

Wood Burning. Where are we?

Background

40 years ago Christchurch had winter air that was as foul and unhealthy as one could find. The combination of a naturally cold and damp climate, frequent temperature inversions, and the almost universal use of open fires, (the majority using coal) covered the city in a brown sulphurous blanket for much of the winter.

Cleaning it up was not an easy task given that there was (and still is) no natural gas, diesel oil and LPG were (and still are) too expensive, and that domestic heat pumps were only just coming onto the market. Clean burning coal equipment was (and still is) non-existent. ECan adopted and championed the widespread uptake of log burners and wood as a practical and affordable way to safely abolish the open fire.

Today our air is massively cleaner. However, it can still improve. During the last 40 years many other things have changed. Without seeking to enumerate them all:

- There is now an ocean of evidence that our cold, damp, poorly insulated, and poorly heated homes drive a host of respiratory and other diseases and ailments.
- Today most of us today live and work in centrally heated or air conditioned workplaces. A very large percentage of us have lived for extended periods abroad where affordable central heating is the norm. There is a very real desire at home now for something better than for the main living space to be intermittently heated and the rest of the house left cold and dank.
- On completion of the Clyde dam New Zealand had a colossal excess electrical generation capacity. That excess capacity no longer exists, particularly in dry years. In recent dry years, approaching half of our generation has been from fossil fuels.
- Christchurch was badly damaged by the 2010/11 earthquakes. There is a strong desire and oft stated intent that the re-built Christchurch will be a sustainable city with all that the word implies. Sadly the authorities are attempting to expunge the word “sustainable” from the re-build vocabulary. (It has been deleted in its entirety from the current draft of the new of the Christchurch City Plan).

It is against this background that the Ministry of Health is forcing the adoption by territorial authorities of clean air regulations which limit the level of sub-10micron particulates (PM10's) in the air to no more than $50\mu\text{g}/\text{m}^3$ averaged over a 24 hour period. From 2020 a given airshed is permitted to exceed this average level only one a year or face sanctions.

The Regulations

We are governed by the Resource Management Act and the subsidiary National Standards for Air Quality Regulations 2004 (NSAQ).

The key elements of those regulations are:

- By September 2016 in Christchurch the $50\mu\text{g}/\text{m}^3$ may be breached no more than 3 times per year in any 24 hour period.
- By September 2020, the limit drops to once per year. (This applies to all of the managed airsheds of New Zealand.
- Wood burners are limited (by the NSAQ regulations) to no more than 1.5g total particulate emissions per kg of fuel burned. Regional Authorities may enforce lower limits if they choose. Currently the Christchurch limit is 1g/kg and is about to be lowered to 0.5g/kg.
- The NSAQ regulations mandate the use of AS/NZS 4012 for the efficiency measurement of wood burners and AS/NZS 4013 for the measurement of particulate emissions.

The Local Enforcers

Ecan is the enforcer of the regulations in Canterbury across the region's 6 managed airsheds. In the beginning Ecan very much lead the way given the major problem that Christchurch had with its air quality. Today Ecan is still at the forefront, but is now the local agent of the Ministry of Health. This is doubly so as Ecan is no longer an independent local authority, it being run by Government appointed commissioners.

In the beginning Ecan adopted an approach which was to encourage and assist householders to move away from open fires by installing wood burners and heat pumps. In more recent times they have insisted on the replacement of any log burners older than 15 years and have heavily favoured the installation of heat pumps. Subsidies have been paid for their installation conditional up on the removal of any wood burning appliances.

Today Ecan has lowered the particulate emission limit for new wood burners to 0.5g/kg. However, Ecan, an organisation which has for many years been seen as doing their best to abolish domestic combustion based heating entirely has had a serious change of heart. In the 2016 air plan is proposing that all householders shall be permitted to fit a 0.5g/kg burner without requiring resource consent. (Building consent will still be required). However, the airplan still has to go through a hearing process before it is accepted into law. Those hearing submissions have the right to amend the airplan as they see fit. At that point Ecan must either accept the amended airplan in its entirety, or reject it and go back to the start. If abolishing wood burners is the price to get the airplan through, it would almost certainly be paid.

The Clean Air Regulations

Everyone likes clear air. We all love those hard clear southern days when one can see 150km with ease. That aside, the case for clean air as promulgated by the MoE and MoH is almost entirely based upon predicted mortality rates using a formula created by the WHO. Current Canterbury District Health Board predictions state that 158 people in Christchurch die prematurely each year from causes directly attributable to particulate pollution.

Dr Pat Palmer, a Christchurch resident and respected clean air critic in Christchurch wrote this in a letter to the Listener a few weeks ago:

“They (the Ministry of Health) calculate that PM10 in smog-ridden Christchurch causes 11% of all deaths. In New Plymouth where the air is pristine, they say PM10 causes only 3% of deaths. Somehow they have neglected to notice that the certified death rates from Chronic Obstructive Pulmonary Disease (COPD) are almost identical in both places. They make up about 6% of all deaths throughout New Zealand, despite the very large differences in concentrations of PM10.

In Christchurch over the past 15 years the Regional Council has waged a campaign to do away with heating homes by log burners. This has about halved the concentrations of PM10 in the city's air. They and the Ministry for the environment claim that this has resulted in a greatly reduced death rate. But the death rate from COPD has remained stubbornly unaltered over the years. This last fact is the nail in the coffin of the claim that lowering PM10 concentrations by putting out log burners will lead to our living longer healthier lives.

The notion that concentration of PM10 in the air is a useful index of the healthiness of the air we breathe in New Zealand is belied by the factual health statistics. The stringent Air Quality Standard, with its consequent severe restrictions on economical and comfortable home heating is useless as a health improver”.

The Green Building Council in its submission on the 2014 Christchurch Air Plan stated:

“Of the 1,756,143 homes in New Zealand, almost a third of New Zealand homes fall below the World Health Organisation (WHO) recommended indoor temperature of 18°C. Homes which are cold, damp, and mouldy put occupants at increased risk of disease. Home temperatures below 18°C are linked to housing related illnesses and hospitalisations.

Poor health outcomes impact on productivity. Damp, cold housing is directly linked to illnesses and diseases

which translate into more GP visits and more days off school/work. By making homes warmer, drier and more energy and water efficient, the country could:

- ☑ Cut sick days off work by 180,000 a year - lifting production by \$17m a year; and
- ☑ Avoid sending 50 people a day to hospital with respiratory diseases - saving \$54m a year.

The Issues

There are three core issues in the wood burning debate:

1. The clean air regulations, the 50µg/m³ limit and the way in which it is to be enforced.
2. The way in which our air pollution is measured
3. The way in which we test and approve solid fuel combustion appliances

The 50µg/m³ limit

The limit of 50µg/m³ comes from a WHO guideline. It assumes that all sub-10 micron particulates are equally evil. Whilst this might have been a reasonable supposition a long time ago today it is no longer sustainable. There is ample evidence that different particles have different toxicities, depending upon what they are made up of. A small particle from a diesel engine carrying as it does a number of other chemical compounds is much more toxic than an inorganic particle of rock dust. Our environmental limits make no distinction.

If we look further, regional authorities such as Ecan are expected to achieve no more than a single exceedence of the 50µg/m³ limit once per year. Yet they have only partial control over the causes. Clearly Ecan et.al have no control over natural sources, but they are included as a part of the limit. Similarly, diesel emissions are (quite reasonably) a part of the limit yet the regional authorities only have control over the static burning of diesel; in other words that which is used for heating and as an industrial fuel. They have no control whatsoever over automotive uses. This is even more telling when one realises that between about 1990 and 2007 NZ trebled its use of diesel oil.

It gets worse. If one wishes to install a diesel burning appliance of 100kW or more, one must apply for a resource consent with all that that implies. A note contained in the current Ecan airplan for Christchurch quotes the US EPA as saying that the emission factors for PM10's from a diesel engine "can be up to 33 times higher than from a boiler burning the same amount of fuel". In other words, a 100kW automotive engine can equate to a 3.3MW boiler in terms of its PM10 output. There are countless thousands of diesel engines on the road all over the country every minute of the day. Ecan et.al. have no control whatsoever over this massive contributor to our airshed pollution. Can one imagine the backlash on anyone in authority if they decided that in future all diesel vehicles must apply for a resource consent? (Indeed, to be consistent with the non-automotive use of diesel, a consent would need to apply to all automotive applications above 3.3kW.....)

To really underline the lunacy of this regime, the assumption from those who look after our airplans is that because new regulations were introduced in 2007 in relation to cleaner burning diesel vehicles, that diesel vehicles are a declining part of the air pollution problem. It entirely misses the fact that diesel engines are rapidly taking over the vehicle fleet (in Europe now more than half of the vehicle fleet is diesel) and that the numbers grow daily.

To put the final nail in the coffin of this argument, NZ has absolutely no regulatory imperative for the maintenance of diesel (or any other) engines. Long before increased fuel consumptions from poorly maintained engines motivate the owners to return them to full health their emissions can skyrocket.

There are many other dimensions to the arguments surrounding the 50µg/m³ limit and its enforcement.

It is also worth noting, and it puts the true lunacy of our own limit into context:

- The USEPA has an average standard of 150µg/m³ which can be exceeded once per year, averaged over 3 years.
- The EU shares with NZ a 50µg/m³ average standard, but allows 35 exceedences per year. This is

from an organisation that contains many countries that are regarded as being in the vanguard of environmental and social responsibility.

The way in which our air pollution is measured.

Air pollution is measured by drawing air at a known rate through a filter system which is supposed to remove anything much above 10microns in diameter. There are different methods for doing it, there is debate around which is the most effective, and questions as to how to reliably compare samples taken by one method with another (which gives a clue that some data may be less than 100% reliable).

Having captured a sample of mostly 10micron or less material on a filter it is weighed and a calculation carried out to equate it back to its original atmospheric concentration.

So how does one know where the particles came from in the first place?

One way is to “know” what is happening in the general environment surrounding the particulate monitoring station and apply “emission factors” to those sources. In essence, by knowing how much of a fuel, say coal, is being burned in the area and applying a suitable emission factor, the contribution of coal to the total collected sample can be estimated. One then applies this sort of logic to all of the assumed contributors to the local airshed particulates. Clearly there are some very big and challenging assumptions as to what is happening, what is a suitable emission factor, how the emissions vary through the day, week, month and so on. (By way of example in 2007 the author of this piece was involved with re-estimating the contribution of commercial and industrial sources to the 6 Canterbury airsheds. He discovered that the previous estimate for coal had used emission factors that had been taken from USEPA data, missing entirely that NZ coals have much lower emission factors than their US counterparts. Overall the industrial and commercial contribution of sub-10 micron particulate to the Christchurch airshed was halved from the previous 2002 estimate.)

Another way is to carry out a spectroscopic analysis of the materials collected by a filter which gives the relative proportions of different elements in a sample. Again, from knowing the likely sources, it is possible to infer the relative contribution of each. It is however an inference with all that it implies.

Much more recently it has become possible using microscopy techniques to identify each particle in a sample. However, there is little data available yet available from such sources.

Christchurch uses two particulate monitoring stations to cover the entire airshed of about 900 sq km. We are assured by ECan that modeling has been done which confirms that this is entirely reliable. Yet to quote the Ecan report, “Modeling Wintertime Concentrations of PM10 in Ambient Air, Christchurch and Timaru”

“When comparing the model performance against the two measures of most interest, it is less successful. The PM10 regulations make the number of days in excess of 50 $\mu\text{g}/\text{m}^3$ the primary interest, with the second highest daily concentration also highly significant, since the regulations set one day in excess of 50 $\mu\text{g}/\text{m}^3$ as the standard.

The model did not demonstrate a consistent performance on predicting the number of days in excess of 50 $\mu\text{g}/\text{m}^3$ and mostly overestimated the number between 10 and 25 days, but in the case of Christchurch 2009, underestimating by two days. The model underestimated the second highest concentration in all cases, significantly underestimating in Christchurch 2006, but being within 1 $\mu\text{g}/\text{m}^3$ in Timaru 2008. This lack of consistency of results means that the model may not be accurate enough to use for these quantities, which would limit the model’s ability to be used for planning scenarios or policy developments”.

Testing and Approving Solid Fuel Combustion Appliances

The NSAQ mandates the use of AS/NZS4012 for combustion efficiency measurements and AS/NZS 4013 for particulate measurements.

As previously stated, the NSAQ makes mandatory 1.5g/kg as the maximum emissions from a log burner and 65% the minimum gross efficiency. Regional Authorities can make tighter limits if they so please. Ecan dropped the particulate limit to 1.0g/kg of fuel burned some years ago and recently lowered it still further

to 0.5g/kg, their so-called Ultra Low Emission Burner (ULEB) limit.

There are several problems.

First and foremost is that the testing standards have failed to deliver clean burning wood burning appliances in real life. There have been several attempts at real life measurement by a number of organisations, but with varying degrees of success. The real emissions measured have varied between 3 to 50 times the regulatory limit. In short, our supposed approval standards are failing to deliver clean burning appliances by a large margin. This is not surprising when one reads them. It is clear that they are a simple “rating” device only. The methods by which a log burner is operated to pass the tests are far removed from what happens in reality.

This has been known since shortly after the tests came into use, yet until a little over two years ago it has been ignored. Only recently has Ecan sought to find an improvement. Even then they are hampered by the NSAQ, given that it mandates the uses of 4012 and 4013. Ecan have attempted to add a third layer to the methodology of 4012 and 4013 to produce something that is nearer real life. The result is the Canterbury Method which is still costly and difficult to use.

A second problem is that AS/NZS's 4012 and 4013 are incredibly prescriptive. They are written around a device which is a steel box with a door on it. If a device departs from what is the common perception of a wood burner, 4012 and 4013 cannot be used. The consequence is that it has utterly stifled innovation. Talk to a local Christchurch man, Roger Best who has spent most of the last 10 years to get accepted his design for a range wood burning appliances which have real life emissions far lower than the new 0.5g/kg limits (measured and verified using USEPA measurement standards that are accepted worldwide). “If it can't be tested to 4012 / 4013, it can't be approved”.

The third problem is that 4012 / 4013 are unique to Australia and NZ. That of itself would not be a bad thing if they were at the leading edge of current thinking. They are not. If you want to see current thinking, go and look at the European standard EN303-5. It covers all solid fuel appliances up to 500kW in a single consistent document. It has been developed and improved over the last 30 years and is accepted (with some local variations) right across Europe. By so doing the Europeans have a vibrant wood heating industry employing thousands of people in manufacturing, installation, servicing, and wood supply. It would not take very much to adapt it to NZ, opening the way for our manufacturers to produce equipment for Europe and opening us to the massive range of devices available from Europe. It would create some real competition instead of creating the serious non-tariff trade barrier that is AS/NZS's 4012 & 4013

Where are we going?

Ecan are belatedly but honestly trying to open the way for wood burning appliances. This week the first ULEB to pass the 0.5 g/kg limit was announced. (That has created a furore in itself as the proposed “Canterbury Method” for testing such devices in something like a real life manner has been accepted with considerable reservations as a prototype only.) However, under the current rules one can only install the device in a new home (or one which did not previously have a wood burning appliance) if one gets a Resource Consent. I believe that the projected sale price is of the order of \$10,000. In short very few will be installed under the current rules and it does not represent an affordable way to a warm home.

The MoE are driving Ecan and the other Regional Authorities hard to achieve the 50µg/m³ limit by 2020. As a member of a Regional Authority remarked, “I don't agree with it, but if I don't do it, I'm out of a job”.

And this is where the central issue lies. As a consequence of adopting an extreme, ill thought through, and inconsistent air quality standard and pursuing it single-mindedly, the Authorities are driving New Zealand into a cold, isolated, and expensive corner.

The MoE that has created the 50µg rule and has mandated the use of NZS's 4012 & 3 for the approval of log burners. The standards are applicable to air heating wood devices only. They have done absolutely nothing to create or encourage the adoption of a consistent standard across the board for all fuels and devices.

The air quality standards fail to take account of background levels of particulates, fail to give those responsible for the delivery of clean air control over all of the sources of emission but is forcing the

responsibility for achievement on them regardless of the consequences. Ultimately the consequences fall back on people trying to heat a home or business affordably.

In 2014 it is even worse because the one dimensional pursuit of a clean air goal on the grounds that “people have a right to clean air” cuts right across the equal right that “people have a right to be affordably warm” and fails recognise that both have to be delivered with a strong eye to sustainability and the reduction of carbon footprint. In this day and age to be promoting electricity, gas, and diesel oil as the clean air alternatives (the official line) is environmentally and economically criminal.

Where should we be going?

We must amend the NSAQ to bring it into line with International Good Practice. What we have now is in the realms of “Unattainable and Unsustainable Practice”. If we do not do this then nothing else matters.

We must create a very clear performance target for sustainable forms of combustion-based heating and identify practical, well understood and developed methods for the assessment of heating devices to ensure that they are capable of meeting those targets. We should be looking at adopting EN303-5 or something very close to it as a national standard.

If we do we can:

- Make a major impact on the reduction of fossil fuel burn for electricity.
- Make a major impact in the reduction of the carbon footprint of New Zealand.
- Take a large step towards the creation of a truly “sustainable” country.
- Encourage the widespread adoption of central heating in New Zealand with a considerable improvement in the comfort and health of our citizens.
- In opening the opportunities for central heating solutions, we are opening a whole new jobs market, both for the installation of systems and the local manufacture of the requisite elements to build them. Manufacturing jobs in New Zealand have been in decline for decades.
- If we create a vibrant wood combustion market we create the possibility of exporting the products that we develop and their associated technologies.
- We will increase employment in the wood supply sector. We can encourage the development of wood-farming operations specifically to grow certain fast growing, clean burning species for fuel. (This practice is already widespread in Europe.)

In addition, if New Zealand adopts standards that are recognised internationally and is willing to accept equipment test certifications from laboratories and testing organizations certified to work to those standards (as we do in so many other fields), then some of the mass of wood, pellet, and chip burning equipment that has been developed over the last 20 or 30 years in Europe and elsewhere becomes available here.

At the same time we will make a major step forward in cleaning up our national airsheds and improve the health and economic well being of all our citizens.

Brian Anderson

December 2014