aimed at replacing in short order large numbers of relatively modern (enclosed-type) domestic cord wood-fuelled burners with alternative (mostly electrically-operated) sources of heat has to be seriously questioned.

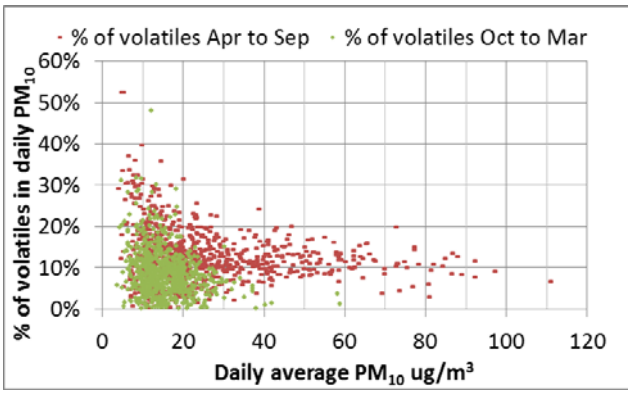
Nature of the polluting effect

Concerning episodic air pollution as normally experienced in New Zealand, entrapment of "fine" relatively (chemically) inert, essentially non-volatile, material leading to gradual physico-chemical interference of normal respiratory functions (cf. silicosis) would appear to have been the "default" mechanism originally. However, considered in the light of the barely detectable acute effects observed, such modus operandi would appear to be obsolete in a modern context. According to the authors of the latest version of the oft-cited Health and Air Pollution in New Zealand (HAPINZ) reports: [6]

> *Particles of different sizes typically have different sources and different chemical and biological composition. The mechanisms of particle toxicity are complex and still not fully understood. For example, it is not yet certain which of the several classes of toxic effects observed in laboratory experiments are responsible for specific human health effects (Brook et al. 2010).*

Meanwhile, the main pollutant gases NO_2, CO, SO_2, and O_3, despite being routinely monitored, typically are ignored by epidemiologists and planners. Based on the evidence available, a mechanism reliant upon such "reactive" substances and the (mainly) organic gases/volatiles and semi-volatiles would appear to be entirely feasible in the ordinary urban environment. Indicative, however, of the subtleties involved are the results obtained for one Christchurch sampling site shown in Fig. 1.

(A)



(B)

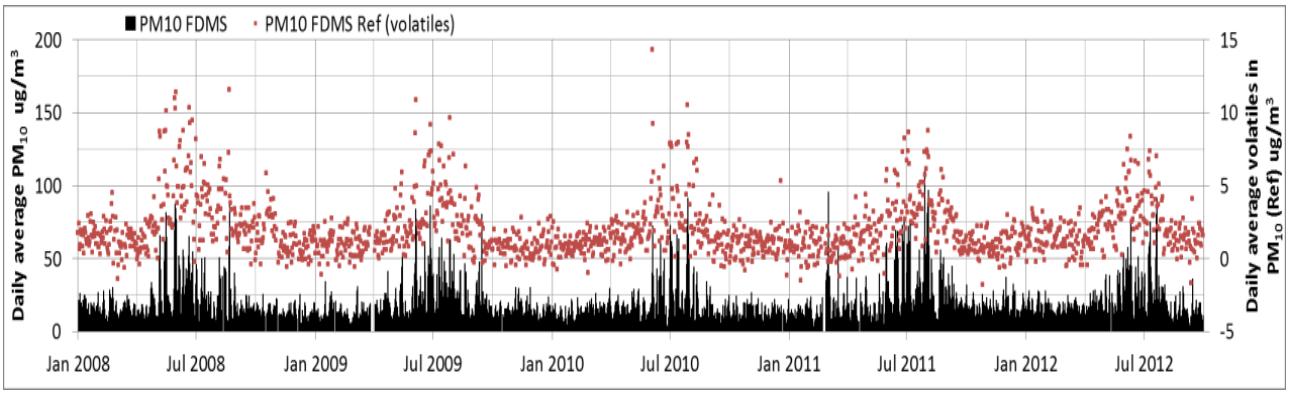


Fig. 1. 24 hour average PM_{10} via Filter Dynamics Measurement System (FDMS), showing seasonal variations in PM and % "volatiles" for Christchurch. (A) Average PM_{10} % volatiles: cooler months (red), 12%; warmer months (green), 8%. (B) Variations in daily average PM_{10} (black) and daily average volatiles in PM_{10} (red). Average volatiles for 2008 - 2012, 11%; "Exceedances"/yr = 20 approximately. Graph B reproduced with permission: Hoare, J.L. *New Directions: Questions surrounding suspended particle mass used as a surrogate for air quality and for regulatory control of ambient urban air pollution*, Atmospheric Environment, 91, 175–177, Elsevier, 2014.

In practice, determination of PM_{10} via FDMS involves the following:
i) sampling the air under the prevailing (outdoor) ambient conditions
ii) obtaining, simultaneously, a sub-sample representative of the "fine" particle fraction ≤ 10 μm e.g. via a "50% efficiency/cut" cyclone
iii) collecting the suspended, moisture free, particulate matter on a filter while weighing it at a temperature of 30^{o} C
iv) repeating the weighing step under conditions facilitating calculation/compensation for concomitant loss of attendant "volatiles"
whence
v) the permanent (largely inorganic) gases are not taken into account/recorded as PM
vi) the more volatile of the volatiles/semi-volatiles (possibly mainly organic) fraction are not taken into account/recorded as such
vii) the less volatile of the volatiles/semi-volatiles (largely organic) fraction presumably are partly taken into account/recorded
viii) significant amounts of relatively inert "fine" particulate matter are taken into account/recorded as potentially harmful material simply from a mass perspective
ix) potential toxicity associated with the "coarse" particle fraction is disregarded/downplayed.

Hence, considering all of the above it seems fair to conclude that monitoring of urban air quality in the interests of public health, as presently carried out, leaves a lot to be desired.

Precautionary Principle
The Precautionary Principle[22] states that:

"…..if an action or policy has a suspected risk of causing harm to the public or to the environment, in the absence of scientific consensus that the action or policy is not harmful, the burden of proof that it is *not* harmful falls on those taking an action... "

Application of the principle appears to have led, in New Zealand at least, to overly stringent standards for PM (Table 1).

Table 1 Ambient air quality standards: comparison of allowable air pollution (PM) limits and exceedances. Reproduced with permission: Hoare, J.L. *New Directions: Questions surrounding suspended particle mass used as a surrogate for air quality and for regulatory control of ambient urban air pollution*, Atmospheric Environment, 91, 175–177, Elsevier, 2014.

		Country		
Pollution index	Averaging period	United States of America[23]	European Union[24]	New Zealand[11]
PM_{10}	24 hours	150*; 1/yr as a 3 yr average	50*; 35/yr	50*; 1/yr (aiming for full compliance by 2020**)
PM_{10}	Annual	N/A	40*	N/A (WHO guideline of 20* currently met virtually everywhere)
$PM_{2.5}$	24 hours	35*; 98th percentile averaged over 3 yr.		
$PM_{2.5}$	Annual	12*; (averaged over 3 yr.) Primary 15*; (averaged over 3 yr.) Secondary	25* 20*; (exposure, averaged over 3 yr.) by 2015 18*; (exposure, averaged over 3 yr.) by 2020	N/A (currently ≤15* assuming PM_{10} annual avg. is ≤ 20* and 70% of PM_{10} is $PM_{2.5}$)

* Measured in µg/cubic metre

** In some towns and cities in NZ, especially those situated in regions experiencing relatively cold winters, exceedances/yr currently exceed the standard by a considerable margin

Comparing the shown data above, New Zealand's PM_{10}-based standard is seen to be much more stringent than the equivalent standards favoured by USEPA and the EU. Also, considering that the individual limits, etc. are largely arbitrary, use of the term "standard" in a regional context is contentious. Consistent with this viewpoint, WHO prefers to promulgate limits described as guidelines rather than legally enforceable standards stated as follows:

"…governments should consider their own local circumstances carefully before using the guidelines directly as legal standards." [25]

Conclusions

- Pursuit in an urban context of perfectly clean and/or pure air is unrealistic and impractical.
- Instead, a reasonable compromise corresponding as much as possible to the likely actual exposures and confirmed risks related to achievable air quality in all its guises is preferable.
- Where local supplies of solid fuels are assured, relatively inexpensive and sustainable compared to alternative sources of available energy e.g. electricity and/or gas, it makes good sense to allow and encourage effective and efficient use of such methods of heating domestically e.g. as a back-up and/or during very cold or otherwise inclement weather.
- Arbitrarily-chosen limits (guidelines) for the individual gaseous inorganic and volatile/semi-volatile organic pollutant categories possibly would be more suitable for regulatory purposes than the epidemiologically-arrived at, PM-based, "standards" currently employed.
- Particle-related toxicity probably resides principally in an adsorbed volatile/semi-volatile sub-component; tolerably stable therein provided the ambient temperature is low enough.

- Such material probably is capable, at least partly, of being volatilised/desorbed at temperatures approaching "blood heat" (approximately 37ºC) thereby assisting the transfer of otherwise relatively harmless, occluded, material deeper into the lungs.

- Probably all airborne particles (i.e. particles ≤ approximately 100 mm in diameter) should be regarded as potentially significant contributors to the acute effects, the latter being mainly attributable to the "permanent" gases and volatiles with additional contributions from the adsorbed semi-volatile and volatile material.

- In practice, global health is a composite of that enjoyed by individuals and as such is best tackled from a local/regional perspective.

- Compared to the US and EU standards for PM_{10} 24 hour average, the equivalent New Zealand standard (NESAQ) permitting no more than 1 exceedance of 50μg/m^3 per year is particularly stringent with accrued benefits likely to be small or unclear relative to the substantive overall costs incurred. Given that the Government appears unwilling to modify its stance enabling a more realistic/straightforward/honest approach to the science involved, a sense of injustice prevails.

Acknowledgements
The author gratefully acknowledges the contributions made by past and present members of the Association for Independent Research (AIR) to the views expressed in this paper. The information provided in Fig. 1 (Graphs A and B) was supplied by Ms Teresa Aberkane, Senior Air Quality Analyst, Environment Canterbury, Christchurch, New Zealand.

This paper was presented and published in part at the BIT 2nd Annual Global Health Conference, Taiyuan, China, Oct 24-26 2014.

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How toxic is your PM_{10}?
A review of some aspects of the HAPINZ reports.

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Abstract

The Health and Air Pollution in New Zealand reports give estimates of the numbers of premature deaths attributable to PM10 from different sources in 67 urban areas. There is a threefold difference in estimated toxicity between PM10 from different places and sources. The estimates are not supported by the official mortality statistics.

Keywords: Air pollution; fine particles; toxicity estimates; mortality statistics.

1. Introduction

In setting the concentration of fine particles [PM10] in the air as a standard for defining the toxicity of air pollution, it has been accepted that this is an adequate measure of the toxicity of PM10 and, incidentally, of air pollution generally. A large body of evidence has been adduced to support this view, which has been widely accepted in New Zealand and encoded in the Resource Management [National Environmental Standards Relating to Certain Pollutants, Dioxins and other Toxics] Regulations 2004 [Smith 2010].

The standard adopted has been justified by the final Health and Air Pollution in New Zealand [HAPiNZ] report that each year 1,100 New Zealanders die prematurely from air pollution, 915 of them from PM10 [Fisher *et al.* 2007]

The estimate of 915 premature deaths each year attributed to air pollution with PM10 was said to have been calculated by assuming that concentrations of PM10 in New Zealand have similar effects as the same concentrations in Europe, and that PM10 from motor vehicles burning diesel and petrol, from domestic heating appliances burning mainly wood, from industry, and from various natural sources all have the same effects on health and mortality.

2. Estimates of toxicity

Detailed estimates of premature mortality attributable to PM10 from the four sources in 67 urban areas from Whangarei to Invercargill are tabulated in Tables 1 to 9 of the appendices to the above report. The report also tabulates estimates of the PM10 incidence of cardiac, respiratory and chronic obstructive pulmonary disease (COPD) morbidity and reduced activity days [RADs] attributed to PM10 in the 67 urban areas.

From Tables 5, 7 and 8 of Appendix I of the report I have calculated the rates per thousand people of COPD and respiratory morbidity, RADs, and mortality which have been attributed to each microgram of PM10 per cubic metre in the 12 urban areas containing more than 50,000 at risk people. The results are in Table 1 below.

For COPD morbidity the rate varied from .0426 per thousand in New Zealand as a whole to .0443 per thousand in Auckland. For Respiratory Morbidity it varied from .0128 in New Zealand as a whole to .0136 in Lower Hutt, and for RADs it varied from 52.9 in New Zealand as a whole to 55.1 in Dunedin. Everywhere in New Zealand the estimated effect attributed to PM10 on morbidity was much the same.

For premature mortality the estimated rates varied from .021 in Auckland to .037 in Tauranga. So PM10 in Tauranga was estimated to be 1.76 times more toxic than PM10 in Auckland. Similarly, PM10 in Inner Christchurch [.034] was estimated to be 1.48 times as toxic as PM10 in Outer Christchurch [.023].

Table 2 of the Appendix 1 gives estimates of the mortality attributed to PM10 from domestic heating, vehicles, industry and background sources in the 67 urban areas. From these and the estimates of the sources of PM10 given in Table 1, and the population numbers given in Tables 4 to 8, I have calculated the annual mortality rate per thousand people attributed to each microgram of PM10 per cubic metre from each source in each area. They are tabulated in Table 2 below.

In Inner Christchurch and Hamilton, background PM10 is estimated to be 1.5 times as toxic as the PM10 from domestic fires in those places, while in Manukau and North Shore the background PM10 is estimated to be twice as toxic as that from domestic fires. For New Zealand as a whole, PM10 from vehicles is estimated to be twice as toxic as

Table 1. Rates per thousand people of COPD and respiratory morbidity, RADs, and mortality attributed to each microgram of PM10 per cubic metre in New Zealand and 12 major urban areas.

	Morbidity		Mortality	
	COPD	Respiratory	RADs	
Auckland	.0443	.0133	54.8	.021
Inner Christchurch	.0441	.0131	55.0	.034
Outer Christchurch	.0441	.0131	56.3	.023
Dunedin	.0441	.0134	55.1	.030
Hamilton	.0440	.0131	54.1	.024
Lower Hutt	.0441	.0136	55.0	.035
Manukau	.0440	.0132	54.5	.024
North Shore	.0443	.0132	54.6	.027
Palmerston North	.0442	.0133	54.3	.029
Tauranga	.0442	.0135	53.8	.037
Waitakere	.0442	.0131	54.4	.028
Wellington	.0442	.0135	54.7	.030
New Zealand	.0426	.0128	52.9	.027

Table 2. Death rates per thousand people per microgram of PM10 per cubic metre from domestic heating, vehicles, industry, background and from all sources in New Zealand and in 12 major urban areas.

City	Domestic	Vehicles	Industry	Background	Total
Auckland	.021	.021	.021	.021	.021
Inner Christchurch	.029	.036	.036	.043	.034
Outer Christchurch	.024	.024	.024	.021	.023
Dunedin	.030	.030	.030	.029	.030
Hamilton	.018	.027	.027	.027	.024
Lower Hutt	.035	.035	.036	.035	.035
Manukau	.013	.026	.027	.027	.024
North Shore	.015	.030	.030	.030	.027
Palmerston North	.029	.029	.029	.029	.029
Tauranga	.033	.039	.040	.038	.037
Waitakere	.028	.028	.028	.028	.028
Wellington	.031	.031	.029	.030	.030
New Zealand	.017	.034	.044	.036	.027

PM10 from domestic fires. PM10 from vehicles in Tauranga is estimated to be nearly twice as toxic as PM10 from vehicles in Auckland, and three times as toxic as PM10 from domestic heating in Manukau which is estimated to be the least toxic PM10 in New Zealand . Background PM10 in Inner Christchurch and PM10 from industry throughout New Zealand are estimated to be the most toxic.

These estimates of induced mortality are curiously erratic. Unlike the estimates of morbidity they are not consistent with the assumption that PM10 from all sources is equally toxic, which was the assumption made when setting the PM10 standard. It seems reasonable to conclude that the variations result from inaccurate arithmetic which was not checked by the many authors of the reports.

3. Estimates of statistics of mortality.

From these estimates of PM10 induced mortality it was concluded, in Table 9 of Appendix 1, that 2.9% of the natural deaths in New Plymouth and 3.3% in Wellington resulted from air pollution, compared with 11.8% in Inner Christchurch and 14.9% in Nelson. It has been assumed in another HAPiNZ report that each estimated air pollution related premature death represents the loss of five years of life (Fisher *et al.* 2005,). No evidence was adduced to demonstrate that death rates are so substantially higher in the more heavily polluted areas.

In the above studies, the major effect was estimated on respiratory mortality (Table 7-10, 7-15 and 7-17 in the Main Report, and Table A1-7 of the Christchurch Pilot Study). Statistics from the Ministry of Health show respiratory deaths as a proportion of total deaths for the 20 district health boards for the years 1999 to 2007 inclusive. The boundaries of the district health boards do not exactly coincide with the boundaries of the urban areas of the reports, but I have matched them up as in Table 3 below.

The estimated percentage of deaths attributed to PM10 varied from a low of 2.9% for New Plymouth to 9.1% for Christchurch, a threefold difference. The recorded percentage of respiratory deaths expressed as a % of the total deaths in the health boards showed no such spread. They ranged only from 5.6%in Hawkes Bay to 7.0% in Hutt. The report estimated pollution induced death rates in

Table 3. Estimated percentages of deaths attributed to PM10 in 12 urban areas, and actual percentages of deaths from respiratory disease in matching district health boards from 1999 to 2007.

Urban area	% of deaths attributed to PM10 *	DHB	Respiratory deaths as % of total deaths **
Whangarei	6.1	Northland	6.0
Auckland	7.2	Auckland	6.2
Hamilton	5.5	Waikato	6.3
Tauranga	6.4	Bay of Plenty	6.4
New Plymouth	2.9	Taranaki	6.1
Napier/Hastings	4.7	Hawkes Bay	5.6
Palmerston North	5.9	Mid Central	5.9
Upper Hutt	6.9	Hutt	7.0
Lower Hutt	7.7		
Wellington	3.2	Capital& Coast	5.8
Christchurch	9.1	Canterbury	6.1
Dunedin	4.1	Otago	6.7
Invercargill	7.2	Southland	6.1

* From Table 9, Appendices, HAPINZ Main Report (2007).
** From Ministry of Health Mortality data. Deaths by DHB regions 1998 – 2007.

Canterbury and Taranaki District Health Board areas to be extremely different. In fact they were very similar at 6.1 and 6.2.both very close to the mean and the median. The estimates of death rates attributed to PM10 appear to be randomly associated with the death rates actually recorded as being due to respiratory disease.

This lack of association between estimated death rates attributed to PM10 and recorded rates of respiratory deaths is similar to that recorded but not reported on in the much cited US 20 Cities study (Samet *et al.* 2000; Palmer & Saville 2002).

4. Conclusion

This elementary treatment of the available data shows that concentration of PM10n is not a good indicator, let alone a suitable standard, for measuring the toxicity of air pollution in New Zealand. The eccentricity of the estimates of the mortality ascribed to PM10 from different sources and places in New Zealand supports this view, or casts doubts on the estimates themselves.

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