Submission No 238

SUSTAINABILITY OF ENERGY SUPPLY AND RESOURCES IN NSW

Organisation: Doctors for the Environment Australia Inc.

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Submission on the Sustainability of energy supply and resources in New South Wales

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Healthy planet, healthy people.

The Environment and Planning Committee of the New South Wales Parliament has established a very important inquiry into the Sustainability of energy supply and resources in NSW.[1] This inquiry comes at a critical time for NSW. NSW continues to be heavily dependent on fossil fuels as the main source of energy. Similarly, some state revenue is derived from the export of fossil fuels. Both of these factors will need to change dramatically and urgently if we are to mitigate against climate change. There will be significant health benefits with a sensible approach to this transition.

Doctors for the Environment Australia (DEA) is keen to appear before the Environment and Planning Committee as part of its remit to improve the health outcomes of all Australians.

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Recommendations

The capacity and economic opportunities of renewable energy.

1. The NSW government should immediately prioritise a transition to a low carbon economy in order to mitigate against worsening climate change.
2. Rapid development of renewable energy sources such as wind, pumped hydro, solar and biomethane developments.
3. Support for renewable energy developments in regional areas where there is current infrastructure (such as the Hunter Valley).
4. A specific "transition unit" for the Hunter Valley, because it is particularly vulnerable to the transition to a low carbon economy given its high current level of employment in the mining industry.

Effects on regional communities, water security, the environment and public health.

Health impacts arising from the use of coal:

5. Modification of operating licenses for the 5 power stations so that they are required to install flue gas desulphurisation and selective catalytic reduction treatments for flue gases.
6. Closure of any CFPS where clean operation is unviable.
7. A moratorium on all new coal mines and extensions to existing coal mines.
8. Strict enforcement of rules to cease mining operations when PM_{10} levels exceed standards, without waiting for complaints.
9. Immediate adoption of the highest international air emission standards for new locomotives.
10. An enforceable requirement for all locomotives to meet US Tier 2 standards by 2024.
11. Urgent review of all coal ash dams in NSW and a plan made for management of the coal ash dams especially when and after a coal-fired power station closes.

Health impacts arising from the use of gas:

12. An immediate moratorium on all unconventional gas and conventional gas developments.
13. A moratorium on offshore seismic testing for conventional gas (as further fossil fuel developments are not needed).

Current environmental impacts:

14. Protection of all native forests as these are essential for providing clean air and water and mitigating against climate change.
15. A moratorium on using forests as "bio-fuel".
16. Clear cut guidelines need to be created on water allocation to prioritise its use for agriculture and food production rather than fossil fuel extraction.

Opportunities to support sustainable economic development in regional and other communities likely to be affected by changing energy and resource markets, including the role of government policies.

17. Encouragement of "regenerative agriculture", as it will provide employment in regional areas, improve productivity on the land, mitigate climate change and improve the physical and mental health of rural communities.
18. Support for the development of further plantation timber resources as a way of providing employment in regional areas and mitigating climate change.
19. NSW Government support for further, "Carbon Farming Initiatives".

Doctors for the Environment Australia

Doctors for the Environment Australia (DEA) is a voluntary organisation of medical doctors in all Australian states and territories. We work to address local, national and global health effects caused by damage to the Earth's environment. The medical profession has a proud record of service to the community. This record not only includes personal clinical care, but also involvement in global issues that threaten the future of humanity. We aim to use our scientific and medical skills to ensure that governments, industry, the public and our colleagues understand the medical importance of our natural environment. In effect we function as an organisation committed to the improvement of the health of the public.

Introduction

While we recognise that this inquiry is focused on NSW, we urge the Committee to "think globally, while acting locally" – to use the words attributed to René Dubos (described as the despairing optimist).

The provision of the supply of energy, and the use of natural resources to achieve this, have many consequences for the health of the public, both

positive and negative, as we see in our daily practice as health professionals.

We see our contribution to this debate as the provision of evidence to support our views about how the use of natural resources in the provision of energy can be achieved in ways which reduce the harmful effects, and which maximise the beneficial effects on the health of the public.

We will consider the health impacts arising from the provision of energy through burning coal, and burning gas, and considering the impact of these activities on the climate and the lack of effectiveness of current attempts to contain them; and finally identifying benefits that can and do accrue from transition to renewable sources of energy, and to the urgency of completing this transition.

The health of the people of NSW, and indeed of the world at large, requires that coal mining, transport and burning must be phased out as fast as possible, and no new activities of this sort should be permitted.

The same restrictions must be imposed on the extraction and burning of natural gas.

The climate is changing. While some may still question the extent of the contribution of human activity to the changes that are undoubtedly taking place, current efforts to reduce the emission of greenhouse gases are proving ineffective. These efforts must increase rapidly, both in scale and effectiveness, if healthy life on this planet is to survive in anything like its current form.

But the transition from fossil fuels to renewable energy must also be accomplished in an orderly way. We conclude with some of the social, health and economic benefits that can arise from such a transition.

Overriding principles for this submission

There are 2 overriding principles for this submission:

- Climate change is being enhanced by NSW fossil fuel exploitation for domestic and exports. This is increasingly harming the health of NSW communities and damages the sustainability of the state.
- Transition from fossil fuels to clean forms of energy is essential to arrest these harms but it must be accomplished in an orderly manner to avoid further harms to NSW communities.

Climate Change Mitigation is urgent

The primary driver of climate change is the increase in greenhouse gas production due to the burning of fossil fuels for power generation, and from emissions from the transport, mining and agricultural sectors. Deforestation and land degradation through agriculture and pests have also destroyed and continue to destroy valuable "carbon sinks".

Climate change is the greatest health challenge of the 21st century and threatens to undermine all aspects of the society in which we live. The impacts to human health are becoming increasingly clear and threaten to nullify over half a century of work in global health.[2]

Medical organisations including the Australian Medical Association are declaring that 'climate change is a health emergency'.[3] Climate change mediates health impacts in numerous ways including via heat, extreme weather events, bushfires, floods, drought, increased air pollution, changing food production and water access, famine, migration and conflict. We are seeing these impacts now at only 1°C of warming since pre-industrial levels.[2]

The grave threat posed by further warming has been clearly articulated in the IPCC special report on the impacts of global warming of 1.5°C.[4] The report concluded that in order to maintain a world somewhat similar to today, our carbon emissions must be in steep decline within 12 years (now 10 years). This will be achieved most effectively by reducing global use of coal, gas and oil. Current policy and pledge trajectories, will result in warming to around 3.2°C by 2100, well above emissions pathways consistent with the Paris Agreement long-term temperature goal[2].

Inaction by governments to rein in emissions along timelines commensurate with the science is in direct contravention of government commitment to progress the realisation of the human right to health for all.[5]

As the drivers of climate change – principally fossil fuel combustion – pose a heavy burden of disease, including a major contribution to the 7 million deaths globally from outdoor and indoor air pollution annually.[6] Therefore mitigating climate change could save over a million lives whilst also enabling many other health benefits.[7]

Recent events such as heatwaves in the Arctic[8] with accelerated permafrost melting[9] and fires in the Amazon[10] will result in feedback loops that are going to significantly reduce our existing carbon budget.[11]

In an interview with NASA when asked to comment about the unprecedented melting of the Greenland ice sheets[12] in August 2019, one of the world's leading climate scientists and current director of the Earth

System Science Center at Pennsylvania State University, Professor Michael Mann stated:

> "We are 50 to 100 years ahead of schedule ..., the more observations we get, the more sophisticated our models become, the more we are learning that things can happen faster and with greater magnitude than we predicted just years before".

Orderly Transition from Fossil Fuels

Rarely has there been an orderly transition for communities from an industry in structural decline. There have been many examples of industries which have declined and have failed to protect the workers and communities from that decline.[13] This has resulted in poor health outcomes with unemployment and subsequent decline in the health of the community.[14]

The Appalachians are a well-documented example of what can happen if the transition is not planned. Between 2005 -2015 there was a 45% decline in coal production, leading to a 27% decline in employment, which resulted in a decrease in the local population particularly in the prime-working age population. There also appears to be an increase in all-age mortality in those regions whereas at the same time the rest of the USA had been in decline.[15]

The Appalachian example is virtually identical to the upper Hunter where 58% of the economic output and approximately 40% of the workforce are employed by mining. The Hunter valley produces approximately 60% of the coal in NSW so is very vulnerable to a decline in this industry. The Hunter Valley has already experienced a period of decreased employment and financial hardship as a direct consequence of the decline in coal prices. Coal prices fell in 2012 which resulted in a 5% decline in employment in the region. More than four fifths of those jobs were in males. Many of these were young males resulting in youth unemployment increase from under 5% to over 20%.[16] This situation should not be allowed to occur again. With adequate government policy, it can be averted.

There have been calls for the Hunter to diversify for many years.[17] Are these calls going to continue to be ignored until the inevitable decline in coal occurs?

It is possible to have an orderly transition and there are some examples from around the world where this has occurred.[18]

In Australia an orderly transition has occurred once for the closure of two coal fired power stations at Port Augusta South Australia which commenced in 2010 and was organised by unions, community, local

government and health organisations without participation of government.[19]

The crucial lessons from the closure of the Port Augusta power stations was the success of education of the community and workers in the health impacts from air pollution

The crucial component to the orderly transition is planning. Having defined dates for closures of coal fired power stations and coal mines allows for an orderly transition. The current known dates for closure of coal mines and coal fired power stations in the Hunter Valley would suggest a step wise drop of 14,000 jobs over 20 years. This gives ample time for planning and implementation of a transition plan.

There needs to be involvement of all levels of government, community and industry with adequate funding to allow for re-training of workers and for new industries to develop in the place of the old.[20]

Term of reference 1

The capacity and economic opportunities of renewable energy

In order to assess the effects of a transition to sustainable energy supply and resources one needs to be aware of the current situation in NSW. According to the most recent State Greenhouse Gas inventory[21], in 2017 NSW's total GHG emissions were 131.5 Mt CO_2-e. 94.2 Mt CO_2-e came from the combustion of fuels and 14 Mt CO_2-e came from fugitive emissions from fuels. Together these made up 82% of emission from NSW. This represents a huge opportunity to improve the emissions from NSW and subsequently improve health and mitigate against climate change.

Renewable energy production in rural areas is becoming a very important source of energy production at the same time boosting regional and rural economies and wellbeing. However, NSW overall is underperforming (with 15% penetration) compared to other states except Queensland (10 %).[22]

Furthermore, the transition is hindered by aging grid infrastructure which is not designed to integrate renewable energy sources. This is compounded national government failure to address energy policy, and it is essential that the NSW government makes strong representations[23].

Wind energy

Wind farm construction has delivered an economic boost of almost $4 billion to regional Australia—over half of this in the last five years with

current wind farm construction projects injecting a further $1.6 billion in economic activity into the regional economy. The two gigawatts of new wind farm capacity currently under construction have created an estimated 1,950 direct local jobs and a further 4,500 indirect jobs in local businesses that supply to projects in Australia.[24] Across the 25-year life span of Australia's existing wind farms and wind farms under construction, an estimated $10.5 billion could be delivered to host communities.

Between $19 and $21.5 million goes directly into regional communities through payments to host landholders and wind farm Community Enhancement Funds (CEFs) every year. With fourteen more wind farms under construction, that annual figure will increase to between $30 and $32.5 million. From 2019, Community Enhancement Funds[24] will make available $2.5 million annually for community projects. A diverse range of other benefit sharing mechanisms will see additional payments go to neighbouring landholders, local councils and community shareholders. If the 70-plus wind farms in the development pipeline are constructed, more than $7 million could flow into regional communities through CEFs each year.

The global transition from fossil fuels to clean energy has gained momentum in recent years and will continue to drive Australia's wind energy sector for decades to come. At the end of 2016, Australia's 79 wind farms accounted for 5.3 per cent of the electricity generated nationally.[25]

By the end of the decade, an additional four gigawatts of wind capacity will have been added to the grid, putting wind farms on track to nearly double 2016's output and supply over 10 per cent of Australia's electricity.[26] Australia's total wind capacity at the end of 2016 was 4,327MW. A further 4,000MW is in the process of being built by the end of the decade. With efficiency improvements and constant total demand, a contribution of over 10% from wind energy is likely.[27]

Farmers also make good use of small wind-turbines for example, in producing energy for the electric fencing which is necessary in intensive grazing techniques of regenerative agriculture. There is extensive use of solar energy for water pumps in irrigation and bore-water use.

Solar Energy

There are also several large-scale solar farms creating jobs and income in regional areas, including in Parkes (65MW), Griffith (36MW), Dubbo (24MW), Moree (56MW), Nyngan(102MW), Broken Hill (53MW) and Gullen(10MW). These are well known to the NSW government. Rural communities could further benefit and in a number of cases are already doing so, from the ability to produce solar energy both for on farm use and in localised grid systems.

Biomethane

Effluent or manure from pigs in piggeries can be converted into biogas (a renewable energy source consisting mostly of methane and carbon dioxide), liquid fuel and/or nutrient-rich solids. Biogas can be burnt to generate electricity and heat, upgraded into a transport fuel (biomethane) and can yield other useful products.

Anaerobic digestion is the process of breaking down waste in oxygen-free (anaerobic) conditions. Anaerobic digestion in lagoons or ponds is the most common method used to process piggery waste to create biogas.

Some very interesting and profitable renewable enterprises using methane emissions to produce biogas from abattoir and piggery waste are operating currently. ReNu Energy Limited and Southern Meats Abattoir have a 20-year Power Purchase Agreement for the acquisition of an anaerobic digester, which is supplied with wastewater from the abattoir, a biogas treatment plant, two 800kW dual fuel Caterpillar generators and electrical interconnection to the abattoir. These are used to generate electricity which is supplied to the abattoir at peak times of the daily billing cycle to reduce the facility's overall electricity costs. To be able to meet the peak demand periods, the generators can be operated on dual fuel, blending biogas with natural gas. Dual fuel blending is a novel and innovative application in the field of bioenergy, enabling projects to meet the demand cycles of customers better, and to enhance project viability through the addition of natural gas.

Term of Reference 4

Effects on regional communities, water security, the environment and public health.

A. The Health impacts arising from the use of coal in providing energy.

Air quality in the Hunter Valley is severely affected by particle pollution from open cut coal mining, coal combustion for electricity, and the transport of coal for export.

Power station air pollution

The impact of NSW coal-fired power stations on the health of the public has attracted considerable attention. Most of these power stations are located in the Hunter region of NSW.

In the report, The Health Burden of Fine Particle Pollution from Electricity Generation in NSW published by Environment Justice Australia in 2018[28] it was shown that CFPS pollution is responsible for 279 premature deaths every year. These deaths are mostly from accelerated heart and lung disease, and occur across Sydney, the Central Coast, Hunter Valley and more distant areas. As well as the mortality burden, there are an extra 361 cases of type two diabetes, and 233 babies born underweight due to this exposure. Being born underweight has lifelong health disadvantage which will be continuing long after coal burning has ceased. As this burden occurs every year, the health impact of the remaining operating life of the power stations can be easily estimated.

Table 1 from the EJA report is reproduced below. It can be seen that the greatest number of attributable deaths are in Sydney even though the power stations are many Km away. This reflects the long-range atmospheric transport of secondary sulphate particles.

Table 1: Number of adverse health outcomes attributable to air pollution in the five NSW regions used for analysis.

	Sydney	Central Coast	Lower Hunter	Upper Hunter	Remainder	Total
Mortality	153	25	51	7	43	**279**
Years of life lost	1433	234	477	65	402	**2614**
Low birth weight	147	16	37	6	27	**233**
Incident diabetes	199	33	63	8	58	**361**

The time from coal closure to improvements in health is uncertain for the adult diseases. Expert opinion on this generally favours some benefit in the first year, and a ramping up of benefit out to 10 years. For birth weight effects the benefit of coal closure would be seen within months.

The five coal fired power stations (CFPS) of NSW released 112 thousand tonnes of NOx and 162 thousand tonnes of SO_2 during 2017 as disclosed to the National Pollutant Inventory.

Power station emissions (tonnes)	NOx	SO_2	Primary $PM_{2.5}$
Bayswater, Upper Hunter	32,214	50,271	294
Liddell, Upper Hunter	18,627	33,490	183
Eraring, Central Coast	18,555	30,533	148
Vales Point, Central Coast	21,008	16,000	71
Mount Piper, Lithgow	22,021	32,000	59
Total emissions from power stations	**112,425**	**162,294**	**755**
NSW emissions, all sources	**280,000**	**190,000**	**3,900**

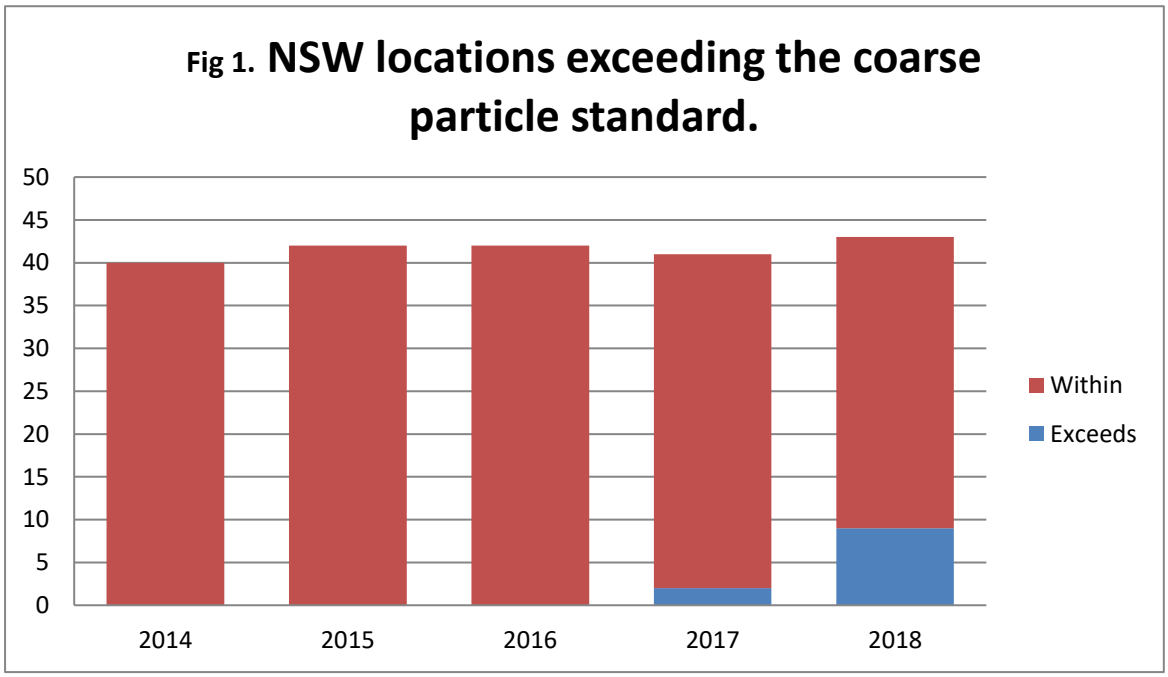
Power station contributions to particle air pollution are from both primary particles released from the stack, and secondary particles formed in the atmosphere.

Simple technological solutions exist for treatment of flu gases to eliminate the air pollution problem at modest cost, and these technologies are required on CFPS in most countries around the world. The primary particles are well controlled by fabric filters which have been in use on all power stations since the final retrofit of Vales Point and Liddell in 2009. Release of SO_2 and NOx continues unabated and secondary particles from these gases are the main threat to public health from coal combustion.

Air pollution from open cut mines in the Hunter Valley

Levels of particle pollution in the fine ($PM_{2.5}$) and coarse (PM_{10}) size fractions are high and increasing in the Hunter Valley.

In 2018 Coarse particles exceeded the national annual standard of 25 $\mu g/m^3$ at 9 locations in NSW, up from 2 locations in 2017 and none in 2016. Apart from Wagga Wagga North with annual average of 27.4 $\mu g/m^3$ the locations exceeding the standard were all in the Hunter Valley or in Newcastle.



The town of Camberwell, between Singleton and Muswellbrook, is surrounded on 3 sides by coal mines and had 2018 annual PM_{10} of 31.1$\mu g/m^3$ (NEPM reference value 25 $\mu g/m^3$) and 44 exceedances of the daily standard (NEPM reference value 50 $\mu g/m^3$). Air pollution exposure takes a heavy toll on the health of the residents of this small historic town. The mines have a token program of dust control called "dust stop"

but it clearly fails to protect the community. Mine operations are supposed to halt during high dust conditions, but this does not occur unless locals complain.

During 2018 there were a number of state-wide dust storms bringing dust from the western plains. The monitor at Merriwa detects these and recorded high levels on 6 days during the year, so regional dust storms are clearly not an adequate explanation for the high levels of particle pollution experienced in the Hunter coalfields.

Coal transport

The Hunter Valley coal corridor transports 150 million tonnes of coal a year past residential suburbs subjecting the community to coal dust, diesel emissions, and excessive noise. People living near the rail line endure multiple trains per hour, day and night, with high levels of noise from wheel squeal and other noises from poorly maintained rolling stock. It has been estimated by the NSW EPA that 70% of locomotives in service do not meet the most basic "Tier zero" emissions standards from the USA. Diesel exhaust is highly toxic, and a recognised carcinogen. The engines in locomotives would never be allowed in road transport but progress to introduce standards has been stalled for a decade. Industry has now adopted a voluntary plan to improve locomotive pollution, but it has a very generous timescale of another decade for compliance.

Coal ash hazards

The coal ash causing air pollution. After closure of the Port Augusta power stations in 2010, the state government and the owner failed to organise adequate re-vegetation of the coal ash deposits, and further air pollution occurred in 2018[29] which has now been resolved.

In NSW there is also potential for similar events. Eraring and Vales Point coal fired power stations produce 1.9 million tonnes of coal ash per year and the coal ash dams are reaching their capacity.[30]

A report by the Hunter Environment Community Centre[30] examined heavy metal concentrations in the water, sediments and seafood of Lake Macquarie to examine the extent to which the two coal fired power stations in the southern portion of the Lake are contributing to these concentrations.

The coal ash dams of Eraring and Vales Point power stations were both constructed before the NSW Protection of the Environment Operations Act was passed in 1997. Both of these ash dams are unlined, and both benefit from specific regulations created in Australia and New South Wales to exempt coal ash from regulation of hazardous waste and landfill.

The study found concentrations of a number of heavy metals in water and sediment, concentrations which exceed the ANZECC Australian and New Zealand Environment and Conservation Council (ANZECC) trigger values which apply in NSW. The study reinforced the results of an earlier NSW Office of Environment and Heritage study (OEH – NSW Office of Environment and Heritage, EPS Branch, 2019. Contaminates and risk assessment and advice for metal concentrations in seafood from Lake Macquarie, NSW June 2018. DOC18/421445) which found elevated concentrations of zinc, copper, and cadmium in samples of seafood caught in Lake Macquarie.

The risk of ash dams to the community were highlighted in the closure of Myuna Bay Sport and Recreation Centre on the NSW central coast. Origin energy suddenly closed the facility in 2019 due to the risk the ash dam posed to the community. It is felt that the ash dam wall could fail in an earthquake. An independent review subsequently stated, "The stability analyses completed to date indicate a relatively high probability of failure of the Eraring Ash Dam due to seismically induced liquefaction of the dam foundations. The dam break assessment also indicates that low lying areas of the Centre in some situations is likely to be engulfed by several metres."[31] The facility remains closed pending "further analysis".

B. Health effects arising from the use of gas in providing energy.

Unconventional gas production in NSW

This is limited to two coal seam gas developments. The first is the AGL's Camden Gas Project which commenced in 2001 with 144 wells. Plans to expand this field met with fierce resistance in the community and in 2013 the expansion plans were withdrawn. AGL plans to cease production from the gas field by 2023 and is progressively decommissioning and rehabilitating the remaining 75 wells.

The Narrabri Gas Project is owned by Santos. An exploratory field of about 30 wells is currently operating along with a reverse osmosis treatment plant at Leewood. Santos has plans to develop the field to 850 wells, 60% of which will be in the Pilliga state forest, a biodiversity hotspot. In February 2017 Santos released its Environmental Impact Statement for comment and received 23 thousand submissions, >97% opposed. One hundred NGO's made submissions including DEA.[32] The project is awaiting final assessment by an Independent Planning Commission.

NSW imports over 95% of its gas from other states. Although gas was once thought of as a cheap form of energy that is no longer the case. Gas

prices in Australia are now subject to international prices as we rapidly become the number one exporter of LNG globally. There are many complex economic factors in the gas market which make gas an expensive rather than a cheap fuel.[33] Expanding NSW gas production from unconventional sources will not solve the problem of expensive gas and will have very significant adverse health impacts via local community impacts and via climate change impacts from greenhouse gas emissions. It is for these two reasons that DEA opposes all new onshore gas development in NSW and Australia.[34] Gas simply does not meet the definition of sustainable and should not be included in the future energy supply of NSW. A plan to phase gas out of commercial and domestic use is urgently needed.

The gas myth

The *cheap clean green* Gas Myth has a hold on Australia's State and national governments who believe that expanding gas production can be 'made safe' for people and the local environment and will help reduce world greenhouse gas emissions. An examination of the facts reveals that this is not so. Gas was embraced as a 'transition' fuel because it produces half the CO_2 emissions as coal at the point of combustion. However, full lifecycle analysis reveals it has a similar carbon footprint to coal once the emissions related to its production and transportation are taken into consideration. In fact, methane is 86 times more potent a greenhouse gas than CO_2, so fugitive methane emissions need only to reach 2-4% of production to cancel the climate benefit of gas over coal. In the US gas fields 2-17% of gas escapes as fugitive emissions. Fugitive emissions are routinely underestimated, not measured and are not regulated. In Australia "there has been no comprehensive, rigorous and independently-verifiable audit of gas emissions".[35]

The climate impact of gas development

Atmospheric methane has risen dramatically since 2006 and accounts for 17-25% of heat trapping gases. Oil and gas production are responsible for 48-75% of human methane emissions globally. Australia is on the cusp of a massive expansion in conventional and unconventional gas extraction with large developments in NT, WA, QLD and potentially NSW. These developments are already driving up our emissions.

Gas mining is responsible for an increasing proportion of Australia's global fossil fuel carbon footprint. Climate Analytics[36] indicates that our domestic and export fossil fuel emissions are now 5% of global emissions and current developments could increase this to 12-17% by 2030. Furthermore, there is evidence that abundant LNG flooding the international market is displacing renewables – e.g. total fossil fuel use in USA has not changed with their transition from coal to gas.

Gas development delays action on GHG reduction and will make it impossible for Australia and the world to meet its climate target of limiting warming to 1.5–2.0°C degrees. Rather than assisting transition to a low carbon world, gas delays the transition, precious time we don't have.

Chemicals used in drilling and released from coal seams and shale

A major concern to health from gas mining is the wide array of chemicals used in drilling and hydraulic fracturing, and released into the environment through airborne emissions and wastewater, and emitted from the high level of industrial activity (e.g. compressor stations, gas processing plants, on-site diesel-powered machinery and heavy vehicles) surrounding the production process.

Furthermore, potentially toxic chemicals within shale and coal seams are released into the air and wastewater. They include volatile organic compounds notably benzene, phenols, polycyclic aromatic hydrocarbons (PAHs), heavy metals, salt and technologically enhanced naturally occurring radioactive materials that may become concentrated through treatment processes.

Studies examining the potential toxicities of chemicals found in shale gas wastewater have reported that while many have not been evaluated, some are known carcinogens and/or have the potential for endocrine disruption and/or are associated with neurological, reproductive and developmental harm.

There are many ways from which ground and surface water is impacted by gas well activity, through spillage, injection procedures, spills or deliberate discharge of inadequately treated water and leakage from wastewater pits and ponds.

Potentially harmful substances are emitted into the atmosphere during dewatering, gas production and processing, wastewater handling and transport. They include $PM_{2.5}$ and PM_{10}, volatile organic compounds, hydrogen sulphide, formaldehyde, diesel exhaust and ground level ozone.

Health effects in gas field communities

The evidence of the health impacts of gas mining is in its infancy, due to limited resourcing to date. However, concerning aspects have already emerged in the scientific literature.[37]

Associations have been reported between residence close to gas mining activities and asthma exacerbations, sinus conditions and migraines, skin rashes, fatigue and headaches as well as hospitalisations for heart, neurological, respiratory, immune system diseases and some cancers. Most of these studies have been from the US, but similar reports have occurred with coal seam gas mining in Queensland.

In addition, there have been reports of negative birth outcomes, such as low birth weight; pre-term delivery; higher risk births and some birth defects in pregnancies spent closer to gas mining activities, compared to pregnancies spent further away, or in the same area before commencement of gas mining activities.

Increased levels of stress, depression, criminal activity and traffic accidents have also been reported among those living near gas mining. These changes likely reflect psychological and social disturbance among individuals and whole communities. Australian researchers have found that stress about coal seam gas mining may contribute significantly to mental health risks among directly affected farmers.

Of particular concern to Australian agriculture and remote communities is research showing an unpredicted but consistent rise in water footprint—up to 7.7- and 14-fold increases in water usage and waste used per well in semi-arid regions across the United States.

Demonstrated health impacts either directly or indirectly through water, air, and soil, require that the precautionary principle is applied to protect the Australian community.

We understand the harms well enough to know that further expansion of gas development will severely harm human health and well-being through exacerbating global heating and through local health impacts. NSW should lead the transition to cheap and available renewable energy technology rather than use gas. It is time to defuse the gas bomb: we neither need nor have time for this 'transition' fuel.

C. Psychological effects of fossil fuel mining in regional and rural NSW

Energy supply in NSW historically has predominantly involved the exploitation of fossil fuels. This has given employment to a few people who have been paid well and had some health monitoring, but the surrounding communities have had very little in the way of financial recompense or community health monitoring and no individual health monitoring. The health impacts from air, water and noise pollution have been considerable on those communities as have the psychosocial stressors.

Rural communities with mining are frequently two speed economies due to these well-paid mining employees. Pressure is put on scarce housing stock by skilled workers from out of town renting or purchasing housing causing rent and house prices to rise. Local inflation can occur. Only a minority of such workers integrate into the community and resentments are rife. Expensive housing etc leads to economic instability, a well-known social determinant of health problems.

Some physical health impacts have been well documented but virtually no psychological impacts have been systematically collected, though living close to a coal mine is universally avoided, by those able to do this, on both physical and mental health grounds. Global warming has added a further dimension and urgency to these many health impacts from fossil fuel extraction. Renewable energy from solar and wind have minimal health impacts.

The costs of health impacts usually involve counting premature deaths and increased hospitalisations. This does not capture any of the costs of psychological disorder.

Psychological impacts involve emotional, behavioural and cognitive impacts on both children and adults. Psychiatric practice of adults and adolescents records patients whose stressors include dust exacerbating respiratory problems, drinking water contamination for the many rural homes and schools on tank water and noise causing daytime irritation, communication and concentration impairment with sleep disturbance leading to cognitive impairment and stress. These impacts have been seen from existing coal mines at Stratford and Duralie and the rail corridor. Patients living close to a proposed new open cut coal mine (Rocky Hill) and a proposed coal seam gas field in the Gloucester basin have a fear for the future and of air pollution from test well fracking and flaring on the CSG field.

There is a loss of wellbeing when a mine is sited in your community with both anxiety and depression often being triggered. Those with past or existing psychological disturbances have exacerbations of their illnesses with mining stress interacting with other life stressors. It is common to hear of someone who sought the peace of a rural lifestyle only to be shattered by the noise of mine blasting, poorly maintained night coal trains etc.

Psychological disturbance can also occur where mining related stress seemed to be the full explanation of their illness. Patients with transient global amnesia, a rare condition, are recorded in two patients fighting off unwelcome approaches from the mining industry.

In addition to the physical harms form air pollution described in section A above, a review of air pollution and psychiatric illness[38], using large health data banks in the United States and Denmark, found almost

identically large correlations between bipolar illness and air pollution with incidence rising 25% in most polluted areas. Most dramatic was a rate rise of 160% in personality disorders in the most polluted areas of Denmark. Researchers comment air pollution is a complex mixture of small particles, gases, metals, organic compounds, transport exhaust, industrial activity, fires etc and obviously varies from site to site but they hypothesise 'neuro-inflammation' engenders increased psychiatric illness in these polluted regions.

Extreme weather events caused by global warming result in psychologically stressful consequences in rural communities which are particularly dependent on the weather. Droughts, such as the current one affecting Northern NSW have increased and farmers have had to sell off all but their most valuable stock for which they have had to buy in feed. All income has ceased in many cases. Fire Danger is increased with no signs of relief. Suicides in farming communities have been rising as higher temperatures cause more evaporation and the carrying capacity of the land is reduced. The number of extreme heat days has increased with an increase in violent behaviour on those days.

D. Health impacts arising from current environmental impacts

We are currently in the midst of a world-wide extinction event with a dramatic decline in the number of species. This has significant implications for human health as outlined in the recent DEA submission into faunal extinction.[39]

Deforestation

Eastern Australia is considered a global deforestation hotspot. In NSW there has been an 800% increase in deforestation of native forest from 2013-14 to 2015-2016[40] Forests are essential for human health.[41, 42] There is an increasing practice of sourcing forests as a fuel supply in NSW under the guise of "biofuels". However, clearing of forests for fuels will exacerbate the land clearing crisis, worsening water security, biodiversity and climate change with the subsequent impact on human health. If forests are going to be used for biofuel then they need to be grown *first* rather than burnt and subsequently replaced. In the current climate and current urgency to reduce emissions there is no place for burning forests as biofuel as these will continue to increase emissions.

Water

Of particular concern to Australian agriculture and remote communities, given their current preoccupation with an increasingly tenuous water supply, are reports such as that in WaterNSW's weekly Water Availability Report[43] which stated that, in relation to the Macquarie River: "*The Macquarie is in drought Stage 4, the highest level under the Incident Response Guide. The combination of current storage volumes and a continuation of zero inflows will mean that there isn't enough water to maintain river flows to the whole valley for all of 2019/20. If zero inflows continue, then the priority will be to extend supply for towns and critical industries. This will mean 'cease to flow' is likely to be implemented for the river below Warren and for Duck and Crooked Creeks in Winter - Spring. If inflows do not occur at all next year and no drought measures are implemented, then all storage water will be depleted before the end of June 2020 and the whole river would then stop flowing.*"

Rural towns are having to have drinking water delivered to them, and there are water restrictions on water use throughout the State. How long can we continue to permit the use of water to wash coal, suppress dust from open cut coal mines and feed the voracious water usage from fracking? Will the use of water for fossil fuel extraction be prioritised over its use for agriculture and food production? Clear cut guidelines need to be created to guide the use of water.

Term of reference 5

Opportunities to support sustainable economic development in regional and other communities likely to be affected by changing energy and resource markets, including the role of government policies.

There are numerous opportunities to improve energy supply and sustainability which will also improve human health. Simply reducing our dependence on fossil fuels will have an immediate impact of human health by reducing morbidity and mortality related to pollution. These opportunities will help both regional and non-regional areas and have the added benefit of mitigating against climate change.

Agriculture

Currently DEA's position on agriculture, diet and sustainability recognises the need for government to assist the agricultural sector to transition toward production that is resilient and also capable of producing adequate amounts of nutritious food for a growing population whilst at the same time minimising climate and environmental harm.[44]

IPCC special report on Climate Change & Land use points out the current situation and what needs to be done.[45]

58% of land in Australia is used for agriculture with 54% of this primarily for livestock feed and grazing. Adoption of a system which encourages and rewards reforestation, regenerative agriculture, agroforestry practices and reduced methane and nitrous oxide production will provide employment and mitigate against climate change. Together with renewable energy projects this will help revitalise small towns and communities resulting in better physical and mental health.

Regenerative agriculture can improve farmer's health

The Canberra based National Environmental Science programme's report[46] for example, found that regenerative farming strengthened farmers sense of self-efficacy, financial resilience, and created more time off farm to spend with friends and family.[46] Psycho-socio benefits included more optimism, reduced stress, and pride and enjoyment from seeing improvements to their landscapes. The report states, "wider adoption of regenerative farming could over the longer term reduce demands for current mental health services (which are being offered especially in drought/fire and flood affected areas) by reducing the numbers of farmers who reach a point at which they have mental health or other wellbeing associated problems that require intervention"

The Graziers with Better Profitability, Biodiversity and Wellbeing study echoes these results and includes measures of increased biodiversity of landscape as well.[47] Regenerative grazing managers in this study had the following characteristics: Significantly higher wellbeing than other similar farmers; were much more satisfied with their health; significantly more satisfied with their future security; happier with what they were achieving in life and their personal relationships; much less likely to report being in fair or poor health. Overall, the results show that Regenerative Managers had significantly higher wellbeing than comparison groups of graziers.

The role of government policy

At present agricultural reforms supported by the federal government's Carbon Farming initiative stand to not only mitigate some of the climate and environmental damage caused in food production but also to create valuable carbon credits which are increasingly in demand.

The Carbon Credits Act of 2011 as part of the Carbon Farming Initiative[48] enabled farmers to enter the carbon credit market.

The various methods[49] one can employ to qualify for the credits and their auditing process administered by the Clean Energy Regulator creates huge

potential for employment, innovation in food production and reduction in waste, research possibilities and gains for Australian agricultural science, increases in food productivity, wiser and more efficient land use, greater carbon sequestration, biodiversity loss, fewer GHG emissions and increases in efficiency generally in food production.

The federal government after the last election topped up the part of the scheme specifically designed for farming initiatives with a further $2 billion.[50]

Government can greatly assist by ensuring that legislation around accreditation, monitoring and approvals is streamlined and aligned with the goals of decreasing carbon emissions, increasing and preserving biodiversity of natural habitats and within agricultural soils.

There is much to be gained from supporting and making this possible. It will improve food nutrition, the reputation of our products, our agricultural exports, the sustainability of our food production and mitigate against climate change.

The Carbon Farming Initiative also provides opportunities for innovation, technology and employment in the need to document activities and report them for auditing purposes. For example, carbon soil testing necessary as proof of increased sequestration, drones that use modern technology such as infrared to document vast areas of vegetation allowing quantitative measures over time.

Other rural community benefits

Employment opportunities can be created in rural and remote regions by giving Landcare and other conservation services certainty with respect to bushland regeneration. This would allow the ability to employ more coordinators and purchase greater stocks of native vegetation from suppliers. Planting more vegetation that sequesters more carbon and provides habitat for greater biodiversity gain and less extinction of species is known to improve the surrounding agricultural land and human health.[42] Government support for Biodiversity credits administered through the NSW Biodiversity Conservation Trust would be appreciated in this area of promise.

Knowledge about the importance of soil microbiology in carbon sequestration in soils and their importance to agricultural growing methods has led to a burgeoning industry in their production, use and research.[51] These are used along with soil conditioners based on biological formulations (made largely from farm and food organic waste) rather than high-analysis soluble fertilisers to improve soils in regenerative agriculture to improve carbon sequestration which in turn increases the water retention in soils. These techniques allow improved stock ratios, reduce

methane and nitrous emissions and allow communities to better withstand drought.

These opportunities could be supported and enhanced by NSW government initiatives. The Hunter Valley in particular will need major rehabilitation as land that was previously used for agricultural production has been degraded by mining and offers great opportunities in land regeneration for various forms of agriculture.

All in all, the agricultural sector is well placed and is already proving to be a major source and user of renewable energy production as well as providing opportunity for large amounts of carbon sequestration and emissions reduction. At the same time improving productivity and enhancing nutritional value of major food sources, much of which will be exported overseas as a major contributor to GDP. Providing employment opportunities in rural and remote locations through agriculture and renewable energy production will also help to save congestion/pollution and overcrowding problems in large cities and provide benefits to those already living in these locations.[37]

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