Summary of Public Submissions and National Environment Protection Council Response

Variation to the National Environment Protection (Ambient Air Quality) Measure

December 2015

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INTRODUCTION

Background

In 1998 the National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM) established national standards for six common air pollutants known as 'criteria pollutants', and provided a consistent framework for the monitoring and reporting of ambient air quality. The criteria pollutants are:

- carbon monoxide (CO)
- nitrogen dioxide (NO_2)
- sulfur dioxide (SO_2)
- lead (Pb)
- photochemical oxidants as ozone (O_3)
- particulate matter with a diameter of less than 10 micrometres (µm) (known as PM_{10}).

The AAQ NEPM was varied in 2003 to include monitoring and reporting protocols and advisory reporting standards for particulate matter (PM) with a diameter of less than 2.5 µm, known as $PM_{2.5}$.

AAQ NEPM standards and goals

The overall goal of the AAQ NEPM is to attain 'ambient air quality that allows for the adequate protection of human health and wellbeing'.

The standards and goals of the AAQ NEPM aim to guide policy formulation that allows for the adequate protection of health and wellbeing. Under the current AAQ NEPM, participating jurisdictions (Commonwealth, states and territories) are required to undertake reporting and monitoring activities to provide data that assist jurisdictions in formulating air quality policies. The AAQ NEPM itself does not compel or direct pollution control measures.

AAQ NEPM review

A strategic and technical review of the AAQ NEPM was published in 2011. This review assessed whether the AAQ NEPM was achieving its desired environmental outcome, and provided an opportunity for public consultation on the efficacy of the current framework. In 2012 the National Environment Protection Council (NEPC) agreed that the review's recommendations would be prioritised. The then Council of Australian Governments (COAG) agreed to prioritise work on particles for the following reasons:

- There is strong evidence that exposure to PM has adverse effects on human health, and a lack of evidence for a concentration threshold below which health effects do not occur. This means that there are likely to be adverse health effects at the concentrations currently experienced in Australian cities, even where these are below the current standards.
- PM_{10} standards are at times exceeded in nearly all regions of Australia; however, such exceedances can occur as a result of uncontrollable natural events.
- The potential health benefits of reducing population exposure to PM, and the associated monetary savings for society are larger than for any other air pollutants.
- The range of cost-effective abatement policies and actions available for PM is larger than that for other pollutants.

The specific standards and goals that are set out for short term (24-hour average) and long term (annual average) PM_{10} and $PM_{2.5}$ concentrations in the AAQ NEPM are summarised in Table 1.1. There is currently no annual mean standard for PM_{10}.

Table 1.1: Air quality standards and goals for PM10 and PM2.5 in the AAQ NEPM

Pollutant	Standard		Goal (maximum allowable exceedances within 10 years)
	Averaging period	Maximum concentration	
PM_{10}	24 hours	50 µg/m³	5 days per year
$PM_{2.5}$[(a)]	24 hours 1 year	25 µg/m³ 8 µg/m³	Not applicable. Goal is to gather sufficient data nationally to facilitate a review of the advisory reporting standards.

(a) Advisory reporting standards

Impact Statement and draft varied AAQ NEPM

In the decade since the AAQ NEPM was varied there have been significant developments in the understanding of the effects of PM on health and the environment, as well as improvements in monitoring methods.

In 2014, current available information about PM in Australia was collated and analysed in an Impact Statement on a proposal to vary the AAQ NEPM standards for particles[1]. The Impact Statement considered the feasibility, costs and benefits of amending the standards and goals relating to PM as currently defined in the AAQ NEPM. It also considered a framework for reducing population exposure to PM.

The Impact Statement outlined the basis for options being considered by government. The draft AAQ NEPM included preferred options for particle standards (see Chapter 3), noting that these would be subject to the outcomes of consultation. The draft varied AAQ NEPM also updated monitoring protocols.

The *National Environment Protection Council Act 1994* (NEPC Act) required that both the Impact Statement and a draft varied NEPM be made available for public consultation for a period of at least two months. NEPC must have regard to the Impact Statement and submissions received during public consultation in deciding whether or not to vary the AAQ NEPM.

Purpose of this document

This document outlines the consultation process undertaken on the proposed variation to the Ambient Air Quality NEPM and Impact Statement. It summarises public submissions received in response to the consultation on the proposed variation and the National Environment Protection Council's responses to submissions.

[1] *Impact statement on the draft variation to the AAQ NEPM,* www.environment.gov.au/system/files/pages/dfe7ed5d-1eaf-4ff2-bfe7-dbb7ebaf21a9/files/aaq-nepm-draft-variation-impact-statement.pdf.

PUBLIC CONSULTATION

Background

In accordance with the requirements of section 18(1) of the NEPC Act, NEPC authorised the release of the Impact Statement and draft varied AAQ NEPM for proposed changes to the particle standards. A number of supporting papers were also released, including:

- *Exposure Assessment and Risk Characterisation to Inform Recommendations for Updating Ambient Air Quality Standards for $PM_{2.5}$, PM_{10}, O_3, NO_2 and SO_2* (referred to as the Health Risk Assessment)
- *Summary for Policy Makers of the Health Risk Assessment of Air Pollution in Australia*
- *Economic Analysis to Inform the National Plan for Clean Air (Particles)*
- *Evaluating Options for an Exposure Reduction Framework in Australia*
- *Methodology for Valuing the Health Impacts of Changes in Particle Emissions*.

The purpose of releasing the Impact Statement, draft varied AAQ NEPM and supporting papers was to:

- publish the extensive data set used to inform the proposals to vary the AAQ NEPM standards for particles
- invite public comment on these documents and the proposals they contained
- ensure the process of developing the variation to the AAQ NEPM was as open and transparent as practicable.

NEPC specifically sought comments, information and feedback about:

- metrics used to quantify PM in the AAQ NEPM
- numerical values of the PM standards
- form of the PM standards (e.g. allowed exceedances)
- options for an exposure reduction framework for PM.

A summary of full issues identified in the Impact Statement is provided in Appendix A.

Feedback was also sought on the analysis and conclusions or any other aspect of the Impact Statement.

Consultation period

Consultation on the Impact Statement and draft varied AAQ NEPM ran for 10 weeks, from 31 July to 10 October 2014. Where requested, extensions to make written submissions were granted to 31 October 2014.

An online survey was developed as an alternative means of making a submission. As the Impact Statement covered a range of issues, some of which were highly technical in nature, respondents were not expected to provide feedback on all issues. They were, however, invited to provide input on the preferred options for the particle standards and exposure reduction framework.

A link to the questionnaire was included on the consultation page of the NEPC website. The survey was open to all stakeholders and the wider community. Ipsos Social Research Institute administered the survey on NEPC's behalf.

The consultation period was advertised through:

- public notices in *The Australian* newspaper and Commonwealth Government Gazette, which included an invitation to provide a submission
- details published on the NEPC website
- details published on a number of state EPA websites
- email advice to approximately 300 identified stakeholders, including notification of and direction to the online survey.

In addition, various other media outlets and professional networks provided information about the AAQ NEPM variation, particularly around the opening of the consultation period. These included state and regional newspapers, regional and metropolitan radio, and the Clean Air Society of Australia and New Zealand.

To assist people who wished to make submissions, a series of national stakeholder meetings was held from August to October 2014 to discuss the options proposed. In total 25 meetings were held with a total of 270 individuals attending. Representation from industry groups comprised almost 50% of attendees, individuals and community groups almost 25%, and academia, state and/or local government around 25%.

A full list of meetings held nationally is provided in Appendix B.

Submissions received

A total of 142 written submissions were received responding to issues raised in the Impact Statement and draft varied AAQ NEPM. This includes 25 responses to the online survey. Additionally, at least 420 letters were sent by community groups and individuals to environment Ministers about national particle standards.

The submissions received provided a range of perspectives. The approximate breakdown of submissions was:

- industry and industry groups ~20%
- individuals and community groups ~50%
- other, including academic/research, state/local government and professional society ~30%.

Written submissions were received from across Australia: NSW (~30%), Victoria (~23%), Queensland (~9%), Western Australia (~6%), South Australia (~5%), Tasmania (~2%), organisations operating nationally (~15%) and location not determined (~10%).

All non-confidential submissions were published on the NEPC website on 23 December 2014. Nineteen submissions requested various levels of confidentiality.

The full list of non-confidential submitters is provided in Appendix C.

Written submissions were reviewed and issues summarised by a project team comprising representatives from NSW, Victoria and the Commonwealth. Responses and recommendations, taking into account the feedback received through consultation, were formulated collaboratively by all jurisdictions.

Technical problems experienced with the online survey caused some data to be lost. Affected individuals were contacted and asked to re-submit their responses. For these individuals, only re-submitted surveys are considered in this Summary.

SUMMARY OF SUBMISSIONS and RESPONSES TO KEY ISSUES

Many submissions raised similar issues and/or made similar comments on an issue but with different connotations, contexts and emphases. It is not possible in this Summary to deal with all submissions individually. The Summary therefore captures the key issues raised and groups similar comments together. Different views about the issues are contrasted. The Summary provides a single response to each issue addressing the different views.

While attributed comments are presented against each issue, no subjective weighting has been given to any submission or point raised that would give cause to elevate the importance of any submission over another. Attributed comments are provided as examples only of the range of views expressed.

Issues relating to the preferred options for particle standards and an exposure reduction framework are dealt with first.

General comments about the NEPM, air quality management and standard setting

The desired environmental outcome of the AAQ NEPM is 'ambient air quality that allows for the adequate protection of human health and wellbeing'. AAQ NEPM standards are health-based.

The AAQ NEPM does not compel or direct pollution control measures. The standards and goals of the AAQ NEPM aim to guide policy formulation that allows the adequate protection of health and wellbeing. The AAQ NEPM requires participating jurisdictions to undertake monitoring, evaluation and reporting activities that assist the formulation of air quality policies.

There is very strong evidence exposure to particulate matter has adverse effects on human health. In its most recent review of evidence on health aspects of air pollution, the World Health Organization[2] notes that the weight of evidence from epidemiological studies show:

- an association between exposure to particulate matter and respiratory and cardiovascular health effects, down to very low concentrations, and
- no evidence of a concentration-effect threshold below which no one would be affected, i.e. some people will experience effects even at very low concentrations.

There are adverse health effects at the concentrations currently experienced in Australian cities, even where concentrations are below the current standards.

The *Summary for Policy Makers of the Health Risk Assessment on Air Pollution in Australia*[3] estimates the attributed health burden associated with current levels of air pollution for Brisbane, Sydney, Melbourne and Perth, where average annual $PM_{2.5}$ exposure ranged from 5 to 8 $\mu g/m^3$, and the average annual daily PM_{10} exposures ranged from 16 to 20 $\mu g/m^3$.

[2] *Review of Evidence on Health Aspects of Air Pollution* (REVIHAAP), www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/2013/review-of-evidence-on-health-aspects-of-air-pollution-revihaap-project-final-technical-report

[3] *Summary for Policy Makers of the Health Risk Assessment on Air Pollution in Australia*, www.environment.gov.au/system/files/pages/dfe7ed5d-1eaf-4ff2-bfe7-dbb7ebaf21a9/files/summary-policy-makers-hra-air-pollution-australia.pdf

There is a growing body of evidence showing benefits associated with improvements in air quality, even at levels that are within a range previously assumed to be 'safe'.[4] Long term observational studies on children in Southern California show improvements in air quality are associated with statistically and clinically significant improvements in childhood lung-function growth.[5]

Long term studies indicate a linear correlation between $PM_{2.5}$ concentration and the associated health risks, and in the absence of an identified concentration response threshold, public health benefits will result from any reduction in $PM_{2.5}$ concentrations, whether or not the current levels are above or below the standards.

Advice provided by the Australian Environmental Health Standing Committee (enHealth) to the COAG Standing Committee on Environment and Water, notes:

> *… there is new evidence that health effects occur at levels of exposure currently experienced in Australia. Indeed, there is evidence that health improvements will be achieved by reducing exposure below these levels. It is clear, therefore, that no standard could be completely protective of health. Because of this, it is enHealth's position that the numeric values should be set as low as reasonably achievable, taking into account social and economic factors.*[6]

The Impact Statement for the draft variation to the AAQ NEPM was prepared for NEPC with reference to the requirements of the NEPC Act, which outlines general considerations NEPC must have regard to when varying a national environment protection measure. These include:

(a) whether the measure is consistent with section 3 (principles of environmental policy) of the Intergovernmental Agreement on the Environment; and

(b) the environmental, economic and social impact of the measure; and

(c) the simplicity, efficiency and effectiveness of the administration of the measure; and

(d) whether the most effective means of achieving the desired environmental outcomes of the measure is by means of a national environment protection standard, goal or guideline or any particular combination thereof; and

(e) the relationship of the measure to existing inter-governmental mechanisms; and

(f) relevant international agreements to which Australia is a party; and

(g) any regional environmental differences in Australia.

The Impact Statement outlines the basis for options being considered by NEPC. It analyses and presents available information about particulate matter and its management in Australia. It considers the feasibility, costs and benefits of varying the standards and goals relating to particulate matter, as currently defined in the AAQ NEPM.

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[4] Dockery DW and Ware JH (2015), 'Cleaner Air, Bigger Lungs', *New England Journal of Medicine*, vol. 372, no. 10, pp. 970–972, Massachusetts Medical Society.

[5] Gauderman, WJ, Urman, R, Avol, E, Berhane, K, McConnell, R, Rappaport, E, Chang, R, Lurmann, F and Gilliland, F (2015), 'Association of Improved Air Quality with Lung Development in Children', *New England Journal of Medicine*, vol. 372, no. 10, pp. 905–913, Massachusetts Medical Society.

[6] *Impact statement on the draft variation to the AAQ NEPM* – Appendix C, www.environment.gov.au/system/files/pages/dfe7ed5d-1eaf-4ff2-bfe7-dbb7ebaf21a9/files/aaq-nepm-draft-variation-impact-statement-appendices.pdf

Submissions

Public consultation on the Impact Statement and draft varied AAQ NEPM occurred between July and October 2014. A total of 142 standalone submissions were received, demonstrating a very significant level of interest and concern from across Australia, in the community and from industry. A large number of submitters commented broadly about air quality management in Australia, the AAQ NEPM framework, the process for setting air quality standards and the need for standards to be adequately protective of human health.

> *As individuals cannot readily control the extent to which they may be exposed to harmful air-borne pollutants there is a reliance on government at all regulatory levels to ensure that appropriate levels of public health protection are established through air quality standards and adequate regulation of polluting activities. (#32 Australian Network of Environmental Defender's Offices Inc)*
>
> *…we require that the AAQ NEPM provides the most ambitious standards that it can, and determine these standards based above all, on what is best for the health of the population…. How 'likely' it is that the standards will be achieved is up to the State and Territory Governments to determine through how they implement and use the standards in policy and law. The 'likelihood' depends on leadership priorities, technological and cultural change, all of which cannot be predicted and should not be factored into the standards set. (#63 Repower Port Augusta)*
>
> *While it is accepted that current science demonstrates there is no 'safe' concentration threshold below which health effects do not occur for PM, understanding the national and regional context will be critical to the development of a sound policy/management response for improved air quality and communicating air quality matters to the general public. (#98 Minerals Council of Australia)*
>
> *… although air quality is good for many Australians, there are numerous communities for whom air pollution is very bad, and in some cases worsening, and that these people unfairly bear the impacts of Australia's polluting activities…. It is unjust that certain communities bear the impacts of pollution significantly more than others. Current air pollution laws do not adequately protect these communities. (#58 Environmental Justice Australia)*
>
> *In essence, the AAQ NEPM is aimed at tracking exposure of the general population to the six pollutants, and is designed based on representative monitoring sites, which are predominantly located in populations of 25,000 or more. The standards are not aimed at public exposure to major point sources, such as major industry and bulk loading facilities, but rather manage air quality on an airshed basis. (#107 Mid West Ports Authority)*
>
> *We strongly support the strengthening of Australia's air quality monitoring and regulation, to reduce the health burden across the nation… without proactive measures [such as those acknowledged in the Impact Statement], we can expect that exposure to air pollution will worsen in the future, with associated adverse health effects and increasing health costs. (#45 Conservation Council of South Australia)*

Response

Public consultation shows a substantial level of interest in air quality issues; community expectations of continual improvement in air quality; and expectations of national and state-based actions to reduce emissions and reduce exposure to air pollution. The range of issues highlighted by submitters is noted. Significant issues are discussed in more detail below.

Issue 1: Inclusion of national $PM_{2.5}$ standards

Impact Statement position

The Impact Statement proposes that current advisory reporting standards for annual and 24-hour $PM_{2.5}$ standards be changed to national standards.

The goal of the current $PM_{2.5}$ advisory reporting standard is to gather sufficient national data to facilitate a review of the standard. At the time of varying the AAQ NEPM in 2003 to include $PM_{2.5}$ monitoring and reporting protocols there was insufficient national data to satisfactorily characterise $PM_{2.5}$ concentrations and establish national standards for $PM_{2.5}$. The $PM_{2.5}$ advisory reporting standards are health-based standards used to assess $PM_{2.5}$ monitoring results. The standards do not have a review timeframe associated with them.

The recommendation to change the current advisory reporting standards to national standards was made on the basis of the substantial body of scientific evidence supporting conclusions that long term and short term exposure to $PM_{2.5}$ are causally associated with mortality and cardiovascular disease, and likely to be causally associated with respiratory disease. Associations are also observed between exposure to $PM_{2.5}$ and reproductive and developmental effects and cancer.

A growing body of research points towards the $PM_{2.5}$ fraction as being the most significant fraction of particle pollution in relation to health effects. Mortality associated with long term exposure to current levels of $PM_{2.5}$ in Sydney, Melbourne, Brisbane and Perth is estimated to be 1590 deaths per year[7].

The Impact Statement highlights recent WHO[8] findings supporting the need for both 24-hour and annual average $PM_{2.5}$ standards, notably:

- Although short term effects may contribute to long term health problems, those affected by short term exposures are not necessarily those suffering from the consequences of long term exposures.
- Not all biological mechanisms relevant to short term effects are necessarily relevant to the long term effects, and vice versa.
- Areas that have relatively moderate long term average concentrations of $PM_{2.5}$ may still have short term episodes of high concentration.

The Impact Statement notes the greatest proportion of health costs associated with exposure to particle pollution are attributable to premature deaths due to long term exposure to $PM_{2.5}$.

The Impact Statement notes the annual average advisory reporting standard for $PM_{2.5}$ of 8 $\mu g/m^3$ is lower than the current WHO guideline of 10 $\mu g/m^3$. The current 24-hour $PM_{2.5}$ advisory reporting standard of 25 $\mu g/m^3$ is identical to the current WHO guideline.

The Impact Statement highlights advice provided by enHealth to the COAG Standing Committee on Environment and Water, noting:

> *Given the clear evidence that long term and short term exposure to $PM_{2.5}$ causes adverse health effects, enHealth strongly supports the proposal to introduce compliance standards for annual average and 24hr average $PM_{2.5}$ concentrations.*

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[7] *Summary for Policy Makers of the Health Risk Assessment on Air Pollution in Australia*, www.environment.gov.au/system/files/pages/dfe7ed5d-1eaf-4ff2-bfe7-dbb7ebaf21a9/files/summary-policy-makers-hra-air-pollution-australia.pdf

[8] REVIHAAP (WHO 2013) op. cit.

Submissions

A wide cross-section and significant number of submitters expressed support for $PM_{2.5}$ national standards. Comments include:

> *This is long overdue. $PM_{2.5}$ is the size fraction with the greatest health impact so should be a strong focus of regulatory measures. There is no safe level of $PM_{2.5}$. (#20 Doctors for the Environment Australia)*
>
> *The inclusion of a compliance standard for fine particles would demonstrate that Australia is prepared to take action to protect the health of current and future residents. Both a daily and an annual standard are required to take account of the recognition of there being no 'safe' level for fine particles. (#53 Les Johnston)*
>
> *Supported so long as they bring us into line with the EU and other first world countries. … Air quality goals must be mandatory rather than just advisory as this is the only way that public health can be protected from air pollution. (#59 Asthma Foundation NSW)*
>
> *MWPA do support the adoption of $PM_{2.5}$ annual and 24-hour means. The $PM_{2.5}$ annual and 24-hour means would be introduced to address the health effects of fine dust. (#107 Mid West Ports Authority)*
>
> *MIM notes that, for the purposes of regulation, the $PM_{2.5}$ advisory reporting standard is already applied in some jurisdictions as a compliance standard. As such, upgrading the advisory standard to a compliance standard is not an issue provided that this results in consistency across all regions (#94 Mt Isa Mines Limited).*
>
> *The evidence linking $PM_{2.5}$ to health outcomes is clear, indeed clearer than for PM_{10}, so it is important that this is upgraded to a compliance standard. (#103 CSIRO)*
>
> *The introduction of 24-hour and annual $PM_{2.5}$ standards will strengthen the case for more action on management of residential wood smoke at the local government level outside cities of 25,000 population directly covered by the AAQ NEPM. (#69 Dr John Todd)*
>
> *24-hour standards are particularly relevant to the issue of shipping pollution... ships are in port intermittently for 24 hour periods, more frequently during summer, burning high sulphur diesel fuel while in berth due to a lack of shore power. Consequently, emissions follow a seasonal pattern and increase substantially across specific 24 hour periods. These emissions occur very close to residential areas, schools and childcare centres. To protect the health of communities like this, stringent 24-hour standards are essential and need to be enforced. (#130 Name suppressed)*

Some submitters suggested that more information about the sources and monitored levels of $PM_{2.5}$ was required before introducing $PM_{2.5}$ national standards.

> *CCAA considers more information and data on the sources of $PM_{2.5}$ and levels of emissions are required prior to the introduction of the proposed standards. Once additional empirical evidence is acquired, appropriate and robust policy responses can be implemented targeting all sources of $PM_{2.5}$, not just industries, contributing to adverse health impacts. (#106 Cement Concrete and Aggregates Australia)*
>
> *There appears to be sufficient evidence internationally that the establishment of $PM_{2.5}$ standards is justified, particularly in large cities… It is important that information on*

particulate composition and the potential impacts associated with non-urban emissions of particulates are gathered and assessed such that more informed standards can be defined in non-urban areas… (#129 Name suppressed)

A number of industry groups support, in-principle, $PM_{2.5}$ standards and suggest a transitional period necessary to allow for the required improvement in $PM_{2.5}$ monitoring and regional airshed characterisation, before a national standard takes effect.

[The MCA] support the introduction of a $PM_{2.5}$ annual mean standard where accompanied by a transitional period (similar to that accompanying the introduction of the NEPM standards) to achieve compliance with the standard. This will allow for the required improvements in $PM_{2.5}$ monitoring and regional airshed characterisation, accounting for natural and secondary $PM_{2.5}$ and to quantify primary anthropogenic contributions. (#98 Minerals Council of Australia)

[The ESAA] support in-principle upgrading of $PM_{2.5}$ standards to compliance standards but with a staged approach to implementation. (#100 Energy Supply Association of Australia)

Some submitters indicated they would not support $PM_{2.5}$ standards if standards were applied retrospectively to existing industrial operations.

[Centennial Coal] support the introduction of an annual mean standard for $PM_{2.5}$ where this is accompanied by a reasonable transitional period… would not support the application of an annual mean standard for $PM_{2.5}$ that was applied retrospectively to existing operations, including where these operations may seek future extensions. (#78 Centennial Coal)

Response

NEPC supports varying the AAQ NEPM to include annual average and 24-hour standards for $PM_{2.5}$.

The 2003 variation to include the $PM_{2.5}$ advisory reporting standards in the AAQ NEPM foreshadowed an intention to establish national $PM_{2.5}$ standards after review. Since that time there has been a considerable expansion of national $PM_{2.5}$ monitoring. Available data has been used to characterise $PM_{2.5}$ concentrations of large Australian urban areas, quantify the attributable health burden associated with exposure to $PM_{2.5}$, and inform and support the introduction of health-based $PM_{2.5}$ standards.

The significant number of submissions supporting $PM_{2.5}$ standards; the weight of evidence relating to the health effects associated with exposure to $PM_{2.5}$; and enHealth support for the introduction of compliance standards for annual average and 24-hour standards for $PM_{2.5}$, are noted.

The Impact Statement provides a comprehensive overview of available information about sources of particulate matter, emissions inventories, ambient concentrations and source apportionment studies in Australia.

The Impact Statement provides a sufficient level of information about the sources, measured concentrations and potential measures to manage $PM_{2.5}$ emissions for understanding the implications of introducing health-based $PM_{2.5}$ standards for the purpose of monitoring and reporting $PM_{2.5}$ concentrations.

A transitional period is not required for the purpose of jurisdictional monitoring and reporting against the AAQ NEPM. The length of time $PM_{2.5}$ advisory reporting standards have been in place has allowed a significant amount of data to be collected, and provided a better understanding of national $PM_{2.5}$ concentrations, sufficient to adequately inform the immediate making of $PM_{2.5}$ standards.

A delay in establishing a $PM_{2.5}$ national standard may serve to delay further expansion of monitoring and constrain the public reporting of air quality and the public understanding of air pollution.

The AAQ NEPM does not directly control or direct emission reduction activities. The rationale for a transitional period, to allow industry adjustment to take place, may be pertinent to a compliance activity associated with actions to reduce emissions at the jurisdictional level. It is not directly relevant to the monitoring and reporting of air quality under the AAQ NEPM, as major 'point sources' are regulated by individual jurisdictions through relevant regulatory instruments.

$PM_{2.5}$ national standards are likely to lead to further expansion of $PM_{2.5}$ monitoring, and in turn, improved information about particle composition and source attribution.

Issue 2: Inclusion of annual average and 24-hour PM_{10} standards

Impact Statement position

The AAQ NEPM includes a 24-hour average standard for PM_{10} of 50 µg/m^3. It does not currently include an annual average PM_{10} standard.

The Impact Statement proposes the retention of a 24-hour average standard for PM_{10} and the introduction of an annual average standard for PM_{10}, noting:

- the strengthening of evidence for an association between long term exposure to PM_{10} and health, specifically for respiratory and pregnancy outcomes
- coarse particles are found at comparably high concentrations in some regional areas of Australia
- the considerable amount of PM_{10} monitoring undertaken in Australia compared to monitoring for $PM_{2.5}$, and
- the monitoring of PM_{10} can, in addition to measuring PM_{10}, also be used as a surrogate for $PM_{2.5}$ monitoring where there is no $PM_{2.5}$ monitoring.

There have been significant advances in the understanding of the health effects of particulate matter. These effects are diverse in scope, severity and duration. They include premature mortality, aggravation of cardiovascular disease and aggravation of respiratory disease.

The Impact Statement notes findings that coarse particles have an independent effect on health, and that PM_{10} is not just a proxy measure of $PM_{2.5}$. Coarse and fine particles deposit at different locations in the respiratory tract, have different sources and composition, partly act through different biological mechanisms, and result in different health outcomes.

There is extensive evidence that short term exposure to PM_{10} is associated with cardiovascular and respiratory health effects and mortality, and that these effects are independent of the effects of $PM_{2.5}$. There is a growing but lower level of evidence that long term exposure to PM_{10} has health effects that are independent of those caused by long term exposure to $PM_{2.5}$.

The Impact Statement highlights the widespread measurement of PM_{10} in Australia, showing that concentrations of inhalable coarse particles in regional areas of Australia are sometimes high and exceed the current 24-hour PM_{10} standard.

The Impact Statement and the Economic Analysis[9] identifies feasible abatement measures that will result in modest reductions of PM concentrations relative to business as usual. Based on historical PM_{10} monitoring data and the future projections, the Economic Analysis shows an annual PM_{10} standard of 20 $\mu g/m^3$ to be achievable, if a package of national abatement measures is enacted.

The Impact Statement notes that the derivation of WHO PM_{10} guidelines are based on studies using $PM_{2.5}$ as an indicator pollutant, and the use of a $PM_{2.5}$: PM_{10} ratio of 0.5 : 1 to derive the WHO PM_{10} guideline value. WHO's use of the 0.5 ratio is justified on the basis of it being the ratio observed in urban areas in developing countries and at the bottom of the range found in urban areas in developed countries. WHO notes that if justified by local conditions, this ratio may be changed based on the local data when local standards are set.

The $PM_{2.5}$: PM_{10} ratio across Australian monitoring sites differs to those observed by WHO. The $PM_{2.5}$: PM_{10} ratio across Australian sites is predominantly in the range of 0.3 to 0.4; however, over a 10-year period extremes range from 0.2 to 0.6.

enHealth supports a 24-hour compliance standard for PM_{10} and considers the introduction of a long term PM_{10} standard prudent, given:

- the increasing evidence in this area
- uncertainty that all health effects would be eliminated by controlling $PM_{2.5}$ only, and
- limited coverage of the $PM_{2.5}$ monitoring network in Australia (compared with PM_{10} monitoring).

Annual hospital admissions in Sydney, Melbourne, Brisbane and Perth attributable to current short term PM_{10} exposure (above background levels) are estimated to be 1130 cases for respiratory effects for 0–14 year olds, and approximately 530 cases for pneumonia and acute bronchitis for 65+ year olds.

There is very limited quantitative evidence available to derive standards relating to $PM_{2.5–10}$.

Submissions

Submitters expressed strongly divergent views about whether PM_{10} annual average and 24-hour standards are warranted.

Support for PM_{10} standards

In supporting 24-hour and annual PM_{10} standards many individuals, health and community groups highlighted emerging health evidence from Europe about the independent health effects, growth in PM_{10} emissions in rural and regional areas, and the desire for better understanding, monitoring and management of PM_{10}.

> *There is a good scientific argument for an annual PM_{10} standard on the basis of exacerbation of lung disease, reduction in lung function in both adults and children, and development of lung cancer from chronic exposure. There is no evidence that these risks are removed by controlling annual average $PM_{2.5}$. (#3 Fee Mozeley)*

[9] Boulter, P and Kulkarni, K (2013), *Economic analysis to inform the national plan for clean air (particles) – Final report*, report prepared for NEPC Service Corporation, www.environment.gov.au/system/files/pages/dfe7ed5d-1eaf-4ff2-bfe7-dbb7ebaf21a9/files/nepc-economic-analysis-final-report.pdf.

The epidemiology for coarse fraction $PM_{2.5–10}$ particles shows exacerbation of lung disease, reduction in lung function in both children and adults (Forbes, Kapetanakis et al. 2009; Gauderman, McConnell et al. 2000) and incidence of lung cancer to be the main problems. The European Study of Cohorts for Air Pollution Effects showed a hazard ratio for lung cancer of 1.22 (95% CI 1.03-1.45) for PM_{10}, which was not significant for $PM_{2.5}$ (Raaschou-Nielsen, Andersen et al. 2013). … We find this compelling evidence in support of a standard for annual PM_{10}, and this goes beyond the justifications in Section 3.1.6 [of the Impact Statement] that Australia should have an annual PM_{10} limit as there is uncertainty in the science, and that many places do not have $PM_{2.5}$ monitoring so a PM_{10} limit gives de facto $PM_{2.5}$ protection... Once we have a strong regulatory and exposure reduction framework for $PM_{2.5}$ the extra benefits of limits for PM_{10} are smaller, but still substantial... From the point of view of coal affected communities, their burden is likely to be in the PM_{10} fraction so this annual limit will give them protection. (#20 Doctors for the Environment Australia)

ANEDO strongly supports the introduction of an annual PM_{10} annual standard. As noted in the NEPM Impact Statement there is clear evidence that PM_{10} is responsible for significant health impacts independent of its association with $PM_{2.5}$. (#32 Australian Network of Environmental Defender's Offices Inc)

…from the point of view of coal affected communities, the burden is likely to be in the PM_{10} fraction… Because of the nature of these industrial emissions in areas such as ours, it is imperative to establish an annual PM_{10} standard at 20 $\mu g/m^3$, encouraging measures to reduce existing poor air, and guide planning in relation to new industrial developments (#42 Nick Higginbotham, Newcastle Public Health Professionals)

An annual average standard will set a benchmark for pollution levels. It also enables us to chart the long term pollution exposure and to separate out extraordinary events such as bushfires, dust storms and other natural disasters. While high short term exposures can be mitigated by various avoidance measures, health advice and policy is based on the effect of long term, daily exposures on the population. An annual average also enables us to see what measures are really reducing long term pollution over time, ... There is international consensus that there are no safe levels of particulate matter and that respiratory distress and exacerbation of existing medical conditions, such as asthma, starts at very low levels. Although most of the attention is focused on ultrafine particles (i.e. $PM_{2.5}$), PM_{10} also has a profound effect on health. There is no scientific evidence that controlling $PM_{2.5}$ levels reduces this exacerbation, therefore PM_{10} standards need to be established. (#59 Asthma Foundation NSW)

Introduction of an annual average PM_{10} standard… is an important amendment as PM_{10} particles are known to have long term effects on lung function. (#121 Phillip Jennings)

There are apparent adverse health effects of coarse particles and their prevalence in some regions. Annual and 24-hour standards will support development of management strategies for long and short term scenarios. (#24 Brisbane City Council)

Latest NPI data has shown PM_{10} emissions from coal mines almost trebled in the last decade. (#41 Lock The Gate Alliance)

PM_{10} vs. $PM_{2.5}$ health protection

The relative health protection afforded by PM_{10} and $PM_{2.5}$ standards was a point of discussion among industry and other stakeholders, with submitters suggesting that efforts should be focused on standards for $PM_{2.5}$, where the greatest health effects are observed.

Historically, the PM_{10} standard has been used by Regulators as a proxy indicator for $PM_{2.5}$ exposure (due to the limited availability of $PM_{2.5}$ data) and therefore there is perhaps less of a case for tightening the PM_{10} standards with the introduction of compliance standards for $PM_{2.5}$. (#100 Energy Supply Association of Australia)

The esaa supports in principle the introduction of a PM_{10} annual standard. However the form of the standard requires further investigation… The proposed AAQ NEPM standard for annual PM_{10} is also stricter than necessary and could potentially be exceeded more often than the $PM_{2.5}$ annual average standard. This is at odds with the health information which suggests that $PM_{2.5}$ is associated with the greatest health risks. (#100 Energy Supply Association of Australia)

By including an annual average PM_{10} standard, we are following recent practices adopted in Europe, which is probably a wise thing to do. However, it is not clear whether Australia will benefit. If coarse-mode particles (between 2.5 and 10 microns) are largely crustal soil or sea-salt, then long term exposure to these particles would be unlikely to drive serious health effects. We may be better off putting our resources into controlling long term exposure to $PM_{2.5}$ which is more related to combustion emissions. (#131 Sean Walsh)

$PM_{2.5–10}$ fraction

Submitters also raised concerns that a PM_{10} annual standard should be based solely on $PM_{2.5–10}$ health impacts, and if so, should not be established until robust scientific evidence can produce a standard targeted to protect those specific health impacts.

A fine and coarse (2.5-10µm) standard would better serve the community than PM_{10}. Fine particles have larger health impacts. PM_{10} contains both fine and coarse particles and is therefore confusing and may be difficult to interpret scientifically if you don't know the fine/coarse components. (#118 Prof David Cohen)

The Impact Statement proposes that a long term PM_{10} limit should be established because of the recent published studies citing relationships between long term health effects and coarse particle ($PM_{2.5-10}$) exposure. A lack of evidence to demonstrate that there are no health effects is not an appropriate reason to establish an air quality limit, especially a limit that was designated for a different purpose (i.e. to protect against long term $PM_{2.5}$ health impacts). This could be seen as regulation leading the science and is not, by definition, the purpose of the AAQ NEPM. An annual PM_{10} standard stated as to prevent health impacts from the $PM_{2.5-10}$ fraction should not be established until the science can produce a standard targeted to protecting those specific health impacts. We do not support the establishment of an annual PM_{10} standard that purports to protect against health risks associated with the $PM_{2.5-10}$ fraction until there is clear, robust scientific evidence. (#91 Rio Tinto)

No PM_{10} annual standard

Other submitters did not see the need for an annual PM_{10} standard at all, or the tightening of the existing 24-hour PM_{10} standard, given most significant health effects are attributable to $PM_{2.5}$.

The case for tighter or new AAQS remains unproven (the Impact Statement has not provided valid justification for tightening of the PM_{10} 24 hr standard from 50 ug/m^3 to 40 ug/m^3 or the introduction of a new PM_{10} annual standard (#106 Cement Concrete and Aggregates Australia)

The selection of an annual standard for PM_{10} appears to be based on minimal evidence of the potential benefits that it would provide… Consideration of its achievability is primarily

focused on Australian cities and is dominated by NSW and Victorian information…. The US EPA revoked its annual PM_{10} standard in 2006 and has not identified the need to reintroduce the standard since that time despite multiple detailed reviews of the particulate standards since. (#129 Confidential)

Given the lack of supporting evidence, the MCA does not support the introduction of a PM_{10} annual mean standard of 20 µg/m^3. Should a standard be introduced in the future, it should specifically account for the direct health effects of PM_{10} and not unnecessarily duplicate the requirements for $PM_{2.5}$. Furthermore, as a surrogate indicator for $PM_{2.5}$, the need for an annual PM_{10} standard will become increasingly redundant as national monitoring of $PM_{2.5}$ improves and specific $PM_{2.5}$ standards are introduced. (#98 Minerals Council of Australia)

…do not support the introduction of a long term annual mean standard for PM_{10} of 20 µg/m^3 due to the absence of supporting evidence that demonstrates an improvement in health benefits and because it is clear there will be a large number of exceedances. Any proposed PM_{10} annual mean standard needs to be supported by research that is independent of $PM_{2.5}$ to account for direct health impacts specifically related to PM_{10}. (#104 Confidential)

An annual PM_{10} standard should not be introduced until such time that there is a higher level of certainty that long term exposure to PM_{10} contributes to health effects and that these health effects will not be addressed by existing or future $PM_{2.5}$ standards. (#105 Cement Industry Federation)

Response

NEPC supports the continuation of a 24-hour PM_{10} standard and the introduction of an annual average PM_{10} national standard.

Analysis of national data from 2003 to 2014 show higher concentrations of PM_{10} in non-metropolitan areas of Australia.

A considerable body of scientific literature exists on the short term and long term health effects of PM_{10} that supports independent limit values for both short term and long term PM_{10}, in addition to $PM_{2.5}$, to protect against the health effects of both fine and coarse particles. WHO[10] comments that PM_{10} is not just a proxy measure of $PM_{2.5}$, noting:

- There is increasing evidence for the adverse effects on health of coarse particles ($PM_{2.5-10}$). Short term effects on health of coarse particles have been observed independently of those related to fine particles ($PM_{2.5}$).
- New European studies[11] further strengthen the evidence for an association between long term exposure to PM_{10} and health – especially for respiratory outcomes – and for health benefits from the reduction in long term mean concentrations of PM_{10}.
- Coarse and fine particles deposit at different locations in the respiratory tract, have different sources and composition, act through partly different biological mechanisms, and result in different health outcomes.
- Maintaining short term and long term limit values for ambient PM_{10} in addition to $PM_{2.5}$ to protect against the health effects of both fine and coarse particles, is well supported.

[10] REVIHAAP (WHO 2013) op. cit.
[11] European Study of Cohorts for Air Pollution Effects (ESCAPE), www.escapeproject.eu/index.php.

24-hour PM_{10} standard

On the basis of advice from enHealth, supported by WHO findings, there is a continued need for 24-hour PM_{10} standards in Australia. There is a considerable weight of evidence that short term exposure to PM_{10} is associated with cardiovascular and respiratory health effects and mortality, and that these effects are independent of the effects of $PM_{2.5}$.

No submitter argued, in-principle, against the continued inclusion of a 24-hour PM_{10} standard in the AAQ NEPM.

In support of this decision are the relatively higher levels of PM_{10} in regional areas of Australia; the extensive network of national PM_{10} monitors, especially in regional areas; and the additional value of monitoring PM_{10} as a proxy for $PM_{2.5}$, in circumstances where $PM_{2.5}$ is not monitored.

Annual PM_{10} standard

There is growing evidence in relation to health effects associated with long term exposure to PM_{10}. To date, there is insufficient quantitative evidence to establish a separate health-based standard or guideline for the $PM_{2.5–10}$ fraction.

Advice provided by enHealth that annual PM_{10} standards are warranted for protection against chronic health effects associated with exposure to PM_{10}, independent of the effects of $PM_{2.5,}$ is noted and supported. This advice is supported by WHO findings.

An annual average PM_{10} standard is warranted on the basis of the growing body of evidence that health effects associated with chronic exposure to PM_{10} are independent of the effects associated with those of $PM_{2.5}$; the relatively higher levels of PM_{10} in regional Australia; the extensive network of PM_{10} monitors in Australia; and the value of monitoring and reporting annual average PM_{10} concentrations, especially where $PM_{2.5}$ monitoring is not undertaken.

There is a very significant weight of evidence supporting health effects associated with chronic exposure to $PM_{2.5}$, and a significant but lesser weight of evidence relating to chronic health effects associated with exposure to PM_{10}.

It is proposed NEPM PM_{10} standards be established with reference to health effects associated with $PM_{2.5}$ (as are WHO PM_{10} guidelines) and reflective of Australian coarse particle concentrations, indicative of $PM_{2.5}$: PM_{10} ratios of 0.3 to 0.4. Australian air quality data shows a lower proportion of fine particles to coarse particles than assumed by WHO guidelines.

Short term and long term PM_{10} standards are protective of effects associated with PM_{10}.

In summary

A 24-hour PM_{10} standard is warranted for protection against short term health effects associated with exposure to PM_{10}.

An annual average PM_{10} standard is warranted for protection against chronic health effects associated with long term exposure to PM_{10}, noting:

- growing body of evidence that health effects associated with chronic exposure to PM_{10} are independent of the effects associated with those of $PM_{2.5}$
- uncertainty that all health effects would be eliminated by controlling $PM_{2.5}$ only
- significance of coarse fraction in regional areas of Australia and the value of monitoring long term PM_{10} concentrations in the absence of $PM_{2.5}$ monitoring

- prevalence of PM_{10} monitoring in Australia over $PM_{2.5}$
- an annual average PM_{10} standard be set with reference to $PM_{2.5}$ standards and in the context of Australian conditions.

Issue 3: PM_{10} annual average standard

Impact Statement position

There is currently no annual average PM_{10} standard. Based on historic PM_{10} monitoring data and future emission projections, the Impact Statement proposed an annual average standard of 20 µg/m^3 as feasible and achievable by 2036, if a package of national abatement measures is enacted. Standards of 25 µg/m^3 or 30 µg/m^3 were not explicitly analysed in the Impact Statement.

There is a long history of PM_{10} measurement in Australia and a formal standard could be introduced immediately.

enHealth advice supports an annual average standard and considers the numeric values be set as low as reasonably achievable, taking into account social and economic factors.

Submissions

Local governments, community groups and individuals expressed a preference for a PM_{10} annual standard of 20 µg/m^3, consistent with WHO guidelines.

> *Council supports the preferred numerical value for… the PM_{10} annual mean standard of 20µg/m^3. (#24 Brisbane City Council)*
>
> *…the PM_{10} compliance standard should have a maximum… one year concentration of 20µg/m^3. (#33 cleanairtas)*
>
> *…strongly support the adoption of the PM_{10} annual standard of 20µg/m^3. (#44 Sarah Joyce)*
>
> *There is good scientific argument for an annual PM_{10} standard… WHO guidelines are for a 20µg/m^3 annual mean. (#49 Nature Conservation Council NSW)*
>
> *The annual standard PM_{10} standard should be made a compliance standard of 20µg/m^3. (#58 Environmental Justice Australia)*
>
> *20µg/m^3… is consistent with international best practice. (#121 Phillip Jennings)*

Some submitters called for a standard of 16 µg/m^3.

> *PM_{10} criteria need to be expressed as compliance values in the form of an annual standard of 16 µg/m^3 and a 24 hour standard of 40 µg/m^3. These values are proposed on the basis that the protection of public health should be implemented on a conservative basis. This is consistent with other public health initiatives, such as, immunisation, where the adopted policy approach is conservative rather than exposing the population to a higher level of risk. (#53 Les Johnston)*
>
> *…support the annual PM_{10} level being set at 16 µg/m^3 … 20 µg/m^3 is already being achieved at most monitoring stations on most days… we are seeking more ambitious targets for the sake of improved health outcomes. (#63 Repower Port Augusta)*

Industry submitters were less supportive of an annual PM_{10} standard, citing a lack of evidence of health benefits to support its establishment and a preference to focus on $PM_{2.5}$ standards which protect against greater health impacts. This is also discussed under Issue 2.

Others submitters indicated that the proposed standard of 20 µg/m^3 would be difficult to achieve in regional areas, or suggested it be introduced only as an advisory standard.

> *While compliance with an annual PM_{10} standard of 20 µg/m^3 may be feasible in the major Australian capital cities, it is not clear that it would be achievable in all places outside of these cities… there are several areas that we are aware of where the application of …[such a] standard would create significant compliance issues due to the semi-arid/arid environment. (#129 Name suppressed)*
>
> *It should only be established as an advisory guideline. (#78 Centennial Coal)*
>
> *If it is to be adopted, it should be advisory only to allow some lenience for areas where regional backgrounds are elevated or that are near significant point sources. (#107 Mid West Ports)*

The derivation of a PM_{10} standard based on a local $PM_{2.5}$: PM_{10} ratio was also raised.

> *The proposed annual PM_{10} limits are based on the WHO guideline which is based on studies using $PM_{2.5}$ as an indicator for health effects and using a $PM_{2.5}$:PM_{10} ratio of 0.5. Ratios for large Australian population centres are around 0.35 to 0.4 and are even lower in smaller urban and regional and remote areas. A more nuanced approach to setting an annual PM_{10} standard that accounts for environmental variations across Australia is therefore needed. (#91 Rio Tinto)*

Response

NEPC supports an annual PM_{10} standard of 25 µg/m^3.

Issue 2 outlines NEPC support for the inclusion of an annual average PM_{10} standard in the AAQ NEPM, on the basis of protection from chronic health effects associated with long term exposure to PM_{10}, effects that are independent of the effects of $PM_{2.5}$. For major Australian cities 4% of all-cause mortality is attributable to long term exposure to PM_{10}.

It is also noted that whilst it would be preferable to establish a $PM_{2.5–10}$ standard based on monitored levels and effects of the $PM_{2.5–10}$ fraction, in concert with the $PM_{2.5}$ standard, there is insufficient quantitative evidence to establish a standard for the $PM_{2.5–10}$ fraction, at this time.

In supporting the inclusion of an annual average PM_{10} standard, NEPC notes the relatively higher levels of PM_{10} in regional areas of Australia, the extensive network of PM_{10} monitors nationally, and the value of monitoring PM_{10} as a proxy for $PM_{2.5}$, where there is no $PM_{2.5}$ monitoring undertaken.

In acknowledging limited epidemiological studies to derive coarse particle standards, the following is noted: the significance of PM_{10} health effects; the derivation of the WHO annual PM_{10} guideline value using $PM_{2.5}$ as an indicator pollutant and a $PM_{2.5}$:PM_{10} ratio of 0.5; Australian ratios of $PM_{2.5}$ to PM_{10} are typically lower; based on local data and justified by local conditions an annual average PM_{10} standard be set with reference to $PM_{2.5}$ and in the context of Australian conditions. On this basis, an annual average PM_{10} standard of 25 µg/m^3 is supported. This is reflective of the $PM_{2.5}$ standard of 8 µg/m^3 and a $PM_{2.5}$:PM_{10} ratio of between 0.3 and 0.4.

Concerns about spatial and temporal variation in achieving a PM_{10} standard are noted. The Impact Statement considered achievability broadly, on a statewide aggregated basis. Analysis undertaken for the Impact Statement considered the standards proposed were achievable, but this varied considerably both temporally and spatially. Detailed analysis was not undertaken on regional or sub-regional impacts. Achievability of PM_{10} standards is highly dependent on sub-regional contexts and state and territory policy responses.

Notwithstanding the spatial and temporal differences in PM_{10} concentrations, the Impact Statement confirms typical conditions would see the 24-hour standard of 50 µg/m^3 remaining as the PM_{10} 'controlling standard'. This is fitting given the strength of evidence associated with health impacts of short term PM_{10} exposure.

An annual average PM_{10} standard of 25 µg/m^3 is considered appropriate. NEPC considers this standard is particularly relevant to regional Australia given the significance of PM_{10} in these areas.

The basis of the PM_{10} standard is protection against PM_{10} health effects.

Issue 4: PM_{10} 24-hour standard

Impact Statement position

The current NEPM standard for 24-hour PM_{10} is 50 µg/m^3.

There is increasing evidence that short term exposure to PM_{10} is associated with health effects independent of $PM_{2.5}$. Observational studies do not provide evidence of a threshold for health effects. There is evidence that exposure to particulate matter at levels experienced in Australian cities is associated with health effects. There would therefore be health benefits from reducing exposure below these levels, and setting standards as low as reasonably achievable.

No single preferred option has been selected for the 24-hour PM_{10} standard in the Impact Statement. The achievability of standards varies temporally and spatially, and is highly dependent on the scale of analysis undertaken. A tighter standard is unlikely to be achievable in all jurisdictions.

The PM_{10} monitoring data and the Economic Analysis indicated that a tightening of the 24-hour standard for PM_{10} could encourage future improvements in air quality.

A change to a standard of 40 µg/m^3 would be possible; however, moving to the lower value would present difficulties in certain jurisdictions. An alternative could be to consider 45 µg/m^3. enHealth supported consideration of a PM_{10} standard of between 40 and 50 µg/m^3.

Submissions

A range of stakeholders favoured lowering the 24-hour PM_{10} standard to 40 µg/m^3.

> *Given the linear relationship of PM with harmful health effects, it is important to strive for the lowest possible levels and to avoid increases in PM_{10} levels over time. A more stringent standard would focus the community on the dangers of PM and encourage technologies and measures associated with their reduction and harm minimisation. (#54 Centre of Air quality and health Research and Evaluation)*
>
> *The precautionary principle should be applied, with the limit set as low as practically possible to avoid harm to human health. (#119 Name suppressed)*

The 24-hour PM_{10} standard should be improved to 40µg/m^3... The Impact Statement notes that on average that the current standard of 50 µg/m^3 is being achieved and that a tightening of the standard could encourage future improvements in air quality. This is surely the key reason for having standards in a NEPM and therefore an improved standard should be adopted. (#58 Environmental Justice Australia)

Council supports a more stringent standard for the protection of resident's health and well-being, in view of recent evidence regarding the impacts of PM exposure [and] council supports broader scale actions that will reduce overall exposure to air pollution such as stricter national vehicle emission standards. (#24 Brisbane City Council)

The 24-hour averaging period for the PM_{10} compliance standard should have a maximum concentration of 40ug/m^3… (#33 cleanairtas)

We should adopt the lowest feasible level and [the Impact Statement] indicates that this is 40 micrograms per cubic metre. (#121 Phillip Jennings)

Some submitters considered 45 µg/m³ would be a more realistic standard.

The lack of any lower cut-off for health impacts associated with particles might be used to argue for more stringent standards. If so, a light tightening of the 24-hour PM_{10} limit to 45 µg/m³ would seem the most realistic change... I worry that the recommendations put forward in the Impact Statement might be viewed by politicians as some sort of ambit claim and so the proposed values will be watered down. I think it is important to emphasise that compromises have already been made and included in the recommended values….
(#69 Dr John Todd)

A number of industry stakeholders consider a lower 24-hour standard unachievable given high natural background levels, and prefer to retain the standard at 50 µg/m³. Industry also raised concerns about the application of the standards by jurisdictions. The application of the standards is discussed in detail at Issue 16.

As the achievability of certain numerical standards has not been adequately demonstrated, it is not clear that a 40µg/m^3 24-hour mean can be achieved. While a 45µg/m^3 24-hour mean has been proposed as a compromise measure there is also no certainty that this level is achievable. It is also not clear that an annual mean of 20µg/m^3 can be achieved in association with the suggested [$PM_{2.5}$] 24 hour standards. (# 101 Australian Institute of Petroleum)

[Alcoa of Australia] do not agree that the lowest values are economically achievable in Australia at the present time. Regional areas, especially those with higher natural background levels and higher concentrations of mining related dust, would be some way off further improvements to comply with the current 24-hr standard, let alone a new and lower value… It would be premature for Australia to lower the standard further, in advance of WHO acting to reduce its guideline value. (#51 Alcoa of Australia)

Regional facilities already have difficulty meeting this standard due to background PM. No jurisdiction internationally has a lower standard, so reducing it below 50ug/m^3 would be premature and likely prove unrealistic for many facilities. (#65 Australian Aluminium Council)

Tightened standards, incorporated into licence conditions, will mean many industries won't be able to operate at full capacity as they could not meet the new standard. (#91 Rio Tinto)

Internationally, the most common 24-hour PM_{10} standard is 50 µg/m^3 and the retention of this standard would appear to be justified. (#129 Name suppressed)

A reduced standard of 40 µg/m^3 would be unachievable due to high background levels, resulting in significant unnecessary costs associated with mitigation, management and acquisition. This in turn will not result in any reduction in the background particulate matter... If a tighter standard is introduced, it should be accompanied by a clear explanation of its focus on urban populations and the resultant existing background PM where these levels and their location are a high health concern. (#78 Centennial Coal)

The relative importance of an annual standard was raised as a consideration when determining the 24-hour PM_{10} standard.

If a 24-hour and an annual standard are applied together there may be a tendency at a given monitoring site for one of them to be exceeded more frequently than the other. The Impact Statement advises that from a health and economic perspective, and hence policy, more emphasis should be placed on the annual mean…. As long as separate annual and 24 hour standards are in place, this should not present a practical problem. If the numerical value and form of the 24 hour standard are defined so that it is exceeded more frequently, this would lead to the 24-hour standard being the controlling standard with greater potential for action to be focused on short term concentrations. In practical terms, this could drive excessive response and cost in attempting to control short term events such as very high wind days, at the expense of more chronic effects contributing to annual averages. (#67 Confidential)

Given the Impact Statement identified the greatest proportion of health costs accrue from avoiding premature deaths due to long term exposure to $PM_{2.5}$, the [PM_{10} 24-hour standard] should ideally be weighted to the greater health and economic cost. A reduction of the PM_{10} 24-hour standard from 50 µg/m^3 to 45 or 40 µg/m^3 would result in an increase in exceedances of the PM_{10} standard… and ultimately place a greater focus on PM_{10} becoming the controlling standard, and diverting resources away from $PM_{2.5}$ exposure reduction. (#78 Centennial Coal)

Support a 24-hour PM_{10} standard of 50µg/m^3… pushing it too low could end up being counter-productive… as it would alarm communities who could influence air quality managers to put more resources into coarse particle management, at the expense of fine particle management (the latter being much more toxic). (#130 Sean Walsh)

Response

NEPC supports maintaining the 24-hour PM_{10} standard of 50 µg/m^3.

Exceedances of the 24-hour PM_{10} standard in capital cities are generally more limited in number and often related to extreme events, as compared with regional areas.

Current PM_{10} standards are more frequently exceeded in regional areas, and not only due to extreme events. 24-hour PM_{10} standards are particularly applicable to air shed monitoring, and management of anthropogenic emissions in regional areas.

Respiratory hospitalisation attributable to current short term PM_{10} exposure above background is estimated to be about 1130 cases, or 2% of annual respiratory 0–14 years hospital admissions, and approximately 530 cases, or 2.5% of annual pneumonia and acute bronchitis 65+ years hospital admissions.

Reducing current exposures to achieve the current standard of 50 µg/m^3 would reduce attributable childhood respiratory hospital admissions by 33%, equivalent to approximately 370 admissions, and adult pneumonia and acute bronchitis hospital admissions by 33%, equivalent to approximately 180 admissions, compared to current exposures.

The existing AAQ NEPM standard for PM_{10} of 50 µg/m^3 prevails internationally and is comparatively stringent and numerically identical to the current WHO 24-hour guideline for PM_{10}.

The 24-hour PM_{10} standard is often used by jurisdictions as a controlling standard which determines day-to-day management of industrial emission sources. The AAQ NEPM standard is intertwined with industry licensing issues. The monitoring and reporting undertaken against this standard is of considerable interest to community, industry and jurisdictions alike.

In considering 24-hour PM_{10} data, it is noted:

- There are no strong inter-annual trends in the patterns of exceedance.
- Rural sites in NSW tend to have more exceedances than urban sites.
- Victoria and SA have a higher frequency of exceedances than the other jurisdictions.

The Impact Statement considered the achievability of this standard on a statewide aggregated basis, and noted a tightening of the 50 µg/m^3 standard was achievable but varied temporally and spatially. It did not undertake detailed analysis on regional or sub-regional impacts. The achievability of the 24-hour PM_{10} standard is almost entirely dependent on state and territory and industry management policy responses.

Analysis of aggregated national monitoring data shows a downward trend in PM_{10} exceedances. Aggregated results mask significant regional and temporal variation.

Compared to many other countries, Australia's current air quality is good. Since inception of the NEPM in 1998 PM_{10} concentrations have generally improved, notwithstanding significant spatial and temporal variation.

The current standard of 50 µg/m^3 provides a sufficient and achievable level of health protection. The present exceedances of the standard are noted, as are the significant benefits associated with achieving the 24-hour PM_{10} standard of 50 µg/m^3.

PM_{10} is a significant pollutant in regional areas of Australia, and these areas experience greater levels of exceedances of the current standard compared with urban areas.

NEPC considers there is sufficient evidence to retain the existing standard of 50 µg/m^3, with a proposed modification to the form of the standard to exclude exceedances attributable to exceptional events. The form of the 24-hour standards is discussed in detail at Issue 7.

Issue 5: $PM_{2.5}$ annual standard

Impact Statement position

The Impact Statement proposes maintaining the current annual average standard of 8 µg/m^3, and elevating it to a national standard (discussed in Issue 1).

Submissions

Community stakeholders preferred an annual $PM_{2.5}$ standard lower than 8 µg/m^3, with many suggesting 6 µg/m^3.

Studies show there is no safe level of $PM_{2.5}$, and the greatest proportion (>99%) of health costs accrue from avoiding premature deaths due to long term exposure to $PM_{2.5}$. The lowest possible level should therefore be chosen as the standard... The NEPM should aim to drive further improvements in national and state based pollution reduction mechanisms by setting standards based not merely on what is currently achievable, but what governments should be achieving to protect the health of Australians. Achieving 6 µg/m^3 would… avoid 700 premature deaths [in Australia]. (#58 Environmental Justice Australia)

There is no safe level of exposure to $PM_{2.5}$ so standards should be set as low as possible, and include a mechanism to drive exposure even lower. (#7 Maribyrnong Truck Action Group)

Setting a stricter $PM_{2.5}$ standard would also help people understand that there is no safe level of $PM_{2.5}$ pollution and that reducing $PM_{2.5}$ below 8 µg/m^3 will also improve our health. (#47 New England Greens)

Concern is that a target of 8µg/m^3 does not create enough incentive to drive continual improvements… Air pollution policies weaken once limit values are no longer exceeded,… achieving standards offers a false sense of security... (#75 – Peter MacCallum Cancer Centre)

Many submitters preferred a standard of 8 µg/m³.

Do not agree that the lowest values selected are economically achievable in Australia at the present time… natural sources of PM including soil erosion, marine aerosol (sea salt) and other background sources are substantial. In some regions outside of the major metropolitan centres, as well as in portions of the metropolitan air sheds, the natural PM component may often be greater than the anthropogenic and secondary atmospheric components. This raises the prospect that in those regions, the margin between peaks in natural levels of PM and the existing and proposed standards may be small, meaning that anthropogenic contributions only need to be modest in order for a standard to be approached or breached... Application of stringent standards, or aggressive exposure reduction actions, needs to be tempered by the local regional dust background to avoid imposing an unreasonable cost of compliance on the minerals industry. (#51 Alcoa of Australia)

The relatively high background concentration (6 µg/m³) limits the allowable contribution from anthropogenic emissions, showing that lowering the standard would not be realistically achievable. (#91 Rio Tinto)

8 ug/m^3 is lower than most countries but as we start from a lower natural background and do not have cross border air pollution problems from neighbouring countries it may be a similar amount of national anthropogenic PM. (#20 Doctors for the Environment Australia)

Some believed a transition from 8 to 6 µg/m³ over a period of time would be appropriate.

Support … 8 µg/m^3 with a stated goal of reducing this to … 6µg/m^3 within 5 years. (#32 Australian Network of Environmental Defender's Offices)

[Occupational Health Society of Australia] support 8 µg/m^3 subject to a documented commitment for gradual reduction to 6 µg/m^3. (#34 Occupational Health Society of Australia (WA))

Response

NEPC supports introducing an annual average $PM_{2.5}$ standard of 8 µg/m^3 and a long term (2025) $PM_{2.5}$ target of 7 µg/m^3.

By international comparison, levels of $PM_{2.5}$ pollution in Australia are generally low; however, national monitoring data from NEPM monitoring sites show around 1 in 5 monitoring sites exceed the current $PM_{2.5}$ advisory reporting standard 8 µg/m^3.

enHealth recommended an annual average standard of 8 µg/m^3 be considered. By international comparison, the current advisory reporting standard of 8 µg/m^3 is comparatively low. The 2005 WHO guideline value is 10 µg/m^3.

Research provides evidence of an association between long term exposure to $PM_{2.5}$ and mortality at levels experienced in Australian cities[12].

Monitoring data shows that most monitoring sites would meet a standard of 10 µg/m³. The adoption of a 10 µg/m³ standard is unlikely to encourage future improvements in air quality.

A standard of 6 µg/m³ represents a concentration marginally higher than the typical combined contribution of natural and secondary particles. A standard of 6 µg/m³ would, on average, see around 50% of monitoring sites in non-compliance.

The 8 µg/m³ option (the current advisory level in the AAQ NEPM) is considered most suitable. Recent analysis shows the proportion of sites exceeding the standard has shown no significant downward trend between 2003 and 2014. It is unlikely a standard of 8 µg/m³ will be met at all sites now without policy intervention to reduce emissions.

Jurisdictions have a capacity to continue to reduce $PM_{2.5}$ emissions in urban areas through specific emission reduction options. Without reductions in primary and precursor $PM_{2.5}$ emissions, it is estimated that an annual average standard of 8 µg/m³ would see around 20% of all national monitoring sites exceeding the standard.

The resourcing obligations imposed on the jurisdictions by varying the AAQ NEPM PM standards predominantly relate to monitoring and reporting requirements (as currently exist). Monitoring and reporting costs currently incurred by jurisdictions would not change in response to a change in the numerical value of the standards; however, an expansion of the $PM_{2.5}$ monitoring network, commensurate with adoption of formal standards, would be expected over time. Costs associated with the phase-in of $PM_{2.5}$ instrumentation, where it currently doesn't exist, would be staged with planned instrument upgrades, refurbishments and site establishment.

A long term target for $PM_{2.5}$ is also considered appropriate and achievable, in lieu of a more elaborate concentration or exposure reduction framework (as discussed further under Issue 9). On the basis of capacity to realise further air quality gains from the priority sectors that have been identified, and the weight of evidence relating to the health effects of $PM_{2.5}$, the adoption of a long term $PM_{2.5}$ target of 7 µg/m^3 by 2025 is proposed, which is broadly equivalent to a concentration

[12] Crouse, DL, Peters, PA, van Donkelaar, A, Goldberg, MS, Villeneuve, PJ, Brion, O, Khan, S, Odwa Atari, D, Jerrett, M, Arden Pope III, C, Brauer, M, Brook, JR, Martin, RV, Stieb, D and Burnett, RT (2012), 'Risk of Nonaccidental and Cardiovascular Mortality in Relation to Long-term Exposure to Low Concentrations of Fine Particulate Matter: A Canadian National-Level Cohort Study', *Environmental Health Perspectives*, vol. 120(5), pp. 708–714, http://ehp.niehs.nih.gov/wp-content/uploads/120/5/ehp.1104049.pdf.

reduction target of 10% over the period from 2015 to 2025. This is not a standard, but an ambitious 10–year goal to achieve continued and further reductions in maximum concentrations.

Issue 6: $PM_{2.5}$ 24-hour standard

Impact Statement position

The Impact Statement proposes maintaining the current 24-hour $PM_{2.5}$ advisory reporting standard of 25 µg/m³ and elevating it to a national standard (discussed in Issue 1).

Submissions

Community stakeholders tended to favour a $PM_{2.5}$ 24-hour standard of 20 µg/m³.

> *The lowest $PM_{2.5}$ standard is appropriate so as to protect those closest to the source and most impacted, but least protected by the current monitoring location protocol. (#89 Community Over Mining – Toongabbie Township Development)*

> *There is evidence of effects well below the current [advisory] standard, so continuous reduction should be the main strategy with the standard as a backstop. (#20 Doctors for the Environment Australia)*

> *Although the proposed standard of 25 µg/m^3 is in line with the current EU standard established in 2010 and 5 µg/m^3 better than the current US standard, Australia's lower pollution levels, huge scope to cut $PM_{2.5}$ pollution and the attendant health risks should enable a greater reduction to 20 µg/m^3. The Impact Statement shows this is already being achieved at most monitoring sites on most days and so is achievable. These factors enable Australia to set new standards, not merely follow levels set in other larger jurisdictions with more pronounced pollution problems, complicated political structures, much larger population and industrial infrastructures. This is desirable as there are no safe levels of PM_{10} or $PM_{2.5}$ sized particles and of the cost to health. (#59 Asthma Foundation NSW)*

> *25 µg/m^3 is too high… there are many air pollution related premature deaths when $PM_{2.5}$ is less than 25 µg/m^3. (#141 Dr Dorothy Robinson)*

Industry submitters however, tended to prefer a $PM_{2.5}$ 24-hour standard of 25 µg/m³.

> *Do not agree that the lowest values are economically achievable in Australia at the present time. (#51 Alcoa of Australia)*

> *25 µg/m^3 is consistent with the WHO guideline. Considering Australia doesn't have a natural event rule, the current 25 µg/m^3 is as stringent as anywhere in the world. (#57 Confidential)*

Some argued for a transition from 25 µg/m³ to 20 µg/m³ over a period of time.

> *Support an annual average for $PM_{2.5}$ of 25µg/m^3 ….with a stated goal of reducing this to an annual average of 20µg/m^3 …. within 5 years. (#32 Australian Network of Environmental Defender's Offices)*

Response

NEPC supports a 24-hour $PM_{2.5}$ standard of 25 µg/m³ and a long term (2025) target of 20 µg/m³.

Numerically, the current advisory reporting standard of 25 µg/m^3 is the same as the current WHO guideline and is comparatively low internationally.

Analysis of $PM_{2.5}$ monitoring data shows between three and seven exceedance days on average per $PM_{2.5}$ monitoring site per year; however, as with PM_{10}, there is substantial spatial variability in exceedances.

Many urban areas with a high proportion of solid fuel wood heaters are associated with high concentrations of $PM_{2.5}$. For some urban areas the attainment of the annual average $PM_{2.5}$ standard may mask relatively high 24-hour levels of particle pollution.

Taking into account five exceedances of the 24-hour standard there is broad equivalence between an annual average standard of 8 µg/m^3 and a 24-hour standard of 25 µg/m^3.

The current maximum daily $PM_{2.5}$ exposures in Sydney, Melbourne, Brisbane and Perth ranged from 26 to 34 µg/m^3. Annual cardiovascular hospital admissions attributable to current short term $PM_{2.5}$ exposure above background levels is estimated to be about 2070 cases across the four cities. Reducing current exposures to achieve a 25 µg/m^3 standard is estimated to reduce annual attributable cardiovascular hospital admissions by 23%, equivalent to about 480 admissions, compared to current exposures.

Annual childhood asthma hospital emergency department attendance attributable to current short term $PM_{2.5}$ exposure above background levels is estimated to be about 120 cases across Sydney, Melbourne, Brisbane and Perth. Reducing current exposures to achieve a 25 µg/m^3 standard would reduce annual attributable childhood asthma hospital emergency department attendance by 27%, equivalent to about 30 cases. Because hospital emergency department treatment only forms a small proportion of childhood asthma treatment in the population, it is likely that the actual improvement in asthma incidence would be greater than that represented solely by asthma hospital emergency department attendance[13].

As with the annual average standard for $PM_{2.5}$, given continued capacity to reduce $PM_{2.5}$ emissions in urban areas through specific emission reduction options, a long term target is appropriate.

A long term target is in lieu of a more elaborate exposure reduction framework (discussed further under Issue 9). On the basis of capacity to reduce primary $PM_{2.5}$ emissions from priority sectors and the weight of evidence relating to the health effects associated with exposure to $PM_{2.5}$, a long term 24-hour standard of 20 µg/m^3 to be achieved by 2025 is recommended. This is not a standard, but an ambitious 10–year goal to achieve continued and further reductions in maximum concentrations. On the basis of analysis of available data, a 24-hour standard of 20 µg/m^3 is broadly consistent with a long term annual average standard of 7 µg/m^3.

Issue 7: The form of 24-hour standards

Impact Statement position

No firm conclusions were drawn in the Impact Statement about the proposed form of the standard. Options included consideration of:

[13] Australian Institute of Health and Welfare (2003), *Asthma in Australia*, Australian Centre for Asthma Monitoring, Australian Institute for Health and Welfare, Canberra.
Australian Institute of Health and Welfare (2010), *Monitoring the impact of air pollution on asthma in Australia: a methods paper*, Asthma Series, Cat. no. ACM 18, Australian Institute for Health and Welfare, Canberra, viewed 18 December 2012.

- a natural or exceptional events rule
- a percentile rule;
- allowed exceedance days.

The most suitable form depends on the objective of the monitoring and required level of stringency.

It is noted that the national standards are not compliance standards. The Impact Statement noted the current application of the 5-day exceedance rule into industry licences and impact assessment by some jurisdictions.

Submissions

Stakeholders supported different forms of the standard, but generally agreed that any option would be workable, provided adequate guidance was available. There was support for separation of high pollution events associated with exceptional and/or natural phenomenon from those associated with anthropogenic management practices.

> *If properly explained, any of the options can be made to work. The important thing is to have a well documented standard that is understood by all. (#118 Prof David Cohen)*
>
> *Whichever form is ultimately applied, it is important to ensure that greater context for exceedances is included in any AAQ NEPM reporting to avoid unnecessary community concern and to promote the most appropriate management response. (#98 Minerals Council of Australia)*
>
> *Any form should ensure that adequate methods are adopted to separate natural/exceptional events from anthropogenic sources. (#101 Australian Institute of Petroleum)*
>
> *Allowable exceedances… should be specifically tied to natural events – this will ensure that the intent of the standards is applied appropriately. Large PM generating projects use the current exceedance rules to justify increases above compliance standards or that any exceedance of compliance standards would still be within the allowed numerical allowance. (#32 Australian Network of Environmental Defender's Offices)*

However, some did not favour the exclusion of exceptional natural events.

> *The inclusion of an exemption for 'natural events' provides a loophole that in my experience is bound to be exploited. (#122 Name suppressed)*

The explanation of the cause of an exceedance, natural or anthropogenic, was considered to be important.

> *All exceedances should be notifiable and those that are unavoidable due to natural events such as bush fires and dust storms should be acknowledged as such. (#54 Centre of Air quality and health Research and Evaluation)*
>
> *Should include a protocol requiring states to specifically identify the source and give a full explanation/information in a special report that is easy for the public to read, of all exceedance events and any steps undertaken to minimise repeat events. (#74 Warren Godson)*
>
> *Exceedances due to natural events need to be better conveyed. (#93 Australian Sustainable Business Group)*

For reporting purposes, the occurrence of exceptional events should be recorded and various statistics would be presented to understand long term or short term health effects. (#113 South Australian EPA)

Statistics should be available and explained to the public with and without the excluded events. (#101 Australian Institute of Petroleum)

The simplest approach is to simply report all exceedances each year, with the option of using a rigorous method of classifying the cause of the event as anthropogenic, natural or unknown… focus on exposure as the primary metric for reporting and taking action. (#131 Sean Walsh)

It is (more) important to explore the reason for each exceedence. This is especially important for particle pollution, where the response needs to be very different if the exceedences are from home wood heaters compared with exceedences arising from vegetation burn-offs, forestry fires or dust storms. Hence, it is equally important to request the reporting authorities to include data about the likely explanation for each exceedence. For pollutants with no safe threshold, it would be beneficial to have similar explanations for high levels which fall within the standard (e.g. those above 50% of the maximum permitted value). (#140 Lung Foundation Australia)

There was some support for maintaining the existing five exceedance rule (for 24-hour PM_{10}).

The provision for five permitted exceedances of PM_{10} and $PM_{2.5}$ 24-hour limits per year is generous, but it is a simple, unambiguous approach outweighing the benefits of adopting the 'exclusion of data for exceptional events' approach. (#69 Dr Jon Todd)

Retaining the existing form will make comparisons across historic data easier. (#121 Phillip Jennings)

Many community stakeholders preferred a rule that allows a fixed number of exceedances (including zero) of a particulate matter standard in a given year, but with exclusion of data for exceptional events.

It is best to aim for the lowest possible levels with the least number of exceedances as there is no safe level of exposure to particle pollution. (#136 Asthma Foundation NSW)

Fixed exceedance rule is preferred as long as the fixed number of exceedances is zero. (#141 Dr Dorothy Robinson)

All PM exposure is detrimental to health so setting 'allowable exceedance' limits is misleading and only serves as a tool to avoid public spotlight. (#63 Repower Port Augusta)

Some industry stakeholders also preferred a defined number of exceedances.

From an industry point of view, compliance with a defined number of allowed exceedances is a more robust form of a standard. It is also recognised that in many areas of Australia natural events (bushfires, dust storms) can cause significant concentrations and therefore exclusion of exceptional events should be included in the form of the standard. (#129 Name suppressed)

Industry expressed a preference for a rule in which the 98th percentile particulate matter concentration in a given year is compared with a standard, and with exclusion of data for exceptional events.

> *Preferred for consistency with international approaches and to reflect the natural variability in background PM levels associated with natural events. This is sensible for Australia given wind erosion of bare and sparsely vegetated soil surfaces, combined with incoming dust from marine and terrestrial sources. (#51 Alcoa of Australia)*

> *98th percentile is the better option compared to a fixed number of exceedances as the percentile approach will remove the peaks in the data without having any need to justify removal of certain data points or be restricted to an artificial number of exceedances. An approach which limits the number of exceedances may lead to an unnecessarily regulatory-driven response, which to be successful would require a greater understanding of source contributions and environmental externalities including regional variations or wet or dry conditions driven by climatic cycles. (#98 Minerals Council of Australia)*

> *The 98th percentile approach appears to be a more balanced regulatory framework as it results in a smoothing of the monitoring data. It will remove the peaks in the data without having to justify these removals and also eliminates the requirement to apply an arbitrary number of exceedances. (#106 Cement Concrete & Aggregates Australia)*

A clear definition of an exceptional natural event was noted as important for identifying real-world causes of pollution events and accounting for breaches of standards caused by human activity; however, some submitters caution that, even with guidance on what defines an exceptional event, an exceptional events rule may not be consistently applied across Australia.

> *Need technical work to develop definitions of which fires are taken into account for which exceedances, based on size, distance, duration, direction and meteorology. There remains a risk that such a system would not be evenly applied across jurisdictions. (#20 Doctors for the Environment Australia)*

> *The exclusion of exceptional events… would require clear guidance as to which events fall under the term 'exceptional', as well as transparency as to how data is to be excluded as a result of such events. (#105 Cement Industry Federation)*

Some submitters offered views as to what an exceptional event may or may not comprise.

> *A distinction should be made between fires in native vegetation and fires associated with waste dumps such as coal stockpiles, land clearing, and spontaneous combustion of green waste or similar. (#53 Les Johnston)*

> *I am mindful that events such as volcanic eruptions are clearly outside anyone's control while others, such as prescribed burns, are arguable. (#80 Graeme Lorimer)*

> *Allowance should be made for regional specific environmental conditions such as background natural dust levels. (#96 The Chamber of Minerals and Energy of Western Australia)*

Some submitters thought the form of the standard should be trialled, to inform the standards or a future review of the AAQ NEPM.

> *The approach should be piloted to ensure the process is robust and to avoid unintended consequences in implementation. (#98 Minerals council of Australia)*

A trial will provide further valuable information to better inform the standards. (#101 Australian Institute of Petroleum)

All options are relatively easy to assess. Why not just report outcomes against all of them for an interim period? (#139 Ecotech Pty Ltd)

Other submitters felt a trial was unnecessary.

Delays in introducing NEPM compliance standards have already been considerable. Any compliance standard will be superior to an advisory standard that is not currently adhered to. (#136 Asthma Foundation NSW))

No further analysis or trial is needed. Current data should permit a realistic estimate of the outcomes of any suggested change. 'Further analysis' appears to provide an excuse for procrastination. (#117 Mark Curran)

PM_{10} monitoring is widely used and easily implemented, and many PM_{10} monitors can easily be upgraded to also monitor $PM_{2.5}$. There should be no trial – human health should be put first with no delay. (#119 – Name suppressed)

Response

NEPC recommends that:

- The current '5-exceedance day' rule be replaced with an 'exceptional event' rule whereby high pollution days that exceed the 24-hour standard, that are attributable to bushfires or dust storms, can be excluded for the purpose of determining compliance with the 24-hour standard.
- All $PM_{2.5}$ and PM_{10} monitoring data and all exceedances of $PM_{2.5}$ and PM_{10} 24-hour standards, with and without exceptional events, shall be fully reported and described.
- The AAQ NEPM shall recognise extenuating circumstances associated with exceedances of the $PM_{2.5}$ and PM_{10} 24-hour standards on high pollution days that are attributed to regional or continental scale bushfire and dust events.
- The AAQ NEPM shall include a definition of 'exceptional events' based on the nature of the activity and include approved prescribed burns with the primary purpose of managing risk to life and property, wild fires and continental dust events.

The current 5-exceedance day form of the PM_{10} 24-hour standard is an attempt to account, through reporting of air quality monitoring results, for the occurrence of natural exceptional events whose management was outside the control of jurisdictions, namely bushfires and dust storms.

The allowance of 5-exceedance days, whilst subjective, was informed by data sets that included high pollution days, and what was considered reasonable at the time. Similar approaches had been adopted overseas. In considering the form of the 24-hour standard the 2011 AAQ NEPM review noted:

The exceedances in the current NEPM are arbitrary. The 5 exceedances for the PM_{10} standard were introduced to account for the impact of bushfires, dust storms and fuel reduction burning for fire management purposes. These exceedances are often misused and have been applied to urban air pollution and, in some cases, individual sources. Given greater understanding of the health effects of air pollution, it is clear that allowing exceedances increases the risk to the population and reduces the level of protection offered by the standard.

> *There was also support for the introduction of a natural events rule that would exclude the assessment of the impacts from bushfires and major dust storms from the compliance assessment (although data would be reported). This would focus compliance on sources of air pollution that can be managed.*[14]

Public submissions show a strong appreciation of potential causes of high pollution events and an acknowledgement that fire activity and dust storms are inherent features of the Australian landscape.

In the case of managed burns for purposes of protecting life and property, submissions showed an acceptance of these management techniques and support for continued efforts by fire and health authorities to minimise population exposure to air pollution when undertaking burning operations.

The application of the 5-exceedance days to anthropogenic pollution events, irrespective of whether 'exceptional' events have actually occurred, is inconsistent with the original intent of the NEPM. It is considered that any days explicitly exempted from the data set should be bound by rules.

Submissions highlight the importance of reporting of air quality data in a way that allows the public to understand causes of high pollution days. It is considered that the development of public understanding around air pollution events makes the provision of 'allowable' exceedances less relevant than it was 10 years ago.

A transparent approach is proposed to ensure that all monitoring data is publicly reported, and that any exceedance of 24-hour standards be described and attributed to the circumstances that led to the exceedance, i.e. due to fire or dust activity or industrial or area-based sources.

It is apparent from public consultation that 'fixed exceedances' can be interpreted by land management and fire authorities as a constraint on hazard reduction fire management activities. This was not the intention of the NEPM.

It is not the intention of the NEPM that exceedances attributable to point source 'industrial' emissions be considered as 'allowable exceedances', or that monitoring take place adjacent to point sources for the purposes of reporting. Furthermore, it is not the intent of the NEPM that a fixed number of exceedances or NEPM standards would be translated into jurisdictional assessment or licensing criteria.

It is proposed that the NEPM remove the current form of the standard that allows for five exceedance days per annum, to be replaced with a form that requires all data to be reported and allows for the reporting of high pollution days that are deemed 'exceptional events', to assist with the public communication of data.

It is proposed that all exceedances of the standard are reported and that the NEPM recognise extenuating circumstances of exceedances when they are directly attributable to regional or continental scale 'exceptional events'.

It is proposed the NEPM defines exceptional events based on categories of prescribed burns for the purpose of managing risk to life and property, wild fires and continental dust events, inherent within the Australian landscape.

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[14] *National Environment Protection (Ambient Air Quality) Measure Review Report*, www.scew.gov.au/system/files/resources/3405e986-afe9-bdb4-5d2c-383f3ea1e911/files/aaq-review-report-2011.pdf.

The following descriptive principles of an 'exceptional event' rule are proposed:

> *An exceptional event means a fire or dust occurrence that adversely affects air quality at a particular location, and causes an exceedance of 1 day average standards in excess of normal historical fluctuations and background levels, and is directly related to:*
>
> - *bushfire;*
> - *jurisdiction authorised hazard reduction burning; or*
> - *continental scale windblown dust.*
>
> *When reporting against PM_{10} and $PM_{2.5}$ 1 day average standards jurisdictions will report all measured data, including monitoring data that is directly associated with an exceptional event, and identify and describe any exceptional event.*
>
> *Jurisdictions are to maintain and make available records relating to the determination of exceptional events.*
>
> *For the purpose of reporting compliance against PM_{10} and $PM_{2.5}$ 1 day average standards, jurisdictions shall exclude monitoring data that has been determined as being directly associated with an exceptional event.*
>
> *For the purpose of reporting compliance against PM_{10} and $PM_{2.5}$ 1 year average standards, jurisdictions shall include all measured data, including monitoring data that is directly associated with an exceptional event.*

Issue 8: Other PM metrics

Impact Statement position

The options considered in the Impact Statement relate solely to PM_{10} and $PM_{2.5}$, and to annual and 24-hour averaging periods in each case.

The Impact Statement considered there was very limited monitoring data and insufficient quantitative data on concentration-response functions to evaluate and propose inclusion of other metrics in the AAQ NEPM.

Submissions

A number of submissions supported further investigation of reporting standards for ultrafine and or nano-particles:

> *There is growing concern internationally about the health impacts of ultrafine particles. A reporting standard in the NEPM will enable better understanding of their impact on health. (#17 Carmen Largaiolli)*
>
> *New research and policy development is needed for the future, especially the health impacts of ultrafine particles. (#26 Ian Tanner)*
>
> *There is a considerable amount of research globally directed at ultrafine particles and nano-particles in particular that could warrant implementation of a standard below $PM_{2.5}$. (#34 Occupational Health Society of Australia (WA))*
>
> *Monitor with a view to providing the required exposure data for epidemiological studies investigating the health effects of ultrafine particles. Although current evidence is insufficient*

to warrant introduction of a standard, the body of evidence is growing that short term exposure is linked to adverse health effects, including cell and DNA damage. (#54 Centre for Air quality and health Research and evaluation)

Ultrafine particles are increasing due to the advent of and increase in diesel fuel and diesel engines. These are particularly harmful to health as they are trapped by the body's natural defences (nose, mouth) and travel deep into the airways and enter the bloodstream causing disease. (#136 Asthma Foundation NSW)

Just as $PM_{2.5}$ was initially included in the NEPM as an advisory standard to gather data, ultrafine particles should be included in the NEPM variation. National Environment Protection Council should investigate including a reporting standard… so their impacts on health can be better understood. (#61 Maribyrnong City Council)

Recommend that trial measurement stations are established to allow for informed discussion of PM_1 management in Australia in the future. (#32 Australian Network of Environmental Defender's Offices)

Another NEPM revision may be necessary to examine nano-particles… New $PM_{2.5}$ standards may be adequate for now, but future epidemiological studies may well find adverse health responses at much lower levels. (#74 Warren Godson)

Analysis of particle characteristics such as size, mass, number and chemical composition, including the black carbon component of particulate matter, was supported to provide data for future decisions for alternative particle standards.

Introduce a reporting standard for PM_1, and monitor and undertake size distribution and chemical composition analysis so as to quantify source contribution. (#31 Mark Curran)

Additional particulate characterisation measures, particularly measures of black carbon, diesel exhaust and secondary sulfate particles, are required… Black carbon is increasingly recognised as an air pollutant that affects human health and climate change. The WHO concludes it can provide a better indicator of harmful particulate substances from combustion sources than undifferentiated PM mass in short term health effects. The WHO and European Union are considering black carbon as an additional standard for air quality… Australia should follow in similar steps and introduce monitoring of black carbon as a precautionary standard. (#32 Australian Network of Environmental Defender's Offices)

Pathogenicity of particles is thought to be from adsorbed polycyclic aromatic hydrocarbons, transition metals, micro-organisms and substances that cause oxidative stress. These cannot routinely be measured directly so particles should be regulated by size and mass. (#20 Doctors for the Environment Australia)

We need to continue research into particle number, particle surface area and particle composition…Standards for these metrics need to be adopted when sufficient evidence becomes available. It is also possible to directly measure particle toxicity using human cell lines – this should also be considered in future research. (#131 Sean Walsh)

PM_1 and particle number monitoring should start as soon as feasible to provide data for future decisions for introducing PM_1 and particle number standards… More speciation work should be done… possibly look at black carbon monitoring to address domestic fuel burning... (#139 Ecotech Pty Ltd)

Measurement of other air particulate parameters, such as, black carbon should be included within the NEPM and be required where non-compliance with PM_{10} or $PM_{2.5}$ criteria takes place. Data provided will provide the public with more information and provide a greater focus on measures that need to be applied to achieve compliance. (#53 Les Johnston)

A few submissions sought consideration of 8-hour particle standards to better capture short term impacts which are not reflected in 24-hour monitoring. Such impacts were of particular concern along busy arterial routes.

[An 8-hour standard] would better capture the significant short term impacts of particulates. Many schools are located on busy arterial routes and children are exposed to elevated pollution levels for 8 hours a day. This short-medium term exposure is not reflected in 24-hour monitoring, and when 24-hour compliance is demonstrated, creates the false impression that nothing needs to be done. (#61 Maribyrnong City Council)

Consideration of a 1-hour standard was also sought.

A much shorter interval than the averaged 24-hour standard is needed for health reasons. Real time monitoring is possible… The NEPM need to be varied to include an additional 1 hour compliance standard for PM_{10}… $PM_{2.5}$ compliance standards need to be set for 1 hour average, 24 hour average and one year concentrations. (#33 cleanairtas)

Response

NEPC notes the issues raised with respect to other PM metrics and considers that this issue is beyond the scope of this variation. The issues raised remain relevant to ongoing national priority processes including the development of the National Clean Air Agreement as well as work underway to review other aspects of the AAQ NEPM.

Currently, there is insufficient monitoring data in Australia to allow for the consideration of options relating to PM metrics other than for PM_{10} and $PM_{2.5}$. There is also insufficient health evidence to support the setting of health-based standards other than for PM 24-hour and annual average standards.

$PM_{0.1}$

While there is increasing epidemiological evidence of the association between short term exposures to ultrafine particles ($PM_{0.1}$) and health, there is, however no routine monitoring data in Australia that could be used to establish standards for such particles. WHO[15] highlights critical data gaps for establishing standards for $PM_{0.1}$:

- a lack of epidemiological evidence on the effect of ultrafine particles on health, with a limited number of studies published on this topic
- insufficient understanding of whether the effects of ultrafine particles are independent of those of $PM_{2.5}$ and PM_{10}, and
- lack of evidence of which ultrafine particle physical or chemical characteristics are most significant to health.

There is a lack of data on the effects of short term exposures to ultrafine particles, and no epidemiological studies of long term exposure to ultrafine particles.

[15] REVIHAAP (WHO 2013) op. cit.

WHO concludes there is considerable evidence that ultrafine particles can contribute to the health effects of PM; however, quantitative data on concentration-response functions are too scarce to evaluate and recommend an air quality guideline. The same evaluation applies for organic carbon.

$PM_{2.5–10}$

There are no Australian health studies for the coarse particle ($PM_{2.5–10}$) size fraction. There is limited monitoring data available, and the available data is insufficient to support setting specific standards at this time (although the simultaneous implementation of standards for PM_{10} and $PM_{2.5}$ effectively addresses this).

WHO notes a number of studies provide evidence for associations between short term exposures to coarse particles and health, but data from clinical studies is scarce and toxicological studies report that coarse particles can be equally as toxic as $PM_{2.5}$ on a mass basis. There is a need to undertake further studies that assess the long term health effects of coarse particles and studies that indicate the relative importance of the various sources of coarse particles.

Given emerging evidence of health effects of exposure to ultrafine particles, and the significance of the $PM_{2.5–10}$ size fraction in Australia due to windblown dust, where feasible, it would be desirable to collect data on these particle size fractions to inform the setting of standards in the future.

Composition

The role of organic particles is not well understood and data is needed on the role of the toxicity of primary or secondary organic aerosols. Soot and elemental carbon have been identified as carriers of toxic volatile compounds.

The 2011 NEPM Review noted:

> *Additional detail on PM composition in Australia would be beneficial for a number of reasons, not least the potential contribution to the understanding of the reasons for exceedances of the standards. Consideration should be given to the routine collection of PM composition data using standardised methods.*

Currently, there is no clear understanding of which particle properties, such as the presence of specific chemical substances, are most responsible for the toxic effects. There is limited monitoring data available in Australia to support the setting of standards for individual PM components.

Exposure times of less than 24 hours

WHO notes significant evidence from toxicological and clinical studies on effects of combustion-derived particles that peak exposures of short duration (ranging from less than an hour to a few hours) lead to immediate physiological changes, and this is supported by epidemiological observations. Epidemiological and clinical studies demonstrate that sub-24-hour exposures to elevated levels of PM can lead to adverse physiological changes in the respiratory and cardiovascular systems. Further studies are required to evaluate whether a high 1-hour exposure would lead to a different response than a similar dose given for 24 hours.

Issue 9: Exposure reduction framework

Impact Statement position

The Impact Statement considered the introduction of an exposure reduction framework in the AAQ NEPM. Two options were proposed for measuring progress towards reducing exposure to $PM_{2.5}$ in major urban areas using monitored or modelled $PM_{2.5}$ concentrations:

- a target of a 10% reduction in the annual mean $PM_{2.5}$ concentration over a 10-year period, or
- a population weighted exposure index, without an explicit numerical target but with a purpose of evaluating continual improvement and/or no deterioration of air quality.

The Impact Statement favoured the exposure index option without including an explicit numerical target.

The relationship between ambient PM concentrations and their health response is, broadly speaking, linear. This means sensitive individuals – the young, the elderly, asthmatics, people with respiratory or cardiovascular disease – may be adversely affected even where an AAQ NEPM standard is met. There are health benefits to be gained from any reduction in overall population exposure to particles.

While air quality standards have an important role to play in driving down PM concentrations where exceedances are measured or predicted, localised remedial actions are unlikely to lead to large-scale reductions in population exposure. In areas of higher population density where there are no exceedances of the standards, there may be little impetus to implement measures to reduce exposure to PM. An exposure-reduction overlay, for non-threshold pollutants like PM, addresses this issue. Scientific support for such an approach to managing PM air quality has been strengthened by the WHO Review of Evidence on Health Aspects of Air Pollution.

The issues and inconsistencies associated with the measurement of $PM_{2.5}$, coupled with the need to detect relatively small changes in concentrations, mean that measuring progress towards any target would be challenging.

A practical approach would involve the development of an exposure index based on multi-year and multi-site and averaged monitoring data to track population exposure. This would provide the first step towards characterising exposure based on the existing monitoring network, with little or no investment required of jurisdictions. The robustness of the exposure index in a given jurisdiction would increase as jurisdictions monitor $PM_{2.5}$ at more sites.

Submissions

There was widespread support among health and community groups for an exposure reduction framework that is genuinely protective of human health.

> *The science is well established that current exposure is causing health problems, so long term targets to progressively decrease exposure should be adopted. (#2 Judith Leslie)*
>
> *The biggest health gains are to be made by reducing the median exposure of a population. Where there is no safe level of exposure the regulatory system should ensure that the levels are as low as can be achieved, and not simply below a given standard. The main regulatory strategy should be to continuously reduce exposure. (#20 Doctors for the Environment Australia)*
>
> *There is an efficiency argument for focussing on the air quality in the biggest populations, and an equity argument for protecting those most exposed, so in practice an exposure reduction system is most relevant to large cities while numerical standards provide an equitable upper exposure limit for people in smaller places (#20 Doctors for the Environment Australia)*
>
> *Given there is no known threshold for health effects, any reduction in exposure will result in health benefits… this approach creates an impetus to ensure air quality monitoring is more*

effectively linked into air pollutant reduction targets and activities. (#75 Peter MacCallum Cancer Centre)

There is strong epidemiological evidence that there is no safe lower concentration threshold for exposure to PM. An exposure reduction framework is a feasible and effective method for reducing PM exposure and improving health outcomes in Australia. (#103 CSIRO)

Should be implemented in the small proportion of locations where proposed standards cannot be achieved within 5 years. (#136 Asthma Foundation NSW)

Should focus on regions where people are already exposed to unsafe or poor air quality. (#41 Lock The Gate Alliance)

Some submitters preferred an approach with formal targets.

As the science is well established that current exposure is causing health problems, why would we not adopt long term targets to decrease exposure? (#20 Doctors for the Environment Australia)

A framework with long term targets should be included in the NEPM. (#89 Community Over Mining – Toongabbie Township Development)

An exposure reduction framework that requires an actual reduction in exposure (rather than just monitoring of exposure) should be adopted via a requirement that the recorded pollution levels at monitoring sites decrease by a certain percentage each year. There should be an overall target of 10% reduction in the annual mean $PM_{2.5}$ concentration between 2015 and 2025, with sub targets to be set for each year. (#58 Environmental Justice Australia)

Preferred option is for a 10% reduction in the exposure index based on an annual assessment. (#108 CASANZ)

Without a specific target (e.g.10%) any reduction will be ad hoc and may not achieve continual improvement. (#32 Australian Network of Environmental Defender's Offices)

Some thought an index-based monitoring approach was preferable, though further evaluation may be needed.

A more practical option, such as the development of an exposure index based on monitoring of $PM_{2.5}$ would seem to be more sensible in the interest of advancing a path towards gradual reduction in PM exposures in urban areas (#51 Alcoa of Australia)

…while this has the potential to be a helpful tool for air quality management, Council would require further information about how such a framework would be implemented and any potential costs to Council and the community before being able to support this option. (#24 Brisbane City Council)

A framework based on monitoring levels against an average exposure concentration index… may be an achievable way to observe and reduce urban population exposure. (#65 Australian Aluminium Council)

Support in principle, based on the concept that greater benefits could be obtained from a general reduction in exposure rather than by policies targeting point source emissions… consideration should be given to the cost impacts, both to the community and regulated

industry, of developing and maintaining more extensive monitoring networks that would be required to effectively implement an exposure reduction approach. (#105 Cement Industry Federation)

Others commented that whatever the approach, exposure reduction needs to be kept simple.

… we believe that NEPC is making this far more complicated than it needs to be. An exposure reduction framework could simply consist of a requirement that recorded pollution levels at existing monitoring sites (as well as sites that come online over time) decrease by a certain percentage each year. As in the European Union system, there could also be a threshold below which no further reduction is required (due to the likely contribution of natural PM sources). An advantage is that delays inherent in the NEPC process for adopting standards can be avoided with targets that automatically decrease over time. A review of the exposure reduction framework could occur every five years to ensure it remained appropriate and on track. (#58 Environmental Justice Australia)

Some submitters commented on issues that would need to be addressed in developing an exposure reduction framework for Australia.

Air shed characterisation studies are needed to inform the development of tailored policies which target key $PM_{2.5}$ exposure risks. This will provide policy makers with the tools to develop regional responses and target sources which present the higher risk to health… Any reduction targets should be tailored to regional/local characteristics and aim to maintain or reduce population exposure to $PM_{2.5}$ (#98 Minerals Council of Australia)

More detailed understanding is required of background levels and source contributions… Also need to consider the cyclic nature of Australian weather and climate influences on background PM levels, e.g. El Nino /La Nina events. (#100 Energy Supply Association of Australia)

Assessment of progress towards achieving exposure reduction should be based on a combination of monitoring and source apportionment and (exposure) modelling. This has advantages over monitoring alone – it provides better information for developing emission reduction programs, and it provides more accurate assessment of the effectiveness of exposure reduction measures for a larger proportion of the population, particularly those closer to local sources… A precondition of being able to do this modelling is the development of improved and consistent air emissions inventories across jurisdictions. (#103 CSIRO)

Exposure assessment will require monitoring systems that are representative of population exposure and exposure situations. Prerequisites for achieving this include (i) expanded monitoring networks; (ii) refined emissions inventories; and (iii) regional, sub-regional and local scale modelling efforts. (#108 CASANZ)

An exposure index derived from an expanded monitoring system would provide a better measure of the success of strategies and policies adopted for population exposure reduction. Tasmania's BLANkET network is a good example of monitoring under varying emission levels (from smoke). (#113 South Australian EPA)

Current air quality monitoring is not suitable for accurate and reliable health surveillance purposes. Air quality management should do more than monitor background air quality. It should provide accurate information of what the population; in particular vulnerable groups are being exposed to. In order to achieve this, monitoring stations need to be sited in

appropriate locations (where humans dwell as opposed to the middle of parks). (#75 Peter MacCallum Cancer Centre)

The method needs to be rigorously defined so that population exposure patterns are adequately captured. Future work in this area needs to consider the fact that we have a mobile population who spend a lot of time indoors and in vehicles, in other words, we need a way to estimate 'true exposure', not just outdoor exposure at ambient monitoring sites. (#131 Sean Walsh)

A number of stakeholders, while considering exposure reduction feasible, did not support its introduction in the AAQ NEPM.

It is outside the intent of the NEPM. The NEPM's original scope is to monitor and evaluate the exposure of the general population. The intent is for States/Territories to report air quality conditions in areas with populations above a certain threshold, not to dictate methods for reducing particle concentrations within an air shed. While the Federal Government could arguably drive $PM_{2.5}$ reductions by establishing emission requirements for diffuse sources (e.g. motor vehicles, off-road engines, wood heaters), reduction methods are left to States/Territories which traditionally focus on regulating non-diffuse sources such as industry. The reduction burden therefore falls on industry. (#91 Rio Tinto)

Technically feasible but not supported at this time because of uncertainties around implementation of policies by jurisdictions to comply with the NEPM and the costs of possible policy responses. An exposure reduction framework should be better understood by all stakeholders before being formalised. Options could be trialled so a framework can be considered in a future NEPM variation. (#101 Australian Institute of Petroleum)

Difficult to justify when the current monitoring and regulatory effort is focused on ambient conditions which appear to bear very little relationship to what individuals are actually exposed to – 'hotspots' (roadsides, tunnels, industrial stacks), industrial and workplace exposures and exposures inside the home... would only support an exposure reduction framework if it included monitoring of specific sources. (#117 Mark Curran)

All economically feasible measures should be implemented first. Don't use the complexity of devising an appropriate exposure reduction framework as an excuse for more delays that will allow more people to die. (#141 Dr Dorothy Robinson)

Response

NEPC supports development of an air quality 'exposure' metric and methodology for reporting by jurisdictions by June 2018.

A long term target is proposed as a simplified approach for employing a framework to provide continual improvement and/or no deterioration of air quality. NEPC supports an annual average target of 7 µg/m^3 for $PM_{2.5}$ for 2025, and a 24-hour target of 20 µg/m^3 for 2025.

Health benefits are associated with a reduction in ambient levels of $PM_{2.5}$ even in circumstances where AAQ NEPM standards are met. Many urban areas in Australia currently meet the $PM_{2.5}$ annual average standard of 8 µg/m^3; however, a number of large urban and smaller urban areas do not. Analysis of regional concentrations show a long term exposure reduction target of 7 µg/m^3 to be achievable.

The Impact Statement notes development of a population exposure framework would be greatly assisted by significant investment in improved monitoring networks, emissions inventories, airshed models, and better information about the spatial and temporal activity of the Australian population.

In the first instance a simplified response to implementing an exposure reduction framework is warranted. The adoption of a long term annual average target for $PM_{2.5}$ is proposed, in addition to further development of inventory, modelling and monitoring capabilities.

The Economic Analysis estimates achieving a 10% exposure reduction target for $PM_{2.5}$ annual average concentrations would require significant additional abatement measures in most jurisdictions. Policy responses to achieve reductions in population exposure to $PM_{2.5}$ are contemplated and do not necessarily relate to licensed premises.

Priority national emission reduction actions under consideration relate to wood heater emissions, small petrol engines, ships and other non-road diesel engines. It is also noted that PM combustion emissions from on-road vehicles are estimated to continue to decline over the next decade. Additional policy responses will be informed by emissions inventories, air quality and modelling and particle characterisation studies.

The AAQ NEPM is a monitoring and reporting protocol. A long term target relating to ambient $PM_{2.5}$ concentrations is considered within scope of the NEPC Act and the AAQ NEPM.

Many submitters support the continued improvement in air quality, especially in circumstances where current ambient standards are exceeded. Implementation of a long term target for $PM_{2.5}$ exposure acknowledges the need for a simplified approach to monitoring and reporting ambient population exposure.

A long term target for $PM_{2.5}$ is considered appropriate and achievable. On the basis of capacity to realise further air quality gains from the priority sectors that that have been identified, and the weight of evidence relating to the health effects of $PM_{2.5}$, the adoption of a long term $PM_{2.5}$ target of 7 $\mu g/m^3$ for 2025 is proposed, which is broadly equivalent to a exposure reduction target of 10% over the period from 2015 to 2025.

It is also recommended that jurisdictions build capacity to characterise population exposure to air pollution. It is appropriate that jurisdictions collaborate on development of a national approach to assessing and reporting population exposure to air pollution. NEPC proposes the inclusion of the following text in the AAQ NEPM:

> ***'Each participating jurisdiction must evaluate and report population exposures to particles as $PM_{2.5}$ annually from June 2018.***
>
> **Note: To ensure national consistency, evaluation and reporting shall be undertaken in accordance with any procedures or methods agreed by participating jurisdictions.'**

Issue 10: Monitoring locations

Impact Statement position

The draft varied NEPM and Impact Statement did not propose any change to the monitoring protocols of the AAQ NEPM (Part 4). The review of monitoring methods, monitoring locations and protocols is prioritised for consideration during Stage 2 of the AAQ NEPM review.

States and territories are required to monitor and report on air quality to determine whether the AAQ NEPM standards are being met within populated areas, either by measuring pollutant

concentrations at performance monitoring stations or assessing concentrations through equivalent measurements such as emissions inventories, dispersion modelling and comparison with other regions.

The AAQ NEPM provides guidance for the location of performance monitoring stations. These are called 'generally representative upper bound (GRUB) for community exposure' sites. The AAQ NEPM provides a formula for determining the number of monitoring stations for a region with a population of 25,000 people or more.

The AAQ NEPM states that additional, or fewer, performance monitoring stations can be implemented depending on local and regional conditions or existing pollutant levels.

Submissions

Many community stakeholders perceived the 25,000 population parameter in the AAQ NEPM as a minimum threshold for monitoring, and called for this to be lowered. This was especially an issue for communities directly impacted by industrial emission sources, and which are known to or are likely to experience high levels of air pollution, such as in mining affected areas, near power stations, airports, shipping terminals and major arterial roads and areas with high wood heater use.

> *Air quality should be monitored more often and in more places. (#10 The 3068 Neighbourhood Group)*
>
> *There should be stronger requirements for monitoring and reporting in small towns and suburbs where it's believed standards are being exceeded… The NEPM should require monitoring and reporting for both $PM_{2.5}$ and PM_{10} in population centres of 5,000 or more, particularly communities known to experience high pollution levels. (#3 Fee Mozeley)*
>
> *Any size population in highly industrialised areas should be afforded the same protections as the rest of the Australian community. (#28 Hunter Communities Network)*
>
> *It is objectionable to us that smaller population centres are excluded from monitoring. We all have the same respiratory system! Yet some of these centres are located close to coal mines, power stations, coal ports and along freight routes… They are undeniably in harm's way. Where the standard is being exceeded there ought to be closer monitoring. (#76 Terminate Tullamarine Toxic Dump & Friends of Steele Creek)*
>
> *Monitoring protocols should require pollution to be measured in places where it is likely to cause the greatest harm, i.e. areas where pollution targets are likely to be exceeded. (#83 Australian Air Quality Group)*
>
> *Monitoring should not be based purely on population size, but also on risk given the proximity of industrial activity. (#45 Conservation Council of South Australia)*
>
> *Monitoring by population size alone is not adequate protection. This is particularly important for people whose health is threatened by industrial activity setting up close to established residential areas of smaller populations. (#58 Environmental Justice Australia)*
>
> *There should be stronger monitoring requirements for monitoring in small towns or suburbs that are close to industrial sources… The clause for optional extra monitoring [in the AAQ NEPM] is weak and optional. It is of no use to people whose health is threatened by industrial activity setting up close to established residential areas. (#20 Doctors for the Environment Australia)*

The current arrangement sends a clear message that regional areas with lower population density are not considered 'worth' investigating even though the risks per person may be higher than in urban areas. (#63 Repower Port Augusta)

Community submitters also felt state and territory regulators exercised considerable discretion around monitoring and the AAQ NEPM should provide clearer guidance on where to monitor.

The AAQ NEPM should provide clear direction to State regulators on where to monitor, to ensure that the goal of exposure reduction, regardless of community size, is achieved. (#89 Community Over Mining – Toongabbie Township Development)

The NEPM should provide clear direction to States on the matter of where to monitor rather than leaving this to the discretion of state regulators. (#58 Environmental Justice Australia)

Some submissions called for mobile sampling, to better identify highly polluted environments and target emission reduction strategies.

Introduce mobile sampling so that highly polluted micro-environments can be identified and mapped (e.g. domestic heaters, vehicular tunnel exhaust stacks). Sampling from a few fixed sites in major population areas is unlikely to provide information that will identify the locations of seasonal and weather mediated hot spots. (#1 William Thomson)

The NEPM protocols should specify use of portable systems (such as those developed by EPA Tasmania) to identify areas of unacceptable pollution and allow monitoring and pollution reduction strategies to be implemented. (#82 Australian Air Quality Group)

Portable $PM_{2.5}$ monitors (e.g. the Tasmanian Travel BLANkET) can be used to identify smaller communities with high pollution levels (#15 Mackay Conservation Group)

Response

NEPC notes the issue raised with respect to monitoring locations and considers that this issue is beyond the scope of this variation. The issue raised remains relevant to ongoing national priority processes including work underway to review other aspects of the AAQ NEPM including strengthening the standards for sulfur dioxide, nitrogen dioxide and ozone.

The AAQ NEPM prescribes monitoring to be undertaken at locations that are generally representative of the level of exposure of the broad population rather than 'hot spots' near major point sources or roads. Monitoring sites are to be located in populated areas which are expected to experience 'upper bound' concentrations and are to provide a basis for reliable statements about air pollution within the region or sub-region as a whole.

The resources required to establish and maintain AAQ NEPM compliant monitoring networks are considerable, and any change to the monitoring protocols will likely have resourcing implications and impact a jurisdiction's broader air quality monitoring program. AAQ NEPM monitoring networks are usually a subset of a jurisdiction's more expansive air quality monitoring network.

An expansion of the $PM_{2.5}$ monitoring network, commensurate with adoption of formal standards, would be expected over time. Costs associated with the phase-in of $PM_{2.5}$ instrumentation, where it currently does not exist, would be staged with planned instrument upgrades, refurbishments and site establishment. It is not proposed that monitoring protocols be changed from the status quo.

The AAQ NEPM provides jurisdictions with discretion and flexibility to determine and justify monitoring locations. Part 4 of the AAQ NEPM requires jurisdictions to prepare and publicly disclose their ambient air quality monitoring plans.

The 25,000 population threshold is provided in the AAQ NEPM as guidance. Jurisdictions can undertake AAQ NEPM compliant monitoring at locations where populations are less than 25,000 people. At their discretion jurisdictions monitor in urban communities of any population size. The NEPM also suggests:

- additional performance monitoring stations may be needed where pollutant levels are influenced by local characteristics such as topography, weather or emission sources, and
- fewer performance stations may be needed where it can be demonstrated that pollutant levels are reasonably expected to be consistently lower than the standards mentioned in this Measure.

The NEPM allows for the use of non-standard monitoring methods that provide equivalent information for assessment purposes. The NEPM also allows for the characterisation of air quality in ways other than monitoring, for instance using emissions inventories and atmospheric dispersion modelling.

It is appropriate that jurisdictions have discretion to prioritise the allocation of resources to undertake monitoring. It is also appropriate that jurisdictions have discretion to undertake non-reference monitoring as an efficient and effective means to characterise air quality, where it can be justified.

Issue 11: Monitoring methods

Impact Statement position

The AAQ NEPM requires Australian Standard monitoring methods to be used for PM_{10}. Where an Australian Standard Method has not yet been developed for a monitoring method, appropriate internationally recognised methods or standards may be used that provide equivalent information for assessment purposes.

For $PM_{2.5}$, measurement and assessment is undertaken using USEPA reference (or equivalent) methods. Continuous methods (e.g. tapered element oscillating microbalance (TEOM)) may also be employed in addition to the reference method.

In practice, various methods are used to measure both PM_{10} and $PM_{2.5}$ in Australia, and internationally, and these vary from jurisdiction to jurisdiction.

Submissions

Some submitters called for more transparency in the reporting of $PM_{2.5}$ monitoring data, either by using standard monitoring methods and/or publishing all relevant monitoring data.

> *All $PM_{2.5}$ measurements should either be by standard reference methods (e.g. low volume samplers or beta attenuation monitors), or use conversion equations to ensure true measurements are not being underestimated. (#17 Carmen Largaiolli)*
>
> *Both data sets (reference or equivalent and continuous methods) should be published to allow conversion procedures to be developed and open to public scrutiny. (#141 Dr Dorothy Robinson)*

One submitter suggested further consideration in the use of appropriate correction factors to account for continental climatic variation is warranted.

> *MIM suggests that, in establishing numeric values for PM materials and exposure indices as per the exposure reduction framework that it is appropriate for standards to reflect local conditions, either by a regional correction, or preferably by expression of PM standards as a consistent ambient value as is done internationally. (#94 Mt Isa Mines Limited)*

Some questioned the measurement methods currently used, and/or called for further development of non-reference methods.

> *The current crude gravimetric measurement method is out of date… it is more appropriate to quantitatively measure the number and size of the full spectrum of particles, i.e. PM_{10}, $PM_{2.5}$, PM_{1}… (#1 William Thomson)*

> *Further work is needed to improve the understanding of discrepancies between the non-reference methods used for measuring PM, e.g. TEOM adjustment factors should be reconsidered in light of improved understanding of PM composition. (#103 CSIRO)*

> *Optical measurement of particles can provide useful data on fine particle levels at low cost. A well-calibrated nephelometer will generally give results that are extremely well correlated with $PM_{2.5}$ mass concentration data. Moreover, there are methods for combining optical and mass based measurements to provide insight into the nature of a particle pollution event (e.g. the PM_{10} scattering ratio) which is a reliable indicator of whether a pollution event is coarse mode dominated (e.g. dust) or fine mode dominated (e.g. urban fire or bushfire smoke). (#131 Sean Walsh)*

Concern was raised about the removal from the draft varied AAQ NEPM of any requirement to achieve consistency of equivalent measurements for $PM_{2.5}$ or PM_{10}.

> *The Peer Review Committee expended considerable effort to establish whether, and ultimately how, TEOM instruments could provide equivalence… the draft variation adds eight new methods for measuring airborne particles… any of these methods can be used without any requirement to achieve equivalence with each other or with NEPM data collected until now. The draft varied AAQ NEPM even does away with the corrective adjustments that the Peer Review Committee approved for achieving equivalence of TEOM measurements for PM_{10}. It would be wrong to make it easier for jurisdictions to comply with particle standards by using a measurement method that loses semi-volatile constituents and therefore underestimates the true concentrations... Now that the Peer Review Committee has been terminated, it is more important than ever that the NEPM itself provide safeguards for national consistency. I regard the draft variation's removal of any requirement to demonstrate equivalence between particle measuring methods as a serious threat to the purpose of the NEPM because it could allow inconsistencies between different locations or years, corrupt trend data and make compliance easier. (#80 Graeme Lorimer)*

Response

NEPC considers that current methods employed by jurisdictions to monitor ambient concentrations of $PM_{2.5}$ and PM_{10} are sufficient for the purposes of compliance with the AAQ NEPM. The issues raised in relation to other monitoring methods and publishing monitoring data are considered to be beyond the scope of this variation. The issues raised remain relevant to ongoing national priority processes including work underway to review other aspects of the AAQ NEPM.

Jurisdictions undertake air quality monitoring and public reporting for reasons other than AAQ NEPM compliance reporting. A priority of air quality monitoring networks is the public reporting of near real-time air quality and health related information. The management and development of air quality monitoring networks are constrained by the considerable establishment and operational costs of monitoring sites. When choosing a monitoring method, jurisdictions consider local operational needs and air-shed characteristics.

The reference methods for PM_{10} and $PM_{2.5}$ in Australia involve a manual gravimetric approach, in which a filter is weighed before and after sampling to determine the particulate matter mass. For a number of practical reasons the reference methods have not been widely adopted in Australia and other countries, and a number of non-reference instruments (for AAQ NEPM purposes) are in widespread use. These include the TEOM, the filter dynamic measurement system (FDMS), the beta attenuation monitor (BAM) and optical systems.

There is inherent uncertainty associated with the monitoring methods employed. There is also potential confounding of direct comparison of data from one site with another due to differences in atmospheric conditions and the monitoring method employed. Internationally, it is standard practice to temperature correct air quality measurement; this, however, does not diminish the benefit of establishing robust location-specific trend data for particulate matter.

Issue 12: Emissions inventories

Impact Statement position

The draft varied NEPM and Impact Statement did not propose any change to AAQ NEPM monitoring protocols in relation to the use of emissions inventories (Part 4). The review of monitoring methods, monitoring locations and associated protocols is prioritised for consideration during Stage 2 of the AAQ NEPM review.

In Australia there are two main types of inventory that are used to quantify the emissions of pollutants to the atmosphere:

- the National Pollutant Inventory (NPI), which is a broad-based mechanism for collecting data on pollutant emissions to air, land and water. Its main purpose is to collect and publish information about emissions of substances on a geographical basis to help environmental decision-making and provide the public with information. The NPI only requires reporting of $PM_{2.5}$ emissions from combustion sources (jurisdictions periodically report diffuse sources), and it does not provide sufficient data to enable air quality modelling
- regional (state-based) inventories, which are maintained by some jurisdictions to inform air quality management decisions and policy analysis, to determine the effectiveness of legislation, and to facilitate air pollution modelling. Five jurisdictions – including the major urban centres (i.e. Sydney, Melbourne, Brisbane, Perth and Adelaide) – currently use emissions inventories to manage air quality in some way.

At present, the approach taken on the development of regional air emissions inventories is not necessarily consistent. The methodology used to estimate emissions from each source may differ significantly, and some inventories are not suitable for regional air quality modelling purposes. The substances included in each inventory also vary from jurisdiction to jurisdiction.

Submissions

Some submissions noted the need for improved emissions inventories in Australia, to facilitate monitoring and exposure assessment and the development of appropriate emission and exposure reduction strategies.

> *Quality up-to-date inventories are critical to identify major sources of air pollution in an air shed and to implement management strategies. It is important in the exposure reduction context. Industry's proportion of emissions is rapidly declining but there are concerns that industry still bears the bulk of reduction efforts. (#97 Caltex)*
>
> *Comprehensive inventories for all PM emissions (natural and anthropogenic) based on consistent methodologies need to be developed to aid interpretation and assessment of monitoring data. (#100 Energy Supply Association of Australia)*
>
> *There is a need for improved air emission inventories across jurisdictions and consistency in the methodology used to produce them and in the substances included. This would enable the latest regional air quality models to be applied across all jurisdictions. (#103 CSIRO)*
>
> *[Accurate assessment of pollutant exposure requires] a substantial increase in the coverage of PM monitoring networks and improved, nationally consistent, expanded emissions inventories that provide better temporal and spatial resolution. (#108 CASANZ)*

Response

NEPC notes the issue raised with respect to improved emissions inventories and considers that this issue is beyond the scope of this variation. The issue raised remains relevant to ongoing national priority processes including the development of the National Clean Air Agreement.

Improved air emissions inventories are critical for airshed modelling, policy and regulatory management purposes and informing future standard setting. This will have funding implications.

Issue 13: Particle characterisation

Impact Statement position

The draft varied NEPM and Impact Statement did not propose any change to AAQ NEPM monitoring protocols in relation to particle characterisation or particle characterisation studies. The review of AAQ NEPM monitoring methods, monitoring locations and associated protocols are prioritised for consideration during Stage 2 of the AAQ NEPM review.

Particulate matter is a complex mixture of substances that are derived from a range of sources and processes. The contributions of these sources and processes, and hence the physical and chemical properties of PM, vary according to many factors, including location, season, time of day, and both local and regional weather conditions.

The biological effects of inhaled particles are determined by their physical and chemical properties, by the sites of deposition, and by their mechanisms of action. The potential of particles for causing health effects is directly linked to their size.

Studies have investigated the relationship between measures of specific PM components (e.g. black carbon, secondary organic aerosols, secondary inorganic aerosols) and health effects. These components are influenced or determined by their sources. In the future, the use of these metrics

may provide a better indication of exposure to particulate matter from particular sources, such as vehicle exhaust, and may improve the understanding of the associated health risks.

Submissions

A number of submissions highlighted the importance of particle composition and source apportionment in understanding potential health effects of particle exposure, and the need for this to be taken into account in setting standards.

> *…there is a complexity of sources of particulate matter ranging from sea spray through dust, biological materials, industrial processes such as mining, products of combustion and even volcanic eruptions. It is evident that the source and physical nature of particles must be a primary determinant of their potential to do harm... the chemical make-up [of particles] is significant, e.g. whether they contain evidently toxic materials such as polyaromatic hydrocarbons or toxic metals… also the actual size… by, amongst other things, determining the ease with which they can penetrate cells within the lungs… yet the [NEPM] treats all [particles] as being the same. (#31 Mark Curran)*
>
> *Bulk measures of PM_{10} and $PM_{2.5}$ fail to reflect the contribution of nucleation mode particles, and therefore underestimate the impact on those close to the source. Characterisation would allow clarification of the contribution from different local sources, from background, and the proportion of primary/nucleation mode particles. (#102 Port Adelaide Resident's Environment Protection Group)*
>
> *To effectively tackle the issue of PM reduction, the first step is an understanding of the amount of PM contributed by each source. These source contributions vary by locality and season. Although isolated projects have endeavoured to characterise these sources in several areas across Australia, the methods used and reporting are not uniform. (#54 Centre for Air quality and health Research and evaluation)*
>
> *Characterising chemical and physical properties of PM is critical for understanding the sources of primary and secondary PM, and potential emission reduction measures. This could be done via routine monitoring, or with comprehensive and accurate chemical transport models using detailed emissions inventories. (#103 CSIRO)*
>
> *An holistic approach is required to frame appropriate standards... need to understand the composition and toxicity of all airborne pollutants emitted from many and varied sources. (#82 Singleton Shire Healthy Environment Group)*
>
> *Such analyses would…facilitate comparison with particulates in mainly urban areas, where health effect studies are predominantly performed. These studies may be unrepresentative of health impacts in regional areas where many particulates (dust) are chemically inert. (#51 Alcoa of Australia)*
>
> *There is very limited information provided on the composition and key sources of particulates which are likely to vary by location and setting (e.g. urban vs rural; industrial vs bushland). In the absence of this information it is difficult to form plans to actively reduce airborne PM concentrations. There would be clear benefit in trying to better understand the sources and composition of PM in more areas beyond major capital cities… where the PM source could be more crustal and potentially less toxic in nature… may occur from natural sources as a result of factors such as increased land clearing and climate change… (#129 Name suppressed)*

Several submitters called for monitoring and/or regulation of particles, by their characteristics (e.g. size, mass, number, black carbon component). Comments on this issue are provided at Issue 8: Other PM metrics.

Response

NEPC notes the issue raised with respect to particle characterisation and considers that this issue is beyond the scope of this variation. The issue raised remains relevant to ongoing national priority processes including the development of the National Clean Air Agreement.

The evidence of a relationship between particle chemical compositions and their health effects is currently insufficient to conclude the relationship is causal.

There are practical difficulties in identifying the different components of PM in ambient measurements and allocating them to sources. It is difficult to know what fractions of secondary organic aerosol result from anthropogenic and natural sources. There is currently little information in Australia on PM_{10} composition, and relatively few studies of secondary PM in urban areas.

Particle characterisation is not readily understood or undertaken in Australia; however, it is critical to understanding the sources of particulate matter, potential emission reduction measures and informing future standard setting.

Issue 14: Other health impacts

Impact Statement position

The Impact Statement summarises the known effects of airborne PM. These include premature mortality; aggravation of cardiovascular and respiratory diseases; changes to lung tissue, structure and function; cancer; reproductive and developmental effects; and changes in nervous system function.

A growing body of evidence points toward the $PM_{2.5}$ fraction as being the most significant in relation to health outcomes. Studies also suggest a linear relationship between exposure to PM and health response, and a lack of evidence of a threshold for health effects.

The Impact Statement also notes other adverse impacts of PM, including on ecosystems, visibility, cultural heritage and climate.

Submissions

Several submissions highlighted additional information on health and associated effects in Australia that they believe should be noted or considered in the review of PM standards.

> *There is growing evidence that PM exposure during pregnancy is associated with adverse birth outcomes including birth weight, pre-term birth and still-birth. (#25 Assoc Prof Adrian Barnett)*
>
> *While the health effects of PM are largely focused on cardiovascular and respiratory disease, there is also evidence for increases in cancer risk, diabetes, adverse birth outcomes and possible neurological impairment. (#54 Centre for Air quality health Research and evaluation)*
>
> *…we are concerned that lung cancer is not given its due prominence in this [NEPC] process. The social and economic impact is significant and should be considered. In 2012, lung cancer was expected to be the leading cause of burden of disease due to cancer among men (57,300*

DALYs) and the second highest among women (43,400 DALYs)… the percentage of younger non-smokers affected by the disease is rising. Currently, an estimated 11,550 Australians have lung cancer. By 2020 this figure is set to rise by an additional 2,090 people. It is reasonable to expect this trajectory may alter according to Australia's air quality over that period… Population demographics and climate change are also likely to play an important role in future health impacts of air pollution and where possible, should be accounted for. (#75 Peter MacCallum Cancer Centre)

…harmful effects of wood smoke appear similar to those of environmental tobacco smoke, for which there is no known safe level of exposure… (#140 Lung Foundation Australia)

Outside air quality has an enormous effect on indoor air quality. Indoor air quality is associated or directly linked to health problems and shortening of lives. (#33 cleanairtas)

It is arguable that indoor air pollution has a larger impact on health than outdoor, though this is not considered in studies used to support the proposed NEPM changes. (#93 Australian Sustainable Business Group)

Mental health effects of living next to a known pollutant source. (#43 Merilyn Plant)

Loss of independence, dealing with pain, tying up valuable resources, loss of productivity, isolation, depression… especially in small communities which don't attract the same vigilance and concern as larger communities. (#85 Carol Cosentino)

Concerns were raised about health 'hot spots', where unusual rates of illness or disease thought to be associated with PM emissions have been reported.

Port Augusta has had South Australia's two coal power stations for many decades and traditionally higher than average rates of cancer and respiratory disease. (#45 Conservation Council of South Australia)

High prevalence of respiratory disease and cancer in a community in Queensland which sits between two coal mines that have problems with dust and spontaneous combustion fires, and a coal fired power station (which closed two years ago). (#133 Name suppressed)

Concern about relatively high lead, mercury and other heavy metals (from coal mines and power stations in the Hunter region) and links to autism and motor neurone disease. (#29 Ted Finnie)

Concern about health effects from excess truck traffic. Diesel exhaust is now classified as carcinogenic, and diesel particles act as chemical hitchhikers. Maribyrnong is a hot spot for hospital admissions for respiratory illness in children (2009-10). (#7 Maribyrnong Truck Action Group)

Chemical sensitivity (from nearby mine) leads to increased sensitivity to electromagnetic frequencies. (#43 Merilyn Plant)

A cluster of new and exacerbated illnesses for residents living in proximity to a terminal in Balmain since cruise ships started docking there. (#14 Prof Alan Rosen)

Impacts on wildlife and ecosystems were noted in some submissions.

Monitoring programs should be established downwind of coal mines and coal seam gas operations… to quantify impacts on wildlife and ecological systems as well as rural residents… (#15 Mackay Conservation Group)

One submission suggests the potential for beneficial health effects from exposure to an optimum concentration of PM.

…disagree that there is no safe limit for exposure. The hormesis principle, which has been studied in the US, suggests that exposure to a toxic substance at a fraction of its toxic dose can have beneficial health impacts... A hormesis based approach to standard setting can deliver an optimum exposure concentration level and therefore a lower cost outcome. (#93 Australian Sustainable Business Group)

Response

NEPC notes concerns about other health effects of air pollution.

The focus of concern is on the direct effects of particulate matter on human health; these effects account for the majority of costs associated with the impacts of air pollution.

The understanding of the health impacts of air pollution, and specifically of particulate matter, has been informed by a number of key reports, including:

- *Air Quality Guidelines* – global update 2005. Particulate matter, ozone, nitrogen dioxide and sulfur dioxide[16]
- *Integrated Science Assessment for Particulate Matter*[17]
- *Long term exposure to air pollution: effect on mortality*[18]
- *The mortality effects of long term exposure to particulate air pollution in the United Kingdom*[19]
- *Review of evidence on health aspects of air pollution* (REVIHAAP) project[20].

In addition to these and other references cited in the Impact Statement more recent published findings including from the Southern California Children's Health Study[21], European Study of Cohorts for Air Pollution Effects (ESCAPE)[22] and Nurse's Health Study Cohort[23] have been considered. Findings from these and other studies add greater weight of evidence to conclusions drawn from health effects reviews previously undertaken, specifically in relation to health effects associated with

[16] WHO Regional Office for Europe (2006), *Air quality guidelines – global update 2005*, WHO Regional Office for Europe, Copenhagen, Denmark.
[17] USEPA (2009), *Integrated Science Assessment for Particulate Matter*, EPA/600/R-08/139F, United States Environmental Protection Agency, Research Triangle Park, NC, USA, http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=216546.
[18] COMEAP (2009), *Long-term exposure to air pollution: effect on mortality*, report by the Committee on the Medical Effects of Air Pollutants, Department of Health, London, UK.
[19] COMEAP (2010), *The Mortality Effects of Long-Term Exposure to Particulate Air Pollution in the United Kingdom*, Committee on the Medical Effects of Air Pollutants, Department of Health, London, UK.
[20] WHO Regional Office for Europe (2013), *Review of evidence on health aspects of air pollution – REVIHAAP Project*, Technical Report, WHO Regional Office for Europe, Copenhagen, Denmark.
[21] https://healthstudy.usc.edu/index.php
[22] http://www.escapeproject.eu/
[23] Puett, RC, Hart, JE, Yanosky, JD, Spiegelman, D, Wang, M, Fisher, JA, Hong, B, Laden, F (2014), 'Particulate matter air pollution exposure, distance to road, and incident lung cancer in the Nurses' Health Study Cohort', *Environmental Health Perspectives*, vol. 122, pp. 926–932, http://dx.doi.org/10.1289/ehp.1307490.

chronic exposure to particulate matter. International literature relating to health effects of air pollution has been adequately considered.

The development of secondary air quality standards to protect wildlife and ecosystems are not proposed at this time. There is currently insufficient evidence about the impacts of air pollution on Australian wildlife and ecosystems.

As noted by the Impact Statement, the current weight of evidence suggests a linear relationship between exposure to particulate matter and health effects, and no evidence of a threshold for health effects.

Issue 15: NEPM objective

Impact Statement position

The overall goal or objective of the AAQ NEPM is to attain 'ambient air that allows for the adequate protection of human health and wellbeing'.

The draft varied NEPM and Impact Statement did not propose any change to the goal of the AAQ NEPM. The review of the goal of the NEPM is prioritised for consideration during Stage 2 of the AAQ NEPM review.

Submissions

A number of submitters called for a revision of the AAQ NEPM objective, indicating that it currently does not provide a basis for a strong regulatory framework.

> *The expression 'adequate' is open to interpretation and does not create a basis for a strong regulatory framework… The objective should be 'ambient air quality that protects human health and wellbeing'. (#2 Judith Leslie)*
>
> *…should be changed to 'minimise the risk from adverse health impacts from exposure to air pollution for all people wherever they may live' as proposed in the 2011 AAQ NEPM review. (#58 Environmental Justice Australia)*
>
> *…should be 'ambient air quality that protects human health and wellbeing to the greatest extent feasible'. (#15 Mackay Conservation Group)*

Response

NEPC notes the issue raised with respect to revising the AAQ NEPM objective and considers that this issue is beyond the scope of this variation. The issue raised remains relevant to ongoing national priority processes including work underway to review other aspects of the AAQ NEPM.

Issue 16: Application and use of the AAQ NEPM

Impact Statement position

The Impact Statement describes the ways the AAQ NEPM is used by jurisdictions in their policy and regulatory frameworks, outside the NEPM framework as currently prescribed.

Use of the AAQ NEPM

The AAQ NEPM provides a nationally consistent framework for the monitoring and reporting of ambient air quality against air quality standards and goals.

The standards and goals of the NEPM aim to guide policy formulation that allows for the adequate protection of health and wellbeing. Under the current AAQ NEPM, participating jurisdictions are required to undertake monitoring and publicly report compliance of air pollution and generate data that assists in formulating air quality policies.

AAQ NEPM standards are derived for application within the context of the AAQ NEPM (and protocols), at locations that are representative of background urban air quality. Under this general exposure approach the standards and goals are applicable to urban sites away from specific sources of pollution, such as busy roads and industrial smokestacks. The original intent of the AAQ NEPM was to avoid monitoring near localised point sources of pollution and at peak sites, as these would not represent general population exposure.

The AAQ NEPM does not prescribe sanctions for non-compliance with the air quality standards and the AAQ NEPM does not compel or direct air pollution control measures.

In relation to the use of the AAQ NEPM by jurisdictions, states and territories are responsible for managing air quality and air emissions in relation to certain types of sources (e.g. industrial facilities including landfills, quarries, power stations, coal mines, etc.). To fulfil these responsibilities, jurisdictions have policies, legislation or guidance which includes facility design goals, assessment criteria, licence conditions or other ways to protect local communities from the impacts of air pollution from industrial facilities.

Where this is the case, AAQ NEPM standards are often used by jurisdictions as criteria for air quality assessments. In this sense, the AAQ NEPM standards are used by jurisdictions for policy and regulatory purposes outside the context prescribed by the AAQ NEPM. AAQ NEPM standards are also sometimes applied by jurisdictions at other locations as part of environmental assessment, for example, at the boundary of an industrial facility.

The Impact Statement notes the situations of various jurisdictions, notably:

NSW

In NSW the statutory methods that are used for assessing air pollution from stationary sources are listed in the document *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*.

Air quality must be assessed in relation to criteria and averaging periods for specific pollutants, including PM_{10}, that are taken from several sources, including the AAQ NEPM and California EPA. There is no requirement to evaluate $PM_{2.5}$ in the NSW approved methods.

The modelling of industrial emissions is required for licensing applications. The approved methods document sets the AAQ NEPM standard for PM_{10} as an assessment criterion at the nearest sensitive receptor, but it is often applied at the boundary.

Victoria

The Victorian State Environment Protection Policy (SEPP) for Ambient Air Quality (SEPP (AAQ)) sets air quality objectives and goals for the state. The SEPP adopts the specifications of the AAQ NEPM, and also includes a separate objective for visibility-reducing particles.

Western Australia

In Western Australia proponents are required to conduct assessments of the air quality impacts of existing or proposed sources of air pollutants under Part IV, or in relation to works approvals and licences under Part V, of the *Environmental Protection Act 1986* (WA).

There is an expectation that the ambient air quality criteria (e.g. AAQ NEPM) will be achieved at all existing or likely future off-site sensitive receptors. For the purposes of air quality assessment, a 'sensitive receptor' means a location where people are likely to reside or congregate; this may include a dwelling, school, hospital, nursing home, child care facility or public recreation area or land zoned residential that is either developed or undeveloped. Locations of cultural or environmental significance, including 'environmentally sensitive areas' declared under the Act, may also be recognised as sensitive receptors and determined on a case-by-case basis.

In exceptional circumstances, the Department of Environment Regulation or the Department of Health may recommend an alternative ambient air quality guideline be applied in ambient air quality assessments that are not consistent with the AAQ NEPM.

Submissions

Responses indicate concern amongst industry stakeholders about the relationship between the AAQ NEPM and jurisdictional management of air pollution.

> *From an industry perspective, the AAQ NEPM is not separate from the State regulations. More often than not, the AAQ NEPM standards are directly used as State air quality standards and used as licence conditions. From this perspective the current AAQ NEPM is considered restrictive to industrial operations where the licence conditions do not result in reduced concentrations in major urban city airsheds. (#91 Rio Tinto)*

Considerable concern exists about the use of AAQ NEPM standards by jurisdictions outside the framework prescribed by the AAQ NEPM itself. A number of industry stakeholders consider that the AAQ NEPM standards should not be used by jurisdictions as policy or facility design goals, assessment criteria or licence conditions for the protection of local air quality.

Stakeholders also expressed concern about approaches employed by some jurisdictions.

> *The NEPM standards are designed to track exposure of significant urban population centres. In practice, jurisdictions apply NEPM standards as licence conditions for industry, beyond and regardless of the scope of the NEPM. Industry does not separate the NEPM from State regulations, and considers the NEPM restrictive to operations. (#91 Rio Tinto)*

> *Standards may be too restrictive if applied as conditions at or nearby boundaries of regional facilities. Such facilities should not be unreasonably inhibited from running at full capacity, provided actual point source emissions are acceptable. (#65 Australian Aluminium Council)*

> *AAQ NEPM goals… are often used by regulators as boundary compliance limits in existing environment licences or as planning assessment criteria for new or expanded facilities. This is not the correct use of ambient concentrations yet it occurs frequently… (#100 Energy Supply Association of Australia)*

> *Air quality standards are applied by State, Territory and Local Government regulators as compliance conditions for particulate control at individual quarry sites, cement works and concrete batch plants. Applying regional air quality standards in this manner goes beyond*

the policy intent of the AAQ NEPM framework and can result in excessive regulatory burden for our industry. (#106 Cement Concrete & Aggregates Australia)

Formulation of PM standards are not aimed at managing public exposure to point source emissions such as major industry and bulk handling facilities. This is not readily understood leading to public pressure for changes to PM standards being adopted in environmental licenses. (#107 Mid West Ports)

These standards are unsuitable to use as a performance or compliance measure for regional industry... Standards should be applied using a buffer zone drawn around an industrial activity for air quality assessment. The size of the zone and air quality standards applied within the zone should be based on a health risk assessment… not at the point source… This would enable standards to be tailored according to local conditions and potential risks arising from the relevant industrial activity. It would also enable any standards to reflect the different composition of particles in different areas if supported by further research on particle composition and health effects. (#50 Australian Paper Pty Ltd)

Standards should be clearly emphasised as ambient monitoring standards, not as boundary conditions. However, it is appropriate that consideration of changes to national standards be kept separate from consideration of how or if they are used as boundary conditions by jurisdictions, as this is beyond the scope and intent of the NEPM. (#108 CASANZ)

Industry stakeholders also expressed concern about the application of the AAQ NEPM standards, sometimes as licensing conditions, where industrial activities take place in regional areas with high natural background levels of PM.

In some regions outside of the major metropolitan centres, as well as in portions of the metropolitan air sheds, the natural PM component may often be greater than the anthropogenic and secondary components. This raises the prospect that in those regions the margin between peaks in natural levels and existing and proposed standards may be small, meaning anthropogenic contributions only need to be modest in order for a standard to be approached or breached… Application of stringent standards, or aggressive exposure reduction actions, needs to be tempered by these background considerations to avoid imposing an unreasonable compliance cost on industry. (#51 Alcoa of Australia)

Some facilities may be unable to avoid exceeding the standard solely because of background PM. (#65 Australian Aluminium Council)

Formulation of PM standards is not necessarily based on areas with elevated natural background levels… Exemption from standards or proportional increase in standards should be available for regional areas where background dust levels are known to be naturally elevated and for areas near significant point sources. [Dust] impacts in these areas should be managed through other legislative measures such as land use planning decisions. (#107 Mid West Ports)

Although standards and goals do not apply outside large metro areas, they appear to inform conditions imposed on licences in regional areas. (#50 Australian Paper Pty Ltd)

Flexibility is required in applying NEPM standards to regional areas, in regard to local environmental conditions. (#96 The Chamber of Minerals and Energy of Western Australia)

Some submitters suggested jurisdictions should adopt more health protective standards for industry emissions in rural and regional areas.

Standards for areas that were pristine prior to mining should be lower than those for an industry in a heavily populated and already polluted environment. These areas attract people with already impaired lung function and hence these individuals are at greater risk when mining commences. (#8 Dr Steve Robinson)

Standards… distinct from major urban city standards, e.g. similar to occupational requirements for underground mine workers so as to effectively safeguard neighbours of open cut mines. (#82 Singleton Shire Healthy Environment Group)

The idea of different standards for regional areas was also raised by some industry submitters.

It is important that information on particulate composition and the potential impacts associated with non-urban emissions of particulates are gathered and assessed such that more informed standards can be defined for non-urban areas (that may be different). (#129 – Name suppressed)

Submitters also expressed concern that AAQ NEPM standards are interpreted by jurisdictions as safe thresholds to pollute up to, particularly when applied in infrastructure and industrial project planning and assessment processes. The health evidence indicates that there is no established safe level of exposure for PM.

NEPM standards are repeatedly misused in project impact assessments, which undermines their value as a public health policy… where incremental impacts of a project are concluded to be within an acceptable range, no health problems are considered. (#25 Associate Professor Adrian Barnett)

Regulatory guidelines allow project proponents to manage up to the limit (of air pollution standards), even when evidence indicates there is no safe lower limit for PM. There is no incentive to reduce pollution in the urban air shed. (#64 Yarra Campaign for Action on Transport)

Current policy practices adopt a managing 'up to' the standards approach… the current 24-hour standard is being used as a licence by industry to pollute, rather than used as a regulatory tool to place downward pressure on particle pollution. (#73 Clean Air Queensland)

Many submitters called for guidance to be provided in or with the AAQ NEPM about its use by jurisdictions for assessment and licensing purposes.

The AAQ NEPM needs to make a clear statement that the standards apply to all outdoor air in Australia. If an air quality manager deems it appropriate to measure air quality near a road or industry, then such results should be directly reportable against the AAQ NEPM standards – there should be no ambiguity about this. (#131 Sean Walsh)

Clarification is needed as to the intent of the NEPM… clear guidance as to how the standards should be applied by the responsible jurisdictions. (#105 Cement Industry Federation)

Better influence the application of the standards through either an explanatory note or guidance section [in the NEPM], reinforcing the intent of the NEPM – being to target urban areas and not regional areas where background dust levels are naturally elevated and not for populations near significant point sources. (#91 Rio Tinto)

A simple 'plain English' explanatory document should be released to aid community understanding of the purpose of the NEPM and address issues around the potential misunderstanding or misuse of the standards. It should also explain air quality considerations

for regional and remote areas, accounting for differing and variable background PM concentrations….For circumstances outside the intent of the NEPM (e.g. small rural communities or development assessment processes), guidance should be non-prescriptive and provide for tailoring of standards in line with air shed and population characteristics. (#98 Minerals Council of Australia)

Clear but non-prescriptive guidance material should be developed to assist jurisdictions in correct application of the AAQ NEPM. (#96 The Chamber of Minerals and Energy of Western Australia)

…guidance should specify how assessments are to be made and compliance requirements met where multiple sources and sites contribute to fine background particle levels. (#56 Construction Materials Processors Association)

Submitters also wanted the AAQ NEPM to clarify that standards are not thresholds below which there are no health effects.

It should be made clear that the NEPM standards are not threshold below which there are no health effects, and that increases in air pollution levels that are below the standards are likely to damage health. (#25 Associate Professor Adrian Barnett)

…the Measure as published should contain a clear statement about appropriate and inappropriate uses of the contents of the measure and of the numerical standards contained in it. (#31 Mark Curran)

Response

NEPC supports development of guidance for evaluating the relevance of air quality standards for jurisdictions' regulatory policy and assessment purposes.

It is the aim of the AAQ NEPM to guide policy formulation that allows for the adequate protection of health and wellbeing. The AAQ NEPM requires jurisdictions to undertake monitoring, publicly report compliance against AAQ NEPM standards and generate data to assist jurisdictions to formulate air quality policies.

Decisions about the way in which the AAQ NEPM is implemented in each jurisdiction are made by jurisdictions individually. It is not the intention of the AAQ NEPM to prescribe the way jurisdictions assess or manage point source emissions.

The intent of the AAQ NEPM is to focus on general population exposure.

Jurisdictions should continue to manage emissions and air quality in their jurisdiction through their own legislation and guidance.

Guidance on application of the AAQ NEPM

Industry stakeholders expressed concern about the level of discretion jurisdictions have in selecting criteria, methodologies and processes for assessment purposes. Some stakeholders seek clear but non-prescriptive guidance to assist jurisdictions in correct application of the AAQ NEPM, other stakeholders seek to constrain the use of NEPM standards by jurisdictions as policy goals, assessment or licensing criteria. In this respect the aim of the AAQ NEPM is clear in its intention to guide ambient air quality policy formulation that allows for the adequate protection of health and wellbeing.

It is considered appropriate that NEPM itself keep the standards detached from how jurisdictions may wish to use them as assessment criteria or industrial boundary conditions by jurisdictions, as this is beyond the scope and intent of the NEPM. It is however reasonable that the intent of AAQ NEPM standards be articulated.

Importance of jurisdictional discretion

The development of principles for use in considering the applicability of appropriate air quality standards is supported.

Different approaches are adopted by jurisdictions to manage their specific air environments, and it is the primary responsibility of jurisdictions to adequately justify and communicate their management approaches.

It is not intended that guidance should impede or restrict jurisdictional management of their air environment. Principles of jurisdictional discretion are important in application of the AAQ NEPM, in managing the air environment, and in choosing fit for purpose policy approaches, assessment criteria and methodologies.

It is proposed that text explaining the application of the AAQ NEPM standards be included in the explanatory statement that accompanies the variation to the AAQ NEPM. The proposed text is as follows:

> *The National Environment Protection (Ambient Air Quality) Measure 1998 (AAQ NEPM) provides a national framework for ambient air quality management in Australia. Ambient or outdoor air quality is influenced by regulated and non-regulated human activities and factors such as the physical geography, climatic conditions and natural events.*
>
> *The AAQ NEPM requires participating jurisdictions to undertake nationally consistent monitoring and reporting activities that support the formulation of air quality management policies. AAQ NEPM monitoring protocols provide guidance to jurisdictions on monitoring population exposure to air pollution.*
>
> *AAQ NEPM standards are health based. The standards in the AAQ NEPM are not intended to be applied as an environmental standard by jurisdictional environmental regulators without consideration of regulatory impacts. Section 7 of the NEPC Acts allow jurisdictions to implement the AAQ NEPM by such laws and other arrangements as are necessary. The implementation of the AAQ NEPM does not preclude jurisdictions from adopting tighter or complementary standards or goals for their own policy or regulatory purposes. In doing this, jurisdictions may utilise a risk-based approach in determining environmental standards appropriate for their own circumstances or conditions, along with improvement strategies for regulated and non-regulated sources and exposure reduction strategies.*

Issue 17: Timing for making and implementing the AAQ NEPM

Impact Statement position

The Impact Statement proposed that the variation to the AAQ NEPM would be effected in mid-2015.

The proposals are not wide-ranging in scope and would involve changes to existing monitoring and reporting procedures. The implementation of the AAQ NEPM variation should be straightforward. Transitional arrangements are not envisaged.

Submissions

Community stakeholders ask for the AAQ NEPM variation to be made without delay, and compliance with the standards to be required from the date of implementation.

> *Given that the proposals have already been subject to a socio-economic analysis and that the process for reviewing the NEPM has been underway for many years…it is appropriate for compliance with the standards to be effective from the first reporting period following enactment of the regulation. (#32 Australian Network of Environmental Defender's Offices)*

> *A timeframe of 0-10 years for a jurisdiction to comply is too long in relation to how many people are suffering or dying and how much it is costing the community in dollar terms as a result of excessively delayed standards and continued poor air quality. (#33 cleanairtas)*

> *Not implementing measures that could save 500 lives per year means one or two additional unnecessary deaths for every day of delay in adopting the NEPM or equivalent legislation. (#120 Name suppressed)*

Some submitters demanded immediate adoption of the standards, but would accept achievement of the standards over time.

> *Regulators should do everything within their powers to ensure compliance from the commencement of the NEPM, and further achieve an annual $PM_{2.5}$ standard of 6µg/m^3 within 7-10 years… (#15 Mackay Conservation Group)*

Some industry submitters indicated a transition period is needed, particularly for the introduction of $PM_{2.5}$ standards, to allow for improvements in $PM_{2.5}$ monitoring and regional airshed characterisation.

> *There needs to be a transition period (e.g. 5 years) so industry can evaluate and contribute to an appropriate regulatory regime. (#56 Construction Materials Processors Association Inc)*

> *There needs to be a transitional period for the annual $PM_{2.5}$ standard to drive improvements in $PM_{2.5}$ monitoring and regional air shed characterisation, accounting for natural and secondary $PM_{2.5}$, and to quantify primary anthropogenic contributions. (#78 Centennial Coal)*

Other submitters commented that the compliance timeframes in the varied AAQ NEPM, as currently drafted, could be misleading.

> *…the proposed NEPM variation incorrectly includes PM_{10} in clause 6(b) with the option of having up to 10 years for compliance. PM_{10} standards have already had a 10 year lead in time and should not be subject to a further one. This appears to be a drafting error and should be fixed… (#58 Environmental Justice Australia)*

Response

Any agreed variation to the AAQ NEPM would become law in each participating jurisdiction once the appropriate legislative processes are completed.

Issue 18: Other pollutants

Impact Statement position

This proposed variation of the AAQ NEPM addresses particles only.

In 2012 the Council of Australian Governments (COAG) agreed that the review of the AAQ NEPM particle standards be prioritised for the following reasons:

- There is strong evidence that exposure to PM has adverse effects on human health, and a lack of evidence for a concentration threshold below which health effects do not occur. This means there are likely to be adverse health effects at concentrations currently experienced in Australian cities, even where these are below the current standards and goals.
- PM_{10} standards are exceeded in nearly all regions of Australia, although such exceedances can occur as a result of uncontrollable natural events.
- The potential health benefits of reducing population exposure to PM, and the associated monetary savings to society, are larger than those for other air pollutants.
- The range of cost-effective abatement policies and actions available for PM is larger than that for other pollutants.

Submissions

A number of submitters called for the variation to address other pollutants, including, sulfur dioxide (SO_2) which is a particular concern to communities impacted by emissions from coal-fired power stations.

> *…would like to see SO_2 standards in place immediately. (#13 Regina Gleeson)*
>
> *The 2011 NEPM review considered that SO_2 standards should be revised with consideration given to sensitive groups. The WHO and US EPA conclude there is no safe level of exposure to SO_2, particularly for sensitive groups. Failure to revise down SO_2 standards in the current NEPM variation will leave Australia's air quality standards significantly behind current world standards, and allow continued exposure of Australian communities to levels of SO_2 known to be associated with serious negative health outcomes, particularly for vulnerable groups… Revised SO_2 standards should also be included in the current variation of the AAQ NEPM, or a further variation dealing with SO_2 should be issued as soon as practicable. (#20 Doctors for the Environment Australia)*
>
> *…seek a review of the SO_2 standards, with consideration of point source emissions in smaller communities. (#27 Surf Coast Shire)*
>
> *…children in Anglesea live and play close to a dangerous source of contamination and air pollution which puts their developing brains, lungs and other vital organ systems at risk of both acute (immediate) and life long damage. This is a public health emergency that requires urgent and immediate attention and governmental intervention. SO_2 must be included in the current draft variation in order to protect the health of this vulnerable population. (#36 Surf Coast Air Action)*
>
> *The US standard for SO_2 of 75ppm should become a minimum compliance standard in Australia. (#52 Emma Fenty)*
>
> *It is negligent not to take into account the effects of pollution from coal fired power stations on human health… The US 1-hour standard of 75ppb should become a bare minimum compliance standard pending implementation of a tighter exposure reduction framework. (#86 Julie Dingle)*
>
> *There are no safe levels of SO_2 (as documented by WHO and USEPA). The toxic effects of this known respiratory irritant occur within seconds. The effects on the young and elderly are particularly pronounced, and asthmatics are another group at serious risk. Other nations*

have moved to tighten SO_2 restrictions recognising the significance of the health issues, with China most recently moving to ban high-sulfur content coal from their own power stations. Despite this, Australia continues to lag behind in this critical area of need, (#110 Assoc. Prof Cameron Shaw)

Response

NEPC notes the issue raised with respect to addressing other pollutants and considers that this issue is beyond the scope of this variation. The issue raised remains relevant to work underway to review other aspects of the AAQ NEPM including strengthening the standards for sulfur dioxide, nitrogen dioxide and ozone.

Issue 19: Public access to monitoring data and NEPM reporting

Impact Statement position

Jurisdictions must submit an annual report to NEPC on the implementation and effectiveness of the AAQ NEPM.

Clause 18 of the AAQ NEPM establishes the reporting requirements for annual performance reports. These include performance assessment at each monitoring station against the AAQ NEPM standards and goals, an analysis of the extent to which the standards are met, a statement of the progress made towards achieving the goal, and a description of the circumstances that led to any exceedances of the standards, including the influence of natural events and fire management.

The draft varied NEPM and Impact Statement did not propose any change to AAQ NEPM monitoring protocols relating to the evaluation and reporting of air quality data (Part 4). The review of AAQ NEPM Part 4 is prioritised for consideration during Stage 2 of the AAQ NEPM review.

Submissions

Submitters commented on the importance of monitoring and reporting of air quality data.

> *Monitoring and reporting of $PM_{2.5}$ and PM_{10} should provide a sound basis and impetus for allocating resources to ameliorate the hazard to public health… I see it as very important that the NEPM reporting guidelines… provide the Australian public with extensive, useful information about trends and conditions leading to exceedances, and the statistical spread of concentrations at each performance monitoring station. In a sense, compliance with a standard is less important than understanding and responding to the broader information that monitoring provides… given that pollutants can have adverse health effects even at global background levels. (#80 Graeme Lorimer)*

Many community submitters wanted greater access to air quality monitoring data, and for this data to be reported on a more consistent basis nationally, and in ways that are easily understood by the public.

> *Community access to data is often the main driver to reduce pollution, The NEPM should require state regulators to ensure easy and timely (real-time) web-access to standardised monitoring data. It is otherwise difficult, expensive or impossible to access in many parts of Australia. (#140 Lung Foundation Australia)*

> *The full potential of the NEPM goals cannot be achieved if the monitoring system is inadequate to inform residents who are most impacted and vulnerable. (#89 Community Over Mining – Toongabbie Township Development)*

The NEPM should require state regulators to ensure easy and timely access to monitoring data, including data from both EPA and industry monitoring. The simplest arrangement would be the creation of one website where community members could access monitoring data from all states and regions in a standardised format. (#3 Fee Mozeley)

… the NSW EPA air quality monitoring website is an excellent model for this. (#63 Repower Port Augusta)

More open data, published in real time… the Morwell fire enquiry shows significant lethal weaknesses in the current framework for managing air pollution. (#64 Yarra Campaign for Action on Transport)

… access to ambient air monitoring data, monitoring plans, annual reports from State EPAs and industry on a coordinated national webpage… More trend data charts could be included in state AAQ NEPM reports and pollutant levels just below exceedance levels should be reported… (#74 Warren Godson)

…Upgrade existing health exposure warning… To help interpret the [air quality data] the Victorian (and the NSW) EPA has categorised and colour-coded the results into five categories from 'very good' to 'very poor'. However, these categories still do not have enough meaning, particularly when people want to know if they should change their behaviour in order to reduce their risk of exposure. …the estimated health impacts could be added. For example, the category of 'fair' for particulate matter ($PM_{2.5}$) could be augmented with the information of an expected extra two - five hospital admissions per 100,000 people exposed per week, whilst for 'very poor' the numbers would be 10 or more admissions. …also recommend that these risk factors be contextualised by an accompanying health advice. For example, if air pollution people with respiratory conditions like asthma should consider staying indoors, refrain from exercising etc. (#59 Asthma Foundation NSW)

Some industry submitters also supported more consistency in national reporting.

… should be investigated and could be part of a future NEPM. (#101 Australian Institute of Petroleum)

Community submitters called for immediate reporting of exceedances of the air quality standards, for example, by high alert text messages.

States should immediately report any exceedance to NEPC or the public. (#74 Warren Godson)

We don't actually know how good or bad rural air quality might be, because of a lack of monitoring. If alerts can be sent for bushfires, why not for mine fires, fuel reduction or too many wood heaters? (#115 Jo McCubbin)

Submitters also argued for the raising of public awareness of the health implications of air quality.

Communities, services and local governments need a greater understanding of the health effects of particulate pollution. A heightened awareness will advance preventative strategies including appropriate actions to reduce exposure and limit health effects (e.g. during acute biomass smoke events). It is important for the public, particularly the more vulnerable members, to understand where to access information about current pollution levels and the associated levels of risk. Greater efforts need to be made to communicate to the public and the relevant service sectors about the health impacts of air pollutants. Heightened

community awareness is likely to support greater compliance and action by policy makers and industry to perform thorough health risk assessments and improve mitigation measures. (#75 Peter MacCallum Cancer Centre)

Response

NEPC notes the issues raised with respect to greater access to monitoring data and considers that this issue is beyond the scope of this variation. Views raised during this process will inform consideration of knowledge sharing options through other approaches. NEPC notes that strengthening knowledge to inform air quality management is a key area of focus in the development of the National Clean Air Agreement.

Issue 20: Role of government in air quality management

Impact Statement position

Government intervention is considered necessary to prompt and accelerate policies and measures to reduce population exposure to particulate pollution.

Submissions

Many submitters affirmed the need for government involvement in air quality management in Australia, though some believed governments were slow to act.

Governments represent the people who need a strong voice on air pollution. Governments can and should provide that balance between economics and a decent environment to live in. (#118 Prof David Cohen)

Given the projected increase in PM_{10} and $PM_{2.5}$ emissions from 2011 to 2036, government intervention is necessary to ensure that the health of the Australian population is maintained and improved. (#32 Australian Network of Environmental Defender's Offices)

If the true costs of adverse health outcomes directly attributable to particulate pollution are balanced against the actual costs of air quality management it becomes obvious that it is economically irresponsible not to act aggressively to reduce and otherwise control emissions. (#117 Mark Curran)

Australians living in a region with high PM levels are unable to escape that pollution and associated risks without moving to a different location. This fact, plus the absence of a safe threshold level for exposure to PM, are powerful reasons for government regulation of PM. (#140 Lung Foundation Australia)

General agreement that government has a role, but it is perceived to take too long to implement actions. Pollution standards are frequently exceeded in some regions but regulators are slow to enforce or prosecute. (#115 Jo McCubbin; #116 Lisa Dowall)

A number of submitters identified specific areas and emission sources with high pollution levels to demonstrate the need for direct government action.

… in coal mining areas where emissions have increased more than 180% over the last decade and exceed current standards. (#2 Judith Leslie; #3 Fee Mozeley)

…areas with high (diesel) truck movements and near unfiltered tunnel ventilation stacks. (#7 Maribyrnong Truck Action Group; #18 Magda Koufariotis; #23 John Anderson; #26 Ian Tanner)

Low income and minority communities are disproportionately impacted. The Yarraville monitoring site already records higher air pollution levels than any other monitoring site in metropolitan Melbourne. Expansion of Port Melbourne and the associated increase in freight traffic require the adoption of more stringent standards and improved monitoring protocols. (#61 Maribyrnong City Council)

…near power stations (#13 Regina Gleeson; #27 Surf Coast Shire)

… near cement works and quarries (#102 Port Adelaide Resident's Environment Protection Group)

At White Bay, Sydney, ships are in port intermittently for 24-hour periods, more frequently during summer, burning high sulphur diesel fuel while in berth due to a lack of shore power… in proximity to residential areas and schools… (#130 Name suppressed)

Response

NEPC notes the issues raised with respect to the role of government in air quality management. The issues raised are relevant to ongoing national priority processes including the development of the National Clean Air Agreement as well as jurisdictional initiatives.

Issue 21: National clean air legislation and national leadership

Impact Statement position

The AAQ NEPM allows for a nationally consistent framework for the setting and implementation of air quality standards and goals, and for the monitoring and reporting of air quality against those standards and goals.

The AAQ NEPM has overcome conflicts or inconsistencies between individual state and territory-based regulations and has resulted in development of policies and initiatives to improve air quality.

Submissions

Many submitters called for national clean air legislation to replace the AAQ NEPM framework, together with better-resourced national institutional arrangements to implement air quality interventions.

The AAQ NEPM is not enforceable, even if it includes standards and goals that correctly reflect current scientific thinking on health effects of air pollution, the NEPM is not a strong mechanism for ensuring the Australian population is protected from health impacts. (#20 Doctors for the Environment Australia)

Current standards are inadequate and have no meaningful role in protecting community health. A National Air Pollution Prevention Act is needed that is binding on all states and territories and oversighted by a national air pollution regulator. (#28 Hunter Communities Network)

Currently, the legal status of standards is uncertain due to the way relevant instruments are drafted (e.g. policy documents). Standards are therefore largely unenforceable. Their intersection with state and territory planning regimes is also very uncertain. Specific tailored

legislation would overcome the problems of clarity and consistency in application and enforcement… (#32 Australian Network of Environmental Defender's Offices)

Australia's current system of policies and laws to prevent and control air pollution, including the AAQ NEPM, are failing. The national air pollution standards adopted in 1998 are breached regularly, particularly in coal-affected communities. States currently do not take adequate steps to ensure standards will be met through their laws, policies and licencing arrangements… a stronger set of national policies and laws are required to protect community health. Commonwealth leadership to develop national air pollution prevention laws is needed as a priority. (#46 Hunter Environment Lobby)

The existing cooperative approach of using NEPMs to develop national air pollution standards is clearly no longer working or adequate… NEPC must move away from this outdated mode of thinking and reconsider what is possible and in the interest of Australian communities… Numerous benefits would flow to both Commonwealth and State Governments if effective national laws were in place, not least the billions of dollars saved in health costs… (#58 Environmental Justice Australia)

While the Australian Constitution does not contain an explicit head of power for air quality, there is no doubt that the Commonwealth has sufficient constitutional powers via its other heads of power to substantially regulate the sources of air pollution and improve ambient air quality… National laws would provide a broad framework for binding national standards and actions. National laws would include the recognition of concurrently operating state and territory laws that would continue to play an important part in regulating and improving ambient air quality. In most instances States and Territories would continue to have responsibility for licencing, data collection and enforcement. There would be no duplications of systems at the State and Territory level. (#58 Environmental Justice Australia)

Robust, well-resourced institutional arrangements capable of decisive policy intervention are needed. (#28 Hunter Communities Network)

National coordination or National Clean Air Legislation is needed to implement pollution strategies… Policies [listed in the Impact Statement and NSW wood smoke measures] would achieve greatest benefits from Australia-wide implementation. The ideal vehicle would be via National Clean Air Legislation, which could be recommended as part of the NEPM variation…The NEPM should not just set standards, but also ensure they are achieved. (#47 New England Greens)

Response

NEPC notes the issue raised with respect to national legislation and leadership and considers that this issue is beyond the scope of this variation. The development of the National Clean Air Agreement seeks to provide the framework for national coordination of priority air quality issues.

Issue 22: Penalties for non-compliance with standards

Impact Statement position

There are no sanctions or penalties associated with not meeting AAQ NEPM standards. Accountability for meeting the AAQ NEPM standards lies in public reporting.

The NEPM does not prescribe emission controls or emission reduction activities.

The Impact Statement and draft varied NEPM do not propose changes to the AAQ NEPM in this regard.

Submissions

A range of submitters would like to see enforcement of the AAQ NEPM involve penalties for non-compliance with the air quality standards.

> *Introducing a compliance standard for $PM_{2.5}$ without any accountability or penalty significantly weakens the intent of the standards and objectives. Penalties should be introduced so that standards will be more vigorously pursued by the States. (#61 Maribyrnong City Council)*
>
> *It is a weakness of the current system that there are no consequences for state regulatory agencies that fail to meet air quality standards. There is risk that state agencies fall under the influence of large industrial emitters and lose sight of the public interest. (#20 Doctors for the Environment Australia)*
>
> *Existing mechanisms for enforcement should be strengthened – improvements to monitoring and reporting, penalties imposed for breach of pollution laws… should these measures fail to effectively implement relevant standards, more comprehensive legislative action may be required. (#32 Australian Network of Environmental Defender's Offices)*
>
> *Consideration should be given to developing an approach that provides sanctions for non-compliance. (#108 CASANZ)*
>
> *Introduce incentives for States/Territories to meet new standards... as evidenced, for example, in the US where funding is linked to compliance… (#54 Centre for Air quality and health Research and evaluation)*
>
> *Although not part of this review, consideration should be given to enact enforceable standards and appropriate sanctions and penalties for non-compliance by the States. It is suggested that NEPC commission a background discussion paper that would provide the background for this to be considered. (#74 Warren Godson)*
>
> *The NEPM framework requires a way of penalising air quality managers for failure to achieve compliance… this is the single biggest weakness of the AAQ NEPM… (#131 Sean Walsh)*

On a similar theme of accountability, some submitters suggested the introduction of polluter-pays taxes.

> *Polluters should be required to pay the estimated health costs of their pollution. This would discourage polluting activities and provide funds to monitor air pollution, evaluate and implement pollution reduction strategies and assist people whose health is affected. (#15 Prof Alan Rosen, #132 Name suppressed, #130 Lung Foundation Australia, #141 Dr Dorothy Robinson)*

Response

NEPC notes comments about compliance issues.

Polluter-pays taxes, and penalties or sanctions related to non-attainment of standards are not part of the AAQ NEPM framework. Consideration of penalties, sanctions and polluter-pays taxes are outside the scope of the AAQ NEPM review.

Issue 23: Economic analysis

Impact Statement position

The Economic Analysis examined the costs and benefits of introducing a package of potentially feasible national abatement measures over the 25-year period relative to a business as usual scenario. The Analysis takes into account jurisdictions' projected growth in economic activity, population density and emissions, as well as costs of reducing air pollution.

The Economic Analysis assessed the likely achievability of air quality standard options given the trends in emissions and the implementation of the abatement measures. Two portfolios of national abatement measures were considered:

- a portfolio containing all abatement measures which could be applied in combination to give the largest possible emission reduction (termed 'all feasible measures')
- a portfolio that gave the largest possible emission reduction, but only including measures where total benefits of implementing the measure outweighed the costs (termed 'all economic measures').

The health impacts of particle emissions were estimated using the unit damage costs ($ per tonne of primary $PM_{2.5}$ emitted at 2011 prices) developed for Australia[24] and adjusted for population density. The unit damage costs are proportional to population and relate to specific geographical areas of Australia based on the Australian Bureau of Statistics data for populations with more than 10,000 people. This links the location of emissions to an approximate population-weighted exposure.

Submissions

Some submitters commented that the economic benefits were understated due to a range of factors including the omission of potential emission reduction measures and the use of deliberately conservative assumptions.

> *Economic benefits are understated by a large margin including by assuming a constant value for secondary particles, non-inclusion of all feasible measures, and ignoring co-benefits of associated emission reductions in other pollutants from measures taken to reduce PM… also conservatism in some of the assumptions explored in the sensitivity analysis… thus the proposed standards are insufficiently ambitious. (#108 CASANZ)*
>
> *The health and monetary impacts of wood burning smoke from heaters and burning off in fire risk areas was not considered in the economic analysis, e.g. lifestyle, tourism, etc… The economic analysis was deliberately conservative. Benefits of reducing PM emissions are likely to be higher than estimated as it omitted $15 billion of health benefits from wood smoke reduction. (#132 Name suppressed)*
>
> *The NSW Government economic analysis of wood smoke control options estimated the health costs of wood smoke in NSW were over $8 billion. Interventions were listed which could reduce these costs by 75%. When these proposed measures are considered for all of Australia, an additional $15 billion per year could be saved by reducing wood smoke in our communities. (#140 Lung Foundation Australia)*

[24] Aust, N, Watkiss, P, Boulter, P and Bawden, K (2013), *Methodology for Valuing the Health Impacts of Changes in Particle Emissions*, www.environment.gov.au/system/files/pages/dfe7ed5d-1eaf-4ff2-bfe7-dbb7ebaf21a9/files/methodology-valuing-health-impacts-changes-particle-emissions.pdf.

A number of submitters raised concerns that the Impact Statement provided no certainty as to which emission reduction measures would be implemented to achieve the proposed particle standards, and that impacts on individual industries or facilities were not addressed. Some also had reservations about estimated costs and challenged the conservatism of assumptions used in the analysis.

> *The Economic Analysis is an overarching assessment based on urban population considerations. The results do not relate to regional locations where a significant proportion of major industry exists or to individual facilities. Misapplying the standard to industrial facilities imposes real and significant costs that can limit operations. (#91 Rio Tinto)*
>
> *Industry bears a disproportionate share of direct costs associated with achieving the standards. These are not assessed in the economic analysis. (#93 Australian Sustainable Business Group)*
>
> *Extractive industries (quarries) are concerned whether reduced standards can realistically be achieved, even with best practices measures to control dust. Impacts on industry have not been assessed. (#56 Construction Materials Processors Association Inc)*
>
> *The Impact Statement proposes specific levels for PM standards but there is no certainty about the process and regulatory criteria for determining which suite of measures would be implemented by jurisdictions to achieve the standards (beyond wood heater and off-road diesel engine measures). Practical application of the achievability of the standards has not been defined, which calls into question whether the proposals and modelled policy measures are achievable in an economically viable manner for individual industrial facilities… The concern is that impacts on industry could be broader than impacts on licence conditions, including a potential suite of policy measures which have not been assessed by the impact statement (e.g. introduction of marine bunker fuel sulfur standards well in advance of international standards). Further understanding of costs of abatement measures is needed, and conditions that ensure business certainty such as prohibition of retrospectively applying new or lower limits to existing facilities. (#101 Australian Institute of Petroleum)*
>
> *The proposed introduction of an annual PM10 standard does not appear to be justified… and consideration of its achievability is primarily focused on Australian cities, dominated by NSW and Victorian related information… [rather than] non-urban areas where the particulate exposure regime and resultant health impacts could be very different,.. The economic analysis appears to present an estimation of the dollar benefit of meeting a reduced standard but hasn't appeared to address the costs of how such reductions could be achieved and who would pay those costs. While the net benefits have been calculated, it is not clear how these benefits are proposed to be realised and who would pay… (#129 Name suppressed)*

Response

NEPC notes comments on the Economic Analysis.

The Economic Analysis assessed the likely achievability of air quality standard options given the trends in emissions and the implementation of the abatement measures. An ambient standard is deemed achievable if all states and territories can meet the overall emission reductions required. This means on average all states and territories would be in attainment; however, achieving emission reduction required to meet some specific particle standards could be more difficult in some specific regions within a state or territory.

Abatement options in the cost–benefit analysis focused on significant sources of particle emissions (with reference to existing emissions inventories) that are not currently regulated or managed and could potentially benefit from a national approach. Direct and indirect costs and benefits to industry, government and community were assessed. More detailed analysis and consultation would be required for further development and consideration of any individual measures. Some measures in the Economic Analysis and Impact Statement are currently being assessed through national and/or state assessment processes.

The Economic Analysis was framed by the monitoring and compliance protocols prescribed by the NEPM itself, and took a national approach. It was assumed that individual jurisdictions would undertake detailed cost–benefit analyses if they chose to adopt specific measures at the state or regional level. The economic assessment did not include analysis of jurisdictional regulations, as this was beyond the scope of the assessment.

In relation to the assessment of wood heater options:

- All notional wood heater emission reduction measures cannot be implemented simultaneously as a number of these measures are mutually exclusive.
- The costs and benefits of a phase-out of wood heaters (as opposed to an emission standard) was considered in the Economic Analysis for completeness. This measure has a net present value benefit of around $10.5B and would require wood heaters to be removed or rendered inoperable on the sale of a house.
- A complete wood heater phase-out appears to be superior to other wood heater measures with respect to both emission reductions and costs; however, it was considered much less practical as it required very significant changes to heating systems Australia-wide. It was not included as part of the core analysis of measures.

Issue 24: Specific emission sources

Impact Statement position

The Impact Statement considered jurisdictions' emissions inventories. The Impact Statement and draft variation of the AAQ NEPM do not propose amendments to the NEPM based on specific emission sources.

Submissions

A number of comments relating to specific emission sources were included in submissions. These include shipping, wood heaters, roads, power stations and smelters.

Shipping emissions

> *Ship, fuel and other standards for emissions associated with shipping, including air pollutants, noise and vibrations, should be aligned with WHO and other international/Northern Hemisphere standards. Current Australian standards allow sub-standard and poorly equipped ships into our harbours (e.g. sulfur concentrations in shipping fuel are 35 times higher than WHO allowable limits and safety standards operating in North America and Europe). Sanctions should be applied to non-conforming ships to act as a commercial deterrent. (#14 Prof Alan Rosen)*
>
> *The impacts of cruise ship operations on our health, productivity and wellbeing is significant and costly… regulations and controls are currently inadequate to protect human health... The fuels being used are amongst the worst in the developed world… (#88 Confidential)*

Support the use of low sulfur fuel by ships in berth. Regulations requiring low sulfur fuel, the use of shore power and distance from residential areas would have an immediate impact on the health of the community through reduced exposure to PM. (#130 Name suppressed)

The potential impact of emissions from ships transiting and anchoring beyond port boundaries also should not be ignored. May require analysis of coastal atmospheric dispersion. (#4 Dr Laurie Goldsworthy)

Wood smoke and wood heaters

Many submissions commented on wood smoke issues and called for stricter controls in residential areas, both urban and regional.

There is strong evidence to support that exposure to $PM_{2.5}$ particle matter has adverse effects on human health and wood heater emissions are recognised medically as a health hazard... Wood smoke lingers in the air from previous evenings and can penetrate into even the best sealed home. Trapped particulates, temperature inversions and air drainage restrictions mean wood smoke can pollute the neighbourhood for days or weeks, even when wood heaters are not in use… Wood smoke is as bad if not worse than cigarette smoke. It was not so long ago that the general population was equally ignorant of the hazards of cigarette smoke, which has since been dealt with through education and legislation… Council appears to lack any clear procedures as well as the necessary time and funding to deal with the serious health effects and concerns of residential wood heater emissions. (#30 Confidential)

Domestic wood-heaters also contribute to secondary particle formation in both Melbourne and Sydney, so tackling wood-heater pollution is likely to produce even greater reductions in $PM_{2.5}$ (#47 New England Greens)

Roads

There is significant potential to reduce PM and other emissions from measures such as bio- and alternative fuels, vehicle GHG emission standards, non-road diesel vehicle standards, state diesel emission reduction programmes (e.g. retrofit, clean machines), regulation of non-road petrol equipment and on-board refuelling vapour recovery. (#97 Caltex)

Federal and State governments should be formulating policy that will lead to a reduction in heavy vehicles that have no engine exhaust emission standards/ regulation (i.e. pre-1995 trucks). This would lead to a significant reduction of the PM emitted by heavy vehicles, particularly in urban environments. (#55 Truck Industry Council)

Consideration should be given to the development and implementation of National emission standards for non-road diesel engines and equipment in alignment with US and EU emissions standards. Additionally, consideration should be given to development, implementation and enforcement of exposure standards, particularly in occupations and industries with an elevated potential for heavy exposure. Such standards have been in place for a number of years in US, Canada, and Europe. (#75 Peter MacCallum Cancer Centre)

Road dust is an important issue is some places, especially from unsealed roads and even on sealed roads during periods of dry weather. Greater action needs to be taken on this issue. (#131 Sean Walsh)

Other measures

> *Exposure reduction action plans for coal affected regions, including buffer zones to protect populated areas from large point-source emitters, a process for assessing cumulative impacts of coal mine developments that take account of other mines in the region and their impact on resident health, health impact assessments as part of the assessment process for new developments, provision of monitoring and real-time air quality data as a condition of environmental approvals and requirements of industry to implement covers on all coal wagon fleets. (#41 Lock The Gate Alliance)*

Response

NEPC notes comments on these issues.

The AAQ NEPM does not compel or direct pollution control measures. It is not proposed that the AAQ NEPM should prescribe or regulate pollution control measures.

Some of the emission sources of concern to submitters are under direct regulatory control of states and territories. Many issues raised by submitters are being addressed by individual jurisdictions, or in the context of national measures via the National Clean Air Agreement. Some proposed measures are being assessed through national and/or state assessment processes.

Issue 25: Frequency of AAQ NEPM reviews

The Impact Statement and draft variation of the AAQ NEPM did not propose changes to the review period of the AAQ NEPM.

Submissions

A number of submitters indicated that the AAQ NEPM should be reviewed on a more frequent basis than has occurred in the past.

> *The NEPM should be reviewed every 3-5 years, not every 10 years as is currently the case, to take account of new research findings. (#59 Asthma Foundation NSW; #141 Dr Dorothy Robinson)*

> *Every five years to better understand how it is adopted and applied. (#100 Energy Supply Association of Australia)*

> *A process for mid-term review of progress towards achievement of the standards should be specified. (#108 CASANZ)*

> *Standards introduced after this current consultation should be reviewed in 5 years to reassess their impact and associated health and economic outcomes. (#140 Lung Foundation Australia)*

Response

NEPC notes comments on this issue. It is recommended that a review period be considered in Stage 2 of the AAQ NEPM review.

The AAQ NEPM itself does not prescribe a review period; however, NEPMs generally do prescribe a fixed review period of between five and 10 years after the measure was last amended, or within any lesser period determined by the Council.

Reviews are generally required to consider:

- the effectiveness of the Measure in achieving the desired environmental outcome;
- the resources available for implementing the Measure, and
- the need, if any, for amending the Measure.

Considerable work is involved in the review of the AAQ NEPM including literature and policy review, health risk assessment and economic analysis.

The review of the AAQ NEPM was initiated within 10 years, and a series of background and technical documents were released prior to a decision in 2012 to formally initiate a review of the AAQ NEPM particle standards.

Consistent with other NEPMs, it is recommended that a review period clause be considered for included in the AAQ NEPM. It is recommended that Stage 2 of the AAQ NEPM review propose a review period of between five and 10 years, and undertake public consultation on this matter.

Issue 26: Community involvement in standard setting

The Impact Statement and draft variation of the AAQ NEPM do not propose changes to community involvement in standard setting.

Submissions

Many community submitters called for greater community involvement in the standard setting process.

> *Community members and groups have been locked out of the policy process for developing, implementing and reviewing air pollution standards. Industry groups have been much more actively engaged than non-government groups and individuals… (#44 Sarah Joyce)*
>
> *A protocol for community involvement in air pollution standard setting should be negotiated along the lines of the protocol that guided community involvement in the initial development of the NEPMs for Ambient Air and the National Pollutant Inventory, and adopted to ensure the interests of industry groups are balanced with the interests of non-government groups and individuals. (#2 Judith Leslie; #3 Fee Mozeley; #15 Mackay Conservation Group; #58 Environmental Justice Australia)*

Response

NEPC notes comments on this issue.

The NEPC Act includes provision for public consultation [c.18] when NEPMs are made or varied, and a requirement [c.19] that in making a NEPM, the Council is to have regard to any submissions it receives that relate to the Measure or to the Impact Statement.

A total of 142 written submissions were received responding to issues raised in the draft varied measure and Impact Statement. Approximately 50% of submissions were made by community groups or individuals.

The current provisions for public consultation when NEPMs are made or varied are considered to be adequate and no change to the measure or NEPC Act on this matter is proposed.

Appendix A – Summary of Impact Statement issues

Chapter 2: Characteristics and measurement of airborne PM

- The characteristics of airborne PM are described in some detail. Would any further information on airborne PM characteristics assist in informing action to reduce airborne PM? If so, please provide details.
- Please provide any additional Australia-specific aspects of PM measurement that you believe are important to the actions to reduce airborne PM being considered in this Impact Statement.

Chapter 3: Health effects and monetary costs of airborne PM

- Is there any additional Australia-specific information on the health effects or monetary costs of PM that should be included? If so, please provide details.

Chapter 4: Policy context and legislation

- Have all aspects of the current air quality management framework in Australia been adequately described? If not, please provide further details.
- Have any significant regulatory developments, local or international, been overlooked? Please provide information.
- What are your views on the feasibility of an exposure-reduction framework for PM in Australia?

Chapter 5: Airborne PM in Australia

- Do you think that any additional information on emissions and ambient PM concentrations in Australia is required to inform the actions being considered for reducing airborne PM?
- Are there other issues that have not been considered or have not been attributed sufficient weight in the discussion?

Chapter 6: The problem and the case for government intervention

- Do you agree that further government involvement is required to address the potential future health impacts and costs of airborne PM?

Chapter 7: Statement of options

- Do you agree that the AAQ NEPM framework should be part of a suite of management actions to address ambient air quality in Australia? If not, please provide a rationale for any alternative.
- Have any options for the metrics, averaging times, and values of the standards been overlooked?
- Do you agree that the metrics and values of PM standards selected for analysis are appropriate for Australia?
- Do you consider the options outlined for the form of the standards to be feasible for Australia? Have any options been overlooked?
- Is there any other information relating to the options for an exposure-reduction framework that should be considered?

Chapter 8 Impact analysis

- Have all health, environmental, economic and social impacts of PM in Australia been identified? If not, please provide reasons and suggestions for additional analyses.
- Have all affected parties been correctly identified? Have the impacts on each of these parties been accurately characterised?

- Have all key assumptions been correctly identified and included in the analysis? If not, please provide details.

Chapter 9: Preferred options

- Do you agree with the introduction of an annual PM_{10} standard, given the apparent adverse health effects of coarse particles and their prevalence in some regions?
- Do you support upgrading the current AAQ NEPM advisory reporting standards for $PM_{2.5}$ to compliance standards?
- Do you support the preferred numerical values for new/revised 24-hour and annual $PM_{2.5}$ and PM_{10} standards? Which value for the 24-hour PM_{10} standard do you consider to be the most appropriate, and why?
- What is your preferred option for the form of the 24-hour PM_{10} and $PM_{2.5}$ standards? Should the options be trialled?
- Do you have any comments regarding the possible inclusion of PM metrics, other than PM_{10} and $PM_{2.5}$, in the future?
- Do you agree with the preferred form of the exposure-reduction framework under which an exposure index based on monitoring would be used to track population exposure for major urban areas?

Appendix B – List of consultation meetings held

New South Wales

14 August 2014	Industry (Sydney)
21 August 2014	Community, Local Government (Newcastle)
22 August 2014	Community, Industry, Local Government, Academic/Research (Sydney)
3 September 2014	Industry (Sydney)
4 September 2014	Industry (Sydney)
5 September 2014	State Government (Sydney)
12 September 2014	State Government (Sydney)
19 September 2014	State Government (Sydney)
24 September 2014	Industry (Singleton)
21 October 2014	State Government (Sydney)

Queensland

26 August 2014	Industry (teleconference)
9 September 2014	Industry (Brisbane)
9 September 2014	Community, Industry, State Government (Brisbane)

South Australia

16 September 2014	Industry, Academic/Research, State Government (Adelaide)
17 September 2014	Community, Industry, Academic/Research, Local/State Govt (Adelaide)
8 October 2014	Community (teleconference)

Victoria

10 September 2014	Community, Industry, Academic/Research, State Government (Melbourne)
11 September 2014	Community, Industry, Local Government (Morwell)

Western Australia

18 September 2014	Industry (Perth)
18 September 2014	Community (Perth)
19 September 2014	Industry (Perth)
19 September 2014	State Government (Perth)

National

2 August	Community (Melbourne)
21 August 2014	Industry (teleconference)
15 September 2014	Industry (teleconference)

Appendix C – List of submitters

Number	***Submitter***
1	William Thomson
2	Judith Leslie
3	Fee Mozeley
4	Dr Laurie Goldsworthy
5	Dominic Wild
6	Jayney Carter
7	Maribyrnong Truck Action Group
8	Dr Steve Robinson
9	Vic Steblin
10	The 3068 Neighbourhood Group
11	Tom Livanos
12	Andrew Laird
13	Regina Gleeson
14	Prof Alan Rosen
15	Mackay Conservation Group
16	Prof Kevin Parton
17	Carmen Largaiolli
18	Magda Koufariotis
19	Denice Campbell
20	Doctors for the Environment Australia
21	Drs Peggy Goldsmith and James Tulip
22	Vic Steblin
23	John Anderson
24	Brisbane City Council

Number	***Submitter***
25	Assoc Prof Adrian Barnett
26	Ian Tanner
27	Surf Coast Shire
28	Hunter Communities Network
29	Ted Finnie
30	Confidential
31	Mark Curran
32	Australian Network of Environmental Defender's Offices
33	cleanairtas
34	Occupational Health Society of Australia (WA Branch)
35	Alanna Ricardo
36	Surf Coast Air Action
37	Mark Smith and Lynne Baston
38	Nick Day
39	Confidential
40	Belconnen Community Council
41	Lock The Gate Alliance
42	Newcastle Public Health Professionals
43	Merilyn Plant
44	Sarah Joyce
45	Conservation Council of South Australia
46	Hunter Environment Lobby Inc
47	New England Greens
48	Oakey Coal Action Alliance
49	Nature Conservation Council of NSW

Number	***Submitter***
50	Corrs Chambers Westgarth, on behalf of Australian Paper Pty Ltd
51	Alcoa of Australia
52	Emma Fenty
53	Les Johnston
54	Centre for Air quality and & health Research and evaluation
55	Truck Industry Council
56	Construction Materials Processors Association Inc
57	Confidential
58	Environmental Justice Australia
59	Asthma Foundation NSW
60	Asthma Foundation of Tasmania
61	Maribyrnong City Council
62	Total Environment Centre
63	Repower Port Augusta
64	Yarra Campaign for Action on Transport
65	Australian Aluminium Council
66	Environment Victoria
67	Confidential
68	Hunter Community Environment Centre
69	Dr John Todd
70	Diane O'Mara
71	Climate and Health Alliance
72	Carol Jamieson
73	Clean Air Queensland
74	Warren Godson

Number	***Submitter***
75	Peter MacCallum Cancer Centre
76	Terminate Tullamarine Toxic Dump Action Group and Friends of Steele Creek
77	Wollar Progress Association
78	Centennial Coal
79	Anna Malos
80	Graeme Lorimer
81	Ally Yin
82	Singleton Shire Healthy Community Group
83	Australian Air Quality Group
84	Association of Mining and Exploration Companies Inc
85	Carol Cosentino
86	Julie Dingle
87	Lisel Thomas
88	Confidential
89	Community Over Mining – Toongabbie Township Development
90	Edward Campbell
91	Rio Tinto
92	Name suppressed
93	Australian Sustainable Business Group
94	Mt Isa Mines
95	Port Hedland Industries Council
96	The Chamber of Minerals and Energy of Western Australia
97	Caltex
98	Minerals Council of Australia
99	Confidential

Number	***Submitter***
100	Energy Supply Association of Australia
101	Australian Institute of Petroleum
102	Port Adelaide Resident's Environment Protection Group
103	CSIRO
104	Confidential
105	Cement Industry Federation
106	Cement Concrete & Aggregates Australia
107	Mid West Ports
108	CASANZ
109	Port Augusta City Council
110	Prof Cameron Shaw
111	Dr Ben Ewald
112	Colleen Packham
113	South Australian EPA
114	Kim Wilson
115	Jo McCubbin
116	Lisa Dowall
117	Mark Curran
118	Prof David Cohen
119	Name suppressed
120	Name suppressed
121	Phillip Jennings
122	Name suppressed
123	Jennifer Meyer-Smith
124	Confidential

Number	***Submitter***
125	Name suppressed
126	Name suppressed
127	Bill Lewin
128	Mark Plackett
129	Name suppressed
130	Name suppressed
131	Sean Walsh
132	Name suppressed
133	Name suppressed
134	Name suppressed
135	Keith Loveridge
136	Asthma Foundation NSW
137	Name suppressed
138	Name suppressed
139	Ecotech Pty Ltd
140	Lung Foundation Australia
141	Dr Dorothy Robinson
142	Russ Bambridge

Appendix D – Exceedances of 24-hour PM_{10} standards

New South Wales

Monitoring site	Number of exceedances of 24-hour mean PM_{10} of 50 µg/m^3 per year											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Sydney: Bargo								0	1	0	2	1
Sydney: Blacktown	5											
Sydney: Bringelly	6	2	2	3	1	1	5	0	2	0	3	0
Sydney: Camden											2	0
Sydney: Campbelltown West											1	0
Sydney: Chullora	11	3	1	3	2	0	8	0	7	1	4	0
Sydney: Earlwood	7	1	3	8	3	1	7	0	2	0	5	0
Sydney: Lindfield	3					0	4	0	0	0	1	0
Sydney: Liverpool	6	1	2	3	1	1	7	0		0	3	0
Sydney: Macarthur			1	4	1	1	6	1	0			
Sydney: Oakdale			0	1	0	1	5	0	1	0	4	1
Sydney: Prospect					0	0	10	0	0	0	4	0
Sydney: Randwick	4	0	0	1	1	0	8	0	0	0	3	0
Sydney: Richmond	7	0	0	2	0	0	5	0	0	3	5	0
Sydney: Rozelle		1	0	1	1	0	7	0	0	0	3	0
Sydney: St Marys	4	1	2	5	0	0	8	1	1	0	2	0
Sydney: Vineyard	10	0	0	3	0	0	5	0	0	0	4	0
Sydney: Westmead	2											
Sydney: Woolooware	2											
Lower Hunter: Beresfield	5	1	1	2	5	5	14	0	0	1	5	0
Lower Hunter: Carrington												3
Lower Hunter: Mayfield												3
Lower Hunter: Newcastle			0	1		2	12	1	0	0	4	2
Lower Hunter: Stockton												18
Lower Hunter: Wallsend	4	1	1	1	2	1	9	0	0	0	2	0
Upper Hunter: Aberdeen										0	0	2
Upper Hunter: Bulga										2	7	3
Upper Hunter: Camberwell										23	36	12
Upper Hunter: Jerrys Plains										0	6	6
Upper Hunter: Maison Dieu									8	20	28	6
Upper Hunter: Merriwa										1	0	3
Upper Hunter: Mt Thorley										28	26	3
Upper Hunter: Muswellbrook									0	1	3	1
Upper Hunter: Muswellbrook NW										1	1	1
Upper Hunter: Singleton									2	6	12	1
Upper Hunter: Singleton NW										29	28	6
Upper Hunter: Singleton South										2	5	0
Upper Hunter: Warkworth										0	8	3
Upper Hunter: Wybong										1	2	3
Central Coast: Wyong											1	0
Illawarra: Albion Park	4	1										
Illawarra: Albion Park South				2	1	1	8	0	1	0	2	0
Illawarra: Kembla Grange			4	9	5	4	13	0	1	3	4	1
Illawarra: Warrawong	5	2	5									
Illawarra: Wollongong	8	0	1	4	3	1	5	0	0	0	6	0
Regional NSW: Albury	29	2	3	14	11	8	15	2	0	1	2	5

Monitoring site	Number of exceedances of 24-hour mean PM_{10} of 50 µg/m^3 per year											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Regional NSW: Bathurst	12	4	0	3	2	1	11	0	0	2	3	0
Regional NSW: Tamworth	7	2		0		3	16	0	1	1	0	1
Regional NSW: Wagga Wagga	20	28	27	37	34	23	20	6				
Regional NSW: Wagga Wagga N										1	15	13

Victoria

Monitoring site	Number of exceedances of 24-hour mean PM_{10} of 50 µg/m^3 per year											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Pt. Phil.: Alphington	10	1	0	8	2	3	7	0	1	0	0	
Pt. Phil.: Box Hill			10	7	2	4	6	0	1	0	0	
Pt. Phil.: Brighton	8	0	0	6	1	5	6	0	0	0	0	
Pt. Phil.: Dandenong	8	1	0	12	5	8	12	0	0	0	1	
Pt. Phil.: Deer Park						7	12	1	0	1	0	
Pt. Phil.: Footscray	10	3	0	11	4	4	13	4	0	3	2	
Pt. Phil.: Geelong South	10	11	7	17	14	6	12	1	2	1	8	
Pt. Phil.: Mooroolbark	13	1	9	17	11	10	20	3	1	2	0	
Pt. Phil.: Richmond				9	3	5	8	0	0	0	0	
Pt. Phil.: RMIT	10	2	0	1								
Latrobe Vall.: Moe	11	1	0	15	13	6	7					
Latrobe Vall.: Traralgon	7	0	0	9	5	2	5	3	0	0	4	

Queensland

Monitoring site	Number of exceedances of 24-hour mean PM_{10} of 50 µg/m^3 per year											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
SEQ: Brisbane CBD	1	2	2	0	1	1	6	0	2	0	0	0
SEQ: Flinders View	1	3	3	0	0	2	7	0	2	2	0	0
SEQ: Mountain Creek	1	1	2	0	0	1	7	0	0	1	1	1
SEQ: North Toowoomba		0	3	1	1	4	10	0				
SEQ: Pinkenba	1	2	4	3	9	7	7	3	4	0	0	7
SEQ: Rocklea	2	0	2	0	1	1	8	0			0	0
SEQ: South Brisbane	1	2	2	0	1	1	14	0	2	0	0	0
SEQ: Springwood	0	0	2	0	0	1	9	0	2	0	0	0
SEQ: Woolloongabba	2	3	3	1			11	0	2	0	0	7
SEQ: Wynnum N			4	0	2	2	8	0	3	2	1	2
Mt Isa: The Gap								0	13	16	13	12
Townsville: Pimlico			5	2	0	1	9	0	1	0	0	0
Mackay: West Mackay	7	0	7	1	2	8	17	0	1	1	0	0
Gladstone: South Gladstone	0	0	4	1	0	2	7	0	3	1	0	0
Gladstone: Clinton	0	0	4	1	0	2		0	8	0	0	1
Gladstone: Targinie (Swans Rd)							10	0		5	3	6
Gladstone: Targinie (Stupkin L)	0	1	5	1	0							
Gladstone: Boat Creek							14	0				0
Gladstone: Boyne Island							10	0	7	2	0	0

South Australia

Monitoring site	Number of exceedances of 24-hour mean PM_{10} of 50 µg/m^3 per year											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Adelaide: B'head				6	5	6	6	2	0	2	2	2
Adelaide: Christie Dns.					3	3	2	5	0	0	1	1
Adelaide: Elizabeth Dns.			6	4	3	3	12	1	0	2	1	0
Adelaide: Kens. Gdns.	2	1	2	2	1	3	2			1	1	0
Adelaide: Netley	6	3	6	11	11	4	5	3	0	1	1	1
Adelaide: North Haven											3	1
Spencer: Pt Pirie F.Grn. Pk.				10	11	13	8	4	0	2	3	6
Spencer: Pt Pirie Oliv. St.		4	6	13	11	17	14	3	1	0	3	3
Spencer: Whyalla Sch. Pk.					5	6	10	3	1	0	2	2
Spencer: Whyalla Walls St			30	29	25	17	23	4	8	10	8	7

Western Australia

Monitoring site	Number of exceedances of 24-hour mean PM_{10} of 50 µg/m^3 per year											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Perth: Caversham		1	1	0	1	0	0	1	1	4	1	1
Perth: Duncraig	1	0	1	0	0	0	0	0	1	2	0	1
Perth: Quinns Rock												
Perth: South Lake	0	1	3	0	1	1	0	4	1	2	0	0
Albany					1	2	0	1	0	0	3	0
Bunbury	1	4	3	3	0	0	1	2	2	2	0	0
Busselton												
Collie						7	3	16	4	6	3	2
Geraldton				4	10	10	14		3	3	2	4

Tasmania

Monitoring site	Number of exceedances of 24-hour mean PM_{10} of 50 µg/m^3 per year											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Launceston: Ti Tree Bend	23	10	14	5	8	1	0	0	0	1	0	
Hobart: New Town					0	0	0	1	0	0	1	
George Town						0	1	2	2	1		
Devonport											0	
Cape Grim												

Northern Territory

Monitoring site	Number of exceedances of 24-hour mean PM_{10} of 50 µg/m^3 per year											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Darwin: Casuarina					0	1	9	1				
Darwin: Palmerston									3	23	1	2
Darwin: Winnellie										2	3	3

Australian Capital Territory

Monitoring site	Number of exceedances of 24-hour mean PM_{10} of 50 µg/m^3 per year											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Canberra: Civic									0	0	1	0
Canberra: Monash	13	3	10	4	5	3		0	0	0	0	0
Canberra: Florey												0

Appendix E – Exceedances of 24-hour $PM_{2.5}$ standards

New South Wales

Monitoring site	Number of exceedances of 24-hour mean $PM_{2.5}$ of 25 µg/m^3 per year											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Sydney: Bargo												
Sydney: Blacktown												
Sydney: Bringelly												
Sydney: Camden											3	0
Sydney: Campbelltown West												
Sydney: Chullora		0	2	2	0	0	2	0	0	0	3	0
Sydney: Earlwood	5	0	2	2	0	0	0	0	0	0	4	0
Sydney: Lindfield												
Sydney: Liverpool		4	2	3	0	1	2	0	2	0	2	0
Sydney: Macarthur												
Sydney: Oakdale												
Sydney: Prospect												
Sydney: Randwick												
Sydney: Richmond	4	0	0	1		0	1	0	2	2	14	0
Sydney: Rozelle												
Sydney: St Marys												
Sydney: Vineyard												
Sydney: Westmead	2											
Sydney: Wooloooware	3											
Lower Hunter: Beresfield	3	1	0	0	0	0	4	1	0	0	2	1
Lower Hunter: Carrington												0
Lower Hunter: Mayfield												0
Lower Hunter: Newcastle												0
Lower Hunter: Stockton												1
Lower Hunter: Wallsend	2	0	0	1	0	0	4	0	0	0	6	0
Upper Hunter: Aberdeen												
Upper Hunter: Bulga												
Upper Hunter: Camberwell										0	1	1
Upper Hunter: Jerrys Plains												
Upper Hunter: Maison Dieu												
Upper Hunter: Merriwa												
Upper Hunter: Mt Thorley												
Upper Hunter: Muswellbrook									4	3	1	3
Upper Hunter: Muswellbrook NW												
Upper Hunter: Singleton									0	0	0	1
Upper Hunter: Singleton NW												
Upper Hunter: Singleton South												
Upper Hunter: Warkworth												
Upper Hunter: Wybong												
Central Coast: Wyong											1	0
Illawarra: Albion Park												
Illawarra: Albion Park South												
Illawarra: Kembla Grange												
Illawarra: Warrawong	4	0	0									
Illawarra: Wollongong	5	0	0	2	0	0	2	0	0	0	4	0

Monitoring site	Number of exceedances of 24-hour mean $PM_{2.5}$ of 25 µg/m^3 per year											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Regional NSW: Albury												
Regional NSW: Bathurst												
Regional NSW: Tamworth												
Regional NSW: Wagga Wagga										0		
Regional NSW: Wagga Wagga N											3	2

Victoria

Monitoring site	Number of exceedances of 24-hour mean $PM_{2.5}$ of 25 µg/m^3 per year											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Pt. Phil.: Alphington	10	0	4	19	7	10	9	3	1	0	2	
Pt. Phil.: Box Hill												
Pt. Phil.: Brighton												
Pt. Phil.: Dandenong												
Pt. Phil.: Deer Park												
Pt. Phil.: Footscray	7	0		18	8	8	6	3	0	1	0	
Pt. Phil.: Geelong South												
Pt. Phil.: Mooroolbark												
Pt. Phil.: Richmond												
Pt. Phil.: RMIT												
Latrobe Vall.: Moe												
Latrobe Vall.: Traralgon												

Queensland

Monitoring site	Number of exceedances of 24-hour mean $PM_{2.5}$ of 25 µg/m^3 per year											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
SEQ: Brisbane CBD												
SEQ: Flinders View												
SEQ: Mountain Creek												
SEQ: North Toowoomba		1	0	0	0							
SEQ: Pinkenba												
SEQ: Rocklea	1	5	0	0	0	0	6	0			0	0
SEQ: South Brisbane							6	0	3	1	0	1
SEQ: Springwood	0	0	0	2	0	0	2	0	3	0	0	0
SEQ: Woolloongabba							3	3	3	1	0	1
SEQ: Wynnum N							1	0	3	0	0	1
Mt Isa: The Gap												
Townsville: Pimlico												
Mackay: West Mackay												
Gladstone: South Gladstone							7	0	9	1	0	1
Gladstone: Clinton								0	14	1	0	1
Gladstone: Targinie (Swans Rd)							4	0		0	1	0
Gladstone: Targinie (Stupkin L)												
Gladstone: Boat Creek							12	0			0	0
Gladstone: Boyne Island							7	0	11	3	3	0

South Australia

Monitoring site	Number of exceedances of 24-hour mean $PM_{2.5}$ of 25 µg/m^3 per year											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Adelaide: B'head												
Adelaide: Christie Dns.												
Adelaide: Elizabeth Dns.												
Adelaide: Kens. Gdns.												
Adelaide: Netley	1	0	0	2	0	0	1	0	0	0	0	0
Adelaide: North Haven											0	0
Spencer: Pt Pirie F.Grn. Pk.												
Spencer: Pt Pirie Oliv. St.												
Spencer: Whyalla Sch. Pk.												
Spencer: Whyalla Walls St												

Western Australia

Monitoring site	Number of exceedances of 24-hour mean $PM_{2.5}$ of 25 µg/m^3 per year											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Perth: Caversham	0				0	0	0	1	1	3	0	1
Perth: Duncraig	0	0	1	1	0	1	1	2	1	4	0	1
Perth: Quinns Rock					0		1	2	1	3	0	2
Perth: South Lake									1	3	0	1
Albany												
Bunbury	1	5	3	6	2	0	3	4	2	3	1	1
Busselton					2	1	11	5	5	4	0	0
Collie												
Geraldton												

Tasmania

Monitoring site	Number of exceedances of 24-hour mean $PM_{2.5}$ of 25 µg/m^3 per year											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Launceston: Ti Tree Bend				35	20	17	12	11	6	16	12	
Hobart: New Town					7	9	4	2	0	3	3	
George Town						6	2	5				
Devonport											0	
Cape Grim												

Northern Territory

Monitoring site	Number of exceedances of 24-hour mean $PM_{2.5}$ of 25 µg/m^3 per year											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Darwin: Casuarina							5					
Darwin: Palmerston									15	24	6	12
Darwin: Winnellie										3	5	13

Australian Capital Territory

Monitoring site	Number of exceedances of 24-hour mean $PM_{2.5}$ of 25 µg/m^3 per year											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Canberra: Civic												
Canberra: Monash		15		20				2	4	3	6	4
Canberra: Florey												

Appendix F – Annual average $PM_{2.5}$ concentrations

New South Wales

Monitoring site	Annual mean $PM_{2.5}$ concentration ($\mu g/m^3$)											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Sydney: Bargo												
Sydney: Blacktown												
Sydney: Bringelly												
Sydney: Camden											6.5	6.3
Sydney: Campbelltown West												
Sydney: Chullora		8.6	7.6	7.2	6.4	5.9	6.6	5.7	5.9	6.1	8.4	9.0
Sydney: Earlwood	7.8	7.5	7.1	6.9	5.9	5.5	6.2	5.7	5.4	5.6	7.9	7.8
Sydney: Lindfield												
Sydney: Liverpool		9.2	8.4	8.9	7.2	6.5	7.5	6.3	5.9	8.5	9.4	8.6
Sydney: Macarthur												
Sydney: Oakdale												
Sydney: Prospect												
Sydney: Randwick												
Sydney: Richmond	6.6	6.5	5.8	5.9		7.3	5.2	4.2	4.7	5.3	8.3	6.7
Sydney: Rozelle												
Sydney: St Marys												
Sydney: Vineyard												
Sydney: Westmead	8.2											
Sydney: Wooloowware	7.5											
Lower Hunter: Beresfield	6.1	7.7	6.8	6.8	6.3	6.0	7.9	6.0	5.5	7.9	8.2	7.5
Lower Hunter: Carrington												8.3
Lower Hunter: Mayfield												8.0
Lower Hunter: Newcastle												8.1
Lower Hunter: Stockton												10.2
Lower Hunter: Wallsend	6.6	6.7	6.5	6.4	5.8	5.9	6.8	4.6	4.8	5.1	7.7	6.7
Upper Hunter: Aberdeen												
Upper Hunter: Bulga												
Upper Hunter: Camberwell										7.5	8.2	7.8
Upper Hunter: Jerrys Plains												
Upper Hunter: Maison Dieu												
Upper Hunter: Merriwa												
Upper Hunter: Mt Thorley												
Upper Hunter: Muswellbrook									9.1	10.1	9.4	9.7
Upper Hunter: Muswellbrook NW												
Upper Hunter: Singleton									7.6	8.0	7.9	7.8
Upper Hunter: Singleton NW												
Upper Hunter: Singleton South												
Upper Hunter: Warkworth												
Upper Hunter: Wybong												
Central Coast: Wyong											6.7	5.5
Illawarra: Albion Park												
Illawarra: Albion Park South												
Illawarra: Kembla Grange												
Illawarra: Warrawong	8.8	8.2	7.4									
Illawarra: Wollongong	7.3	6.7	6.3	6.4	6.0	5.3	6.4	5.1	4.6	4.6	7.7	7.0

Monitoring site	Annual mean $PM_{2.5}$ concentration ($\mu g/m^3$)											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Regional NSW: Albury												
Regional NSW: Bathurst												
Regional NSW: Tamworth												
Regional NSW: Wagga Wagga										8.7		
Regional NSW: Wagga Wagga N											7.9	7.5

Victoria

Monitoring site	Annual mean $PM_{2.5}$ concentration ($\mu g/m^3$)											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Pt. Phil.: Alphington	8.8	6.9	8.1	10.6	8.5	8.2	8.4	7.4	7.2	6.8	7.1	
Pt. Phil.: Box Hill												
Pt. Phil.: Brighton												
Pt. Phil.: Dandenong												
Pt. Phil.: Deer Park												
Pt. Phil.: Footscray	7.7	6.1		9.6	7.6	7.0	7.3	6.8	7.0	6.2	6.4	
Pt. Phil.: Geelong South												
Pt. Phil.: Mooroolbark												
Pt. Phil.: Richmond												
Pt. Phil.: RMIT												
Latrobe Vall.: Moe												
Latrobe Vall.: Traralgon												

Queensland

Monitoring site	Annual mean $PM_{2.5}$ concentration ($\mu g/m^3$)											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
SEQ: Brisbane CBD												
SEQ: Flinders View												
SEQ: Mountain Creek												
SEQ: North Toowoomba		5.2	4.4	3.7	3.6							
SEQ: Pinkenba												
SEQ: Rocklea	4.6	6.3	4.4	3.9	4.3	3.7	10.4	8.3			6.6	5.8
SEQ: South Brisbane							10.4	6.8	7.0	6.8	7.9	7.0
SEQ: Springwood	5.3	5.3	4.5	4.6	4.3	4.1	5.1	4.5	4.6	4.4	4.5	4.5
SEQ: Woolloongabba							8.4	8.3	8.7	7.8	8.0	7.4
SEQ: Wynnum N							5.2	4.0	4.8	4.1	4.8	4.7
Mt Isa: The Gap												
Townsville: Pimlico												
Mackay: West Mackay												
Gladstone: South Gladstone							9.2	6.1	7.5	5.3	5.6	6.0
Gladstone: Clinton								5.1	9.8	7.1	7.9	5.5
Gladstone: Targinie (Swans Rd)							5.2	3.6		4.8	5.7	4.4
Gladstone: Targinie (Stupkin L)												
Gladstone: Boat Creek							9.1	6.7			4.7	4.2
Gladstone: Boyne Island							7.2	3.1	7.0	4.5	5.7	4.6

South Australia

Monitoring site	Annual mean $PM_{2.5}$ concentration ($\mu g/m^3$)											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Adelaide: B'head												
Adelaide: Christie Dns.												
Adelaide: Elizabeth Dns.												
Adelaide: Kens. Gdns.												
Adelaide: Netley	9.0	8.2	7.9	8.3	7.9	7.7	8.1	7.5	7.1	7.3	7.2	7.4
Adelaide: North Haven											7.3	6.8
Spencer: Pt Pirie F.Grn. Pk.												
Spencer: Pt Pirie Oliv. St.												
Spencer: Whyalla Sch. Pk.												
Spencer: Whyalla Walls St												

Western Australia

Monitoring site	Annual mean $PM_{2.5}$ concentration ($\mu g/m^3$)											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Perth: Caversham	4.9				4.4	4.0	4.6	5.0	3.9	4.7	4.7	5.0
Perth: Duncraig	5.7	4.8	4.7	5.0	4.2	4.6	5.1	5.1	4.6	5.0	4.4	4.5
Perth: Quinns Rock					3.8	4.1	4.6	4.6	4.1	4.8	4.7	4.9
Perth: South Lake									4.7	5.8	4.8	4.9
Albany												
Bunbury	5.5	6.0	5.2	5.6	4.7	4.5	5.1	6.0	4.9	5.4	4.7	4.6
Busselton					4.2	4.2	5.8	5.3	5.4	5.4	4.6	4.0
Collie												
Geraldton												

Tasmania

Monitoring site	Annual mean $PM_{2.5}$ concentration ($\mu g/m^3$)											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Launceston: Ti Tree Bend				10.4	9.5	8.8	7.5	8.3	7.5	8.3	8.1	
Hobart: New Town					7.6	7.3	7.1	7.1	6.2	6.5	6.1	
George Town						7.7	6.9	7.2				
Devonport											6.4	
Cape Grim												

Northern Territory

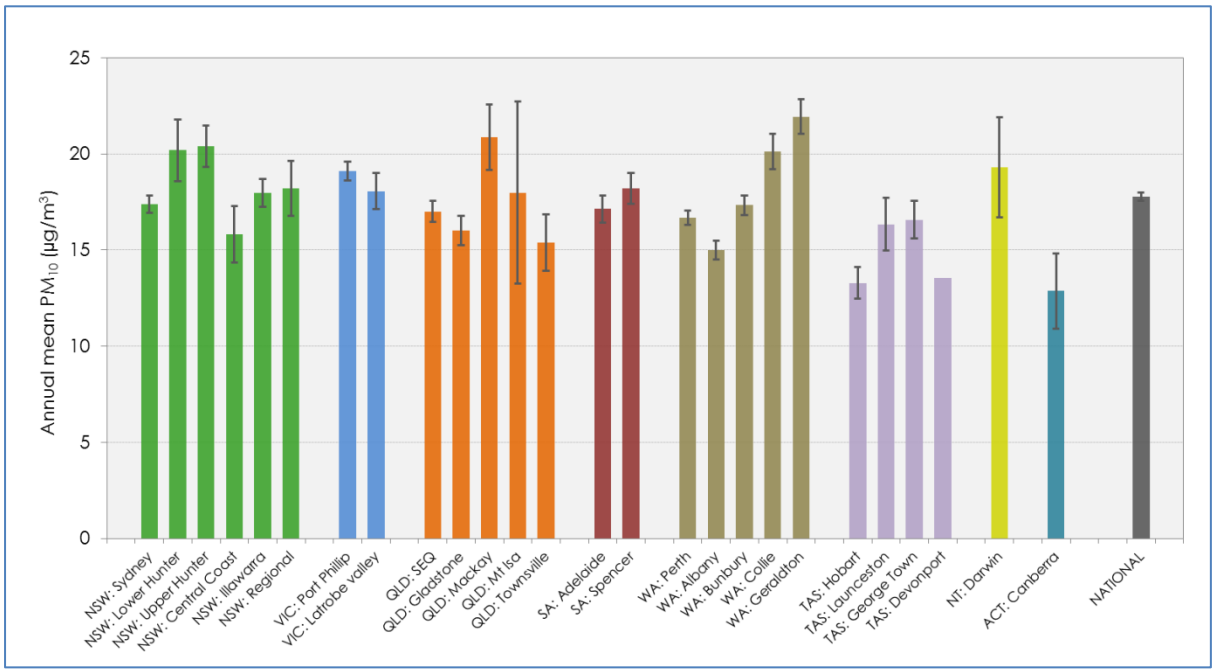
Monitoring site	Annual mean $PM_{2.5}$ concentration ($\mu g/m^3$)											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Darwin: Casuarina							8.3					
Darwin: Palmerston									10.2	11.8	8.8	9.2
Darwin: Winnellie										12.2	6.9	8.3

Australian Capital Territory

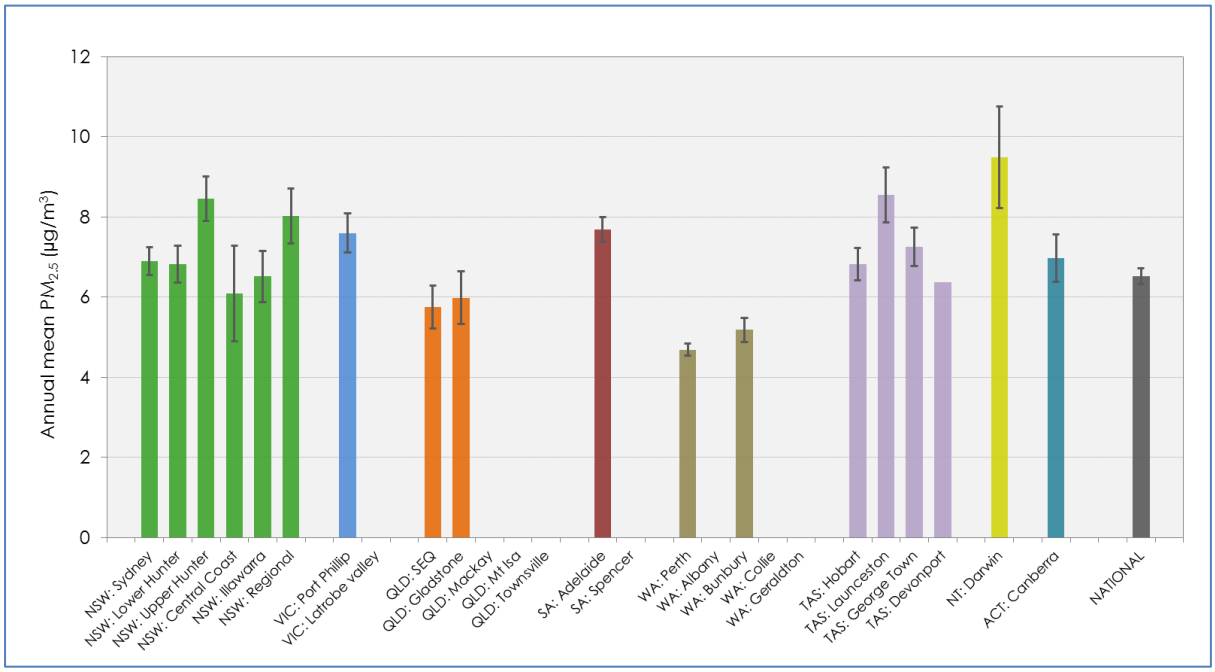
Monitoring site	Annual mean $PM_{2.5}$ concentration ($\mu g/m^3$)											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Canberra: Civic												
Canberra: Monash		8.2		7.9				6.3	6.0	6.7	6.7	7.1
Canberra: Florey												

Appendix G – Analysis of monitoring data

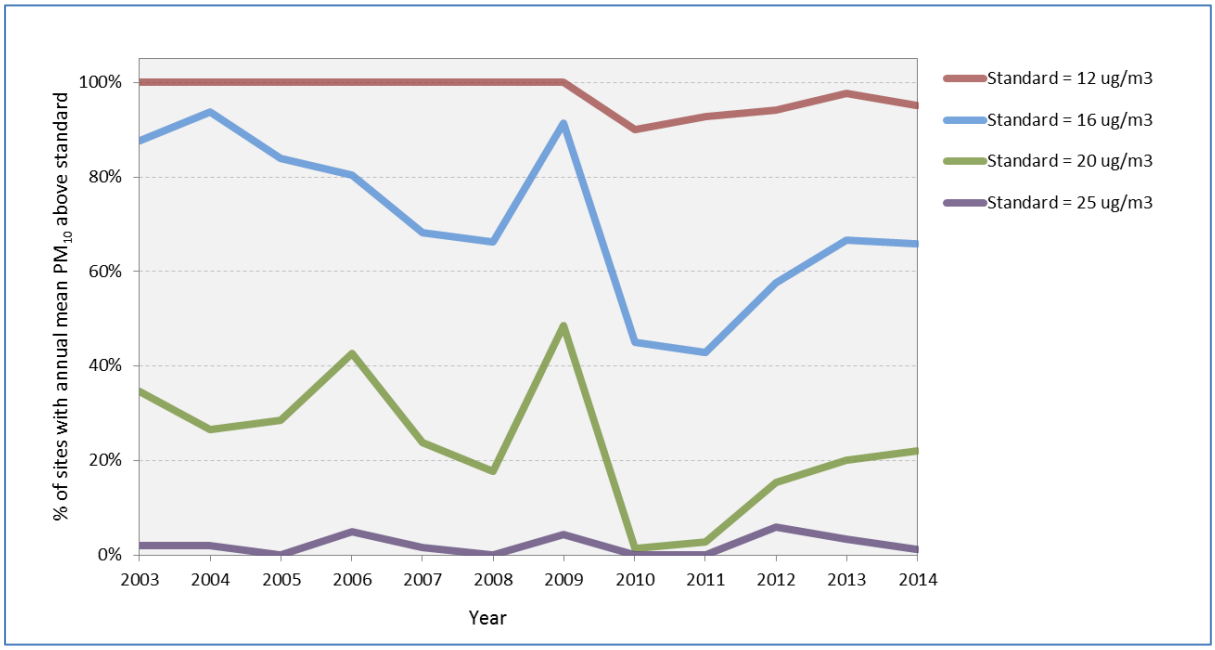
Regional annual average PM_{10} concentrations (2003–2014)



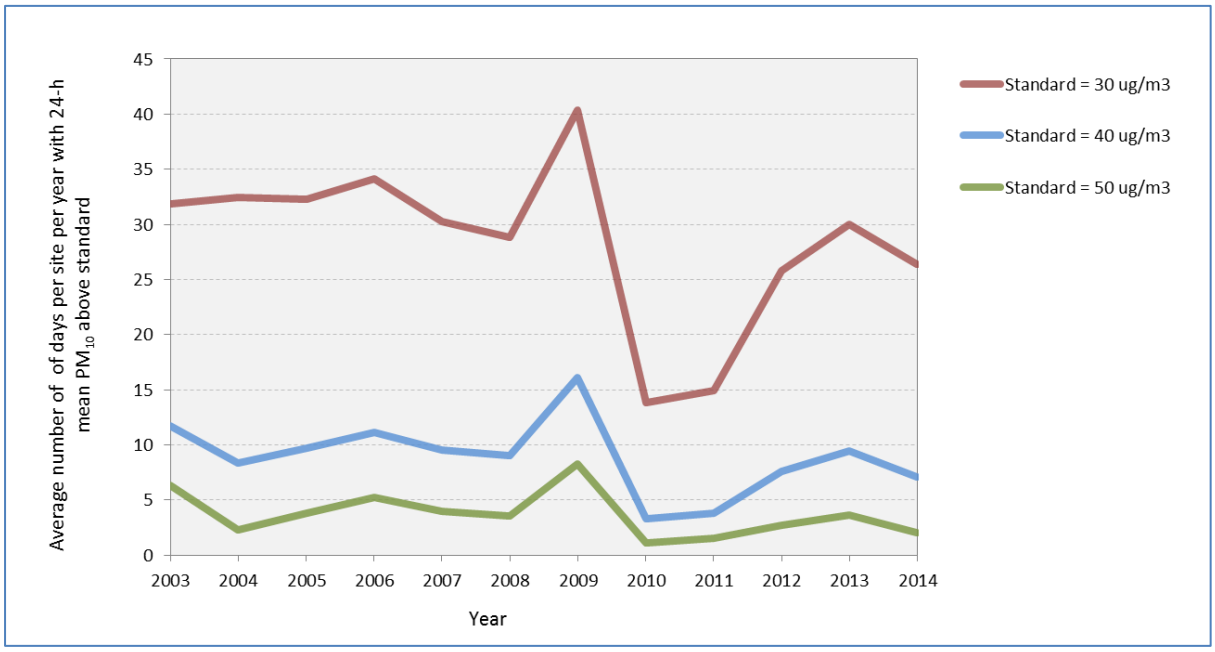
Regional annual average $PM_{2.5}$ concentrations (2003–2014)



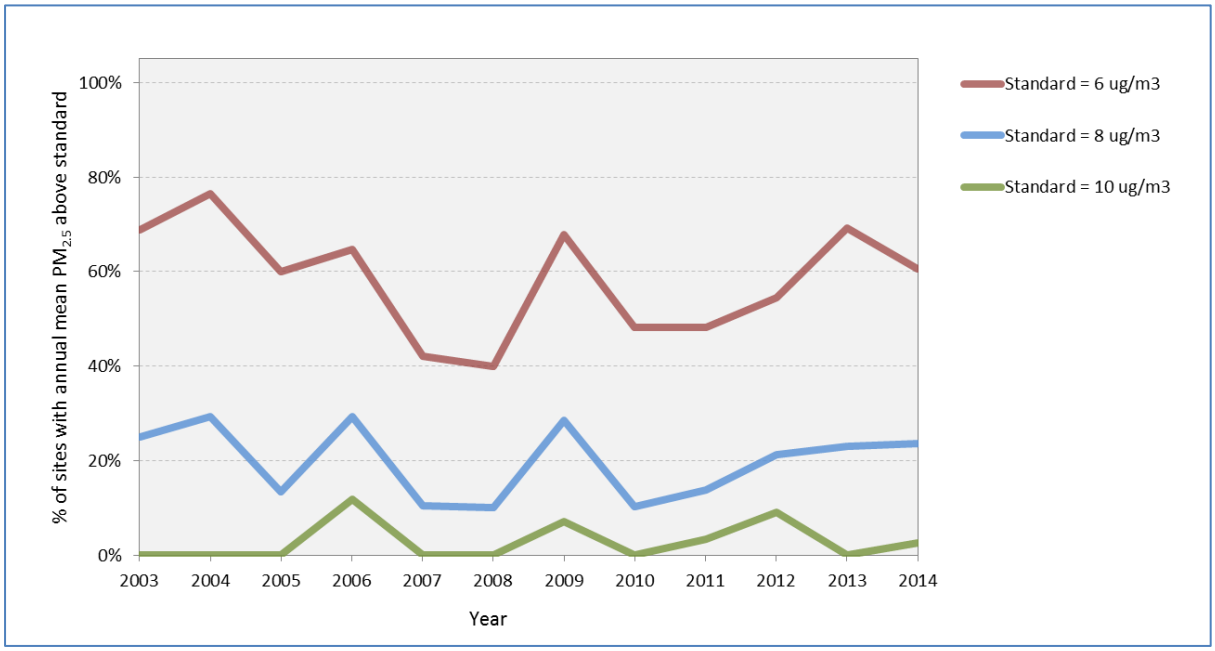
Proportion of monitoring sites with annual mean PM_{10} concentrations above standard



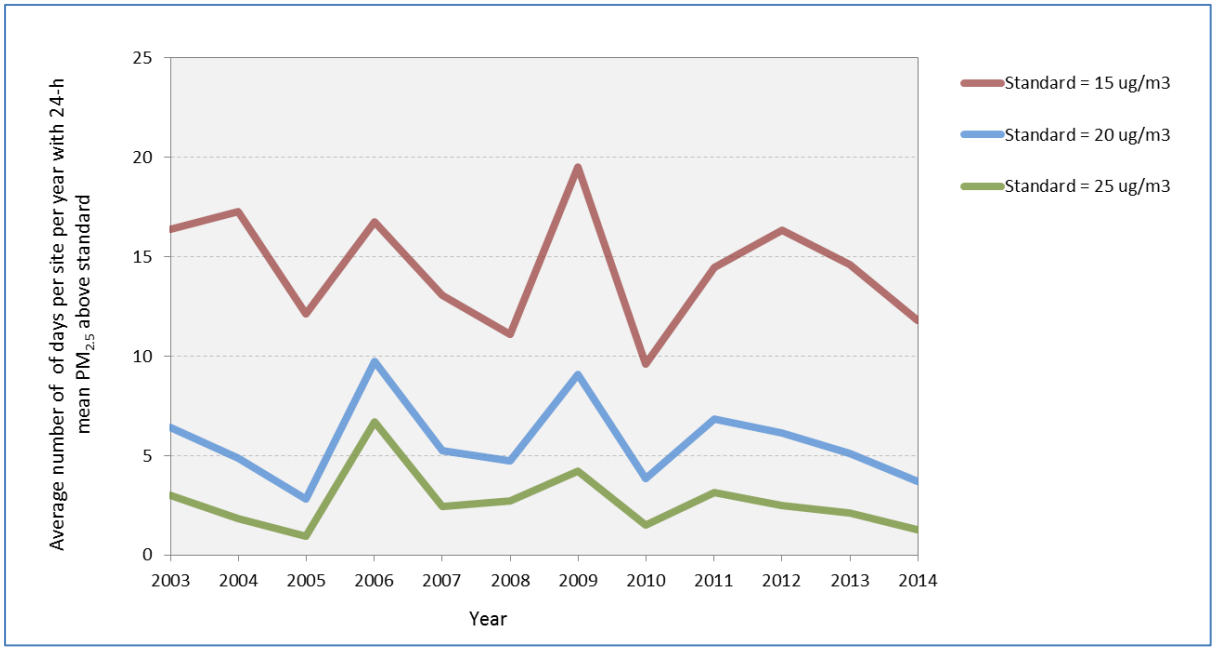
Average days per site per year with 24-hour PM_{10} concentrations above standard



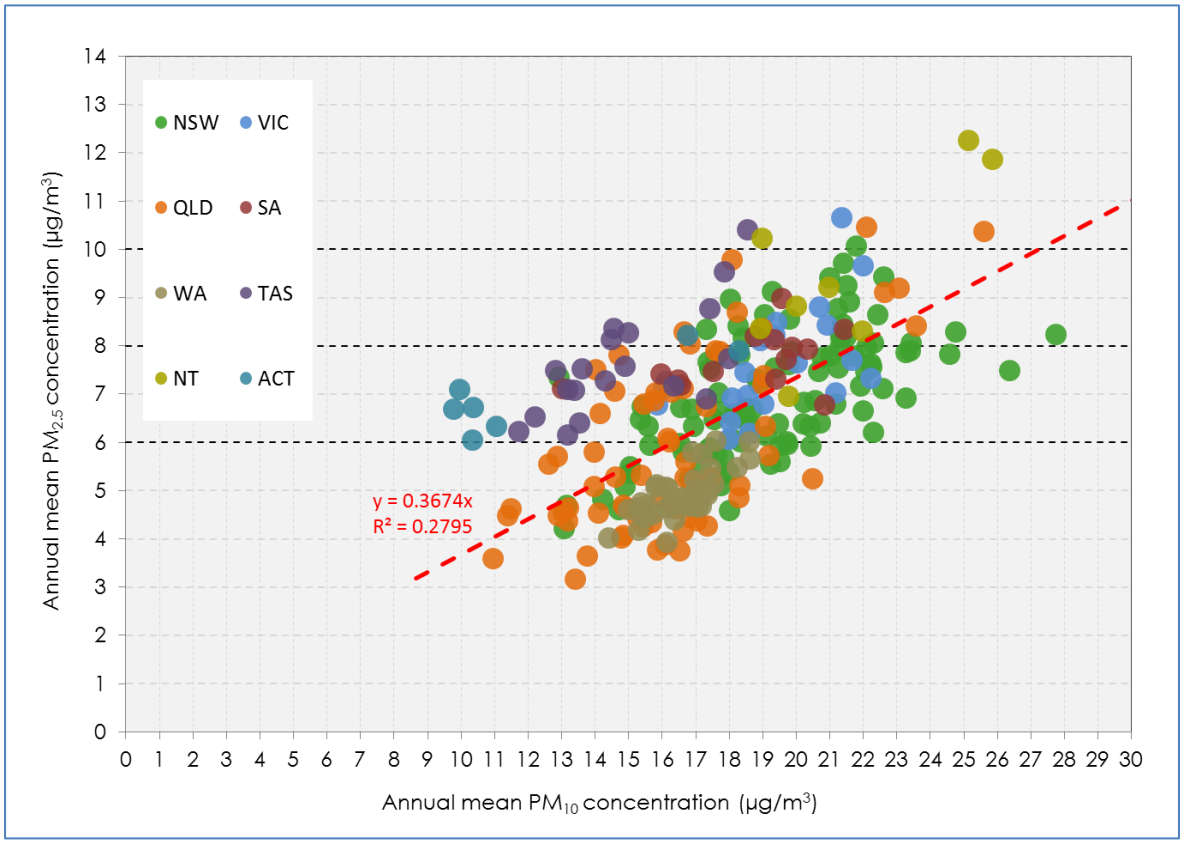
Proportion of monitoring sites with annual mean $PM_{2.5}$ concentrations above standard



Average days per site per year with 24-hour $PM_{2.5}$ concentrations above standard



Annual mean $PM_{2.5}$ vs. annual mean PM_{10} (2003–2014)



Average $PM_{2.5}$: PM_{10} ratio (2003–2014)