



Public Health Association
AUSTRALIA

Inquiry into the implications for Western Australia for hydraulic fracturing for unconventional gas

PHAA WA Advocacy Subcommittee
Email: phaa@curtin.edu.au

Contact for PHAA (WA Branch)
Dr Emma Croager
President
phaa@curtin.edu.au

20 September 2013

Contents

Introduction	1
Public Health	1
The Public Health Association of Australia	1
Advocacy and capacity building	1
Terms of Reference	2
This Submission	2
1. National Harmonised Framework on Coal Seam Gas.....	3
2. Hydraulic Fracturing for Unconventional Gas (fracking) and health	4
3. How hydraulic fracturing may impact on current and future uses of land	6
4. The regulation of chemicals used in the hydraulic fracturing process.....	6
5. Other issues	7
Delaying transition from fossil fuel energy.....	7
Amenity.....	7
Extreme Weather and Bush fire risk.....	8
Future liabilities	8
Recommendations	8
Conclusion	8
References.....	10

PHAA WA Submission - Inquiry into the implications for Western Australia for hydraulic fracturing for unconventional gas

Introduction

The Public Health Association of Australia Incorporated (PHAA) is recognised as the principal non-government organisation for public health in Australia and works to promote the health and well-being of all Australians. The Association seeks better population health outcomes based on prevention, the social determinants of health and equity principles.

Public Health

Public health includes, but goes beyond the treatment of individuals to encompass health promotion, prevention of disease and disability, recovery and rehabilitation, and disability support. This framework, together with attention to the social, economic and environmental determinants of health, provides particular relevance to, and expertly informs the Association's role.

The Public Health Association of Australia

PHAA is a national organisation comprising around 1900 individual members and representing over 40 professional groups concerned with the promotion of health at a population level.

Key roles of the organisation include capacity building, advocacy and the development of policy. Core to our work is an evidence base drawn from a wide range of members working in public health practice, research, administration and related fields who volunteer their time to inform policy, support advocacy and assist in capacity building within the sector. PHAA has been a key proponent of a preventive approach for better population health outcomes championing such policies and providing strong support for the Australian Government and for the Preventative Health Taskforce and National Health and Medical Research Council (NHMRC) in their efforts to develop and strengthen research and actions in this area across Australia.

PHAA has Branches in every State and Territory and a wide range of Special Interest Groups. The Branches work with the National Office in providing policy advice, in organising seminars and public events and in mentoring public health professionals. This work is based on the agreed policies of the PHAA. Our Special Interest Groups provide specific expertise, peer review and professionalism in assisting the National Organisation to respond to issues and challenges as well as a close involvement in the development of policies. In addition to these groups the Australian and New Zealand Journal of Public Health (ANZJPH) draws on individuals from within PHAA who provide editorial advice, and review and edit the Journal.

Advocacy and capacity building

In recent years PHAA has further developed its role in advocacy to achieve the best possible health outcomes for the community, both through working with all levels of Government and agencies, and promoting key policies and advocacy goals through the media, public events and other means.

PHAA WA Submission - Inquiry into the implications for Western Australia for hydraulic fracturing for unconventional gas

Terms of Reference

The terms of reference for the Inquiry into 'The Implications for Western Australia of Hydraulic Fracturing for Unconventional Gas' are:

- a. How hydraulic fracturing may impact on current and future uses of land
- b. The regulation of chemicals used in the hydraulic fracturing process
- c. The use of ground water in the hydraulic fracturing process and the potential for recycling of produced water
- d. The reclamation (rehabilitation) of land that has been hydraulically fractured

This Submission

Our Submission covers these topics:

1. The National Harmonised Framework on Coal Seam Gas
2. Overview of health effects of Hydraulic Fracturing For Unconventional Gas (fracking) – a framework and summary
3. How hydraulic fracturing may impact on current and future uses of land
4. The regulation of chemicals used in the hydraulic fracturing process
5. The use of ground water in the hydraulic fracturing process and the potential for recycling of produced water
6. Other relevant issues

PHAA WA Submission - Inquiry into the implications for Western Australia for hydraulic fracturing for unconventional gas

1. National Harmonised Framework on Coal Seam Gas

In making this submission, PHAA would like it noted that we were involved on the Coal Seam Gas Stakeholder Reference Group (CSGSRG) of the Standing Council on Energy and Resources (SCER) of COAG.

Our role in that process was to ensure that a public health viewpoint was included in the development of the National Harmonised Framework on Coal Seam Gas and in the Multiple Land Use Framework.¹ The purpose of these processes was to develop leading practice, trustworthy regulation of the CSG industry in order to ensure Australia's vast deposits of unconventional gas are able to be exploited with minimal damage to social, economic and natural environments. PHAA commends the outcomes of this process to the current review.

However PHAA would like to emphasise that from the public health view, the focus of development of the National Harmonised Framework was extremely limited and was not able to address the complete range of public health concerns that exists in relation to the extraction and use of CSG specifically, and coal and gas fuels more broadly.

Further, PHAA is concerned that while the Harmonised Framework sets standards in relation to CSG development and extraction activities, it is only as good as the actual practice by companies and contractors in implementation of the standards. PHAA's concerns are that the confluence of any combination of deliberate malfeasance by contractors, poor workmanship, mistakes and bad luck can overwhelm the best laid risk management plans. We are also concerned that for standards to be effective they need to be implemented, monitored and any breaches followed up, and adequate and realistic action taken in response. We also wish to emphasise that because risks to health (outlined in this submission) carry a high personal, social, economic and environmental cost, safety standards need to be extremely robust. PHAA is concerned that in the current rush to develop CSG there is insufficient pre-development, baseline studies against which to compare subsequent monitoring, and that there may be insufficient monitoring during production and if problems occur, inadequate response to prevent or rectify problems. We are also concerned about the emerging problem of long term post production well integrity as the concrete and steel well shafts age – this issue has not been adequately factored into the assessment and risk profiling process.

2. Hydraulic Fracturing for Unconventional Gas (fracking) and health

Although the impact of hydraulic fracturing for unconventional gas (fracking) on health is not a specific focus of this Inquiry, the issues being investigated in the terms of reference have potential implications for public health.

As outlined in the American Public Health Association's Policy Statement 2012², fracking poses potential risks to public health and the environment, through ground water and surface water contamination, air pollution, climate change and effects on worker and community health.³

Ground water and surface water contamination

Fracking is a water intensive process and it is estimated that in Western Australia around 30 million litres of fresh water is required by each natural gas well.⁴ The fracking process returns up to half of this water back to the surface, by which stage it contains heavy metals, salts and naturally occurring radioactive material from below ground, as well as the chemicals and proppants used during the fracking process (some of which are toxic to humans).⁵ This water must then be collected, treated, recycled or disposed of safely to prevent contamination of ground and surface water supplies, as well the environment more generally. Methane migration from active drilling sites to aquifers has been reported, suggesting the potential for groundwater contamination exists.⁶ In areas with limited water resources, such as Western Australia, the impact of fracking on water quality and quantity for human consumption and agriculture is therefore of considerable concern.

Air pollution and climate change

Methane – a greenhouse gas – is the main component of natural gas, as well as emissions from fracking. As such, methane makes a considerable contribution to air pollution and climate change. Public health threats related to climate change are predicted to be the greatest global health concern this century.⁷ High levels of known carcinogens, such as benzene, in the air have also been attributed to fracking.⁸ The large amounts of crystalline silica used as a proppant during the fracking process generate particulate matter that contributes to air pollution.⁹ Inhalation of this fine dust can cause silicosis and crystalline silica has also been identified as an occupational lung carcinogen.^{10,11}

Effects on worker and community health

Occupational health implications of fracking are not well understood. As mentioned previously, workers are at risk of developing pulmonary disease from exposure to silica dust.¹¹ Acute health problems –including fatigue, burning eyes, skin irritation, headache, upper respiratory gastrointestinal, neurologic, sensory, vascular, bone marrow endocrine and urologic problems, and endocrine disruption – have been reported in people living near fracking sites.¹²⁻¹⁴ Workers and people living near drill sites have the potential to be exposed to elevated levels of radiation from technologically enhanced naturally occurring radioactive material (TENORM), as fracking can require drilling onto rock that contains naturally occurring radioactive material.¹⁵

The World Health Organization defines health as a state of 'complete, physical, mental and social well-being and understanding that living environment is a determinant of health.'¹⁶ As such, the reported health consequences of fracking can be framed according to primary (direct), secondary (indirect) and tertiary effects (flow on effects), as summarised in Table 1.

PHAA WA Submission - Inquiry into the implications for Western Australia for hydraulic fracturing for unconventional gas

Table 1. Effects of Fracking that impact health ©Peter Tait, 2013

Primary/Direct effects		Secondary (indirect) effects (Note: these effects arise synergistically from several primary effects)	Tertiary/ Flow-on effects on well-being and health
Issue	Effect		
Methane, volatile hydrocarbons	Air quality	Compromise of agricultural land ^{6,17}	Conflict in mining affected communities
Drilling and fracking chemicals Volatile hydrocarbons and methane from coal Salts Heavy/radioactive metals from coal and rock	Water quality (surface and underground)	Adverse effects on livestock ⁶ Adverse effects on ecosystems and the biosphere No reduction in GHG emissions and continued global warming	Loss of control over access to property Reduced water availability Fears of loss of land, livelihood and community Actual loss of agricultural productivity impacting food security for Australia
Use of water in production Inadvertent linkage of aquifers and water loss	Water availability		Loss of wellbeing due to concerns about health
Chemical leakage/spillage from production or waste water	Soil quality		Psychological effects from several of the above sources
From fracking and pressure changes below ground	Seismic activity		
Increased travel over roads and country	Erosion		
Increased vehicle access	Spread of weeds		

The secondary and tertiary effects have a much larger impact on well-being and health overall than the direct effects and are therefore more serious. As such, the public health approach should be to prevent adverse health events that result from fracking rather than managing them, or attempting restitution.

A comprehensive approach to addressing the public health concerns regarding fracking development is needed. This may be achieved by adopting the framework for the role of public health in decisions relating to fracking recently developed in the US⁵ and through conducting Health Impact Assessments to systematically and comprehensively evaluate the impacts to health of fracking in Western Australia.¹⁸

3. How hydraulic fracturing may impact on current and future uses of land

With WA's fracking industry currently in exploration phase¹⁹ the impact of expansion on current and future land use is an important issue. The WA Mines Minister, Bill Marmion, recently stated that 'WAs vast resources of shale and tight gas offered significant economic benefits to Australia' and projected an increase in liquefied natural gas (LNG) sales of 32 million tonnes a year by 2016 (The Sunday Times, 8 September 2013). This leads PHAA WA Branch to believe that, despite claims that increased activity will be gradual,¹⁹ the expected increase in LNG output from the current level of 18 million tonnes a year to 50 million tonnes a year will significantly increase required land use for the purposes of fracking in the short term.

A 2011 review of unconventional gas regulation in WA recommended that the Department of Mines and Petroleum address conflicting land use and land access in its management of shale gas operations through legislative provisions and pre-emptive land use management strategy developed in consultation with stakeholders and communities.²⁰ PHAA WA Branch believes that these recommendations, if taken up, would negate some of the flow-on effects on wellbeing and health associated with these issues, including:

- Conflict in mining affected communities
- Loss of control over access to property
- Reduced water availability
- Fears of loss of land, livelihood and community
- Actual loss of agricultural productivity impacting food security for Australia
- Loss of wellbeing due to concerns about health
- Psychological effects from several of the above

Unfortunately, the Department of Mines and Petroleum did not take up the recommendations outlined in the 2011 review relating to addressing conflicting land use and land access. Instead the focus is on fracking as a strategic resource, which fails to take into account affected individuals and communities.²¹ From a public health perspective, vast improvements could be made regarding the social and environmental impacts of land use for fracking. Uptake of the 2011 recommendations relating to addressing conflicting land use and land access would be an acceptable starting point for these improvements.

4. The regulation of chemicals used in the hydraulic fracturing process

The PHAA WA Branch is aware that Department of Mines and Petroleum must approve all chemical additives used for hydraulic fracturing and that all chemicals must be listed on the Department of Mines and Petroleum's website.¹⁹ This process was recommended in the 2011 review and has been taken up by Department of Mines and Petroleum.^{20,21} The accepted current practice for management of produced water is to store it in polymer and clay lined ponds to prevent surface contamination and the water evaporates and chemical residue is disposed of following testing.¹⁷ This process has high risk of contamination of surrounding land and any existing ground water aquifers due to product water spillage and overflow following heavy rains. There are also further risks associated with non-compliance in WA the use of unlined or plastic lined waste ponds has been

PHAA WA Submission - Inquiry into the implications for Western Australia for hydraulic fracturing for unconventional gas

observed despite the known environmental risks associated with produced water.⁴ PHAA WA is also concerned about the safe disposal of chemical residues.

Many of the chemicals commonly used for fracking are known carcinogens and some have already been banned in parts of Australia. Additionally, chemicals naturally occurring in the shale deposits are also released through the fracking process, as are naturally occurring radioactive materials.⁴

Regulation of the use of chemicals as well as the implementation of processes to mitigate the release of carcinogenic and radioactive chemicals through fracking are two very important steps recommended to ensure produced water and residue is not harmful.⁴ Regulation will reduce current risks associated with fracking, for example chemical seepage, residue spillage and contamination of drinking water.^{4,6,12,17,22} The use of ground water in the hydraulic fracturing process and the potential for recycling of produced water.

As discussed previously, fracking is a water intensive process and carries the risk of contamination of ground and surface water. In areas with limited water resources, such as Western Australia, the impact of fracking on water quality and quantity is therefore of considerable concern.

At this point in time recycling the millions of litres of ground water used for fracking is not a viable option. Recycling of water used during the fracking process is not presently used in WA due to the inability of most water treatment facilities to handle this process. As the filtration process is unable to remove all chemicals from the water, the produced water would be unsafe to be released in to the environment.⁴

Fresh clean water for drinking, agriculture and stock, over and above the needs of industry, requires a long term prospective planning outlook. Australia is a dry continent. With the progression of global warming it is forecast that Australia will become drier and hotter.²³ Simultaneously the population is projected to rise to between 30.9 and 42.5 million people by 2056.²⁴ Any sector within a multiple land use framework, including requirements for energy, has to be subordinate to the requirements to provide drinking water and food for the long term future.

5. Other issues

Delaying transition from fossil fuel energy

With the world warming at a rapid rate and the likelihood of temperature increases of beyond the two degrees Celsius guardrail, taking rapid action to reduce fossil fuel emissions is critical.^{25,26} Taking a 'big picture' approach must recognise the importance of not delaying transition from fossil fuel to renewable energy. Continued focus on fossil fuel sources locks in further decades of reliance on fossil fuel use and associated emissions because of the huge infrastructure and systems investments. As well, rapid action to promote energy efficiency and energy demand reduction is necessary to complement any continued fossil fuel use.^{26,27} Further, recent studies by Southern Cross University suggests that because of methane leakage, unconventional gas sources may not be much better than coal from a life cycle emissions perspective.²⁸

Amenity

The amenity provided to humans by access to unspoilt natural places is significant for well-being and conversely are detrimental to and damage local and natural environments.²⁹⁻³²

PHAA WA Submission - Inquiry into the implications for Western Australia for hydraulic fracturing for unconventional gas

The Draft Multiple Land Use Framework recognised that the intrinsic importance national parks and unspoilt places may override requirements for energy.

Extreme Weather and Bush fire risk

With global warming and climate change there is an increased probability of extreme weather and of bush fires in bush areas around Australia. Experience of heat and fire events in Australia over the past few years raises at this stage theoretical concerns about fracking in burnable country, as malfunction of well-flow controllers may occur and this might likely contribute to worsening fire damage to the environment, property and life.

Future liabilities

Government, that is tax payers, may be liable for a broad set of costs if fossil fuel infrastructure needs to be withdrawn in future, consequent to energy policy change resultant on emerging effects of global warming. Taxpayer financial liability can also arise from several factors including paying out contracts, as well as having to take 'additional' action on adaptation.

Recommendations

Given the environmental, occupational and community health impacts of fracking, there is an urgent need to monitor, regulate and respond to fracking in local communities. Regulations that take a cautionary and adaptive approach should be adopted. Protecting worker and community health requires involving public health professionals in assessing fracking activities and this should be a priority to ensure planning and policy approaches take into account the uncertainty around the effects of fracking.

PHAA WA Branch recommends that:

- Government should take a comprehensive approach to addressing public health concerns regarding fracking in Western Australia.
- Public health considerations should be formally included in policy and decisions relating to fracking in Western Australia.
- The framework for the role of public health in decisions relating to fracking recently developed in the US should be adopted in Western Australia.⁵
- Robust technology and best management practices should be employed at all stages during the fracking process (site preparation, well development, operation and land reclamation) to prevent ground and surface water contamination, minimise air pollution and monitor the impact on public health.
- Health Impact Assessments should be conducted to systematically and comprehensively evaluate the impacts to health of fracking in Western Australia.¹⁸

Conclusion

PHAA welcomes the inquiry into the Implications for Western of Australia of hydraulic fracturing for unconventional gas. We submit that a range of public health concerns arise from the focus on fracking at the expense of transition to renewable energy sources supported by improving energy efficiency and promoting energy demand reductions.

PHAA WA Submission - Inquiry into the implications for Western Australia for hydraulic fracturing for unconventional gas

There are direct effects on the health of workers, nearby residents as well as on the environment near fracking operations.

There are secondary and flow-on effects particularly on Australia's future capacity to provide drinking water and to support agriculture and livestock to provide food for ourselves and for export.

Continuing development of fossil fuel infrastructure ties us into decades of emissions at a time when scientists and bodies such as the World Bank and the International Energy Agency are warning that we need to rapidly de-carbonise our economies to prevent dangerous global warming.

In addition to any large scale effects, mental wellbeing, bush fire risks and future government liabilities are important extra issues that need to be included in accounting for the effects of fracking and fossil fuel use.

Yours sincerely

Dr Emma Croager
Branch President
Public Health Association of Australia

PHAA WA Submission - Inquiry into the implications for Western Australia for hydraulic fracturing for unconventional gas

References

1. Standing Council on Energy and Resources. *National Harmonised Regulatory Framework for Natural Gas from Coal Seams.*; 2013:1–86. Available at: <http://scer.govspace.gov.au/files/2013/06/National-Harmonised-Regulatory-Framework-for-Natural-Gas-from-Coal-Seams.pdf>.
2. American Public Health Association (APHA). The Environmental and Occupational Health Impacts of High-Volume Hydraulic Fracturing of Unconventional Gas Reserves. *APHA Policy Statement*. 2012. Available at: <http://www.apha.org/advocacy/policy/policysearch/default.htm?id=1439>. Accessed September 17, 2013.
3. Finkel ML, Law A. The rush to drill for natural gas: a public health cautionary tale. *American journal of public health*. 2011;101(5):784–5. Available at: <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3076392&tool=pmcentrez&rendertype=abstract>. Accessed September 16, 2013.
4. Wilderness Society, Conservation Council of Western Australia. *What the Frack? The Threat of Fracking and Onshore Unconventional Gas in WA.*; 2012:1–9.
5. Korfmacher KS, Jones WA, Malone SL, Vinci LF. Public Health and High Volume Hydraulic Fracturing. *New Solutions: A Journal of Environmental and Occupational Health Policy*. 2013;23(1):13–31.
6. Osborn SG, Vengosh A, Warner NR, Jackson RB. Methane contamination of drinking water accompanying gas-well drilling and hydraulic fracturing. *Proceedings of the National Academy of Sciences of the United States of America*. 2011;108(20):8172–6. Available at: <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3100993&tool=pmcentrez&rendertype=abstract>. Accessed September 16, 2013.
7. Costello A, Abbas M, Allen A, et al. Managing the health effects of climate change. *Lancet*. 2009;373(9676):1693–733. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/19447250>. Accessed September 16, 2013.
8. McKenzie LM, Witter RZ, Newman LS, Adgate JL. Human health risk assessment of air emissions from development of unconventional natural gas resources. *The Science of the total environment*. 2012;424:79–87. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/22444058>. Accessed September 17, 2013.
9. Esswein E, Kiefer M, Snawder J, Breitenstein M. Worker Exposure to Crystalline Silica During Hydraulic Fracturing. *NIOSH Science Blog*. 2012. Available at: <http://blogs.cdc.gov/niosh-science-blog/2012/05/23/silica-fracking/>. Accessed September 17, 2013.
10. National Toxicology Program. Silica, crystalline (respirable size). In: *12th Report on Carcinogens.*; 2011:377–9. Available at: <http://ntp.niehs.nih.gov/go/roc12>.
11. McDonald JC, McDonald AD, Hughes JM, Rando RJ, Weill H. Mortality from lung and kidney disease in a cohort of North American industrial sand workers: an update. *The Annals of*

PHAA WA Submission - Inquiry into the implications for Western Australia for hydraulic fracturing for unconventional gas

occupational hygiene. 2005;49(5):367–73. Available at:

<http://www.ncbi.nlm.nih.gov/pubmed/15728107>. Accessed September 17, 2013.

12. Bamberger M, Oswald RE. Impacts of gas drilling on human and animal health. *New Solutions: A Journal of Environmental and Occupational Health Policy*. 2012;22(1):51–77. Available at:

<http://baywood.metapress.com/index/661442P346J5387T.pdf>. Accessed September 16, 2013.

13. Colborn T, Kwiatkowski C, Schultz K, Bachran M. Natural Gas Operations from a Public Health Perspective. *Human and Ecological Risk Assessment: An International Journal*. 2011;17(5):1039–

1056. Available at: <http://www.tandfonline.com/doi/abs/10.1080/10807039.2011.605662>. Accessed September 17, 2013.

14. Perry SL. Using ethnography to monitor the community health implications of onshore unconventional oil and gas developments: examples from Pennsylvania's Marcellus Shale. *New solutions : a journal of environmental and occupational health policy : NS*. 2013;23(1):33–53.

Available at: <http://www.ncbi.nlm.nih.gov/pubmed/23552647>.

15. US Environmental Protection Authority, Radiation Protection Division. Technologically-Enhanced, Naturally-Occurring Radioactive Materials (TENORM). 2013. Available at:

<http://www.epa.gov/rpdweb00/tenorm/>. Accessed September 17, 2013.

16. World Health Organization. Frequently asked questions. 2013. Available at:

<http://www.who.int/suggestions/faq/en/>. Accessed September 17, 2013.

17. Entrekin S, Evans-White M, Johnson B, Hagenbuch E. Rapid expansion of natural gas development poses a threat to surface waters. *Frontiers in Ecology and the Environment*.

2011;9(9):503–511. Available at: <http://www.esajournals.org/doi/abs/10.1890/110053>. Accessed September 16, 2013.

18. Witter RZ, McKenzie L, Stinson KE, Scott K, Newman LS, Adgate J. The use of health impact assessment for a community undergoing natural gas development. *American journal of public health*. 2013;103(6):1002–10. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/23597363>.

Accessed September 17, 2013.

19. Government of Western Australia. Department of Mines and Petroleum. *Natural Gas from Shale and Tight Rocks Fact Sheet. Hydraulic fracture stimulation: the basics.*; 2013:2. Available at:

www.dmp.wa.gov.au/15139.aspx#15732. Accessed September 16, 2013.

20. Hunter T (Bond U. *Regulation of Shale, Coal Seam and Tight Gas Activities in Western Australia: An analysis of the capacity of the Petroleum and Geothermal Energy Act 1967 (WA) to regulate onshore gas activities in Western Australia.*; 2011.

21. Government of Western Australia. Department of Mines and Petroleum. *Department of Mines and Petroleum Response to Report: Regulation of Shale, Coal Seam and Tight Gas Activities in Western Australia.*; 2011:10. Available at:

http://www.dmp.wa.gov.au/documents/DMP_Response_to_Report.pdf.

22. Government of Western Australia. Department of Health. *Hydraulic fracturing in the onshore gas industry and drinking water.*; 2012:2. Available at:

[http://www.public.health.wa.gov.au/cproot/4474/2/Hydraulic fracturing and drinking water.pdf](http://www.public.health.wa.gov.au/cproot/4474/2/Hydraulic%20fracturing%20and%20drinking%20water.pdf).

PHAA WA Submission - Inquiry into the implications for Western Australia for hydraulic fracturing for unconventional gas

23. CSIRO. Climate Change in Australia. Technical Report 2007. 2007. Available at: http://www.climatechangeinaustralia.gov.au/technical_report.php. Accessed September 17, 2013.
24. Australian Bureau of Statistics. 3222.0 - Population Projections, Australia, 2006 to 2101. 2008. Available at: [http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3222.02006 to 2101](http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3222.02006%20to%202101). Accessed September 17, 2013.
25. International Energy Agency. *Electricity in a Climate-Constrained World - Data & Analyses.*; 2012:118. Available at: <http://www.iea.org/w/bookshop/add.aspx?id=445>.
26. Potsdam Institute for Climate Impact Research., Climate Analytics. *Turn Down the Heat: Why a 4°C Warmer World Must be Avoided.*; 2012:106.
27. Dangelman a TCJ, Schellhuber HJ. Energy systems transformation. *Proceedings of the National Academy of Sciences of the United States of America*. 2013;110(7):E549–58. Available at: <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3574957&tool=pmcentrez&rendertype=abstract>. Accessed September 17, 2013.
28. Santos I, Maher D. Fugitive Emissions from Coal Seam Gas. *Submission to Department of Climate Change and Energy Efficiency*. 2012. Available at: <http://www.scu.edu.au/coastal-biogeochemistry/index.php/70/>. Accessed September 17, 2013.
29. Connor L, Albrecht G, Higginbotham N, Freeman S, Smith W. Environmental Change and Human Health in Upper Hunter Communities of New South Wales, Australia. *EcoHealth*. 2004;1(S2):SU47–SU58. Available at: <http://link.springer.com/10.1007/s10393-004-0053-2>. Accessed September 17, 2013.
30. Higginbotham N, Freeman S, Connor L, Albrecht G. Environmental injustice and air pollution in coal affected communities, Hunter Valley, Australia. *Health & place*. 2010;16(2):259–66. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/19884036>. Accessed September 17, 2013.
31. Louv R. Last Child in the Woods - Overview - Richard Louv. 2008. Available at: <http://richardlouv.com/books/last-child/>. Accessed September 17, 2013.
32. Peacock J, Hine R, Pretty J. *The mental health benefits of green exercise activities and green care.*; 2007:18. Available at: http://www.greenexercise.org/Papers_Reports.html.