Submission No 33

INQUIRY INTO HEALTH IMPACTS OF EXPOSURE TO POOR LEVELS OF AIR QUALITY RESULTING FROM BUSHFIRES AND DROUGHT

Organisation: Australian Nuclear Science and Technology Organisation - ANSTO

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Australian Government

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to the New South Wales Portfolio Committee No. 2 – Health Inquiry into the health impacts of exposure to poor levels of air quality resulting from bushfires and drought

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Contact

For further information in relation to this submission, please contact Government Affairs on (02) 9717 7399 or government.liaison@ansto.gov.au

ANSTO welcomes the opportunity to contribute to the inquiry into the health impacts of exposure to poor levels of air quality resulting from bushfires and drought. As one of the nation's leading research agencies with established capabilities and expertise in air quality monitoring, characterisation and source identification, ANSTO is well-placed to comment on a number of the committee's terms of reference.

About ANSTO

The Australian Nuclear Science and Technology Organisation (ANSTO) is Australia's national nuclear research and development organisation, and the centre of Australian nuclear expertise. ANSTO operates a large proportion of Australia's landmark research infrastructure, including the OPAL multipurpose reactor, the Australian Synchrotron, the Australian Centre for Neutron Scattering (ACNS), and the Centre for Accelerator Science (CAS). This infrastructure places New South Wales (NSW) and Australia at the forefront of research and innovation for the benefit of public health, industry and the environment, and is used by universities, researchers and industry from around Australia and internationally.

While ANSTO is best known for the production of lifesaving nuclear medicine, it also applies its unique expertise to conduct and facilitate research into other areas of national importance, including air pollution. ANSTO has a long history of studying climate change, air pollution and extreme weather events, including bushfires, as well as working with national and international collaborators to understand the impact on our environment. By building on our understanding of past and current events, we are able to inform and improve our responses and proactive management practices, and thereby reduce the impact of such events.

Air pollution has now become one of the most lethal environmental health threats globally. According to recent estimates by the World Health Organisation (WHO), about 7 million deaths result from cancer, heart disease and pulmonary illnesses caused by the combined effect of outdoor and household air pollution around the world every year[1]. The NSW Government estimates that around 520 people die prematurely each year in NSW due to fine particle air pollution[2].

Capabilities

Centre for Accelerator Science (CAS)

CAS has been applying accelerator-based ion beam analysis (IBA) techniques to measurement, characterisation and source apportionment of fine particle pollution, including bushfire smoke, topsoil and dust, across Australia and throughout Asia since 1989. The high-sensitivity particle accelerators enable scientists to determine elemental air pollution 'fingerprints', quantifying the sources and origin of air pollution with great precision. This includes analysis of fine particle pollution, generated naturally (e.g. from fires) or man-made (e.g. fossil fuel combustion), and consequent impacts on the environment and human health. This capability and expertise are unique in Australia and are also widely drawn upon by our regional neighbours.

[1] https://www.who.int/health-topics/air-pollution#tab=tab_1

[2] https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Air/clean-air-for-nsw-consultation-paper-160415.pdf

Outside the terms of reference for this inquiry, CAS also has the capability to study individual micron-sized particles and undertake isotopic dating that enables researchers to develop historical climate and atmospheric records through the analysis of bedrock surfaces, caves, tree rings, corals and sedimentary deposits, for example.

Multi-wavelength Absorption Black carbon Instrument (MABI)

ANSTO's MABI technology was developed to improve accuracy in air quality monitoring and characterisation, including in distinguishing black carbon soot particles emitted from bushfires from black carbon emitted from the burning of fossil fuel. Black carbon is one of the most significant constituents of atmospheric fine particle pollution, and has impacts on health, visibility and climate change.

MABI can determine the severity of urban air pollution because black carbon is a key component of the fine particles that are detrimental to the environment and human health. By measuring black carbon on each filter, scientists can distinguish between black carbon from diesel vehicles formed at high temperatures and black carbon formed in lower temperature biomass burning or bushfires. The MABI instrument has been sold into 40 different countries, including to the International Atomic Energy Agency's (IAEA) environmental monitoring facility in Vienna.

Aerosol Sampling Program (ASP)

ANSTO has played a leading role in measuring, characterising and sourcing fine particle pollution at a range of locations across Australia, Asia and internationally. We hold several comprehensive multi-decadal fine particle composition datasets covering NSW and the larger Asian region. This data is used by our partners in Australia and across the world for health studies and to improve air quality by guiding environmental protection measures.

ANSTO's Aerosol Sampling Program (ASP) has been running for almost 30 years with routine sample collections taken at a number of Australian sites as well as within Asia, leading to a dataset with more than 18,000 sampling days in them and a historical archive at ANSTO of more than 65,000 filters, dating back to 1991[3].

These monitoring programs rely on collection of air pollution (particulate) samples by filtration and then subsequent analysis by CAS back at ANSTO. Typically, Teflon filters are placed at urban or industry sites of interest from midnight to midnight twice a week. These filters are sent to ANSTO and are analysed by Accelerator-based Ion Beam Analysis (IBA) techniques. These techniques are ideally suited to this task, as they have the sensitivity to non-destructively measure a large suite of elements from hydrogen to lead at a concentration level as small as nanograms per cubic metre of air sampled. This approach can detect more than 20 different elements, including toxic chemicals such as chromium, cobalt, sulphur, lead and nickel. The elemental composition of each filter is then used to determine source 'fingerprints' and their contribution to the total mass of fine particles on the filters. This is done using unique statistical Positive Matrix Factorisation (PMF) methods introduced into Australia by ANSTO researchers in 1996. This method enables between six and nine different pollution sources to be identified for each sampled day. When this information is combined with wind speed and direction trajectory data, the source locations can be determined.

[3] https://www.ansto.gov.au/research/programs/environment/impact-of-contaminants/air-quality/asp-databases

Bushfires

In the Australian context, the issue of concern is the health effect of inhaling particulate matter, and in particular particles with diameters less than 2.5µm (PM2.5). These very small particles originate mainly from combustion products – coal-fired power stations, automobiles, biomass burning and industry, and from bushfires.

The average annual PM2.5 mass levels across the greater Sydney region are currently typically 6-8 µg/m^3. NSW Health estimates that these PM2.5 levels in the Greater Metropolitan Regions of NSW are responsible for 420 premature deaths each year. Dust storms and bushfires can raise these levels to several hundred µg/m^3 on any given day, noting that the 'poor air quality' threshold is 25 µg/m^3.

The recent bushfire events have seen particulate levels rise substantially beyond the 'poor air quality' threshold, leading to a significantly greater potential health risk. Hazardous levels of PM2.5 were reached on 118 days in NSW in 2019, more than twice the number of days reached in 2018 (52 days).

Public perception is that visibly bad pollution days during the fire seasons are largely due to the smoke. However, ANSTO research shows there may be other sources such as dust or topsoil (often present during bushfire seasons because of dry and windy conditions) that may contribute. Differentiation of the types and sources of particulates, particularly during times of significantly elevated levels of air pollution, is important in managing the health risks associated with bushfire conditions. It is in these scenarios that ANSTO's highly specialised capabilities are critical, as they not only measure fine air particle mass (as NSW EPA does), but also determines the sources that make up this mass. This provides substantial insight into what is actually in the air, providing more information for public health and environmental impact analyses. This in turn can support Government in shaping policy, preparations and responses to bushfire events, as well as in addressing industrial pollution. Evidence of the impact ANSTO's work can have in improving management and responses to environmental concerns can be seen through its work in the international space and in over 15 countries throughout the Asian region.

Potential Contributions as modelled by International Experience

ANSTO maintains the Asia-Pacific Aerosol Database project, which involves fifteen countries as part of the Regional Co-operative Agreement (RCA) under the International Atomic Energy Agency (IAEA). Air sampling in this project has been undertaken weekly or bi-weekly in fifteen countries since 2002 and has been critical in the development of new models of air pollution and reduction strategies, given the improved accuracy of measurements and ability to locate pollution sources.

In many countries, the database is used to guide environmental protection measures, such as the issuing of advisories and regulatory activity. The results gained have also offered essential information to pollution regulators, such as the environmental protection agencies, for policy decisions and issuance of standards in relation to air pollution. Examples include the banning of leaded petrol in five countries in major urban areas based on high lead levels found in blood samples of local children; the government of Bangladesh proclaimed an order banning two-stroke engines, which took out the major portion of vehicle emissions of fine particles in Dhaka; and 13 out of 15 participating countries establishing their own air pollution programs to address respective air particulate problems by 2019.

It has also led to the detection and identification of pollution sources, including the long range transport of secondary sulphur from coal fired power stations in China into Vietnam, smoke from forest fires in Indonesia into Malaysia, dust from the Gobi desert in China to Korea and Japan, smog haze from India into Pakistan and sulphur emissions from Indonesian volcanoes across the Indonesia archipelago.

ANSTO has the ability to undertake this same work to help support the NSW Government's policies, environmental management and the identification of public health challenges from both man-made and natural air pollutants, including in preparing for and responding to bushfire and drought events.

Supporting NSW Government

There are nine long-term Australian sampling sites with continuous bi-weekly data from 1998 to the present - at Warrawong, Mascot, Lucas Heights, Richmond, Liverpool, Mayfield, Stockton, Muswellbrook and Cape Grim. As can be seen, eight of those sites are located in Sydney, the Illawarra or the Hunter Valley. Research and industry partners include BHP, Alcoa, some State EPAs, mining companies in the Hunter Valley and local councils in Sydney and Newcastle.

In the past five years, ANSTO has completed major PM2.5 pollution studies in collaboration with CSIRO, NSW Office of Environment and Heritage, ACT Health and local industry groups in the Upper Hunter, the Lower Hunter, the Greater Sydney Basin and Canberra. These studies have focused on characterising and quantifying source contributions to PM2.5 pollution from burning of wood for domestic heating, emission from open cut mining and industry, emissions from motor vehicles and natural emissions associated with windblown soils and sea spray.

Informing health policy including proactive and reactive responses to climate events

The NSW Office of Environment and Heritage has funded the past five years of operation of airborne particulate sampling sites at Stockton, Rockdale and Mayfield to access PM2.5 mass and source apportionment data. This information is key in identifying problematic public and industrial sites in terms of pollution.

ANSTO is uniquely placed to continue this support to the NSW Office of Environment and Heritage, the NSW Environment Protection Authority, the broader NSW Government and local councils by both measuring and characterising what is in the air, and tracking air quality across the state to better understand the impact of bushfire smoke. To do this, the development of a NSW Aerosol Sampling Program would be the most effective approach in advancing the NSW approach to air quality. This could be achieved by expanding the existing ANSTO network of sampling stations from sites clustered around Sydney, Newcastle and Wollongong to include regional NSW. The management of sampling sites is typically low maintenance, and therefore could be undertaken by a local farmer, business, council or mining representative who has received the relevant half-day training by ANSTO staff. Expanding to a state-based program would facilitate greater connectivity into regional and rural areas throughout NSW, working with locals and enabling coverage of the entire state in the management and understanding of air quality.

A NSW-wide Aerosol Sampling Program would enable analysis of a wider range of samples, improving understanding of the impact of natural disasters and fires, as well as man-made pollutants, on air quality throughout the state. These types of results would provide health experts and policy makers with the information required to make informed decisions in response to the environmental and health impacts of extreme climate events. These results could also be used to inform proactive mitigation strategies for future fire seasons and drought periods.

Supporting NSW Government in measurement, reporting and communication on air quality

ANSTO collects and keeps comprehensive records related to the Aerosol Sampling Program, the majority of which are made publically available through an online ANSTO database and the Australian National Data Service. This includes monthly summary sheets for a number of sampling sites in Australia and across Asia, with historical records dating back to 2001. This data can be supplied to support NSW Government reporting and analysis. However, as noted above, it would become even

more valuable if a state-wide sampling program was established. This would support comprehensive reporting for Government, as well as public communications, and would complement the EPA's current ability to provide near real-time data on concentrations of PM2.5 particles.

In light of its expertise and role as one of the nation's leading scientific organisations, ANSTO has the ability to work with the NSW Government in facilitating a deeper understanding of the nature of air pollution, the results and implications of air quality monitoring and characterisation as well as the impact of bushfire events. ANSTO's expertise in pollution type, source identification and apportionment can also support the NSW Government in strengthening its communication to the public. This may include the distribution and use of summary sheets for each sample site, seasonal or yearly retrospective reports on what was observed, as well as the production of fine particle contour maps (when enough test sites are present) to provide pollution level estimates across areas of both NSW and Australia. ANSTO can also work with local councils and state government on raising public awareness on the issue of air quality, with supporting evidence, experts and technologies.