Independent Planning Commission NSW
HVO North and South Open Cut Coal Continuation Projects
SSD-11826681 & SSD-11826621

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The University of Melbourne

B. Eng. (Chemical) (2001), The University of Newcastle

Ph. D. (Chemical Engineering) (2006), The University of Newcastle

- Undergraduate training with significant coal and mining industry input.
- Doctoral research into the formulation of mining explosives.
- Postdoctoral training in combustion chemistry and pollutant formation.
- Recognised expert in atmospheric chemistry and air pollution. Over 130 peer reviewed publications, invited speaker at major international meetings.

Air Quality and Air Pollutants

Unclean air kills millions globally every year.

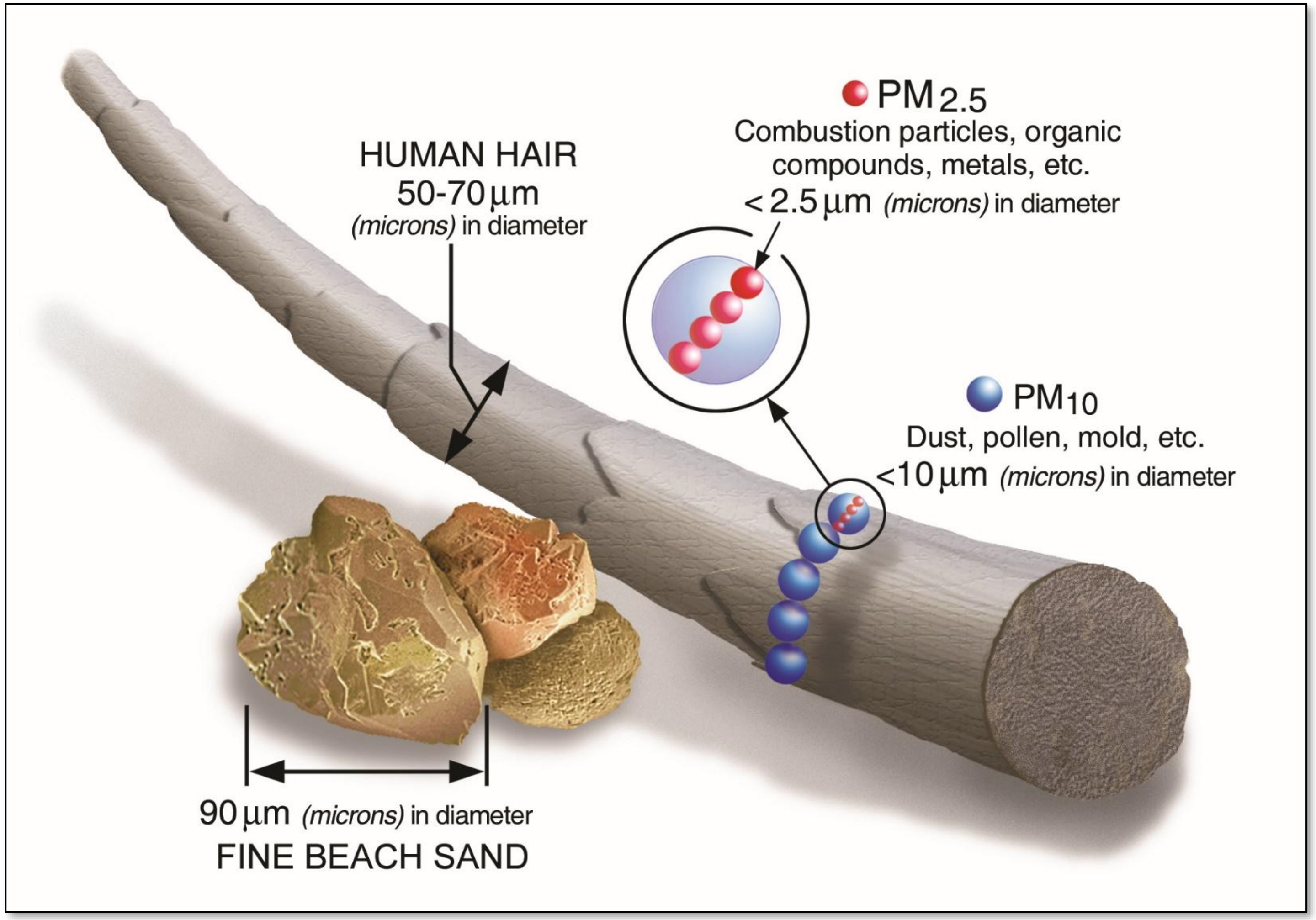
Even visibly “clean” air can be unhealthy.

Unhealthy air is the cumulative effect of multiple pollutants – both a cumulative impact on the body and a synergistic effect of some pollutants on others.

Fine Particulate Matter

Microscopic particles are an air pollutant of incredible concern.

Often measured as PM2.5; Not "dust" particles, more closely described as "haze".



US EPA

Why PM2.5?

Small enough to stay airborne for long periods of time.

- Can be transported long distances or accumulate in a stagnant air mass.

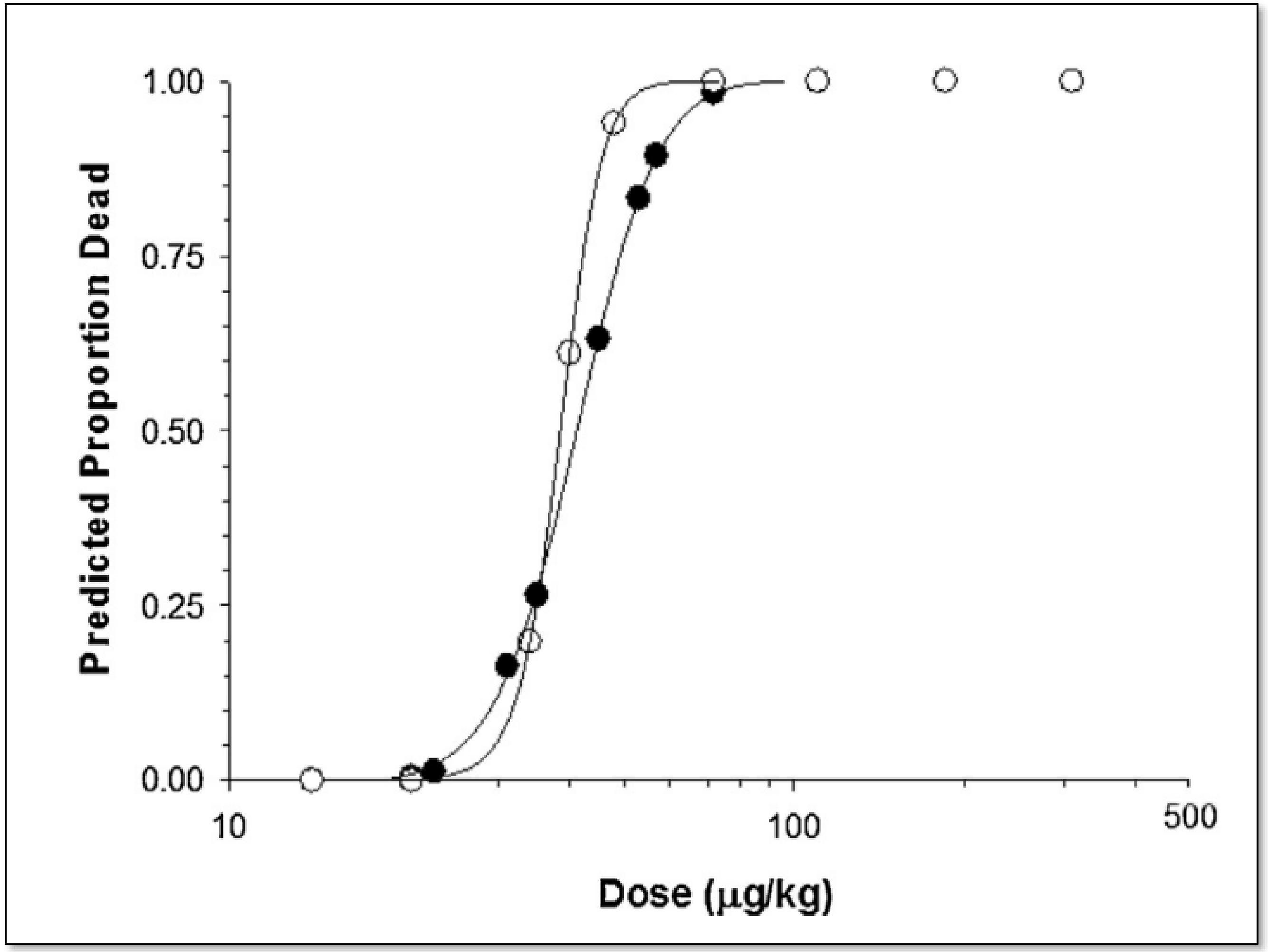
Small enough to penetrate deep into the lungs and cross into the bloodstream.

- Can impact almost every bodily system.

The latest studies can not find a lower limit for when PM2.5 exposure becomes safe.

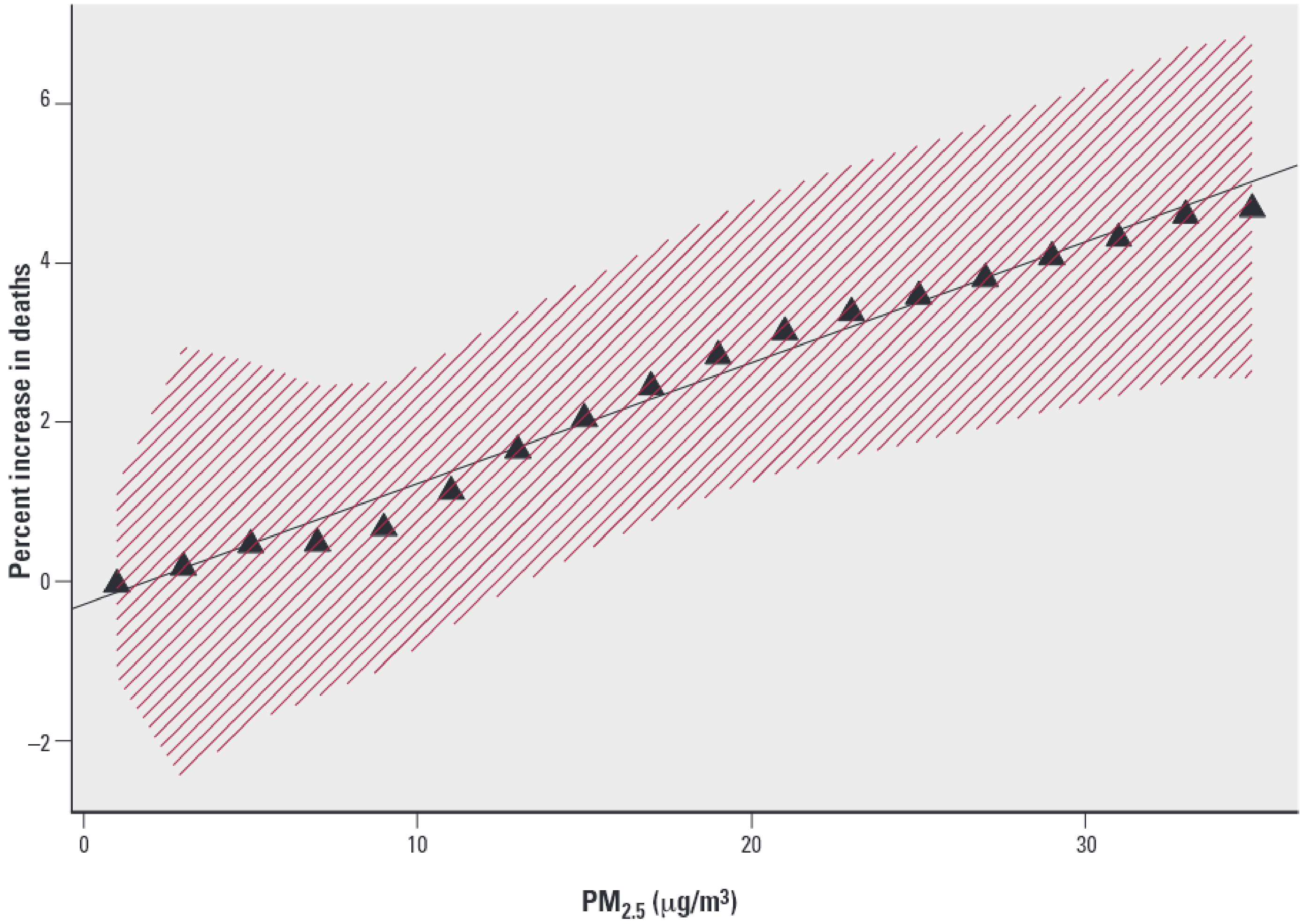
- *There is no known safe exposure level.*

A typical dose - response "*S*" curve:



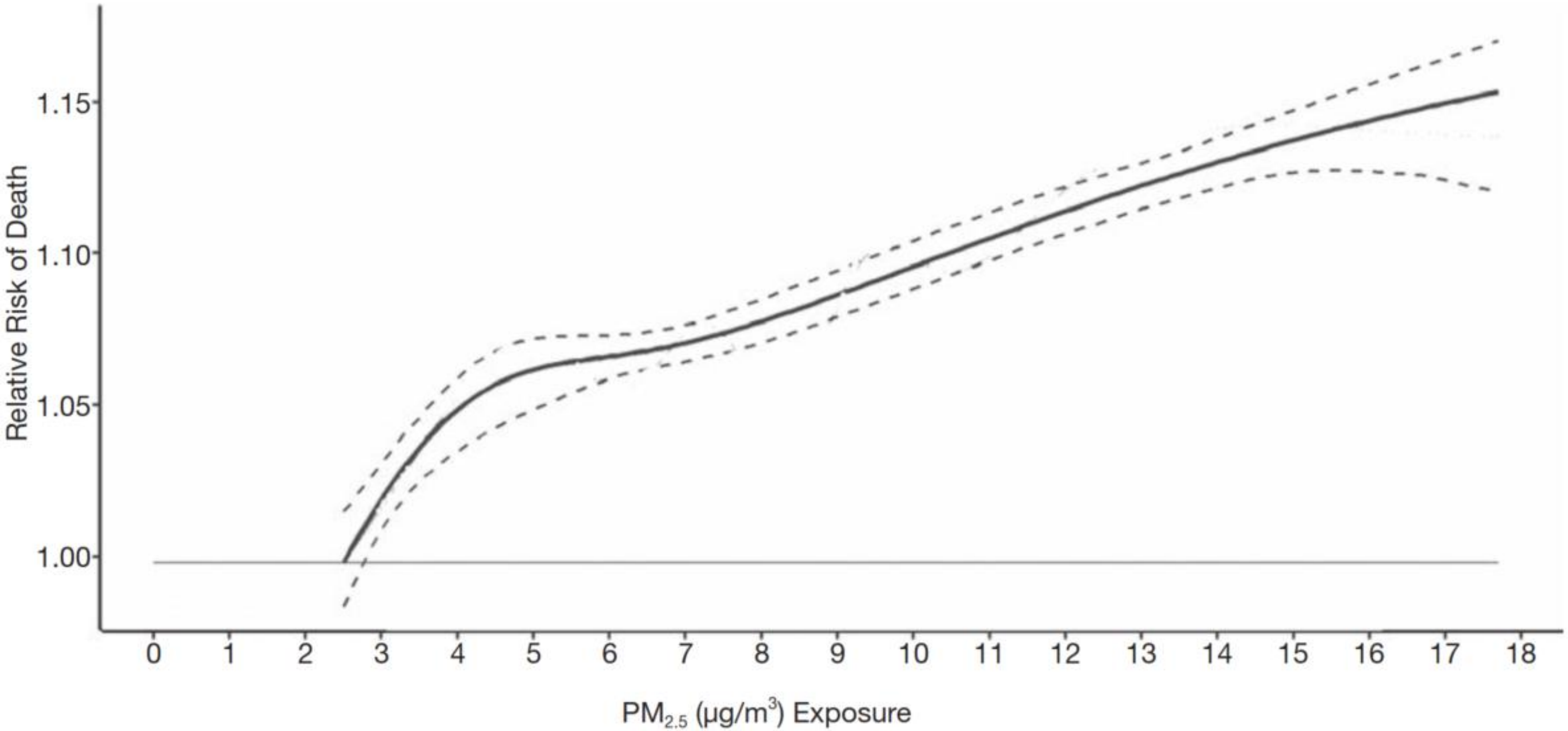
Wright, L. K. M., et al., Female rates are less susceptible during puberty to the lethal effects of percutaneous exposure to VX. *Toxicology Reports* 2016, 3, 895 – 899.

PM2.5 dose-response (2002):



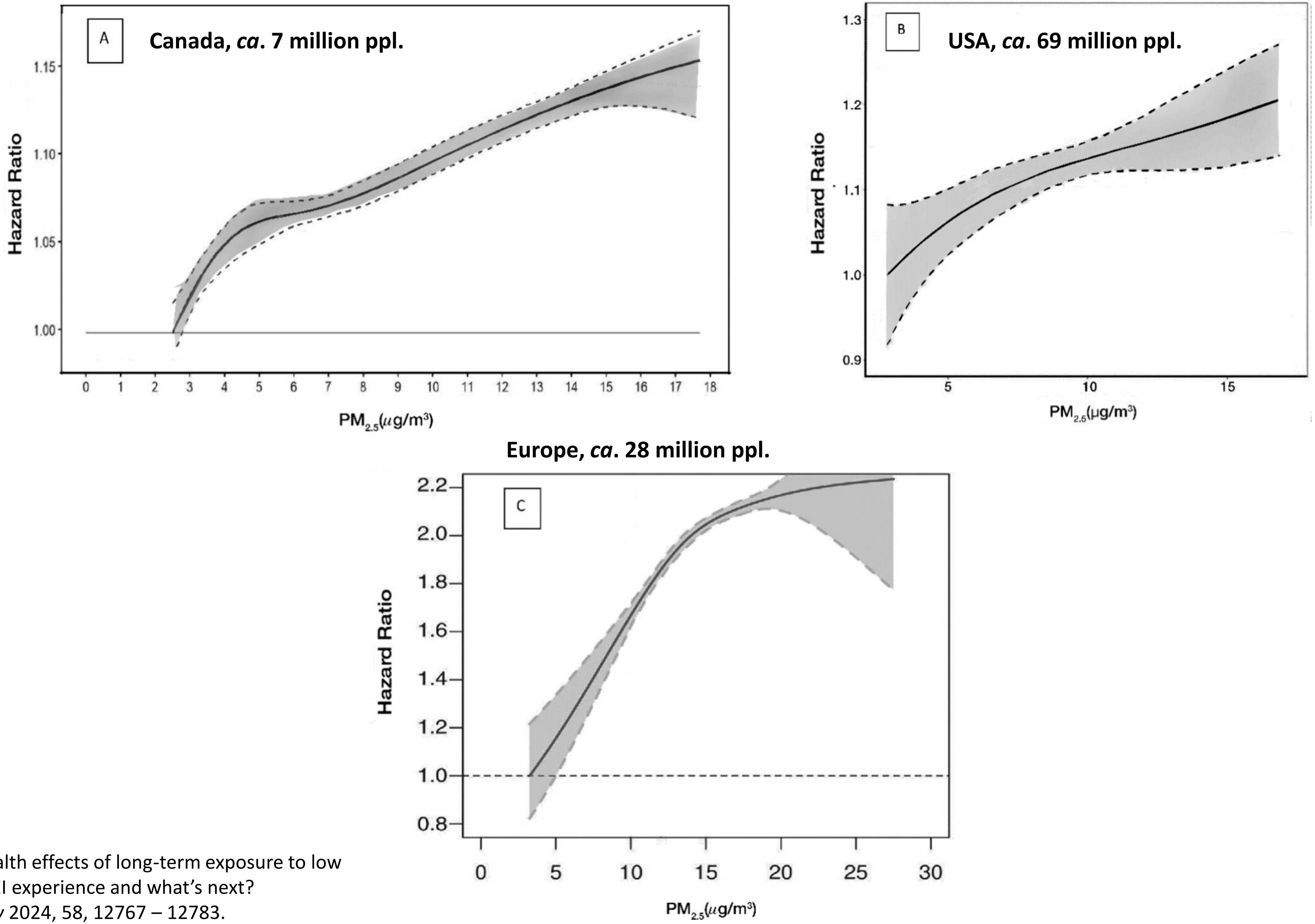
Schwartz, J., Laden, F., Zanobetti, A., The Concentration-Response Relation Between PM2.5 and Daily Deaths. *Environmental Health Perspectives* 2002, 110, 1025 – 1029.

PM2.5 dose-response (2022):



Statement Figure. Shape of the association between outdoor $PM_{2.5}$ exposure and nonaccidental death. This plot shows how the risk of death changes over different $PM_{2.5}$ exposure concentrations. The relative risk of death compares the lowest observed $PM_{2.5}$ concentration (2.5 μg/m³) to all higher concentrations. (Adapted from Investigators' Report Figure 29.)

Brauer, M., et al., Mortality – air pollution associations in low-exposure environments (MAPLE): Phase 2. *Research Reports: Health Effects Institute* 2022



Boogaard et al., Assessing adverse health effects of long-term exposure to low levels of ambient air pollution: The HEI experience and what's next? *Environmental Science and Technology* 2024, 58, 12767 – 12783.

A Brief History of Annual PM2.5 Standards

1997	15 $\mu g/m^3$	USA
2005	10 $\mu g/m^3$	WHO
2008	25 $\mu g/m^3$	EU
2013	12 $\mu g/m^3$	USA
2016	8 $\mu g/m^3$	Australia ("standard")
2021	5 $\mu g/m^3$	WHO
2024	10 $\mu g/m^3$	EU
2024	9 $\mu g/m^3$	USA
2025	7 $\mu g/m^3$	Australia ("goal")

PM2.5 Regulation in Australia

Air pollution in Australia is regulated under the National Environment Protection (Ambient Air Quality) Measure, or Air NEPM.

The 2021 variation to this instrument legislated the 2025 PM2.5 goal of 7 $\mu g/m^3$, which is now in effect.

This variation introduced a mechanism for Australia to respond to the evolving science on the harms of air pollution.

National Environment Protection Goal:
Goals that relate to the desired environmental outcomes and that guide the formulation of strategies for the management of human activities that may affect the environment.

AUSTRALIA

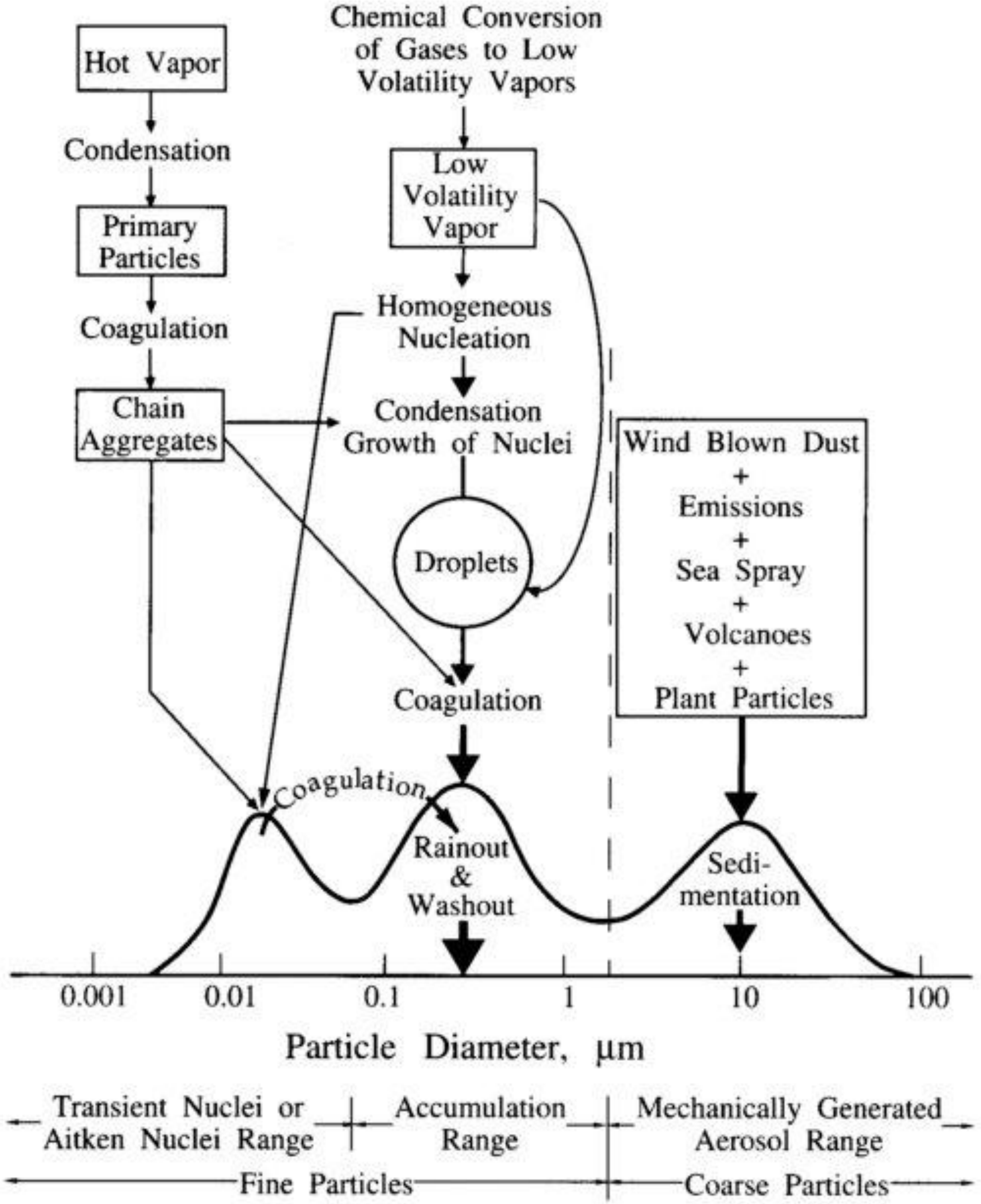
National Environment Protection (Ambient Air Quality) Measure Variation Instrument 2021

Particulate Matter Formation

Coarse and fine particles are fundamentally different in the ways they are:

- Made;
- Removed; and
- Measured in the atmosphere.

Coarse particles (dust) are mostly mechanically generated and removed through sedimentation. Measured as PM10.

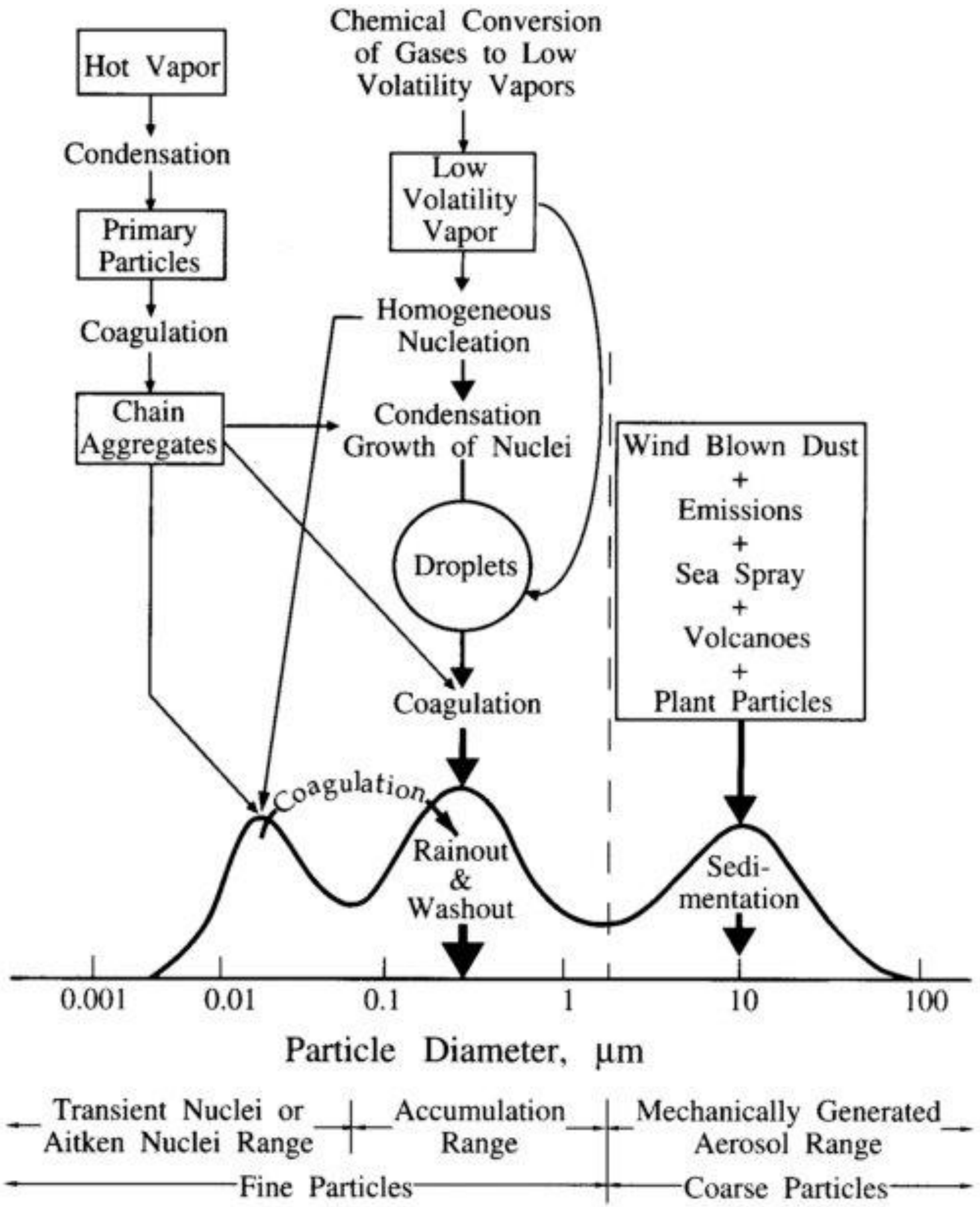


Particulate Matter Formation

Coarse and fine particles are fundamentally different in the ways they are:

- Made;
- Removed; and
- Measured in the atmosphere.

Fine particles (haze) are mostly chemically generated and removed through washout. Measured as PM2.5.



Particulate Matter – HVO

Open pit coal mining produces primary particulate matter:

- Blasting, crushing, grinding, coal preparation, handling and transportation.
- Mostly PM10.

Diesel engines also create PM2.5 (plus NO_x). Non-road diesel trucks not required to implement emission control measures.

Secondary PM2.5 particle formation is a concern. Primary mine site emissions (NO_x, VOCs) can mix and react with other pollutants (ammonia, SO_2, biogenic VOCs) to create new particles like sulfates and nitrates.

Particulate Matter – Hunter Valley

Existing coal mining operations:

- Similar to HVO

Coal fired power station:

- PM2.5, SO_2 and NO_x

Wood fireplaces:

- Soot (smoke)

Agriculture:

- Ammonia (NH_3)

Table 1: Mean annual PM2.5 levels (μg/m³) at the Muswellbrook, Singleton, and Camberwell air quality stations.

	Muswellbrook	Singleton	Camberwell
2011	9.1	7.6	-
2012	10.1	8.0	7.5
2013	9.4	7.9	8.2
2014	9.7	7.8	7.8
2015	8.7	7.6	7.2
2016	8.4	7.9	7.5
2017	9.4	8.2	7.4
2018	9.4	8.1	8.4
2019*	12.2	10.9	10.5
2020	9.3	8.4	7.5
2021	7.3	6.3	5.7
2022	6.2	5.1	4.8
2023	7.5	6.7	6.1
2024	7.1	-	5.9

*Substantially bushfire impacted measurements.

Particulate Matter – Hunter Valley

Chemical composition of these particles is known. At Muswellbrook:

36 % secondary particles (sulfates, nitrates, and aged salt)

11 % soil (inc. coal dust)

8 % vehicle/industry (inc. diesel particulates)

Dispersion modelling of primary particle emissions will always be a severe under-estimate for PM2.5.

Control measures that focus on dust suppression instead of secondary PM pre-cursors will be ineffective.

Hibberd, M. F., Selleck, P. W., Keywood, M. D., Cohen, D. D., Stelcer, E., and Atanacio, A. J., Upper Hunter Particle Characterisation Study, CSIRO, Australia.

Proponent's Air Quality Assessment

Air Quality Impact Assessment (AQIA) estimates an average burden of 0.8 $\mu g/m^3$ to sensitive receptors.

- Primary particulate matter only.
- Not a small component of PM2.5 budget.

Project-specific impact is very similar to that of the original project. The Amendment Report is incorrect in making such statements as:

> The amended Project is unlikely to affect air quality beyond the range of historically measured fluctuations of key air quality indicators around the region. In addition, it poses a lower air quality risk than the original Project as presented in the EIS (EMM 2022a), due largely to the significantly (approximately 23%) lower quantities of material to be moved in each year.

Amendment Report AQIA estimates are only lower because of a newly-chosen PM2.5 assumed background.

Proponent's Air Quality Assessment

New assumed background (around 5 $\mu g/m^3$) is inconsistent with long-term measurements in the region (*e.g.* at Camberwell; Table 1). NSW EPA points out deficiencies in the assumed background, which are never satisfactorily addressed.

I have recalculated mean PM2.5 exposure at sensitive receptors using the assumed background from the initial project EIS, and the predicted impact is now almost identical:

- Amendment Project not predicted to have lower PM2.5 impact than initial proposal.
- 35 sensitive receptors predicted to experience exceedance(s) of PM2.5 standard.
- Likely a best-case scenario, as it ignores climate extremes and secondary particles.

Department’s Air Quality Assessment

The SSD Assessment Report is in my opinion in error when it finds:

> Air quality was assessed in accordance with the EPA’s *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (2022), using worst-case future scenarios (2029, 2034 and 2041) and cumulative modelling that incorporated surrounding approved mines.

Air quality modelling has not been carried out using an assumed background consistent with the Approved Methods, it neglects future climate scenarios, and it omits the main known source of PM2.5 in the region (secondary particles).

Department's Air Quality Assessment

Recommendations in the Assessment Report with respect to annual PM2.5 pollution are based on the 8 $\mu g/m^3$ standard. I do not see where they have considered meeting the goal of 7 $\mu g/m^3$ which entered into effect in 2025.

I have evaluated the dispersion modelling results against the 7 $\mu g/m^3$ goal.

From the Amendment Report modelling, 30 sensitive receptors are predicted to experience an exceedance of the PM2.5 goal.

When the dispersion modelling results are adjusted using the original EIS background, 91 sensitive receptors are predicted to experience an exceedance of the PM2.5 goal, with 64 of these exceedances attributable to HVO project pollution.

Mitigation Measures

The SSD Assessment Report includes mitigation measures for short-term exposure to dust pollution, such as real-time dust monitoring with proactive and reactive measures.

There are no real measures to reduce the long-term intensity of PM2.5 emission generation.

One feasible measure is to require Tier 4 emissions controls on new diesel-powered machinery.

More substantial reductions likely require reduced mining intensity and coal production.

Summary of Opinions

- The HVO project will create substantial PM2.5 pollution in the region.
- Dispersion modelling of this pollution is inadequate and flawed. When partially corrected, it predicts substantial exceedances of the annual PM2.5 standard of 8 $\mu g/m^3$ for numerous sensitive receptors.
- Impact assessments have not engaged with the current goal of 7 $\mu g/m^3$ for PM2.5 exposure.
- Many sensitive receptors predicted to exceed this PM2.5 goal for decades to come, exposed to air that is well-established as being harmful to human health.
- Department's assessment report does not include mitigation measures for long-term PM2.5 exposure, instead focusing on the easier problem of controlling short-term PM10 emissions.