Submission No 24

INQUIRY INTO HEALTH IMPACTS OF AIR POLLUTION IN THE SYDNEY BASIN

Organisation: Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Name: Dr John Carras

Position: Science Director

Telephone:

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Summary

Inquiry into the health impacts of air pollution in the Sydney basin

Legislative Council General Purpose Standing Committee No. 2

CSIRO submission

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CSIRO wishes to make a submission to the NSW Legislative Council's 'Inquiry into the Health Impacts of Air Pollution in the Sydney Basin'.

1. Introduction

CSIRO carries out research into the origins and impacts of air pollution and has considerable expertise in most aspects of air pollution science. CSIRO has worked with, and continues to work with, Commonwealth, State and Local governments as well as industry and the community in exploring air pollution issues and seeking solutions. CSIRO has traditionally focussed on elucidating the physical and chemical processes important for describing and controlling air pollutants in the atmosphere. In recent years, however, CSIRO research has begun investigating the impacts of different air pollution scenarios on human health.

2. Air Pollution in urban areas

In broad terms, air pollution in large urban areas is influenced by a number of factors including population distribution and growth; economic activity; distribution and type; transport infrastructure and patterns of usage and the natural features of the airshed including terrain and meteorology. In addition the nature of emissions is very important. Factors here include the chemical composition, the physical nature (whether the emissions are gases, liquids or solids) and whether the emissions emanate from individual stacks where air pollution impacts can be localised, or occur over much larger scales e.g. bushfire emissions, or are formed over wider areas from atmospheric chemical processes, e.g. ozone. As a result, measuring, managing and controlling air pollution in large urban areas is a significant challenge.

3. CSIRO's contribution to air pollution science in NSW

CSIRO has worked with the NSW Department of Environment and Conservation (DEC) and its predecessors and other State Government Departments and instrumentalities for over thirty years on a variety of air pollution-related issues. The interaction began with the Sydney Oxidant Study (mid-1970s) and continues to this day through joint work with DEC on measuring and modelling ozone concentrations in the Sydney region. Attachment 1 lists major studies CSIRO has been involved in which are of particular significance for NSW. In addition, CSIRO personnel have played roles in advising the DEC, other State Government instrumentalities and the community in relation to specific air quality issues (e.g. emissions from road tunnels and power stations).

4. Response to the Terms of Reference

The current submission considers the Terms of Reference in three groupings. These are:

- Those concerned predominantly with levels and occurrence of air pollution – Terms of Reference (a) to (c);
- Those concerned mainly with human health impacts - Terms of Reference (d) and (g); and
- Any other relevant matter - Terms of Reference (h)

4.1 'Air Pollution' Terms of Reference

a) *Changes in the emissions of various air pollutants and the impacts of those changes on air quality in the Sydney basin over the past three decades including any 'hot spots' where pollution is concentrated.*
b) *The impact of NSW air pollution laws (including the Clean Air Act 1961, the protection of the Environment Operations Act 1997 and any regulations made under those Acts) on air quality over the past three decades.*
c) *The causes of air pollution in Sydney over the past three decades.*

While CSIRO has extensive expertise in air pollution science, CSIRO does not carry out air quality monitoring on an ongoing basis in NSW. CSIRO work has tended to focus on specific pollution issues, be they of a local or more regional nature. Consequently, CSIRO information on air pollution monitoring is largely guided by data obtained by the NSW Department of Environment and Conservation and described in the NSW State of the Environment Report, 2003 (NSW SOE) and in Action for Air. Nevertheless, through its involvement with NSW over an extended period CSIRO is able to make a number of statements concerning the above three Terms of Reference, as follows;

- **Criteria pollutants**

Sulfur dioxide

The concentrations of sulfur dioxide in Sydney air would be expected to have declined with the siting of coal fired power stations in locations remote from the Sydney region, and with the general reduction in the sulfur content of transport fuels. NSW SOE indicates that this pollutant occurs at low concentrations in the Sydney region.

Lead

As anticipated, there has been a significant decline in the levels of airborne lead since the phasing out of lead in petrol in the 1980's.

Carbon Monoxide

NSW SOE suggests that carbon monoxide levels have been in decline, including in the Sydney CBD. There is, however, growing appreciation of the significance of the role played by carbon monoxide in photochemical smog formation.

Nitrogen dioxide

Nitrogen dioxide is both a primary emission from combustion processes, and also an important constituent of photochemical smog. Although improvements in motor vehicle emissions technology have lead to a reduction in nitrogen dioxide emissions for new vehicles, it is likely that reductions in the total emissions of nitrogen dioxide will be offset to some degree by increased vehicle numbers and a subsequent increase in the total vehicle kilometres travelled in Sydney. NSW SOE suggests that the levels of nitrogen dioxide have remained relatively stable over recent years.

Ozone

Ozone is not emitted directly into the atmosphere but is the product of photochemical smog forming reactions that take place in the atmosphere and that are driven by the concentrations of precursor compounds, sunlight and temperature. The precursor compounds include a number of volatile organic compounds (VOC), nitrogen oxides (NO_x) and carbon monoxide. The major sources of VOC are industrial processes, transport fuels (petrol), commercial–domestic users (e.g. surface coatings, solvents) and vegetation (biogenics).

The chemical reactions that form photochemical smog (of which ozone is the main constituent) are complex and it normally takes a number of hours before the ozone concentrations approach significant levels. While the major features of ozone formation chemistry have been known for many years there are still details that have not been elucidated. In addition meteorological conditions play an important role. Days with significant ozone concentrations tend to be characterized by summer conditions where temperature and sunlight are optimum, atmospheric mixing heights are low and wind speeds are low to moderate. As the pollutant mix of precursors moves with the prevailing wind, and the ozone formed tends not to achieve its maximum concentrations for some hours, ozone peaks generally occur many kilometres downwind of precursor source regions. For example, the emissions of precursors from the central part of Sydney typically impact most on the western and south-western areas of Sydney, and the rural areas beyond.

While there have been improvements in control of precursor emissions, e.g. vehicle emission control technology has improved dramatically over the last two decades and emissions have generally declined from individual vehicles, the emissions of precursor compounds tend to follow broad population trends, which are not declining.

In addition to the above, there is also a 'natural' ozone signal as a result of the chemical reactions that occur between the naturally occurring NO_x and the biogenic emissions of VOC. This typically produces peak natural ozone concentrations which can be about 30% of the National Environment Protection Measure (NEPM) standard. As a result and because of the complex nature of its formation, ozone remains a very difficult pollutant to control in Sydney. This is borne out by the NSW SOE data which show that Sydney continues to be challenged by the one hour average and the four hour average standards for ozone concentration. CSIRO is currently working with DEC, undertaking a program of ambient precursor measurements, analysis and airshed modelling, in order to further improve predictions of ozone occurrence for input into future policy considerations.

Fine particles (PM10)

Fine particles are comprised of a complex mixture of solid and liquid particles (with both solid and liquid phases present in some particles) suspended in the air. As the particles are not normally of uniform size or shape, it has become common to regulate particles according to size. For instance, PM10 refers to particles that have equivalent diameters that are predominantly less than 10 micrometre (or ten millionths of a metre).

The importance of fine particle pollution has received considerable attention in recent years because of the finding that human mortality and morbidity could be correlated directly with fine particle loadings in the atmosphere.

Fine particle emissions arise from a variety of sources including wind blown dust, bushfire smoke, industrial, domestic and combustion sources including motor vehicles, particularly diesels. While industrial sources are subject to emissions controls as specified by NSW DEC, other combustion sources such as bushfires cannot be. Over the past twenty years the banning of backyard burning has removed a previously significant source.

Another source of fine particles is those formed from the photochemical processes described, above. These are known as 'secondary aerosols' as they are not emitted directly, but are formed in the atmosphere from chemical reactions of other pollutants. Formation of secondary aerosol is a complex area of science and one that is not completely understood at present. It is an area where considerably more work is required to be able to predict the concentrations which may be expected under changed emission conditions.

The NSW SOE suggests that peak concentrations of ambient levels of fine particle concentrations, as PM10, are largely dominated by bushfires.

In recent years there has been growing appreciation that PM2.5 (particles predominantly smaller than 2.5 micrometre) and even smaller size fraction are more important for health impacts than PM10. As a result a reporting standard for PM2.5 has been introduced across Australia. CSIRO is actively working in the area of aerosol science, undertaking programs of ambient measurement, physical and computer modelling in order to provide tools which authorities, including NSW DEC, will be able to use for informing future policy considerations.

- **Air toxics**

Air toxics is the general name given to other air pollutants of environmental and health significance which are known to accumulate in the human body and lead to chronic health impacts such as cancer. These consist of a number of metals and inorganic and organic chemical compounds. Air toxics, which are ubiquitous to urban areas have been identified by Action for Air as a priority area.

State of the Environment reporting for NSW suggests that the compounds benzene, polycyclic aromatic hydrocarbons (PAHs) and 1,3-butadiene are of most concern in NSW. In addition the NSW SOE comments

that emissions of dioxins to the atmosphere have reduced in NSW as a result of new regulations. CSIRO is currently working with DEC on the development of tools for accurately modelling reactive ambient air toxics, again for the purpose of better informing future policy considerations.

4.2 Health Impacts Terms of Reference

d) *The health impacts of air pollution on any at risk health groups.*
e) *The financial impacts of air pollution on any 'at risk' groups.*
f) *The effectiveness of current laws and programmes on mitigating air pollution.*
g) *Strategies to reduce health impacts of air pollutants.*

Over the past few years, CSIRO has launched the National Research Flagships initiative which targets CSIRO research in a number of areas of major national significance. One of these areas is in Preventative Health which includes a project to develop numerical modelling techniques for forecasting the short-term (one to seven days) health impacts of changes in urban air quality. A system has now been developed for forecasting daily hospital admission rates as a function of meteorological and air quality variables, and other factors such as time of year and the presence of 'flu within an urban population.

4.3 Other Relevant Matters Term of Reference

h) *Any other relevant matters*

There are a number of other air pollution matters of relevance to the Sydney Basin in which CSIRO has expertise and wishes to comment. These are listed below with a brief indication of the issue;

- The implications for human health of changes to air quality resulting from the increasing use of motor vehicle tunnels. The issues here are air quality in the tunnel, the impact of changed traffic flows on feeder roads and the impact of air pollutant emissions from tunnel vent stacks and tunnel portals.
- The impact of global warming on air quality (and the associated health impacts) in Sydney. Global warming may result in increased incidence of hot days and drier conditions which may lead to an increased number of photochemical smog events, bushfires and dust storms. CSIRO is currently working with DEC on a methodology for detecting the impact of climate change on ozone levels.
- The current levels of photochemical smog in Sydney and the lack of downward trend, particularly for the four hour average. A new lower standard for ozone would be even more difficult to achieve. CSIRO is currently working with DEC on issues related to ozone management.
- The balancing of controlled burning and reduced risk of bushfires with urban fine particle pollution and the increased risk of health impacts. The issue here is the ability to make accurate forecasts of local meteorological conditions so that the plume pathways for emissions for controlled burning can be predicted in advance and thereby reduce the of risk of smoke plumes impacting urban or regional population centres.
- The formation of secondary aerosol air pollution and the associated health impacts. A much better scientific understanding of this issue is required for the Sydney airshed. CSIRO is currently developing tools for identifying and quantifying secondary organic aerosols in Australian cities.
- Quantification of emissions and chemical fate of air toxics emissions from transport and large industrial sources. As indicated previously, CSIRO is currently working with DEC on air toxics.

5. Concluding Remark

CSIRO is happy to provide further details of any of the above, if required.

6. References

NSW State of the Environment Report SOE (2003) - http://www.epa.nsw.gov.au/soe/soe2003/chapter3

Action for Air, the NSW Government's 25 – Year Air Quality Management Plan

Attachment 1

Summary of major CSIRO involvement with NSW Government Departments and instrumentalities

Year	Dept	Study
1975	SPCC	Sydney Oxidant Study
1978	SPCC	Brown Haze Study
1980	ECNSW	Plume studies from Liddell power station
1986	SPCC/ECNSW	Acid rain in the Hunter Valley
1990	ECNSW	Plume studies in the Hunter Valley
1990	SPCC	Pilot study: Evaluation of air quality issues for the development of Macarthur South and South Creek Valley regions of Sydney
1993	PPI	Cogeneration of electricity: an investigation of air quality issues for the Sydney region
1994	RTA	Traffic generated pollution near roads and highways
1996	EPA NSW	Metropolitan Air Quality Study, MAQS
1998	EPA NSW	Quantifying ozone impacts for the Petrohol Study
1998	EPA NSW	Measurements of toxic air pollutants in the exhaust emissions from diesel and compressed natural gas (ethanol) vehicles
1999	RTA	Development of a model to estimate fuel consumption and pollutant emissions from motor vehicles on major roads in the Sydney area
2000	SERDF	Reactive NOx emissions management for energy efficiency and air pollution control
2001	DEH	Air Quality Forecasting for Australia's major cities, AAQFS
2002	PPI	Inter-regional Transport of air pollutants Study (IRTAPS)
2003	DEC	Air quality impacts from the use of a 10% ethanol-blended fuel in the Sydney greater metropolitan region.
2003	DEC	The impact of changes in motor vehicle fuel characteristics on photochemical smog production in the Sydney greater metropolitan region
2004	RTA	Assessment of air toxic organic compounds in the tailpipe emissions from diesel and alternative-diesel fuelled engines
2004	Environment Trust- NSW	Biogenic emissions in the greater Sydney region
2004	EPA	A study of inter-regional transport of NO_x and ozone in the greater Sydney region – Stage 1: Tracer transport
2006	DEC	Speciation of volatile organic compounds in the Sydney basin

In addition to the above studies, CSIRO has provided information and comment on a variety of air pollution matters over the past three decades. Most recently these have included;

Dr Merched Azzi – Assessment of ozone potential and ozone management in the Sydney Basin.

Dr John Carras – DEC Director General's Nominee (Independent) on the NSW Load Based Licensing Technical Review Panel.

Dr Martin Cope – Assessment on the adoption of ethanol-blended petrol and the associated changes to photochemical smog concentrations in Sydney.

Dr Mark Hibberd – Impact of emissions from M5 East stack for NSW Health and Member of Independent Monitoring Committee for Orica's Botany Bay Groundwater Project

Dr Peter Manins – Technical Advisor to both the Lane Cove and Cross City Tunnel Air Quality Community Consultative Committees; Submissions on air quality issues to NSW Parliamentary Committees on the Cross City and M5 East Tunnels