Regulatory Impact Statement

Amending the PM_{10} Air Quality Standards:

Final Recommendations

Agency Disclosure Statement

This Regulatory Impact Statement has been prepared by the Ministry for the Environment.

It analyses the costs and benefits of proposed amendments to the PM_{10} (particulate matter less than 10 microns) regulations contained within the national environmental standards for air quality.

It updates a regulatory impact statement dated 12 May 2010 published for consultation purposes. It incorporates, where possible, further cost information provided by submitters on a discussion document *Proposed Amendments to the National Environmental Standards for Air Quality* (MfE, 2010). It also specifically addresses the costs associated with increasing in the number of permitted exceedances of the PM_{10} standard from one to three, costs of declining consent under status quo and assumed costs to industry for mandatory offsets.

The nature of costs and benefits arising from the options considered can be readily identified. However, the magnitudes of these impacts are uncertain and are estimated based on a number of assumptions. These include the benefits of avoided premature deaths due to air pollution and the number of, and cost to, industries required to offset emissions in over-allocated airsheds in future years. Conservative values have been adopted for benefits and generous values have been adopted for costs. However, the ranking of the options by net present value is insensitive to moderate changes in these values.

The options considered in this regulatory impact statement are consistent with the Government's Statement on Regulation (The Treasury, 2009). They may give existing discharging industries an additional competitive advantage over new industries, but total compliance costs to industry are significantly lower than under the status quo.

The proposals are not likely to materially impair property rights or override fundamental common law principles.

26 November 2010

Kevin Currie

Date

Background

Around 25 urban airsheds in New Zealand suffer poor air quality due to elevated levels of particulate matter (PM), particularly in the winter due to emissions from domestic heating.[1] These areas range from large cities such as Auckland (which also has significant emissions from the transport sector) and Christchurch, to medium sized places such as Rotorua and Nelson as well as very small centres such as Reefton and Alexandra.

PM_{10} is particulate matter that is less than 10 microns in diameter. PM_{10} is small enough to be inhaled into the lungs and can cause serious adverse health effects including premature death. There is no 'safe' threshold for PM_{10} and therefore, air quality standards for PM_{10} must balance the acceptability of risk factors and the need to protect vulnerable population groups against issues of feasibility and the anticipated costs of compliance.

National Air Quality Standards

In October 2004, the Government introduced the national environmental standards for air quality.[2] The objective of these regulations was to provide certainty for councils and industry, and public health protection through nationally consistent, bottom-line standards that should not be breached.

The national environmental standards for air quality include PM_{10} regulations as follows:

- Ambient (i.e. outdoor) PM_{10} standard of 50 $\mu g/m^3$ as a 24-hour average with one permitted exceedance in any 12 month period;
- Maximum particle emission and minimum efficiency standards for new wood burners in urban areas;
- Restrictions on granting of consent for industries with significant discharges of PM_{10} in over-allocated airsheds (straight/curved line path requirements) before 2013;
- Target date of 1 September 2013 for compliance with the ambient PM_{10} standard through prohibition on granting of consent for any industry with discharges of PM_{10} in over-allocated airsheds after 2013.

Transport Emissions

With respect to transport, the introduction (2004) and amendments (2007 and 2008) of the Vehicle Exhaust Emissions Rule has reduced harmful vehicle exhaust emissions, including PM_{10}, by imposing stringent vehicle emission requirements. Amendments to fuel quality regulations (2002, 2003 and 2008) have also reduced emissions of benzene and sulphur.

Domestic Emissions

The *Warm Up New Zealand: Heat Smart Programme* managed by the Energy Efficiency and Conservation Authority (EECA) is expected to reduce the home heating emissions of pollutants from residential dwellings by providing subsidies for clean and efficient heating

---

[1] These airsheds are Auckland, Hamilton, Hastings, Napier, Putaruru, Rotorua, Taupo, Te Kuiti, Tokoroa, Wairarapa, Ashburton, Blenheim, Christchurch, Geraldine, Gore, Invercargill, Kaiapoi, Nelson (airsheds A and B), Otago (airsheds 1, 2 and 3), Rangiora, Reefton, Richmond, Timaru and Waimate. The term 'airshed' is more akin to an 'air quality management area' rather than a strictly science-based concept of an airshed (although in many instances the two are equivalent).

[2] *Resource Management (National Environmental Standards Relating to Certain Air Pollutants, Dioxins and other Toxics) Regulations 2004.*

options. It is expected that approximately 80,000 homes across New Zealand will be heated cleanly and efficiently over the coming years as a result of the programme.

Many regional councils also provide subsidies or loans to assist with installation of a clean heating source. Some regional councils and unitary authorities also have rules in their regional plans with performance standards for new wood burners to ensure they are clean and efficient. These rules are in addition to, and in some cases more stringent than, the specifications for new wood burners covered by the national environmental standards. Councils with regional rules for domestic burners are Auckland Regional Council, Hawke's Bay Regional Council, Nelson City Council, Tasman District Council, Canterbury Regional Council and Otago Regional Council.

In August 2010 Rotorua District Council enacted New Zealand's first air quality bylaw to reduce emissions of PM_{10} from home heating in Rotorua. In addition to regional rules for domestic heating, bans on outdoor open burning are becoming increasingly common across New Zealand as awareness of PM_{10} and dioxins from this type of burning grows.

Industrial Emissions

Under the Resource Management Act 1991, emissions to air from industry are governed by regional plans which typically require resource consent for significant discharges of PM_{10}. Current examples of industry likely to be significant sources of PM_{10} are provided in Table 1.

Table 1 Examples of firms likely to have significant PM_{10} emissions*

Region	Industry	Type
Auckland	Penford New Zealand Limited	Food/animal products
	Waste Management NZ Limited	Landfill/combustion
	Mighty River Power Limited	Power station
	Auckland District Health Board	Combustion
	Atlas Concrete Limited	Concrete batching plant
	Southdown Cogeneration Limited C/-Mighty River Power Limited	Power station
	Carter Holt Harvey - Packaging Case Division	Pulp, Paper and Cardboard
	Contact Energy Limited	Power station
Canterbury	Health South Canterbury Limited	4.6 MW coal boiler
	Tegel Foods Limited	8 MW coal boiler
Otago	Dunedin City Council	Wastewater treatment plant + boiler
	Southern Cross Forest Products	Timber manufacturing, 6 MW boiler
	Fulton Hogan Limited (Dunedin)	Sand Quarrying
	Kiwirail Holdings Limited	Foundry
Waikato	Fonterra	Dairy processing & milk products (Te Rapa)
	The Laminex Group	Wood processing/manufacturing

* Significant discharges are defined as those likely to result in an off-site increase in PM_{10} of 2.5 $\mu g/m^3$ as a 24-hour average.

Before 2013, the national environmental standards for air quality impose constraints on granting resource consent for significant discharges in over-allocated airsheds. After 2013, the regulations require that no consent for any PM_{10} discharge may be granted in over-allocated airsheds (i.e. regardless of significance of discharge).

Review of the PM_{10} Regulations

Three problems have been identified with the air quality standards requiring review:

- perceived stringency of the PM_{10} standard
- equity of current regulations
- compliance with the PM_{10} standard by 2013.

Perceived stringency of the PM_{10} standards

The ambient PM_{10} standard is currently 50 µg/m^3, as a 24-hour average, with one permitted exceedance per year. The World Health Organisation global guideline for PM_{10} is 50 µg/m^3, as a 24-hour average, with three permitted exceedances per year. The Minister for the Environment is concerned that the New Zealand standard may be too stringent.

PM_{10} has no 'safe' threshold. This means that setting a PM_{10} standard, with associated compliance criteria, represents a set level of risk reduction to be achieved. World Health Organisation guidance notes that, when setting standards, countries must balance the acceptability of risk factors and the need to protect vulnerable population groups against issues of feasibility and the anticipated costs of compliance (WHO, 2006).

Different jurisdictions take different approaches for compliance criteria. For example, the European Union 2008 directive on air quality has a target for PM_{10} of 50 µg/m^3, as a 24-hour average, with 35 exceedances permitted each year. Countries that breach the target, or fail to prepare plans to achieve compliance, may be subject to prosecution. The European Commission is currently taking proceedings against ten member states (Cyprus, Estonia, Germany, Italy, Poland, Portugal, Slovenia, Spain, Sweden and the UK) for failure to meet the air quality target for PM_{10}.[3]

Australia has a national environmental protection measure for PM_{10} of 50 µg/m^3, as a 24-hour average, to be met by 2007. The measure explicitly permits five exceedances for bushfire hazard reduction burning, however, there are no sanctions for non-compliance.

The US has moved towards an ambient air quality standard for $PM_{2.5}$ (whilst retaining an older PM_{10} standard) with different compliance criteria for each pollutant.[4] States that fail to reach the standards are required to prepare plans to achieve compliance. There is further detailed guidance on the exclusion of 'exceptional events' (incidents such as bushfires, volcanic eruptions, etc).

Currently the New Zealand PM_{10} regulations are silent on how to deal with exceptional events such as bushfires and volcanic eruptions (i.e. whether to count these events as exceedances or not).

Equity

The regulations set a bottom line requirement, that after 2013 no resource consent may be issued for **any** discharge of PM_{10} in an over-allocated airshed. Neither the Act, nor most regional plans, requires resource consent for discharges from the domestic sector and, therefore, the burden of these restrictions fall on industry (which do require resource consents). The problem is that domestic solid-fuel combustion, not industry, is the

---

[3] http://europa.eu/rapid/pressReleasesAction.do?reference=IP/09/174

[4] $PM_{2.5}$ standard is 35 µg/m^3, as 24-hour average, 3 year average of the 98th percentile. The 1987 PM_{10} standard is 150 µg/m^3, as 24-hour average, not be exceeded more than once per year on average over 3 years.

primary source (often 80 – 90%) of PM_{10} pollution during winter. The regulations, therefore, are not considered equitable.

The current restrictions also create investment uncertainty since the continued operation of industries (post-2013) depends on the compliance of the airshed in which the industries are located. This may have significant economic and social implications.

Compliance with the PM_{10} standard by 2013

The air quality standards were promulgated in 2004 with the intent of compliance with the PM_{10} standard by 2013. However, as of September 2010 the Ministry estimates that in 2013 there will be 15 airsheds which will not comply with the PM_{10} standard. These airsheds are shown below in Table 2 and in Figure 1 (overleaf). Notably, the airsheds listed in Table 2 include Auckland which represents nearly 30% of New Zealand's population (and 55% of those living in over-allocated airsheds).

Table 2 MfE Assessment of Non-Compliance in 2013

Regional Council	Will not comply	Unlikely to comply
	(typical number exceedances / year)	
Auckland	Auckland (3 – 7)	
Bay of Plenty	Rotorua (20 – 30)	
Environment Canterbury	Christchurch (15 – 30) Kaiapoi (15 – 30) Timaru (40 – 50)	Ashburton (15 – 25)
Environment Waikato	Taupo (3 – 15) Tokoroa (10 – 30)	Te Kuiti (2 – 7)
Environment Southland		Invercargill (1 – 10)
Hawke's Bay	Hastings (15 – 30)	Napier (3 – 5)
Otago	ORC 2 (5 - 45)	ORC1 (40 – 90)
West Coast	Reefton (15 – 20)	
	Total = 10	**Total = 5**

A national study, the *Health and Air Pollution in New Zealand* study (Fisher et al, 2007), estimated that about 1,100 New Zealanders die prematurely from air pollution in urban areas each year. In August 2008 the Auckland Regional Council (ARC) updated this study incorporating 2006 census data. The ARC update estimates that around 1,640 New Zealanders die prematurely from air pollution in urban areas each year.

The study identifies long-term exposure to PM_{10} from combustion sources as the largest contributor to premature mortality. The updated study also estimates that nationally each year, air pollution contributes to an extra 930 hospital admissions for respiratory and cardiac illnesses and over two and a half million restricted activity days – days on which people cannot do the things they might otherwise have done if air pollution was not present.

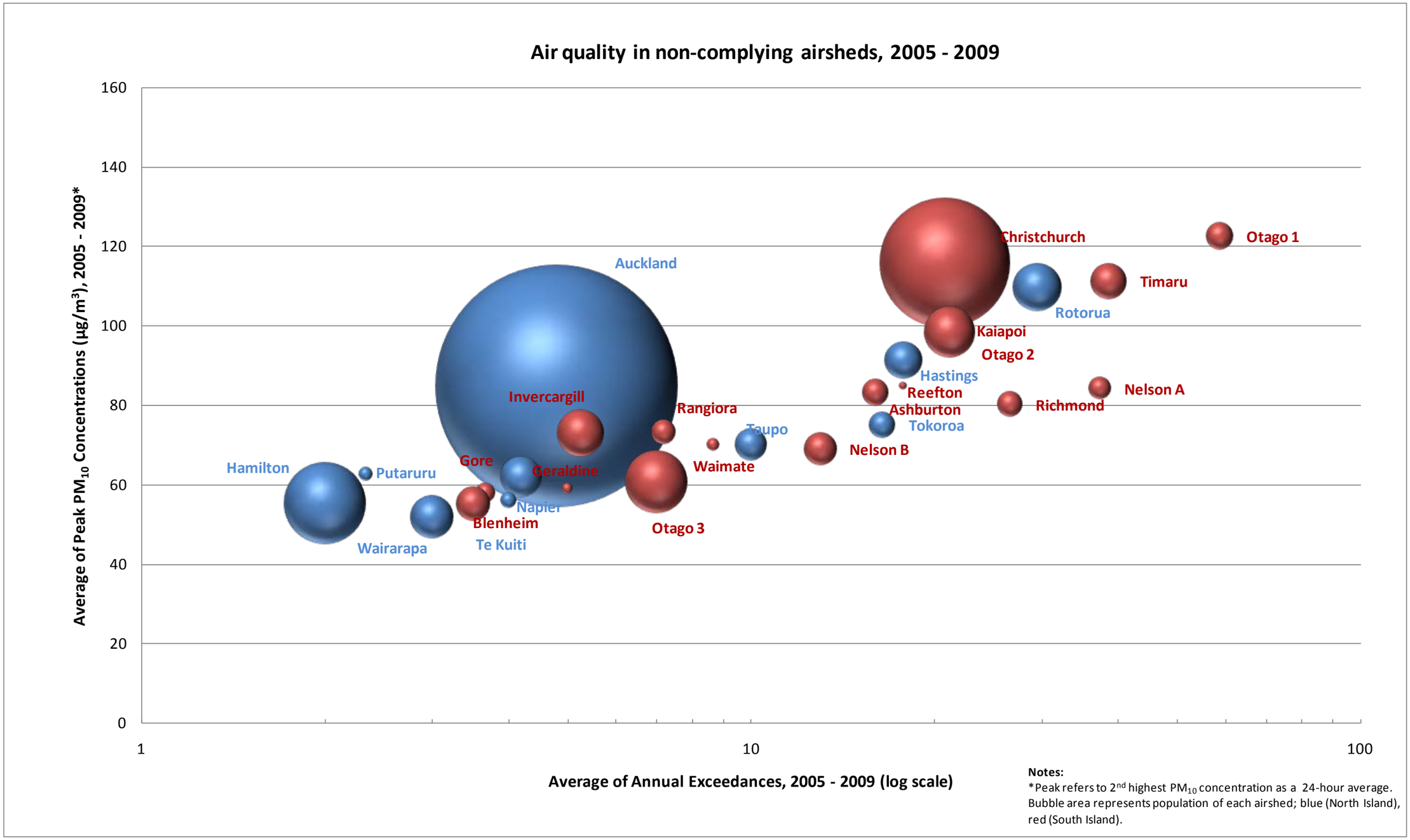

Figure 1 Air quality in over-allocated airsheds, 2005 – 2009

A regional study in Otago (Public Health South, 2006) showed that hospitalisation rates are significantly higher for residents of high pollution areas in Otago than for residents in low pollution areas. The study further showed that children under 5 years old living in areas with higher PM_{10} are more than twice as likely to be admitted to hospital with a respiratory condition as children living in areas with low PM_{10}.

These studies demonstrate the health costs from non-compliance with the PM_{10} standard. There are also, however, costs for meeting compliance depending on how that compliance is achieved. Further details are provided in the cost benefit analysis.

Policy Decisions to Date

On 31 May 2010, Cabinet agreed in principle, subject to the outcome of consultation, to amend the air quality standards by:

- increasing the number of permitted exceedances of the ambient PM_{10} standard from one to three;
- making provision for the exclusion of exceptional events (e.g. volcanic eruptions, bushfires and Australian dust storms);
- requiring information on airshed implementation plans from councils (section 27 of the Resource Management Act 1991);
- requiring the mandatory reporting of PM_{10} monitoring data by regional councils post-2013 to improve transparency and accountability;
- developing a compliance strategy to demonstrate the Minister for the Environment's intent to monitor and follow up non-compliance by councils;
- investigating the feasibility of funding links (e.g. removal of funding from breaching airsheds);

Cabinet further requested comment on the options of:

- repealing the prohibition on industry resource consents post-2013, but retaining a revised offset provision which requires mandatory offsets for new industry with significant discharges of PM_{10} in over-allocated airsheds after 2018;
- relying on existing regulatory measures for compliance.

Consultation

A discussion document titled *Proposed Amendments to the National Environmental Standards for Air Quality* was published by the Ministry for the Environment in June 2010. This detailed the policy options agreed to by Cabinet and requested further information on the costs and assumptions presented in the cost benefit analysis.

Five workshops were held in Auckland, Wellington, Nelson, Christchurch and Dunedin for a total of 160 participants. The workshops included presentations outlining the five options provided in the discussion document.

These presentations were generally well received, however, there did not appear to be a common understanding that the proposal for mandatory offsets only related to **new**, industry with significant discharges of PM_{10} in over-allocated airsheds. This may be due

to provisions of the RMA which require that existing industry be considered as 'new' when applying to renew a resource consent. However, the PM_{10} regulations currently contain different provisions for existing (regulation 17C) and new (regulations 17A and 17B) industry. A 2008 review of implementation of the regulations (MfE, 2009) showed that these different provisions have not been implemented effectively to date, largely due to interpretation of the term 'significant'.

A total of 114 submissions were received.

No single option emerged as the clear favourite, although there was a clear theme that the existing PM_{10} rules are not equitable (i.e. they focus sanctions primarily on industry). There was almost unanimous support for more education and strong support for a government-led national compliance strategy.

The majority of submitters were comfortable with increasing permitted exceedances of the PM_{10} standard from one to three to align with the World Health Organisation. Some, however, noted technical reasons why the World Health Organisation guideline differs from the New Zealand PM_{10} standard.[5] Others cautioned against increasing the permitted number of exceedances as it would decrease public health protection with an inevitable increase in adverse health impacts.

It should be noted that whilst the previous regulatory impact statement discussed the impact of increasing permitted exceedances from one to three, the reduced benefits that would follow were not specifically included in the cost benefit analysis.

The majority of submitters (60) supported the proposal to extend the target compliance date to 2018. There was also, however, reasonable support (20) for retaining the existing date of 2013. Local Government New Zealand, on behalf of all regional councils in New Zealand, requested a new target compliance date of 2016.

Sectors differed in what they expressed opposition to:

- Strong opposition to perceived inequity of current standards from local government and industry – particularly the blanket prohibition on industry consents imposed after 1 September 2013.
- Strong opposition from industry to mandatory offsets. As noted during the workshops, there did not appear to be a common appreciation of the proposal intent to only target **new** industry with significant discharges of PM_{10} in over-allocated airsheds.
- Strong opposition from other stakeholders to decreasing health protection by extending the current target compliance date from 2013.

Environment Canterbury responded with useful cost information that was incorporated into assumptions in the updated cost benefit analysis. The majority of industry submissions noted that the status of an airshed was an important consideration when choosing to locate a new site, however, it was only one of many important drivers (proximity to fresh water, raw materials, a workforce and necessary support services being examples offered).

On 3 August, the Auckland Regional Council published *A Review and Update of HAPINZ for the Auckland Region* (ARC, 2010) which provides an update of health modelling of the

[5] The World Health Organisation (WHO) guidelines for PM_{10} are 50 µg/m^3 as a 24-hour average with three exceedances per year and 20 µg/m^3 as an annual average. These guidelines are in fact based on $PM_{2.5}$ and they assume a ratio of $PM_{2.5}$ to PM_{10} of 0.5. In the majority of urban areas in New Zealand the key source of PM_{10} is domestic heating and the ratio of $PM_{2.5}$ to PM_{10} is significantly higher – in some areas 0.8 – 0.9. This ratio difference makes the New Zealand PM_{10} guideline less stringent than the WHO PM_{10} guideline.

impacts of air pollution over all New Zealand. The report further highlights the importance of Auckland complying with the PM_{10} standard as it reveals that nearly 50% of all premature deaths due to air pollution in New Zealand occur in Auckland. This updated health modelling was incorporated into the updated cost benefit analysis.

Status Quo

Status quo is the current regulatory regime prior to the May 2010 Cabinet decision discussed above i.e. what would happen if the current regulations continued with no amendments (one permitted exceedance, prohibition on all industry consents after 2013 in over-allocated airsheds, etc). Based on current air quality monitoring data and an assessment of current regional plan provisions, the Ministry estimates that status quo would unfold as follows:

- Fifteen airsheds will still be non-compliant in 2013. Importantly this includes Auckland which is responsible for nearly 30% of New Zealand's population. These non-compliant airsheds are listed in Table 2.
- As a result of non-compliance, **all** industrial consents for PM_{10} discharges will be declined in non-compliant airsheds. If this eventuates, the Ministry assumes:
    - Three industries will be forced to relocate and one industry will completely close down, in each of the 15 over-allocated airsheds, each year between 2013 and 2016. This is a total of 180 industries affected which is broadly similar to the actual number of consents due for renewal over that period (we estimate around 160).
    - The (one-off) costs of relocation are assumed to average $1 million per site.
    - The cost of industry closing down and being lost to a region is estimated to be $22 million per site, per year, based on a review of industry with significant PM_{10} discharges in the Auckland Regional Council Industry Economic Model.
- Councils will take severe action on domestic emissions following the decline of industrial consents so that compliance with the PM_{10} standard (with one permitted exceedance) will be achieved at the end of 2016. The choice of date for the status quo scenario is a matter of judgement. Arguably, given Local Government New Zealand's undertaking that all councils could comply by 2016 with no severe sanctions (albeit with three exceedances), it would be harder to justify any later date.
- The benefits of complying by end of 2016 have been interpolated from those calculated for 2013 and 2020 scenarios (NZIER, 2009). These include avoided premature deaths, reduced hospitalisations and restricted activity days due to improved air quality.
- The base case number of deaths attributable to air pollution each year has been scaled from the original modelling (Wilton, 2003), which included only some urban areas in New Zealand, using the *ARC Review and Update of HAPINZ* (ARC, 2010) to include 67 urban areas in New Zealand. This was further scaled from 2001 census data to 2008 population estimates.
    - As an example, the original modelling estimated 730 deaths per year in 2008 attributable to air pollution. Based on scaling from the ARC Review and update of HAPINZ and increase in population this has increased to 1,688 deaths per year in 2008.

- Based on this modelling, meeting the PM_{10} standard at the end of 2016 will avoid around 990 premature deaths (between 2008 and 2020).

- Except where noted here, status quo has the costs and benefits outlined in the NZIER 2009 report. This analysis estimates that approximately 300,000 solid fuel burner retrofits will be necessary to comply with the PM_{10} standard (with one permitted exceedance).[6] These retrofits incur a present value cost of around $178 million. The NZIER report further assumes the value of a statistical life to be $3.35 million, the cost of hospitalisation is $8,404 per visit and restricted activity days are valued at $46.50 (NZIER, 2009).

An updated analysis of the costs and benefits of status quo (as compared with a base case of no regulation) is presented in Table 3.

Table 3 Updated Cost Benefit Analysis for Status Quo*

2008 – 2020 inclusive	**$M (2008 dollars)**
Present Value Combined Benefits	1,911
Present Value Costs	867
Net Present Value	1,044
B:C Ratio	**2.2**
Direct cost to industry	679
Industry % total costs	78%
Direct cost to government	10
Govt % total costs	1%
Direct cost to households	178
Household % total costs	21%

* As compared with base case of no regulation

It should be noted that compared with the previous regulatory impact statement, the updated health modelling results in benefits increasing from $685 million to $1.9 billion. This means that there would be approximately $1.9 billion (in $2008) of benefits to the New Zealand economy over the period 2008 – 2020 if the PM_{10} standard was met by 2016 (due to the current regulations). This is primarily from avoided premature deaths due to air pollution over that period.

The New Zealand Institute of Economic Research has commented at length on their choice of value of statistical life in Appendix C of their report to the Ministry (NZIER, 2009). The Ministry notes that the National Environment Protection Council of Australia recommends a value of $AUD 6 million for the value of a statistical life *specifically for the purpose of setting air quality standards* (NEPC, 2009). As such, the choice of $3.35 million appears rather conservative in that it will not overestimate benefits. The NEPC further recommends sensitivity testing using values ranging from $3.7 million to $8.1 million. Given our choice of value is already less than the lower estimate of $3.7 million, sensitivity testing on the value of a statistical life is not considered necessary.

[6] Assuming no change to the number of exceedances, the total number of burners requiring retrofitting does not change. Present value costs to households are, however, highly sensitive to the chosen target compliance date. This is because natural attrition assumes a 15 year turnover of burners that, depending on the chose date, impacts on the marginal costs of the proposed amendments. Costs incurred in later years as a result of an extended compliance date are similarly less expensive in present value terms.

It should be noted that the previous regulatory impact statement did not explicitly include the costs of industry relocation and/or loss due to consents being declined as required by the current regulations. These have been included in the updated modelling using the assumptions described above. This results in present value costs increasing from $438 million to $867 million ($2008 over period 2008 – 2020 as compared with base case of no regulation).

Another important feature of the status quo scenario is the heavy burden borne by industry with estimated present value costs of $679 million. This is due to industry relocations and closures due to non-compliance in 15 airsheds after 1 September 2013.

Objectives

The original objectives of the PM_{10} regulations in the air quality standards were:

- provision of greater certainty for industry by providing a "level-playing field" that clarifies environmental expectations prior to the resource consent process;
- support for the protection of public health and the environment by providing a bottom-line standard that shall not be breached;
- provision of greater certainty in resource consent decision-making and regional plan preparation at the local level.

These objectives are still government priorities. The main objective of the review of the PM_{10} regulations is to ensure that they provide the maximum net benefit to New Zealanders taking into account the economic, social and environmental benefits and costs of air pollution. In line with this, the review was to address three aspects of the regulations:

- improving the equity of the compliance aspects of the standards;
- consider increasing the number of permitted exceedances;
- address the credibility of the target compliance date.

Regulatory impact analysis

A regulatory impact statement was published in May 2010 along with a consultation document outlining five options.[7] Following submissions, four new options are now considered. The new options all have the same basic approach that was previously approved by Cabinet as follows:

- provision for exceptional events;
- repeal prohibition on industrial consents post 2013;
- require mandatory reporting by regional councils;
- preparation of national compliance strategy;
- Ministerial oversight of non-compliance.

[7] http://www.mfe.govt.nz/laws/ris/ris-air-quality-review.pdf

In addition to this, all new options include the following:

- **Amended proposal**: retain one exceedance per year of the ambient PM_{10} standard, but use different target compliance dates to reduce compliance costs and maximise credibility and feasibility. It is hard to justify any relaxation of the stringency of the ambient PM_{10} standard in the face of adverse health impacts and increased costs.
- **Amended proposal**: mandatory offsets for industry to apply from 1 September 2012 instead of 2018. The intent of mandatory offsets is to assist councils to achieve compliance with the PM_{10} standard by the target compliance date as opposed to an after-the-fact sanction.
- **New proposal**: a prohibition on *new* open fires (in over-allocated airsheds) from 1 September 2012 to improve equity across sectors. This proposal was developed in response to a number of submissions from regional councils calling for increased national controls on domestic burners. In this regard, a national standard is more efficient and effective than changes to multiple regional plans.
- **New proposal**: revision of the national ambient air quality guidelines for $PM_{2.5}$ and consideration of a future annual PM_{10} and $PM_{2.5}$ standards were good suggestions by submitters.

The assumptions, on which the analysis of costs and benefits for these four new options was based, are outlined in Appendix 1. The four new options differ from each other in terms of target compliance dates as outlined below:

Option 1 – Split Targets

In this option, over-allocated airsheds are divided into two groups:

- Heavily Polluted (i.e. more than 10 exceedances per year as averaged over the last five years)
- Polluted (i.e. less than 10 exceedances per year as averaged over the last five years)

Heavily polluted airsheds are to achieve the PM_{10} standard with no more than three exceedances in a 12-month period by 1 September 2016.

Polluted airsheds are to achieve the PM_{10} standard with no more than one exceedance in a 12-month period by 1 September 2016.

Both heavily polluted and polluted airsheds are to achieve the PM_{10} standard with no more than one exceedance in a 12-month period by 1 September 2020.

Option 2 – Set and Review

All over-allocated airsheds are to achieve an initial target of the PM_{10} standard with no more than three exceedances in a 12-month period by 1 September 2016. At that stage, the target will be reviewed.

Option 3 – Interim Targets

All over-allocated airsheds are to achieve an interim target of the PM_{10} standard with no more than three exceedances in a 12-month period by 1 September 2016. All airsheds are then to achieve the PM_{10} standard with no more than one exceedance in a 12-month period by 1 September 2020.

Option 4 – Strict Compliance

In this option, all airsheds are to achieve the PM_{10} standard with one exceedance by end 2016.

Table 4 compares the new options with what has been approved, in principle, by Cabinet. Table 5 (overleaf) summarises the existing regulatory regime and the new options against the problems to be addressed.

Table 4 Previous Decisions and New Options

Action	Previously approved in principle by Cabinet	Option 1 Split Targets	Option 2 Set and Review	Option 3 Interim Targets	Option 4 Strict Compliance
Regulatory					
Provide for exceptional events	Y	✓	✓	✓	✓
Increase permitted exceedances from one to three	Y*	Heavily polluted airsheds meet 3 by 2016; Polluted airsheds meet 1 by 2016; All airsheds meet 1 by 2020.	All airsheds meet 3 by 2016 and then review.	All airsheds meet 3 by 2016; All airsheds meet 1 by 2020.	All airsheds meet 1 by 2016.
Repeal prohibition on industrial consents post 2013	Y	✓	✓	✓	✓
Revise existing mandatory offsets provisions to apply to NEW significant industry in over-allocated airsheds:	from 2018	from 2012	from 2012	from 2012	from 2012
Revise existing domestic controls to prohibit new solid fuel burning open fires in over-allocated airsheds post 2012	-	✓	✓	✓	✓
Non Regulatory					
New target compliance date:	by 2018	by 2016	by 2016	by 2016	by 2016
Require mandatory reporting by regional councils	Y	✓	✓	✓	✓
National compliance strategy	Y	✓	✓	✓	✓
Ministerial oversight of non-compliance	Y	✓	✓	✓	✓
Revise national ambient air quality guidelines for $PM_{2.5}$ and consider future standards for annual PM_{10} and $PM_{2.5}$	-	✓	✓	✓	✓

* Impact of increase from one to three exceedances was not explicitly modelled in previous regulatory impact statement.

Table 5 Summary of options compared with review objectives and problem definition

Status quo
- One permitted exceedance per year
- All industry consents prohibited in over-allocated airsheds after 2013
- Target compliance date 2013

New Option 1: Split Targets
- Split target compliance dates: Heavily polluted airsheds to meet 3 exceedances by 2016; Polluted airsheds to meet 1 exceedance by 2016; All airsheds to meet 1 exceedance by 2020.
- New open fires prohibited in over-allocated airsheds after 2012
- New industry must offset emissions in over-allocated airsheds after 2012
- Assisted compliance
- Review national ambient air quality guidelines for $PM_{2.5}$ and consider future standards for annual PM_{10} and $PM_{2.5}$
- Explicit provision for exceptional events

New Option 2: Set & Review
- All airsheds to meet 3 exceedances by 2016 and then review progress.
- New open fires prohibited in over-allocated airsheds after 2012
- New industry must offset emissions in over-allocated airsheds after 2012
- Assisted compliance
- Review national ambient air quality guidelines for $PM_{2.5}$ and consider future standards for annual PM_{10} and $PM_{2.5}$
- Explicit provision for exceptional events

New Option 3: Interim Targets
- All airsheds to meet 3 exceedances by 2016; All airsheds to meet 1 exceedance by 2020.
- New open fires prohibited in over-allocated airsheds after 2012
- New industry must offset emissions in over-allocated airsheds after 2012
- Assisted compliance
- Review national ambient air quality guidelines for $PM_{2.5}$ and consider future standards for annual PM_{10} and $PM_{2.5}$
- Explicit provision for exceptional events

New Option 4: Strict Compliance
- All airsheds to meet 1 exceedance by 2016.
- New open fires prohibited in over-allocated airsheds after 2012
- New industry must offset emissions in over-allocated airsheds after 2012
- Assisted compliance
- Review national ambient air quality guidelines for $PM_{2.5}$ and consider future standards for annual PM_{10} and $PM_{2.5}$
- Explicit provision for exceptional events

Key trade-offs:	Status quo **puts the greatest weight on health benefits**, has severe penalties on industry for non-compliance and does not take equity into account.	This option has **most of the health benefits** of status quo but with **significantly decreased industry costs** due to assisted compliance approach. Provision for split targets **increases complexity** but also **increases credibility**.	This option has **reduced health benefits** compared with status quo but also has **significantly decreased industry costs** due to assisted compliance approach. Additional review in 2016 **decreases certainty**.	This option has **reduced health benefits** compared with status quo but also has **significantly decreased industry costs** due to assisted compliance approach. Provision for interim targets **increases complexity** but also **increases credibility**.	This option **maximises health benefits** and has **significantly decreased industry costs** due to assisted compliance approach. One target and one deadline **increases simplicity** but increased stringency also **reduces credibility**.
Risks:	Significant negative economic impacts.	Will not provide a 'level playing field' because new entrants in over-allocated airsheds will be disadvantaged compared with existing industry.	Will not provide a 'level playing field' because new entrants in over-allocated airsheds will be disadvantaged compared with existing industry. Additional review may relax pursuit of compliance.	Will not provide a 'level playing field' because new entrants in over-allocated airsheds will be disadvantaged compared with existing industry.	Benefits may not be realised in practice because some councils face challenging implementation issues. Will not provide a 'level playing field' because new entrants in over-allocated airsheds will be disadvantaged compared with existing industry.
Problems to be address in Review:					
Improve equity	No. Only penalises industry.	Yes. Each sector bears cost burden that is more proportional to emission contribution.	Yes. Each sector bears cost burden that is more proportional to emission contribution.	Yes. Each sector bears cost burden that is more proportional to emission contribution.	Yes. Each sector bears cost burden that is more proportional to emission contribution.
Consider increasing permitted exceedances	No	3 or 1 by 2016 in heavily polluted or polluted airsheds; 1 by 2020 in all airsheds. Exceptional events excluded.	Yes, albeit with provision for future review. Exceptional events excluded.	3 by 2016 and 1 by 2020 in all airsheds. Exceptional events excluded.	No
Credible target compliance date	No. MfE estimates 15 airsheds will not be compliant in 2013.	Yes	Yes	Yes	Yes, but less certain than other options.
Costs and Benefits Compared with Status Quo		**Δ Benefits : $ - 165 million** **Δ Costs : $ - 671 million** **Δ NPV : $ 506 million**	**Δ Benefits : $ - 943 million** **Δ Costs : $ - 706 million** **Δ NPV : $ - 238 million**	**Δ Benefits : $ - 588 million** **Δ Costs : $ - 695 million** **Δ NPV : $ 107 million**	**Δ Benefits : $ 0 million** **Δ Costs : $ - 662 million** **Δ NPV : $ 662 million**
Review Objective: Provide the maximum net benefit to New Zealanders taking into account the economic, social and environmental benefits and costs of air pollution					
Met?	No	Yes	No	No	Not as certain as other options

Table 6 presents a cost benefit analysis for the new options.

Table 6 Cost Benefit Analysis for New Options*

$2008 million (2008 – 2020 inclusive)	**Status Quo**	**New Option 1 Split Targets**	**New Option 2 Set & Review**	**New Option 3 Interim Targets**	**New Option 4 Strict Compliance**
Description	1 exceedance by 2013	1 or 3 exceedances by 2016, 1 exceedance by 2020	3 exceedances by 2016 then review	3 exceedances by 2016, 1 exceedance by 2020	1 exceedance by 2016
PV Combined Benefits	1,911	1,746	967	1,323	1,911
Present Value Costs	867	196	161	172	204
Net Present Value	1,044	1,550	806	1,151	1,706
B:C Ratio	**2.2**	**8.9**	**6.0**	**7.7**	**9.3**
PV Costs Industry	679	16	17	17	15
	78%	8%	10%	10%	7%
PV Costs Government	10	11	11	11	11
	1%	6%	7%	7%	6%
PV Costs Households	178	168	133	144	178
	21%	86%	82%	84%	87%

* As compared with base case of no regulation

New Option 1 (Split Targets) has over 90% of the present value benefits of status quo, but present value costs have been reduced by $671 million. The big reduction in costs is due to industry no longer being declined consent (as would be the case under status quo) and an extended target compliance date with reduced costs to householders. Instead, compliance is achieved through a variety of regulatory and non-regulatory requirements for both domestic and industrial sectors. The retention of the majority of benefits of status quo is primarily due to the large population (1.5 million) achieving compliance with the PM_{10} standard with one exceedance by 2016.

When compared with status quo, New Option 2 (Set and Review) has reduced both present value benefits by $943 million and present value costs by $706 million. The big reduction in benefits is due to increased impacts from compliance with a less stringent standard. The big reduction in costs is due to industry no longer being declined consent (as would be the case under status quo) and reduced compliance costs for householders.

The present value benefits of New Option 3 (Interim Targets) are between New Options 1 and 2 with reduced health benefits and present value costs when compared with status quo. The distributions of compliance costs for all new options are more proportional to each sector's contribution to emissions than status quo.

New Option 4 has the same present value benefits when compared with status quo, but present value costs have been reduced by $662 million. The big reduction in costs is due to industry no longer being declined consent (as would be the case under status quo). Instead, compliance is achieved through a variety of regulatory and non-regulatory requirements for both domestic and industrial sectors.

In summary, all new options offer significantly reduced costs to industry over the status quo with additional reductions in household costs varying across the options under consideration. The costs and benefits of varying the number of permitted exceedances and target compliance dates differ between locations. There is no generally accepted, correct answer and the choice of a national standard may be guided by its impacts on locations of particular concern, including their ability to achieve the standard by 2016.

From a national viewpoint, however, the maximum net benefit to New Zealand would be delivered through compliance with the existing standard (i.e. 1 exceedance) in as short a timeframe as feasibly possible. In this regard, the consideration of feasibility is paramount.

The Ministry notes that Local Government New Zealand (submitting on behalf of councils) requested a new target compliance date of 2016; for compliance with the PM_{10} standard with **three** permitted exceedances. Option 4 (Strict Compliance) requires compliance with the PM_{10} standard with **one** permitted exceedance. Having considered the air quality in both polluted and heavily polluted airsheds, the Ministry is less certain that Option 4 (Strict Compliance) would be achieved in practice than other options, notably Option 1 (Split Targets). Put simply, whilst Option 4 would have the maximum benefits these are not as likely to be realised as Option 1.

This lack of certainty is largely due to concerns over implementation. Success of the policy objectives will require the combined efforts of local authorities, households and industry stakeholders working together to achieve compliance with the PM_{10} standard. This in turn depends on both political and economical factors because the incentives for compliance (or rather the penalties for non-compliance) are less powerful than the status quo. The Ministry recognises that councils need to manage both their statutory processes and their constituencies to achieve the outcomes sought. In light of the problems experienced by local authorities to date in pursuit of compliance by 2013, the Ministry is concerned that a regime permitting only one exceedance by 2016 might be perceived as an “all or nothing” ultimatum, and may discourage the community-wide political consensus necessary for success. These concerns are allayed by the increased flexibility offered by Option 1 (Split Targets).

The Ministry’s best advice is that Option 1 (Split Targets) is the most likely to provide the maximum net benefit to all New Zealanders taking into account the economic, social and environmental benefits and costs of air pollution.

Conclusions and recommendations

Cabinet has already approved, in principle, amendments to the national environmental standards for air quality. Following public consultation, four new options for amending the standards have been assessed. All options have significantly reduced compliance costs compared with the status quo.

In terms of the review objectives, the Ministry for the Environment considers that New Option 1 (Split Targets) is the most feasible of all options investigated. Based on the assumptions and limitations outlined in the cost benefit analysis, therefore, the Ministry considers that the Split Target approach would deliver the maximum net benefit to all New Zealanders taking into account the economic, social and environmental benefits and costs of air pollution.

Implementation

The approved option will be given effect through amendments to the PM_{10} regulations, which impose obligations on regional councils, by early 2011. Government will further support regional councils in implementing the regulations through the following actions:

- The preparation of a national compliance strategy by the Ministry for the Environment incorporating education on the health impacts of PM_{10}, best practice guidance for airshed management (included public reporting) and best available technology, technical details to assist in interpreting the standards, including mandatory offsets and measuring compliance;
- Requiring annual public reporting on PM_{10} by regional councils;
- Review of public reporting and strategic oversight of compliance by the Minister for the Environment.
- Revision of the ambient air quality guidelines for $PM_{2.5}$.

The Ministry considers the above approach will effectively mitigate any implementation risks and minimise compliance costs.

The proposed national compliance strategy will outline an enforcement strategy that will be implemented to ensure that the proposed option achieves its public policy objectives.

Monitoring, evaluation and review

Ambient monitoring of PM_{10} (required by the regulations) provides the best key indicator of the effectiveness of the regulations. Put simply, compliance with the appropriate standard by the chosen target compliance date would demonstrate the regulations have worked.

The proposed national compliance strategy will outline plans for monitoring and evaluating the effectiveness of the approved option. Without precluding the design of the national compliance strategy, key performance indicators are likely to include:

- Maximum recorded daily PM_{10} levels each year (after allowing for permitted exceedances);
- Number of days PM_{10} standard breached each year;
- Percentage of New Zealanders living in compliant, and non-compliant, airsheds;
- Details of non-compliant airsheds and airshed action plans to achieve compliance by target compliance date(s);
- Details of offsets achieved each year within non-compliant airsheds including implementation and transaction cost estimates.

At this stage, any future review of the regulations will not occur until an update of the national ambient air quality guidelines has happened (currently scheduled to occur in 2012 and 2013).

References

ARC, 2010 *Review and Update of HAPINZ for the Auckland Region*, Auckland Regional Council Internal Report No. 2010/004, August 2010.

Fisher et al, 2007 *Health and Air Pollution in New Zealand,* Fisher et al, June 2007. Available at www.hapinz.org.nz

MfE, 2009 *2008 Report on Progress: National Environmental Standards for Air Quality,* Ministry for the Environment, June 2009.

MfE, 2010 *Proposed Amendments to the National Environmental Standards for Air Quality,* Ministry for the Environment, June 2010.

NEPC, 2009 *An Australian Approach to Setting Air Quality Standards*, Consultation draft, National Environment Protection Council, Australia, September 2009.

NZIER, 2009 *The value of air quality standards, Review and update of cost benefit analysis of National Environmental Standards on Air Quality*, New Zealand Institute of Economic Research, October 2009

Public Health South, 2006 *Investigation of the Effect of Air Quality in Otago on Hospital Admission Rates,* Public Health South Policy Planning and Information Team, June 2006.

The Treasury, 2009, *Government Statement on Regulation: Better Regulation, Less Regulation*, The Treasury, August 2009. Available at: http://www.treasury.govt.nz/economy/regulation/statement

WHO, 2006 *Air Quality Guidelines Global Update 2005*, World Health Organisation, Denmark, 2006.

Wilton, 2003 *Assessing the benefits of introducing standards for air*, Unpublished – Wilton, E, Ministry for the Environment, 2003.

Appendix 1 Assumptions for New Options in CBA

Except where noted here, the costs and benefits outlined in the NZIER 2009 report have been used. Benefits have been scaled for increased population and three exceedances (where appropriate). The following assumptions were also made in assessing the new options:

Option 1 Split Targets (1 or 3 exceedances by 2016, 1 exceedance by 2020)

Option 2 Set and Review (3 exceedances by 2016 then review)

Option 3 Interim Targets (3 exceedances by 2016, 1 exceedance by 2020)

Option 4 Strict Compliance (1 exceedance by 2016)

Government Costs – All Options

- 15 airsheds will each incur one-off costs of $50K to prepare airshed action plans to reach compliance by the new target compliance date(s).
- Reporting costs will be $5K per council per year for all 16 councils. These are only reporting costs *additional* to reporting already undertaken by councils, as a direct result of the regulations.
- The preparation of a national compliance strategy will incur one-off, external costs of $150K in 2011.
- Preparation of best practice guidance (including Good Wood scheme) will incur one-off, external costs of $75K in 2013.
- Ministerial oversight will incur external costs of $100K per annum 2014 – 2016.
- The prohibition on new open fires in over-allocated airsheds is assumed to have zero direct cost because it only relates to new sources. People who would have built new houses including new solid-fuel burning open fires would suffer some utility loss (mainly derived from aesthetics), but this will be partly offset by the lower operating costs of more efficient heating (e.g. modern wood burners, heat pumps, flued gas heaters, electrical heaters).
- Revision of the national ambient air quality guidelines will incur external costs of $75K in 2012 and 2013 (delayed due to preparation of national compliance strategy).
- The direct costs of exceptional events (e.g. volcanic eruptions, wild fires) are not specifically included in the cost benefit analysis. This is because they cannot be controlled and will occur regardless of the regulations. Hence including their costs serves no useful role in a cost benefit analysis of regulatory approaches. However, their indirect costs will be addressed through council plans for managing air quality, which will be the same under both options.

Benefits – Option 1 (Split Targets)

- The following airsheds were assumed to be polluted based on less than 10 exceedances per year as averaged between 2005 and 2009; Auckland (5), Blenheim (4), Geraldine (5), Gore (4), Hamilton (2), Invercargill (5), Napier (4), Otago 3 (7), Putaruru (2), Rangiora (7), Te Kuiti (4), Waimate (9), Wairarapa (3). These airsheds

contain approximately 1.5 million people which is 72% of people living in over-allocated airsheds in New Zealand.

- Polluted airsheds are assumed to reach one exceedance per year by end of 2016. The benefits for this were calculated from a pro-rata calculation of the benefits for status quo (which similarly assumes achieving one exceedance by end of 2016) based on population in these airsheds (i.e. 72% of $1.9 billion).

- The following airsheds were assumed to be heavily polluted based on more than 10 exceedances per year as averaged between 2005 and 2009; Ashburton (16), Christchurch (21), Hastings (18), Kaiapoi (21), Nelson A (37), Nelson B (13), Otago 1 (59), Otago 2 (21), Reefton (18), Richmond (27), Rotorua (30), Taupo (10), Timaru (39), Tokoroa (16). These airsheds contain approximately 580,000 people which are 28% of people living in over-allocated airsheds in New Zealand.

- Heavily polluted airsheds are assumed to reach the PM_{10} standard with three exceedances by end of 2016 and then reach the PM_{10} standard with one exceedance by 2020. The benefits for this were estimated from a pro-rata calculation of the benefits calculated for Option 3 (Interim Targets which similarly reaches 3 exceedances by 2016 and then 1 by 2020) based on the population in these airsheds (i.e. 28% of $1.3 billion).

- The present value benefits for both polluted and heavily polluted airsheds reaching one exceedance by end 2020 were then summed to total present value benefits.

Industry Costs – Option 1 (Split Targets)

- As under status quo, fifteen airsheds will still be non-compliant in 2013. The difference now, however, is that existing industry has had all consent restrictions repealed. New industry, and existing industry that wish to increase emissions, must use offsets to gain consent in over-allocated airsheds.

- It is assumed that two industries will be required to offset emissions each year from 2012 – 2016 (when Auckland achieves compliance). Between 2016 and 2020, one industry will be required to offset emissions each year.

- The (one-off) cost to each industry of doing so will average $400K based on an average of 5 tonnes of PM_{10} discharged per year and a mix of open fires and older wood burners being replaced.

Household Costs – Option 1 (Split Targets)

- Costs to households were calculated from summing pro-rata calculations of the costs for status quo (which assumes achieving one exceedance by 2016), and the costs for interim targets (which achieves one exceedance by 2020 with interim target of three exceedances by 2016), based on population in these airsheds (i.e. 72% of $178 million and 28% of $144 million).

Benefits – Option 2 (Set and Review)

- The benefits of compliance with **three** exceedances by end 2016 are reduced from the benefits for compliance with **one** exceedance by end 2016. This is due to adverse health impacts that will *not* be prevented because compliance will be achieved to a less stringent standard. New Zealand monitoring data shows that annual levels of PM_{10} are directly correlated with the number of exceedances of the PM_{10} standard each year. The adverse health impacts of PM_{10} (including premature mortality) are also directly

correlated with annual levels of PM_{10}. It can be assumed, therefore, that the number of exceedances is directly correlated with adverse health impacts. Appendix 2 of the previous regulatory impact statement estimated that increasing the number of permitted exceedances of the PM_{10} standard from one to three would result in an increase of 3.8% in annual PM_{10}, resulting in around 470 deaths that would not be avoided (over the period 2008 – 2020) when compliance is achieved at the end of 2016.

- The annual 3.8% increase in mortality, hospitalisations and restricted activity days was calculated for each year commencing in 2011 (for NZIER 2013 scenario), and commencing in 2016 (for NZIER 2020 scenario) with staggered increases prior to this (0.8% in 2012, 1.6% in 2013, 2.3% in 2014 and 3.0% in 2015). Benefits were then interpolated, as before, between the 2013 and 2020 scenarios for a new target compliance date of 2016. The estimated present value benefits of compliance with the PM_{10} with three exceedances by end of 2016 are $967 million (cf present value benefits of compliance with the PM_{10} with one exceedance by end of 2016 of $1.91 billion).

Industry Costs – Option 2 (Set and Review)

- As under status quo, fifteen airsheds will still be non-compliant in 2013. The difference now, however, is that existing industry has had all consent restrictions repealed. New industry, and existing industry that wish to increase emissions, must use offsets to gain consent in over-allocated airsheds.
- It is assumed that two industries will be required to offset emissions each year from 2012 – 2020.
- The (one-off) cost to each industry of doing so will average $400K based on an average of 5 tonnes of PM_{10} discharged per year and a mix of open fires and older wood burners being replaced.

Household Costs – Option 2 (Set and Review)

- The Ministry has assumed one quarter fewer retrofits (75,000) will be needed nationally to comply with three permitted exceedances than with one permitted exceedance. In reality, however, the impacts of this will differ between locations:
    - there is likely to be little or no impact on airsheds already on track to meet the current standard of one exceedance;
    - many of those airsheds that are heavily over-allocated (i.e. more than 20 exceedances) have quite small populations and could achieve compliance at comparatively low cost by retrofitting wood burners – there is likely be little difference in cost between meeting 1 or 3 exceedances in these airsheds;
    - the majority of avoided retrofits are likely to occur in Auckland. Auckland has approximately 140,000 solid fuel burners (including around 30,000 open fires).

Benefits – Option 3 (Interim Targets)

- The benefits of compliance with the PM_{10} standard with three exceedances by end 2016 are as per those calculated for Option 2 (Set and Review).
- The additional benefits of compliance with one exceedance by 2020 are estimated from the difference between the NZIER 2020 scenario scaled for one exceedance

and the NZIER 2020 scenario scaled for three exceedances ($356 million). These benefits are for years 2017 – 2020 only.

Industry Costs – Option 3 (Interim Targets)

- As under status quo, fifteen airsheds will still be non-compliant in 2013. The difference now, however, is that existing industry has had all consent restrictions repealed. New industry, and existing industry that wish to increase emissions, must use offsets to gain consent in over-allocated airsheds.
- It is assumed that two industries will be required to offset emissions each year from 2012 – 2020.
- The (one-off) cost to each industry of doing so will average $400K based on an average of 5 tonnes of PM_{10} discharged per year and a mix of open fires and older wood burners being replaced.

Household Costs – Option 3 (Interim Targets)

- The costs for Option 3 assume the same present value costs as Option 1 plus costs from the last four years of wood burner costs for the NZIER 2020 scenario to meet 1 permitted exceedance ($11 million).

Benefits – Option 4 (Strict Compliance)

- The benefits of compliance with the PM_{10} standard with one exceedance by end 2016 are as per those calculated for status quo (which similarly assumes compliance with one exceedance by end 2016).

Industry Costs – Option 4 (Strict Compliance)

- As under status quo, fifteen airsheds will still be non-compliant in 2013. The difference now, however, is that existing industry has had all consent restrictions repealed. New industry, and existing industry that wish to increase emissions, must use offsets to gain consent in over-allocated airsheds.
- It is assumed that two industries will be required to offset emissions each year from 2012 – 2016. After this date all airsheds achieve compliance and so no further offsets will be required.
- The (one-off) cost to each industry of offsets will average $400K based on an average of 5 tonnes of PM_{10} discharged per year and a mix of open fires and older wood burners being replaced.

Household Costs – Option 4 (Strict Compliance)

- The costs to households for complying with the PM_{10} standard with one exceedance by end 2016 are as per those calculated for status quo (which similarly assumes compliance with one exceedance by end 2016).