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Senate Standing Committees on Community Affairs
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RE: THE IMPACTS ON HEALTH OF AIR QUALITY IN AUSTRALIA

Asthma in Australia

More than 2.2 million (10%) of Australians have asthma and in 2009, asthma was the cause of death for 411 Australians.[1] We don't know the cause and don't yet have a cure[2]. Many people with asthma report poorer quality of life; a substantially higher proportion of days of reduced activity with impacts on physical and social activity; and poorer mental health[3].

Evidence[4] consistently shows that people with asthma and their carers urgently need more information and community support to safely self manage their asthma. Asthma Australia, working through its state and territory Foundations and strong intersectoral partnerships, has the skills, experience and mandate to do this work.

Asthma Australia

Asthma Australia is the recognised national community voice of Australians with asthma and linked conditions and their carers. It comprises the Asthma Foundations from each Australian state and territory working together on national policy, advocacy and programs and promoting research. It is a national, nongovernment, incorporated body with no political affiliations.

Introduction

This paper is being submitted by Asthma Foundation New South Wales (AFNSW). AFNSW has been a strong advocate for clean air and has run many high-profile campaigns on the need to reduce various kinds of air pollution including unflued gas heaters; road tunnels; coal-fired and gas power stations; wood-fired heaters; traffic; and bushfire emissions. For this reason, AFNSW has authored this submission and much of the perspective is NSW specific, based on our experience.

AFNSW will be the point of contact for Asthma Australia and its Member Foundations in this Committee Inquiry. Asthma Australia and all its Member Foundations look forward to further opportunities, through the work of the Committee and its report recommendations, to enabling people with asthma, and their carers, to have a genuine voice in decision making about the quality of air we breathe and associated health and quality of life outcomes for them and all Australians.

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[1] Australian Centre for Asthma Monitoring [ACAM] 2008 *Asthma in Australia 2008* AIHW Asthma Series no. 3.Cat. no. ACM 14. Canberra: AIHW.
[2] Asthma Australia, *Asthma basic facts*, 2012
[3] ACAM ibid
[4] Centre for Health Initiatives , The self management needs and wants of adults with asthma in NSW. Gillian Stillfired, Sandra Jones and Kelly Andrews, 2010 (embargoed)

Air pollution is a major contributor to asthma related hospitalisations and mortalities as is highlighted in this paper. Our role as the representative voice for asthma consumers and carers is to advocate for cleaner air and educate the general public about the risks of air pollution. Asthma Foundations across Australia provide consumer information through community programs, a telephone information line, websites, brochures and newsletters on how best to reduce the effects of air pollution for people with asthma.

This document is organised in the following way:

1. Causes of air pollution over the past three decades

2. Health impact of air pollution on people with asthma

3. What we believe needs to be done to improve current air pollution levels to improve health outcomes for people living with asthma.

Sincerely

Debra Kay
Chief Executive Officer
Asthma Australia

8 March 2013

Executive Summary

The harvesting and the use of hydrocarbons as our principal sources of energy exacts a heavy social, health and economic toll that has yet to be adequately studied or quantified in Australia, which lags some way behind the rest of the developed world in this respect. Despite the known health effects of the coal lifecycle no local studies have been conducted in the past two decades – a situation that must be rectified.

The existing modus operandi not only allows, but rewards polluters and asks little in return. It is the Australian taxpayer, who is not only asked to bear the health burden, but the financial cost of generous subsidies handed out to coal mining in particular.

A considerable issue for Federal and state governments, is the escalating cost of public health, which has increased by a massive 40% in the past five years alone.[5] The coal industry provides an important source of government revenue by way of royalties and taxes. However this needs to be considered in the context of the health and social costs that are created by the coal industry's activities.

When you consider the long term health costs and the relatively short term life-span of coal in a post-Kyoto world, is coal, which pollutes the atmosphere at every step of the exploration, extraction, transport and generation phase of its lifecycle, really such a good deal?

When considering the effects of air pollution most of the media and public attention is focused on the production of CO2 and its longer term affect on the temperatures of the oceans and the ice cover at both poles. While this is undoubtedly a major concern the short-term health effects of air pollution and the immediate "health dividend" that could be gained from cutting hydrocarbon emissions receive much less of a focus from both the media and government.

Perhaps the reason Australia is so far behind most developed countries in realising that hydrocarbons are a serious health issue and implementing measures to limit them is that its air pollution issues are not yet as acute as other parts of the world and coal is such a major export earner. However, the public health impacts in areas like the Hunter Valley and the Blue Mountains suggest urgent action is needed.

This submission has made a number of recommendations that AFNSW believes can make an immediate difference.

AFNSW recommendations include:

Vehicle emissions

- Develop air quality standards for the more harmful particles of PM2.5 and smaller
- Develop initiatives to reduce car use, including investment in public transport infrastructure
- Implement initiatives aimed at reducing vehicle emissions

Tunnels

In the short term:

- Public information campaign re health risks.
- Effective warning signs, appropriately placed, so that motorists can exit the tunnel route in the event of a high pollution warning.
- A commitment to "real time" monitoring of CO, CO2, NO2 and particulate matter PM1-10 in the M5 tunnel.

[5] Australian Federal Government *Key Initiatives of the 2012- 13 Budget* http://www.budget.gov.au/2012-13/content/overview/html/overview_key_initiatives.htm Viewed 1/3/2013

In the medium term:

- The need to establish health based exposure limit for CO, NO2 and PM 1-10 in the M5.
- Air quality standards (CO, NO2, PM1-10) for road tunnels based on best practice international models.
- Emission mitigation measures including the mandatory fitting of *oxidation catalysts and particle traps* in all diesel vehicles and the retrofitting of the tunnel with Electrostatic Precipitator (ESP) technology.

Woodsmoke heaters

- Reduce particle emissions and increase efficiency levels of wood burners
- Remove old wood burning heaters as properties are sold
- Consider a buy-back or a rebate scheme

Coal

- Undertake well designed local studies to obtain primary evidence to accurately quantify the health impacts of coal mining and combustion.
- The establishment of a statutory authority independent of government and the coal industry to undertake all monitoring of harmful impacts to land, air and water from coal mines and power stations.
- Comprehensive cost benefit analysis including all health, social and environmental externalities to be undertaken before the approval of any new coal mines, mine expansions or coal power stations.
- A minimum buffer zone between human habitation and all new open cut coal mines, mine expansions, coal and port infrastructure.
- Comprehensive monitoring of PM 10 and 2.5 particulates by the independent authority
- Develop a "Utility Air Toxics" law to limit emissions of toxins known to be harmful to human health.
- Removal of the diesel fuel subsidy for mining activities.
- Mandatory adoption of new technology shown to cut emissions.

Air quality monitoring

- Introduce a comprehensive air quality monitoring system which measures particles right down to 0.1 microns. Ensure monitors are placed in high pollution areas to identify when pollution levels exceed national standards, and enable action to be taken to reduce these levels and prevent undesirable health impacts.

A final word

AFNSW congratulates the Federal Government on this Inquiry into the impacts of air quality on health, and looks forward to seeing actions taken to both improve the standard of air quality monitoring in Australia and to initiate strategies to reduce the impact of activities that are detrimental to the quality of our air.

Sincerely

Michele Goldman
Chief Executive Officer
Asthma Foundation NSW

8 March 2013

Air pollution and Asthma

1. Causes of air pollution over the past three decades

The causes of pollution are manifold. Domestic activities such as using wood burning stoves, commercial activities such as driving goods from A to B, industrial processes such as incineration and smelting and conservation measures such as fire hazard reduction (burn-off) as well as a significant increase in population and car ownership all contribute to the problem.

The major sources of air pollution that most affect people with asthma are principally man-made hydrocarbon pollutants and include: motor vehicle emissions, woodsmoke, gas (natural and coal seam) and "the coal cycle." Scientific studies have proven that these all have adverse health effects. This submission will concentrate only on the sources of pollution with the most significant impact on people with asthma.

Although overall pollution levels have decreased during the past three decades, pollution caused by motor vehicle emissions remains high. Certain pollutants such as ozone and particulate matter smaller than 10µm (PM_{10}) and particulate matter smaller than 2.5 µm ($PM_{2.5}$) are of major concern because their peak concentrations exceed the National Environment Protection Measure (NEPM) standards[6] in cities like Sydney. Worryingly, there is no pollution monitoring in the heart of our most populous, most polluted city, Sydney. [7] Research has shown that it is particles of PM2.5 and smaller that reach the lungs and lodge in the respiratory tracts that increase asthma exacerbations and admissions to hospitals and the NSW Government has admitted air pollution kills more people in Sydney each year than car accidents.[8]

[6] Department of the Environment and Heritage April 2004, State of the air: national ambient air quality status and trends report 1991 – 2001.

[7] "Auditor-general pulls veil on Sydney's dirty air"

by Anne Davies, Sydney Morning Herlad - April, 2005

[8] "Pollution is killing hundreds" by Sharri Markson 28/5/2006 Sunday Telegraph

[5] Adapted from Tord E Kjellstorm, Anne Neller and Rod W Simpson, Air Pollution and its health impacts: the changing panorama MJA 2002; 117

1.1 Man-made pollutants

Air pollution is made up of a range of pollutants including; particles, sulphur dioxide, nitrogen oxides, ozone, carbon monoxide and lead. Of these pollutants a number have been shown to have direct health effects on people with asthma.

The following table[9] outlines the pollutants with known health effects on people with asthma and their primary source.

Pollutant group (primary source)	Known health effects
Airborne particles (primarily from combustion sources such as power stations, petrol and diesel – powered motor vehicles, wood heaters, fireplaces and incinerators)	• PM10 deposit in respiratory tract • PM2.5 penetrate deep into the smaller airways • Exacerbation of respiratory diseases • Increase in asthma requiring hospital admission
Sulphur dioxide (combustion of sulphur containing fossil fuels)	• Respiratory tract irritation • Triggers asthma episodes
Nitrogen Oxides (measured as nitrogen dioxide) (biomass and fossil fuel consumption, tobacco smoke and exhaust fumes)	• Respiratory tract infection, especially in children • Exacerbation of asthma • Increase in asthma requiring hospital admission
Ozone (reaction product of sunlight and vehicle pollutants; hydrocarbons and oxides of nitrogen)	• Respiratory tract infection, especially in children • Exacerbation of asthma • Increase in asthma requiring hospital admission • Reduced exercise capacity

High levels of particulate matter and ozone in the environment remain a concern for people with asthma and we believe it is vital that strategies are employed to reduce these levels to meet the NEPM standards.

1.2 Natural Pollutants

Natural pollutants are important to mention here because although they are difficult to control, they have a significant effect on people with asthma.

Bushfires are a natural phenomenon, which create an increase in particulate matter, causing an increase in respiratory admissions to hospital[10] [11]. Back burning measures used to control bush fires are also responsible for increases in air pollution. Over the last three decades, air pollution from bush fires is commonly experienced every summer in Sydney, most significantly in 1994 and 2002 during large-scale bushfires. Thunderstorms in rural NSW are responsible for concentrating grass pollens in the air, which in summer and spring may be responsible for up to 50% of asthma exacerbations in the area. While controlling air pollutants caused by natural phenomena is difficult, health targeted

[10] Cooper C, Mira M, Danforth M, Abraham K, Fasher B and Bolton P. Acute exacerbations of asthma and bushfires. Lancet 343:1509 1994

[11] Jalaludin B, Smith M, O'Toole B and Leeder SR, Acute effects of bushfires on peak expiratory flow rates in children with wheeze: a time series analysis. Australian and New Zealand Journal of Public Health 24: 174-77 2000.

seasonal promotion campaigns which educate people on how to best protect themselves from these pollutants are essential to reduce asthma exacerbations and hospitalisations.

2. Health impact of air pollution on people with asthma

The health impact from air pollution may have both short and long term effects. The short-term effects caused by variations to pollution exposure may result in exacerbations of pre-existing illness, admission to hospital and in some cases death.

A long-term prospective study of adults in the United States showed that chronic levels of higher PM10 pollution were associated with increased mortality after adjusting for several individual risk factors. Daily fluctuations in PM10 levels were shown to be related to acute respiratory hospital admissions in children, to school and kindergarten absences, to decrements in peak flow rates in normal children, and to increased medication use in children and adults with asthma[12].

A review study by the American Thoracic Society showed that the respiratory health effects from air pollution include more than just the clinical outcomes (such as hospital admissions, loss of lung function and mortality); they also include diminished quality of life and are the cause of symptoms which interfere with daily activities.

The following list outlines the adverse respiratory effects of air pollution as reported in the review paper:

- Increased mortality.
- Increased incidence of lung cancer.
- Increased frequency of symptomatic asthma attacks.
- Increased incidence of lower respiratory tract infections.
- Increased exacerbation of chronic cardiopulmonary or other diseases, reflected in various ways, including reduced ability to cope with daily activities, increased hospitalisation, increased physician visits and medication, and decreased pulmonary function.
- Reduction of forced expiratory volume in one second (FEV1) or forced vital capacity (FVC)
- Increased prevalence of wheezing
- Increased incidence of chest tightness
- Increased cough/ phlegm production requiring medical attention
- Increased upper respiratory tract infections
- Eye, nose and throat irritations that may interfere with normal activities.

Local studies are consistent with overseas studies showing both an increase in hospitalisations and mortality due to air pollution in Sydney[13] [14].

2.1 Exhaust Emissions

The link between air pollution and a worsening prevalence of asthma and death has been made by a plethora of recent international and Australian studies. While pollution levels in Australian cities may not be high by international standards, the same patterns of ill health, high health costs and fatalities are already evident and will continue to rise, unless urgent remedial action is taken.

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[12] Health effects of ourdoor air pollution. Committee of the Environmental and Occupational Health Assembly of the American Thoracic Socity, American Journal of Respiratory Critical Care Medicine, Jan 1996; 153 (1): 3-50

[13] Morgan G, Corbett S, Wlodarczyk J, Air pollution and hospital admissions in Sydney, Australia 1990 to 1994, American Journal Public Health 1998 Dec; 88(12):1761-64

[14] Morgan G, Corbett S, Wlodarczyk J, Lewis P, Air pollution and daily mortality in Sydney, Australia, 1989 through 1993, American Journal Public Health 1998 May; 88(5):759-64

A significant proportion of the air pollution is due to exhaust emissions from cars, which release nitrogen oxides and ozones into the air - the major pollutants in what is known as smog. Studies suggest these pollutants both worsen asthma symptoms and trigger asthma attacks. Exposure to nitrogen oxides causes infection in the airways, especially in children. A 2004 Department of Environmental Health study done by the University of Washington in America concluded,

> "Air pollution is convincingly associated with many signs of asthma aggravation. These include pulmonary function decrements, increased bronchial hyper responsiveness, visits to emergency departments, hospital admissions, increased medication use and symptom reporting, inflammatory changes, interactions between air pollution and allergen challenges, and immune system changes."

A 2002 study by the University of Southern California[15] went further and suggested that air pollution causes asthma and other diseases in children. The study followed 3,500 children in 12 communities over five years to determine potential health damage caused by growing up in polluted air. Six communities had higher than average ozone concentrations; whilst the other six were lower than average.

Major results of the study:

- Children in the higher ozone communities who played up to three team sports developed asthma at a rate three times higher than children living in the lower ozone communities.
- Children living in communities with higher concentrations of nitrogen dioxide, particulate matter, and acid vapor have lungs that develop and grow more slowly and are less able to move air through them. This decreased lung development may have permanent adverse effects in adulthood.
- Children who moved away from study communities had increased lung development if the new communities had lower particulate pollution, and had decreased lung development if the new communities had higher particulate pollution.
- Days with higher ozone concentrations resulted in significantly higher school absences due to respiratory illness.
- Children with asthma who are exposed to higher concentrations of particles are much more likely to develop bronchitis.

The study concluded that smog can trigger attacks in asthmatics, but that ozone, another constituent of smog, can cause asthma.

Several studies have demonstrated a higher prevalence of chronic cough among children living close to main roads. Sydney researchers detected a link between higher pollution levels and reduced birth weight in babies in the metropolitan area, suggesting the noxious effects of traffic fumes may cross the placenta to the developing foetus[16].

Researchers from Taiwan have shown that chemicals in vehicle exhausts lead to an increased risk of respiratory disorders in children living in heavy traffic areas and support the increasingly popular hypothesis that exposure to traffic pollution modifies children's susceptibility to allergens. Boys exposed to high levels of traffic pollution had a 16% higher risk of hay fever, which is linked to the development of asthma, while girls had a 17% increase[17]. Children may be more vulnerable than

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[15] "Study Links Air Pollution, Ozone, and Asthma". Sinus News 1/2/2002 http://www.sinusnews.com/Articles2/air-pollution-ozone-asthma.html

[16] "Car fumes driving us to early grave" by Alexandra Smith and Julie Robotham, 30/7/2005, Sydney Morning Herald http://www.smh.com.au/news/national/car-fumes-driving-us-to-early grave/2005/07/29/1122144024506.html

[17] "Traffic fumes shown to raise asthma risk in children", Reuters News Service, May 28, 2003 http://www.planetark.org/dailynewsstory.cfm/newsid/20951/story.htm

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adults because they spend more time outdoors, breathe in more air pound for pound than adults and their airways are more efficient in trapping pollutants. Because of this, air pollution can affect children up to nine times more harshly than adults[18].

A survey conducted by Asthma UK found that 81% of people with asthma said air pollution brought on their asthma symptoms.

Exhaust emissions don't just cause and exacerbate respiratory conditions, they kill too. The emissions from car exhausts are responsible for more deaths than road accidents, according to World Health Organisation (WHO) research. A study in France, Austria and Switzerland found that the number of people dying from respiratory or cardiovascular problems which could be attributed to car fumes far outweighed the death toll from crashes.[19]

This conclusion is supported by statistical data from Australia. The Bureau of Transport and Regional Economics found that in 2000, air pollution from cars caused between 900 and 2000 early deaths and contributed to between 700 and 2050 asthma attacks in Australia. About 4500 people are thought to be treated in hospital each year as a result of car-related pollution. The Federal Government estimates the health impact costs at around $2.7 billion a year.[20]

These findings are borne out by statistics in Sydney. A NSW Government report confirmed more people are dying from heavy air pollution on Sydney's roads than are killed in car accidents. There were 267 deaths from car accidents in 2000 while vehicle-generated air pollution was associated with between 339 and 762 deaths.[21]

These statistics are inconsistent with the NSW Auditor Generals report in April 2005 which stated that air quality had improved in Sydney during the past decade due to cleaner fuels and better vehicle technology. Whilst cleaner fuels and better technology have led to the significant reduction of pollutants including sulphur dioxide, lead and carbon monoxide, ozone and particles – the two ingredients of photochemical smog with strong links to asthma, are still present in high quantities.

The reason for the discrepancy between the pollution levels and the health statistics is that better motor engines haven't reduced the number of particles, but have just made them smaller and more harmful. Importantly, current pollution monitoring methods are not able to detect them.

Air particles are of particular concern because they cause breathing problems, exacerbate respiratory diseases such as asthma and are not detected by current pollution monitoring. The predominant measure used to determine the number of particles in the air is PM10, which measures all particles

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[17] Today@UCI article "Air Pollution from Fires May Affect Children More Harshly" quoting atmospheric expert Dr Robert Phalen http://today.uci.edu/news/tipsheet_detail.asp?key=163#large

[18] Transport 2000 briefing UK – 28/5/2004 http://www.transport2000.org.uk/news/maintainNewsArticles.asp?NewsArticleID=168

http://news.bbc.co.uk/1/hi/health/369169.st BBC News, June 15, 1999

[19] "Car fumes driving us to early grave" by Alexandra Smith and Julie Robotham, 30/7/2005, Sydney Morning Herald http://www.smh.com.au/news/national/car-fumes-driving-us-to-early-grave/2005/07/29/1122144024506.html

[20] "Pollution is killing hundreds" by Sharri Markson 28/5/2006 Sunday Telegraph

less than 10 microns in diameter. Yet it is the smaller particles, those which are PM2.5 [2.5 microns or less] that are the most harmful. Almost all diesel exhausts are PM1 or less. These small particles enter the lungs, and the finest particles penetrate the cells of the lungs. Anything bigger than PM2 is caught in the nasal passages. The smaller particulates are not stopped in the nose or throat like the larger ones, but are actually small enough to enter into the lower respiratory tract where they accumulate as the body is unable to remove them. It is for this reason that pollution continues to cause illness and death. The Environmental Protection Authority (EPA) measures particulate matter by weight rather than particle size and does not distinguish between the larger particle sizes and the smaller more harmful particulates. This is disturbing as when fuel combusts, the predominant particulate sizes that are released are PM0.1 and PM0.03.[22]

An estimated 70 per cent of vehicle emissions are of this smaller particulate matter and the number is increasing with new motor technology development.

Recommendation 1:
Develop air quality standards for the more harmful particles of PM2.5 and smaller

We believe the EPA should urgently develop standards for these small and highly dangerous particulates so that pollution information is meaningful.[23] It is worth noting that despite the size of the pollution problem there are no monitoring sites currently operating in the CBD. The one site that was located on George and Market streets was shut down with the claim that the technology had become obsolete. It has not been replaced. It was reported that the number of stations monitoring air quality were cut by 25 per cent in 2005 due to budget cuts[24].

There is convincing documentary evidence that cutting car use will also cut asthma rates. For example, during the 1996 Summer Olympics, the city of Atlanta, fearing gridlock, took extraordinary measures to reduce traffic. For the 17 days of the games, auto use dropped 22.5 percent. Daily ozone concentrations dropped almost 30 percent. The benefit to asthma sufferers was direct and dramatic. During that period, the number of asthmatics who saw a doctor dropped by 40 percent, the number admitted to hospital dropped 19 percent, and the number who were admitted to the emergency room dropped 11 percent[25].

Recommendation 2:
Develop initiatives to reduce car use, including investment in public transport infrastructure

The Auditor General is on the public record as saying that the NSW Government's failure to get people out of cars and onto public transport was the prime reason that Sydney would not meet its own national air quality and greenhouse emission targets. Instead, private car use is growing faster than the population. In 2001-2002 every car in NSW travelled 15 per cent more than the year before

Recommendation 3:
Implement initiatives aimed at reducing vehicle emissions

AFNSW welcomes a number of recent initiatives which aim to reduce the level of harmful emissions from vehicles. These include; restricting emission on new smaller SVU vehicles, and introducing petrol vapour traps to capture emissions at petrol stations. Schemes to buy back smoky vehicles are also encouraged.

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[22] "Car fumes driving us to early grave" by Alexandra Smith and Julie Robotham, 30/7/2005, Sydney Morning Herald http://www.smh.com.au/news/national/car-fumes-driving-us-to-early-grave/2005/07/29/1122144024506.html

[23] NSW Legislative Assembly Hansard Speaker: Ms Clover Moore "Cross-city tunnel air filtration" Page: 17655

[24] "Auditor-general pulls veil on Sydney's dirty air" by Anne Davies Sydney Morning Herald April 7, 2005

[25] "Driving and Asthma" by Ryan O'Greal, 29/6/2006 http://www.raisethehammer.org/blog.asp?id=251

2.2 Underground Road Tunnels

In the 1990's road tunnels were hailed as a modern, innovative solution to the old problem of traffic congestion. Tunnels can move traffic under previously gridlocked streets and in some cases cut travel times considerably. However, as evidenced by many recent Australian and overseas scientific studies, road tunnels also pose many serious potential health risks from death due to lung cancer and cardiopulmonary diseases,[26] to cardiovascular,[27] asthma and respiratory diseases.[28]

Although not all Australian cities have road tunnels - the increase in road vehicles, which has grown from almost 14,775,000 in 2007 to almost 16,742,000 in 2012 means that they will become more prevalent in times to come.[29]

Concerns about potential health risks have dogged Sydney's M5 East tunnel since its conception. It is a 4 km twin tunnel connecting the city's airport/ Port Botany with the southwestern suburbs. It opened to traffic in December 2001. It is the second longest road tunnel in Australia, just behind Brisbane's 4.8kms Clem 7.

The M5 was an example of a good idea and bad policies, which has left Sydney with a poisoned artery running right through its heart. Although it is a specifically Sydney issue it should serve as an example of how road tunnels tunnel can impact public health and highlights the need for stringent Federal legislation governing the planning and building, environmental controls and the imposition of health-based emission levels and mandatory air quality monitoring associated with such projects. Problems with the M5 happened because there are no national standards governing the construction and air pollution monitoring of such key infrastructure, just a series of *ad hoc* state arrangements, which chop and change with change of governments, reminiscent of the pre-Federation era when each state railway operated its railways with a different gauge.

There was much public controversy before the tunnel was even built. The three proposed ventilation stacks to be sited near residential areas was cut to one following a public campaign – a decision which was described by a 1999 Parliamentary Inquiry [30] as:

> *"....made both hastily and with no public consultation. There were no published environmental studies or a supplementary environmental impact statement undertaken to support the decision to build a single stack.*
>
> *It is apparent that the original three stack option was the more scientifically valid option, though unacceptable to the community. It is equally apparent that the single stack option is also unacceptable to the community. The current stack, located in a valley, is likely to be 25 metres high, yet has ridges of the valley surrounding it 40 metres high. It is clearly an inappropriate location to site for the ventilation exhaust stack.*

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[26] Dockery et al *An Association between Air Pollution and Mortality in Six U.S. Cities* The New England Journal of Medicine, December 1993 http://www.nejm.org/doi/full/10.1056/NEJM199312093292401

[27] Fung et al (2005). *Air pollution and daily hospital admissions for cardiovascular diseases in Windsor, Ontario*. Canadian Journal of Public Health 96:29–33.

[28] Jerrett et al *Traffic-Related Air Pollution and Asthma Onset in Children: A Prospective Cohort Study with Individual Exposure Measurement* Environmental Health Perspectives October 2008 http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2569108/

[29] The Australian Bureau of Statistics Total Number of Vehicles on Register http://www.abs.gov.au/ausstats/abs@.nsf/mf/9309.0/ viewed 21/2/2013

[30] Parliament of New South Wales Legislative Council, General Purpose Standing Committee No 5 *Report on Inquiry into the M5 East Ventilation Stack* December 1999 http://www.parliament.nsw.gov.au/Prod/parlment/committee.nsf/0/58908a6040c5dfd0ca256cf4002108c7/$FILE/m5report.PDF

The single stack as currently planned will concentrate the tunnel emissions into one source and add to the pollutant load of the valley. The adverse health effects of this increased pollution on the surrounding community must be acknowledged, but the RTA fails to do so.

The world's best practice has not been incorporated in the design of the tunnel ventilation and exhaust system. The technology exists to fit particulate and gaseous pollutant control technologies either on the stack or within the tunnel."

This design fault is also responsible for the reduced air flow in the tunnel resulting in high concentrations of pollutants. It should be noted that this mistake was not repeated in the design of the Cross City or Lane Cove tunnels, both of whom appear to be functioning safely at current traffic volumes.

This crucial design flaw was compounded by the fact that the M5 reached its projected capacity for its first decade of 80,000 cars almost as soon as it opened.[31] As a result it has faced constant questions about the quality of air both in the tunnel and the levels of pollution in the surrounding suburbs. As recently as April 2012, the Mayor of Rockdale made a media statement expressing concern for the health of his residents when an increase in air pollution in the tunnel was reported.[32]

The main cause of pollution in road tunnels is tailpipe emissions, which can become trapped in high concentrations inside the tunnels and settle on the surrounding suburbs once expelled through a ventilation stack. They contain a cocktail of toxic gases such as Carbon Monoxide (CO) and Nitrogen Dioxide (NO2) and particulate matter (PM) of various sizes (coarse, fine and ultrafine) as well as Volatile Organic Compounds (VOCs) such as BTEX (benzene, toluene, ethyl benzene, and xylenes) and Sulphur Dioxides that can directly and through interaction cause a variety of short and longer term health issues in the short and longer term.[33]

Cars are one of the major sources of air pollution in Sydney and according to the NSW Government's own data, more people die from pollution related illness in NSW than in car accidents.[34]
The main harmful constituents of pollution generated by cars are:

Carbon Monoxide

Carbon Monoxide (CO) is a highly toxic, colourless and odourless air contaminant that is produced when fossil fuels such as diesel and petrol are burned. The recommended limit for carbon monoxide is given by WHO Guidelines for Indoor Air Quality: Selected Pollutants 2010 and the Australian Government (Department of Sustainability, Environment, Water, pollution and Communities)[35] as 10 mg/m3 or 9 parts-per-million (ppm) for an eight hour time weighted average.

In 1999 the WHO set guidelines for 15-minute average exposure of 87 ppm and 30-minute average exposure of 50 ppm. These guidelines are designed to offer protection in situations where more intense exposure can occur, for example in heavy traffic in urban canyons, enclosed car parks or tunnels.[36]

Nitrogen Dioxide

Nitrogen oxides (NOx) refer to a collection of highly reactive gases containing nitrogen and oxygen, most of which are colourless and odourless. NOx gases form when fuel is burned; automobiles, along with industrial, commercial and residential sources, are primary producers of nitrogen oxides. In Sydney, motor vehicles account for about 70% of emissions of nitrogen oxides, industrial facilities account for 24% and other mobile sources account for about 6%.

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[31] As 14
[32] Interview on radio 2UE www.2ue.com.au/blogs/2ue-blog/...**tunnels**.../20120416-1x270.html Viewed 5/9/2012

[33] NSW Health *Air pollution health warning - high ozone days* http://www.health.nsw.gov.au/news/2005/20050114_02.html
[34] *Exhaust fumes kill twice as many as road accidents: study*
http://motoring.ninemsn.com.au/cars/news/8453965/exhaust-fumes-kill-twice-as-many-as-road-accidents-study
[35] http://www.environment.gov.au/atmosphere/airquality/standards.html viewed 5/9/2012
[36] http://www.health.nsw.gov.au/pubs/2003/pdf/m5complete.pdf viewed 5/9/2012

In terms of health effects, nitrogen dioxide (NO2) is the only oxide of nitrogen of concern. NO2 can cause inflammation of the respiratory system and increase susceptibility to respiratory infection. Exposure to elevated levels of NO2 has also been associated with increased mortality, particularly related to respiratory disease, and increased hospital admissions for asthma and heart disease patients.

Chamber studies, where people were exposed to varying concentrations of NO2 for 30 minutes to several hours, have demonstrated adverse impacts on asthmatics at levels over 200ppbv. The National Environment Protection Council (NEPC) adopted a NO2 standard of 120ppbv or 245 Cg/m3 for a one-hour average by applying a safety factor to the 200ppbv level found in the chamber studies.

In recent years, peak levels in metropolitan Sydney have ranged from 90 -130ppbv, and it has been uncommon for the daily Air NEPM standard to be exceeded.[37]

Particulate Matter

Acute health effects of particulates include increased daily mortality, increased rates of hospital admissions for exacerbation of respiratory and heart diseases, fluctuations in the prevalence of bronchodilator use and cough and peak flow reductions. Particulate air pollution is especially harmful to people with lung disease such as asthma and chronic obstructive pulmonary disease (COPD), which includes chronic bronchitis and emphysema, as well as people with heart disease.[38]

Exposure to particulate air pollution can trigger asthma attacks and cause wheezing, coughing, and respiratory irritation in individuals with sensitive airways. Recent research has also linked exposure to relatively low concentrations of particulate matter with premature death. Those at greatest risk are the elderly and those with pre-existing respiratory or heart disease.

Described as the “new asbestos” fine particulate matter (less than PM2.5) is of particular health concern because they can be inhaled deep into the lungs where they can be absorbed into the bloodstream or remain embedded for long periods.

Australian studies have also shown adverse health effects associated with exposure to particulate matter. Current studies have been unable to define a threshold below which no health effects occur. Recent studies suggest that even low levels of fine particle exposure are associated with health effects. There are limited standards available against which to judge the potential effects of short term (less than 24-hour) exposure to high levels of fine particles.

In addition, recent studies have also found potentially harmful interactions between particulates and NO2 in relatively high concentrations.[39]

Consequently, there are concerns about the effect that these gases and particulate matter are having on motorists in the tunnel and on residents in the surrounding residential areas.

A number of studies have been conducted focusing on air quality in and around the M5 tunnel. The following details a couple of these which inform AFNSW’s recommendations.

2008

The National Health and Medical Research Council (NHMRC) published a study on the M5 in 2008 with support from the Department of Health & Ageing.[40] However, unlike prior studies which included air pollution testing, this research constituted a literature review. Traffic flows in this study were based on 100,000 vehicles, up considerably from the some 80,000 using the tunnel in 2003.

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[37] http://www.health.nsw.gov.au/pubs/2003/pdf/m5complete.pdf viewed 5/9/2012

[38] NSW Health – Air Pollution http://www.health.nsw.gov.au/publichealth/environment/air/air_pollution.asp

[39] As 17

[40] *Air Quality in and Around Road Tunnels* National Health and Medical Research Council 2008 http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/eh42.pdf

The report addresses the health of tunnel users and those living or working near portals or ventilation stacks by developing evidence-based approaches to the management of air quality in and around road tunnels in Australia.

The main findings:

- The most effective way to manage vehicle pollution is to deal with it at source through control of vehicle emissions.
- Solutions will include adopting new automotive engineering and fuels, implementing existing regulatory processes and controlling congestion.

Meanwhile new tunnel regulations are required:

- Guideline values or health-based exposure limits should be developed for the priority pollutants—including particulates and nitrogen dioxide—based on transit times through tunnels, and realistic estimates of total trip and daily exposure.
- Future tunnel design should not be based on carbon monoxide levels and exposures alone.
- Revised standards should take into account the fact that all components interact in determining the safety of in-tunnel conditions and the comfort of users.
- Tunnels can cause adverse health impacts:
- There is evidence that airborne pollutants in tunnels will affect the health of users of these tunnels.
- The evidence for health effects on people living close to tunnel portals or stacks is more equivocal.
- Nevertheless, good practice has long been to limit, as far as possible, exposure around tunnel portals and stacks; this practice should be continued and, where possible, reinforced.

Recommendations (in-tunnel)

- We recommend development of a health-based exposure limit for NO2 and PM as a precautionary interim measure appropriate to both average and above average tunnel transit times in order to capture normal and congested conditions.
- This process should consider interactions with co-exposure to other tunnel pollutants. “Particulate matter levels should be monitored with a view to reduction, as current levels of PM in some tunnels in Australia are in excess of 1000 µg m–3 which is clearly dangerous to health.”

Studies required (in-tunnel impacts)

- The health effects of exposure to tunnel air and its components at the relevant timescales (minutes) need to be determined from experimental studies.
- The relative importance of different indicators of in-tunnel air quality (eg NO2, particulates) in predicting patho-physiological or health effects should be explored.
- A practical and reliable method for monitoring NO2 concentrations in road tunnels needs to be developed.
- A practical method needs to be developed for predicting tunnel users’ exposure to NO2.

Recommendation (ambient air)

- Environmental impact assessment should include induced emission changes arising from changes to surface traffic as well as emissions from the tunnel itself.
- Air quality monitoring is an essential component of environmental management of a road tunnel in the early stages after opening.
- Monitors should be sited, where possible and practical, in locations relevant for exposure (including plume impact).
- We are not convinced that long-term monitoring of PM10 is useful for the purposes of managing the impact on a community of a road tunnel alone, as opposed to the road network in general. CO and NOx are more robust indicators of effects on traffic impacts.
- Further study should investigate the impacts of tunnels on the indoor air quality of residences near portals or stacks. This should include study of the health effects resulting from any increased exposure to pollutants.

Illustrative points

- Executive Summary:
  'No clear evidence exists to show that monitoring such as that carried out to assess compliance with air-quality goals, especially for PM10, can reliably predict the size, nature and course of adverse health impacts.'

- Executive Summary:
  'People who live near to tunnels or their stacks may be at risk if the presence of the tunnel alters the ongoing quality of the neighbourhood ambient air. Risks to cardio-respiratory health might arise if people are exposed to contaminated air from tunnel emissions. Important indicators for this risk are levels of NO2 and particulates. Of particular concern is an association between impaired lung development in children and emissions from traffic. Particulates from tunnels and volatile compounds including benzene may produce an increased lifetime risk for cancer.'

- p33. The true importance of NO2 levels in relation to the significance of PM should be given serious consideration. The potential for harm appears to lie strongly on the side of PM.

- P98. Diesel exhaust is carcinogenic in its own right. The United States Office of the Environmental Health Hazard Assessment lists "Diesel exhaust" as a toxic air contaminant

2009

Within a year of the NHMRC paper Queensland University of Technology released a study entitled *On-road ultrafine particle concentration in the M5 East road tunnel, Sydney, Australia*. It provided much-needed information on the concentration and potential health effects of particulate matter – as outlined in the NHMRC report.

According to the Abstract:

> *The human health effects following exposure to ultrafine (<100nm) particles (UFPs) produced by fuel combustion, while not completely understood, are generally regarded as detrimental. Road tunnels have emerged as locations where maximum exposure to these particles may occur for the vehicle occupants using them. This study aimed to quantify and investigate the determinants of UFP concentrations in the 4km twin-bore (eastbound and westbound) M5 East tunnel in Sydney, Australia.*

In terms of the health effects the official UTQ media release summarised the study's findings as follows[41].

> *"What this study aimed to do was identify the concentration levels (of ultrafine particles) found in the tunnel. It generated a huge body of data on the concentrations and the results show that, at times, the levels are up to 1000 times higher than in urban ambient conditions."*
>
> *"When compared with similar studies reported previously, the measurements here were among the highest recorded concentrations."*

[41] *Tunnels concentrate air pollution by up to 1000 times.* UTQ media release 27/8/2009 http://www.news.qut.edu.au/cgi-bin/WebObjects/News.woa/wa/goNewsPage?newsEventID=29820 Viewed 3/9/2012

"The human health effects of exposure to ultrafine particles produced by fuel combustion are generally regarded as detrimental."

"Effects can range from minor respiratory problems in healthy people, to acute myocardial infarction (heart attack) in people with existing heart complaints.

In subsequent media interviews[42] Professor Morowska was quoted as saying:

"If healthy people travel in these conditions regularly they are subjected to a more chronic exposure."

"On a longer term it can lead to chronic respiratory problems or cardiovascular problems."

2012

This year has seen the release of two pieces of research into air quality in the M5 – one outside and one inside the tunnel.

Outdoor Air Quality/ Health Study

In July 2012 NSW Health released a study[43] that concluded that there was no link between emissions from the M5 tunnel ventilation stack and increased cancer rates in residents in the neighbouring Turrella area. The study was held in response to concerns by RAPS community group (Residents Against Polluting Stacks). Prominent among these concerns were reports of leukaemia. After meeting with the group to clarify concerns, the Public Health Units decided to investigate the incidence of all cancers combined, leukaemia and lung cancer in the period after tunnel opening.

Whilst an increase in the incidence of lung cancer was found, most of the variation in lung cancer rates was due to current or past smoking. Although it was noted that lung cancer is one of the few cancers where there is good evidence that air pollution is the cause.

The study concluded that the increase in lung cancer incidence appeared to predate the opening of the M5 East tunnel and that a causal association between air pollution from the M5 East tunnel and lung cancer were unlikely.

In Tunnel Study

Channel 7 News commissioned their own air pollution monitoring in the tunnel during August 2012. They engaged air pollution experts, CETEC, conducted real time air monitoring of carbon monoxide (CO), nitrogen dioxide and particulate matter (PM1-10). Measurements were collected using a TSI Q-Trak for CO, TSI Dust-Trak for PM and iTX Gas Detector for NO2.

Two sequences of testing were done during a single day in the morning and afternoon.
In terms of the levels of NO2, CO and particulate matter, the study found the following:

Nitrogen Dioxide

Results indicate that nitrogen dioxide levels significantly exceeded the NEPM Ambient Air limit of 120 ppb during all tunnel trips on the day of testing.

Based on extrapolated results, one peak hour trip would expose vehicle occupants to double the one hour limit for nitrogen dioxide. The recorded NO2 results are at levels known to have adverse impacts on asthmatics.

Carbon Monoxide

Carbon monoxide (CO) results were below the NEPM limits for a peak-hour trip.

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[42] M5 tunnel regulars 'risk chronic health problems' ABC News 28/08/2009 http://www.abc.net.au/news/2009-08-28/m5-tunnel-regulars-risk-chronic-health-problems/1407728 Viewed 3/9/2012

[43] A review of cancer registry data in response to concerns about a possible excess of cancer associated with emissions from the M5 tunnel NSW Health July 2012
http://www.health.nsw.gov.au/pubs/2012/pdf/m5_east_tunnel.pdf

Two daily peak hour trips through the M5 tunnel would contribute to approximately 10% of an individual's carbon monoxide (CO) NEPM limit.

A recorded carbon monoxide (CO) peak of 55ppm during moderate traffic, indicates that it would be likely for an individual stuck in heavy M5 tunnel traffic for more than 30 minutes to be exposed to CO above the WHO limit of 50ppm.

PM1-10
The PM1-10 concentration in the tunnel is up to 10 times the NEPM limit. When the 15 minute exposure period in the tunnel is averaged over 24 hours, the net exposure for an individual would be below the 24 hour exposure limit.

Two daily peak hour trips through the M5 tunnel would contribute to approximately 30% of an individual's PM2.5 NEPM limit.

The airborne respirable dust in the M5 is highly likely to contain toxic substances such as PAHs, heavy metals and sulphates.

In terms of putting these results into a health context CETEC concluded:

- *All results for NO2, CO and PM1-10 were significantly elevated compared to above-ground road air during heavy traffic.*
- *The recorded levels of NO2, CO and PM1-10 were high enough to cause adverse acute health symptoms such as asthma and inflammation of the respiratory system, as per previous Health Department reports.*
- *Driving during an asthma attack could result in a car accident, increasing the risk profile of the poor air conditions in the M5 tunnel.*

In conclusion, although the two studies conducted in residential areas outside the tunnel have not found a significant link between the M5 tunnel and reported public health issues; all the studies done inside the M5 tunnel since 2002 have, to a greater or lesser extent, raised a number of health concerns concerning the levels of toxic gases and particulate matter.

While there have been attempts to improve ventilation in the tunnel the absence of consistent air monitoring means it is impossible to see the difference and the most recent testing, which saw levels of PM2.5 and NO2 over NEPM and CO at very high levels does not suggest it has made much difference given the rising volumes of traffic.

These volumes are certain to rise in the near future as work begins on widening the M5 and Port Botany opens a third terminal, which will result in a 70 per cent rise in trucks in the next decade[44].

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[44] *Port's rail failure forces trucks to clog city roads* Drive.com.au http://news.drive.com.au/drive/roads-and-traffic/ports-rail-failure-forces-trucks-to-clog-city-roads-20111127-1o1jy.html Viewed 20/8/2012

Recommendations

There are a variety of potential solutions available to address the air pollution challenges associated with the M5 tunnel in the short and medium terms.

In the Medium Term

The 2008 NHMRC report and other tunnels studies have rightly concluded that the best way to clean up emissions is to regulate what comes out of a car's tailpipe. This may be achieved by; cleaner fuels, the use of so-called "hybrid" (petrol/ electric) cars, filters and converters and ultimately the production of "greener" cars not powered by petrol. Unfortunately, in a market-based economy, driven by consumer demand, there is no way of predicting when this may happen and the levels of air quality already present in the M5 and predicted increases in traffic flow in the near future mean that some interim, medium term solutions will need to be implemented to safeguard public health.

These measures might include:

- Setting enforceable air quality standards for road tunnels.
- Fitting of pollution traps and converters to the worst offenders – diesel trucks.
- Retrofitting the M5 with technology that will reduce pollution.

Air Quality Standards

Monitoring the levels of air pollutants in the tunnel is just the first step in improving air quality in the M5. As recommended by the 2008 NHMRC report,

> *"Development of an exposure limit for nitrogen dioxide (NO2), set in the context of co-exposure with particulate matter (PM), and numerous other toxins and irritants from road vehicle emissions, is justified."*

This has not been done. Currently, there are no air quality standards for road tunnels. The often quoted National Environment Protection Measure (NEPM) standards are to do with ambient air quality and were specifically not designed for road tunnels.

Although NEPM has set ambient air quality standards for NO2 and PM it is not an enforceable standard, it is merely a yardstick. Without enforceable standards there is no obligation for government, tunnel operators or tunnel users to do anything about the problem and no consequences if they don't.

In the absence of enforceable Australian standards or any legislated international standards the solution may be to adopt WHO guidelines. Despite gaps in our understanding of the health effects of particles in tunnel air, including the crucial issues of dose duration and repetition, WHO has established guideline values for PM10 and PM2.5 in 2006. The guidelines values are 50 .g m–3 24-hour mean and 20 .g m–3 annual mean for PM10, and 25 .g m–3 24-hour mean and 10 .g m–3 annual mean for PM2.5.

Emission Mitigation Measures

Most tunnel studies agree that the best method of reducing pollution is reducing tailpipe emissions. The 2008 NHMRC report summarised it:

> *In road tunnels such as the M5 East control of particle emissions at the source, such as the installation of oxidation catalysts and particle traps in diesel vehicles (Morawska et al., 2008), seems a logical and potentially more effective approach to reduce emissions and subsequent on-road UFP concentrations compared to reliance on tunnel air filtration devices. Developing particle number emissions standards in Australia, similar to those being promulgated in Europe,*

could prove to be efficacious at reducing UFP concentrations on above ground and tunnel roadways.

While persuading government to set such standards is another big step it cannot be tackled until pollution in tunnels is monitored and health-based air quality standards set.

Another NHMRC recommendation was the retrofitting of the M5 with Electrostatic precipitator (ESP) technology, as a supplement to filtration and ventilation technology, which as evidenced by the pollutants in the M5, is not sufficient.

> *"...ESP technology also potentially provides additional benefits by reducing the emission of PM into the external environment. The environmental benefits of ESP technology should always be balanced against its environmental costs, including energy costs and treatment and disposal of the collected particulate mass. Experimental evidence from Norway shows that a 50% saving can be achieved using ESP filtration compared with conventional ventilation (EPA Victoria 2006). Estimates from Japan are that ESP technology costs at least 30% less than conventional ventilation operational costs (EPA Victoria 2006)."*[45]

Recommendations

AFNSW has encouraged the NSW Government to undertake a number of measures to reduce pollution levels in the M5 tunnel to cut air pollution, provide better, more accurate research data and educate and make people with asthma more aware of the dangers that air pollution presents.

In the short term:

- A public information campaign to convey the appropriate facts about the health risks.
- Effective warning signs, appropriately placed, so that motorists can exit the tunnel route in the event of a high pollution warning.
- A commitment to "real time" monitoring of CO, CO2, NO2 and particulate matter PM1-10 in the M5 tunnel.

In the medium term:

- The need to establish health based exposure limit for CO, NO2 and PM 1-10 in the M5.
- Air quality standards (CO, NO2, PM1-10) for road tunnels based on best practice international models.
- Emission mitigation measures including the mandatory fitting of *oxidation catalysts and particle traps* in all diesel vehicles and the retrofitting of the tunnel with ESP technology.

Whilst AFNSW believes that ultimately fitting all vehicles with pollution traps is the best way to reduce air pollution, it also believes that any such emission reduction scheme must be done in a scientific manner ie: through monitoring of air pollution in the tunnel so that road users and the surrounding community can maintain confidence in the tunnel's operation.

[45] As 17 Section 7.2.4 pg 111

2.3 Wood-burning Heaters

They are harmful to health because they emit a number of noxious gases (including carbon monoxide, nitrogen oxides and a range of organic compounds, some of which are toxic or carcinogenic) and fine particles, of PM2.5 which go deep into the lungs. In Sydney, solid fuel heaters contribute 40% of air particle pollution at certain times of the year. On a winter weekend it can be as high as 50%. In colder rural areas the contribution of wood smoke to pollution is even higher.[46] *In ACT and New England it can reach 85% and well over 90% in Tasmania.*

A plethora of peer-reviewed Australian and overseas scientific studies conducted over the past 20 years have cited the toxins, gases and fine particulate matter produced by the burning of wood as a major risk factor for asthmatics[47]. It exacerbates asthma symptoms and has been associated with higher rates of asthma in areas where wood burning takes place over a sustained period each year. [48]

While the human body can tolerate a certain level of air pollutants such as Nitrogen Dioxide (NO2) and Carbon Monoxide (NO), which are by-products of wood burning there is no safe level of particle pollution – no threshold below which health problems are not observed. Fine particle pollution known as PM2.5 (particles less than 2.5 microns in diameter) or the "new asbestos" causes the premature deaths of thousands of Australians every year, the majority at levels below the current Australian standard.[49]

PM2.5 is believed to be the most health-hazardous air pollutant, responsible for 10 to 20 times as many premature deaths as the next worst pollutant, ozone. Just as "every cigarette is doing you damage", every gram of wood smoke or other particle emissions is also causing health problems. Wood smoke is more hazardous than cigarette smoke – in tumour initiation tests it was found to cause 12 to 30 times as many cancers as the same amount of cigarette smoke. The estimated health cost of a kg of PM2.5 emissions in Sydney is more than $235. [50]

That the *Options for wood smoke control in NSW: Discussion paper* describes wood burning stoves as a *"...major cause of air pollution in NSW"* and concedes that *"...Exposure to the fine particles in wood smoke is a significant health concern as they can cause respiratory and circulation problems, particularly in elderly people, children and those with existing health conditions"* suggests that urgent action is needed. The same report estimates that wood smoke will add $8b to the NSW health budget in the next 20 years. That equates to a cost of $22,000 for every wood heater in the state.

This need is reinforced by the further admission in the same report that *"...data supplied by the Australian Home Heating Association (AHHA), sales of wood heaters across Australia grew 33% in 2011. With an extra 640,000 new residences expected in Sydney by 20311 and no change to current wood smoke controls, newly installed wood heaters alone are expected to emit 1629 tonnes of particulate matter (PM10) per year. This equates to a 20% growth in wood heater emissions."*

According to the NSW EPA Emissions inventory there are only some 360,000 wood heaters in NSW, yet they produce over 50% of air pollution in Sydney (despite only 4% of households having wood

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[46] Robinson DL. Air pollution in Australia: review of costs, sources and potential solutions. *Health Promot J Aust* 2005; 16: 213-220

[47] *Oxidative stress, DNA damage, and inflammation induced by ambient air and wood smoke particulate matter in human* A549 and THP-1 cell lines. Danielsen et al. Chem Res Toxicology 2011 Feb 18;24(2):168-84. Epub 2011 Jan 14. http://www.ncbi.nlm.nih.gov/pubmed/21235221

[48] *Low-Level Subchronic Exposure to Wood Smoke Exacerbates Inflammatory Responses in Allergic Rats* Tesfaigzi et al. Oxford Journals, Life Sciences & Medicine Toxicological Sciences, Volume 88, Issue 2 (2005) Pp. 505-513 http://toxsci.oxfordjournals.org/content/88/2/505.full

[49] NEPC data on premature deaths from PM2.5 pollution – see figure A2.2 of: Methodology for setting air quality standards in Australia Part A: http://www.scew.gov.au/publications/pubs/air/methodology-air-quality-standards-in-australia-parta.pdf

[50] AECOM *Economic Analysis on Woodsmoke Control Options* Report (2011) http://www.environment.nsw.gov.au/resources/air/WoodsmokeControlReport.pdf

heaters) during winter and up to 85% in regional centres like Armidale.

Powerful industry restricting positive measures to curb woodsmoke pollution

AHHA is a large, proactive industry body representing a $90m industry. Their recent intervention in the ACT State election[51], which had wood smoke legislation under consideration, suggests that they will be doing likewise in NSW.

The wood heating industry has long resisted attempts to reduce emissions in Australia. In 2007, recommendations by the Australian/NZ Standards Committee (approved 15 votes to 4) to halve the emissions limit (as an interim measure, while a new standard was being developed) were vetoed by the AHHA and another industry representative. Standards Australia had little choice but to abandon attempts to update the wood heater standard. This led to New Zealand breaking away and going it alone. It has managed to reduce its emissions without destroying its local wood heating industry (see below).

The Regulation of Wood Smoke Measures

AFNSW believes that the current arrangements for the management of wood smoke are neither adequate nor effective. Indeed they are outdated and well behind best practice countries such as Norway, Sweden, Denmark and New Zealand.

Because air pollution knows no borders and it is a public health matter, AFNSW would welcome Federal legislation on this issue to determine the current level of air pollution and prescribe the correct measures to reduce it.

Legislation dealing with vehicle pollution also suggests that Government legislation is the best method of achieving results in the area of air pollution. Cost-benefit analyses recently led to the introduction of new standards (Euro 5/6) for diesel utes and sports utility vehicles (SUV) – a limit of 0.005 grams of particles per km, i.e. less than 0.1 kg for a vehicle travelling 20,000 km per year. [52]
The new standards add about $980 to the price of the average diesel SUV – but are considered well worth the $1.5 billion saving over the next 20 years in health costs for Australia. [53]

Such regulations have reduced PM2.5 emissions by more 99% since 1989, when the average diesel ute or SUV was as polluting as the average wood heater. The Euro 5/6 regulations are so strict, and those for wood heaters so lax, that the average new wood heater in colder areas of NSW emits as much PM2.5 pollution as 370 new diesel SUV each travelling 20,000 km per year.

Recommended measures to limit the Impact of Wood Smoke

AFNSW believes that there are practical, commonsense measures that would allow the wood heater industry to operate profitably and enable consumers to enjoy the benefits of a cheaper, renewable energy at a time of soaring power costs, whilst producing a dramatic reduction in pollution and associated health costs.

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[51] *Pressure on voters over wood smoke* ABC report October 16, 2012
http://www.abc.net.au/news/2012-10-16/pressure-on-voters-over-wood-smoke/4316618

[52] Current emission levels for diesel cars - http://www.news.com.au/national-old/car-pollution-crackdown-to-save-lives/story-e6frfkvr-1226073347555 The Euro 5/6 standard requires emissions of .005 g/km - http://en.wikipedia.org/wiki/European_emission_standards - i.e. 0.1 kg of particle emissions if travelling 20,000 km per year.

[53] Car pollution crackdown will save lives but comes at a cost
http://www.news.com.au/national-old/car-pollution-crackdown-to-save-lives/story-e6frfkvr-1226073347555

Recommendation 1:
Reduce Particle Emissions and Increase Efficiency Levels of Wood Burners
The Foundation strongly supports the widely held view that the particle emission level per kilogram of dry wood burnt be reduced from the current 4g (established in 1999) to 1g, which would bring it into line with other best-practice countries. A significant reduction in particle emission level is required to produce a sizeable reduction in air pollution because with the operation of domestic fires you have to consider "real life emissions" not laboratory emissions, which are often much higher as many wood stoves are not being operated correctly, not using the correct wood and have not been cleaned for some time.

Table 1. Comparison of lab-test and real-life emissions for new heaters, estimated health costs for a heater installed in Sydney and the number of Diesel SUV required to produce the same level of annual emissions.

		Sydney			Colder rural area	
Lab-test	Real-life	Health Cost	Diesel SUV	Real-life	Health Cost	Diesel SUV
4 g/kg	18.6	$4436	186	39.2	$2188	392
3 g/kg	16.8	$3992	168	35.3	$1970	353
2 g/kg	14.4	$3420	144	30.2	$1687	302
1 g/kg	13.3	$3167	133	28.0	$1562	280

Source: AECOM Office of Environment & Heritage: Economic Appraisal of Wood Smoke Control Measures - Final Report, 29 June 2011. Emissions by lab test rating, table 15 (9.8 g/kg for limit of 4 g/kg); table 18 (reductions of 10%, 22.9%, 28.6% and 34.3% for ratings of 3, 2 and 1 g/kg respectively). Table 24 - estimated Health costs for capital cities ($235.26/kg PM2.5) and rural areas $55.82/kg PM2.5). Estimates are based on assumes average firewood consumption of 1.9 tonnes per year in Sydney and 4 tonnes per year (the average for Armidale, NSW and Canberra) in a cold rural areas.

The CSIRO estimates that the average new 4g wood heater actually emits about 10 grams of particles per kg of wood,[54] therefore, an evening's heating (10 kg firewood) emits 100 grams of particles – more than the smoke from 5,000 cigarettes. Per year, the average new wood heater in colder regions such as Armidale or Canberra emits more particle pollution than in the smoke of *1.85 million* cigarettes.

Reductions in emissions can be made without sacrificing the local wood heating industry. A decade ago, wood heaters in New Zealand's had similar emissions to those in Australia, but, from 2000 to 2005, NZ introduced emissions limits of 1.0 to 1.5 g/kg – half the standard (2.5 to 3 g/kg) suggested in the NSW discussion document. Cities are also phasing out older-style heaters, e.g all models rated more than 1.5 g/kg were removed in Otago by 1 Jan 2012. The current limit in Otago is 0.7 g/kg. In Christchurch, where new heaters are permitted only as replacements for more polluting models, the limit is 1.0 g/kg. New Zealand's strict limits have led to the development of dozens of cleaner local wood burner models.

Asthma Foundation NSW also supports a greater efficiency level of 70% or above for Australian heaters. A greater efficiency level is required because they ensure a cleaner burn and emit less small particulate matter.

Recommendation 2:
Remove Old Wood Burning Heaters as Properties are Sold
The table below compares estimates from the NSW Government's own economic analysis of benefits versus costs of various control options. There is a compelling argument for phasing out existing wood heaters when houses are sold – a $4.015 billion health benefit is many times greater than the cost of just $36 million. The next most cost effective option is not allowing the installation of new heaters,

[54] As 66

estimated to save $2.206 billion for a cost of just $134 million. In contrast to the billions from not allowing new heaters, new emission and efficiency standards (option 3 in the table) provide an almost negligible net benefit of only $298 million.

Table 1. Estimated health benefits and costs of woodsmoke control options in NSW

	Health Benefit $million	Cost $million	Net Benefit $million
4) Phase out at sale of house	$4,015	-$36	$3,978
2) Ban on heater sales	$2,206	-$134	$2,071
7) Licensing fees	$1,267	$11	$1,278
6) Sales tax on new wood heaters	$1,049	-$1	$1,048
9) Cash incentive phase out	$879	-$12	$867
8) Levying an excise/tax on biomass fuels	$419	$36	$455
5) Fuel moisture content regulations	$399	-$33	$366
3) Emission standards (3g/kg, 60% efficiency)	$301	-$3	$298

Source: Tables 26 and 28, AECOM Office of Environment & Heritage: Economic Appraisal of Wood Smoke Control Measures - Final Report, 29 June 2011

Recommendation 3:
Consider a Buy-Back or a Rebate Scheme

As described in the table above for a modest cost of $12m (almost as much as it is spending on reducing pollution in the M5 tunnel) the NSW Government could more quickly retire the existing stock of wood heaters and gain a health dividend more quickly.

AFNSW believes that there is no other single air pollution policy in Australia that could be so simply implemented and make such a difference to air pollution levels. It would quite literally transform the levels of air pollution across many colder climate states during winter, which can last up to five/ six months in some areas, and bring much needed relief to the 2.2 million Australians who live with asthma.

Proof of this came in Launceston, which has suffered with woodsmoke pollution issues for decades. A recently published study, conducted by University of Tasmania researchers and published in the British Medical Journal, highlighted the pollution risks from inefficient wood burning.[55]

They looked at what happened when the city implemented a scheme to reduce pollution from wood smoke in the early 2000's. It launched a campaign to educate residents about the risks of smoke from wood-burning stoves and offered help to replace these with electric ones.

From 2001 to 2004, the number of households that used wood-burning stoves fell from 66 to 30 per cent. Atmospheric pollution from air particulates during winter fell by 40 per cent. Deaths among men fell by 11.4 per cent, particularly from cardiovascular causes, which saw a decline of 17.9 per cent, and from respiratory causes, which retreated by 22.8 per cent.

[55] *Evaluation of interventions to reduce air pollution from biomass smoke on mortality in Launceston, Australia: retrospective analysis of daily mortality, 1994-2007* by Johnson et al BMJ 2013; 346 doi: http://dx.doi.org/10.1136/bmj.e8446 (Published 8 January 2013)

2.4 Coal Mining

Introduction

Coal is synonymous with the birth of the Industrial Revolution. The hydrocarbon fuels (ie: coal, gas, oil, coal seam gas) that powered our industrial revolution and fuelled our material prosperity and social advancement are also leading to illness and death. This is both a terrible irony and an indisputable scientific fact.

It slowly became apparent that the smog created by coal fires in cities was affecting human health, a realization that finally led to coal being discontinued as a domestic fuel source in most western cities by the 1980's. PM2.5 pollution was reduced in Dublin by banning non-smokeless coal in 1990. There were 2154 fewer deaths in the first 6 years of the ban than in the previous 6 years (15.5% fewer respiratory deaths per year).[56] However, despite the known health risks coal has continued to be used as the primary means of generating electricity in Australia. Some 80% of our domestic power is produced by coal-fired power stations.[57]

Australia also has one of the highest prevalences of asthma in the world. The burning of hydrocarbon fuels has been associated with higher rates of asthma and higher rates of respiratory distress requiring medical attention. In May 2010 the government of New South Wales released a report on child health showing that nearly 40% of 9 to 15-year olds in the Hunter Valley and New England region had suffered at some stage from asthma. That is significantly above the national average of 10%. [58]

This is an inconvenient fact – inconvenient because Australia has vast reserves of coal. According to the Energy in Australia Report, the economically demonstrated reserves to production ratios for bituminous coal and lignite in Australia are 111 years and 539 years respectively. [59] In 2009 economically recoverable black coal resources were reported to be 43.8 billion tonnes with over 96% of these resources in New South Wales and Queensland. Australia has about 7% of the world's economically recoverable black coal and ranks fifth behind USA (31%), Russia (22%), China (14%) and India (8%).[60]

Australia is the world's largest coal exporter. It exports 70%, of which 54% is sent to the new powerhouse economies in eastern Asia.[61] Coal exports are Australia's second-largest source of export income, after iron ore exports. In 2011, coal exports were worth $47 billion with $USD 15.6 billion coming from exports of thermal coal for power stations, generating billions of dollars of profits for both State ($1.17 billion in NSW in 2010-2011) and Federal Governments. [62] In turn, governments are happy to subsidise an industry in which less than half of one per cent of the Australian workforce is employed and which is 87% foreign owned to the tune of $4b per year.[63] The tax rebate on the diesel that fuels the trucks and machinery amounts to a $2 billion a year subsidy for the Australian

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[56] Rissel CE. Clinicians prescribing exercise: is air pollution a hazard [letter; with other letters by du Plessis and Sharman] *Med J Aust* 2005; 183: 334-336.

[57] http://www.csiro.au/en/Organisation-Structure/Flagships/Energy-Transformed-Flagship/CarbonDioxideCapture.aspx

[58] *Australia's coal mines blamed over asthma* BBC News 18/5/2010 http://news.bbc.co.uk/2/hi/8688820.stm

[59] Energy in Australia - 2011. ABARES. Commonwealth of Australia. Viewed 24/2/2011

[60] The Australian Government – Geoscience Australia – Atlas of Resources & Minerals http://www.australianminesatlas.gov.au/education/fact_sheets/coal.html viewed 23/2/2013

[61] "Australia Mineral Statistics 2009- June Quarter". Australian Bureau of Agricultural and Resource Economics. Retrieved 3 October 2009

[62] Reuters (5 September 2012). "New Frontier in Australian Mining Under Threat". *The New York Times*. Viewed 24/2/2013

[63] *New pollution figures underscore perversity of coal mining subsidies* Nature Conservation Council of NSW http://nccnsw.org.au/media/new-pollution-figures-underscore-perversity-coal-mining-subsidies

mining industry. This is equivalent to an $87 annual contribution from every Australian.[64] These subsidies exist without any clear, primary studies addressing the health impacts of coal in Australia.

Governments cannot continue to complain about the escalating cost of public health while ignoring the root causes of many public health issues – namely "externalities" such as air pollution.

The term "externalities" was coined in a 2009 study by Australian Academy of Technological Sciences and Engineering (ATSE) and is described as "…the external social and environmental costs that accompany all electricity generating technologies." This study attempted to look at the true cost of using coal as a primary fuel source once you factor in hidden costs such as depreciation of human health, associated medical expenses, the cost to the economy of days off work and school etc. These are hidden costs not accounted for in the market price of electricity arising from impacts on, for example, climate, human health, crops, structures and biodiversity. Until identified, and then if possible quantified in monetary terms, they remain hidden, playing a limited role in technology selection."[65] This was the first ever study of this kind in Australia, but is following a international trend as countries around the world consider energy policies for the 21st century.

The best available studies of externalities of power generation are the European Union's (EU) ExternE Project and its successor NEEDS (New Energy Externalities Development for Sustainability). ExternE produced estimates of monetary costs of greenhouse, health and other environmental impacts of power station emissions, based on full lifecycle assessments in dollars per megawatt-hour ($/MWh) which allows objective, quantitative comparisons between the environmental credentials of different technologies. ExternE work for Europe arrived at total external costs, in 2005 terms, of €41/MWh and €58/MWh for electricity generation from black and brown coal respectively. Renewable and nuclear energy had substantially lower external costs than all fossil fuels. For example, external costs were only €0.9/MWh for on-shore wind power and €4/MWh for nuclear power (light water reactor). While producing such formulas for Australia may present initial difficulties – it could very usefully inform the conversation about the use of various energy sources and their impact on the environment and population and the direction in which energy policy should be headed.

The United States has seen a sharp rise in the prevalence of asthma and other respiratory diseases in the past decade. According to the US Department of Health and Human Services the number of persons with asthma increased 2.9% each year, from 20.3 million persons in 2001 to 25.7 million persons in 2010.[66] Air pollution is cited as a principal cause in a 2010 report from the Clean Air Task Force entitled *The Toll From Coal*.[67]

It found that, in the United States, particle pollution from existing coal power plants was expected to cause some 13,200 premature deaths in 2010, as well as 9,700 additional hospitalizations and 20,000 heart attacks.[43]

The report found that the total monetized value of these adverse health impacts amounts to more than $100 billion per year. This burden is not distributed evenly across the population. Adverse impacts are especially severe for the elderly, children, and those with respiratory disease. In addition, the poor, minority groups, and people who live in areas downwind of multiple power plants are likely to be disproportionately exposed to the health risks and costs of fine particle pollution.[43]

In the previous version of this study, conducted in 2004,, it was estimated that coal pollution caused about 24,000 premature deaths annually. The authors cited the Environmental Protection Agency (EPA) action in 2005 under the Clean Air Interstate Rule (CAIR) as resulting in the declining mortality

[64] *Is Coal Mining Harming Our Health?* Beyond Zero Emissions, October 2012.

[65] Executive summary *Hidden Cost of Electricity*, Australian Academy of Technological Sciences and Engineering (ATSE) 2009

[66] US Department of Health and Human Services Report *National Surveillance of Asthma: United States, 2001–2010* November 2012 http://www.cdc.gov/nchs/data/series/sr_03/sr03_035.pdf viewed 25/2/2013

[67] *The Toll from Coal: An Updated Assessment of Death and Disease* ***from America's Dirtiest Energy*** *Source* Published: September 2010 http://www.catf.us/resources/publications/view/138 viewed 25/2/2013

figures. Though CAIR was struck down in Federal court in 2008, the pollution reduction requirements remain in effect until a replacement is established. In making their projections, the authors of the study assume similarly stringent requirements will be in place for the remainder of 2010.[43]

Even with much decreased numbers, the report says sulphur dioxide and nitrogen oxide emissions from coal power plants will "continue to take a significant toll on the health and longevity of millions of Americans." Tellingly, the report concludes; "....among all industrial sources of air pollution, none poses greater risks to human health and the environment than coal-fired power plants."[43]

The study estimated that coal cost the economy about $345 billion a year in hidden expenses not borne by miners or utilities, including health problems in mining communities and pollution around power plants.[68]

A 2011 Harvard University study concluded that if these costs were added onto consumers bills they would effectively triple the price of electricity produced by coal-fired plants, which are prevalent in part due to the their supposedly low operation costs. Accounting for all the ancillary costs associated with burning coal would add about 18 cents per kilowatt hour to the cost of electricity from coal-fired plants, shifting it from one of the cheapest sources of electricity to one of the most expensive. The current cost of coal-fired electricity is 10 cents per kilowatt hour.

"The public cost is far greater than the cost of the coal itself. The impacts of this industry go way beyond just lighting our lights," commented Paul Epstein, a Harvard Medical School instructor and the associate director of its Centre for Health and the Global Environment, the study's lead author. [69]

Similarly, the ATSE study concluded that the cost of Australia's cheap coal-fired electricity would more than double if the toll on human health and the volume of greenhouse gas emissions were taken into account. The health cost from Australia's black coal, brown coal and natural gas power was about $2.6 billion a year. This is roughly the same as the health costs from traffic emissions in Australia's capital cities.

The Hidden Costs of Electricity examines these external costs of Australia's power by adding a world carbon price for greenhouse gas emissions and a health cost for emissions of sulphur dioxide and nitrogen oxides, which can increase respiratory disease and cardiovascular disease.
The report says the combined cost of greenhouse gas emissions and damage to people's health would add - on average and per megawatt hour - about $52 to the cost of brown coal power, $42 to the cost of black coal power and $19 to the cost of natural gas. The report says these are "very significant" costs, given the average wholesale price of electricity is about $40 per megawatt hour. The report's author, Dr Tom Biegler, said policymakers needed to look at the external costs of the nation's power in light of the Government's carbon pollution reduction scheme to reduce greenhouse gases.

Despite a plethora of international scientific evidence testifying to the fact that coal does impact on human health there have been no publically funded studies in Australia. This lack of local data and analysis was emphasised in a recent literary review done by the University of Sydney on behalf of the Beyond Zero Emissions with a special focus on the Hunter Valley in NSW.[70] With 30-40 active coal mines and six coal-fired power stations, the Hunter Region of NSW has the highest concentration of coal mining and coal burning in close proximity to population centres and farmland in Australia. Around 16% (approximately 315 square kilometres) of the Upper Hunter Valley is occupied by open cut coal mines.[71]

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[68] *Full cost accounting for the life cycle of coal* Epstien et al Annals of the New York Academy of Sciences Volume 1219, Ecological Economics Reviews pages 73–98, February 2011

[69] *Coal's hidden costs top $345 billion in U.S.: study* Feb16, 2011, Reuters news agency http://www.reuters.com/article/2011/02/16/us-usa-coal-study-idUSTRE71F4X820110216 viewed 21/2/2013

[70] *Health and Social Harms of Coal Mining in Local Communities* – Research Report, Beyond Zero Emisions 2012 http://beyondzeroemissions.org/blog/coal-health-report-121023

[71] Rosewarne, S. & Connor, L. (2012) *Coal curse: the black side of the subsidised resources boom*, The

In their compilation of evidence of 50 international peer reviewed studies from 13 countries on the health and social impacts of coal mining and combustion they discovered that there had not been a publically funder peer-reviewed study done in Australia for two decades.[72] Despite the lack of health studies, coal mining in the Hunter Valley is expected to double in the next few years, with another 30 major new mines or mine expansions planned as well as a huge new coal export terminal at Newcastle.

The study concluded that the coal-cycle did present a clear and present danger to public health. Despite these risks, there is a lack of adequate monitoring to detect when pollution levels exceed national health standards.

Adults in coal mining communities have been found to have:

- Higher rates of mortality from lung cancer and chronic heart, respiratory and kidney diseases.
- Higher rates of cardiopulmonary disease, chronic obstructive pulmonary disease (COPD) and other lung diseases, hypertension, kidney disease, heart attack, stroke and asthma.
- Increased probability of a hospitalisation for COPD (by 1% for each 1,462 tons of coal mined) and for hypertension (by 1% for each 1,873 tons of coal mined).
- Poorer self-rated health and reduced quality of life.

Children and infants in coal mining communities have been found to have:

- Increased respiratory symptoms including wheezing and coughing; increased absence from school due to respiratory symptoms.
- A high prevalence of any birth defect, and a greater chance of being of low birth weight (a risk factor for future obesity, diabetes and heart disease).

Communities near coal-fired power plants and coal combustion facilities have been found to have:

- Increased risk of death from lung and some other cancers.
- Increased risk of heart attack.
- Increased asthma rates and respiratory symptoms.
- Higher rates of preterm birth, low birth weight, miscarriages and stillbirths.

The Extraction of Coal

There are a number of negative health effects of coal that occur through its mining, preparation, combustion, waste storage, and transport. Negative health effects from coal use include:[73]

- Reduction in life expectancy (particulates, sulphur dioxide, ozone, heavy metals, benzene, radionuclides, etc.)
- Respiratory hospital admissions (particulates, ozone, sulphur dioxide)
- Black lung from coal dust
- Congrestive heart failure (particulates and carbon monoxide)
- Non-fatal cancer, osteroporosia, ataxia, renal dysfunction (benzene, radionuclides, heavey metals etc)
- Chronic bronchitis, asthma attacks, etc. (particulates, ozone)
- Loss of IQ from air and water pollution (mercury)
- Degradation and soiling of buildings that can effect human health (sulphur dioxide, acid deposition, particulates)
- Global warming (carbon dioxide, methane, nitrous oxide)

Conversation, 3 July 2012

[72] As 137

[73] ExternE, (European Union Comission) *Externalities of Energy* Vol 3 Lignite and Coal http://www.externe.info/externe_d7/sites/default/files/vol3exsum.pdf viewed 22/2/2013

— Ecosystem loss and degradation, with negative effects on health and quality of life.

Specifically this happens through:

— The release of methane (CH_4), a potent greenhouse gas estimated to account for 18% of the overall global warming effect triggered by human activities (CO_2 is estimated to contribute 50%).[74]
— The release of carbon monoxide (CO) from explosives, which pollutes the air and poses a health risk for mine workers.[75]
— Coal particles stirred up during the mining process, as well as the soot released during coal transport, which can cause severe and potentially deadly respiratory problems.[76]
— Drastic alteration of the landscape, particularly with mountaintop removal, which can render an area unfit for other purposes, even after coal mine reclamation. The clearing of trees, plants, and topsoil from mining areas destroys forests and natural wildlife habitats. It also promotes soil erosion and flooding, and stirs up dust pollution that can lead to respiratory problems in nearby communities.[77]

Chronic exposure to coal dust can lead to black lung disease, or pneumoconiosis, which took the lives of 10,000 miners worldwide over the last decade.[78] Rates of black lung are on the rise, and have almost doubled in the last 10 years. The US National Institute for Occupational Safety and Health (NIOSH) reported that close to 9 percent of miners with 25 years or more experience tested positive for black lung in 2005-2006, compared with 4 percent in the late 1990s.[79]

Miners can also suffer other serious, long-term respiratory ailments: industrial bronchitis is very common among coal workers. In nonsmokers (who are less prone to develop bronchitis than smokers), studies of coal miners have shown a 16%[80] to 17%[81] incidence of industrial bronchitis.

A by-product of the open cut coalmining method, which results in carbonated waste being piled in huge piles, is spontaneous combustion. This sees the release of a number of gases associated with air pollution, namely:

— Sulphur Dioxides (SO2) (arising from sulfur associated with coal, either as
— mineral matter or bound to the organic fraction);
— Nitrogen Oxides (NOx)
— Carbon Monoxide (CO) due to incomplete combustion;
— Fine particulate matter
— Other hazardous air pollutants (eg Polynuclear aromatic hydrocarbons, PAH).[82]

The health affects of coal extraction on communities was demonstrated by a study that looked at asthma rates following the activation of an open cast mine in Wales.[83]

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[74] Environmental Impacts of Coal Mining, World Coal Institute, viewed 1/3/2013

[75] "The Dirty Truth about Coal: Mining", Sierra Club, June 2007.

[76] "Coal mine air pollution targeted" WY Business report, June 18, 2010.

[77] Jeff Biggers,"What Killed the Miners? Profits Over Safety?", *Huffington Post*, April 6, 2010.

[78] "Black lung on the rise among US coal miners" World Socialist Web Site, January 11, 2010

[79] Seixas NS, Robins TG, Attfield MD, et al. ["Exposure-Response Relationship for Coal Mine Dust and Obstructive Lung Disease Following Enactment of the Federal Coal Mine Health and Safety Act of 1969"] Am J Ind Med 1992;21:715-734.

[80] Marine WM, Gurr D, Jacobsen M. [Clinically Important Respiratory Effects of Dust Exposure and Smoking in British Coal Miners], Am Rev Resp Dis 1988;137:106-112.

[81] Massey Energy, "Update on Rescue Efforts From Massey Energy", Media Release, April 10, 2010.

[82] *Spontaneous Combustion in Open Cut Coal Mines - Recent Australian Research* Carras et al 2005 Wollongong University Faculty of Engineering and Information Sciences http://ro.uow.edu.au/cgi/viewcontent.cgi?article=1143&context=coal viewed 26/2/2013

[83] *Asthma and open cast mining* J M F Temple, A M Sykes , BMJ 1992;305:3%-7 viewed on 26/2/2013

A GP practice in the town of Glynneath started keeping detailed records of asthma patients in 1983 following Welsh Office concern about apparently excessive prescribing for asthma in 1983. The Glynneath practice started to audit its treatment of new asthma episodes.

When the Secretary of State for Wales granted permission to start open cast mining to the north of the town, despite local opposition, a natural experiment began to test the hypothesis that the weekly number of new episodes of asthma treated by the town's general practitioners would increase when the new mine started.

Weekly new episodes of asthma were recorded for the period 30 September 1989 to 14 January 1992. The gradient of the cusum graph showed a sustained and sudden change from the week beginning 3 October 1990. The new mine started excavation on 29 September 1990.

Before mining operations began the mean weekly number of new episodes of asthma was 4-4 (95% confidence interval 3-6 to 5 2), and after mining began it was 7-9 (7-0 to 8 6). The 95% confidence interval for the change in mean was 2 3 to 4 6 weekly new episodes of asthma.

The paper concluded: “Our findings are prima facie evidence to support the practice's concern about the risks to the general population from the open cast coal site.”

With some 30 open cut mines approved the residents of the Hunter Valley have every reason to be concerned.

Coalmining can change the lifestyle and character of a community. Medical practitioners in coalmining areas have reported that increases in asthma, stress and mental ill health have become more common.[84]

An Australian review of air pollution by Kjellstrom and colleagues, while not specifically focusing on the effects of coal combustion, summarises the effects of particle exposure on health.[85] These include respiratory symptoms such as cough, aggravated asthma, the development of chronic bronchitis and decreased lung function; arrhythmias, nonfatal heart attacks and premature death in people with heart or lung disease; the effects of absorption of toxic material; and allergic or hypersensitivity effects. The smallest particles, particulate matter (PM) 2.5, are the most damaging.[86]

Transportation of Coal

Coal is transported via open trucks, railroad trucks, and large cargo ships, which leads to fine black soot, the so-called “Devil’s Dust,” being distributed throughout the surrounding neighbourhoods.

A number of studies have explored this phenomenon, notably one conducted in Liverpool in the UK, a main coal port.[87] It was carried out to determine whether schoolchildren in a specific locality exposed to pollution from steam coal dust have an excess of respiratory symptoms compared with children in control areas.

A total of 1872 primary schoolchildren (aged 5-11 years) from five primary schools in the Bootle dock area of Liverpool (exposed area), five primary schools in South Sefton (control area), and five primary schools in Wallasey (control area) were studied.

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[84] Fowler A. A dirty business. *Four Corners* [television program]. Sydney: ABC, 2010. http://www.abc.net.au/4corners/content/ 201 2870687.htm Viewed 28/2/2013

[85] Kjellstrom TE, Neller A, Simpson RW. *Air pollution and its health impacts: the changing panorama*. *Med J Aust* 2002; 177: 604-608.

[86] Australian Air Quality Group. Particles. AAQG: Armidale, 25 Apr 2010. http://aaqg.3sc.net/air-pollution-and-health/particles Viewed 27//2/2013

[87] *Respiratory morbidity in Merseyside schoolchildren exposed to coal dust and air pollution* Barabin et al. 1994 adc.bmj.com viewed on 26/2/2013

The children in the three areas were of similar mean age (7.5 years), height (1-24 m), sex ratio, and had a similar prevalence of paternal (6.2%) and maternal (7%) asthma. The exposed zone contained more unemployed parents (41%, 29%, and 29% respectively), more rented housing (64%, 45%, 34%), and more smoking parents (71%, 60%, 59%) than the control areas.

Respiratory symptoms were significantly more common in the exposed area, including wheeze (25.0%, 20.6%, and 17.5%), excess cough (40.0%, 23.4%, and 25.1%), and school absences for respiratory symptoms (47.5%, 35.9%, and 34.9%). These differences remained significant even if the groups were subdivided according to whether or not parents smoked or were employed.

Multiple logistic regression analysis confirmed the exposed zone as a significant risk factor for absenteeism from school due to respiratory symptoms (odds ratio 1.55, 95% confidence interval 1.17 to 2.06) after adjusting for confounding factors. Standard dust deposit gauges on three schools confirmed a significantly higher dust burden in the exposed zone.[88]

The conclusion was that an increased prevalence of respiratory symptoms in primary schoolchildren exposed to coal dust was confirmed.

Combustion of Coal

Burning coal is the single largest cause of global warming and has been described by the world's leading medical journal, *The Lancet*, as "the biggest health threat of the 21st century." [89]

Many tiny PM 2.5 particles are produced during coal-fired power generation. Specific data in Australia is lacking; however, in the US, the Physicians for Social Responsibility examined the evidence for health damage caused by coal.[90] The risk of premature death for people living within 30 miles of coal-burning power plants has been quoted to be three to four times that of people living at a distance.[91] Fifty thousand US deaths each year have been attributed to air pollution,[92] and air pollution from combustion of coal, diesel fuel and wood was estimated to account for 5% of male and 3% of female cancer deaths between 1970 and 1994.[93]

The limited evidence on the impacts of air pollution from burning coal in Australia suggests that the health impacts are similar to those reported from other developed countries.[94] A 1993 study reported an increase in symptoms of childhood wheeze and asthma-like breathing difficulties from a community near a coal-fired power station.[95]

Coal combustion in power plants releases nitrogen oxides, sulphur dioxide, particulate matter (PM), mercury, and dozens of other substances known to be hazardous to human health.[96] According to the

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[89] http://www.thelancet.com/climate-change

[90] Lockwood AH, Welker-Hood K, Rauch M, Gottlieb B. Coal's assault on human health: a report from Physicians for Social Responsibility. Washington DC: PSR, 2009. http://www.psr.org/assets/pdfs/psr-coal-fullreport.pdf Viewed 28/2/2013.

[91] Epstein PR, Reinhart N. Testimony for the Kentucky General Assembly, House

of Representatives Committee on Health and Welfare. London, Ky: Kentuckians for the Commonwealth, 2010. http://www.kftc.org/blog/linkeddocuments/ documents/Epstein%20Testimony.doc Viewed 28/2/2013

[92] As 137

[93] Grant WB. *Air pollution in relation to US cancer mortality rates: an ecological study; likely role of carbonaceous aerosols and polycyclic aromatic hydrocarbons*. *Anticancer Res* 2009; 29: 3537-3545.

[94] Voigt T, Bailey M, Abrahamson M. Air pollution in the Latrobe Valley and its impact upon respiratory morbidity. Aust N Z J Public Health 1998; 22: 556-561.

[95] Halliday JA, Henry RL, Hankin RG, Hensley MJ. Increased wheeze but not bronchial hyper-reactivity near power stations. J Epidemiol Community Health 1993; 47: 282-286.

[96] "Green Coal?," Rachel's Environment & Health News, November 6, 2008.

Union of Concerned Scientists, in an average year, a typical coal plant (500 megawatts) generates the following amounts of air pollutants.[97]

- 3.7 million tons of carbon dioxide (CO_2), an amount equivalent to chopping down 161 million trees. CO_2 pollution is the principal human cause of global warming and climate change.
- 10,000 tons of sulphur dioxide (SO_2), which causes acid rain and forms small airborne particles that can cause lung damage, heart disease, and other illnesses such as asthma.
- 10,200 tons of nitrogen oxide (NOx), equivalent to half a million late-model cars. NOx leads to formation of smog, which inflames lung tissue and increases susceptibility to respiratory illness.
- 500 tons of small airborne particles (particulate matter), which has been associated with asthma and increased respiratory distress, reductions in lung function, increased hospital and emergency room admissions, and premature death.[98]
- 220 tons of hydrocarbons, which contribute to smog formation.
- 720 tons of carbon monoxide (CO), which causes headaches and places additional stress on people with heart disease.
- 170 pounds of mercury 1/70th of a teaspoon of mercury deposited in a 25-acre lake can make the fish unsafe to eat. Mercury also causes learning disabilities, brain damage, and neurological disorders.[99]
- 225 pounds of arsenic, which leads to cancer in 1 out of 100 people who drink water containing 50 parts per billion.
- 114 pounds of lead, 4 pounds of cadmium, and other toxic heavy metals. These toxic metals can accumulate in human and animal tissue and cause serious health problems, including mental retardation, developmental disorders, and damage to the nervous system.[100]

Physical Effects of Coal Combustion

A November 2009 report on the effects of coal by the Physicians for Social Responsibility (PSR) found that coal combustion affects not only the human respiratory system, but also the cardiovascular and nervous system.[101]

- Premature death: according to a 2004 report by the Clean Air Task Force, fine particulates from power plants result in nearly 24,000 annual deaths, with 14 years lost on average for each death.[102]
- Coal combustion contributes to smog through the release of oxides of nitrogen, which react with volatile organic compounds in the presence of sunlight to produce ground-level ozone, the primary ingredient in smog. Air pollutants such as nitrogen dioxide (NO2) and fine particulate matter adversely affect lung development.[103] and are associated with an increased prevalence of asthma.[104]
- Air pollution triggers attacks of asthma, which now affects more than 9% of all U.S. children, who are particularly susceptible to the development of pollution-related asthma attacks. There are now tens of thousands of hospital visits and asthma attacks each year.[105]

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[97] "Coal Power: Air Pollution," Union of Concerned Scientists, viewed 27/2/2013

[98] Particulate Pollution, NRDC, viewed 27/2/2013

[99] Air Pollution in the Mountains, Appalachian Voices, viewed 27/2/2013

[100] Public Benefits of Renewable Energy Use, Union of Concerned Scientists, 1999.

[101] Alan Lockwood, Kristen Welker-Hood, Moll Rauch, Barbara Gottlieb,"Coal's Assault on Human Health" Physicians for Social Responsibility Report, November 2009.

[102] U.S. Environmental Protection Agency (EPA), "Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2004," April 2006.

[103] Barbara Freese and Steve Clemmer, "Gambling with Coal: How New Climate Laws Will Make Future Coal Plants More Expensive," Union of Concerned Scientists, September 2006, page 2.

[104] "Groundbreaking Study Quantifies Health Costs of U.S. Climate Change-Related Disasters & Disease: Set of Climate-Related Events Result in Billions in Health Costs and Lost Lives" NRDC Press Release, Nov. 8, 2011.

[105] Charles Duhigg,"Cleansing the Air at the Expense of Waterways" New York Times, October 12, 2009

- Coal pollutants also plays a role in the development of chronic obstructive pulmonary disease (COPD), a lung disease characterized by permanent narrowing of airways.[106]
- Exposures to ozone and PM are also correlated with the development of and mortality from lung cancer, the leading cancer killer in both men and women.[107]

Change needed to Australia's current regulatory system

Any Australian health submission on the effect of the coal cycle on public health currently needs to draw most of its evidence from overseas studies as there have been no State or Federal funded studies for two decades in Australia, the largest coal exporter in the world, despite the raft of peer-reviewed scientific evidence that coal is harmful to public health at every stage of its life-cycle.

This fact was brought into sharp relief with the release of a study into the health effects of coal mining commissioned by the NGO Beyond Zero Emissions in 2012.

There has been widely expressed community concern in coal mining areas such as New South Wales' Hunter Valley and Lithgow in the Blue Mountains, which has a coal mine and a newly extended coal-fired power station and an asthma rate 80% higher than the NSW average for other LGAs.[108] The Lithgow LGA also has hospital separation rates 26% higher than the average for NSW.[109] Average annual rates for all causes of death for the period 2000-2002 indicate the annual death rate for the Lithgow LGA is more than 30% higher than NSW and significantly higher than the remaining LGA's within the SWAHS boundaries. For males the rate is 25% higher than the NSW male rate, and for females the rate is 40% higher than the NSW female rate.[110]

As in so many areas of air pollution there are solutions that would either eliminate or drastically cut air pollutants.

"Clean coal" carbon capture and storage technology could cut exhaust emissions from coal-fired power stations by about 90 per cent [111]. This would add costs to energy companies, which will most likely be passed on to the public. Although there is a huge resistance to increasing energy costs, reflecting the true cost of producing coal fired electricity will increase the attractiveness of renewable energy and much needed investment in this area.

Due to the deficiencies discussed above, the coal industry in Australia has been to operate largely unchecked and unmonitored for decades and immediate action is needed to rectify this. A unified national framework for assessing the health, social and environmental impacts of large scale coal mining is urgently needed – one that is open, transparent and takes into account the prospects, health and concerns of the affected communities.

Recommendations

- **The Federal Government to undertake well designed local studies to obtain primary evidence to accurately quantify the health impacts of coal mining and combustion.** This should be undertaken before approving any new mines or major coal infrastructure.
- **The establishment of a statutory authority independent of government and the coal industry** to undertake all monitoring of harmful impacts to land, air and water from coal mines and power stations.
- **Comprehensive cost benefit analysis including all health, social and environmental**

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[106] "What is a Coal Sludge Impoundment?," Sludge Safety Project, accessed August 2009.

[107] Eilene Toppin Ording,"Heavy Metals and Coal: Carbon Footprint Aside, Coal is not Environmentally Friendly" Suite 101, accessed November 2009

[108] *Crime Prevention Plan* Lithgow City Council September 2009 http://archive.lithgow.nsw.gov.au/documents/Crime%20Prevention%20Plan.pdf viewed 1/3/2013

[109] As 176

[110] As 176

[111] As 175

externalities to be undertaken before the approval of any new coal mines, mine expansions or coal power stations. This includes the contribution that coal makes to global warming and the cost of the impacts from this via worsening and more frequent droughts, bushfires, floods, heat waves and storms.

- **A minimum buffer zone between human habitation and all new open cut coal mines, mine expansions, coal and port infrastructure.** The size of the buffer zone should be based on independent modelling of PM 10 and PM 2.5 particle dispersion which takes into account all existing and future projected climatic conditions. Until this modelling has been completed a precautionary 10 km buffer zone should be established.
- **Comprehensive monitoring of PM 10 and 2.5 particulates** by the independent authority in relation to all existing and proposed mines, port and rail infrastructure.
- **Develop a "Utility Air Toxics" law** similar to the one being written in the US to limit emissions of toxins known to be harmful to human health. When passed it will be the first time in US history that the release of mercury, arsenic, lead, dioxins and other potentially deadly gases from coal-fired power stations will have national, enforceable limits.
- **Removal of the diesel fuel subsidy for mining activities.** The fumes from diesel engines have been recently listed by the World Health Organisation as a carcinogen.
- **Mandatory adoption of new technology shown to cut emissions.** For example, if coal-fired power stations used "clean coal" carbon capture and storage technology, their exhaust emissions could fall by about 90 per cent.[112]

3. What we believe needs to be done to improve current air pollution levels to improve health outcomes for people living with asthma.

Air Pollution Monitoring

The main pillar on which all air pollution policy should be based is air pollution monitoring data. It is the means by which we can scientifically measure and assess the quality of the air and monitor changes, both positive and negative, when new technologies, energy sources, processes or policies are introduced.

Recommendation:

Upgrade Australia's Pollution Monitoring System

Introduce a comprehensive air quality monitoring system which measures particles right down to 0.1 microns. Ensure monitors are placed in high pollution areas to identify when pollution levels exceed national standards, and enable action to be taken to reduce these levels and prevent undesirable health impacts.

Tackling any form of air pollution and monitoring changes in pollution levels after new regulations are enacted requires a state-of-the-art air pollution monitoring system. After lagging a decade behind most advanced countries, NSW recently supplemented its PM10 system with some PM2.5 monitoring. Still compared to the US where most cities monitor particles smaller than PM2.5, down to 0.1PM NSW and other areas in Australia, are still some way behind. It is widely accepted that nano particles, which are produced by a variety of other sources (industry, coal-fired power stations, gas-fired power stations, coal seam gas, motor vehicles) are one of the major threats to public health. Therefore, its time Australia came into line with other advanced countries.

One of the key problems with air pollution in Australia is an antiquated air pollution monitoring system, which is some 10- 15 years behind other first world countries, and means we have no real idea what quality of air is in Australia.

The current National standard for air pollution monitoring is PM10, although some states, such as NSW do measure PM2.5. Whereas in countries like the US measure right down to the so-called micro-particles produced by the new generation of so-called "clean and efficient" diesel engines.

[112] As 132

This enables unsubstantiated claims to be made about air quality in Australia such as,

"The air quality in Australian cities is generally better than cities in most parts of the world, even comparable countries. A global air pollution map produced by the European Space Agency shows parts of China, the US and Europe being among the major air pollution hot spots."

"In NSW, the air we breathe is generally good. It's certainly much cleaner than it was 15 years ago thanks to Government controls on industry, motor vehicles and fuels, as well as on backyard burning."

"Lets Clean the Air" Air quality and pollution, NSW Government website
http://www.cleartheair.nsw.gov.au/science_and_research/science/air_quality_and_pollution.aspx
Viewed 22/2/2013

Whilst the air appears cleaner at PM10 levels, there is no scientific measure of what the levels of air pollution below PM10 are. It is scientific fact that air pollution particles have gotten smaller in the past decade or so. Particulate matter from new, so-called "cleaner, greener" fuels and "more efficient" engines are now smaller than one micron. In new diesel engines they begin at 0.1 microns. These smaller particles are more deadly than PM10, yet under current air pollution standards it is not possible to identify what levels of small particulate pollution we are breathing in. Perhaps it is not cleaner, just smaller.

A radical overhaul of Australia's air pollution monitoring standards is urgently needed as a first step in revealing just how clean Australia's air really is. Until this is done any assertions about Australia's air is without any valid scientific foundation.

Without proper air pollution monitoring it is not possible to accurately detect improvements or deterioration in air quality, nor in an era of increasingly unpredictable weather and seasonal patterns to issue accurate or timely public health warnings in the event of a natural disaster or catastrophe such as a dust storm.