



CLIMATE<sup>AND</sup>  
HEALTH  
ALLIANCE

**Submission to Senate Standing Committees  
Community Affairs**

**Inquiry into the impacts on health of air  
quality in Australia**

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## About the Climate and Health Alliance

The Climate and Health Alliance (CAHA) is a not-for-profit organisation that is a national alliance of organisations and people in the health sector working together to raise awareness about the links between ecology and health including the health risks of climate change and the health benefits of emissions reductions.

CAHA's members recognise that health care stakeholders have a particular responsibility to the community in advocating for public policy that will promote and protect human health.

The membership of the Climate and Health Alliance includes a broad cross section of the health sector with 26 organisational members, representing health care professionals from a range of disciplines, health care service providers, institutions, academics, researchers, and health consumers.

For more information about the membership and governance of the Climate and Health Alliance, please see Appendix A. For further information see [www.caha.org.au](http://www.caha.org.au)

## Terms of reference

The terms of reference for this Inquiry into the impacts on health of air quality in Australia that will be addressed in this submission:

- (a) particulate matter, its sources and effects;
- (b) those populations most at risk and the causes that put those populations at risk;
- (c) the standards, monitoring and regulation of air quality at all levels of government; and
- (d) any other related matters.

## Summary

The evidence suggests that the Australian community is being exposed to increasing levels of harmful air pollution, causing significant illnesses and leading to thousands of hospitalizations and premature deaths each year.

Of particular concern are emissions from transport and power generation which create toxic air pollution that is causing cardiovascular disease, respiratory diseases and cancer, and is also implicated in adverse health impacts on people's reproductive, urological and neurological systems.

Figures from NSW in 2009 indicate the annual health costs of air pollution from transport, power generation and industry in that state alone are A\$4.7 billion.<sup>1</sup> The costs for the whole of Australia are likely to be much higher.

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<sup>1</sup> NSW Government, Air Pollution, [www.health.nsw.gov.au/publichealth/environment/air/air\\_pollution.asp](http://www.health.nsw.gov.au/publichealth/environment/air/air_pollution.asp)

Reducing air pollution from these sources should be a national priority. The evidence from the US suggests that there is a very high benefit: cost ratio from improving air quality, with twenty-five dollars saved in healthcare costs for every dollar spent complying with regulations, due to the lower disease burden.

The health gains from improved air quality can be achieved quickly and the potential savings significant. We should not delay in making improved air quality for better health and well-being an urgent national priority for Australia.

## **Air quality: a significant public health issue**

The adverse health effects of air pollution are well recognised in terms of its adverse impact on cardiovascular (heart) and respiratory (lungs) systems. Depending on the type however, air pollution is also associated with harm to neurological, urological and reproductive systems, can affect brain development in children and is in some cases carcinogenic.

History provides a guide the harm that air pollution can cause – the 1952 London smog episode in which stagnant weather conditions led to a sharp increase in the concentrations of air pollutants is estimated to have caused 12,000 additional deaths due largely to high levels of smoke, sulphur dioxide and sulphuric acid are considered to be the cause.<sup>2</sup> Thanks to the introduction of air quality controls, levels of pollution subsequently declined.

However since the 1970s air quality has re-emerged as a significant public health issue, with particulates, nitrogen oxide and photochemical pollution such as ozone produced from the combustion of fossil fuels for heating, power generation and in motor vehicles considered responsible for millions of premature deaths each year globally.

In Australia, air pollution is estimated to kill more people every year than the road toll.<sup>3</sup>

## **Sources of air pollution**

In Australia, the main sources of air pollution are carbon monoxide (CO), nitrogen oxides (NO, NO<sub>2</sub>), sulphur dioxide (SO<sub>2</sub>), and particulate matter (PM<sub>10</sub>-PM<sub>2.5</sub>) which are produced by the combustion of fuel or other high-temperature industrial processes, and ozone. Ozone is a gas produced in the presence of sunlight and volatile organic compounds from the combustion of fossil fuels.

Particulate matter from combustion is composed of many chemical compounds, including organic carbon species, elemental or black carbon, and trace metals (eg lead and arsenic). These can range in size from a few nanometers in diameter to particles in the diameter range of 200 to 1000 nm (0.2 to 1 µm). Ultrafine particles are strongly linked to fresh combustion and traffic-related pollution.

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<sup>2</sup> Bert Brunekreef, Stephen T Holgate Air pollution and health Lancet 2002; 360: 1233–42

<sup>3</sup> Australian State of the Environment Committee, State of the Environment 2011 (SoE 2011), Independent report to the Australian Government Minister for Sustainability, Environment, Water, Population and Communities, 2011; Bureau of Transport and Regional Economics, Health Impacts of Transport Emissions in Australia: Economic Costs, Working Paper 63, Commonwealth of Australia, 2005.

Air pollution from transport contains particulates, nitrogen dioxide, ground level ozone and carbon monoxide.<sup>4</sup> Diesel emissions are particularly toxic as they emit fine particulate matter (PM2.5) containing polycyclic aromatic hydrocarbons (PAHs), a known carcinogen.<sup>5</sup>

The mining and combustion of coal for electricity generation in Australia produces toxic air pollution containing particulate matter (PM10 and PM2.5), nitrogen oxides, sulphur dioxide, as well as emissions of arsenic, sulphuric and nitric acids, boron, fluorides, mercury, antimony, cadmium, chromium, cobalt, lead, manganese, nickel, selenium and zinc.<sup>6,7</sup>

The mining and transportation of coal also generates large quantities of dust: for example, the National Pollutant Inventory estimates 42,000,000 kg of dust is produced in the Hunter Valley each year from coalmining.<sup>8</sup>

Particulate matter (PM) includes airborne solid or liquid particles including dust, pollens, soot and aerosols arising from combustion. The particles known as PM10 (with a diameter less than 10 µm) are most commonly measured, however finer particles such as PM2.5 are of considerable concern as they can penetrate deeper into the lungs and have the potential to be more damaging.<sup>9</sup>

Volatile organic compounds (VOCs), which occur as both gases and particles, are associated with combustion and fugitive emissions. They include benzene, toluene, xylene, 1,3-butadiene, and polycyclic aromatic hydrocarbons.<sup>10</sup> Many VOCs contribute to the formation of ozone (O<sub>3</sub>) as well as to the composition of PM2.5.<sup>11</sup> Vehicle exhaust is a major source of volatile organic compounds in urban areas.

Ozone is a secondary pollutant formed through photochemical reactions involving nitrogen oxides and volatile organic compounds in the presence of sunlight and warm temperatures.

Other pollutants such as ammonia, methane, pesticides (persistent organic pollutants), reduced sulphur compounds, re-suspended dust, and natural coarse particles (PM10–2.5) are associated with non-combustive (eg. agriculture) and natural (eg. erosion) activities, as well as from agricultural practices and from industrial facilities (eg. mineral industry).<sup>12</sup>

## Effects of air quality on the health of people

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<sup>4</sup> Environment Protection and Heritage Council, Expansion of the multi-city mortality and morbidity study, Final Report, 2010.

<sup>5</sup> <http://www.ncbi.nlm.nih.gov/pubmed/16982530>

<sup>6</sup> Environment Protection and Heritage Council, Expansion of the multi-city mortality and morbidity study, Final Report, 2010.

<sup>7</sup> Higginbotham, N. et al. Environmental injustice and air pollution in coal affected communities, Hunter Valley, Australia. *Health and Place*, 16, 2010, 259-266.

<sup>8</sup> Environment Defenders Office NSW, Fact Sheet 4.7: Air Quality and Dust Monitoring.

<sup>9</sup> Carey, M. and Dennekamp, M. Air quality and chronic disease: why action on climate change is also good for health, *NSW Public Health Bulletin* Vol. 21(5–6) 2010.

<sup>10</sup> *ibid*

<sup>11</sup> *ibid*

<sup>12</sup> Brook, R.D., et al. Particulate matter air pollution and cardiovascular disease: an update to the scientific statement from the American Heart Association. On behalf of the American Heart Association Council on Epidemiology and Prevention, Council on the Kidney in Cardiovascular Disease, and Council on Nutrition, Physical Activity and Metabolism. *Circulation*. 2010;121:2331–2378.

Numerous studies point to links between airborne particulate matter and gases such as ground level ozone and increases in mortality and hospital admissions associated with exposure.

Studies in Boston Studies in Boston, MA, USA, showed that nitrogen dioxide and PM<sub>2.5</sub> were associated with life-threatening arrhythmia (irregularity of heartbeat) sufficient to necessitate the implantation of pacemakers.<sup>13</sup> This same study showed the onset of myocardial infarctions (heart attacks) in a large group of patients was associated with exposure to high PM<sub>2.5</sub> concentrations in the hours and days before the onset of illness.<sup>14</sup>

Adverse effects from airborne particulates and ozone both occur at very low levels of exposure, and it is unclear whether a threshold concentration exists below which no adverse health effects occur.

Exposure to nitrogen dioxide even for short periods is associated with respiratory illness, while long term exposure can reduce resistance to respiratory infections. Sulphur dioxide is also a respiratory irritant, and long exposures are associated with cardiopulmonary diseases and lung cancer.<sup>15</sup>

In Switzerland, studies in a number of communities have found lung function in adults and children was adversely affected by exposure to PM<sub>10</sub>, nitrogen dioxide, and sulphur dioxide with exposure associated with bronchitis. These effects were seen at PM<sub>10</sub> concentrations of only 10–33 µg/m<sup>3</sup>, well below the concentrations in many European countries.<sup>16</sup>

The development of bronchitis in children in US and Canadian communities is also associated with exposure to fine particles.<sup>17</sup>

Time series studies suggest that adverse effects increase with increasing exposure to air pollution, suggesting that cumulative exposures over a long duration have a stronger effect on mortality than daily exposures to varying levels of air pollution.<sup>18</sup>

An important study in the American Heart Association Journal *Circulation* in 2010 found that even short exposures to PM 2.5 µm in diameter (PM<sub>2.5</sub>) (a few hours to weeks) can trigger cardiovascular deaths and illness, while longer-term exposure (i.e. over a few years) greatly increases the risk for cardiovascular mortality than shorter exposures reduces life expectancy among highly exposed groups by several months to a few years.<sup>19</sup>

The same study also found that reducing exposure to particulate matter reduced the risk of cardiovascular mortality within a short time frame (i.e. a few years).

This is supported by a recent study of heart health among young healthy people in Beijing: the reduction of air pollution associated with decline in traffic during the Beijing Olympics was found to have an immediate and positive effect on cardiovascular health, demonstrating that even

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<sup>13</sup> Bert Brunekreef, Stephen T Holgate Air pollution and health Lancet 2002; 360: 1233–42

<sup>14</sup> Bert Brunekreef, Stephen T Holgate Air pollution and health Lancet 2002; 360: 1233–42

<sup>15</sup> Higginbotham, N et al. 2010. *ibid.*

<sup>16</sup> Bert Brunekreef, Stephen T Holgate Air pollution and health Lancet 2002; 360: 1233–42

<sup>17</sup> Bert Brunekreef, Stephen T Holgate Air pollution and health Lancet 2002; 360: 1233–42

<sup>18</sup> Bert Brunekreef, Stephen T Holgate Air pollution and health Lancet 2002; 360: p. 1237.

<sup>19</sup> Brook, R.D., et al. *ibid.*

healthy people can benefit from improving air quality. The two week period saw a significant decline in air pollutants: PM2.5 dropped 27 per cent, nitrogen dioxide 43 per cent and sulphur dioxide 60 per cent.<sup>20</sup>

The US EPA has calculated that the ratio of healthcare cost savings to the costs of compliance with the Clean Air Act was 25:1 in 2010. This means that for every dollar spent complying with the Clean Air Act, twenty-five dollars were saved in healthcare costs due to lower disease burden, including a reduction in premature deaths, and reduction in cases of bronchitis, asthma, and myocardial infarction.<sup>21</sup>

A 2010 report from Europe found improvements in air quality from moving to cleaner energy systems would deliver significant improvements in population health and boost productivity.<sup>22</sup> The improvement in air quality from associated reductions in fine particles, NO<sub>x</sub> and SO<sub>2</sub> from reducing emissions from power generation would save the European Union €80 billion a year in avoided ill health and productivity gains.

Exposure to ozone leads to the development of an inflammatory response which affects respiratory health and can cause a decline in lung function, including in the lungs of healthy young people.<sup>23</sup>

A study released in 2011 from the USA Union of Concerned Scientists suggests climate change is contributing to increased ozone pollution which causes respiratory disease. Ozone affects the airways and lungs, causing inflammation and reduced function. Exposure to increased levels of ozone is associated with increased hospital admissions for pneumonia, chronic obstructive pulmonary disease, asthma and other respiratory diseases, and with premature mortality. As well as affecting people who are particularly sensitive to air pollution, such as children, asthmatics and the elderly, ozone can also affect the lungs of healthy people.

The UCS report suggests the health impact costs of the projected increase in ozone will cost the US \$5.4 billion each year by 2020, lead to one million missed school days, and almost three million additional acute respiratory attacks.

Exposure to ozone pollution, along with nitrogen dioxide and particulate matter, is considered to be responsible for the deaths of over 2 million children each year due to acute respiratory infections.<sup>24</sup>

There is increasing evidence of adverse health effects on babies and children from maternal exposure to air pollutants: exposure is associated with adverse pregnancy outcomes, risk of low birth weight, foetal growth restriction, and pre-term delivery.<sup>25</sup>

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<sup>20</sup> Zhang, K. Air pollution closely linked to heart health, *ABC Environment*, 15 October 2012. Available at: <http://www.abc.net.au/environment/articles/2012/10/15/3609769.htm>

<sup>21</sup> US Environmental Protection Agency Office of Air and Radiation. *The Benefits and Costs of the Clean Air Act: 1990-2020*. Washington DC: EPA, 2010.

<sup>22</sup> Health Care Without Harm (HCWH) and the Health and Environment Alliance (HEAL), *Acting Now for Better Health*, 2010, Brussels.

<sup>23</sup> Union of Concerned Scientists, *Climate Change and Your Health: Rising Temperatures, Worsening Ozone Pollution*, 2011.

<sup>24</sup> Bert Brunekreef, Stephen T Holgate Air pollution and health *The Lancet* 2002; 360: 1233–42

## Deaths from air pollution

Even a small increase in air pollution can have big impacts across densely populated regions: it is estimated that an increase in PM<sub>2.5</sub> of 10 µg/m<sup>3</sup> contributes (on average) to the premature death of one susceptible person per day in a region of 5 million people.

As Brook et al point out in their 2010 study: “the danger to any single individual at any single time point may be small, but the public health burden [is] enormous”.

This suggests that short-term increases in PM<sub>2.5</sub> levels lead to the premature deaths of tens of thousands of individuals each year in the United States alone.<sup>26</sup>

Motor vehicle-related air pollution is believed to be responsible for between 900 and 4,500 cases of cardiovascular and respiratory diseases and bronchitis each year in Australia, and between 900 and 2,000 early deaths.<sup>27</sup>

An Australian study on the health effects of air pollution in Brisbane, Melbourne, Perth and Sydney in 2005 found a 10 mg/m<sup>3</sup> elevation in PM<sub>2.5</sub> concentration was associated with a 1% increase in the daily total number of deaths.<sup>28</sup>

Another more recent study from the UK that monitored over 150,000 people for more than four years suggests for every increase of 10 µg/m<sup>3</sup> in PM<sub>2.5</sub> there was a 20 per cent increase in the death rate.<sup>29</sup>

In a study of a cohort of women, the Nurses' Health Study, an increase in exposure to PM<sub>10</sub> of 10 µg/m<sup>3</sup> was associated with a 7% to 16% increase in all-cause mortality and a 30% to 40% increase in fatal coronary heart disease.<sup>30</sup>

In the Netherlands (with 16 million inhabitants) it is estimated that air pollution is responsible for more than 2,100 deaths annually - almost twice the number of deaths due to traffic accidents.<sup>31</sup> For the combined population of Austria, France, and Switzerland (about 74.5 million), it is estimated 40 000 deaths per year are attributable to air pollution, with about half specifically associated with air pollution from traffic.<sup>32</sup>

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<sup>25</sup> <http://www.scew.gov.au/publications/pubs/air/achaps-final-report-may2012.pdf>

<sup>26</sup> Brook, R.D., et al. 2010.

<sup>27</sup> Bureau of Transport and Regional Economics, Health Impacts of Transport Emissions in Australia: Economic Costs, Working Paper 63, Commonwealth of Australia, 2005.

<sup>28</sup> Simpson R, Williams G, Petroeshevsky A, Best T, Morgan G, Denison L et al. The short-term effects of air pollution on daily mortality in four Australian cities. *Australian and New Zealand Journal of Public Health* 2005; 29: 205–12.

<sup>29</sup> Tonne, C et al. Airborne pollution and cardiovascular disease: burden and causes of an epidemic, *European Heart Journal*, 2013; Smith, R. Air pollution causes 4,800 early deaths: research, *The Telegraph*, 20 February 2013.

<sup>30</sup> Hales S, Blakely T, Woodward A. Air pollution and mortality in New Zealand: cohort study *J Epidemiol Community Health* (2010).

<sup>31</sup> Bert Brunekreef, Stephen T Holgate Air pollution and health *Lancet* 2002; 360: p. 1239.

<sup>32</sup> Bert Brunekreef, Stephen T Holgate Air pollution and health *Lancet* 2002; 360: p. 1239.

In 2004, Australian government scientists estimated that 2,400 of the 140,000 Australian deaths each year were linked to air quality – a number they say would be much greater if the long term effects of air toxics on cancer were included.<sup>33</sup>

The World Health Organization estimates that urban outdoor air pollution causes 1.34 million premature deaths worldwide annually, and that PM2.5 contributes to approximately 800,000 premature deaths per year, ranking it as the 13th leading cause of worldwide mortality.<sup>34</sup> According to WHO, the number of deaths attributable to air pollution increased by 16% from 2004 to 2008.<sup>35</sup> There is no reason to suppose this has improved since then.

## Factors contributing to increasing air pollution

Contributors to increasing levels of air pollution in Australia and globally include increasingly vehicular traffic in cities, expansion of mining for energy and resources, combustion of coal, gas, and oil for electricity and industrial processes, compounded by rising temperatures associated with global warming.

Climate affects air pollution levels and impacts because temperature, humidity, wind and rain affect air pollutant emissions, its chemistry, and influence its distribution.<sup>36</sup> Temperature can further influence the health impacts of air pollutants such as sulphur dioxide and particulate matter.<sup>37</sup>

Air pollution from the expanding energy and minerals sector is a driver of ill-health and avoidable deaths.<sup>38</sup> Air pollution associated with the extraction, transportation and combustion of coal, oil and gas causes ill health and deaths by contributing to the development of respiratory diseases such as asthma and lung cancer and cardiovascular diseases which lead to heart attacks. Mercury pollution from coal fired power is associated with developmental delay and permanently reduced intellectual capacity in exposed children.<sup>39</sup> The mining and transportation of coal exposes workers and local communities to dangerous coal dust, and diesel emissions from coal transport are also a significant contribution to local air pollution.<sup>40</sup>

Air pollution associated with coal seam gas exploration and mining with potentially serious health risks has been demonstrated in a 2012 study, where 44 hazardous air pollutants were detected at gas drilling sites.<sup>41</sup> This 12 month study found a wide range of toxic air pollutants in proximity to unconventional gas exploration sites, including methane, methylene chloride,

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<sup>33</sup> Higginbotham, N et al. 2010. *ibid*.

<sup>34</sup> Brook, R.D., et al. 2010.

<sup>35</sup> Mannucci, P. M. Airborne pollution and cardiovascular disease: burden and causes of an epidemic, *European Heart Journal*, Editorial, published online, 19<sup>th</sup> February 2013.

<sup>36</sup> Carey, M. and Dennekamp, M. Air quality and chronic disease: why action on climate change is also good for health, *NSW Public Health Bulletin* Vol. 21(5–6) 2010.

<sup>37</sup> *ibid*

<sup>38</sup> Gohlke, J. M. et al. Estimating the global public health implications of electricity and coal consumption, *EHP*, 119:6, pp.821-826, 2011.

<sup>39</sup> Physicians for Social Responsibility, *Coal's Assault on Human Health*, November 2009.

<sup>40</sup> PSR, 2009, *ibid*.

<sup>41</sup> Colborn T, Schultz K, Herrick L, and Kwiatkowski C. 2012 (in press). An exploratory study of air quality near natural gas operations. *Hum Ecol Risk Assess*



ethane, methanol, ethanol, acetone, and propane, formaldehyde, acetaldehyde, polycyclic-aromatic hydrocarbons and naphthalene.<sup>42</sup>

Worsening air quality in our cities is due to motor vehicle pollution, wood smoke from home heating and industrial pollution.<sup>43</sup> Ozone levels are increasing as the climate warms and this is most severe in urban areas, where transport and industrial emissions cluster and temperatures tend to be higher due to “heat island” effects. In rural areas, ozone negatively affects agriculture and may lead to declining crop yields.

Australian research on the health effects of ozone has supported the findings in international studies, and significant health effects are already observed even at current levels of ozone in Australian cities.

## **Impacts on health from air quality from energy and resources sector**

The mining, transportation and combustion of coal for electricity generation all produce harmful air pollution.

Coal combustion produces particulate matter (PM) and emissions that can contain (depending on the composition of the coal) arsenic, mercury, fluorides, boron, cadmium, sulphuric and nitric acids, lead, selenium and zinc. radon and uranium

Mercury emissions are converted into methylmercury, which dissolves in the sediment of waterways, and enters the human food chain through fish.<sup>44</sup> Uncertainty exists as to the mercury content of coal burnt in Australian power stations as well as in regard to the efficiency of mercury capture devices.<sup>45</sup>

Dust is an air pollutant that has adverse health impacts. Particulates such as PM10 and PM2.5 are of particular concern as inhalation of these particulates can lead to absorption of the dust into the bloodstream with potentially toxic effects and can lead to permanent lung damage.

Long term exposure to coal dust leads to pneumoconiosis, and if the dust contains silica, to silicosis.

The use of coal in steel production poses risks to health through the production of volatile polycyclic aromatic hydrocarbons - exposure to which puts steel workers at twice the risk of lung cancer as the general population.<sup>46</sup>

Particulate matter (PM) from coal combustion (particularly the smallest particles – PM2.5) is harmful to health and contributes to cardiovascular and respiratory disease and lung cancer.<sup>47</sup>

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<sup>42</sup> National Toxics Network, *Toxic Chemicals in Unconventional Gas Exploration and Production*, 2013.

<sup>43</sup> Kjellstrom, T. et al. Air pollution and its health impacts: the changing panorama, *Medical Journal of Australia*, 2002; 177 (11): 604-608.

<sup>44</sup> Castleden, W. et al. The mining and burning of coal: effects on health and the environment, *Medical Journal of Australia*, 2011; 195: 333–335.

<sup>45</sup> Nelson, P. Atmospheric emission of mercury from Australian point sources, *Atmospheric Environment*, 2007, 41:8, pp.1717-1724.

<sup>46</sup> Kjellstrom, T. *Energy, the Environment and Health*, in Holdren, J.P. and Smith K. R. (eds), *World Energy Assessment: Energy and the Challenge of Sustainability*, 2000, Chapter 3, pp.61-110.

Coal-fired power stations also produce sulphur dioxide (SO<sub>2</sub>) and nitrogen dioxide (NO<sub>2</sub>). Even short periods of exposure to low levels of sulphur dioxide can affect pulmonary function (as short as ten minutes); while exposure to nitrogen dioxide reduces lung function and contributes to increased asthma<sup>48</sup> and can cause permanent lung damage.<sup>49</sup>

Research from Europe published in *The Lancet* estimates that 24 people die for every terrawatt (TWh) of coal combusted, from the harmful effects of the airborne particulates, nitrogen oxide, and toxic metals such as mercury and lead released.<sup>50</sup> The International Energy Agency estimates that more than 7,500TWh of electricity was generated by burning coal in 2009.<sup>51</sup> According to this and other estimates,<sup>52</sup> the toll from coal-fired power generation globally may exceed over 200,000 deaths per annum.

A recent review of broad health indicators across 40 years in 41 countries revealed large unaccounted for costs associated with pollution from coal.<sup>53</sup> Studies from the US National Academies of Sciences suggest the ‘hidden costs’ of energy systems (i.e. the monetized value of energy related burdens and damages) cost the US more than \$120 billion in 2005.<sup>54</sup>

A more recent analysis of the costs associated with the lifecycle of coal in the US – extraction, transport, processing, and combustion – estimates the cost at over one-half of a trillion dollars annually.<sup>55</sup> Accounting for these damages would “conservatively double to triple” the price of electricity from coal per KWh generated.<sup>56</sup>

A recent study on the health costs associated with coal fired power in India found emissions from Indian coal plants in 2011-2012 resulted in 80,000 to 115,000 premature deaths and more than 20 million asthma cases.<sup>57</sup>

A new study on the health costs associated with coal fired power in the European Union found the burden of disease associated with emissions from coal power plants are responsible for 18,200 premature deaths, about 8,500 new cases of chronic bronchitis, and over four million lost working days each year.<sup>58</sup> The economic costs of the health impacts from coal combustion in Europe are estimated at up to €42.8 billion per year. Adding emissions from coal power plants in Croatia, Serbia and Turkey, the figures for mortality increase to 23,300 premature deaths, or 250,600 life years lost, while the total costs are up to €54.7 billion annually.

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<sup>47</sup> Witter, R. et al. *Potential Exposure-Related Human Health Effects of Oil and Gas Development: A Literature Review (2003-2008)*, School of Public Health, University of Colorado.

<sup>48</sup> World Health Organisation, Air quality and health, Fact Sheet No. 313, September 2011.

<sup>49</sup> National Library of Medicines, Nitrogen Oxides, November 2012.

<sup>50</sup> Markandya, A., and Wilkinson, P. Energy and Health 2: Electricity generation and health, *The Lancet*, Sep 15-Sep 21, 2007; 370, 9591

<sup>51</sup> International Energy Agency, Emissions From Fuel Combustion, IEA Statistics, 2011 edition, p.122.

<sup>51</sup> Available at <http://www.iea.org/co2highlights/co2highlights.pdf>

<sup>52</sup> Gohlke, J. Health, Economy, and Environment: Sustainable Energy Choices for a Nation, *Environmental Health Perspectives*. 2008 June; 116(6): A236–A237.

<sup>53</sup> Gohlke, 2011.

<sup>54</sup> NAS, Hidden Costs of Energy, 2009.

<sup>55</sup> Epstein, P. Full cost accounting for the life cycle of coal, *Annals of New York Academy of Sciences*, 1219: 73-98.

<sup>56</sup> Epstein, P. Full cost accounting for the life cycle of coal, *Annals of New York Academy of Sciences*, 1219: 73-98.

<sup>57</sup> Goenka, D., and Guttikunda, S. *Coal Kills*, A report by Urban Emissions, Conservation Action Trust, and Greenpeace India, February 2013.

<sup>58</sup> Huscher, J. *The unpaid health bill: How coal power plants make us sick*, Health and Environment Alliance (HEAL), March 2013.

The most recent study evaluating the economic costs associated with pollution from power generation on health and environment in Australia was released by the Australian Academy of Technological Sciences and Engineering (ATSE) in March 2009.<sup>59</sup>

ATSE found that the health costs of burning coal are equivalent to a national health burden of around \$A2.6 billion per annum. If the currently externalised total climate and health costs is considered (including greenhouse gas effects) the estimate rises to \$8.3 billion annually.<sup>60</sup>

A recent report from the University of Sydney evaluated the impacts of coal on communities in the Hunter Valley in New South Wales.<sup>61</sup>

This review found there are serious health and social harms associated with coal mining and coal fired power stations for people living in proximity to them.<sup>62</sup> Some of the potential risks to health from the international literature include lung cancer, chronic heart, lung and kidney diseases; respiratory symptoms, higher prevalence of birth defects; poorer self rated health and reduced quality of life.<sup>63</sup>

In Australia, it is estimated that that the adverse health impacts of air pollution from coal fired electricity generation - from associated respiratory, cardiovascular, and nervous system diseases - is costing A\$2.6 billion annually.<sup>64</sup>

Air emissions from unconventional gas activities such as coal seam gas mining and exploration also pose health risks. While little monitoring has been done of air quality around Australian gas fields, high levels of toxic air contaminants are found in around US gas operations, including acrylonitrile, methylene chloride, benzene and hydrogen sulphide – which pose risks of cancer, as well as nervous system and respiratory damage.<sup>65</sup>

## **Impacts on health from air quality from transport sector**

Evidence continues to grow regarding the harmful cardiovascular effects of traffic-related pollution.<sup>66</sup> Living close (within 500 m) to a major road or a freeway is to be chronically exposed to elevated concentrations. Given much of the adult population in most cities spend at least part of their day commuting in these conditions; a sizable proportion of any city's population is being exposed daily to harmful pollutants at levels that increase the risk of cardiovascular disease.<sup>67</sup>

A multi-city study of the effects of air pollution on health in Australian and New Zealand cities (Auckland, Brisbane, Canberra, Christchurch, Melbourne, Perth and Sydney) over a four-year

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<sup>59</sup> Biegler, T. The hidden costs of electricity: Externalities of power generation in Australia, Report for the Australian Academy of Technological Sciences and Engineering (ATSE), 2009.

<sup>60</sup> Biegler, T. The hidden costs of electricity: Externalities of power generation in Australia, Report for the Australian Academy of Technological Sciences and Engineering (ATSE), 2009.

<sup>60</sup> *ibid*

<sup>61</sup> Colagiuri R, Cochrane J, Girgis S. *Health and Social Harms of Coal Mining in Local Communities: Spotlight on the Hunter Region*, University of Sydney, 2012.

<sup>62</sup> *ibid*

<sup>63</sup> *ibid*

<sup>64</sup> ATSE, Hidden costs of power generation, 2009.

<sup>65</sup> Lloyd-Smith, M. and Senjen, R. *ibid*.

<sup>66</sup> Brook, R.D., et al. 2010.

<sup>67</sup> Brook, R.D., et al. 2010.

period from January 1998 to December 2001 found increases in concentrations of air pollutants including CO, NO<sub>2</sub>, PM<sub>2.5</sub>, PM<sub>10</sub> and ozone was significantly associated with increases in mortality from both cardiovascular and respiratory disease, and increases in hospital admissions for a range of disease categories including ischemic heart disease, myocardial infarction, and cardiac failure (with elderly people most affected).

Increased air pollution was also associated with increases in respiratory hospital admissions for including asthma, chronic obstructive pulmonary disease (COPD), pneumonia and acute bronchitis (with children most affected in this group).<sup>68</sup>

Exposure to traffic-related air pollution (nitrogen dioxide, PM<sub>2.5</sub>, and PM<sub>10</sub>) during pregnancy and during the first year of life is associated with autism, with children living in homes with high levels of transport emissions three times more likely to have autism than those with lower exposures.<sup>69</sup>

A recent evaluation of the health costs associated with air pollution from transport in the US was undertaken by the Harvard Center for Risk Analysis at the Harvard School of Public Health.<sup>70</sup>

They found strong evidence for a causative role for traffic related air pollution and premature death, particularly from heart attacks and strokes. Their risk assessment for mortality from traffic generated air pollution in 83 US cities estimated traffic congestion-related PM<sub>2.5</sub>, NO<sub>x</sub> and SO<sub>2</sub> emissions in these cities caused approximately 4,000 premature deaths in 2000, with a monetized value of approximately \$31 billion (in 2007 dollars).<sup>71</sup>

There is increasing evidence of an association between lung cancer and transport emissions, thought to be caused by exposure to fine particle pollution and carcinogenic gases such as benzene.<sup>72</sup>

Diesel emissions have recently been classified by the World Health Organization as carcinogenic.<sup>73</sup> The health costs of diesel particle emissions have been estimated at \$257,000 per tonne. In Sydney, over 1500 tonnes of diesel particles are emitted each year, resulting in a potential health cost of over \$400 million.<sup>74</sup>

Reducing emissions from transport can have a powerful effect on health: a road transport reduction strategy implemented for the summer Olympics in Atlanta in 1996 led to a 22.5 per cent reduction in weekday peak traffic, and a corresponding decline in concentrations of carbon

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<sup>68</sup> Environment Protection and Heritage Council, Expansion of the multi-city mortality and morbidity study FINAL REPORT, September 2010, University of the Sunshine Coast, University of Queensland, Department of Environmental Protection Western Australia, Environment ACT, Environment Protection Authority Victoria, New South Wales Health, New Zealand Ministry for the Environment, Queensland Health.

<sup>69</sup> Volk, H. Traffic-Related Air Pollution, Particulate Matter, and Autism, *JAMA Psychiatry*. 2013;70(1):71-77.

<sup>70</sup> Levy, J. et al. The Public Health Costs of Traffic Congestion: A Health Risk Assessment, Harvard Center for Risk Analysis, 2010.

<sup>71</sup> *ibid*

<sup>72</sup> Kjellstrom, 2002, *ibid*.

<sup>73</sup> Metherell, L. WHO confirms diesel fumes carcinogenic, *The World Today, ABC News*, 13 June 2012.

<sup>74</sup> Department of Environment and Climate Change, August 2008. *NSW Cleaner Vehicles and Fuels Strategy* Available at <http://www.environment.nsw.gov.au/resources/air/actionforair/cleanervehicles08327.pdf>

monoxide, particulates and nitrogen dioxide, as well as a drop of almost 30 per cent in ozone levels.<sup>75</sup> There was also a lower rate of acute childhood asthma attacks during the period.<sup>76</sup>

The health costs from air pollution in Australia arising from burning fossil fuels (petroleum and gas) for transport amounts to several billion dollars a year - a 2005 estimate put the national cost at A\$3.3 billion annually.<sup>77</sup>

The only way to reduce the health consequences of transport emissions is to reduce overall traffic emissions through reducing the amount of vehicles on the road while increasing the proportion of low or zero emission vehicles, and reconfiguring our cities to allow for lifestyles in which most daily commuting can occur by walking, cycling, and via public transport.<sup>78</sup>

## **Need for more research**

Despite the substantial evidence of significant harm to human health associated with air pollution, there is a lack of research on the issue in Australia and limited understanding about the full extent of harm being caused.

In particular the impacts on human health from air pollution arising from the mining, transportation and combustion of coal should be evaluated in all affected communities. This should include an assessment of the economic costs associated with the adverse health impacts from this type of pollution.

The impacts on health from air pollution from transport should also be evaluated, and the monetised value of the health benefits associated with reducing urban air pollution from transport evaluated for each of Australia's major cities.

## **Communities affected by air pollution**

The Climate and Health Alliance is aware that there are many communities in Australia concerned about declining air quality posing risk to their health. In regions in proximity to coal fired power stations or where there is establishment or expansion of coal mining activities, particularly open cut and CSG extraction, there are particularly high levels of concern about toxic air pollution associated with these activities. Concerns are also raised about dust along coal transport corridors.

The Hunter Valley, Newcastle, and Gunnedah Basin in NSW and Mackay and the Bowen Basin in Qld are some of these areas. Concerns are such that communities are planning and even funding their own health studies, recognising that current state and territory regulations for this industry fail to recognise and account for risks to human health in planning decisions.

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<sup>75</sup> Union of Concerned Scientists, *Climate Change and Your Health: Rising Temperatures, Worsening Ozone Pollution*, June 2011.

<sup>76</sup> Larouche, R. (2012). The environmental and population health benefits of active transport: A review. *Greenhouse Gases – Emissions, Measurement and Management*. InTech.

<sup>77</sup> Bureau of Transport and Regional Economics, *Health impacts of transport emissions in Australia: Economic costs*, Working Paper 63, 2005.

<sup>78</sup> Brook, R.D., et al. 2010

Communities such as those in the Upper Hunter in NSW have been calling for years for research to evaluate the cumulative impacts of coalmining and coal fired power generation, including the impact on health from associated particulate matter, and for continuous dust monitoring. Their calls have been repeatedly ignored by state government, and mining industry groups have sought to discredit the concerns of residents.<sup>79</sup>

In Angelsea in Victoria, residents are seeking an independent study into air quality to establish level of pollutants associated with the expansion of an open cut coal mine and ongoing pollution from a coal-fired power plant on the outskirts of their town. The pollution emissions from Angelsea Alcoa plant and mine exceed world health standards for emissions, and the community experience frequent exposure to harmful levels of SO<sub>2</sub>.

In the Gunnedah Basin in NSW, communities are facing large scale developments of coal mines and coal seam gas development. The local community is seeking for a health impact assessment to evaluate the potential cumulative impacts of current and potential coal and coal seam gas exploration and other extractive industries on the health of the people living and working in the region.

In Dungeon Point near Mackay in Qld, where a significant expansion of coal export facilities is proposed, the community is seeking an evaluation of the health impacts of dust emissions from coal ports. There is no monitoring of coal dust in the region, with the nearest monitor for PM 10 only, and it is 19 kilometres away from the port.<sup>80</sup>

In Newcastle in NSW, an expansion of coal export facilities is anticipated to double the volume of coal being transported from the Hunter Valley through Newcastle. Around 25,000 children attend schools within 500 metres of the coal corridor. The project's environmental assessment report does not provide a comprehensive analysis of fine particle pollution levels or the associated health impacts, and the community is seeking an independent assessment of the associated air pollution and its likely impacts on their health.

The Climate and Health Alliance urges the Committee to visit and conduct public hearings in these areas to allow communities to express their concerns and share their experiences with regard to the impact of air pollution on their health and well-being.

## **Clean air policy: Standards, monitoring and regulation**

Current regulations for air quality in Australia are inadequate to protect health and well-being. There are strong economic arguments for improving air quality as evidenced by the cost: benefit ratio associated with improving air quality under the USA Clear Air Act.

Australian state and territory regulations need to be expanded to ensure the impacts on health and wellbeing are being considered in planning and development decisions. In addition improved monitoring of compliance with existing regulations is needed.

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<sup>79</sup> Higginbotham, N. 2010, *ibid*.

<sup>80</sup> Communities Protecting Our Region, *Coal Dust and Health In the Mackay Region*, February 2013.

While standards exist for PM10, there is much evidence that these standards are frequently exceeded in some settings. In addition to developing a standard for the even more harmful PM2.5, efforts should be made to reduce the entire population's exposure to air pollution by the development of policy to reduce air pollution generally.<sup>81</sup>

The NSW Department of Environment and Conservation guidelines for assessment of air pollutants suggest that dust deposition should be limited to 2g/m<sup>2</sup>/month.<sup>82</sup> It is recommended that these samples be collected every 30 days via sensitive receivers at mine sites.

The National Environment Protection Council suggests that the implementation of a national standard for PM2.5 of less than 20µg/m<sup>3</sup> could save \$5 million each year from avoided hospital admissions and save hundreds of lives.<sup>83</sup> It indicates a standard of 8µg/m<sup>3</sup> could realistically be implemented, providing even greater health benefits.

## Conclusion

Adverse health impacts from air pollution in Australia are already significant and likely to increase as a result of increasing ground level ozone associated with rising temperatures in conjunction with fossil fuel use.

Communities living and working in proximity to heavy traffic (which includes most Australians, since we live largely in cities) are being exposed daily to toxic air pollution. Air pollution might be largely invisible, but its effects are deadly, causing thousands of hospitalizations and premature deaths each year.

Air pollution created by coal fired power generation, coal mining and transportation causes heart disease, lung disease and cancer, can have harmful impacts on other body systems, and adversely affect children's development.

International research demonstrates conclusively that air pollution created by the combustion of fossil fuels for electricity generation and transport contributes to illness and deaths and is associated with significant health costs and productivity losses.

Reducing air pollution from these sources can dramatically and rapidly reduce health risks and improve health, and provide substantial economic savings.

Reducing the burden of disease from air pollution in Australia, which currently kills more people each year than the road toll, should be national priority.

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<sup>81</sup> <http://www.scew.gov.au/publications/pubs/air/methodology-air-quality-standards-in-australia-parta.pdf>

<sup>82</sup> NSW EDO, *ibid.*

<sup>83</sup> National Environment Protection Council Methodology for setting air quality standards in Australia Part A, February 2011.

## **Recommendations**

### **For the Committee:**

1. Conduct public hearings for this Inquiry in communities affected by air quality issues

### **For the Australian Government:**

1. Develop and implement a national plan for clean air to improve air quality and community health and wellbeing
2. Development of integrated policies, supported by research, to simultaneously reduce greenhouse gas emissions and reduce air pollution (in many cases, carefully targeted strategies to reduce GHG emissions will also improve air quality)
3. Develop and implement policies to encourage investment in non-polluting energy and transport technologies and infrastructure
4. Establish a national standard for particulate matter of less than 2.5 µg (PM2.5)
5. Establish a national guideline for monitoring and reporting of PM10 and PM2.5
6. Establish and implement a national framework for monitoring compliance with state and territory air quality regulations

### **For Australian state and territory governments:**

1. Require all new energy and minerals and resources projects including power generation to undertake a comprehensive health impact assessment in addition to an environmental impact assessment

### **For local governments:**

1. Encourage local transport and energy initiatives that reduce air pollution and improve health and wellbeing

### **For all Australian governments:**

1. To fund further research into the health impacts of air pollution in Australia, in particular the impacts of air pollution associated with coal mining / gas extraction, transportation and electricity generation.



## Definitions

**Particulates / particulate matter:** A distinction is made between **PM10** (particles smaller than 10 µm in diameter that can penetrate into the lower respiratory system; **PM2.5** (considered “respirable” particles i.e. smaller than 2.5 µm that can penetrate into the gas-exchange region of the lung); and **ultrafine particles** (UFPs) smaller than 100 nm which contribute little to particle mass but which are most abundant in terms of numbers and offer a very large surface area, with increasing degrees of lung penetration.<sup>84</sup>

Concentrations of PM10 and PM2.5 are typically measured in their mass per volume of air (µg/m<sup>3</sup>) while UFPs are often measured by their number per cubic centimeter.<sup>85</sup> Reporting of PM2.5 is becoming more common because of its impact on public health and frequent violations of standards.<sup>86</sup>

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<sup>84</sup> Bert Brunekreef, Stephen T Holgate *Air pollution and health Lancet* 2002; 360: 1233–42

<sup>85</sup> Brook, R.D., et al. 2010

<sup>86</sup> Brook, R.D., et al. 2010.

## **APPENDIX A**

### **Climate and Health Alliance (CAHA) Committee of Management**

Dr. Liz Hanna, CAHA President (Australian College of Nursing)  
Fiona Armstrong, CAHA Convenor  
Dr. Erica Bell (Australian Rural Health Education Network)  
Dr. Brad Farrant (Australian Research Alliance for Children and Youth)  
Dr Bret Hart (Alliance for Future Health)  
Michael Moore (Public Health Association of Australia)  
Julia Stewart (CRAN*plus*)  
Kristine Olaris (Women's Health East)  
Elizabeth Reale (Australian Nursing Federation)  
James Lawler (Australian Medical Students Association)

### **CAHA Organisational Members**

Australian Association of Social Workers (AASW)  
Australian College of Nursing (ACN)  
Australian College of Rural and Remote Medicine (ACRRM)  
Australian Council of Social Service (ACOSS)  
Australian Hospitals and Healthcare Association (AHHA)  
Australian Health Promotion Association (AHPA)  
Australian Medical Students Association of Australia (AMSA)  
Australian Physiotherapy Association (APA)  
Australian Institute of Health Innovation (AIHI)  
Australian Women's Health Network (AWHN)  
Australian Nursing Federation (ANF)  
Australian Psychological Society  
Australian Research Council for Children and Youth (ARACY)  
Australian Rural Health Education Network (ARHEN)  
CRAN*plus*  
Doctors Reform Society (DRS)  
Friends of CAHA  
Health Consumers' Network (Qld)  
Health Issues Centre (HIC)  
Public Health Association of Australia (PHAA)  
Royal Australasian College of Physicians (RACP)  
North Yarra Community Health (NYCH)  
Services for Australian Rural and Remote Allied Health (SARRAH)  
Women's Health East  
Women's Health in the North  
World Vision

### **Expert Advisory Committee**

Associate Professor Erica Bell, University Department of Rural Health, University of Tasmania  
Associate Professor Grant Blashki, Nossal Institute for Global Health  
Associate Professor Colin Butler, College of Medicine, Biology and Environment, Australian National University  
Professor Garry Egger, School of Health & Human Sciences, Southern Cross University  
Professor David Karoly, Federation Fellow in the School of Earth Sciences, University of Melbourne  
Professor Stephan Lewandowsky, School of Psychology, University of Western Australia  
Dr Peter Tait, FRACGP, MClimChng, FPHAA; General Practitioner of the Year 2007; Canberra  
Professor Anthony Capon, National Centre for Epidemiology and Population Health, Australian National University  
Professor Simon Chapman, Professor of Public Health, University of Sydney  
Dr Susie Burke, Senior Psychologist, Public Interest, Environment & Disaster Response, Australian Psychological Society